The conditions stated above apply only to this first award, and are not to be considered as a precedent for future competitions. The Committee is of the opinion that part of the income from the Fund may well be devoted to encouraging the younger students and workers in meteorology to take up special problems for investigation. The frequency with which such awards can be offered will depend upon the size of the Fund.

The Committee further hopes that awards in the form of medals may become possible for particularly important contributions or series of contributions, with no restrictions as to age, scientific attainments or nationality of the recipients. The Fund would thus serve two distinct purposes: First, encouragement to young workers to take up meteorological research; Second, recognition of unusual merit in more mature workers who have spent many years, perhaps a lifetime, in such research.

To carry out these purposes the Fund must be materially increased. It amounts now to nearly $1100. The Committee will welcome further contributions, in order that the Fund may function in a really large way and thus realize the purposes for which it was started.

W. I. MILHAM, *Chairman*,
C. F. MARVIN,
R. DEC. WARD,
W. R. GREGG,
Committee.

SYMPOSIUM: SOLAR RADIATION AND THE WEATHER

(American Meteorological Society Meeting, Washington, D. C. May 2, 1925)

C. F. MARVIN

(Author's Abstract)

The speaker has only praise to express for the many years of devoted work by Dr. Abbot and his colleagues in securing the very accurate measurements of the solar constant published by the Smithsonian Institution. The meteorologists of the Weather Bureau, however, are compelled to pause when it is insisted that the day-to-day variations in the published values of the solar constant are fair representations of real solar changes and that such changes form a satisfactory basis for the forecasting of the weather for short and long periods in advance.

A critical analysis of all available data is now being made by the speaker and others in the Bureau.

The following are the major points presented at the symposium:

(1) Agreement was expressed on all sides that there is no evidence that one hemisphere of the sun as presented to the earth is permanently hotter or cooler than another. Temporary differences may prevail for various times, but disappear and shift from place to place.

(2) Graphs of consecutive values of the solar constant, together with statistical values of the scatter or probable day-to-day variation thereof, covering a period of 20 years or more, show in a highly striking and

convincing way that all day-to-day variations have continually and steadily diminished from an average value of over 1 per cent for the best values six years ago to much less than half of one per cent for the best recent values. It is humanly impossible to make errorless observations, and the most positive and convincing evidence must be adduced to show that this now very small total variation due to all causes is not almost, if not entirely, due to errors of observation.

(3) The earth does not produce an annual periodicity in the values of solar intensity, and the presence of such a periodicity in values of the solar constant is *prima facie* evidence that those values are not actual solar intensities and cannot be accepted as fair valuations of day-to-day or even annual changes of real solar intensity. The periodicity is statistical, a real thing as shown by different analyses of data, and cannot be brushed aside by selecting or rejecting particular sets of observations or questioning the use of all the data.

(4) The periodicity is shown as a summer and winter effect at Mt. Wilson, Calif., and at Calama, Chili, with phases six months apart to match climatic conditions in the two hemispheres.

(5) The amplitude of the period E'_0 at Mt. Wilson is nearly twice as great as E_0, a supposedly inferior value of the solar constant.

(6) The provisional values of the solar constant for Harqua Hala show an annual period, but its phases are physically inconsistent with those for the period as found from Mt. Wilson data. Dr. Abbot has employed a cross-comparison method of harmonizing the observations at Calama and Harqua Hala. However basically correct the method of corrections may have seemed to be at the start, the sequel shows that the published values of *Harqua Hala are not independent values of the solar intensity, but are correlated in an artificial way with those at Montezuma.*

(7) The whole year is the natural and only safe climatic interval to employ to adjust and free solar observations from terrestrial correlations. Observations at different stations *must be kept entirely independent and free from artificial correlations.* The values at all stations are correlated with atmospheric water vapor, especially with the so-called *precipitable water* and atmospheric transmission.

(8) The speaker presented for the first time seemingly original statistical equations by which the proportionate part of the variation caused by the sun and by the errors of measurement could be numerically evaluated from simultaneous observations at two *independent stations.* These are:

$$V_1^2 = \epsilon_1^2 + S^2$$
$$V_2^2 = \epsilon_2^2 + S^2$$
$$V_3^2 = \epsilon_1^2 + \epsilon_2^2$$

V_1, V_2 and V_3 are three known quantities, namely, the total variation at stations 1 and 2 and the variation of the differences between the values of each; ϵ_1, ϵ_2 and S are the unknown quantities representing the errors at Stations 1 and 2 and real solar variation.

Applied to the simultaneous observations at Harqua Hala and Montezuma, the equations gave a solar variation of about 0.2 per cent, but this has little or no physical meaning, because for the reasons given the observations used are not independent, and both stations show strong terrestrial correlations.

(9) The hope was expressed that a comprehensive reanalysis of the original observations should be made to free the solar constant values of the periodicities and correlations with terrestrial conditions, in order that the real facts may be brought to light and enable the various authorities to go before the public with one and the same story on such important questions.

SMITHSONIAN SOLAR CONSTANT VALUES

H. H. KIMBALL

Abstract. A critical study of the values published during the past 20 years leads to profound respect for the skill, energy, and devotion to science evidenced in connection with their determination. The mean of these values is generally accepted as correct within the limits of the accuracy of the observations. This paper has to do principally with the two following sources of error, and their probable effect upon the day-to-day variations in the solar constant values:

(1) Pyrheliometer readings. Numerous comparisons between different instruments indicate a probable error in the readings of one, provided both are equally good, of about ±0.30 per cent. For Montezuma, Chili, Dr. Abbot computes the error to be ±0.20 per cent, and since a solar constant value depends upon the readings of two instruments, the error would be only $\pm \sqrt{\frac{(0.20)^2}{2}}$. This enters directly into the determination of the solar constant values.

(2) The difficulties of extrapolating pyrheliometer readings to the outer limit of the atmosphere, which is accomplished through determinations of atmospheric transmissibility for monochromatic radiation, (a), by the bolometer, or (b) by the pyranometer. An examination of individual determinations made at Montezuma and Harqua Hala on days having not less than 6 determinations at the two stations, gives probable errors of from ±0.23 per cent to ±0.74 per cent, and the day-to-day variability seems to be a function of the number of determinations upon which the daily values are based.

Since the probable error, or the probable variability, in the day-to-day values of the solar constant derived from determinations at these two stations is less than ±0.5 per cent, it is seen that solar variability, if it exists, is of the same order of magnitude as the probable error of the determinations. Therefore, this fact must be taken into account in attempting to correlate solar constant values with weather and other phenomena.