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NOTES, ABSTRACTS AND REVIEWS

RAINFALL CORRELATIONS IN TRINIDAD, BRITISH WEST INDIES

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Preliminary investigation by W. R. Dunlop has established the fact that annual variations in the yields of certain crops in Trinidad, the deviations in which sometimes amount to 100 per cent or more from a five-year moving average, are primarily due to fluctuations in rainfall. For La Vega estate (cacao) the very high negative correlation  $-0.95 \pm 0.10$ , was found between May-June rainfall and the yield of the subsequent crop. For May rainfall alone (six months earlier than the harvest) the correlation was  $-0.85 \pm 0.15$ . Hence, contrary to local opinion, smaller yields appear to be due, at least partly, to too much rain rather than to too little.

The point is emphasized that statistical analysis of weather-and-crop relations for the Tropics is assuming prime importance as contrasted to purely descriptive treatment, this being especially true from the point of view of economic geography. Reference is made to the work on climatic factors and the cane crop for Mauritius by A. Walter, to M. Koenig's investigations in the same colony, and to those of T. A. Tengwall and C. E. van de Zyl in Java, where they found a positive correlation between sugar yield and the October-November rainfall.

In Trinidad variations of rainfall seem intimately to affect the whole economic activity. Business done in the shops fluctuates in amount not only in response to the current rainfall but to the previous season's rainfall through changes in the purchasing power of the people.—*B. M. V.*

THE SOLAR-CONSTANT AND THE FORECASTING OF TERRESTRIAL WEATHER

While continued critical investigations conducted by the Weather Bureau<sup>1</sup> appear to furnish convincing evidence that the magnitudes of the alleged changes in value of the solar-constant are, if the changes exist at all, well within the magnitudes of the uneliminated errors of observation, and therefore unknowable, and certainly not a satisfactory basis for forecasting the weather, nevertheless, the Bureau is glad to present the following extracts from the 1924 Annual Report of the Astrophysical Observatory of the Smithsonian Institution, indicating the present status of, and progress being made in, these interesting measurements.

As in previous years, the variation of the sun has been the main concern. The generosity of Mr. John A. Roebling enabled arrangements to be made for daily telegrams from our two solar radiation stations. This service was begun September 13, 1923. The results obtained in Chile are cabled in code, so that the weighted mean solar-constant, the date and hour of observation, and its grade are all included in two words. Messages arrive at Washington from both stations within 24 hours of the actual measurements, and generally represent mean results of five independent determinations at each station. Arrangements have been made (also owing to Mr. Roebling's interest and generosity) to test the value of the solar measurements for forecasting according to the methods of Mr. H. H. Clayton. For this purpose Mr. Clayton \* \* \* receives before noon daily from the Smithsonian Institution the weighted mean of the solar-constant values observed in Arizona and Chile on the preceding day. He makes his forecasts for

3, 4, 5, and 27 days in advance, and mails them to the Institution on the same afternoon. Thus we receive the forecasts sufficiently long before their maturity to make a very real and searching test of their validity.

These forecasts for definite days relate to the mean temperature of New York City, and are later on compared with the observed temperatures and analyzed by several purely mathematical methods quite independently of any bias of the computer. The official weather services of the various countries do not, of course, make predictions parallel to these, except in Argentina, where such forecasts are made by similar methods to Clayton's. Hence it is impossible to know at present how much gain, if any, Mr. Clayton's solar forecasts show over the present official methods. That they do show some prevision of the event, even to five days after the solar observations, is certain.

Hitherto, however, the 27-day detailed forecasts have shown no correlation with the New York temperatures. This is not at all surprising. Indeed, all such forecasts have to contend against great odds. For we recall that the march of temperature often goes quickly from crest to trough, so that even if a true forecast could be made, and it should be no more than 12 or 24 hours off in point of time, there would be large divergences between the prediction and the event. With the unyielding mathematical methods of verification this would greatly diminish the correlation found.

A fairer test for very long-range forecasts is found in general statements as to the expected departure from mean normal temperatures for coming months. These Mr. Clayton has furnished from 15 to 30 days before the beginning of each month from December, 1923, to the present time. He also furnishes similar predictions about the approaching weeks furnished three days before the beginning of the week in question. With few exceptions, these broader prognostications have been fairly verified.

On the whole, therefore, although the results are as yet far from being entirely satisfying, these experimental forecasts of Mr. Clayton's are promising enough to warrant further trial. New methods are continually being devised and tried in making them. Mr. Roebling has generously arranged to continue them until June 30, 1925. As the work is purely experimental, no detailed publication of it will be made at present.

Naturally, if the forecasts made by Mr. Clayton really represent solar changes, he can not succeed unless good solar measurements are supplied. As soon as we began to receive daily telegrams from both stations occasional fairly wide disagreements of individual days commanded attention. We felt it necessary, in studying the causes of such disagreements, to revise again entirely the systems of little corrections to solar-constant values which have to be made to allow for the haziness and humidity of our atmosphere. This revision could be made with more advantage because much additional data had meanwhile accumulated.

\* \* \* A new method of determining these corrections has been devised by the Director and Mr. Fowle, which eliminates satisfactorily the influence of the solar changes which have occurred. Hitherto this matter of solar change superposed upon the small terrestrial sources of error which we desire to eliminate has been very embarrassing. Of course, if one could wait many years before proceeding to evaluate the terrestrial effects, the solar changes, being independent or but loosely connected with local terrestrial ones, would be eliminated in the mean of a mass of observations. We can, indeed, after several years more of observing, finally proceed in this way. But, wishing to make immediate use of our results, a new method of procedure has fortunately occurred to us which permits us to avoid the interference of solar changes altogether. The details will be published soon.

As both to us and to the Chief of the Weather Bureau it seemed unwise to publish preliminary values of the solar constant which later on would have to be corrected, we have discontinued the frequent publications of them in the MONTHLY WEATHER REVIEW which we have been accustomed to make for several years past. After we come to a fully satisfactory basis of systematic atmospheric corrections, these publications may be resumed.

Of the two solar-radiation stations, Montezuma, Chile, has proved far more suitable to the purpose than Harqua Hala, Ariz. It seems probable that a place somewhat farther west and decidedly higher would be preferable to Mount Harqua Hala. Violent storms occur there in various months of the year, and the summer months in particular have proved very unsatisfactory. If financial means were available it would be highly desirable to remove the station to another site, and, indeed, a better one is already selected which would present many advantages. The cost of removal would be about \$7,000.

The systematic revision of results in the hands of Mr. Fowle and Mrs. Bond has led to much improvement, as shown by the close accord of daily solar-constant values at the two stations. For the period September, 1922, to March, 1924, the average daily

<sup>1</sup> See 2 papers by Marvin, Charles F.: Forecasting the Weather on Apparent Short-Period Solar Variations. Mo. Weather Rev. March, 1920, 48: 149-150. Solar Radiation Intensities and Terrestrial Weather. Mo. Weather Rev. April, 1923, 51: 186-188. The data published in Smithsonian Miscellaneous Collections, vol. 77, No. 3, Feb. 17, 1925 entitled "Provisional Solar-Constant Values, August, 1920 to November, 1921," by C. G. Abbot and Colleagues, furnishes the basis for a further statistical analysis of this important subject. This analysis and the conclusions therefrom will appear in a future issue of the Monthly Weather Review.

