

*Delaware.*—Cape Henlopen, 5th.  
*Idaho.*—Boisé City, 2d; Fort Oœur d'Alene, 13th, 15th, 26th, 27th.  
*Illinois.*—Cairo, 13th.  
*Indiana.*—Vevay, 23d.  
*Iowa.*—Independence, 21st, 22d; Cedar Rapids, 22d.  
*Maine.*—Cornish, 22d.  
*Massachusetts.*—Westborough, 14th, 21st; Dudley, 15th, 24th.  
*Nebraska.*—Tecumseh, 22d.  
*New Jersey.*—Beverly, 5th, 29th; Salem, 24th.  
*New York.*—West Point, 14th; Setauket, 15th.  
*North Carolina.*—Raleigh, 5th, 17th; West Point, 12th.  
*Ohio.*—Jacksonborough, 28th.  
*Oregon.*—Astoria, 15th, 19th, 20th, 21st, 24th, 25th, 26th, 29th, 30th, 31st; Albany, 21st, 26th.  
*South Carolina.*—Spartanburg, 9th.  
*Tennessee.*—Austin, 13th, 29th; Milan, 17th, 22d.  
*Virginia.*—University of Virginia, 13th.  
*Washington Territory.*—Neah Bay, 14th, 15th, 16th, 20th, 21st, 24th, 30th.  
*Wisconsin.*—Embarras, 21st.

Table of excessive and greatest monthly precipitation for January, 1887.

Station.	Specially heavy.		Largest monthly amount.	Station.	Specially heavy.		Largest monthly amount.
	Date.	Amt.			Date.	Amt.	
<i>Alabama.</i>				<i>N. Carolina—Con.</i>			
Greenville			7.55	Lenoir	23, 24	2.50	
Fayette			6.50	<i>Oregon.</i>			
Mount Vernon	23	2.18		Astoria	22, 23	2.75	18.24
<i>California.</i>				Do	29, 30	4.28	
Fort Gaston	19, 20, 21	5.87	9.43	Mount Angel	18, 19	2.03	15.36
Summit			6.25	Do	23, 24	2.90	
<i>Connecticut.</i>				Do	29, 30	3.10	
Middletown			7.07	Albany	28, 29	2.82	12.58
Voluntown			7.00	Portland	23	2.67	12.31
Collinsville			6.10	Do	29, 30	2.19	
<i>Florida.</i>				Eola	29, 30	2.42	9.86
Tallahassee	11, 12	2.70	6.20	Roseburg			8.64
Jacksonville	13, 14	2.18		Fort Klamath	18, 19, 20	3.33	
<i>Illinois.</i>				<i>Pennsylvania.</i>			
Sandwich	21, 22	2.09		Phillipsburg			6.50
South Evanston	21, 22	2.40		Zionsville	13, 14	3.10	
Geneseo	22	2.26		Wellaborough	23	2.00	
Waukegan	22	2.10		<i>Rhode Island.</i>			
Beviders	22	2.00		Block Island	6	2.15	6.99
Oneida	22	2.13		Narragansett Pt			6.73
Pekin	22	2.00		Providencea			6.61
Sycamore	22, 23	2.18		Bristol			6.59
Lake Forest	23	2.04		Woonsocket			6.52
Centerville	23	2.00		Olneyville			6.29
<i>Louisiana.</i>				Providenceb			6.19
Shreveport	28	2.00		<i>Tennessee.</i>			
<i>Maine.</i>				Waynesborough	23	3.10	6.65
Eastport	1, 2	2.30		Do	28	2.05	
Orono			7.78	Fosteria	23	3.03	6.40
Gardiner	14, 15	2.18	7.56	Milan	22	2.04	
<i>Massachusetts.</i>			7.32	Do	28	2.10	
Fall River				Memphis	22, 23	3.11	
South Hingham			7.38	Chattanooga	23	3.48	
Taunton			7.34	Nashville	23	2.02	
Rowe			7.33	Do	29, 30	2.05	
New Bedford a			7.30	Andersonville	23	2.00	
Wellesley			7.18	Parkeville	23	2.50	
Cambridge			7.10	Grief	23	2.95	
Randolph			7.04	Farmingdale	23	2.62	
Gilbertville			6.96	Manchester	23	2.43	
Northampton			6.68	Beech Grove	23	2.10	
Millford			6.66	Hohenwald	23	2.80	
Blue Hill (base)			6.46	Dickson	23	2.67	
Williamstown			6.36	Do	28	2.53	
Lynn			6.29	Trenton	22, 23	2.49	
Concord			6.20	Bolivar	28	2.80	
Beverly Farms			6.16	<i>Vermont.</i>			
Fitchburg			6.20	Brattleborough	14	2.03	6.58
Somerset			6.12	Do b			6.54
New Bedford b			6.08	Jacksonville			6.43
<i>Michigan.</i>			6.02	<i>Virginia.</i>			
Grand Haven	22	2.67		Rappahanock	23, 24	2.18	
East Saginaw	22, 23	2.71		Washington Ter.			
<i>New Brunswick.</i>				New Bay	11, 12, 13	4.49	22.30
Saint John			10.95	Do	25, 26	2.26	
Parker's Ridge			6.91	Do	29, 30	2.85	
<i>New Hampshire.</i>				Tatoosh Island	11, 12	2.44	14.46
Woodstock			6.90	Pysh	13, 14	2.15	13.76
<i>New Jersey.</i>				Fort Canby	14, 15	2.00	11.01
Phillipsburg			6.65	Olympia			9.83
Union			6.35	Port Angeles			6.20
Dover			6.21	<i>Wisconsin.</i>			
<i>North Carolina.</i>				Madison	22, 23	2.48	
Hatteras			6.09	<i>Wyoming.</i>			
Flat Rock	23	3.19		Camp Sheridan			7.70

SLEET.

Sleet fell in the various states and territories during the month, as follows:  
*Alabama.*—5th.  
*Arizona.*—22d.  
*Connecticut.*—5th, 14th, 17th.  
*Florida.*—5th.  
*Georgia.*—5th, 7th, 17th.  
*Illinois.*—12th, 13th, 23d, 25th, 26th, 31st.  
*Indiana.*—28th.  
*Indian Territory.*—7th.  
*Iowa.*—21st, 22d, 23d.  
*Kansas.*—7th.  
*Kentucky.*—13th.  
*Louisiana.*—9th.  
*Maine.*—1st, 2d, 7th, 14th, 17th, 18th, 26th.  
*Maryland.*—9th.  
*Massachusetts.*—10th.  
*Michigan.*—13th, 15th, 16th, 21st.  
*New Jersey.*—5th, 24th, 26th.  
*New York.*—1st, 14th, 17th, 22d.  
*North Carolina.*—5th, 23d.  
*Ohio.*—13th, 14th, 28th.  
*Pennsylvania.*—1st, 14th.  
*South Carolina.*—5th, 7th.  
*Tennessee.*—9th, 17th, 26th.  
*Utah.*—29th.  
*Vermont.*—1st.  
*Wisconsin.*—13th, 14th, 21st, 23d.

DROUGHT.

During the past summer, when other parts of Texas were suffering from drought, copious rainfalls occurred at San Antonio and over the surrounding country, but since the first of October, 1886, very little rain fell at that station, the total precipitation of the four months from October 1, 1886, to January 31, 1887, being only 1.36 inches. Water pools have dried and ranch men are forced to drive their stock five to ten miles for water. Grass in some sections has become parched and unnutritious. Cattle men say that but for the abundant growth of cactus large numbers of cattle would have starved. At Fort Elliott, in the "Panhandle" district, one of the great cotton and cattle-raising sections of the state, during the months of November, December, and January only 0.28 inch of rain fell. Reports from Dallas, Fort Worth, Sherman, and Waco, situated in the midst of the grain-growing districts of the state, say that the wheat fields are dry and dusty. The observer at Rio Grande City states that a severe drought prevailed in that district during the month; in some places the ground was entirely bare and very dusty, and during high winds which occurred there on the 17th, 19th, 20th, 21st, 23d, and 27th, very heavy clouds of dust and sand filled the atmosphere.

The rainfall of the winter thus far has been small in Illinois; the observer at Windsor, Shelby county, states that this county has been much in need of rain since the drought began in July, and that numerous wells have become dry. The observer at Pekin, Tazewell county, says that many wells are dry and farmers are obliged to drive their cattle long distances for water.

WINDS.

The most frequent directions of the wind during January, 1887, are shown on chart ii by the arrows flying with the wind; they are also given in the table of miscellaneous meteorological data. In New England, the middle Atlantic states, the Lake region, and upper Mississippi valley, the wind blew generally from the west or northwest; in the west Gulf states the prevailing winds were from the south; in the Ohio Valley southwest; along the eastern slope of the Rocky Mountains the wind blew mostly from the west; in California northwesterly winds prevailed. In other parts of the country they were vari-

HIGH WINDS.

[In miles per hour.]

Wind-velocities of fifty or more miles per hour were recorded during the month, as follows:

Mount Washington, New Hampshire, 62, sw., 1st; 90, nw., 2d; 70, nw., 3d; 50, sw., 4th; 50, sw., 5th; 78, nw., 7th; 60, sw., 9th; 97, nw., 10th; 100, nw., 11th; 82, w., 12th; 92, nw., 13th; 78, se., 14th; 55, nw., 16th; 70, sw., 17th; 90, nw., 18th; 87, nw., 19th; 81, s., 20th; 132, w., 21st; 100, w., 22d; 97, w., 23d; 94, nw., 24th; 94, nw., 25th; 80, nw., 26th; 80, nw., 27th; 94, nw., 28th; 66, nw., 29th; 80, w., 30th; 71, nw., 31st.

Pike's Peak, Colorado, 70, nw., 1st; 52, n., 2d; 54, nw., 4th; 52, nw., 5th; 64, nw., 6th; 56, nw., 8th; 58, n., 9th; 64, w., 10th; 80, nw., 11th; 80, nw., 12th; 98, nw., 13th; 60, nw., 14th; 70, nw., 15th; 50, n., 16th; 62, nw., 17th; 72, nw., 18th; 78, w., 19th; 74, nw., 23d; 96, w. and nw., 24th; 64, w., 25th; 68, w., 26th; 76, w., 27th; 94, nw., 28th; 80, w., 29th; 76, w., 30th.

Fort Maginnis, Montana, 50, nw., 3d; 54, nw., 10th; 64, nw., 11th; 51, nw., 12th; 60, w., 29th.

Fort Bridger, Wyoming, 55, sw., 13th.

Eastport, Maine, 55, ne., 14th.

Fort Assinaboine, Montana, 56, w., 14th; 52, sw., 26th.  
 Fort Totten, Dakota, 53, nw., 15th; 60, nw., 29th.  
 Buffalo, New York, 58, sw., 17th and 20th.  
 Rochester, New York, 52, w., 17th; 50, w., 20th.  
 Chincoteague, Virginia, 56, nw., 17th; 52, nw., 24th.  
 Fort Canby, Washington Territory, 56, w., 20th.  
 Tatoosh Island, Washington Territory, 52, w., 27th.  
 Denver, Colorado, 56, nw., 28th; 56, w., 29th.  
 Fort Stanton, New Mexico, 51, nw., 29th.

TORNADO STUDIES FOR JANUARY 1887.

[Prepared by Lient. JOHN P. FINLEY, Signal Corps, U. S. Army, Assistant.]

During the month of January, 1887, there were furnished to the Chief Signal Officer, by tornado reporters for the Signal Service, records of the occurrence of twelve tornadoes.

These storms were distributed as follows: Alabama, one; Tennessee, two; Texas, two; South Carolina, three; North Carolina, two; and New York, two.

The tracks of the tornadoes here mentioned are graphically shown on chart number i (tracks of low pressure areas) of this REVIEW.

Further consideration of these storms will appear in the following tables, which are self-explanatory:

Relation of tornado regions to areas of low barometer, January, 1887.

Date of tornado.	Time.	Barometric depression—central region.				Tornado region.				Temperature gradients per geographical degree.								
		Location.	Time (75th meridian.)	Lowest barometer.	Form.	Ratio of axes.	Departure from normal.	Location.	Direction and distance (in miles) from central area of barometric minimum.	Velocity of southerly winds—miles per hour.	Distance of maximum velocity from tornado region.	Velocity of northerly winds—miles per hour.	Distance of maximum velocity from tornado region.	Time (75th meridian.)	Maximum current temperature gradient.	Mean current temperature gradient.	Normal temperature gradient.	Departure from normal.
January 13.	a. m.	Central Missouri.	7 a. m.	29.40	Mississippi to Montana.	8 to 4	-0.83	Southwest Alabama.	se. 435	6 to 16	Miles. 20	5 to 20	1000	7 a. m.	7.66	7.16	3.52	4.14
13.	6 p. m.	Southern Illinois.	3 p. m.	29.31	Gulf of Mexico to Minnesota.	7 to 4	-0.83	Southern Tennessee.	se. 460	5 to 30	250	5 to 41	1200	3 p. m.	3.96	2.46	2.96	1.00
13.	6 p. m.	Southern Illinois.	3 p. m.	29.31	Gulf of Mexico to Minnesota.	7 to 4	-0.83	Northern Tennessee.	se. 460	5 to 30	250	5 to 41	1200	3 p. m.	3.96	2.46	2.96	1.00
22.	7 a. m.	North west Texas.	7 a. m.	29.47	Southern New Mexico to Lake Superior.	10 to 3	-0.61	Northeast Texas.	se. 210	5 to 23	144	5 to 17	435	7 a. m.	9.07	7.69	2.94	6.13
22.	About 4 a. m.	North west Texas.	7 a. m.	29.47	Southern New Mexico to Lake Superior.	10 to 3	-0.61	Northeast Texas.	se. 210	5 to 23	144	5 to 17	435	7 a. m.	9.07	7.69	2.94	6.13
23.	Afternoon.	Lake Huron.	3 p. m.	29.47	Gulf of Mexico to Lake Huron.	9 to 3	-0.54	Northwest South Carolina.	s. 530	5 to 22	250	5 to 22	425	3 p. m.	10.35	7.50	3.28	7.07
23.	Afternoon.	Lake Huron.	3 p. m.	29.47	Gulf of Mexico to Lake Huron.	9 to 3	-0.54	Northwest South Carolina.	s. 530	5 to 22	250	5 to 22	425	3 p. m.	10.35	7.50	3.28	7.07
24.	a. m.	Upper Canada.	7 a. m.	29.30	Georgia to mouth of St. Lawrence River.	10 to 3	-0.74	Northern Carolina.	nsw. 700	5 to 34	180	7 to 32	460	7 a. m.	16.10	10.39	2.85	13.25
25.	4 a. m.	Lake Huron.	7 a. m.	29.50	South west Texas to Lake Huron.	10 to 3	-0.56	Western Carolina.	nsw. 540	5 to 24	300	5 to 22	540	7 a. m.	12.10	7.55	2.85	9.29
30.	5 p. m.	Lower Canada.	3 p. m.	29.24	Kentucky to Lower Canada.	4 to 3	-0.77	Northwest York.	nsw. 200	5 to 22	75	5 to 31	200	3 p. m.	12.86	11.13	3.56	9.30
30.	4.20 p. m.	Lower Canada.	3 p. m.	29.24	Kentucky to Lower Canada.	4 to 3	-0.77	Southwest York.	nsw. 200	5 to 22	75	5 to 31	200	3 p. m.	12.86	11.13	3.56	9.30
30.	9 p. m.	Lower Canada.	3 p. m.	29.24	Kentucky to Lower Canada.	4 to 3	-0.77	Northwest Carolina.	s. 650	5 to 22	300	5 to 31	400	3 p. m.	12.86	11.13	4.37	8.49

Report of tornadoes for the month of January, 1887.

Place.	Date.	Time.	Direction.	Form of cloud.	Number of persons killed.	Number of persons wounded.	Width of path.	Number and kind of animals killed.	Number and kind of buildings destroyed.	Total valuation of property destroyed.	Authority.
Sim's Chapel, Alabama.....	13	A. M.....	no.	Funnel.....			Feet. 1,320	Great loss of stock.		Many thousands of dollars.	Saint Louis: "Globe-Democrat."
Chapel Hill, Tennessee.....	13	6 p. m.....	no.	Funnel.....	None.	Several	1,320	Many.....	Many.....	Many thousands of dollars.	E. D. Thompson, Marshall county, and C. Foster Williams, Ashwood, Tennessee.
Near Greenbrier, Tennessee.....	13	6 p. m.....	Easterly	Funnel.....			1,320 to 2,640		Many.....	Very destructive.	Martin Walter, Cross Plains, Tennessee.
Brookston, Texas.....	22	7 p. m.....	no.	Funnel.....				One church, several houses, number of barns.		Many thousands of dollars.	Saint Louis: "Globe Democrat."
Near Brazos, and three miles west of Millsap, Texas.	22	About 4 a. m.	no.	Funnel.....	None.	None.	2,640	Very destructive.			H. M. Harrison, Millsap, Texas.
Anderson's Mills, South Carolina.....	23	Afternoon	Easterly	Funnel.....					Very destructive.		Geo. E. Ladsham, Pacolet, South Carolina.
Near Fairview, South Carolina.....	23	Afternoon	Easterly						Very destructive.		Geo. E. Ladsham, Pacolet, South Carolina.
Graham and Company shops, North Carolina.....	24	A. M.....	Easterly		None.	None.	1,320	None.....	Many.....		A. T. Smith, Altamahaw, North Carolina.
Four miles south of Catawba, North Carolina.....	25	4 a. m.....	e. no.		None.	None.	600	None.....	Very destructive to timber		G. C. McNeill, Catawba, North Carolina.
Pultneyville, New York.....	30	5 p. m.....	no.	Funnel.....	None.	None.	600	None.....	Cloud mostly on Lake Ontario.		M. A. Veeder, Lyons, New York.
Twenty miles west of East Otto, New York.....	30	4.20 p. m.....	no.	Column of smk.			Narrow				Orylle L. Larkib, East Otto, New York.
Burnt Factory, South Carolina.....	30	9 p. m.....	no.		None.	None.	Narrow		Many farm buildings.		F. C. Sexton, Burnt Factory, South Carolina.

TEMPERATURE OF WATER.

The following table shows the highest and lowest temperatures of water observed at the several stations; the monthly ranges of water temperature; the average depth at which the observations were made; and the mean temperature of the air:

Temperature of water for January, 1887.

Station.	Temperature at bottom.		Range.	Average depth, feet and tenths.	Mean temperature of the air at station.
	Max.	Min.			
Alpena, Michigan a.....					
Augusta, Georgia.....	49.2	36.2	13.0	7.7	41.8
Baltimore, Maryland b.....	36.3	32.3	4.0	12.0	32.4
Boston, Massachusetts.....	34.5	29.2	5.3	23.9	25.9
Buffalo, New York a.....					
Canby Fort, Washington Territory.....	45.2	43.0	2.2	15.7	44.9
Oedar Keys, Florida.....	62.5	40.1	16.4	7.5	50.3
Charleston, South Carolina.....	52.9	42.7	10.2	36.4	45.6
Chicago, Illinois.....	33.0	32.5	0.5	8.8	17.3
Chincoteague, Virginia c.....	44.0	30.0	14.0	2.6	35.2
Cleveland, Ohio.....	34.5	31.2	2.3	13.0	24.9
Detroit, Michigan a.....					
Duluth, Minnesota a.....					
Eastport, Maine.....					
Escanaba, Michigan.....	40.0	36.1	3.9	15.5	20.5
Galveston, Texas.....					
Grand Haven, Michigan f.....	57.6	39.4	18.2	13.6	51.2
Jacksonville, Florida.....	32.4	32.2	0.2	18.0	20.1
Key West, Florida.....	59.1	47.6	11.5	18.0	49.8
Mackinaw City, Michigan a.....	74.7	60.4	14.3	18.3	66.5
Marquette, Michigan a.....					
Mobile, Alabama.....	47.5	36.1	11.4	15.3	47.6
New London, Connecticut g.....	43.1	34.5	8.6	11.2	28.6
New York City.....	35.0	30.7	4.3	14.7	30.1
Norfolk, Virginia.....	43.1	33.4	9.7	15.4	39.4
Pensacola, Florida.....	57.3	45.5	11.8	17.0	49.1
Portland, Maine.....	33.5	30.0	3.5	17.0	18.7
Portland, Oregon.....	47.5	41.2	6.3	56.9	42.8
Sandusky, Ohio.....					
San Francisco, California.....	52.7	50.7	2.0	37.1	51.8
Savannah, Georgia.....	51.0	39.4	11.6	9.8	46.3
Toledo, Ohio h.....	34.4	32.4	2.0	15.8	21.9

a Frozen throughout the month.  
 b Frozen 4th, 9th, 10th, 19th, 20th.  
 c Frozen from 1st to 26th, 30th, 31st.  
 d Frozen 3d, 4th, 5th.  
 e Frozen from 1st to 24th.  
 f Frozen from 1st to 22d, and 31st.  
 g Frozen 4th, 5th.  
 h Frozen from the 1st to 23d.

INLAND NAVIGATION.

STATE OF WATER IN RIVERS AND HARBORS.

The Mississippi River at Cairo, Illinois, was frozen over from the 1st to the 19th, the ice being of sufficient firmness as to allow heavy wagons to cross; on the 3d a channel was cut through the ice from Bird's Point, Missouri, to Cairo, to be used by the railroad transfer boats. An ice gorge formed at Bird's Point, Missouri, on the 7th and broke on the 20th, the

heavy ice passing out rapidly but doing no damage, as upon the first indications of the movement all river craft moved into safe quarters at the mouth of the Ohio River. On the 21st river men reported the Mississippi River clear of ice from Cairo, to Grand Tower, Illinois. On the 22d an ice gorge which had formed at Fountain Bluff, Illinois, five miles above Grand Tower, broke, but did no damage to the numerous boats and barges in winter quarters at the latter place. The river rose steadily on the 24th, 25th, and 26th, and was filled with heavy floating ice, but on the 27th it was sufficiently clear to allow navigation between Cairo, Illinois, and Saint Louis, Missouri, to be resumed. At La Crosse, Wisconsin, Dubuque, Davenport, and Keokuk, Iowa, and intervening points, the river was frozen solid throughout the month. At Saint Louis, Missouri, on the 1st, heavy floating ice gorged south of the bridge which crosses the river at this city, and remained so until the 24th, when it broke, and the ice began moving down. On the 25th the river was free of ice at this place. On the 27th a heavy gorge that had formed above the bridge broke, being forced down by ice from above. On the 28th, 29th, 30th, and 31st heavy ice passed down, filling the river from bank to bank, but steamboat navigation was generally being resumed.

On the 2d heavy floating ice in the Ohio River rendered navigation between Cairo and northern points impossible; the river continued in the same state until the 14th, when the ice became so soft as to offer but little impediment to navigation. On the 15th the river between Cairo and Paducah, Kentucky, was comparatively free of ice, but above that point heavy ice was reported as filling the river from bank to bank. On the 21st the steamer "Guiding Star" arrived at Cairo from Cincinnati. The captain reported the ice as very heavy north of Evansville, Indiana, and that he experienced great difficulty in getting through. The voluntary observer at Portsmouth, Ohio, reports heavy flowing ice in the Ohio River from the 2d to 13th, and from the 18th to 24th, during which time navigation was practically closed at that point. At Louisville, Kentucky, the river was filled with floating ice on the 2d and 3d, rendering navigation difficult; from the 4th to 9th it was entirely suspended owing to the heavy drift ice. From the 10th to 19th navigation was partially suspended; from the 20th to the end of the month the river was tolerably clear of ice.

The Alleghany and Monongahela rivers at Pittsburg, Pennsylvania, were filled with floating ice from the 1st to 15th, and from the 17th to 29th. On the 19th and 20th two heavy ice gorges, each nearly two miles long, formed in the Monongahela