figures by general agreement in the future. Meanwhile, we offer the following statement for the guidance of observers who are in a position to measure central intensities: If an observer knows that the central intensity of a flare at maximum is as much as 0·8 of the continuum, he can feel justified in calling it a flare of importance 1. If the intensity is greater than the continuous spectrum and the corrected area is of the order of 250 millionths or more, the importance can safely be estimated as at least 2. No flare should be called importance 3 if its intensity is known to be less than that of the continuous spectrum. Flares for which the intensity is more than twice that of the local continuum are generally of importance 3 or 3+.

6. It is emphasized that the new scale based on area is closely related to the present practice of most observers, and there will be no appreciable discontinuity between lists of flares drawn up on the new and the old systems. If the new scale is consistently applied, it may lead to considerably better accord than in the past.

7. Geophysical effects of flares (e.g. crochets, fade-outs, S.E.A.'s, etc.) should not be allowed to influence the importance classification. In this way we shall avoid prejudging the question (still to be decided) whether all flares of the same Hα importance have comparable ionospheric effects.

8. Flare surges are an important, and as yet little understood, feature of the flare process. These prominences make their first appearance nearby within a few minutes of the time of peak intensity of the flare emission; when seen against the disk they exhibit dense absorption by contrast with the wings of the Hα line. They are best observed by 'hunting' with the spectrohelioscope line-shifter, since they show a characteristic sequence of sightline velocity—blue shift followed by red shift (6).

In view of their intrinsic interest, and their possible bearing upon the radio noise and cosmic ray phenomena, we recommend that their association with flares should be reported to the *Quarterly Bulletin*. This can be done by the insertion of the letter *d* after the figure which denotes the flare importance, and in special cases by an independent note giving the maximum observed sightline velocities.

9. Greater attention should be given to the correct assignment of the co-ordinates of flares. Discrepancies between different observations of the same flare are often considerable. The heliographic latitude and central meridian distance should be stated for the time of flare maximum, and these should refer to the 'centre of gravity' of the emission region, rather than the brightest point.

M. A. Ellison
Chairman of the Working Group

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11*a*. SUB-COMMISSION ON CINEMATOGRAPHY OF CHROMOSPHERIC PHENOMENA

The principal question facing the sub-commission is that of accomplishing international co-ordination of the cinematography of chromospheric and prominence phenomena. At the 1948 meeting of Commission 11 the goal was set of producing films, by inter-observatory co-operation, presenting in uninterrupted sequence the whole life-evolution of prominence and chromospheric manifestations of active solar regions, not only for the limb but also the disk manifestations of the activity. The increasing number of observatories now engaged in obtaining such films brings the long-established goal within hope of realization. However, serious problems of the magnitude of the task of assembling

such a co-operative film or films now arise. The sub-commission must evaluate, in very concrete terms, the usefulness of such a film, and balance against this the great effort and expense that will be involved in its preparation.

Observatories engaged in prominence and chromospheric cinematography

Observatories engaged in cinematic recording of prominence and chromospheric phenomena to standards that meet or approach those adopted at the 1951 meetings of the sub-commission include the following, for which the available instruments have been described in previous reports:

1. Mount Wilson Observatory—spectroheliograph in K_2 and Hα.
2. McMath-Hulbert Observatory—spectroheliograph in K and Hα.
3. Meudon Observatory—spectroheliograph and birefringent filter in K and Hα.
4. High Altitude Observatory—birefringent filter in Hα.
5. Crimean Astrophysical Observatory—birefringent filter in Hα and other lines.
6. Upper Air Research Observatory, Sacramento Peak—birefringent filter in Hα and other lines.
7. Royal Observatory of Belgium—birefringent filter in Hα.

Some of the above instruments, of course, are not available for full-time cinematic surveys, but at times are engaged in other research programmes. Several additional observatories have disk- or limb-observing equipment readily adapted to continuous solar cinematography; still others contemplate the construction of such instruments. It is also hoped that cinematographic observations will soon be possible in India, Australia, Japan and possibly also Hawaii, in order to fill in the longitude gaps in the observing locations.

Progress of research

Research based on cinematographic records of solar prominence motions has occupied numerous workers in recent years:

1. A. B. Severny reports several items of work performed at the Crimean Astrophysical Observatory. Day-to-day cinematography of disk and limb has been performed with a Lyot-type coronagraph equipped with a narrow-band birefringent filter centred at Hα which permits the user to change from a band-width of 0·5 Å to 1·5 Å. Since 1952 about 2000 metres of cinematographic records on 35 mm. film have been obtained, and extensive analyses made, particularly of flares and eruptive prominences. Recently a photoelectronic guiding system has been added to the coronagraph, with attendant improvement in guiding quality.

The cinematographic recording of phenomena associated with flares, and of flare spectra and other characteristics has been pursued at Crimean Observatory (1) with important conclusions regarding the radiated flare energy in Hα and Lα. It is concluded from this work that ample energy is available for substantial D and E--region ionospheric effects, and also for ejection of H atoms from the solar surface.

Several papers have also come from the Crimean Observatory regarding prominence motions and brightness changes. The main types of prominence motions were considered in one paper (2) in which the distinctions between 'eruptive', 'electromagnetic' and 'turbulent' prominences were described and illustrated by actual prominence trajectories. Another paper (3) extensively described the brightness and motion changes of prominences. It established a size-dependence of the rate of fading out in knots of prominence material, and also the relationship of sudden brightness changes to motion changes in eruptives.

2. Cinematic records of the chromosphere in Hα by Lyot furnished the material for analysis of the spicules by Dizer (4) at Meudon Observatory. Dizer found velocities of ascending material in spicules of about 20 km./sec. with similar descent velocities. Some regions of greater agitation exhibited larger velocities and heights. Similar films of Lyot, showing the small 'fibrils' of dark filamentary material that join sunspots, were studied

by Lippincott at the Meudon Observatory. The fibrils last from several minutes to more than an hour without being displaced, and may form and disappear, only to form again at exactly the same location. These researches demonstrate the important work that is possible when high-resolution cinematic studies of solar phenomena are carried out under conditions of good seeing. Working at Meudon on cinematographic records by Lyot, taken in integrated light rather than monochromatic, Macris (5) obtained valuable results on lifetimes of solar granules.

3. Cinematic observations were made of the limb flare of 8 May 1951 by Dodson and McMath (6) at McMath-Hulbert Observatory. The flare was accompanied by rapidly ascending prominence material that reached outward velocities of the order of 500 km./sec., and line-of-sight velocities of over 200 km./sec. Their analysis was particularly useful because of its associated photometry, and because the McMath-Hulbert Observatory is able simultaneously to study the development of so many characteristics of the solar activity accompanying the short life of a flare. A similarly valuable study was made by Dodson (7) of motions in a disk flare and dark flocculus. A study of the ejection of high-velocity Ca and H material with solar flares, derived from the integrated observing programme, revealed a close association of the ejecta with distinct solar noise bursts at 200 mc./sec. (8).

Pettit (9), using several older cinematographic records, studied the motion of ascending eruptive prominences to heights that reached or exceeded 10^6 km. He found further evidence for results he had reported earlier: namely, uniform velocities punctuated, at times, by relatively sudden changes of velocity.

The great usefulness of extensive cinematic records in statistical study of the chromosphere is illustrated by the valuable results of Richardson (10) on the characteristics of solar flares.

5. Over 80 knots of prominence material from High Altitude Observatory cinematic records from the Climax coronagraph were analysed by L. Larmore (11) of the University of California at Los Angeles in a doctoral dissertation. Examination of the accelerations of the prominences led to the conclusion, in contrast to that of Pettit, that there were no sudden changes of velocity. Parabolic curves fitted the time-distance diagrams very satisfactorily. Force fields for knots travelling similar trajectories were similar, unless the overall prominence form was changing significantly.

6. A motion analysis from cinematographic records taken by Harvard College Observatory at Sacramento Peak was made by Bartlett, Witte and Roberts (12) at the High Altitude Observatory and revealed, for the ejected prominence material associated with the 8 May 1951 limb flare, that forces large compared with gravitation were present, but that no simple symmetry or consistency in the forces could be discovered.

Spicule studies from five different Climax films, reported by Rush and Roberts (13), gave mean lifetimes of 3·5 minutes, and mean ejection velocities of about 30 km./sec. The size and frequency distributions suggested the existence of numerous small, short-lived spicules unresolved in the films, and indicated the great importance of higher-resolution studies.

The distinctive character of prominences associated with intensely active solar regions exhibiting yellow coronal line emission was analysed by Dolder, Billings and Roberts (14) from 41 cinematographic sequences of prominences associated with coronal emission, and 42 control sequences.

The motion characteristics of the large ascending arch prominence of 25 July 1951 were studied by Rothschild, Pecker and Roberts (15).

7. High-resolution chromospheric observations at the limb now in progress by Dunn, Evans and their colleagues at the Upper Air Research Observatory at Sacramento Peak in Hα and other lines reveal, as earlier films taken in America have not done, the intricacies of spicule motion. Evans has developed a method for accurate stereoscopic measurement of line-of-sight prominence motions from specially obtained cinematic records. The new method should improve the precision and simplify the execution of three-dimensional prominence motion analysis.

Continuous cinematic record of solar phenomena

The last meeting of the sub-commission in Rome recognized that it was premature to designate a single central observatory to prepare a co-operative international film giving the uninterrupted life-history of a solar region or regions. However, the Meudon Observatory was temporarily designated to carry out liaison preliminary to such an effort, and to aid in the development of standardized procedures for preparation of the materials for such a central effort.

In pursuit of this goal, d'Azambuja and his colleagues have undertaken the development of a prototype monochromatic heliograph, designed for this purpose by Lyot, prior to his death, and have made arrangements for the construction and sale of such instruments, which will meet the standards for a co-operative continuous film set by the sub-commission. The heliographs will also be highly useful for a variety of cinematic researches on the solar limb and disk, though, of course, they will not meet the requirements for high-resolution chromospheric photography to limits below 1″ arc. Specifications for these instruments have been widely distributed from the Meudon Observatory.

Dollfus suggests that the goals of a co-operative programme of continuous cinematic recording may be analysed as follows:

(*a*) To produce a documentary record at a central observatory that will permit us to reconstruct, as later studies might require, the state of the chromosphere for any specified time.

(*b*) To produce statistics of flares, surges, sudden prominence disappearances, and other chromospheric phenomena from time-analysis and photometric study of the films.

(*c*) To examine phenomena based in the solar chromosphere, on a time-scale intermediate between that of the daily mapping studies that have been so useful in the past, and the fast time-scale necessary for high-resolution studies. Film records like this will be particularly adapted to the study of such things as the evolution of active centres, reactions between centres and slow modifications of quiescent prominences.

The first two classes of studies would be useful for solar-terrestrial research, and in particular for the programme of the International Geophysical Year. The third would be of value for a concerted attack on problems of solar physics.

McMath suggests, and Roberts concurs, that at the coming meeting the sub-commission should carefully examine certain practical aspects of the problem of preparing and distributing such a co-operative film. Included in such consideration should be: the exact use to which such a film would be put; the number of interested participants; the problems of assembling, distribution and cost. Roberts notes that photometry could probably not be safely done on the film copies, even if careful printing procedures were used. On the other hand, a momentous task of reduction, expression of results, and publication would face a central observatory if reduced data only were to result from the undertaking.

Roberts suggests that the more useful and practical approach may be to establish certain procedures of reporting reduced observations to a central observatory, the reductions being made by the observatory responsible for the original films. For this, the sub-commission could draw up standards for the reports, and a designated central observatory could combine them suitably for publication.

Severny recommends the following points for international co-operative observations:

(*a*) The observatories should conduct their cinematography in such a way as to observe simultaneously the radio emission of the sun for meter and decimeter wave-lengths.

(*b*) The observatories engaged in co-operative preparation of a film or catalogue of cinematic records of solar phenomena should use Lyot-type coronagraphs in order to obtain uniform and comparable results at different stations.

Severny adds the hope that photometric procedures as well as observing instruments can be made uniform, so that the films from different observatories will be comparable in all respects.

Researches from cinematic records

Kiepenheuer suggests, in the following proposal, that routine photometry of chromospheric faculae and flares should be undertaken from cinematographic records:

It has been found that: (*a*) the emission of the coronal lines λλ 5303, 6374 (16); (*b*) the radio-emission of the corona at λ 10 cm. (17); and (*c*) the Lyman-region emission as deduced from ionospheric observations (18) correlate much better with the chromospheric faculae (plages) than with sunspots. Although these three above-named radiations have been observed more or less quantitatively for some years, there exist only provisional and incomplete estimates of the intensity of chromospheric faculae (*Zirkular des Fraunhofer Instituts* and its predecessor, since 1942).

To us it seems therefore urgently necessary that a few observatories start quantitative photometry of faculae on a routine basis. It is still debated whether one should pay more attention to the total Hα emission of groups of chromospheric faculae (in Hα quanta/sec.) or to the maximum brightness. It is clear to us that the latter depends to a high degree on the quality of the image and therefore would introduce great difficulties in a routine programme. The undersigned intends to demonstrate at the Dublin meeting a simple apparatus which will allow the user to evaluate photometrically routine photographs taken with a Lyot filter (Δλ 0·6 Å). Without alteration this same apparatus can be used for the photometry of flares.

It has been suggested that the sub-commission assist in assuring that suitable photographic film is available for standard cinematographic recording. Roberts therefore proposes that the sub-commission establish, if possible, standards for the optimum photographic film emulsion for this work, after which an effort will be made to assure that such film is kept in available stock by a suitable film-manufacturing firm.

W. O. Roberts
President of the Sub-commission

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Report of meeting. 30 August 1955

PRESIDENT: Prof. Y. Öhman.

SECRETARY: Dr M. A. Ellison.

The Chairman expressed his thanks to all members of the Commission for their co-operation in submitting data for the preparation of the Draft Report. Before asking for approval the Chairman invited discussion of some important questions referred to in the report.

1. Dr d'Azambuja reported that since the Rome meeting the prototype Hα heliograph had been successfully completed and brought into operation at Meudon. The firm of S.E.C.A.S.I. at Bordeaux had been entrusted with the construction of similar instruments and two had been ordered—one for Mitaka and one for Cape of Good Hope—for use during the International Geophysical Year. Construction time would be about six months. The ideal to be aimed at was a continuous 24-hour patrol. A model of the S.E.C.A.S.I. instrument would be on view during the meetings.

In congratulating Dr d'Azambuja on the important progress, the Chairman said that he understood similar instruments on a different type of mounting were about to be manufactured by Carl Zeiss in Oberkochen.

2. The Chairman invited Dr Roberts to speak on the programme of observing hours for the cinematographic patrol of the chromosphere. Dr Roberts presented a tentative scheme for daily observing hours from the proposed stations arranged in order of longitude. On the Chairman's suggestion hours of good seeing conditions had been selected. The final details of the programme would be arranged by Commission 11*a*.

3. Dr Rösch explained the difficulties met with in correlating the coronal line intensity measures being made with different instruments at the various observatories. The problem was an urgent one because it was necessary to publish all the measurements in the *Quarterly Bulletin*, and it was not possible yet to publish mean values owing to the wide discrepancies. At the Pic du Midi the coronal line and artificial line were being photographed simultaneously and comparisons were made by photographic photometry. The results showed good agreement with the visual measures. The method, however, was too slow to be applied to the daily patrol round the limb.

Dr d'Azambuja reported on the progress made at Meudon in the development of the coronameter of Lyot for the photoelectric recording of the 5303 line without coronagraph. Owing to many unforeseen difficulties the method had not yet been brought to completion and further work would be necessary.

Dr Roberts reported upon experiments carried out at Climax, where comparisons had been made between the line intensity and the intensity of light transmitted by an opal glass screen placed over the objective. These measurements had revealed some of the causes of discrepancies in the visual measurements and it was hoped to report on these in greater detail.

The Chairman suggested that a practical solution in the daily patrol would be absolute photometry of the intensity maxima only, whereas the details of the contour might be obtained from estimated intensities.

4. Dr d'Azambuja reported that *Les Cartes synoptiques de la Chromosphère solaire* for Rotations 1222–60 had been published but had not yet been distributed. He had pleasure in presenting them to the meeting. The motion:

> La Commission recommande que la subvention annuelle de 2700 francs-or, accordée depuis 1925 par l'U.A.I. à l'Observatoire de Meudon pour la publication des *Cartes synoptiques de la chromosphère solaire*, soit renouvelée pour la période qui s'écoulera jusqu'à la prochaine Assemblée générale.

was carried unanimously.

Dr Roberts reported that in future the Bulletins of the H.A.O., published quarterly, would contain contours printed in red and green of the intensities of the lines 6374 and 5303, as well as accurate drawings of the limb prominences in Hα. These would be distributed to all observatories wishing to receive them.

5. The Chairman then invited discussion of the different suggestions listed on pp. 144 and 145 in this volume.

1. The suggestion was adopted.

2. M. Rösch reported on the plotting of isophotes for the white coronal rays from photographs taken through birefringent filters. M. Dollfus said he was designing a photo-electric polarimeter for measuring with coronagraph the extension of the white corona without eclipses. Dr Roberts reported the construction of a similar instrument at Climax. He considered that some of the errors in coronal photometry arose from errors in the height measurements from the limb. Prof. Severny agreed with these remarks.

It was agreed to express the gratitude of the Commission to the Meudon Observatory for its efforts towards the completion of the Lyot coronameter in the near future.

3. Prof. Kiepenheuer proposed that photographs taken with Lyot filters should be used to obtain a measure of the total brightness of chromospheric faculae. His suggestion was to place the solar image in a parallel beam of light and to measure photoelectrically the amount of light transmitted. Miss Dodson pointed out the difficulties associated with limb darkening and doubted if the measures would have precise meaning. It was agreed that the matter should be further discussed.

4. On this matter of surges, it was agreed to ask the working group on Flare Classification to assume responsibility for the problem. The names Giovanelli, Roberts and Unsöld were added to the members of this working group. The resignation of Mr Newton was accepted with the greatest regret.

5. It was agreed to pass this matter to 11*a* for consideration.

6. Passed for consideration to the working group on Flare Classification.

7. Considered under 2.

8. The Chairman expressed thanks to Dr Roberts for having taken up this question with Eastman Kodak Company. After some discussion and divergence of opinion as to the best Hα films it was agreed to pass this matter to 11*a* for further consideration.

9. Dr d'Azambuja's suggestion, that the fine structure in spectroheliograms observed say 0·5 Å outside the centre of the Hα_1 line should be designated Hα granulation, was adopted.

10. Prof. Kiepenheuer said he had undertaken the printing and distribution of daily maps of the Sun, showing limb and disk prominences, spots, plages and coronal intensities. These would begin on 1956 January 1, and he was distributing copies at the meeting for comments. Mme d'Azambuja gave details of an alternative method proposed from Meudon. Further discussions of these matters were suggested for the combined meeting of solar commissions.

6. The Chairman reported on a proposal made by Dr Sellers that the term 'radial' as now applied to motion in the line of sight should be discontinued and that the word 'sightline' velocity should be substituted. The proposal was agreed to unanimously.

7. Dr Ellison spoke briefly on the report prepared by the working group on Flare Classification (*Trans.* **9**, pp. 146–154). It was agreed to insert the word 'local' in line 8, p. 154, before the word 'continuum', this being the sense intended. After further discussion on the problem of measuring the intensities of flares, the following motion was adopted for presentation to the Executive Committee:

> The Commission recommends that the new scheme of flare classification, as set out in the table of Section 3 [p. 135 in this volume] should be adopted as from 1956 January 1.

On behalf of the Commission the Chairman expressed thanks to the working group for their valuable work, and satisfaction that the working group will be active during the next period as well.

8. The Chairman drew the meeting's attention to Dr Švestka's announcement that he is preparing a summary of the literature dealing with chromospheric flares.

Report of the meeting of Sub-commission 11*a*. 1 September 1955

PRESIDENT: Dr W. O. Roberts.

SECRETARY: Prof. A. B. Severny.

CO-OPERATIVE OBSERVATIONS FOR CONTINUOUS Hα PATROL OF FLARES

The President introduced discussion of the most important goal of the sub-commission, namely, to make recommendations for the most effective form of co-operative cinematographic observations of chromospheric phenomena throughout the 24 hours of each day, and for the efficient distribution of the results therefrom. The first phase of discussion was devoted to the question of obtaining the necessary observations. To begin the discussion, the President introduced the following series of resolutions, compiled from suggestions by members of the sub-commission, and from others participating in similar work.

(*a*) Cinematographic records of the solar disk should be made in Hα, continuously over the entire day. This will require extensive co-operation between observatories capable of making such observations, and as evenly distributed in longitude as possible.

(*b*) The Lyot heliograph may serve as an ideal prototype of the observing instrument, and all instruments should approximate its optical system as closely as is feasible. In particular, the Hα line should be isolated by a birefringent filter with an effective band halfwidth between 0·5 and 1·0 Å; the whole disk of the Sun should be photographed on successive frames of 35 mm. film.

(*c*) Exposures should be made on successive frames of a standard 35 mm. film at intervals not exceeding 3 minutes during the daily observing period covered at each observatory.

(*d*) Every tenth exposure should be made long enough to record limb prominences. (This recommendation modified below.)

(*e*) The same film emulsion and film processing should be used by all observatories. The most suitable film and processing will be recommended by a special working committee of the sub-commission.

(*f*) Adequate photometric calibration of the films should be provided, according to specifications to be recommended by the working committee.

(*g*) The working committee will arrange a recommended observing schedule for participating observatories.

Dr Öhman, while agreeing with the general plan proposed, expressed the hope that such an extensive programme would not cause the research programmes of the participating observatories to become too inflexible. He remarked, for example, that participating observatories should at some times depart from a strict patrol to make observations at 1, 2 and 3 Å away from Hα for the purpose of determining sightline velocities. He also expressed the hope that observations would sometimes be made in wave-lengths other than Hα.

Dr McMath called attention to the film shown by Dr Dodson at the flare symposium, where the lesser quality of section taken in recent years may possibly be due to the fact that the Eastman Kodak Company now supplies a grey-base film rather than clear-base film. This matter should be considered by the working committee when making their recommendations concerning the standard films to be used in the programme.

Dr Ellison suggested that prominence exposures on every tenth frame might not be optimum, and would also interrupt the chromospheric sequence. Dr Evans suggested that alternation of disk and prominence frames might be more suitable. As a result of this discussion, part (*d*) in the above resolutions was modified to read as follows:

(*d*) Efforts should be made to include exposures long enough to record limb prominences without interrupting the chromospheric sequence; a standard for this will be recommended by the working committee.

Dr Rosseland suggested that it might be useful also to have cinematographic sequences in integrated light as a part of the general patrol programme, perhaps by having an integrated light photograph made every few frames of the Hα patrol. Dr Rosseland also mentioned that Zeiss had designed a patrol instrument suitable for this.

The series of resolutions, as modified above, was adopted.

The President then introduced the following resolution, which was adopted:

The President of Sub-commission 11*a* shall appoint a working committee to recommend uniform standards of film characteristics, photometric procedures, and to arrange reporting schedules for the continuous Hα patrol. The final product of the work of this committee shall be a detailed operating manual for distribution to participating observatories.

List of Participating Observatories

The President pointed out that the sub-commission must recommend a schedule of hours and the specific responsibility for various observatories. He called attention to large charts on the wall, breaking the day into 2-hour periods, based on Universal Time. He requested that representatives of observatories able to participate fill in the chart for the two or 4-hour period when they can assume responsibility for a Hα survey to meet the standards above. (The President will also be glad to receive written communications on this point after the close of the General Assembly.) The information so derived will be turned over to the working committee and used as a basis for recommended distribution of responsibilities for Hα patrol among participating observatories. The effective date for the establishment of such a co-operative programme was set for the beginning of the International Geophysical Year, 1 July 1957.

Dr Das said that it would not be possible for Kodaikanal Observatory to buy a complete Lyot Monochromatic Heliograph manufactured by S.E.C.A.S.I. of Bordeaux as the price quoted by them is prohibitive; but Kodaikanal Observatory was planning to obtain all the essential optical parts from Messrs O.P.L. of Paris and construct the instrument at the observatory workshop to minimize the cost. Dr Das was not sure whether the instrument would be ready for operation during the International Geophysical Year. However, fairly frequent observations of the Sun between 2 and 6 hrs. U.T. would be made during the International Geophysical Year with the spectrohelioscope, spectroheliograph and prominence spectroscope which are instruments in regular use at the observatory.

Dr Kiepenheuer mentioned the desirability of considerable overlap in time periods between observatories, and also suggested that the manual prepared by the working committee should contain a list of participants, so that a given observatory could communicate promptly with a supplementary observatory in case of equipment failures, or other emergency.

Centralization of Data and Films

The President summarized the previous discussions among sub-commission members concerning the problem of producing, at a central observatory, a continuous chromospheric cinematographic record, combining results from all co-operating observatories. Most members expressed general agreement with the plan, but a number expressed worry over the great cost and magnitude of the project. As the central questions to be answered, he listed the following:

(*a*) What information can be reliably derived from a continuous film record?

(*b*) Will the full length of a continuous film be useful in research, or only selected lengths?

(*c*) Can a central agency be found with the resources, manpower, and wish to undertake such an arduous task?

(*d*) Is there any way in which the labour of a central observatory could be reduced by modifying the programme, and perhaps substituting tabular data reports for all or parts of a co-operative film?

The President suggested that, if the sub-commission is unable to reach definite conclusions in this matter today, a recommendation on this matter be added to the task of the working committee.

Dr McMath expressed the desirability of film centralization, with subsequent distribution of the results, to all participants, but expressed the view that the financial problem of carrying out the effort was so great, he could not see its solution. Dr d'Azambuja emphasized that it would not really be wise to spend so large an effort to establish a 'factory' for a continuous film, and that co-operative film exchange might be limited to specific phenomena of special interest.

Dr Öhman suggested it might be better to establish an information centre rather than a film centre, and the participating observatories could send reports to such a centre, which should be closely allied with the International Geophysical Year headquarters in Brussels and with Dr Nicolet. This data centre could maintain or distribute a catalogue of films listing what coverage is available from participating observatories for specific periods. Dr d'Azambuja suggested that since the standard instruments for the programme are just now being built, it may be premature to detail the centralization programme now. On the other hand, Mr Shapley and Dr Kiepenheuer expressed the view that it is impossible to delay plans for the detailed cataloguing, and that coverage necessary for the International Geophysical Year cannot be obtained unless extensive work begins immediately. Mr Shapley suggested the possibility of using the World Day facilities of the International Geophysical Year for the centralization. Dr Öhman expressed the view that the extensive experience of the Meudon Observatory was an invaluable asset in this programme, and that the Meudon Observatory might well be able to assist the International Geophysical Year by making available this extensive experience in the evaluation of the solar data. The matter was referred to the working committee.

Simultaneous Optical and Radio Observations

Dr Severny stated that undoubtedly everyone is in favour of a programme of simultaneous radio and optical observations. He mentioned the very successful experience at the Crimean Observatory where the data became even more valuable when radio and optical observatories are on the same site. Dr Dodson and Dr McMath spoke strongly in favour of such records. Dr Pawsey mentioned that radio-frequency spectrographs would, of course, be even more valuable in such a programme than fixed frequency observations. Dr Das mentioned that 100 and 200 Mc./s. observations are now made at Kodaikanal Observatory and they expect to have 3000 Mc./s. equipment in operation before long. Dr Wild suggested that perhaps radio data could be included on patrol films in the form of an accompanying sound track. On this subject, the following resolution was adopted:

The sub-commission strongly recommends that participating observatories, wherever possible, make observations of radio emission in metre and decimetre wave-lengths simultaneously with their cinematographic programme.

Photometry of Hα Plages

The President stated that Dr Kiepenheuer and others had stressed the importance of pilot observations, at several observatories, of the photometric properties of Hα plages. Dr Kiepenheuer stated that it may be worth while to devise a photoelectric system combined with a Lyot filter to make routine measurements of plage intensities. Dr Dodson supported this position stating that even the consistent measurement of plage areas would be a step forward. The following resolution was adopted:

The sub-commission recommends that several observatories engage in routine photometry of Hα plages from cinematic records, and that they report on their experience to the sub-commission, if possible, before the time of the next general assembly.

Composition of the Working Committee

Dr Öhman suggested that the working committee of the sub-commission consist of the following: Roberts, d'Azambuja, Dodson, Severny, Coutrez and Kiepenheuer. Dr d'Azambuja suggested the inclusion of Öhman. Dr Roberts expressed thanks for these suggestions, and appointed all of these members to serve in this capacity.

Report of Combined Meeting of Commissions 10, 11, 12, 13 and 40. 2 September 1955

President: Sir Harold Spencer Jones, I.A.U. representative on I.C.S.U. Special Committee for the International Geophysical Year (C.S.A.G.I.).

Secretary: A. H. Shapley.

The President reviewed the work accomplished at the second meeting of C.S.A.G.I., Rome, October 1954, and the resolutions adopted concerning solar activity programmes recommended to be carried out during A.G.I. (see *C.S.A.G.I. Information Bulletin*, no. 2, pp. 153–6). All resolutions were read; there was significant comment on the following:

Resolution 2 concerning weekly preliminary reports of solar activity: Öhman referred to the need for maps to supplement the telegrams in Europe; Shapley referred to the forthcoming meeting of the Ursigram Committee in Paris.

Resolution 4 concerning extension of normal watching periods: Öhman reported the plans of Commissions 11 and 11*a* for continuous patrol with Lyot Hα heliographs or equivalent. This brings up new problems not encountered in the visual watch, for instance, selection of the times of best seeing. There are plans both for morning and afternoon observing periods, and there are already almost enough existing or proposed stations to fill all observing hours, including longitudes where the coverage was previously weak. The visual observations, under the Meudon plan, provide as complete a service as could be desired. It appears quite certain that there will be Hα film record 24 hours a day during A.G.I.

Resolution 5 concerning frequency of flare patrol observations: Evans pointed out that the Commission 11*a* recommendation, that observations be made at intervals of not more than three minutes, is consistent with this resolution.

Resolution 6 concerning standard observing procedures: Ellison mentioned that the stated procedures are agreeable to Commissions 11 and 11*a*.

Resolution 7 concerning flare classification: Öhman reported that the report made by the special committee on this subject within Commission 11 had been adopted and had been referred to the I.A.U. General Assembly.

Resolution 8 concerning standardization of instrumentation and observations of flares: Öhman referred to the work of d'Azambuja leading to relevant specifications and also to the instrument available from S.E.C.A.S.I. which meets these specifications. Öhman warned against too strict standardization, which can limit progress in science. It appears that for purposes of flare patrol, agreement on standardization has been reached.

Resolution 9 concerning improved measures of intensity of solar flares in terms of adjacent continuous spectrum: discussion by Dodson and Ellison brought out that this problem is at best difficult; that the position of flares should be specified very precisely; and that the difficulty of the usual (and recommended) method becomes greater with flares near the limb. Öhman pointed out that flare area is the principal criterion under the adopted classification scheme. Dodson emphasized that even this is a photometric problem of no little difficulty.

Resolution 11 concerning solar prominence studies during A.G.I.: Öhman said this had been recommended by Commission 11 and increased work in this field is to be expected.

Resolution 12 concerning prominence patrols: Öhman said that the plans of Commission 11*a* call for longer exposures interspersed among the flare patrol observations. It is too early to say what kinds of maps will be published. Spencer Jones said that the problems of publication will be considered by C.S.A.G.I. at Brussels.

Resolution 15 concerning measures of polarization of white light corona: Öhman referred to work under way by Dollfus and at Climax, Sacramento Peak and Pic du Midi which represents considerable progress.

Resolution 16 concerning standardization of coronal intensity measures: d'Azambuja reported that the photometer being constructed under I.A.U. auspices will be put into operation, it is hoped, before the end of the year.

Resolution 18 concerning dynamic radio spectra of solar noise bursts: Pawsey re-emphasized the advantages of this technique over fixed frequency observations. Menzel reported that Harvard has under construction an instrument covering the range 100–600 Mc/s.

Resolution 19 on indices for solar radio-emission: Shapley called attention to Chapman's suggestion to Commission 10 that solar indices be compiled for intervals shorter than one day. Evans stated that such indices two or three times a day may be derivable from the 24-hour photographic flare patrol. Öhman referred to Kiepenheuer's proposals to obtain better measures of plage areas and intensities. Öhman answered Spencer Jones's query as to whether a small sub-commission on such indices was needed, by stating that there is so much preliminary work to do that Commission 11 does not seem ready to undertake this now. Redman asked for the number of man-hours involved in the proposed A.G.I. solar activity programmes. Miss Dodson described a sample A.G.I. 'week' (20–27 August 1954), for which she had co-operation of many observatories. The observations have been reduced and the analysis is only now about to start. Many short cuts in the A.G.I. reductions and analyses should be apparent from this pilot study. Spencer Jones remarked that no single observatory will undertake all types of observations; the effect of the resolutions should be that each observatory can determine in what way it can best co-operate in A.G.I. programme.

Resolution 21 concerning prompt reporting of preliminary summaries of observations to A.G.I. network for Special World Intervals: Spencer Jones stated that details will be considered at C.S.A.G.I. Brussels meeting.

Resolution 22 concerning importance of solar patrol observations in the longitudes of Australia: Pawsey said Australia is aware of the resolution and there is a good possibility that a group near Sydney will undertake such observations.

Other matters

(*a*) Suggestion that an I.A.U.-A.G.I. special committee be formed. Spencer Jones remarked that the solar activity work was well in hand in the relevant I.A.U. Commissions, and that the Presidents of these Commissions constitute, in effect, such a committee. There was general agreement.

(*b*) Centralization of solar information: Öhman stated that we have a very fine central organization, Meudon, whose experience is very much needed for the desired reports and publications of uniformly high quality. Further, we have mechanisms through which geophysicists can find out what is happening on the Sun, promptly through Ursigrams and leisurely through the *Quarterly Bulletin*. But beyond this, we need an information bureau so that anyone will know to whom to write for information about certain hours on certain days. Commission 11*a* has recommended a scheme under which cards are collected (not published) by a central bureau, so that institutions can get in touch with one another. This will stimulate collaboration among institutions and give a feeling of real participation in the programme. There is also need for an advisory institution to give scientific judgement when appropriate; we are glad to be informed that Meudon is willing to act in this capacity.

(*c*) Weekly Solar Information Bulletins: During discussions in different solar commissions it had been fully understood that there is a great need for weekly solar information bulletins giving events of each day and covering all hours. Reference had been made to such bulletins already prepared by the High Altitude Observatory, National Bureau of Standards, in Boulder, the Fraunhofer Institute in Freiburg and the Meudon

Observatory. Öhman suggested that the regional Ursigram centres should, in collaboration with astronomical institutions, distribute weekly by post the information distributed the preceding week as telegrams, but in the form of maps with centres of activity, coronal isophotes, flares, radio solar noise data, etc. The bulletins should be available on subscription. There was general agreement on the desirability of such a plan.

(*d*) Complete solar information for final publication: it is generally held among the solar commissions that every institution engaged in the solar patrol should contribute data for a final publication as planned by the General Secretary of the C.S.A.G.I. This publication should preferably contain Hα and K line pictures of the Sun for each day, coronal isophotes, certain radio observations of flares, bright and dark surges, as well as special observations of prominences, yellow corona line, etc. For the compilation of these data a close collaboration with such institutions which are collecting data for the I.A.U. *Quarterly Bulletin*, and the different weekly bulletins and Ursigrams is to be recommended. There was general agreement on the importance of this work. Waldmeier pointed out that the *Quarterly Bulletin* will be published during A.G.I. and mentioned the possible addition of the other items referred to. Kiepenheuer warned against trying too much and considered the *Quarterly Bulletin* and the material distributed promptly to be sufficient. Spencer Jones remarked that the contemplated publication would be a reference volume. Mme d'Azambuja proposed daily maps to be collected by an international bureau like the I.A.U. telegraphic bureau. Newton stated that a full-day record appeared to be the minimum. Spencer Jones said that the question would be considered further by C.S.A.G.I. and thanked all participants for their contributions.