always be in contact with sufficient moisture to allow them to make a normal, sturdy growth, have gone on in such a careless manner as to greatly reduce the wheat yields of all countries wherever such cropping has been practised upon a large scale such as is known in the new lands of the northwest. Where this contamination of soil has occurred the loss of the flax crop has been unavoidable, and profitable wheat raising has only been continued under intensified farming conditions. My belief is that we must yet be able to produce the bread of the world by the use of extensive machinery and upon extensive plans, such as is yet being carried on in the new lands of the west. I have set forth *the reasons why this can not be done unless we recognize this question of soil sanitation,* or, if you will, *the necessity of conserving the virgin purity of the land.* I am, however, confident that with the proper understanding of the methods which are now known for selecting seed, disinfecting seed, rotating crops and perfecting the seed bed there should be no necessity of growing wheat upon the costly lands now under intensified farming systems, and that there is no immediate necessity of abandoning the cropping to cereals on the large plan which is characteristic of the northwest. I believe firmly, however, if we do not thus recognize this matter of the necessity of soil sanitation, soil disinfection by means of proper cultivation, and well-planned series of crop rotation, that, no matter how fertile the soil of one of your western valleys may be, no distant year will see your crop fall very close to the world average for that particular cereal.

This message, if so it may be called, has also a direct bearing upon matters in which you are interested which I think you will thoroughly appreciate. Those of you who are directly interested in dry land farming may expect these diseases to be less effective under dry farming conditions than under the old-line cropping methods. For the dry farming methods and the dry atmospheric conditions are just such as tend to keep such cereal organisms in best control. If, however, you wilfully spread diseases upon your lands through infected seed and through infected fresh, uncomposted manures, if you wilfully neglect to rotate and if you fail to properly aerate and firm down the seed bed, you may expect these destructive cereal diseases to take their annual quota from your crop, and that the crop depletion will increase with the years. There seems to be no exception to the common observation that the living can not thrive in contact with the dead of the same species.

If, on the other hand, you declare for careful seed selection in all cases, careful seed disinfection at all times, the formation of a well-aerated but compacted seed bed, and for as extensive a rotation of crops of as wide-spread character as possible, you of the new dry land regions of the west have the greatest possible opportunity to prove to the world that it is not necessary to lose a crop of such importance as linseed from among your rotations, nor is it necessary that your wheat yields should fall from the now promising ones of thirty to sixty bushels per acre to the general average of twelve to fifteen.

H. L. BOLLEY

NORTH DAKOTA AGRICULTURAL COLLEGE,
September 20, 1910

THE FOURTH CONFERENCE OF THE INTERNATIONAL UNION FOR COOPERATION IN SOLAR RESEARCH

THE main party of delegates to the fourth Conference of the International Union for Cooperation in Solar Research arrived in Pasadena on August 28. On the following

morning the laboratory, shops and offices of the Mount Wilson Solar Observatory were inspected. In the afternoon the members and their friends were entertained at a garden party given by Mr. and Mrs. Hale at their home. On Tuesday the ascent of Mount Wilson was made, by some in carriages via the Mount Wilson Toll Road from Pasadena, by others on saddle animals from Sierra Madre. Including the staff of the Mount Wilson Observatory, the entire party making the ascent numbered about one hundred. Forty-two delegates from abroad, representing ten different nations, were present.

The sessions of the conference were held in the museum building of the observatory on the mornings of August 31, September 1 and September 2, with an afternoon session on the last day. The afternoons were for the most part given up to committee meetings and an inspection of the equipment of the observatory.

Professor Pickering occupied the chair at the session of the first day, Professors Campbell and Frost on the second and third days, respectively.

In his opening address Professor Hale considered the following salient points:

1. Emphasis of the union's function as a stimulator of research.

2. Benefits of formal cooperation as shown in the adoption of standards of wave-length.

3. Sun-spot spectrum map.

4. Description of the 150-foot tower telescope of the Solar Observatory and its equipment, when used for spectrographic observations and as a spectroheliograph.

5. The observation and interpretation of various groups of phenomena observed in sun-spots and in their spectra: sun-spot lines appearing as triplets or as quadruplets; lines asymmetrical in intensity or in separation; variations of intensity of magnetic field as shown in lines of the same and of different elements; apparent rotation of plane of polarization of the light by its passage through the spot vapors; methods of mapping the magnetic field in and around spots; unipolar, bipolar and multipolar vortices around spots.

6. Cooperative work—(*a*) with spectroheliographs, and the importance of the H_α line for this work; (*b*) in connection with eclipse expeditions.

The remainder of the first session was occupied by the presentation and discussion of the reports of the executive committee and of the committee on wave-lengths.

Professor Kayser presented the last-named report. The following recommendations were incorporated in it and were separately adopted by the conference:

1. In the region of the spectrum, in which three independent measurements by the interferometer method of the lines of the iron arc are available, *i. e.*, between λ4282 and λ6494, the arithmetical mean of the three measurements shall be adopted as definite international standards of second order, provided there is sufficient agreement between them.

2. The committee be given authority to publish these standards as soon as possible.

3. For the part of the spectrum in the neighborhood of λ5800, where the number and character of the iron lines is not satisfactory, the committee propose the use of barium lines as additional standards.

4. The laboratories or observatories possessing first-rate concave gratings are invited to determine by interpolation as soon as possible standards of the third order in the spectrum of the iron-arc within the above range of spectrum (*i. e.*, λ4282 to λ6494).

5. The measurement of standards of the second order shall be extended to shorter and longer wave-lengths, and the arithmetical mean of three independent determinations shall be adopted as secondary standards.

6. Standards of the third order shall then be obtained from them in the manner indicated.

7. The above system of standards shall be called the international system, the unit on which it is based being called the international unit (I. U.) as defined by the conference of 1907.

8. It is very desirable that in different laboratories possessing concave gratings of the first quality photographs of arc, spark and

solar spectrum and new measurements according to the international system shall be taken as soon as possible.

Professor Hartmann made the following suggestions, which were not accepted by the committee, but in accordance with his request are appended to the report of the committee:

1. In all cases, where owing to special reasons, wave-lengths are measured and published according to the "Rowland system," those wave-lengths shall be used as standards which are calculated from the recent interferometer measurements, taking as the wave-length of the red cadmium line λ6438.7098. (Such standards have been published by Hartmann in the *Physik. Zeitsch.*, vol. 10, p. 123, and others will be published in accordance with the best measurements.)

2. In order to avoid misunderstanding in the publication of wave-lengths, the system of standards used in each case shall be indicated by using special symbols after the wave-lengths. The following method is proposed:

(*a*) "M." "The Michelson System," based upon 6438.4722 M., as the wave-length of the red cadmium line.

(*b*) "C." "The International System," based upon 6438.4696 C., as the wave-length of the red cadmium line, the value adopted by the third International Conference.

(*c*) "R." "The Rowland System," as defined above.

At the second session the following reports were presented:

Measurement of Solar Radiation: Mr. ABBOT.
Sun-spot Spectra: Mr. FOWLER.
Eclipses: M. LE COMTE DE LA BAUME PLUVINEL.

Mr. Abbot discussed the measurement of solar radiation under the following headings: (1) Solar Constant Work by method of Langley, (2) Solar Variation, (3) Simplified Methods for Solar Constant Work, (4) Pyrheliometry, (5) Sky Radiation and Cloudiness, (6) Distribution of Radiation over the Sun's Disk, (7) Mount Whitney Station.

The committee on sun-spot spectra closed its report with the following resolutions, which were adopted by the conference:

1. That the report of the work of the sun-spot spectrum committee and of the cooperating observers, be printed in the next volumes of the *Transactions of the Solar Union*, in full or in abstract as circumstances may determine.

2. That notwithstanding the progress of photographic work, visual observations of spot spectra should be continued, and that the committee should be reappointed to continue the organization of this work.

3. That in view of our increased knowledge of spot spectra, the committee be authorized to prepare and circulate a revised and extended scheme of visual observations.

4. That in view of the fact that several observers have prepared manuscript catalogues of several thousands of lines in the photographic spectra of sun-spots, it is desirable to have such catalogues collated by those who made them, in such manner that all the available data should be collected in a single catalogue.

5. That it is desirable that, for the use of visual observers, the separate sections of the new photographic map of the sun-spot spectrum should not exceed 60 centimeters in length, and should be on a scale of 5 mm. to the Angstrom.

The eclipse committee, through its secretary, M. le Comte de la Baume Pluvinel, briefly recounted the experiences of the Flint Island expedition of 1908 and the Tasmanian expedition of 1910. The committee undertakes to further cooperation among eclipse observers by distributing observing programs to avoid duplication of work, and by aiding in the loaning of apparatus for eclipse observations. It was recommended by the committee that the direction of measurement of position angles around the sun's limb be from north to east. The recommendation was adopted by the conference.

Father Cirera presented the following report:

1. La communication de M. le Secretaire sur les eclipses a eté presenteé par moi à le Section d'Astronomie de l'Association Espagnole pour l'Avancement des Sciences. On

a decidé de cooperer avec l'Union solaire pour l'eclipse de 1912.

2. L'Observatoire de l'Ebro à Tortosa, peut fournir une copie photographique des éléments magnétiques, si l'on veut étudier le rapport des éclipses avec le magnétisme terrestre.

3. L'Observatoire de l'Ebro a tiré quelques photographies de l'éclipse partiel du soleil de Juin 1908. Il peut fournir des copies: le lieu et l'heure sont exactment connues pour faire des études astronomiques.

Professor Campbell explained a method that he has developed for obtaining a continuous photographic record of the change from the ordinary Fraunhofer spectrum into a bright line spectrum at the time of a solar eclipse.

At the third session reports were heard from the committees on solar rotation and on work with the spectroheliograph.

The solar rotation committee discussed the following topics:

1. The accurate determination of the angular velocity of rotation at various latitudes and the derivation of a formula representing with a high degree of precision the variation of velocity with latitude.

2. A definite conclusion as to the existence of secular or periodic variations in the sun's rate of rotation.

3. The investigation of the rate of rotation as shown by the lines of different elements and of the arc and enhanced lines of the same element, with a view to determining whether either the absolute rate of rotation or the law of variation with latitude differs for different substances.

4. The study of lines selected from different regions of the spectrum.

5. The detection of possible systematic proper motions or drifts in the sun's reversing layer.

The committee made the following recommendations to observers:

1. That the observers select at least to a partial extent different regions of the spectrum so that the total range of wave-length under observation may be as great as possible.

By general consent of those present at the meeting of the committee, the following regions of the spectrum were selected by the various observers:

λ3800–λ4000	Bélopolsky.
λ4000–λ4140	Schlesinger.
λ4300–λ4500	Newall.
λ4500–λ4700	Adams.
λ5100–λ5300	Adams.
λ5500–λ5700	Plaskett.
λ6250–λ6350	Dyson.

2. That within these regions the selection of lines be made with a view to the inclusion of a considerable number of elements, particularly such as are of very high or very low atomic weight, and also the enhanced and the arc lines of the same element.

3. That an agreement be made upon the latitudes to be observed.

After considerable discussion the committee decided to recommend the following points of heliographic latitude: 0°, 15°, 30°, 45°, 60°, 75°.

4. That an especial attempt be made to secure observations in the highest latitudes, particularly between 75° and 90°.

One or two of the observers present expressed their willingness to attempt determinations at latitudes 80° and 85°.

5. That a short list of selected lines be employed by all of the observers in common, the results to serve as a check upon instrumental or personal errors, and that a list of the points of latitude to be observed accompany this list.

The committee selected for this purpose the portion of the spectrum between λ4220 and λ4280, and the three points of latitude 0°, 30° and 60°. The secretary was authorized to choose a list of lines and forward it to the various observers for approval.

That an attempt be made to secure at least one independent series of observations in each of the solar hemispheres with a view to determining a possible difference in the rate of rotation.

Several observers expressed their willingness to undertake such observations of this character as the construction of their instruments would permit.

The resolutions reported by the spectroheliograph committee were as follows:

1. That daily photographs of the calcium flocculi be continued by the cooperating observatories.

2. That provision be made, if possible, for the measurement of the photographs.

3. That the desirability of providing for the daily photography of the hydrogen alpha flocculi be suggested to the cooperating observatories.

4. That the observatories at Tacubaya, Mexico, and Madrid, Spain, be added to the list of cooperating observatories and that their directors, Messrs. Valle and Iniguez, be invited to join this committee.

5. That the advantage of undertaking work with the spectroheliograph in Japan be suggested to the Japanese government.

6. That the desirability of utilizing large spectroheliographs of high dispersion for the study of the upper layers of the solar atmosphere is recognized by the committee.

7. The committee express the hope that the Secchi memorial fund now being raised in Italy may be devoted to a tower telescope equipped with a spectroheliograph.

At the fourth session the conference voted to extend the activities of the Solar Union so as to include general astrophysics. A committee was appointed to examine and report upon the question of the classification of stellar spectra.

The following resolution with regard to the proposed solar observatory in Japan was passed:

That this conference learns with satisfaction that the erection of a solar observatory in Japan is in contemplation and expresses the opinon that the establishment of such an observatory would fill a gap in the distribution of solar observatories over the surface of the earth, and would materially help in obtaining results of great value in the study of solar phenomena.

It was decided that the next meeting of the Solar Union be held in Bonn in 1913, the exact date to be determined later.

The following committees were appointed or reappointed:

The Committee on Standards of Wavelengths: H. Kayser (chairman), J. S. Ames, Ch. Fabry, A. A. Michelson, A. Perot.

The Committee on the Measurement of Solar Radiation: J. Violle (chairman), C. G. Abbot (secretary), H. L. Callendar, C. Chistoni, W. H. Julius, A. Schuster.

The Committee on Work with the Spectroheliograph: G. E. Hale (chairman), H. Deslandres, E. B. Frost, W. J. Lockyer, A. Riccò, Father Cirera, Philip Valle, Francisco Iniguez, P. Eversheim.

The Committee on the Investigation of the Spectra of Sun-spots: H. F. Newall (chairman), A. Fowler (secretary), A. Bélopolsky, The Astronomer Royal of England, Father Cortie, H. Deslandres, G. E. Hale, Sir N. Lockyer, P. Eversheim, A. Wolfer, Philip Fox, Walter Mitchell and Walter S. Adams.

The Committee for the Organization of Eclipse Observations: Sir Norman Lockyer (chairman), le Comte de la Baume Pluvinel (secretary), W. W. Campbell, Father Cirera, P. Kempf, H. H. Turner, A. Riccò, N. Donitch, Major E. H. Hills.

The Committee on the Determination of Solar Rotation by Means of the Displacement of Lines: N. C. Dunér (chairman), W. S. Adams, A. Bélopolsky, H. Deslandres, J. Halm, H. F. Newall, R. A. Sampson, F. W. Dyson, Frank Schlesinger, J. S. Plaskett, M. Perot.

Committee to Report upon the Question of the Classification of Stellar Spectra: W. S. Adams, W. W. Campbell, E. B. Frost, J. S. Ames, J. C. Kapteyn, H. F. Newall, E. C. Pickering (chairman), J. S. Plaskett, H. N. Russell, Frank Schlesinger, K. Schwarzschild, J. Hartmann, G. E. Hale.

On the evening of September 1 Mr. Abbot lectured on the measurement of the solar constant of radiation, while on the following evening Professor Kapteyn gave an account of his investigations of the systematic motions of the Orion stars.

The 60-inch reflector was placed at the dis-

posal of the visitors for three nights, during the first two of which excellent views were had of nebulæ, star clusters and planets at the 100-foot focus. On the third night the focal plane spectrograph was exhibited in operation at the 25-foot focus of the instrument.

The Snow telescope, the 60-foot tower telescope and the 150-foot tower telescope were observed in operation on the sun, as was also the equipment of the Astrophysical Station of the Smithsonian Institution.

The committee on magnitudes for the Carte du Ciel and the committee on selected areas took advantage of the presence of their respective members to hold meetings. The first-named body agreed on the following:

1. That the photographic magnitudes shall be perfectly independent of the visual ones.

2. The two scales, however, shall coincide for the stars of spectral type Ao of magnitude 5.5 to 6.5, Harvard system.

The several methods used at Harvard for obtaining fundamental magnitudes were explained and discussed. Further work on such fundamental photographic magnitudes is contemplated by the observatories of Harvard, Potsdam, Mount Wilson, Simeis and Johannesburg.

The committee on selected areas noted the progress of their work along the following lines: (1) Durchmusterung plates, (2) parallaxes, (3) proper motions, (4) additional proper motion plates for the parallels of $-45°$ and $+45°$, (5) visual and photographic standards of magnitude, (6) estimates of visual magnitudes, (7) the photographic magnitudes, (8) photographic magnitudes of the Cape Photographic Durchmusterung, (9) classification of spectra, (10) red sensitive plates, (11) radial velocities, (12) sun's motion through space, (13) brightness of the background of the sky, (14) selective absorption of light in space.

On Saturday, September 3, the descent from the mountain was made. That evening the members of the conference were entertained at dinner at the Maryland by Mr. and Mrs. Hale.

H. D. Babcock

Sessions of the International Commissions for Terrestrial Magnetism, Atmospheric Electricity and Meteorology[1]

The Commission for Terrestrial Magnetism and Atmospheric Electricity met in Berlin, at the Royal Meteorological Institute, Professor Dr. G. Hellmann, director, on September 23, with about twenty members present, M. Rykatschew, president, and Ad. Smidt, secretary. The first business was the reading of a report of progress on the work laid down by the commission at Innsbruck three years ago. Prominent place was given in further reports to the intercomparison of standard magnetic instruments, by Dubinsky, Schmidt and Chree, including the observatories at Pavlovsk, Karsani, Katharinenburg, Irkutsk, Upsala, Rude Scov, Kew, Potsdam and Cheltenham. The European observatories, especially in Russia, agree closely together, while an unexpectedly large discrepancy was reported for Cheltenham, which was accompanied by an explanation. With the view of enlarging the network of observatories it was intimated that steps were being taken to found one or two new permanent magnetic stations in Norway, and one in Italy or Tunis. The establishment of the magnetic observatory at Pilar, Argentina, in connection with solar physics and ionization researches, was reported. This station is a few miles south of Cordoba, and it is proposed to make it an important institution for the work of the southern hemisphere. Professor Bigelow, recently of the U. S. Weather Bureau, has been appointed to this duty, and Dr. W. G. Davis, director of the Meteorological Office, expects to develop the equipment as rapidly as is practicable. Arrangements were discussed at Berlin to facilitate the exchange of magnetic curves on days of large disturbances. The best methods of publishing the routine magnetic data, in order to meet the demands of students interested in solar physics and atmospheric ionization, were considered, but as the subject is complex it was referred to a special committee, v. Everdingen, Chree, Schmidt, for further

[1] Berlin, September 23–29, 1910.