

## 10. COMMISSION DE L'ACTIVITE SOLAIRE

### Report of Meetings

PRESIDENT: Z. Švestka.

SECRETARY: A. D. Fokker.

#### Business Meeting, 23 August 1967

The President, in his opening address, thanks for the cooperation he has experienced in preparing the draft report.

#### I. CO-OPERATIVE STUDY OF SOLAR ACTIVE REGIONS (CSSAR)

*R. Michard* gave the following report.

The programme of CSSAR, accepted by IAU Commission 10 and the IQSY Committee called for:

- (1) Selection of some interesting active regions for study;
- (2) Compilation and publication of a catalogue of data available in all participating stations;
- (3) Compilation of the material by a number of 'collectors', with final compilation in Meudon;
- (4) Publication of the material in the form of microfilms.

Later it was agreed that interested scientists would be given the opportunity to study the collected material in Meudon, to insure an immediate and efficient use of the material.

A number of 10 suitable active regions were selected. It turned out that point 2 of the above programme would involve too great an amount of work for its expected value.

Point 3 of the programme has been achieved with reasonable success. The cooperativeness of all collectors should be gratefully acknowledged. Between February and June 1967 the CSSAR material at Meudon was studied by G. Godoli, V. Bumba, R. Hedeman, T. Fortini, M. Torelli, T. Tsap, M. J. Martres, I. Iscovici, J. Leroy and M. Trellis. Some papers dealing with the CSSAR will be presented at the IAU Symposium No. 35 in Budapest.

The CSSAR project seems to have given already most of its expected results and the scientific information has been largely extracted from the collected data. Therefore point 4 of the initial programme can be cancelled.

The following is a short enumeration of the aspects studied.

For the first time it was possible to describe without gaps the birth and development of an active region with a resolving power in time of about 1 hour in white light. Sunspot evolution was studied by Waldmeier in Zürich and Mrs Martres and Iscovici in Meudon. The chromospheric development, from K spectroheliograms and filtergrams, was studied by Godoli and Fortini. Interesting comparisons between spots, K and H $\alpha$  structures could be made in Meudon.

Unfortunately the magnetic field data were more limited. They consisted of whole disk magnetograms of Mt Wilson, detailed maps of longitudinal fields in active regions from Crimea and Meudon and data on sunspot polarities and peak values from a few other observatories. Comparisons of magnetic field structure, morphology of the active regions, flare production, etc. were made by the visiting scientists in Meudon. Synoptic charts for the coronal lines were discussed by Leroy in connection with white light coronal observations of Haleakala and Pic du Midi, with Stanford heliographic maps and with chromospheric data.

As to the organization of such a project as CSSAR one has the choice between a rather loose planning which leaves much initiative and freedom to the data collectors (as was the case with CSSAR) or a more rigid type of organization, with detailed scheduling. A balance between detailed planning and free initiative must be found which is proper to each particular project.

It should be avoided to have different international projects going on at the same time. This puts too many obligations on the participating institutes and individuals.

The CSSAR, in the reporter's opinion, was a reasonable success in achieving world wide compilation and leading to substantial scientific results. The cooperation of all those who contributed, collected and studied the material is gratefully acknowledged.

Consequently to the report of R. Michard, *M. Waldmeier* presented some pictures illustrating the development of sunspots in various active regions. Most of the spots selected for study in the CSSAR belonged to the new cycle.

## II. THE PROTON FLARE PROJECT (PFP)

*P. Simon* gave the following report.

The idea of organizing a comprehensive study of all the solar-geophysical effects associated with a proton flare was initiated by IAU Commission 10 and subsequently the IQSY Committee decided to have organized a special Proton Flare Project as part of the IQSY program. The organizational framework was established by Z. Švestka on the recommendations of several members of Commission 10.

The scope of the project was the following:

- (1) to stimulate the observations of a particular proton flare and of its geophysical effects;
- (2) to prepare a series of papers on this event for publication in the IQSY Annals.

It was decided that, prior to publication, the results of the cooperative undertaking would be presented during the IQSY/COSPAR meeting in London and at the IAU Symposium in Budapest.

Early in 1966 I accepted the invitation to act as coordinator of the PFP. In the period of between 1 May and 1 October 1966 one or more alerts for imminent proton flare events were to be issued from Meudon Observatory. The two alerts which were given to the cooperating observers were both successful and the proton flare events of July 7, Aug. 28 and September 2 were assigned for a common study. Especially on the occasion of the July 7 event good optical observations were secured, while information was available from several satellites at many different places in space.

The cooperative study was subdivided in the following sections:

- (1) the magnetic and the velocity field before the formation of the active region;
- (2) the birth and development of this region (magnetic, optical and radio aspects);
- (3) the activity of the region (optical, radio and X-ray aspects);
- (4) the flare event proper, in its various aspects;
- (5) the associated high energy particles (satellite, balloon, neutron monitor and polar absorption data);
- (6) the low energy particle effects (satellite observations in the magnetosphere, geomagnetic storms etc.).

Almost 60 reports on the various aspects of the event were received; for the papers belonging to each of the above sections a summarizing paper was prepared.

This joint study has been a success in providing the fullest possible description of all the aspects—optical, radio, X-ray and corpuscular—of the event and the centre of activity to which it was associated. Although no spectacular discoveries were made, a very comprehensive picture was obtained of all the processes which lead to the occurrence of a proton flare event; very valuable observations of protons both outside and inside the magnetosphere were obtained.

The cooperation of many scientists all over the world was very fine indeed.

## III. THE COOPERATIVE STUDY OF FAST VARIATIONS OF LOCAL MAGNETIC FIELDS

*V. A. Krat* gave the following report.

In this cooperative study seven observatories in the USSR, and the observatories in Ondřejov, Bucuresti, Debrecen, Potsdam and Berlin (HHI) participated by obtaining directed photographs in white light, H $\alpha$  spectroheliograms, radio noise records and maps of magnetic fields near sunspots. The study of a large body of observational material obtained during the summer of 1966 is now in

progress. A preliminary report is given in 'Solnečnije dannije', 1967 nr. 3. Large fluctuations of the sunspot magnetic fields, of the order of several hundred gauss, were established. A fieldstrength variation of 10 gauss per minute is common. From this study it appears that sporadic measurements of fieldstrengths in sunspot regions cannot be considered as representative for periods of the order of several hours. Also the finestructure of magnetic field configurations is subject to appreciable fluctuations.

#### IV. PROSPECTIVE INTERNATIONAL PROJECTS

The President gives the word to *E. R. Mustel* for presenting a recommendation of the Soviet Committee on Solar-Terrestrial Physics.

The Soviet Committee on STP proposes to launch an international enterprise, 'International Years of the Active Sun', devoted to a study of solar phenomena during the years 1968–1970, aiming at a better understanding of solar activity and its influences on radiocommunications and corpuscular radiation. This enterprise would be different from the IGY and IQSY programs by

- (1) emphasis on special projects (like the PFP);
- (2) use of advanced methods of space research;
- (3) emphasis on uniform flare patrols, for instance to be made in polar regions.

In the statement of the Soviet Committee a number of specific research items are recommended.

In the discussion following this recommendation, *C. de Jager* appreciates the idea, but he wonders whether the start of the Active Sun Years can be postponed until 1969 or even to the declining phase of the solar cycle. *K. O. Kiepenheuer* reminds that IGY and IQSY were largely geophysical undertakings; solar people need not feel themselves responsible for launching such enterprises. *R. Michard* warns that solar observers should not bear the burden of too many projects. *R. Howard* thinks the initiative should come from the Inter-Union Commission on Solar-Terrestrial Physics (IUCSTP); Commission 10 could then endorse the plans submitted by IUCSTP. *H. W. Dodson-Prince* and *R. Michard* express willingness for rendering good services, but these should not hamper too much the pure solar research.

The President closes the discussion, promising to prepare a suitable resolution of Commission 10, taking into account these comments, and to be approved later.

#### V. SOLAR-TERRESTRIAL SERVICE

*A. H. Shapley* gives information on a newly proposed Solar-Terrestrial Service.

In recent meetings of URSI and COSPAR the need of a solar-terrestrial service has been discussed; this item will be on the agenda of the UGGI Assembly in Switzerland (Sept. 1967), while also the IUCSTP Commission has paid attention to this matter.

Apart from the already existing services, like IUWDS, Quarterly Bulletin on Solar Activity, there is need of a central body which cares for such matters as are important for workers in different fields. This service should look into questions like

- uniformity of reporting;
- publication of solar-terrestrial data;
- improvement of the communication network;
- forecasts of solar activity.

In this connection *A. H. Shapley* calls attention to the monthly bulletin 'Solar-Geophysical Data', published by the U.S. Environmental Science Service Administration (ESSA). He suggests that Commission 10 makes a statement, stressing the importance which this bulletin has for both solar- and geo-physicists. The following statement is approved. 'Commission 10 notes that a prompt publication of solar activity data from world sources is highly useful to solar astronomers as well as to solar-terrestrial scientists; it considers the bulletin "Solar-Geophysical Data", published by the U.S. Environmental Science Service Administration, as an outstanding specimen of such a short-term publication and therefore urges the authorities concerned to maintain this valuable service and recommends the solar astronomers to cooperate in providing their data to ESSA whenever practical'.

## VI. THE COSPAR PANEL ON FLARES

*A. B. Severny* gives some information on the activities of the COSPAR Panel on Flares.

The Panel on Solar Flares of COSPAR was created in 1965 as one of the sections of Working Group II, which is concerned with the physical processes in space and in the environment of the Earth. The main purpose of the Panel is to make the fullest possible use of space experiments for understanding the physical nature of the flare phenomenon and the disturbances produced by flares in space and in the upper atmospheric layers of the Earth. Data obtained from space experiments should be combined with ground-based observations of flares and their effects. The Panel is also concerned with the possible methods of flare forecasting, in view of the radiation hazards which flares may produce. During the COSPAR meeting in London (1967) a resolution, drafted by the Flare Panel, was adopted which urges the appropriate organizations to increase their efforts in the field of rapid interchange of solar and geophysical data. Working Group II also adopted the proposal to organize a symposium on solar flares at the next COSPAR meeting in Japan, to be held in May 1968.

*R. Michard* suggests that Commission 10 endorses the resolution of COSPAR Working Group II. This suggestion is approved.

## VII. PHOTOGRAPHIC JOURNAL OF THE SUN

*M. Cimino* introduces a new publication, called *Photographic Journal of the Sun*.

During the last year a photographic supplement with daily H $\alpha$  and K-line photographs of the Sun has been inserted in the Monthly Bulletin of the Monte Mario Observatory (Rome). It has now been decided to start a more complete photographic journal as from January 1968. This will be made possible through the cooperation of the Solar observatories at Manila, Kodaikanal and Teheran. It is intended also to include photographs in white light. Some specimen photographs are presented to the meeting.

On the proposal of *R. Michard*, Commission 10 will give moral support to the new journal by an appropriate resolution.

## VIII. SPECTRAL DIAGRAMS OF TYPE IV SOLAR RADIO BURSTS

*A. D. Fokker* makes a recommendation on the preparation and the publication of spectral diagrams of type IV bursts.

A spectral diagram gives a representation in the time-frequency plane, by equal intensity contours, of the overall course of development of a radio event. Such a representation may be derived if a sufficient number of single frequency records, all over the spectrum, is available.

A number of such diagrams for type IV events have been published by different authors. Since type IV events deserve great interest on account of their association with high-energy corpuscular radiation from flares, it seems desirable to prepare their spectral diagrams more systematically and in a standardized fashion. The whole set of diagrams, to be obtained in a cooperative effort, should be published towards the end of the present cycle.

*C. de Jager* suggests to prepare a resolution, asking observers to contribute to a better coverage in frequency. The President will look into this.

## IX. FORECASTS OF SOLAR ACTIVITY

*A. H. Shapley* gives some details on the forecasts of solar activity and the experience obtained. He discusses the various needs of forecasts and the possibilities for giving different kinds of forecasts. There is still insufficient agreement about the evaluation of different aspects of solar activity; for instance, there is no unanimity on what solar radio outbursts should be rated as a type IV event. The President remarks that a simple classification system of radio bursts is hard to establish, in view

of the enormous complexity of many events. *V. A. Krat* points out that the Sun is such a capricious object as to seriously limit the feasibility of giving detailed forecasts. In any forecasting the structure of magnetic fields is the most important piece of information.

#### X. THE INTER UNION COMMISSION ON SOLAR TERRESTRIAL PHYSICS (IUCSTP)

The President gives some information on the activities of IUCSTP, in which he himself represents the I.A.U.

This Commission (President: H. Friedman) was formed by ICSU in 1966; it is meant to coordinate activities in the field of solar terrestrial physics, as a substitute for the IQSY organizational framework. IUCSTP is now preparing a list of research programmes to be recommended for the years of solar maximum. The commission is assisted by representatives from different disciplines. Representatives for the domain of solar activity are C. de Jager, E. R. Mustel and M. Pick-Gutmann.

#### XI. ORGANIZING COMMITTEE

The President announces the proposed composition of the organizing committee of Commission 10: Švestka (President), Jefferies (Vice President), Fokker (Secretary), Kiepenheuer, Michard, Nagasawa, Newkirk, Rösch, Severny, Waldmeier.

#### **Joint Meeting of Commissions 10 and 44 on the Cooperation of Solar Observations made at Ground-based Observatories and made with Space Vehicles, 24 August 1967**

The following papers were presented to this meeting.

- Z. Švestka*: Introduction
- \* *K. O. Kiepenheuer*: The need of ground correlated high resolution space observations in the visible.
- \* *A. B. Severny*: Space observations needed for improving our knowledge of solar flares.
- \* *Y. Öhman*: Space observations of flare sprays and related surge phenomena.
- \* *E. M. Reeves*: The needs and requirements from the standpoint of the ultraviolet solar observations.
- J. R. Winckler*: Hard solar X-rays in the deka-keV range (read by de Jager).
- \* *C. de Jager*: Hard solar X-rays in the deci-MeV range.
- \* *G. G. Fazio*: Solar gamma rays and their correlation with ground based observations.
- \* *C. de Jager*: Concluding remarks.

Papers marked by asterisks will be published in the volume Highlights of Astronomy Presented at the XIIIth General Assembly of IAU, Prague 1967. The contribution by Winckler appears in Proceedings of the IAU Symposium No 35.

#### **Business Meeting, 26 August 1967**

##### I. RESOLUTIONS

The President reads the following resolutions, drafted for approval by Commission 10.

1. The Working Group of Commission 10 on Coronal Intensity Standardization,

*Recognizing* the importance of patrol measurements for a better knowledge of the solar corona and of its time evolution, as well as for an early warning of the arrival of active centers at the East limb,

*Stressing* that these measurements should be expressed in a homogeneous scale and be taken at a sufficiently large number of stations well distributed in longitude,

Aware of the difficulty of time-sharing problems on instruments during the limited observing periods available,

*Recommends:*

- That the authorities responsible for the scheduling of the instruments already in operation, or soon to be operative, stress equally the following three types of work:
  - patrol observations;
  - special purpose observations of the corona;
  - observations needed for technical improvements;
- That, in all stations which presently assure (or have in the past assured) patrol observations, the time allocated to these observations be at least maintained, or reestablished, to the minimum level required for a meaningful coverage; this applies to the K-corona as well as to the emission corona for those stations which are now equipped (or would soon be equipped) with a K-coronameter;
- That patrol observations be organized at the stations of Huancayo and the Hawaiian Islands, which are particularly important on account of their longitudes and favourable meteorological conditions;
- That patrol observations be organized also at the stations of Irkutsk and Abastumani;
- That patrol observations be made with the Kodaikanal coronagraph;
- That steps leading to the temporary exchange of observers between different stations be encouraged;
- That, because of the important technical work (to be described somewhere else) which remains to be done in order to reach a homogeneous system of measurement, and which has been divided among its members, the Working Group continues its activities past the XIII General Assembly.

2. Recognizing the usefulness of well-specified international cooperative projects, particularly for better understanding of the problems of solar-terrestrial physics, but also for the study of solar activity itself, and bearing in mind the great significance of close international cooperation for present-day science,

Commission 10 of the I.A.U. recommends that IUCSTP promotes and organizes short-term cooperative projects during the coming years of the active Sun, provided that these projects are well prepared, will not overlap in time and will not place such a burden on the solar observers that their own research work would be influenced in an unfavourable way.

3. Commission 10, being informed about the resolution adopted by the COSPAR Working Group II during the London meeting (1967), in which the continuations and the rapid exchange of information on solar activity through regional warning centres is recommended,

wishes to endorse this resolution and recommends that solar observers continue their efforts to keep the Sun under permanent observation and to make data on current solar activity available for rapid world-wide dissemination.

4. Commission 10

- notes that the *Cartes Synoptiques de la Chromosphere Solaire* and associated catalogues give in a concise form an exhaustive description of solar activity including the location, size and progressive evolution of active regions and filaments;
- considers that, although similar information has recently been made available on a day to day basis, the synoptic presentation is more directly useful for the study of long term changes;
- notes that the *Cartes Synoptiques* have been used during recent years in a number of investigations of 27 days, yearly and cyclic variations of solar activity and associated terrestrial effects;
- considers that their value in such work is due to their availability for nearly 5 eleven-year cycles of solar activity and increases with time;
- therefore recommends the continuation of this publication under partial financial support from I.A.U.;

being aware of severe limitations in the resources of the Union and of the necessity to help new projects,

— proposes to reduce the subvention to this publication to 1500 U.S. dollars for the period until the XIV General Assembly.

5. Commission 10 recommends to continue the annual subvention of gold francs 1000,— for the *Heliographic maps of the photosphere* for the coming 3 years.

The *Heliographic maps* contain the sunspot groups, the plages and the evolution tables. They are compiled from observations of the Zurich Observatory and its branch stations in Locarno and Arosa as well as from many collaborating observatories. They are published on an international basis and since 1966 printed in English. The *Heliographic maps* are distributed in 500 copies to all astronomical observatories and to a large number of magnetic, ionospheric and geophysical observatories that are interested in solar activity. This series covers the last 30 years and was widely used in many geophysical researches, in statistics on sunspot activity and in recent years for the study of local magnetic fields on the sun. The maps are a necessary addition to the heliographic maps of the chromosphere published by the Meudon Observatory and to the heliographic maps of the corona published in the *Quarterly Bulletin on Solar Activity*.

The annual subvention granted by the I.A.U. covers about half of the printing costs in a year of low solar activity and about one third in a year of solar maximum. If the subvention granted in the last 20 years should be stopped, the Zurich Observatory would be faced with severe financial difficulties. The special character of the heliographic maps does not allow to publish them in an astronomical journal. Therefore, the continuation of the subvention would be highly appreciated.

6. Commission 10, having been presented a sample of the series of photographs of the Sun prepared by the Monte Mario Observatory in Rome and being informed about the plan to publish these as a *Photographic Journal of the Sun*, starting January 1968.

wishes to express its appreciation for this initiative and welcome this *Journal* as a valuable contribution to making basic information on the development of solar activity available to the scientific community.

All these resolutions were accepted.

## II. DISCUSSION ON THE QUARTERLY BULLETIN ON SOLAR ACTIVITY

### (a) *History and present status*

*M. Waldmeier* gives some information on the history and the present status of the *Quarterly Bulletin on Solar Activity*. In 1928 this bulletin started as a publication of character figures for solar phenomena. Since 1938 it contains a list of flares. Since 1938 the name *Quarterly Bulletin* is used. In 1947 tables for coronal observations and for radio emission appeared in the *Q.B.* Since 1956 the *Q.B.* is financed by the Federation of Astronomical and Geophysical Services (FAGS). In 1961 the Inter Union Commission for Solar Terrestrial Relationships was assigned as an advising committee to the *Q.B.* This function was transferred in 1966 to the IUCSTP. The *Q.B.* consists at present of four parts: Sunspots, flares, coronal observations and radio emission.

The *Q.B.* has always been meant to be a final publication. Certain aspects of solar activity are not represented in the *Q.B.*: filaments, magnetic fields and X-rays. If one should like to have these data included in the *Q.B.* as well, a recommendation to this effect should be presented to FAGS and a centre should be found for preparing the data.

### (b) *Publication of magnetic maps*

*R. Howard* gives an account of the publication of magnetic maps.

Daily magnetograms are now being published in the *Solar-Geophysical Data of ESSA* (Boulder). A publication of synoptic maps, covering the period 1959–1966, is in preparation, but this series will not be continued.

*A. B. Severny* shows some examples of comparisons of magnetic field measurements made by the Crimean observatory with magnetograms from Irkutsk, Mt. Wilson and Meudon. In order to give regular standardized information in the form of magnetic maps of separate active regions, one

should know how to reduce the different systems of measurement to each other. At present five observatories make measurements of the magnetic field in active regions on a regular basis. It seems possible, by further cooperative study and intercomparison of the maps, to arrive at an adequate system for the publication of magnetic data.

*V. A. Krat*, on account of the rapid variation of magnetic fields, doubts whether a combination of measurements by different observatories is possible.

*Severny* however thinks that the general features vary sufficiently slowly so as to permit the combination of the results from different observatories into one presentation.

*H. W. Dodson-Prince* recommends to give some educational aid to those who want to study the magnetic data.

*E. Tandberg-Hansen* stresses the need of having a magnetic map for each day.

### (c) Flare data

*R. Michard* gives the following report.

A new system of classification for the  $H\alpha$  flares was adopted at the Hamburg meeting (1964). This system became effective 1 Jan. 1965. Practically all patrol stations shifted from the old to the new system of assigning importance at the proper time. At present the World Data Centers receive more than 1000 flare reports each month.

Although the observatories generally do their best to comply with the IAU recommendations, there are still large inhomogeneities in the reported flare data. One method to get rid of the inconsistencies between reports from different stations is to derive correction factors for reducing the data from individual observatories to a common scale. This procedure has been introduced in the *Solar-Geophysical Data*, published by ESSA (Boulder). But even after such reductions the number of reported flares per hour is still unevenly distributed over the 0<sup>h</sup>–24<sup>h</sup> U.T. interval. Another method is to urge the observers to adhere to the definition of a flare as a sudden and strong brightening of part of the  $H\alpha$  plage and to the recommended procedures for assigning the importance. It is obvious that a few observatories report as flares certain brightness fluctuations which by most stations are not rated as a flare.

At the Hamburg Assembly it was recommended that WDC-C at Meudon should look into the trends of each station and should bring the results to the attention of the observers. This was done in a preliminary way for the flare reports of 1966. The usual method of defining a 'Mean Observatory' was followed. The average number of flares per time interval reported by a given station  $i$  was compared with the corresponding quantity for the Mean Observatory; the ratio is to be called  $K_i$ . For flares of importance 1 we note the following: The range of  $K_i$  is enormous, ranging from 0.39 to 5.59. For cinematographic stations the dispersion of  $K_i$  is much smaller. For flares of importance 2 the dispersion is still larger, even for cinematographic stations.

In many cases it is possible to trace the cause of anomalies for certain stations.

*First*, visual observers often see more details on the sun than does the usual cine-patrol with small image; they also have difficulties in telling apart the more gradual brightness fluctuations from the sudden ones. So,  $H\alpha$  variations may be reported as a flare of importance S or 1 which are not flares according to the definition. Statistical methods of correction are powerless against this kind of error.

*Secondly*, a number of stations easily shift subflares into class 1. This error is to some extent corrected by averaging the different reports relating to the same flare.

In order to improve the homogeneity of flare data the most important problem is to eliminate the spurious flares. For instance, if someone sees a flare of importance 2, but three other stations do not report any flare whatsoever, one is justified to eliminate this flare. It is tried to adapt the computer programme for treating flare data to make such checks. The effort towards improvement of the supply of data by all colleagues participating in the flare patrol is gratefully acknowledged.

In the discussion to Michard's report *M. Rigutti* gives some details on photometric analysis of flare photographs made at Arcetri. It appeared that the area of a flare is strongly dependent on the

threshold brightness level. There is a tendency to overestimate the area of flares near the limb. From isodensitography a more meaningful flare classification could be derived.

*C. Popovici* confirms the fact that many observatories do not adhere to the conventions set for flare classification. He makes some comments on the feasibility of adopting the "mean observation" as a reference standard.

*H. W. Dodson-Prince* notes that flare importance rating can also be influenced by the sort of instrument used. Photometry, according to her, is difficult to standardize.

(d) *Solar radio data*

*A. D. Fokker* gives the following report.

The part solar radio emission now comprises about one half of the Quarterly Bulletin on Solar Activity. The biggest and most important of the tabulations in the part Solar Radio Emission is the one which contains single-frequency data of the so-called distinctive events. This table has greatly expanded during recent years, not only due to the increase of solar activity, but also because the number of contributing observatories has increased. For a given event, more frequencies can now be listed than a few years ago. The data are so arranged that one can appreciate the approximate extent in frequency and the overall character of each radio event at a glance. Particularly at frequencies near 3000 and 200 Mc/s there is a good deal of redundancy of information. From the several reports that are available for each of these, or other frequencies, a representative one is selected for insertion in the table.

At the higher frequencies, about 500 Mc/s and up, the world-wide patrol coverage is quite satisfactory. One can be sure that practically all solar microwave radio bursts at frequencies above 2600 Mc/s do figure in the table. At lower frequencies the situation is less satisfactory. Especially on the American continent there is a certain neglect of single frequency observations at frequencies below 500 Mc/s. As a consequence, the low frequency representation of distinctive events that occur between, say, 18·00 and 26·00 UT, is often insufficient.

The second largest tabulation is the one of spectral classification. Recently a new system of tabulation has been introduced, in which separate entries are provided for metric and decametric events. The radio spectrographic patrol coverage was maintained essentially by stations in USA and Australia, leaving a gap in European a.m. hours. Recently, spectrographs have been put in operation that will probably help to bridge this gap.

The Harvard spectral data figured both in the *QB* and in the *ESSA Solar-Geophysical Data*. At present the duplication of spectral information in these two periodicals has become complete, since now also the Sydney data are contained in the *SGD*, while the Boulder spectral data are being entered in the *QB*. The *QB* listings have the advantage, though, that the three series of observations are combined on one table.

There is also duplication with regard to the synoptic charts of Nançay interferometer observations at 169 and 408 Mc/s.

Radio-heliographic maps are lacking in the *QB*. At present 9.1 cm heliograms from Stanford and 21 cm heliograms from Fleurs are both published in the *SGD*. Since it does not seem to have sense to enter more duplicated data in the *QB* I would not exactly advise to enter the heliograms in the *QB*. Yet it is a pity that the *QB* does not comprehensively contain all the data relating to solar radio noise activity.

It is very fortunate that more and more observatories include copies of selected radio events in their reports. It would be somewhat troublesome to enter all these in the *QB* and moreover, such a collection of selected events would have a somewhat haphazard character.

From the figures of daily flux density at several frequencies one can see at a glance that there are still discrepancies among the different stations resulting from imperfect intensity calibration. Very few data are available at frequencies below 200 Mc/s and little is known about their reliability. A working group of URSI Commission 5 pays attention to the question of absolute calibration.

The typescript of solar radio data generally is finished within 6 months after the end of the period it covers.

**Business Meeting, 30 August 1967**DISCUSSION ON THE QUARTERLY BULLETIN  
ON SOLAR ACTIVITY (CONTINUED)*(e) Solar index for the central part of the disk*

*G. Newkirk*, on behalf of S. I. Akasofu, S. Chapman and W. O. Roberts, presents a recommendation for the renewal of the publication of a solar index (based on sunspots) for the central part of the solar disk in the Quarterly Bulletin. This recommendation is argued by the fact that solar activity in the central part of the disk has been found to correlate appreciably better with various geophysical effects than the activity of the sun as a whole.

*M. Waldmeier* remarks that, consequently to an advice of Commission 10, no central disk index for sunspots has been entered in the Quarterly Bulletin since 1939. He asks whether, on resumption of a central disk index, it should be tried to fill the gap which then will exist for the period 1939 until now.

*C. W. Allen* comments that central disk data, in his opinion, are not particularly useful; studies can better be concentrated on individual active areas.

*H. W. Dodson-Prince* recommends to reconstitute the central values in order to be able to compare the solar cycles 18 and 19.

*K. O. Kiepenheuer* notes that the central index is obviously of interest to geophysicists only; interested people might look themselves more closely into the solar data.

*S. Chapman* finds it reasonable that the solar people provide the data; he calls also for the publication of a flare index. *H. W. Dodson-Prince* remarks that the derivation of a suitable flare index is still a research problem.

The President concludes the discussion by requesting *M. Waldmeier* to consider the possibility of resuming the publication of a central disk index and of filling in the gap. *Waldmeier* declares himself willing to look into this matter.

*(e) Further discussions*

*H. Nussbaumer* stresses the desirability to publish in the Quarterly Bulletin data on the Sun's ultraviolet and X-ray emission. The data, now scattered over various sources, should be collected in one publication as soon as possible.

*A. B. Severny* notes that Commission 44 should be consulted on this matter. The President promises to discuss this with the President of Commission 44; perhaps a working group can be formed.

*P. J. Cardus* points to the duplication of data that are published both in the ESSA Solar-Geophysical Data and in the Quarterly Bulletin. He wonders whether such duplication should not be avoided.

The President thinks it is reasonable to have a fast appearing bulletin of a preliminary nature and a more retarded one giving definitive data.

*H. W. Dodson-Prince* notes that the Solar-Geophysical Data is a service bulletin whereas the Quarterly Bulletin is a contribution to prosperity.

*M. Waldmeier* notes that the flare tables in the two bulletins are different; coronal data figure in the *Q.B.* only. The *Q.B.* should contain such data as can be contributed for a long time on the basis of a regular and uniform system. In the *Q.B.* publication of magnetic data and of ultraviolet and X-ray data should only be started once one can be sure of a continuous and standardized supply.

*J. T. Jefferies* proposes that a working group will study the philosophy for the *Q.B.* and will look into the possibilities of entering new data in it. It is agreed that the following scientists will be asked to become members of a Working Group on the Presentation of Solar Data:

Fokker, Howard, J. Virg. Lincoln, Mandelshtam, Sawyer, Severny, H. J. Smith, Waldmeier.

III. RECOMMENDATION PRESENTED BY THE REPRESENTATIVES  
OF THE SOLAR PHYSICS DISCIPLINE IN THE IUCSTP

The representatives of the solar physics discipline in IUCSTP (de Jager, Mustel, Pick) have been asked by IUCSTP to present recommendations for research in the coming years of solar maximum.

Therefore, during this IAU-meeting the representatives discussed some aspects of international cooperation in the field of solar physics and solar terrestrial relations and formulated the following recommendation, which they have requested to be submitted for the approval of Commission 10 of the IAU, at its meeting on August 30th, 1967:

Apart from special projects which have already been recommended by Commission 10, the main emphasis during the coming years of the active Sun should be placed on the following observations:

(1) Observation and analysis of changes of local magnetic fields on the Sun, using the highest possible spatial and time resolution. The behaviour of magnetic fields during chromospheric flares is an especially important matter for study – as is the question of the origin of solar magnetic fields.

(2) Non-stationary and non-thermal processes inside the solar corona. This study should include a detailed analysis of the following:

(a) Decametric and metric wave-length observations during chromospheric flares and at times of other non-stationary phenomena. Intensity measurements with radio-spectrographic, and polarimetric observations are recommended using the highest possible angular and time resolution.

(b) Radar studies of the Sun outside and during active periods.

(c) Coronal cinematographic observations of active events in different coronal lines.

(d) Direct observations of active regions using geophysical rockets.

(e) Satellite observations of the evolution of short wave-length spectral lines during periods of solar activity. Intensity and polarimetric measurements should be made.

(f) Photography of the Sun in those ultra-violet and X-ray regions to which the solar corona is the most important contributor.

(g) Satellite observations of the continuum radiation arising from active coronal regions in the short wave-length range. Simultaneous polarimetric observations are highly recommended.

It is very important that attempts be made to carry out these studies simultaneously.

This recommendation has been approved.

IV. REPORT OF THE WORKING GROUP ON THE STANDARDIZATION  
OF INTENSITY MEASUREMENTS OF THE SOLAR CORONA

*J. Rösch* presents the report of this Working Group.

The Working Group, after having treated the subject by correspondence, had a meeting in Bagnères de Bigorre from 7 to 11 August 1967. The results of the discussions will be published in *Solar Physics*. On the basis of the general conclusions, a resolution has been drafted for adoption by Commission 10 (see page 74). In the following, a summary of the technical aspects, relating to the emission corona only, is given.

The Working Group realizes that it is premature and difficult in practice to prescribe a unique method of observation to all the stations. Nevertheless, considerable progress towards uniformization can be made if each individual observatory makes frequent comparisons of its measurements, made by its normal methods, with measures made according to a uniform method.

To this end the Working Group recommends to photograph the spectrum at position angles  $5^\circ$  apart, with the slit of the spectrograph perpendicular to the solar limb. Such spectra can be obtained, by practically all stations with their available equipment, without drastic modifications.

The Working Group stresses the fundamental importance of knowing the altitude above the limb to which the measurements pertain. The difficulty of establishing the height is no doubt one of the

main causes of discrepancies between the measurements made at different stations. The following possibilities are suggested for improving the evaluation of height:

(1) The use of an occultation disk of glass or metalized silicum with a transmission of  $10^{-4}$  through which the solar limb may be seen.

(2) The use of a metallic disk, which is centered with the solar image in such a way as to obtain the most regular distribution of chromatic brilliance around it. The height at the base of the spectra is given by the difference between the disk's radius and the photospheric radius.

(3) If, in order to reduce scattered light, an over-sized disk is used, this disk should be first centered along with a disk of minimum size as referred to in (2).

The Working Group prefers to await the results of the above mentioned observations before making a definitive choice of the standard height at which the patrol measurements will have to be made. In the meantime, it recommends that preparative studies be made in a range of heights containing the distance of 1' to the limb. The standard height, to be fixed ultimately, will probably not exceed this level.

The amount of information provided by observations with radial slits and at many different position angles is very great indeed. As long as there will be no means of treating the material automatically, one may restrict oneself to derive only the information which is needed to serve as a reference standard for the patrol measurements. The Working Group recommends that such methods of analysis will be applied as allow the evaluation of possible causes of systematic discordances.

The Working Group recommends that, preliminary to achieving full uniformization of the observational methods, the measurements be reduced to a common scale, according to methods which aim at eliminating the following causes of error:

- (a) the small weight of certain observations;
- (b) the fact that measurements are not made simultaneously;
- (c) the errors in position angle;
- (d) the effect introduced by averaging over a certain length of the slit;
- (e) the discrepancies among the heights above the limb to which the various measurements refer.

With regard to (a) and (b), the stations are requested to derive 6-monthly averages for position angles  $5^\circ$  apart, giving appropriate weights to the individual measurements.

In view of (c) it is recommended to investigate the causes of systematic differences in position angle. To this end the 6-monthly averages should be plotted in polar coordinates. Intercomparisons can be made by the superposition of two polar plots, rotating them until the best coincidence between maxima and minima is obtained.

It should be investigated how effect (d) depends on the gradient of coronal intensity. For the present, the procedure of measurements should be kept as constant as possible.

In view of (e) it is very desirable to have the intensities derived for a height which, at a given observatory, is kept constant throughout the series of measurements.

Utilizing the 6-monthly polar diagrams, each station  $S_i$  can be compared with an arbitrary station  $S_o$  by plotting against each other the measured intensities at corresponding position angles. A mean curve drawn through the points defines a relation between the values of  $S_i$  and those of  $S_o$  and this curve can be used to transform the polar diagram of  $S_i$  in a polar diagram corresponding to the scale of  $S_o$ . Taking the average of all these transformed diagrams (including the diagram of  $S_o$ ), one obtains a representation of a 6-monthly mean corona in an arbitrary scale. Coronal data should then be reduced to this common scale before entering them in the Quarterly Bulletin on Solar Activity.

The Working Group estimates that a 6-months period suffices for the series of green coronal line measurements. Over a longer period certain stations might not keep their scale sufficiently constant. For the red line the average should be taken over at least one year since the number of available measurements is smaller.

As a matter of fact, the described comparisons can be applied already to the observations made during the past several years, notably with regard to the effects (a), (b) and (c).

**Scientific Meeting, 30 August 1967**

This meeting was devoted to a discussion of dynamic solar radio events. The following communications were presented.

**1. Optical observations.**

- E. Tandberg Hansen:* The interaction of dark active filaments and flares.  
*D.H. Menzel:* Solar flares and shock waves.  
*L. Křivský:* The evolution structure of proton flares near the limb and associated coronal effects.

**2. Radio observations.**

- A. Boischof:* A source of synchrotron radiation at a large distance from the Sun.  
*F. Fürstenberg and A. Krüger:* On the acceleration of particles in the post-maximum phase of solar microwave bursts.  
*A. Krüger:* On homologous bursts of continuous solar radio emission.  
*T. de Groot:* Remarks on type I bursts.  
*A.D. Fokker:* On the connection between solar electron events and noise storms.  
*M. Vinokur:* The 169 Mc/s multilobe interferometer at Nançay.  
*J.M. Malville:* Starting frequencies of type III bursts.