UNITED STATES SIGNAL SERVICE

# MONTHLY WEATHER REVIEW.

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## INTRODUCTION.

This REVIEW is based on reports for July, 1890, from 2,320 regular and voluntary observers. These reports are classified as follows: 168 reports from Signal Service stations; 126 reports from United States Army post surgeons; 5 reports of rainfall observations of the United States Geological Survey in Arizona, Colorado, and New Mexico; 1,463 monthly reports from state weather service and voluntary observers; 24 reports from Canadian stations; 171 reports through the Central Pacific Railway Company; 363 marine reports through the co-operation of the Hydrographic Office, Navy Department; marine reports through the "New York Herald Weather Service;" monthly weather reports from the local weather services of Alabama, Arkansas, Colorado, Illinois, Indiana, Iowa Weather and Crop Service, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Meteorological Report of the Missouri State Board of Agriculture, Nebraska, Nevada, New England, New Jersey, New York, North and South Dakota, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, and Texas, and international simultaneous observations. Trustworthy newspaper extracts and special reports have also been used.

## CHARACTERISTICS OF THE WEATHER FOR JULY, 1890.

The month was warmer than the average July over the interior of the country, on the south Pacific coast, and in the Canadian Maritime Provinces; elsewhere it was cooler than usual. The greatest departures above the average temperature were noted in Kansas and Nebraska, on the northeast slope of the Rocky Mountains, and in the lower valley of the Red River of the North, where they exceeded 3°; and the most marked departures below the average temperature were reported along the middle and south Atlantic coasts, and in northwest Oregon, where they exceeded 2°. At stations in the Missouri Valley and on the eastern slope of the Rocky Mountains the month was the warmest, and at stations along the Atlantic coast south of Massachusetts, and on the west Gulf and north Pacific coasts it was the coolest July on record. The highest temperature reported by a regular station of the Signal Service was 115°, at Yuma, Ariz., and by a voluntary observer, 126°, at Volcano Springs, Cal. The lowest temperature reported by a regular station of the Signal Service was 36°, at Tatoosh Island, Wash., and by a voluntary observer, 26°, at Breckenridge, Colo. (9,670 feet). At Albany, N. Y., and at stations in the lower Mississippi valley, the lower lake region, the extreme northwest, the Missouri and upper Mississippi valleys, and the northern plateau region, the maximum temperature was as high or higher, and at New Haven, Conn., at stations in the middle and south Atlantic states, northern Florida, the lower Mississippi valley, western Arkansas, the Ohio Valley, and the lower lake region the minimum temperature was as low or lower than previously reported for July. On the 7th a warm wave was central in the middle Mississippi valley, with temperature rising to 102° in Iowa, 94° to 96° in Illinois, the Ohio Valley, and Tennessee, and to 96° in the lower Mississippi valley. On the 8th the warm wave had extended eastward, and maximum temperature, 98°, occurred at Washington City, and Albany, N. Y., 96° at New York City, and Philadelphia, Pa., and 92° at Boston, Mass. The 13th was an unusually hot day, except in the northeast part of the country, and at a number of stations in the central valleys the temperature rose above 100°. On the 16th a warm wave extended over the middle Missouri valley, where the temperature rose to 100°. In the middle Atlantic states from Washington City northward to Albany and Rochester, N. Y., and in portions of New England the mornings of the 20th and 21st were the coolest on record for July. Heavy frost was reported on one date only, the 21st, at Youngstown, Ohio, near which place considerable damage was caused to corn and potatoes.

The precipitation was in excess of the average for July in the south Atlantic and east Gulf states, in the lower Rio Grande valley, the east part of the southern plateau region, in southeast Wyoming, northern Nebraska, and south South Dakota, on the north Pacific coast, and at Canadian stations from Manitoba to Quebec; elsewhere it was deficient. The greatest excess occurred in the south Atlantic and east Gulf states, where it was more than 5.00 inches at Charleston, S. C., and more than 7.00 at Pensacola, Fla., and the greatest deficiency occurred within an area extending from the Ohio Valley over Kansas, in the upper part of the Mississippi Valley, and in northeast South Dakota, where it exceeded 3.00 inches. In the lower Rio Grande valley the monthly rainfall was about ½ greater, and in the south Atlantic and east Gulf states it was about ⅓ greater than the average amount for July, while on the middle-eastern slope of the Rocky Mountains about ¼, in the upper Mississippi valley about ⅓, and in the northern and middle plateau region, the lower lake region, the Ohio Valley and Tennessee, the northeast slope of the Rocky Mountains, and in the west Gulf states about ½ the usual amount of rain fell. At stations in the south Atlantic and east Gulf states the rainfall was the heaviest, and at stations in the Ohio Valley and Tennessee, the upper Mississippi and upper Missouri valleys, Kansas, and Nebraska it was the least ever reported for July. Trace of snow was reported at Mount Washington, N. H., on the 19th, and at Calais, Me., on the 20th.

Tornadoes destructive to life and property occurred in Ramsey and Wabasha counties, Minn., on the 13th; at Wesley, Ill., on the 17th; at Marshall, Minn., on the 22d, and at Lawrence, Mass., on the 26th. Tornadoes without an attendant loss of life occurred at Marshall, Ill., on the 17th; near Fort Bennett, S. Dak., on the 21st; and near Galesburg, N. Dak.,

and at Pleasanton, Nebr., on the 22d. Destructive thunderstorms occurred in Ohio on the 1st; in New Jersey on the 2d; in Minnesota, North Dakota, and Wisconsin on the 7th; in New York, Vermont, New Hampshire, Maine, Pennsylvania, Ohio, Indiana, Michigan, and Ontario on the 8th; in Tennessee on the 9th; in New Jersey the night of the 12–13th; in Minnesota, Indiana, and Maine on the 16th; in New Jersey, Pennsylvania, Maryland, and Illinois on the 17th; in North Carolina, Illinois, Missouri, and Iowa on the 18th; in Nebraska and Iowa on the 19th; in South Dakota and Iowa on the 20th; in Wyoming on the 21st; in Michigan on the 23d and 24th; in southeast Arizona on the 30th; and in New England, 31st.

Damaging drought prevailed generally in Kansas, Nebraska, and Iowa, and in parts of South Dakota, Minnesota, Arkansas, Texas, Tennessee, Kentucky, Illinois, Indiana, Ohio, Michigan, New York, Massachusetts, Maryland, Virginia, North Carolina, South Carolina, and Alabama.

Navigation was suspended on account of low water on the upper Ohio River, and on the Cumberland River at Nashville; and the Arkansas River at Fort Smith, Ark., was lower than at any time since April, 1887.

Noteworthy auroral displays were observed at Sandusky, Ohio, the night of the 15–16th; at Huron and Rapid City, S. Dak., and Fort Buford, N. Dak., the night of the 16–17th; at Saint Vincent, Minn., the night of the 17–18th; and at Green Bay, Wis., the early morning of the 18th.

## ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean atmospheric pressure for July, 1890, as determined from observations taken daily at 8 a. m. and 8. p. m. (75th meridian time), is shown on chart ii by isobars. The departure of the mean pressure for July, 1890, obtained from observations taken twice daily at the hours named, from that determined from hourly observations, varied at the stations named below, as follows:

| Station. | Departure. | Station. | Departure. |
|---|---|---|---|
| Eastport, Me | +.006 | Duluth, Minn | —.000 |
| Boston, Mass | +.009 | Chicago, Ill | —.000 |
| New York City | +.011 | Cincinnati, Ohio | —.003 |
| Philadelphia, Pa | +.005 | Saint Louis, Mo | —.006 |
| Washington City | +.002 | Galveston, Tex | —.005 |
| Savannah, Ga | +.005 | Santa Fé, N. Mex | —.008 |
| Buffalo, N. Y | +.003 | Denver, Colo | —.005 |
| Detroit, Mich | +.002 | Salt Lake City, Utah | —.008 |
| New Orleans, La | +.004 | San Francisco, Cal | —.015 |
| Saint Paul, Minn | +.001 | San Diego, Cal | —.015 |

The mean pressure was highest over the Atlantic coast states south of the 40th parallel, and along the Pacific coast north of the 40th parallel, where it was above 30.05, and the mean pressure was lowest from southern Nevada southward over southeast California and west Arizona, where it was below 29.80. In the British Possessions north of west Montana the mean pressure was below 29.85, and on the northeast slope of the Rocky Mountains, over the southeast part of the southern plateau region, and in the lower Saint Lawrence valley the mean readings were below 29.90.

A comparison of the pressure chart for July with that of the preceding month shows that there was an increase in pressure over the greater part of the interior of the country, and that there was a decrease in pressure at extreme northern lake stations and thence eastward over the lower Saint Lawrence valley, over the Gulf States and Tennessee, and along the Pacific coast south of the 45th parallel, and thence eastward over the northern plateau region and the western parts of the middle and southern plateau regions. The greatest increase in pressure occurred at Atlantic coast stations north of the 39th parallel, where it was more than .05, and the most marked decrease in pressure was noted over the northern plateau region, and at stations in the Sacramento and San Joaquin valleys, California, where it was .05.

The mean pressure was above the normal from the upper Mississippi and Red River of the North valleys eastward, in the south Atlantic states, the northern part of the west Gulf states and thence westward over the eastern part of the plateau region, and on the Pacific coast north of the 35th parallel, and thence eastward over the northern and the northwest parts of the middle plateau region. The mean pressure was below the normal from Montana and the Dakotas southeast over the Missouri Valley and Kansas, on the south Pacific coast and thence eastward over southern Nevada and Arizona, and from Alabama westward over the lower Mississippi valley and the west Gulf states to the lower Rio Grande valley. The greatest departures above the normal pressure occurred along the Atlantic coast north of the 35th parallel, in the Saint Lawrence Valley, and at the more northern lower lake stations, where they exceeded .05. In districts where the mean pressure was below the normal the departures were less than .05.

### BAROMETRIC RANGES.

The monthly barometric ranges at the several Signal Service stations are shown in the table of miscellaneous meteorological data. The general rule, to which the monthly barometric ranges over the United States are found to conform, is that they increase with the latitude and decrease slightly, though somewhat irregularly, with increasing longitude. In July, 1890, the monthly ranges were greatest in the lower valley of the Red River of the North and in extreme eastern Maine, where they exceeded .70, whence they decreased southward to less than .30 over extreme southern Florida and in the lower Rio Grande valley, southwestward to less than .30 over the east part of the southern plateau region and on the south Pacific coast, and westward to less than .30 on the coast of northern California, and to less than .40 in Washington and Oregon. Along the Atlantic coast the monthly ranges varied from .24 at Key West, Fla., to .79 at Eastport, Me.; between the 82d and 92d meridians, .36 at New Orleans, La., to .66 at Marquette and Alpena, Mich.; between the Mississippi River and the Rocky Mountains, .28 at Abilene, Tex., to .80 at Saint Vincent, Minn.; in the Rocky Mountain and plateau regions, .21 at Fort Grant, Ariz., to .58 at Fort Custer, Mont.; on the Pacific coast, .24 at Eureka, Cal., to .45 at Fort Canby, Wash. Chart ii shows that in July, 1890, there was a range in mean pressure of .31 from the south Atlantic coast to the southern plateau region; a range of .16 from the southern plateau region to the south Pacific coast; a range of .20 from the south Atlantic coast to the lower Saint Lawrence valley; and a range of .29 from the British Possessions north of Montana to the Pacific coast north of the 40th parallel.

### HIGH PRESSURE AREAS.

Within the limits of the United States the paths of 5 high pressure areas were charted during the month of July. It is rather remarkable that these had nearly a steady motion from the west to the east and this was much more uniform than is ordinarily the case. The permanent high area of the Pacific coast had an important bearing upon the origin of at least 3 of these areas. The eastern portion of this high area rested upon the California coast throughout the month, and, as will be noted later on, there was a transference of offshoots from this to the plateau region and thence across the country. The table at the end of this description contains in concise form many of the characteristics of these high areas, and the following details are added:

I.—This had its origin to the north of the region of observation before the beginning of the month. Its general course was southeast, just to the south of Lake Michigan, until it