SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 111, NUMBER 6

Roebling Fund

A PREDICTION OF WASHINGTON TEMPERATURE 1948
(MADE JANUARY 1948)

BY
C. G. ABBOT
Research Associate, Smithsonian Institution

(Publication 3982)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
MARCH 8, 1949

The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

Roebling Fund

A PREDICTION OF WASHINGTON TEMPERATURE 1948 (MADE JANUARY 1948)

By C. G. ABBOT

Research Associate, Smithsonian Institution

ABSTRACT

The author in January 1948 predicted 55 dates in 1948 as near dates of minima in Washington temperatures. He predicted that between successive pairs of these dates higher temperatures would occur. He predicted that the average excess of these higher temperatures over those of the predicted dates would be 7°.1 F. On January 19, 1949, the Director of the Astrophysical Observatory checked the prediction and found that in 48 of the 55 cases higher temperatures did intervene, and that their average excess was 6°.96 F. The author shows by a graph that the main part of the brief fluctuations in temperature ordinarily ascribed to "weather" is caused by a periodicity of 6.6456 days in solar radiation, rather than by terrestrial complexities, as generally supposed. The author claims that similar successful predictions may be made for any station and, if desired, for many years in advance. The predicted dates of minima are approximate, and may be out of phase by 1, 2, or rarely 3 days. If predictions are limited to 1 or 2 months in advance, however, displacements of phase may be nearly eliminated. A prediction of approximate dates for Washington minimum temperatures for 1949 is given.

In January 1948 I made a prediction relating to temperatures at Washington for the entire year 1948. I then sealed the prediction and placed it in the safe in the Smithsonian accounting office, with the provision that it was to be opened on or about January 20, 1949, by the Director of the Smithsonian Astrophysical Observatory.

This paper contains the text of my prediction for 1948, the verification of the prediction by the Director of the Astrophysical Observatory, comments on the outcome, and my prediction for 1949.

PREDICTION FOR 1948

In Smithsonian Miscellaneous Collections, vol. 107, No. 4, 1947, I disclosed an average period of 6.6456 days in temperatures of Washington and other cities, identical in length with a periodic variation of solar radiation. Due, as I suppose, to complex terrestrial influences, the phases of this period shift somewhat as to tempera-

ture, though the phases do not shift in solar variation. However, it seemed to me probable that the period could be used for long-range predictions of temperature, though such predicitions may sometimes be out of phase by from 1 to 3 days. I propose to make a prediction of Washington temperature for the year 1948 now [January 22, 1948], seal and deposit it with the Smithsonian Treasurer, to be opened and checked by the Director of the Smithsonian Astrophysical Observatory in January 1949.

The enclosed graph [1] contains plots of the departures from normal temperature at Washington for the years 1945-46-47. From a marked repetition of the 6.6456-day period of March 1946 I observed the phases of minimum temperature at that [2] time. Assuming no changes of phase, I indicated corresponding dates of minimum temperature for all repetitions of the period from January 1945 to December 1947. As these indicators in most cases bounded curves of higher temperature between each pair of indicators, I was encouraged to continue with my project.

Using the method described on page 4 of the paper above cited, and allowing for the fact that now I am concerned, not with "zero" dates but with dates of minima, I compute the following dates in the year 1948 as likely to be at or near dates of minima in the march of temperature at Washington:

1948	Jan.	5	11	18	24	31	July	2	9	15	22	29
	Feb.	7	13	20	27	..	Aug.	4	11	18	24	31
	Mar.	4	11	18	24	31	Sept.	7	13	20	26	..
	Apr.	7	13	20	27	..	Oct.	3	10	16	23	30
	May	3	10	17	23	30	Nov.	5	12	19	25	..
	June	5	12	19	25	..	Dec.	2	9	15	22	28

To verify the prediction I am about to make, the departures from normal temperatures at Washington, as published monthly by the United States Weather Bureau, should be taken for each of the dates tabulated above, and also the departure occurring at the highest temperature which occurred between each pair of dates. Then the mean value for the year 1948 of the departures for the dates above tabulated should be found to indicate a lower mean of departure temperatures than the mean departure of the said dates of "highest temperature."

I will also predict what the difference will be in degrees Fahren-

[1] Not here reproduced.
[2] See figure herewith.

heit between the two means of departures just indicated. For this prediction I take values from the three years 1945-46-47, selected as specified in the next preceding paragraph. The computed differences of these means are as follows:

1945, 6°.6; 1946, 8°.6; 1947, 6°.0; Mean, 7°.1

I predict the "Mean" just stated, for 1948.

Should the method of prediction succeed in Washington, it will probably succeed equally well in all other places. If any should be bold enough to use it, and wish to estimate how much difference in temperature between predicted maxima and minima is to be expected, he should consult figure 5 of the publication above cited and note that the range between maxima and minima varies several fold in Washington for the various months of the year.

VERIFICATION OF THE PREDICTION

January 19, 1949.

This is to certify that I have caused examination to be made of the sealed package deposited by Dr. C. G. Abbot in the Smithsonian safe in January 1948. I have tabulated the temperature departures from normal at Washington on the 55 dates specified therein, and the temperature departures at the warmest dates intervening between the 55 pairs, all as published in Weather Bureau Form 1030. I find that on 48 occasions warmer dates occurred between the dates specified, and that for the entire series of 55 dates the mean excess found thus was 6°.96 F., as compared with 7°.1 F. predicted by Dr. Abbot.

L. B. ALDRICH,
Director, Astrophysical Observatory.

COMMENTS

The test proposed in the preceding pages came out nearly as expected. But I realized soon after the manuscript was deposited, in January 1948, that the test might perhaps give an exaggerated impression of the amplitude of the 6.6456-day temperature fluctuation. For by using the highest temperatures which intervened between the predicted dates of minimum temperatures at Washington, there can be no question that some of these higher temperatures are made higher than they otherwise would be by local terrestrial meteorological influences, not directly caused by the solar periodic variation. Such extraneous influences may, it is true, have correspondingly

raised the temperatures at the predicted low dates. If so the error would be compensated. But one is inclined to think that this would not always be the case, and that the higher intervening values are higher in the mean than they should be in comparison with the values occurring on the predicted dates.

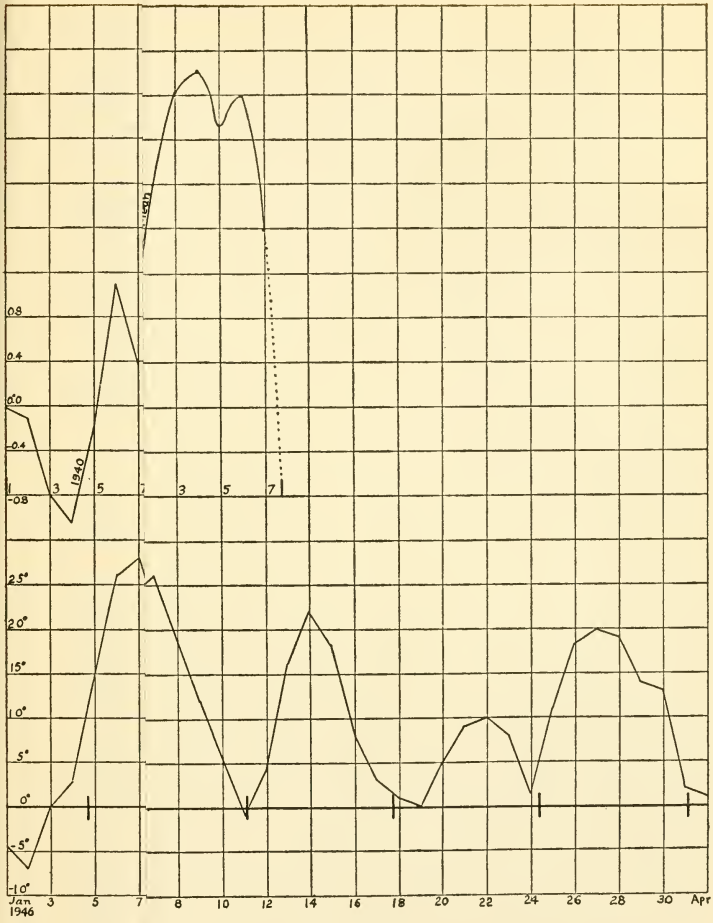
I sought a method to estimate the average increases of temperature between the predicted dates which would give too low a mean value of the excess. For this purpose I plotted the daily departures from the normal Washington temperatures from January 1 to April 1, 1946, as shown in the accompanying figure. Then with a scale divided into intervals of 6.6456 days, I marked, as shown by short, heavy vertical lines in the figure, the dates which seemed best to represent the minima of the 6.6456-day periodicity at Washington.[8] Inspection indicated that January 17.0000 would be a proper date for the zero phase. From this date I calculated all corresponding phases from January 1, 1940, to December 31, 1948. Assuming these 495 dates to be exact dates of minimum temperatures at Washington, I computed yearly tables of temperature departures as arranged in groups averaging 6.6456 days in length. In these yearly tables of 55 lines each, approximately two out of every three lines were 7 days long, and the others 6. To arrange the short lines symmetrically I wrote 45 lines with the first space unfilled, and the rest with the seventh space unfilled.

Table 1 gives the mean yearly marches of the 6.6456-day periodicity

TABLE 1.—*Mean march of 6.6456-day temperature groups at Washington in the years 1940-1948*

Year	Mean temperature marches						
1940	−0°.02	−0°.11	−0°.80	−1°.05	−0°.20	+1°.09	+0°.34
1	2.63	2.31	1.76	3.65	3.31	3.18	1.72
2	0.22	2.16	2.98	2.96	3.49	2.27	2.29
3	1.84	2.62	2.78	2.80	1.38	1.00	0.76
4	0.61	1.49	2.69	2.38	2.85	2.11	1.02
5	1.86	1.84	2.09	2.13	2.51	2.49	2.24
6	0.72	2.16	4.62	4.31	3.36	2.78	2.64
7	−0.69	2.89	2.11	2.00	2.47	2.38	1.93
1948	1.49	2.25	1.93	1.45	1.33	3.44	3.02
Mean	1.08	2.20	2.62	2.71	2.46	2.59	1.99

[8] It used to be the view of most meteorologists, and perhaps still is, that the brief fluctuations of temperature which we associate with the term "weather" are caused by terrestrial complexities. I think the figure shows plainly that they are mainly of solar origin.



indicated by short, thick, vertical lines.

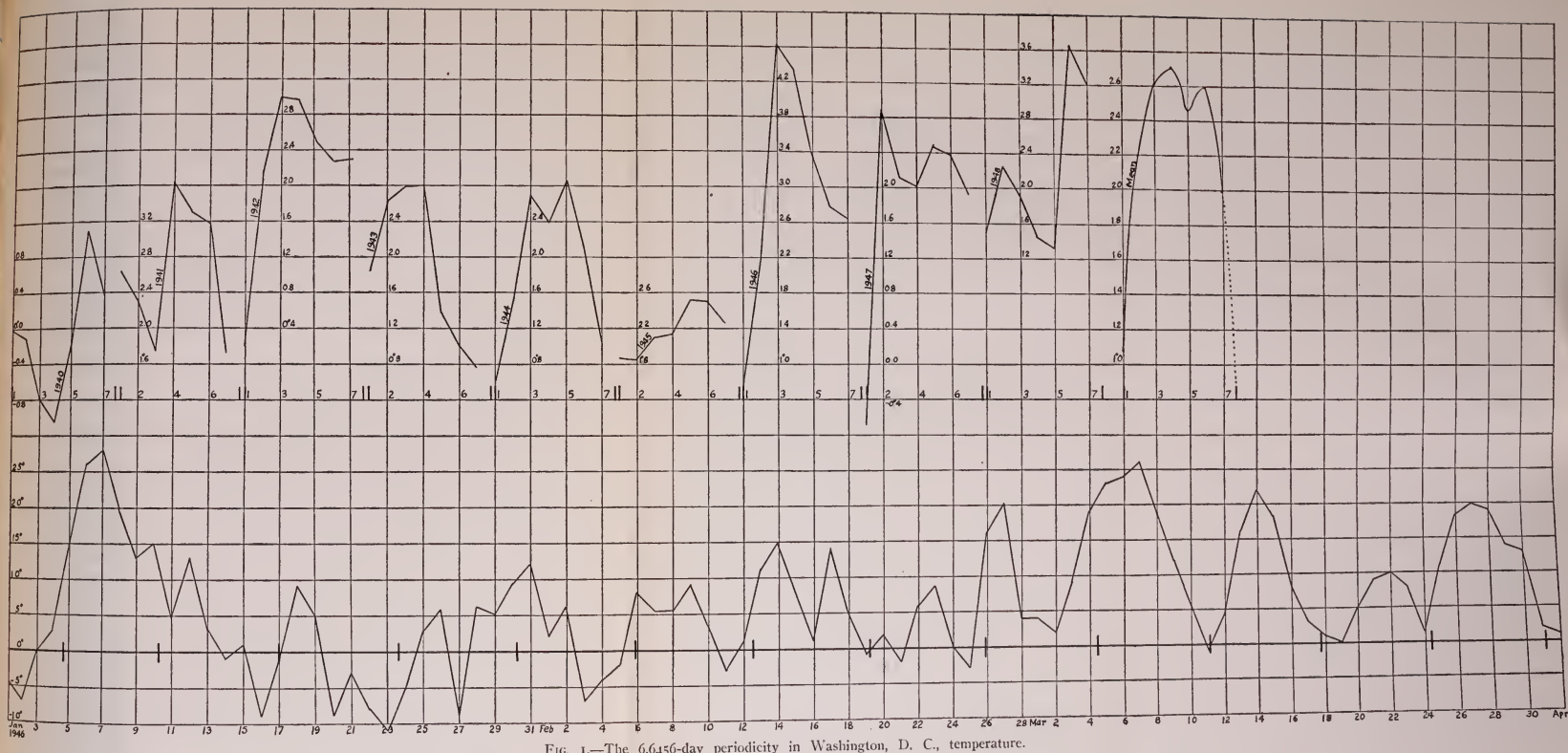


FIG. 1.—The 6.6456-day periodicity in Washington, D. C., temperature.

Lower curve, the daily departures from normal temperature, Jan. 1 to Apr. 1, 1946 (see Weather Bureau Form 1030). The 6.6456-day period is indicated by short, thick, vertical lines. Upper curves, average temperature departures for 55 repetitions of the periodicity each year, 1940-1948, and the mean of them for 9 years.

in Washington temperature departures for the 9 years 1940 to 1948. The upper part of the figure shows these results and their mean graphically. It is satisfactory to see that the mean curve is nearly smooth, with the correct phases for maximum and minima. The range of the mean curve is 1°.63. This is certainly too low a value to be a correct estimate of the amplitude of the periodicity. For, as shown in my paper cited above, the phases of the periodicity are subject to a sort of backlash effect, and they are apt to occur 1, 2, or rarely 3 days too early or too late. Hence where, as in my tabulation just referred to, no allowance is made for these shifts of phase, the real mean amplitude of the periodicity must be much greater than computed.

I have computed also the average range per year after the method set forth in the test paper above. I give these results for the 9 years in table 2. They are very closely all the same, and give a mean of

TABLE 2.—*Average amplitudes of the 6.6456-day temperature variations in Washington, 1940-1948*

Years	1940	1941	1942	1943	1944	1945	1946	1947	1948	Mean
Amplitudes	5°.81	6°.95	6°.55	6°.56	6°.58	6°.60	8°.60	6°.00	6°.96	6°.73

6°.73. For the reason mentioned above, I consider this value too high an estimate of the amplitude of the 6.6456-day periodicity in Washington temperatures. But I do not think it as much too high as the other one, 1°.63, is too low. However their mean, 4°.18 F., may be nearly of the right order of magnitude.

While yearly forecasts of dates of minimum and maximum temperatures by this method may be out of phase by from 1 to 3 days, they may be made with equal success for many years in advance, as my earlier paper which covers 35 years shows. If the forecaster should content himself, however, with forecasts only a month or two in advance, and should take into account the phase prevailing when the forecast was made, he might hope to be within 1 day of correct phases for minima and maxima. See, for instance, in the lower part of the figure, how closely the phases held true from February 5 to March 31, 1946.[4] The method, as I have said, is probably applicable everywhere.

[4] Note also by the curves of the upper part of the figure that in the years 1940, 1941, 1945, and 1948 the phases were prevailingly appearing 2 days or more late.

PREDICTION OF APPROXIMATE DATES FOR MINIMUM TEMPERATURES IN WASHINGTON, D. C., FOR THE YEAR 1949

Following the method described in this paper, I give the following dates expected to be close to dates of minimum temperatures in Washington in the year 1949.

1949	Jan.	4	11	18	24	31
	Feb.	6	13	20	26	..
	Mar.	5	12	18	25	..
	Apr.	1	7	14	21	27
	May	4	10	17	24	30
	June	6	13	19	26	..
	July	3	9	16	23	29
	Aug.	5	12	18	25	31
	Sept.	7	14	20	27	..
	Oct.	4	10	17	24	30
	Nov.	6	13	19	26	..
	Dec.	3	9	16	22	29
1950	Jan.	5	11	18	25	31

The departures of temperature from the normal, as published by the U. S. Weather Bureau, Form 1030, may be taken for these dates, and also for the warmest days that occur between them. Then the average excess of these warmer temperatures over the mean of the temperatures of two cool dates preceding and following each warm one will be found about 6°9 F. for the 55 cases of the year 1949.