The correlation computed after adjustment was made was $r=+0.46$. This is much higher than the $+0.33$ correlation of the chronological data, confirming the evidence not only as to the reality of this cycle, but that it is actually related to the sun-spot cycle and equal to one-eighth of that cycle.

The writer examined Alter's California and Oregon data for the eighth harmonic and found a small correlation of $+0.178$ between the halves of the data. This appears probably due only to the few Oregon stations included among the California ones. He also examined the above data of Oregon and Washington for the ninth harmonic and found the negligible correlation of $+0.036$. There seems to exist very definitely in Washington and Oregon a different cycle from that which exists just as definitely in California and in many other parts of the world.

TABLE 1

Group	I	II	Group	I	II	Group	I	II
1877 a	-----	54	1895 a	89	116	1913 a	81	77
b	-----	x	b	147	x	b	141	x
c	-----	77	c	119	56	c	90	140
1878 a	-----	186	1896 a	151	101	1914 a	120	149
b	-----	x	b	149	x	b	71	x
c	-----	56	c	182	39	c	87	103
1879 a	120	92	1897 a	145	98	1915 a	81	141
b	179	x	b	91	x	b	103	x
c	96	144	c	130	52	c	118	82
1880 a	123	103	1898 a	86	34	1916 a	132	147
b	115	x	b	104	x	b	131	x
c	80	160	c	93	60	c	70	129
1881 a	144	74	1899 a	123	87	1917 a	90	72
b	122	x	b	146	x	b	73	x
c	105	66	c	118	128	c	92	24
1882 a	107	87	1900 a	74	50	1918 a	88	104
b	75	x	b	133	x	b	69	x
c	123	63	c	93	119	c	81	123
1883 a	99	71	1901 a	100	100	1919 a	128	85
b	46	x	b	68	x	b	59	x
c	87	64	c	69	65	c	83	77
1884 a	77	207	1902 a	105	105	1920 a	65	75
b	104	x	b	84	x	b	93	x
c	92	120	c	120	102	c	130	144
1885 a	72	39	1903 a	84	107	1921 a	121	83
b	110	x	b	98	x	b	78	x
c	114	176	c	96	59	c	110	168
1886 a	95	120	1904 a	140	110	1922 a	78	54
b	95	x	b	51	x	b	78	x
c	110	45	c	95	114	c	89	162
1887 a	144	96	1905 a	69	132	1923 a	82	61
b	93	x	b	104	x	b	100	x
c	105	77	c	87	58	c	71	46
1888 a	90	100	1906 a	84	143	1924 a	63	57
b	157	x	b	116	x	b	46	x
c	76	153	c	121	137	c	115	110
1889 a	64	76	1907 a	102	151	1925 a	95	87
b	104	x	b	87	x	b	76	x
c	92	341	c	101	88	c	77	64
1890 a	135	114	1908 a	84	83	1926 a	73	157
b	97	x	b	116	x	b	113	x
c	51	65	c	70	72	c	114	136
1891 a	96	99	1909 a	106	177	1927 a	105	124
b	127	x	b	84	x	b	82	x
c	140	82	c	115	166	c	106	138
1892 a	77	72	1910 a	106	64	1928 a	97	67
b	99	x	b	76	x	b	40	x
c	115	160	c	107	42	c	87	112
1893 a	118	124	1911 a	74	171	1929 a	66	60
b	112	x	b	102	x	b	71	x
c	134	79	c	84	49	c	57	8
1894 a	147	62	1912 a	101	86	1930 a	-----	-----
b	106	x	b	174	45			
c	104	158	c	100	45			

TABLE 2.—*Data repeated or averaged in keeping rainfall periodicity in step with sun spots*

Averaged	Repeated	Averaged
1861 Mar., Sept.	1865 July	1872 April
1862 June	1866 July	1873 Sept.
1863 June	1867 Mar., June, Sept., Dec.	1874 April, Sept.
	1868 Jan., Apr., June, Aug., Nov.	1875 Mar., June, Nov.
	1869 Feb., June, Oct.	1876 Feb., May, Aug., Nov.
	1870 April, Oct.	1877 Jan., Apr., July, Sept., Dec.
	1871 April	1878 Mar., June, Aug., Nov.
		1879 Mar., July, Nov.
		1880 Apr., Oct.
		1881 July
		1883 Mar.

Repeated	Averaged	Repeated
1884 Jan., Sept.	1891 Jan.	1915 Jan.
1885 April, Oct.	1894 May	1917 July.
1886 Jan., May, Sept.	1895 Jan., Sept.	
1887 Jan., May, Sept.	1896 April	
1888 Jan., May, Sept.	1897 Mar.	
1889 Feb.	1898 Jan., Dec.	
	1899 Dec.	
	1901 Jan., Nov.	
	1902 June	
	1903 Sept.	
	1909 July	
	1913 Jan.	

Repeat:	Average:
1915 Jan.	1926 Jan.
1917 July	1927 Jan.
1918 June	1928 Jan.
1919 Feb., Sept.	
1920 Mar., Sept.	
1921 Mar., Oct.	
1922 May, Dec.	
1923 July	

REFERENCES

(1) Dinsmore Alter. A rainfall period equal to one-ninth the sunspot period. Kansas University Science Bulletin, vol. xiii, No. 11, July 1922.

(2) G. Udney Yule. Presidential address, Sec. V. Jour. Roy. Stat. Soc., January 1926.

(3) Dinsmore Alter. A group or correlation periodogram. MONTHLY WEATHER REVIEW, June 1927.

RELATION OF THE EXTREMES OF NORMAL DAILY TEMPERATURE TO THE SOLSTICES

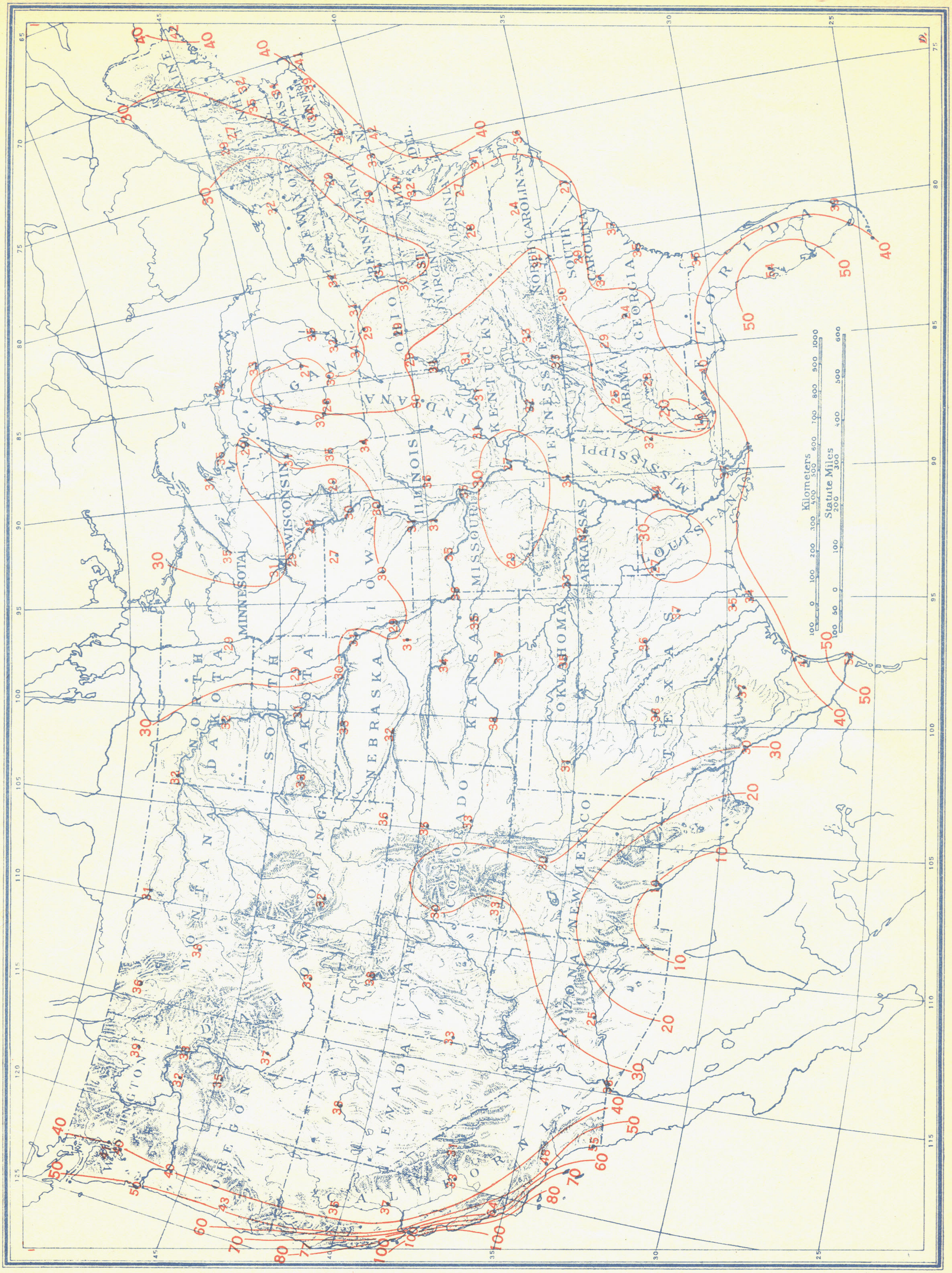
By Edward H. Bowie

[Weather Bureau, San Francisco, Calif., August 1935]

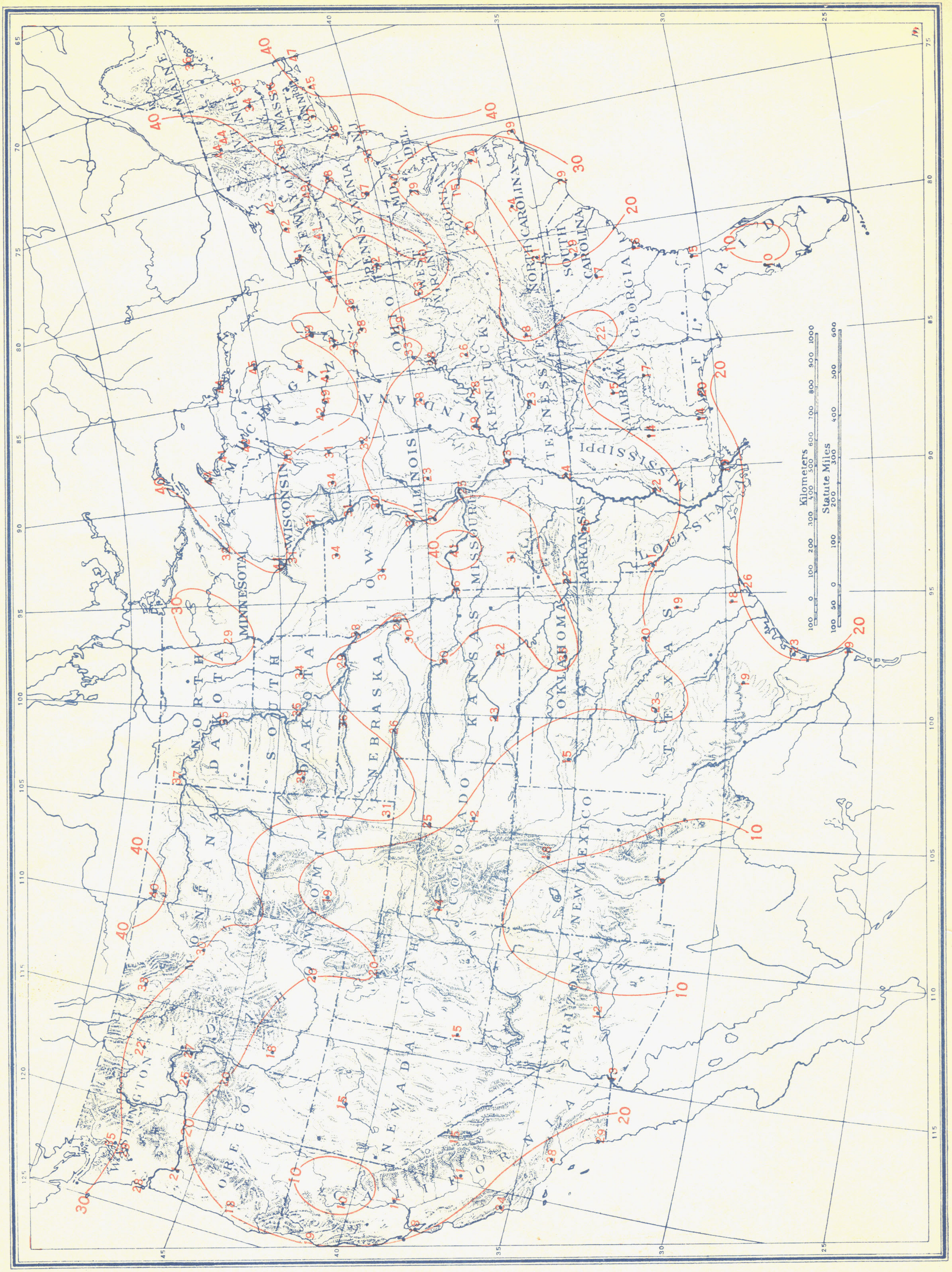
A true normal daily temperature is defined as one that has been computed from a long series of values of hourly temperatures for each day, derived from automatically-recording thermometers.[1] There are numerous records of this character that cover periods of upwards of 20 years at many Weather Bureau stations; but these, according to Marvin and Day, are insufficient in number adequately to represent the details of the climatic conditions over an area the size of the United States.

Moreover, the labor of computing normals from hourly readings is too great to justify their general preparation. In lieu thereof, normal daily temperatures, based on the maxima and minima of temperature, have been computed, since they are nearly the same as the normal daily temperatures determined from hourly readings for similar periods of time. Such normals are given in Supplement

[1] MONTHLY WEATHER REVIEW, Supplement No. 25, Normals of Daily Temperature for the United States, by Marvin and Day.



E. H. B. **Fig. 1. Number of Days from Summer Solstice to Highest Normal Daily Temperature**



E.H.B. Fig. 2. Number of Days from Winter Solstice to Lowest Normal Daily Temperature

No. 25 of the Monthly Weather Review for all regular Weather Bureau stations of long or relatively long record. They have been determined to tenths of a degree Fahrenheit for each day in a way that leaves little doubt as to their accuracy.

Since 1922 these daily normals have been in official use at all Weather Bureau stations. From them the departures from the current mean daily temperatures are ascertained and made a part of the local climatological record. Should anyone desire to know the precise way in which these normals were computed he should consult the official report containing them.

Because the daily normals are given to tenths of a degree Fahrenheit, it is easy to determine quickly the dates of occurrence of the highest and the lowest normal daily temperatures at each of the stations. This has been done by the writer for all stations; and the dates of highest normal daily temperatures referred to the summer solstice (June 21), and those of lowest normal temperature to the winter solstice (Dec. 21). If the highest or lowest normal temperature is tabulated on 2 days, the first is selected as the date of highest or lowest as the case may be; if on 3 days, the middle one is selected; if on 4 consecutive days, the second; if 5, the third, and so on for any number of consecutive days having the same temperature.

In all instances the extremes of normal daily temperature *follow* the date of the solstice to which they have been referred. The dates of the extremes are to be regarded as those on which, on the average, a turn from rising to falling or from falling to rising temperature takes place; hence, too, they may be regarded as those times of the year when on the average there is exact balance between outgoing and incoming radiation—i. e., they are the summer and winter *thermal* solstices. These dates do not correspond to the days of possible maximum and minimum sunshine (the summer and winter astronomical solstices), but follow them in some instances by less than 10 days and in other instances by as much as 100 days. These time intervals have been plotted on charts of the United States and isochrones for differences of 10 days drawn to the plotted data.

The accompanying figure 1 shows the number of days between the date of the summer solstice and that of the highest normal daily temperature; and figure 2, the number of days from the winter solstice to the date of the lowest normal daily temperature for stations in the United States.

The writer does not recall having seen similar charts in any of the climatologies. This and the added fact that the charts present, in what seems to be an interesting way, the variations in the normal dates of occurrence of the warmest and coldest days of the year over a considerable area of the earth's surface, suggest the desirability of their incorporation in the climatology of the United States next to be written.

Figure 1 shows that the variation in time between the summer solstice and the dates of highest normal daily temperature is not to be attributed wholly to a latitudinal effect, although there is no doubt that this effect is predominant in the Rocky Mountain and plateau regions. Thus, at El Paso, Tex., the date of the highest normal daily temperature occurs 10 days after the summer solstice, while the period increases at Grand Junction, Colo., to 30 days; at Lander, Wyo., to 32 days; and at Kalispell, Mont., to 36 days. In the Middle Western, Eastern, Southern, and Pacific Coast States, the effect of latitude is largely hidden and subordinate to other influences. For example, the retardation of the dates of occurrence of the highest normal daily temperature along the Gulf of Mexico beyond that in the interior of the Gulf States is interesting, and no doubt owing to the slow warming of the surface waters of the Gulf of Mexico in comparison with the land surface of the interior. The winds being prevailingly from the Gulf of Mexico during the summer, the air temperature at coastal stations rises mainly with that of the water and therefore does not reach its maximum until late in the summer. This effect is seen in a retardation of the date of occurrence of the average warmest day of the year until 54 days after the summer solstice at Tampa, Fla., and 52 days at Brownsville, Tex.

Perhaps, too, the relatively early occurrence of the highest normal daily temperature in the interior of the Southeastern States is determined by the occurrence of the season of afternoon thunderstorms in this area, that results in lower afternoon temperature maxima than otherwise would be observed. These two effects are brought out in sharp contrast as between the Pensacola station, which is immediately on the coast, and Mobile, Ala., which is some distance inland. At Pensacola the retardation is 40 days beyond the summer solstice; at Mobile it is 18 days.

The effect of cool surface water in delaying the arrival of the highest normal daily temperature is quite pronounced along the Atlantic coast from Cape Hatteras, N. C., to Eastport, Maine, the maximum retardation being 41 days at the last-named station and 42 days at Atlantic City, N. J. But it is not until one examines the isochrones for the far West that the effect of a large surface of cool water and prevailing winds therefrom is fully realized. This effect reaches its maximum retardation of *100 days* beyond the summer solstice on the central California coast as shown by the record for San Francisco. A pronounced retardation of the date of the annual highest normal daily temperature beyond the summer solstice is general along other parts of the Pacific coast, but nowhere else is it as great as at San Francisco. This oceanic influence on retardation does not extend far inland; for example, the retardation is but 37 days at Sacramento as compared with 100 days at San Francisco—Sacramento is inland, and approximately 90 miles northeast of San Francisco. An influence of the cold surface waters of the Great Lakes in retarding the arrival of the highest normal daily temperature is also shown by the trend of the isochrones drawn to the data for this region.

Figure 2 shows that the retardation of the annual lowest normal daily temperature is least in the interior of the Gulf and South Atlantic States and in the far Southwest, reaching a minimum of only 6 days beyond the winter solstice at El Paso, Tex. The latitudinal effect is outstanding everywhere in the United States, although it is apparent that the effect of warm water surfaces enters into the physical processes that produce the larger retardations. Thus, the isochrone of 20 days retardation beyond the winter solstice skirts the coast of the Gulf of Mexico from Pensacola to extreme southern Texas. No doubt, the slow cooling of the surface waters of the Gulf of Mexico, together with the prevailing winds, accounts for this. Similarly, there is a pronounced retardation along the Atlantic Coast north of Cape Hatteras, N. C.; while over the region of the Great Lakes, and the area immediately to the eastward of them, there is a greater retardation of the arrival of the dates of lowest normal daily temperature beyond the winter solstice than is found elsewhere generally over the interior of our country. This retardation is no doubt brought about by the slower cooling of the waters of the Great Lakes than that of the land areas adjacent to them.

These simple but outstanding effects of terrestrial controls, made manifest by a study of the normal daily temperatures, should make us pause in our contemplation of efforts to correlate variations in the so-called "solar constant" and local responses in temperature. It seems evident that anyone seeking to establish a relation between a change in the radiation from the sun and the local temperature should first take into consideration and determine the factor of terrestrial control that is peculiar to each observing station. This response for one station has a way of differing from that of other stations that is peculiarly its own. It might be 6 days, as at El Paso, or 100 days as at San Francisco.

TROPICAL DISTURBANCE OF AUGUST 18–25, 1935

By W. F. McDonald

[Weather Bureau, Washington, September 1935]

The first indications of probable origin of this hurricane appeared on August 17, or possibly a little earlier, as a mild general disturbance of the normal trade-wind conditions over the lesser Antilles, attended by a slight but fairly widespread depression of the barometer, that became quite definitely localized during the night of the 17th-18th in the area around the intersection of the twentieth parallel and the sixtieth meridian. (The synoptic situation on the morning of August 18 is shown on chart IX.)

The American tanker *California Standard* made the first definite contact with the developing storm center on the morning of August 18, when a northeast gale was encountered near latitude 22° N., longitude 65° W. During that afternoon the wind rose at maximum to storm force (Beaufort 11) and the barometer fell to 29.55 inches, the lowest point, about 8 p. m., after which the wind shifted through east to southeast by south, holding the force of a whole gale (Beaufort 10) until the morning of the 19th. It would appear from these observations that the *California Standard* crossed the track of the storm not far in advance of the center, which at that time was moving west-northwest.

The next report which clearly identified the location and intensity of the cyclone was obtained from the American steamship *Angelina* which passed very close to the center about 5 a. m. of the 21st. This ship was then near 27° N., 68°30′ W. A barometer reading of 28.2 inches was observed, attended by hurricane winds which shifted from northeast through west to southwest, without a lull. The storm had by that time entered the recurve and was moving almost due northward; the *Angelina* was involved in the left-hand semicircle quite close to the center.

The hurricane moved on northward during the 22d, and on the morning of the 23d was central about 180 miles west of Bermuda. Shipping had been well warned of the approximate position and course of the disturbance, so that vessels successfully avoided the center, and it was not until the morning of the 24th that another ship was heavily involved.

The storm had by that time turned northeastward, and was moving at a much more rapid rate. The British steamer *York City* encountered the central region about 400 miles northeast of Bermuda, and there for 24 hours the vessel experienced storm conditions culminating about 5 a. m., August 24, in a south-to-west hurricane that lasted for 4 hours and caused considerable damage to the lifeboats and superstructures of the ship. The barometer fell to 28.71 inches (uncorrected) at the lowest point, when the ship was in a position 36°30′ N., 59°30′ W. The wind changes, from south-southeast through southwest to northwest, show that the *York City* passed fairly near and just behind the center of the storm, then moving rapidly northeastward.

The synoptic situation over the Atlantic on the morning of August 24, when the *York City* was in the hurricane, is shown in chart X. This chart also gives the full track of the hurricane center, which again turned northward during the 24th, and on the morning of the 25th was over Newfoundland. The disturbance rapidly diminished in intensity thereafter.

As the storm center passed over the Grand Banks, it caused heavy damage to fishing fleets and took a toll of lives estimated from press reports at upward of 50 in all, some as far northward as the Labrador coast. No life losses have been reported from the earlier movements of this hurricane.

The rate of progression during the first 5 days, while the cyclone moved from its origin within the Tropics to the waters west of Bermuda, averaged only 8 to 10 miles per hour. For the last 2 days, August 23 to 25, the rate of movement tripled and averaged nearly 30 miles per hour.

BIBLIOGRAPHY

C. Fitzhugh Talman, *in Charge of Library*

RECENT ADDITIONS

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies:

Andrews, Rapin.

Diary of Rapin Andrews, 1837–74, Perry Township, Allen County, Ind. n. p. tables. 27 cm. (Typewritten.) (January 1837 to May 1839, Gorham, Ontario County, N. Y. July 1839 to April 1874, Perry Township, Allen County, Ind.)

Gillette, Halbert P.

The cycles that cause the present drought. [1935.] [6 p.] diagrs. 29½ cm. (A paper read June 26, 1935, at the annual meeting of the American meteorological society at Los Angeles, Calif.)

Great Britain. Meteorological office.

Averages of bright sunshine for the British Isles for periods ending 1930. London. 1934. 41 p. tables. 24½ cm.

A handbook of weather, currents and ice, for seamen. London. 1935. 151 p. maps, tabs., diagrs. (horn card in pocket in back.) 23½ cm. (M. O. 379.)