at 4.55 p. m., when a maximum velocity of 50 miles per hour was recorded. No damage resulted from the storm in this vicinity.

Portland, Maine.—A violent gale occurred on the 9th (low area iv.). A wind-velocity of 56 miles se. was recorded at 8.30 a. m., and for five minutes the wind blew at the rate of 60 miles per hour. The schooner "Etna" was foundered off Portland Head Light, and three fishing schooners were driven ashore on Cape Elizabeth.

Eastport, Maine.—A gale occurred on the 9th lasting from 9.25 a. m. until 4.15 p. m. (low area iv.), during which a maximum wind-velocity of forty-six miles se. occurred.

Troy, New York.—A violent storm swept over Rensselaer county between 1 and 4 a. m. of the 9th (low area iv.) Its track was about four miles in width. In the town of Poestenkill every house was damaged; chimneys were blown down and barns moved from their foundations.

SAND STORMS.

Arizona.—Maricopa, 10th, 11th; San Carlos and Willcox, 11th; Fort McDowell, 20th; Yuma, 23d.

NAVIGATION.

STAGE OF WATER IN RIVERS.

The highest stage in the Ohio river was noted at Cincinnati, Ohio, and Louisville, Kentucky, on the 1st, and at Pittsburg, Pennsylvania, on the 2d.

The Missouri river continued frozen at Leavenworth, Kansas, and at all points northward, throughout the month.

The Mississippi remained frozen during the month at Keokuk, Iowa, and points above.

The Arkansas river was frozen at Fort Smith, Arkansas, on the 7th, 8th, 9th, and 12th; and at Little Rock, Arkansas, from the 7th to 13th.

In the following table are shown the danger-points at the various river stations; the highest and lowest stages for January, 1884, with the dates of occurrence; and the monthly ranges:

Heights of rivers above low-water mark, January, 1884.

Stations.	Danger-point on gauge.		Highest water.			Lowest water.			Monthly range.	
			Date.	Height.		Date.	Height.			
	Ft.	In.		Ft.	In.		Ft.	In.	Ft.	In.
Red River:										
Shreveport, Louisiana	29	9	1	13	5	31	10	2	3	3
Arkansas:										
Little Rock, Arkansas‡	33	0	1	5	10	29, 30	3	10	2	0
Fort Smith, Arkansas‡			6	—1	7⅞	26	—3	6⅞	1	11
Missouri:										
Yankton, Dakota †	20	0								
Omaha, Nebraska †	16	0								
Leavenworth, Kansas†	21	0								
Mississippi:										
Saint Paul, Minnesota †	14	6								
La Crosse, Wisconsin †	18	0								
Dubuque, Iowa †	21	10								
Davenport, Iowa†	15	0								
Keokuk, Iowa †	14	6								
Saint Louis, Missouri	30	0	18	12	4	4	3	4	9	0
Cairo, Illinois	40	0	3	35	3	16	23	2	12	1
Memphis, Tennessee	34	0	5	20	9	18	17	7	9	2
Vicksburg, Mississippi	41	0	11, 12	36	2	1	23	11	12	3
New Orleans, Louisiana *	—2	6	20	—3	9	1	—10	6	6	9
Ohio:										
Pittsburg, Pennsylvania	20	0	2	17	2	24, 26, 28, 29	3	2	14	0
Cincinnati, Ohio	50	0	1	38	11	13	15	5	23	6
Louisville, Kentucky	24	0	1	19	10	13	7	0	12	10
Cumberland:										
Nashville, Tennessee	42	0	17	31	11	10	9	4	22	7
Tennessee:										
Chattanooga, Tennessee	33	0	21	14	10	10	3	5	11	5
Knoxville, Tennessee			20	6	4	8	1	7	4	9
Monongahela:										
Pittsburg, Pennsylvania	29	0	2	17	2	24, 26, 28, 29	3	2	14	0
Savannah:										
Augusta, Georgia			20	22	8	10	5	0	17	8
Willamette:										
Portland, Oregon			10	8	10	24	0	8	8	2
Sacramento:										
Red Bluff, California			6	6	0	3, 4, 5	0	10	5	2
Sacramento, California			31	13	6	5, 23, 24, 25	7	10	5	8
Mobile:										
Mobile, Alabama			18	15	8	3	12	0	3	8
Colorado:										
Yuma, Arizona			2, 3	16	8	17, 18	14	4	2	4

* Below high-water mark of 1874 and 1883. † Frozen throughout the month. ‡ Frozen part of month; see text. ⅞ below bench-mark.

ICE IN RIVERS AND HARBORS.

Saint Croix river.—Calais, Maine: the river closed to navigation during the night of the 15–16th.

Narragansett bay.—Narragansett Pier, Rhode Island: large fields of ice passed out of the bay on the 20th. At 4 a. m. an ice-field, fully three miles in length, passed this station; ice continued to pass until the afternoon of the 21st.

Block Island, Rhode Island: the harbor froze on the 6th.

Broad lake.—Burlington, Vermont: the lake froze over on the 9th, which is the earliest closing of the last ten years.

Lake Champlain.—Charlotte, Vermont: the lake began to freeze on the 8th; on the 10th, it was firmly frozen.

New Haven harbor.—New Haven, Connecticut: the harbor froze on the 6th, but the ice was broken up by the storm of the 9th; some of the vessels sustained damage in consequence.

Housatonic river.—Bethel, Fairfield county, Connecticut: the ice broke up in the river on the morning of the 9th.

New York harbor.—New York City: the flood tide on the morning of the 13th brought up from the harbor an immense floe of ice which blockaded East river from shore to shore. At 6.30 a. m. the end of pier 27 was carried away and a two-masted schooner and a lighter on the north side of the pier were sunk. The damage to the pier is estimated at $3,000. Navigation was interrupted for several hours during the morning. On the 22d navigation was interrupted by ice-fields in the upper harbor. All sailing vessels passing through the narrows on that date were compelled to employ tugs.

David's Island: persons crossed on the ice to the mainland on the 27th.

Barnegat bay.—Barnegat City, New Jersey: the bay closed by ice on the 7th, cutting off communication with the mainland. It remained frozen until broken up by the storm of the 9th. It froze over again on the evening of the 20th.

Little Egg harbor.—Little Egg harbor, New Jersey: large quantities of ice in the harbor on the 9th.

Hudson river.—New York City: considerable floating ice on the 12th.

Delaware river.—Philadelphia, Pennsylvania: from Trenton, New Jersey, to Port Richmond, the ice was sufficiently strong to permit the crossing of teams on the 8th. The river below Philadelphia was frozen nearly across for the first time in several years.

Delaware bay.—Delaware Breakwater, Delaware: the harbor was filled with ice on the 7th.

Chincoteague bay.—Chincoteague, Virginia: the bay froze over on the 6th, but the ice broke up on the afternoon of the 8th. Ice formed rapidly on the bay on the 21st.

Chesapeake bay.—Baltimore, Maryland: brisk southeast to northeast winds on the 8th drove large quantities of ice from the bay into the river and harbor, causing much inconvenience to vessels. Large quantities of ice were driven into the track of vessels on the west shore. The large amount of ice in the bay on the 9th rendered navigation very difficult. Many oyster boats were ice-bound and much suffering was experienced by their crews.

Severn river.—Annapolis, Maryland: the northeast wind on the night of the 8–9th cleared Annapolis harbor of ice and opened navigation.

Patapsco river.—Baltimore, Maryland: ice formed rapidly in the harbor on the 6th, and on the 7th it varied from two to three inches in thickness. Large quantities of ice were driven into the harbor and river by the strong easterly winds on the 28th, rendering navigation difficult.

Potomac river.—Washington City, District of Columbia: river frozen over on the 1st; ice strong enough for skating from about the 7th to 27th; the ice was softened considerably by the increasing temperature on the 30th. The ferry steamer "City of Alexandria" made her way through the ice to Alexandria, Virginia, on this date. On the 31st the channel was clear as far as Georgetown, District of Columbia; above this point the ice remained unbroken on the 31st.

Choptank river.—Oxford, Maryland: a breaking of the ice

occurred during the night of the 8–9th. No serious damage resulted, although a number of vessels were carried several miles from harbor by the ice.

Susquehannah river.—Port Deposit, Maryland: on the 9th the ice in the river was seven inches thick. At the close of the month the ice in the Susquehannah was sixteen inches thick at Wilkesbarre and Catawissa, Pennsylvania.

Oswego river.—Oswego, New York: the river was clear of ice from the upper bridge to the harbor on the 18th; the harbor froze over on the 25th.

Detroit river.—Detroit Michigan: the river was frozen from shore to shore, on the 1st; nearly all the ice went out of the river on the 30th; on the 31st the river was full of floating ice.

Monongahela river.—Pittsburg, Pennsylvania: during the night of the 10–11th an ice-dam, which had formed in the river, broke at 1.30 a. m.; forty-one flats broke from their fastenings and were carried down the river. The river was full of floating ice on the 31st.

Ohio river.—Portsmouth, Ohio: on the 6th the river was filled with floating ice causing suspension of navigation; navigation was resumed on the 30th.

Cincinnati, Ohio: heavy floating ice caused suspension of navigation on the 7th, 8th, and 9th; navigation between the city and points southward was resumed on the 12th; floating ice on the 13th.

Vevay, Indiana: river full of floating ice on the 28th and 31st. For several days preceding the 26th boats were unable to make trips between Evansville, Indiana, and Henderson, Kentucky.

Cairo, Illinois: ice began to form along the shores of the Ohio river on the 14th, and light floating ice was observed on the 5th. A heavy flow of ice continued from the 6th to 18th, 22d, 23d, 25th, 26th and 27th: light ice from the 27th to 31st; the river was clear of ice on the 19th, 20th and 24th. Navigation between Cairo and Paducah, Kentucky, was open during entire month.

Elk river.—Charlestown, West Virginia: the ice in the river broke up on the 12th, resulting in heavy losses to barge owners and lumber men. The losses sustained by the stave and bark dealers alone are estimated at $100,000.

Tuscarawas river.—Canal Dover, Ohio: river full of floating ice on the 3d; on the 4th river froze over.

Otsego lake.—Cooperstown, Otsego county, New York: ice in lake was eighteen inches thick at close of month.

Lake Erie.—Buffalo, New York: on the 3d floating ice covered the lake for several miles. Traffic on the New York Central railroad was interrupted on account of the tracks being covered with large quantities of ice, washed ashore by the storm of that date.

Saint Clair river.—Port Huron, Michigan: ice formed in the river on the 5th. The steamer "A. D. Conger" was the last boat to arrive at this port. Floating ice on the 6th; river free of ice on the 9th. At 2.30 a. m. of the 15th the ice bridge across the head of the river broke, filling the river with heavy ice and stopping the ferry boats. Subsequently a similar ice bridge formed, which was broken by the high winds of the 19th, with the same results.

Grand river.—Grand Haven, Michigan: the river froze over on the 3d.

Lake Michigan.—Grand Haven, Michigan: the westerly winds of the 23d drove large quantities of ice into the entrance to the harbor, where it was reported to be from twenty to twenty-five feet in thickness. On that date heavy ice-fields, extending lakeward as far as the eye could reach, were observed floating southward. The propellers "Wisconsin" and "Michigan" succeeded in reaching here at noon. Heavy ice-fields continued floating lakeward on the 24th. On the 27th the propellers "Wisconsin" and "Michigan" effected an entrance into the harbor, after having drifted from twenty to twenty-five miles northward with the ice-fields. On that date the ice extended outward a distance of fifteen miles. On the 28th the harbor was comparatively free of ice, but it was again obstructed on the 31st, on which date the ice extended lakeward a distance of twenty miles.

Milwaukee, Wisconsin, 13th: the steamers plying between here and points on the opposite shore were unable to make trips during the past week on account of rough weather and fields of heavy ice. On the 31st steamers reported ice-fields on the lake varying from five to ten miles in width.

South Haven, Michigan: on the 19th a field of ice extended lakeward a distance of ten miles.

Northport, Michigan: lake free of ice on the 31st.

Grand Traverse bay.—Traverse city, Michigan: bay frozen over on the 15th.

Straits of Mackinac.—Mackinaw City, Michigan: the steamer "Algomah," in attempting to cross the straits on the 3d, became fast in the ice when near the middle of the straits, where the ice was from one to three feet thick; she reached Saint Ignace on the 14th, and in attempting to return on the 15th became fast in the ice in the centre of the straits. She arrived here on the 18th, and reported the ice to be from fifteen to twenty feet thick in the channel.

Mississippi river.—Keokuk. Iowa: the river continued frozen here, and at all points northward, throughout the month. At La Crosse, Wisconsin, the ice was reported to have been twenty-four inches thick on the 9th.

Cairo, Illinois: floating ice ran in the Mississippi on the 1st, 2d, and 3d; the river froze over on the 4th and remained frozen after that date.

Memphis, Tennessee: drift ice in river on 3d, 4th, 7th to 13th, 15th, 17th, 18th, 19th. Ice formed along the shores on the west bank of the river on the 6th.

Saint Louis: the river was clear of ice on the 1st; from 2d to 7th it was full of floating ice; from 8th to 18th ice-dams obstructed parts of the harbor; from 19th to 29th the entire harbor was obstructed; on the 30th and 31st ice-dam broke up, resulting in but little damage.

Vicksburg, Mississippi: the steamer "W. P. Thompson" encountered large quantities of drift ice at Illawara, about thirty-four miles north of this place, on the morning of the 5th, and was compelled to return to this city. Large quantities of floating ice passed here during the 12th and 13th.

Missouri river.—Leavenworth, Kansas: on the 5th loaded wagons crossed the river on the ice, which was ten inches thick. The ice became unsafe for crossing teams on the 29th. On the 31st the ice was still intact.

Lexington, Missouri: the ice in the river was eight inches thick on the 3d.

Kansas river.—Manhattan, Kansas: ice in the river was ten and one-half inches thick on the 7th.

James river.—Richmond, Virginia: navigation was interrupted to some extent by ice on the 8th.

Cumberland river.—Nashville, Tennessee: floating ice on the 9th and 10th.

Tennessee river.—Chattanooga, Tennessee: floating ice on the 8th and 9th. On the latter date the heavy floating ice impeded navigation, and the broken ice accumulated along the shore in large quantities.

Knoxville, Tennessee: the river froze over one mile above the city on the 7th; floating ice on the 8th.

Tallapoosa river.—Montgomery, Alabama, 30th; it is reported that during the late cold weather more ice formed in the Tallapoosa river than has been known for many years.

The director of the "Tennessee Weather Service," in his January report, states:

> The Forked Deer river was reported frozen over at Dyersburg on the 5th; ice remained until the 24th. The Elk river was frozen over near Fayetteville on the 7th, sufficient for skating. The Ocoee river froze over on the 7th and 8th.

Red river.—Shreveport, Louisiana: floating ice on the 8th.

Rio Grande river.—El Paso, Texas: the river froze over on the 1st.

Arkansas river.—Fort Smith, Arkansas: floating ice on 1st,

2d, 3d, 11th, 13th, 20th, 21st, 24th, 25th. On the 11th an ice-dam which had formed on the river broke, and resulted in the sinking of the steamer "Fort Smith," and caused other damage.

Little Rock, Arkansas: floating ice on 3d and 5th; ice-dam on 6th. The river was frozen from the 7th to 13th.

Miscellaneous.—Lynchburg, Virginia: ice on the streams in this vicinity was four inches thick on the 9th.

Brevard, Transylvania county, North Carolina: the creeks in this vicinity were frozen on the 6th.

FLOODS.

Ellicott City, Howard county, Maryland.—The heavy rain on the night of the 8-9th (during the passage of low area iv.), caused the streams throughout this county to rise to an unusual height for this season of the year. At Oakland Mills the water covered the roadway to a depth of four feet, rendering travel almost impossible and causing delay of mails. The bridge over the Middle Patuxent river is reported to have been carried away.

Red Bank, Monmouth county, New Jersey.—The freshet on the night of the 8-9th caused much damage to the bridges over the Shrewsbury river at this place. A stone pier of an iron bridge was swept away. Bridges were also carried away at Newman Springs, Swimming River, and Hart's Mills.

Fredericksburg, Virginia, 9th.—A destructive freshet has occurred in the Rappahannock river. Several thousand railroad ties, and much other property, was swept away from the wharves.

HIGH TIDES.

Narragansett Pier, Rhode Island.—The severe southeasterly storm of the 9th (low area iv.) caused very high tides, which resulted in serious damage along the sea front. From twenty to thirty large bathing houses were damaged to a more or less extent, and the McSparran hotel grounds and dock were almost completely washed away. The engine-house on Lucker's dock was also washed away and the wharf badly damaged. The sea broke over the banks in places from the mouth of Narragansett bay to Point Judith, causing great damage to roadways and fencing.

Point Judith, Rhode Island.—The heaviest surf and highest tide known here for several years occurred on the 9th (during low area iv.), causing much damage to fences, walls, and small boats.

New London, Connecticut.—The high tides of the 9th (during low area iv.) submerged the Shore Line railroad track, and caused numerous washouts. This road was built in 1853, and was never before submerged by high tides. Several wharves in this vicinity were carried away and completely wrecked. Great damage was done at Osprey Beach, a summer resort about one mile south of station. All of the cellars in the lower part of New London were flooded. The damage in this vicinity resulting from the storm and high tides is estimated at $150,000.

Block Island, Rhode Island.—The heaviest sea known for many years accompanied the storm of the 9th (low area iv.). Slight damage was caused by the sea washing over the seawall. Vessels in the harbor dragged anchor, and the United States Coast Survey tide-gauge was completely ruined. The tide ran into Great Pond, which is one hundred and fifty yards from the mean high-tide limit.

New Haven, Connecticut.—The high tides of the 2d flooded the cellars along the wharves in this city. The high easterly winds of the 9th (low area iv.) caused the highest tide that has been observed for many years. The Shore Line railroad at West Haven was two feet under water, and the flooring of the bridge over Oyster river was covered. The Long-wharf road bed was badly washed.

Portland, Maine.—On the 9th the high tides broke completely over the breakwater. Many vessels in the harbor were damaged.

Eastport, Maine.—The heavy sea and high tides of the 10th caused slight damage to small craft in the harbor. Very high tides also occurred on the 12th, 13th, and 14th.

New York City.—The tides of the 9th were the highest known for many years, and resulted in serious damage along the adjacent coast. The following are estimates of the principal losses sustained: Manhattan Beach Marine railroad, $70,000; Engeman's Pier, $10,000; property owners along the beach, from $6,000 to $7,000.

Atlantic City, New Jersey.—The storm of the 9th (low area iv.) was accompanied by unusually high tides. Nearly four miles of the coast telegraph line were carried away, and other damage caused along the beach.

Baltimore, Maryland.—The brisk southeast to northeast winds of the 8th caused very high tides.

New River Inlet, North Carolina.—Very high tide and heavy sea occurred on the 8th, cutting away the banks and damaging the coast telegraph line.

Hatteras, North Carolina.—Very high tides were caused by the violent southeasterly gale of the 8th (low area iv.).

Fort Macon, North Carolina.—A strong southeasterly gale prevailed on the 8th (low area iv), causing the tide to rise to a height of four feet above the mean high-tide point. The coast telegraph line was washed down, cutting off communication.

Cedar Keys, Florida.—High tides occurred on the 1st, 8th, 18th, 24th, and 31st.

LOW TIDES.

Galveston, Texas.—The water in Galveston bay was very shallow on the 3d and 24th, owing to "northers."

Indianola, Texas, 8th, 12th, 19th, 20th, 21st.

Cedar Keys, Florida, 8th, 12th, 19th, 20th, 21st.

VERIFICATIONS.

INDICATIONS.

The detailed comparison of the tri-daily indications for January 1884, with the telegraphic reports for the succeeding twenty-four hours, shows the general average percentage of verifications to be 88.85 per cent. The percentages for the four elements are: weather, 92.26; direction of the wind, 87.03; temperature, 88.65; barometer, 87.14 per cent. By geographical districts they are: for New England, 88.27; middle Atlantic states, 91.73; south Atlantic states, 89.92; eastern Gulf states, 91.31; western Gulf states, 89.49; lower lake region, 88.68; upper lake region, 87.50; Ohio valley and Tennessee, 90.59; upper Mississippi valley, 87.87; Missouri valley, 84.27; north Pacific coast region, 83.04; middle Pacific coast region, 84.48; south Pacific coast region, 83.62. There were sixteen omissions to predict, out of 3,813 or 0.42 per cent. Of the 3,797 predictions that have been made, forty-six, or 1.21 per cent., are considered to have entirely failed; ninety-three, or 2.45 per cent., were one-fourth verified; three hundred and thirty-six, or 8.85 per cent., were one-half verified; five hundred and fifty-nine, or 14.72 per cent., were three-fourths verified; 2,763, or 72.77 per cent., were fully verified, so far as can be ascertained from the tri-daily reports.

CAUTIONARY SIGNALS.

During January, 1884, two hundred and forty-one cautionary signals were displayed. Of these, two hundred and eight, or 86.31 per cent were justified by winds of twenty-five miles or more, per hour, at or within one hundred miles of the station. Ninety-four cautionary off-shore signals were displayed, of which number, eighty-six, or 91.49 per cent., were justified as to direction, and seventy-seven, or 81.92 per cent., were justified, both as to direction and velocity. One "northwest" signal was ordered (at Milwaukee, Wisconsin), which was justified as to direction and velocity. Three hundred and thirty-six signals of all kinds were displayed, of which two hundred and eighty-six, or 85.12 per cent., were fully justified. These do not include signals ordered at display stations where the wind velocities are only estimated. Ten signals were ordered late. Of the ninety-four cautionary off-shore signals that were displayed, forty-nine were changed from cautionary signals.