THE VALUE OF PYRHELIOMETRIC READINGS ALONE FOR INVESTIGATIONS ON SOLAR RADIATION AND WEATHER FORECASTING

By Charles F. Marvin

(Author's Abstract)

With the aid of blackboard diagrams and equations the speaker explained the methods and theory of securing derived values of the solar constant of radiation by the extrapolation of observed values secured by pyrheliometer readings at the bottom of the ocean of atmosphere in which all observations must be made, even at stations on the tops of relatively high mountains. The name pyrheliometer in this usage embraces any of the standard types of instruments whose readings give, in appropriate thermal units, the intensity of the total solar radiation of all wave lengths subject to “black body” absorption and which reaches the station and instrument through the intervening atmosphere.

A major purpose of the speaker was to enlist a better appreciation of the immense value to science and atmospheric physics of more plentiful systematic observations of the pyrheliometer. Standardized and high grade instruments of this type are extremely simple, portable, and easy to use by observers of average training. Their constants are of a far more permanent character than are those of the bolograph about which so much has been written as to overshadow the pyrheliometer,
which, after all, is the one basic and indispensable instrument in every solar constant determination.

The effects of selective atmospheric absorption were briefly set forth and especially the theoretical differences between the extrapolation to zero air mass of pyrheliometer measurements of the ordinary polychromatic solar radiation and what the results would be if the same thermal energy were transmitted in a monochromatic beam.

Pyrheliometer observations at elevated, arid stations can be freed in a highly satisfactory way from errors due to local atmospheric conditions, and when extrapolated to zero air mass give approximate values of the solar constant, which are 94 or 95 per cent of the absolute value thereof. Such values must of course show the same percentage of whatever variations may occur in solar intensities. Results secured in this way are especially suited to show the small long-time changes of intensity extending over months, years, the sunspot cycle, etc.

The speaker has thoroughly tested his theories upon the pyrheliometer readings made by the Astrophysical Observatory from July, 1918, to August inclusive, 1920, but unfortunately later observations will not be made available until several months or years in the future. Any serious examination of observations made over many earlier years at Mount Wilson is stopped because Dr. Abbot himself discredits the entire dependability of these, which, since they were made before the invention of the silver disk pyrheliometers, he classes as ancient and medieval.

The further study of solar constant values for evidence of real solar variability must await for more plentiful and more prompt publication of pyrheliometer observations alone and from as many high class stations as possible.

International co-operation to maintain several entirely independent observations was urged.

Discussion.—Dr. Milham asked about a new solar station to be established by Dr. Abbot. Prof. Marvin stated the National Geographic Society had appropriated $50,000 for this purpose and Dr. Abbot is now abroad looking for a suitable location for the station. He also stated Dr. Abbot does not attempt to make weather forecasts from solar variations and the Smithsonian Institution disclaims any intention of doing so, but is merely collecting data with the intention of turning them over to the Weather Bureau for study. At present the outlook for long range forecasting from solar radiation observations is not promising.

APPLICATION OF SCHUSTER'S PERIODOGRAM TO RAINFALL PERIODS BETWEEN TWO AND A SIXTH AND NINE YEARS

By DINSMORE ALTER

(Author's Abstract)

(This paper will appear in full in the Monthly Weather Review)

The paper is a continuation for these shorter periods of the work published in Monthly Weather Review of October, 1924. The same sections of the world are used. Pacific Coast and Eastern United States, North-
ern Europe and The Punjab of India. The data are almost the same as in the previous paper, although some additional have been found.

If periodicities really exist, the method should show them much more certainly within this range than it did for the previous one. This is found to be strikingly true of the Pacific Coast of the United States, of Northern Europe and of The Punjab. Any periodicities which may exist in the Eastern United States are either of small amplitude, or else not effective over the entire area. The author realizes that he included far too large a territory in this section.

A method has been devised for the application of Schuster's method of systematically varying periodicities, under any previously assumed law. The question of varying vs. constant periodicities is discussed. The evidence favors the latter, although it is impossible to make a definite pronouncement. The constancy of the sunspot period during the last eighty years is discussed in this connection.

A very marked bias of the Schuster Periodogram peaks toward harmonics of the sunspot period of 22.25 years is noted, especially in the constant periodicity solution, which of itself bore no connection to sunspots. This bias is more pronounced the higher the peaks considered. Agreement is practically perfect for the highest peaks.

The author believes the following to be well established:
(a) Periodicities or cycles of various lengths exist.
(b) These are related to the sunspot period.
(c) The periodicities are different, though related, for different types of climate.

The following points are neither established nor disproved:
(a) Constant vs. varying periodicities.
(b) Economic value of periodicities.

Discussion.—Prof. Marvin commended the conservative nature of the paper, stating that we are liable to jump at conclusions. He said Dr. Alter has been working long enough on this problem to become very enthusiastic and very cautious and something fine would come from his work. He also stated there are many physical periods of very small amplitudes and asked how Dr. Alter was going to find them. Dr. Alter stated the peak of small amplitudes will eventually be shown when we gather enough data.

Dr. Milham asked if rainfall is considered better than temperature for investigating periodicity. Dr. Alter stated it was not, but that he was more interested in rainfall and, further, feared exposure of thermometers might influence results, as such exposure has not always been satisfactory.

AN UNUSUAL DISPLAY OF THE MAMMATO-CUMULUS
By W. J. HUMPHREYS
(Author's Abstract)

Two illustrations, by lantern slides, were shown of an exceptionally fine display of the mammato-cumulus, photographed by the speaker at Ashland, Kentucky, early in July, 1925.
The afternoon on which these clouds appeared was very hot and humid. They formed in a sheet of cloud running ahead of the rain of a thunderstorm. At first there were some five or six parallel bands of billow-like clouds separated by narrow, lighter streaks, followed by a continuous cloud sheet, and also preceded for a short distance by thin cloud at the same level. After a very few minutes the cloud bands and much of the cloud sheet behind them developed into adjacent festoons of the order of 200 feet in diameter. In about fifteen minutes the mammato-cumulus had disappeared.

A very similar display, including the cloud bands, but not so fine, was seen in the same region the previous afternoon, also just in front of a thunderstorm.

Discussion.—Mr. Belden said such clouds were nearly always observed in proximity with tornadoes, within a radius of 100 miles of them. Mr. Flora stated they occurred on an average of about twice a year in the vicinity of Topeka, and promised to secure some pictures of them at the first opportunity for Dr. Humphreys.

A CRITICAL EXAMINATION OF THE ALLEGED EFFECTS OF THE PLANETS ON THE WEATHER
By W. J. HUMPHREYS

(Author's Abstract)

It was explained that the chief ways by which the planets conceivably might act on the weather of the earth are:

1. By electrical forces between the earth and the planets.
2. By their magnetic interactions.
3. By variations in the amount of radiation, both reflected and emitted, which the planets send to the earth.
4. By the tides on the earth due to the planets.
5. By changes of insolation owing to variations in the distance from the earth to the sun caused by the planets.

Calculation shows that each of the first four of the above causes produces an effect that is immeasurably small, while the fifth can produce a temperature variation of, at most, only .02° F.

Our common sense, therefore, to the effect that the planets do not measurably affect the weather, is fully supported by quantitative calculations.

CLIMATIC ASPECTS OF COTTON GROWING IN SOUTHERN ILLINOIS AND MISSOURI
By WILLIAM E. BARRON

(Author's Abstract)

Cotton was grown in Illinois and as far north as northern Missouri during and before the Civil War, but after the War, it was abandoned north of the Ohio River. Production was as low as 11,816 bales in Missouri in 1895. Since the boll weevil has become serious in the South, cotton growing has come back north. Tables are given showing the pro-
duction in Missouri for the last 11 years and in southern Illinois for the last three years. The official estimate for 1925 is for a crop of 260,000 bales on 487,000 acres in Missouri, and 6,030 bales on 9,000 acres in Illinois. Other tables are also given, showing the summer temperatures, average annual precipitation, and the length of the frostless season in the areas where cotton is grown in these States.

The author concludes that by using early varieties of cotton, and probably fertilizers, cotton growing may be profitably undertaken in suitable soils in Illinois and eastern Missouri as far north as St. Louis, or the line of 180 average frostless days, save on the Plateau or in pockets rendered unfavorable by air drainage.

Discussion.—Dr. Humphreys asked whether extension of cotton growing north would have any effect on the boll weevil. Mr. Barron said its activities would be greatly lessened. Dr. Ball stated the trend of agriculture is away from the tropics to colder regions. Maximum production is very near the north line of production due to the fact that severe climate kills off insect pests and diseases.

SOME OUTSTANDING TORNADOES

By C. J. Root

A rather full abstract of this paper, with tables, will be published in the Monthly Weather Review.

THE CLIMATE OF SOUTHEASTERN WYOMING

By S. S. Visher

(Read by title)

TUESDAY MORNING SESSION, DECEMBER 29, 1925

The meeting was called to order at 9.10 o'clock, Dr. Milham in the chair.

POTENTIAL GRADIENT OBSERVATIONS ON A TYPICAL NEBRASKA THUNDERSTORM

By J. C. Jensen

(Author's Abstract)

At the Washington meeting of the American Meteorological Society last year, a report was made of certain electrical phenomena connected with thunderstorms. A method for measuring the sign of the charge on the lower side of a storm cloud was described, the method consisting essentially of measuring by means of a ballistic galvanometer the charge induced on an insulated metallic deck 9 meters above the ground. It was shown that potentials of more than 10,000 volts are induced in the deck, the lightning discharge serving to release the charges held by the deck. These charges are registered by the galvanometer as they rush to earth. Analysis of several hundred galvanometer readings showed that in about 5 times out of 6, when a storm-cloud was directly overhead, the deflections were in such a direction as to indicate a positive charge.
on the deck before the lightning discharge, indicating that the lower pole of the cloud was negatively charged. When a storm cloud was approaching or receding, the preponderating number of discharges was often of the opposite sign.

A continuation of this work has resulted in further observations in general accord with those previously reported. A storm of unusual violence from the standpoint of electrical phenomena occurred on the evening of June 14, 1925. The black nimbus cloud approached rapidly from the west, having developed from a low, dark bank to a rolling, boiling mass that covered the whole sky, in about thirty minutes. The lightning display was not unusual until the storm “broke” at 7:44 P. M. During the next 31 minutes 48 positive discharges were noted and only one negative. In the next few minutes, as the storm abated, a number of throws to negative were noted. .56 inch of rain fell in about 33 minutes, .15 of which came in five minutes while the electrical display was most marked. Of the 48 discharges recorded, 15 were so violent as to throw the galvanometer “off scale” even when using a 4 ohm shunt, and many more passed without being recorded, as an automatic device was not available. Such a mechanism has recently been developed in connection with radio signal fading investigations, and will be used to make much more complete and continuous records in the future.

In order to check on the sign of the induced charges above referred to, use was made last summer of an insulated ball mounted according to the design used by C. T. R. Wilson. The ball is joined to a highly insulated wire, connecting through a metal shielding tube to a Compton electrometer. Because of its construction an electrometer is not well fitted for use as a ballistic instrument and hence no attempt has been made to use it to measure the magnitude of the charges induced by a thunderstorm, but it has been used to check the sign of the discharge and this has been found to agree, in every case, with that recorded by the galvanometer.

Discussion.—Prof. Marvin asked Mr. Jensen what record his instrument gave when the sky was clear. Mr. Jensen answered he got small throws of the galvanometer.

SOME RELATIONS BETWEEN RADIO RECEPTION AND WEATHER CONDITIONS

By J. C. Jensen

(Extract from report by Science Service)

Prof. Jensen, who is also engineer-in-charge of radio station WCAJ, has been studying the relations of wireless and weather for nearly ten years. “Actual reception,” he stated, “depends not only on the signal strength, but also on the ratio of signal to static. When the strength of static interference begins to approximate the signal strength, reception becomes impracticable. Static noises are known to vary from day to day and have been shown to be worst on the approach of a storm area. When the storm has passed, the high area which follows is characterized by settled weather in which ‘atmospherics’ are largely absent.”
Some of the conclusions which have been reached as a result of this work are as follows:

Reception is best when the broadcasting station and the receiving set are within the same area of high atmospheric pressure, or when the weather conditions are settled.

Good reception may occur when the transmission is from a high pressure area into an adjoining low pressure area, or vice versa; but when it takes place across a low pressure area so as to extend through it to a high on the opposite side, low audibility occurs.

Static disturbance is most troublesome when the low pressure area of an approaching storm is to the northwest.

Fading is more troublesome at night than in the day and is most severe when there is little difference in atmospheric pressure in different parts of the country, a condition which accompanies unsettled weather.

Prof. Jensen pointed out that these conclusions are only preliminary, and require further study, but to test them, he has been issuing a daily forecast of radio conditions from his station, and that the success of these has been very encouraging.

Discussion.—Dr. Milham asked what caused fading in radio reception, and suggested there might be a relation between areas of low pressure and fading as every low is electrified. Mr. Jensen said he was not ready to discuss this; that fading does not occur in receiving from nearby stations, but when reflecting or refracting occurs in the upper air.

Mr. G. K. Greening stated that at Sioux City he had difficulty in hearing Kansas City and Minneapolis, but could get Dallas and other southern plains stations without difficulty.

Mr. Jensen remarked this was probably due to reflection from the upper atmosphere. His investigations showed that distribution of radio from Lincoln, Nebraska, had difficulty in reaching northwestern Nebraska, but reached Montana and Canada without so much difficulty. Dr. Milham stated that he had no trouble in getting KDKA, but couldn't get Boston, in the same state with him.

THE MUSCLE SHOALS DEVELOPMENT IN THE TENNESSEE RIVER

By W. E. Barron

(Author's Abstract)

The Muscle Shoals district is a portion of the Tennessee River lying between Decatur and Florence, Alabama, where the river widens and plunges forward with a descent of 125.8 feet in 32 miles. The hydroelectric development of the district has been begun by the erection of the Wilson Dam, just above Florence, with a height of 102 feet, and capable of producing 624,000 horse power. The pool above the dam extends upstream 15 miles to the proposed site of Dam No. 3, which will back up the water almost to Guntersville, 54 miles above Decatur. No storage is expected beyond the maximum pool stage; this will depend on further developments up stream.

The average annual precipitation over the area is 52 inches or more;
14 inches each in winter, spring and summer, and 10 inches in autumn. It is one of the best watered interior regions in the United States.

The paper concludes with a discussion of the rates of pondage in the pool and the discharge from lowering the pool. These elements are to be applied to the Florence rating table in order to determine corrections to river stage forecasts which will arise from abnormal stages in the pool.

Discussion.—Mr. C. J. Root asked how the power output from Muscle Shoals compared with that from Keobuk, Iowa. Mr. Barron was not able to state.

EXPOSURE OF RAIN GAGES
By B. R. Laskowski

(Author's Abstract)

It is generally conceded that the standard 8 and 12-inch rain gages in use at the various 4000 Weather Bureau stations in the United States, give an accurate record of precipitation. If wind blows against rain gages during a storm, it is apt to cause a deficiency in the record, especially when gages are not protected in some way so as to obstruct the full force of the wind.

In studying this problem an 8-inch gage was installed at my residence in Topeka, and daily readings taken for a year's time. The residence gage is protected by nearby trees and buildings, but none closer than their height above the gage, while the Weather Bureau Office gage is located on a roof of a building with very little protection whatever. The protected gage caught 28.24 inches while the exposed one received only 25.93 inches.

Continuing the study, the rain gage records at Colby, Kansas, Weather Bureau Co-operative station, a protected gage, and the Colby Dry Land Agriculture gage, in an unprotected exposure, were compared for a ten-year period from 1915 to 1924. The average difference was 1 inch of precipitation in favor of the sheltered gage.

A comparison of the records at the Weather Bureau Offices at Topeka and Wichita, Kansas, was also made with nearby surrounding co-operative stations. The co-operative gages are located in protected places while the Weather Bureau Offices' gages are on tops of buildings. This comparison is for the 10-year period, 1915 to 1924. Similar differences were noted, of the same order.

Discussion.—Prof. E. C. Converse reported similar difficulty in getting agreement between protected and unprotected rain gages at Manhattan, Kansas. Mr. J. C. Jensen remarked about difference in catch in individual showers at 4 gages in Lincoln, Neb. Mr. Laskowski called attention to the fact that part of his investigations of difference in catch between protected and unprotected gages covered a period of 10 years, eliminating the difference due to individual showers or even of a record over a year's time. Prof. Marvin stated there was no question about Weather Bureau gages differing, and stated that, while absolute measurements could not be obtained with any instrument, we are more vitally interested in relative quantities.
FLOODS IN THE MIDDLE MISSOURI RIVER
By W. S. Belden
(Author's Abstract)

The normal time of continuous crest movement of the annual highest water in the Missouri River from Plattsmouth, Neb., to Kansas City, Mo., a distance by river of 253 miles, is two and one-fourth days. There are two well defined flood periods, one, the secondary, extending from the latter part of March to about April 29, and the other, the primary, from about May 20 to the middle of July. The interval between these two periods is exactly three weeks at Omaha, Plattsmouth, St. Joseph and Kansas City. At Kansas City the average date of the crest of the first rise is April 12, and the average date of the crest in the second rise is June 25.

Discussion.—Dr. Alter remarked that floods in Kansas were largely due to distribution of seasonal rainfall.

At this point, which closed the reading of papers, Dr. Milham stated it would be impossible for the Society to publish all papers read at the meeting. Prof. Marvin announced a meeting of Weather Bureau officials either immediately following the business meeting of the Society or in the afternoon. Dr. Alter announced a trip to Kansas University, Lawrence, Kansas, on the following Thursday at 8.30 A. M. Dr. Milham announced other important events of the A. A. A. S. in Kansas City during the remainder of the week.

Following this a Symposium of ideas and suggestions for the good of the Society was held. Suggestions for increasing the membership were made. Prof. Marvin asked to hear from the Section Directors present. Mr. Root stated he had sent literature to co-operative observers in Illinois. Mr. Alexander also said he had circularized co-operative observers in Ohio. Other suggestions and reports of action were made by other members present.

Conference at Clark University on Fire Weather

An informal conference on fire weather investigations in the northeastern United States was held at Clark University, on December 18, 1925. Since the establishment of the Northeastern and Great Lakes Forest Experiment Stations in 1923, much interest has been aroused in improved methods of forest fire protection, with the aid of weather forecasts along lines already developed in the West. Last spring the Weather Bureau and Forest Service in co-operation began fire weather warnings in New England, even though at that time investigations on the relations between humidity and the incidence of forest fires had not yet been made for this section of the United States. Mr. S. T. Dana, Director of the northeastern station, encouraged investigations, especially of humidity relative to fire danger, placing Mr. P. Stickel in the field to make special studies from the forecasters' standpoint, and asking Clark University to interest graduate students in geography in research on this problem. In the fall of 1925, Mr. M. F. Burrill, of...