A QUINTETTE OF COLD WAVES IN FLORIDA.

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[Weather Bureau office, Jacksonville, Fla., May 25, 1917.]

(Accompanied by Charts XLV–85 and XLV–86.)

Introductory.

Cold waves are closely associated with the development and movement of areas of high pressure (anticyclones) and areas of low pressure (cyclones). The movement of the cold wave in latitude is largely controlled by the movement of the cyclone immediately preceding. If the latter has moved over a track that extended far to the southward, the cold wave will usually pursue a similar path. In its mechanical development the cold wave is the antithesis of the low-area storm, the former having downward components, whereas the latter has ascending components.

The late Prof. Cleveland Abbe, writing of cold waves several decades ago, said[1] "The cold waves of the whole Northern Hemisphere, as studied on the daily weather charts, evidently have most to do with the great areas of low pressure on the Atlantic and Pacific Oceans, and the great areas of high pressure over Asia and America." And the later investigations of the origin and development of areas of high pressure (anticyclones) by Bigelow and others have amplified the subject to a gratifying extent. Prof. Garriott's atlas of cold-wave maps (Weather Bureau Bulletin **P**, 1906) is a very convenient guide to the accompanying weather conditions, which are there amply illustrated.

Florida has to do no less with frosts and cold waves than with the hurricanes of the Tropics. In fact, aside from loss of life on land incidental to tropical hurricanes, statistics during recent years show that the losses due damage to fruit and truck crops, the loss of stock from exposure, the discomfort and suffering of the poor, and the more or less widespread embargo on transportation as a result of heavy snowfall in northern districts, resulting from cold waves, bring them up to the rank of the hurricane in their capacity for destroying property and demoralizing human industry. It is established, however, that cold waves are of shallow depth; that a transverse barrier, say 8,000 or 10,000 feet high, extending from the South Atlantic to the Plains States, would materially affect their southward sweep. Were such an artificial barrier feasible the agricultural and horticultural interests of the South would be subjected, in great measure, only to such climatic vicissitudes as might arise from latitude together with the modifying effects of the Atlantic Ocean and the Gulf of Mexico.

Severe cold waves in Florida.

The effects of the cold wave of February 3 and 4, 1917, resulting in severe losses among citrus fruits and other vegetables in Florida and the adjacent territory, make an interesting comparison with similar conditions during previous cold-wave years.[2] The severest cold waves of authentic record in the South since the Federal weather warning service was established were those of January, 1886; December, 1894; and Februaries in 1895, 1899, and 1917, thus making 5 within a period of 31 years. There is also the known cold wave of February, 1835; and although the temperature on that occasion is alleged to have approximated 10°F. over extreme northern Florida, the absence of well-authenticated or of official reports compels one to some reserve in accepting the available data.

Frost occurs in the Florida Peninsula with slight pressure gradients, although the pressure at the crest of the HIGH to the north and west is usually 30.2 inches or higher. Severe cold waves generally are an accompaniment of areas of high pressure of great magnitude, preceded by areas of low pressure, which are frequently of great depth. The farther south the track of the area of low pressure is located, the more severe, as a rule, will be the cold wave in lower latitudes. The types of the HIGHS, their maximum central pressures, and the associated LOWS incident to the progress and development of the cold waves previously mentioned are indicated in the following paragraphs and Table 1.

January, 1886.—The maximum central pressure of this cold wave was 31.0 inches in Alberta on the morning of January 8. Its movement southward was preceded by the development of a LOW in southeastern Texas on the 7th, which moved northeastward over the Gulf States on subsequent dates.

December, 1894.—The maximum central pressure of this cold wave was 31.3 inches in Alberta on the evening of December 26. It was preceded by a LOW in eastern Texas concerning which the MONTHLY WEATHER REVIEW (December, 1894, **22**:489, No. *XIV*) remarked: "The great development of this storm on the 27th contributed somewhat to the southward flow of cold air which culminated in Florida on the 29th."

February, 1895.—The maximum central pressure of this cold wave was 31.4 inches in Alberta on the morning of February 6. This phenomenal HIGH was preceded by a LOW near the Texas coast, which moved northeastward over the Gulf States during the 5th and 6th.

February, 1899.—This cold wave had a maximum central pressure of 31.4 inches in Alberta on the morning of the 11th. It was preceded by a LOW which was first noticed when over New Mexico—probably one of the "South Pacific" type—and it moved northeastward near the coast line, crossing the Florida peninsula between Jacksonville and Tampa. The cold wave was attended by snow over northern and central Florida during the night of February 12.

February, 1917.—The maximum central pressure of this cold wave was but slightly lower than the three preceding ones. The highest barometer was 31.1 inches in Alberta on the morning of February 1. It was preceded by a LOW of the North Pacific type which moved to the Central Valleys during January 30–31, and thence to the North Atlantic. This was the only North Pacific LOW that was associated with any of the five Florida cold waves here under consideration.

The location of the area of highest pressure 24 hours before the cold wave reached Jacksonville, Fla., and the depth of the preceding LOW are so related as to be of interest in the study of the rapidly shifting areas. The marked rapidity of movement of the HIGH on February 2–3, 1917, was somewhat unusual, although the configuration of the isobars showed that it would move with great celerity.

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[1] *Cf.* also his remarks in his "Preparatory Studies," etc., pp. 154–155 (Ann. Rpt., C. S. O., 1889. App. 15).—C. A., jr.

[2] For lists and accounts of Florida freezes prior to September, 1895, see "Florida Freezes for a Century and a Half," by Geo. R. Fairbanks, in this REVIEW, September, 1895, 23:336–337; also a brief paragraph in the REVIEW, August 1898, 26:360.—EDITOR.

TABLE 1.—*Synoptic view of elements and effects of the five severe cold waves in Florida.*

Dates of occurrence of cold waves at Jacksonville, Fla.	Highest pressure and location 24 hours previous.	Lowest pressure at Jacksonville during passage of preceding LOW.	Range in pressure.	Lowest temperature at Jacksonville.	Effects of cold wave.
	Inches.	*Inches.*	*Inches.*	°*F.*	
Jan. 12, 1886.	Dakota, 30.8	29.5 on 8th	1.3	15	Vegetables killed; citrus fruits frozen in north and central portions. Many fish frozen in shallow waters.
Dec. 28, 1894.	Texas, 31.0	29.8 on 26th	1.2	14	Vegetables and pineapples killed; citrus fruits frozen in north and central portions. Trees defoliated.
Feb. 8, 1895.	Dakota, 31.1	29.6 on 7th	1.5	14	Citrus trees killed north and central and damaged some sections south portion.
Feb. 13, 1899.	Texas, 31.0	29.6 on 7th	1.4	10	Severest cold wave of record in Florida. Destroyed most of citrus trees except in extreme south. Heaviest snow fall of record, trace of snow occurring in south-central portion of State.
Feb. 3, 1917.	South Dakota, 30.9.	29.8 on 1st	1.1	16	Trees defoliated and fruit frozen on trees in north and central portions; some damage in south portion of State. All truck killed.

It is noted that, including the one of February, 1835, four of the six cold waves occurred during February when the thermal tendency is upward, and only one during January, the coldest month of the year. The cold wave of February, 1899, was the only one whose preceding LOW dipped to the Gulf of Mexico and thence across the Florida Peninsula. It was also characterized by Florida's record snowfall and low temperature for, possibly, 60 or 70 years.

Figures 1 to 4 (Charts XLV–85 and 86) are reproductions of the 8 a. m. and 8 p. m. weather maps for February 2–3, 1917. In a general way they are typical of the pressure distribution in the severe cold waves that reach lower latitudes. A study of antecedent conditions show that, although cold waves lose intensity as they push southward, yet the outflow of cold air from the phenomenal HIGHS is so pronounced as to reach even the lower portions of the Florida Peninsula. Figure 5 shows the lowest temperatures ever recorded in Florida.

Hitherto, the limiting southern position of the frost line in Florida has been a geographical enigma. Since January, 1886, which brought some of the severest abnormally cold weather since that of February, 1835, the southern limit of frost in Florida has been a feature of every cold wave, each increase in severity, pushing the known frost line farther equatorward. During 1916 the Chief of Bureau authorized the establishment of a cooperative meteorological station at Long Key, Monroe County, Fla., which is about equally distant (60 miles) from Homestead on the north and Key West on the south. On February 4, 1917, a temperature of

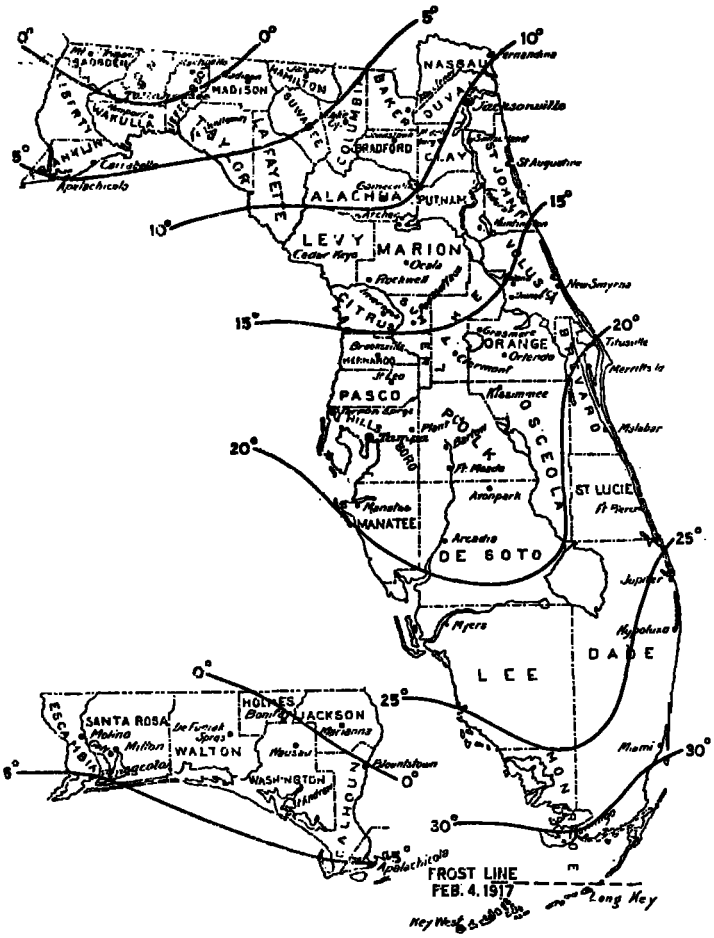
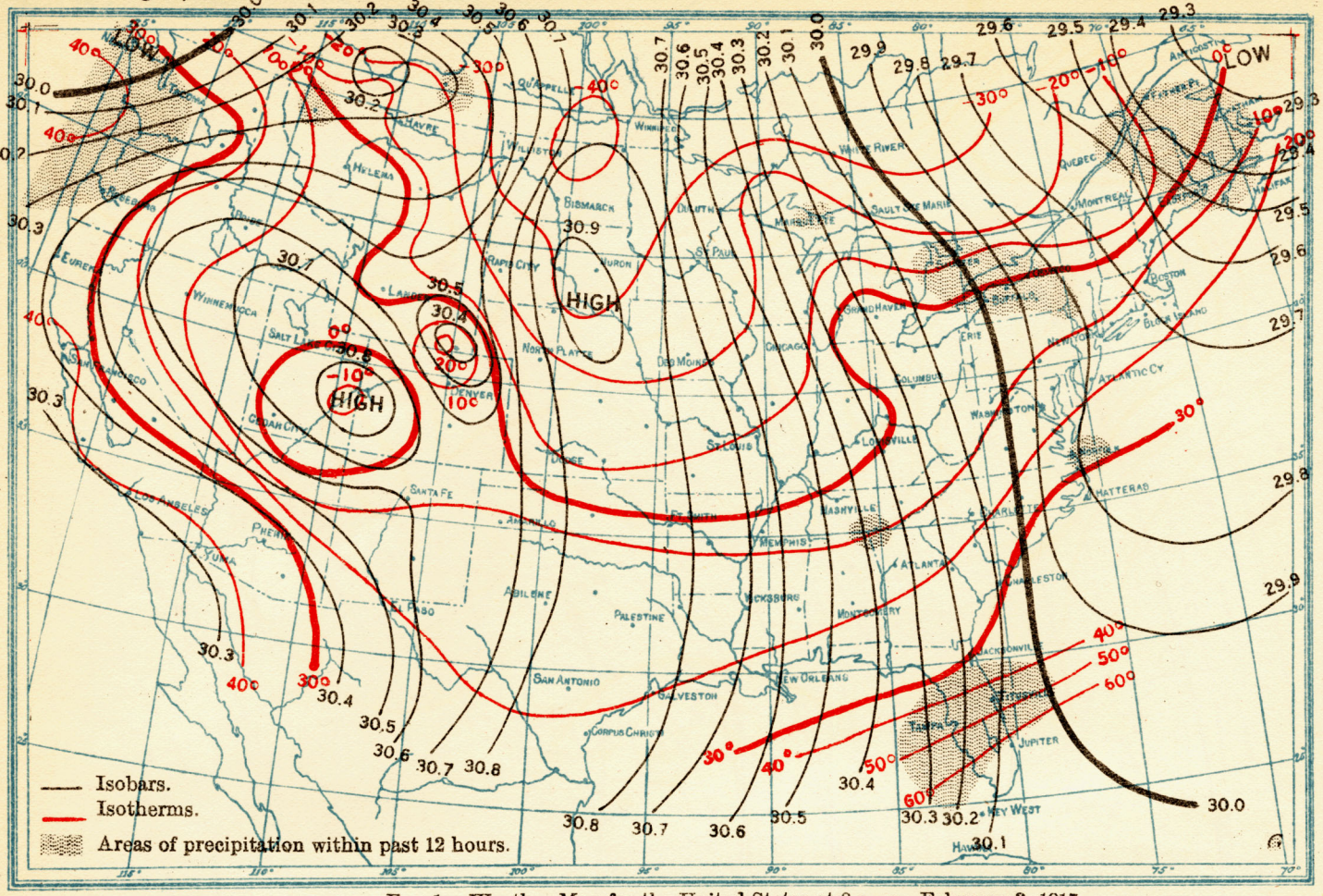
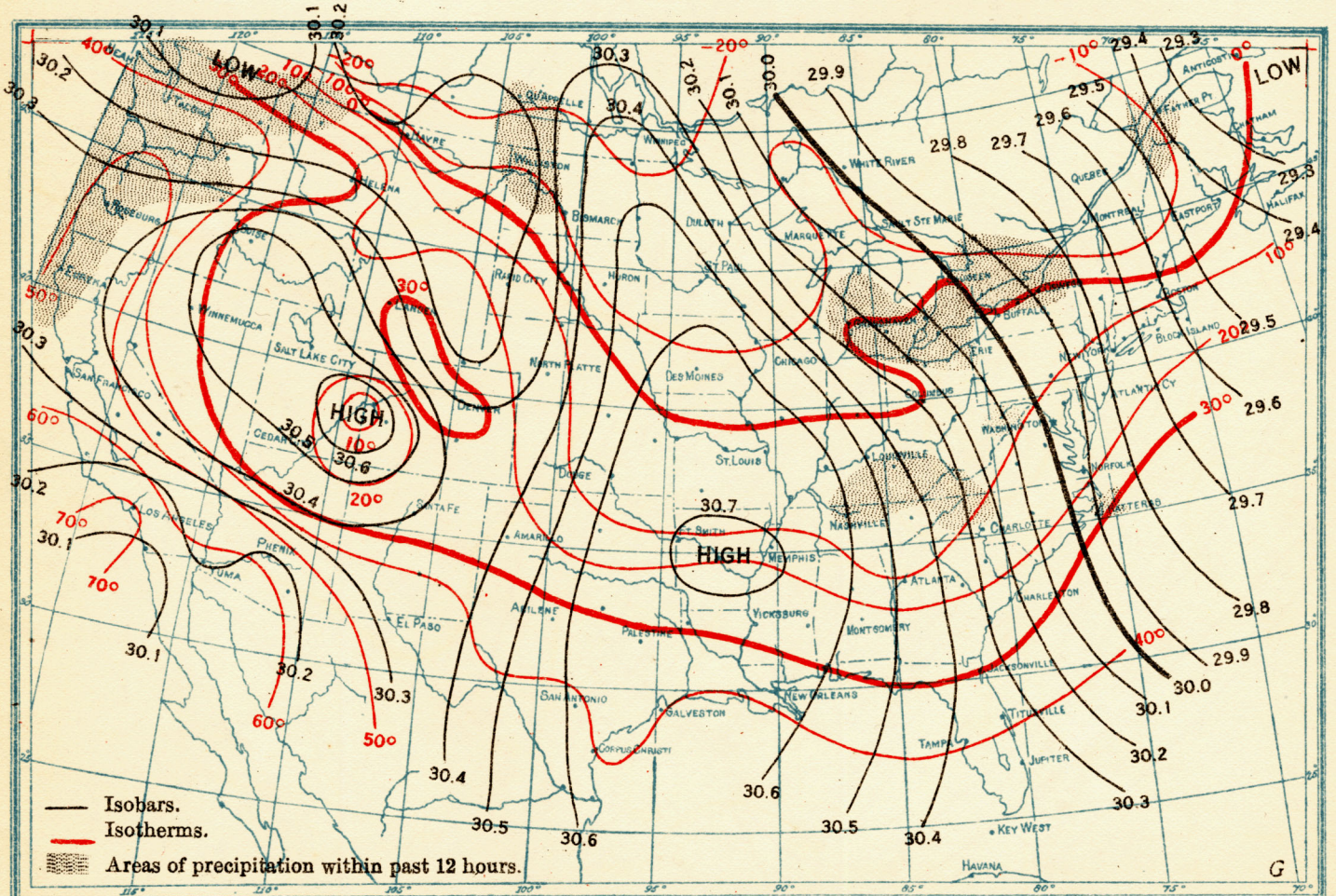


FIG. 5.—Extreme minimum temperatures in Florida, 1870–Feb. 28, 1917.

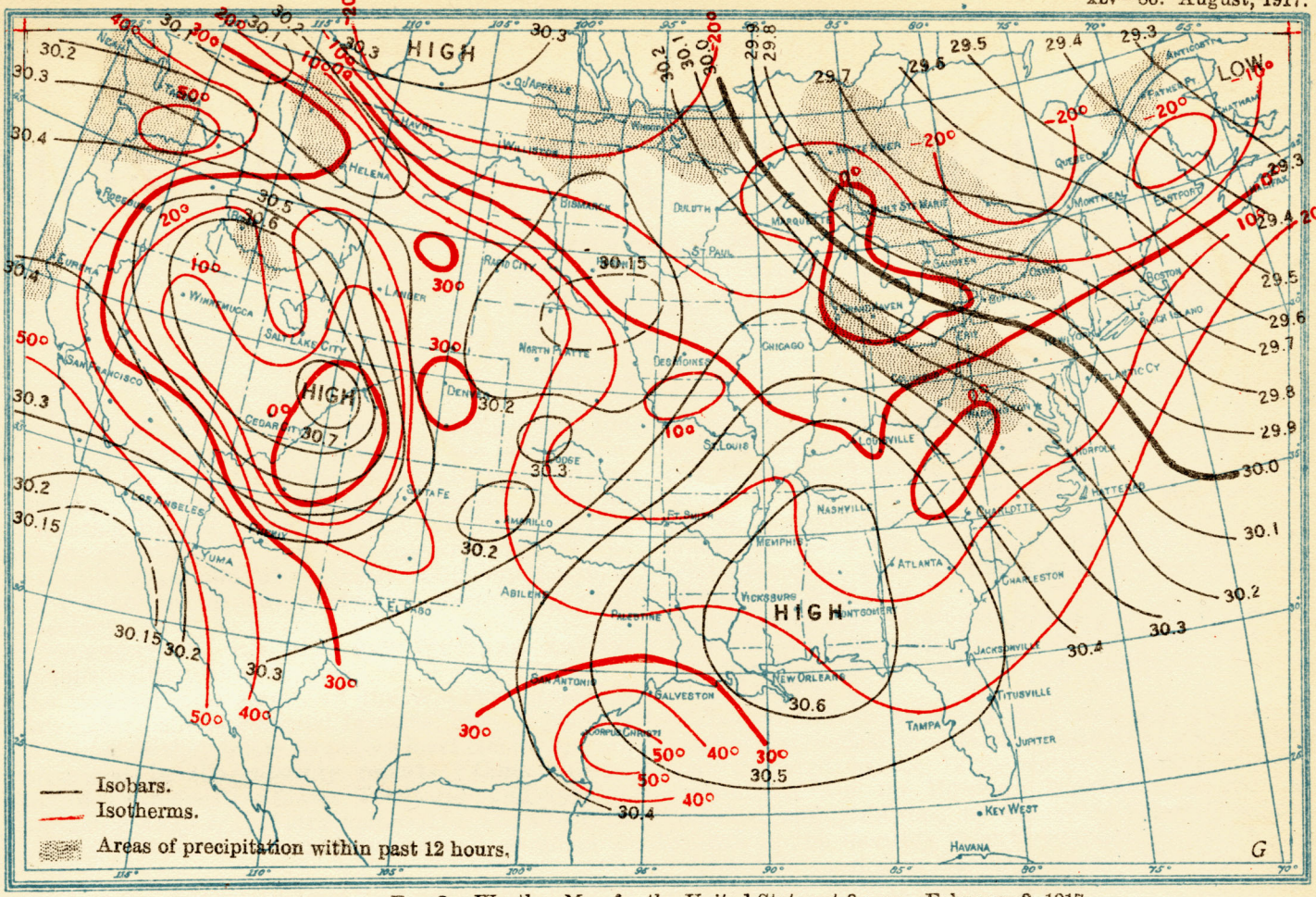
37°F. was recorded at Long Key. This temperature, of course, indicated frost deposit provided other factors were favorable, which was the case. In all probability, Long Key is the southern limit of frost formation on the islands adjacent to, or on the littoral of the United States.



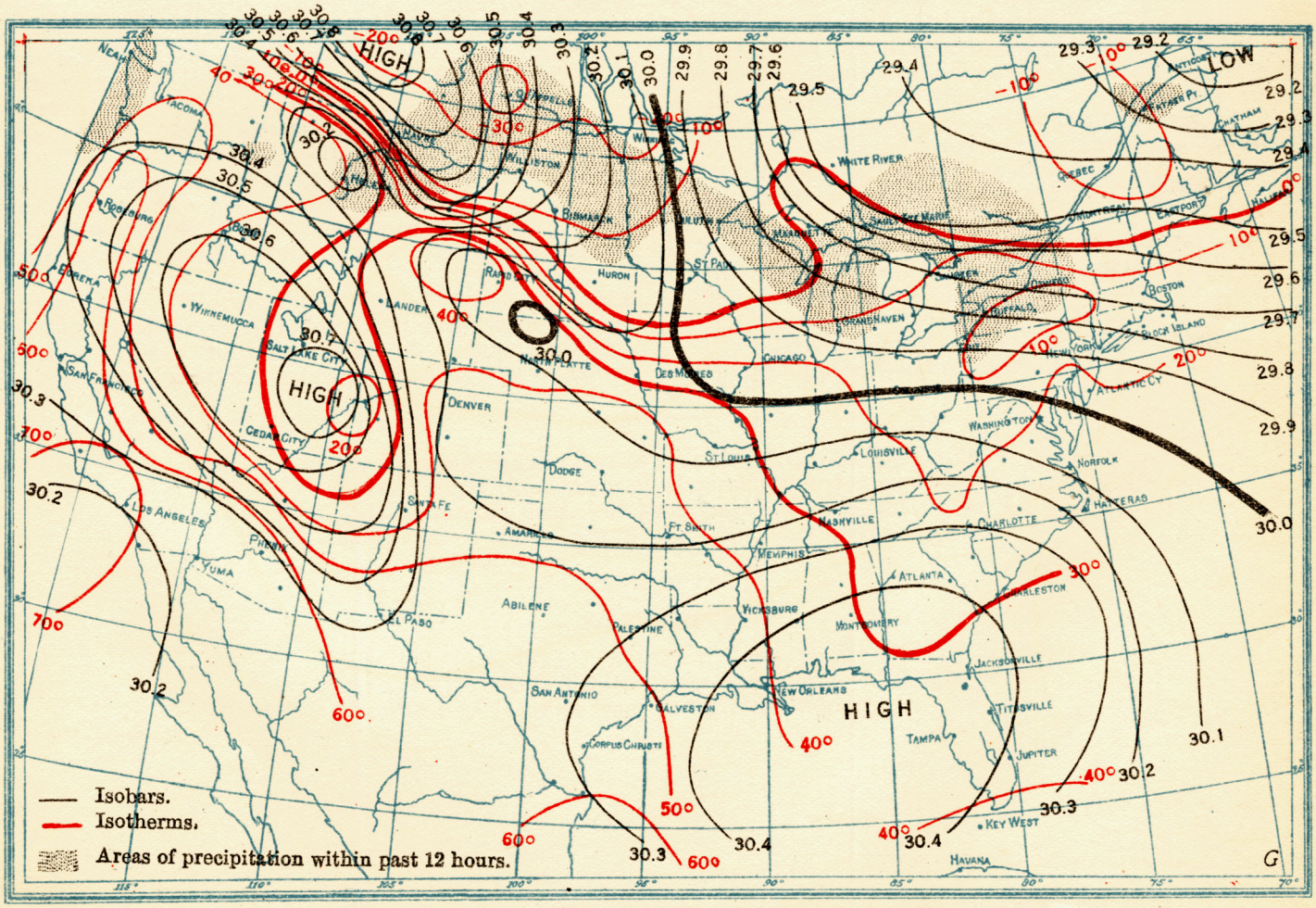
A. J. M. FIG. 1.—Weather Map for the United States at 8 a. m., February 2, 1917.



A. J. M. FIG. 2.—Weather Map for the United States at 8 p. m., February 2, 1917.



A. J. M. FIG. 3.—Weather Map for the United States at 8 a. m., February 3, 1917.



A. J. M. FIG. 4.—Weather Map for the United States at 8 p. m., February 3, 1917.