

UNITED STATES OF AMERICA:
WAR DEPARTMENT.

MONTHLY WEATHER REVIEW.

(GENERAL WEATHER SERVICE OF THE UNITED STATES.)

FEBRUARY, 1887.

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List of merchant marine steam and sailing vessels from which International Simultaneous Meteorological reports were received at the Office of the Chief Signal Officer, U. S. Army, Washington, D. C., in time to be used in the preparation of the Weather Review for the month of February, 1887.

Name of vessel.	Captain.	Name of vessel.	Captain.	Name of vessel.	Captain.
<i>Allan Line.</i>		<i>Miss. & Dominion S. S. Co.</i>		<i>Watts Ward Line.</i>	
Br. s. s. <i>Hibernian</i>	Capt. J. Brown.	Br. s. s. <i>Ontario</i>	Capt. W. P. Couch.	Br. s. s. <i>Chiswick</i>	Ch. Off. Jos. Mayne.
<i>Manitoba</i>	W. Dalziel.	<i>Sarnia</i>	Jos. Gibson.	<i>White Cross Line.</i>	
<i>Sardinian</i>	Wm. Richardson.	<i>Toronto</i>	Jos. McAuley.	Belg. s. s. <i>DeBuyter</i>	Capt. J. J. Brarens.
<i>Scandinavian</i>	W. H. Smith.	<i>Vancouver</i>	C. J. Lindall.	<i>Pictor de Coninck</i>	E. Smit.
<i>American Line.</i>		<i>Morgan Line.</i>		<i>White Star Line.</i>	
Br. s. s. <i>British King</i>	John Kelly.	Am. s. s. <i>Eureka</i>	R. B. Quick.	Br. s. s. <i>Adriatic</i>	H. Parsell.
<i>British Prince</i>	S. Nowell.	<i>National Line.</i>		<i>Britannic</i>	H. Perry.
<i>British Princess</i>	E. H. Freeth.	Br. s. s. <i>Canada</i>	Thos. Foote.	<i>Celtic</i>	P. J. Irving.
<i>Lord Clive</i>	P. Urquhart.	<i>Denmark</i>	R. S. Rigby.	<i>Germanic</i>	Bonj. Goudell.
<i>Lord Gough</i>	E. M. Hughes.	<i>Egypt</i>	J. Sumner.	<i>Republic</i>	P. J. Irving.
<i>Anchor Line.</i>		<i>England</i>	T. P. Healey.	<i>Wilson Line.</i>	
Br. s. s. <i>Australia</i>	A. McKitchie.	<i>Erin</i>	J. Robinson.	Br. s. s. <i>Bassano</i>	W. Rea.
<i>Bolivia</i>	J. J. Small.	<i>France</i>	A. D. Hadley.	<i>Galileo</i>	R. T. Jones.
<i>British Crown</i>	Archibald Smith.	<i>Greece</i>	A. J. Jeffrey.	<i>Lepanto</i>	T. M. Irwin.
<i>British Queen</i>	R. Wills.	<i>Spain</i>	W. A. Griffiths.	<i>Marengo</i>	W. Abbott.
<i>Caledonia</i>	R. T. Garvie.	<i>Navigazione Generale Italiana.</i>		<i>Otranto</i>	W. Rippeth.
<i>Circassia</i>	R. T. Garvie.	It. s. s. <i>Gottardo</i>	Domenico Viola.	<i>Miscellaneous.</i>	
<i>Devonia</i>	Hugh Young.	<i>New York and Cuba Mail S. S. Co.</i>		Nor. s. s. <i>Amicilia</i>	P. M. Reimers.
<i>Ethiopia</i>	John Wilson.	Am. s. s. <i>Cienfuegos</i>	F. M. Faircloth.	Br. s. s. <i>Angerton</i>	S. M. Orr.
<i>Arrow Line.</i>		<i>N. Y., Havana & Mexican Mail S. S. Co.</i>		<i>Aurota</i>	G. W. Reed, FRGB
Br. s. s. <i>Critic</i>	W. R. Lord.	Am. s. s. <i>City of Alexandria</i>	J. W. Reynolds.	<i>Bedford</i>	Thos. Attkinhead
<i>Atlas Line.</i>		<i>City of Washington</i>	W. M. Rittig.	<i>Chittangong</i>	A. McDougal.
Br. s. s. <i>Alisa</i>	J. W. Sanson.	<i>North German Lloyd Steamship Co.</i>		<i>Dragonfly</i>	J. W. Howling.
<i>Alveta</i>	— McKay.	Ger. s. s. <i>Aller</i>	H. Christoffers.	<i>Edith Godden</i>	J. H. Bennett.
<i>Andes</i>	T. M. MacKnight.	<i>Donau</i>	H. Supper.	<i>El Callao</i>	Jos. Scholtz.
<i>Booth's S. S. Co. (limited).</i>		<i>Elbe</i>	G. Meyer.	<i>Elcano</i>	V. de Ispizua.
Br. s. s. <i>Ambrose</i>	E. Bisson.	<i>Emu</i>	Th. Jungst.	<i>Emiliano</i>	Fernando Bengoa
<i>Bernard</i>	Ch. Off. S. Richards.	<i>Falda</i>	R. Ringat.	<i>Fitzroy</i>	Henry Gibb.
<i>Clement</i>	Capt. Thos. Burley.	<i>Hohenstaufen</i>	A. Kohlmann.	<i>Gwendoline</i>	Robt. Milburn.
<i>Jerome</i>	Benj. Crimp.	<i>Neckar</i>	H. Baur.	<i>Lord Lansdown</i>	C. H. Baskfold.
<i>Bordeaux Steam Navigation Co.</i>		<i>Rhein</i>	L. Jahns.	<i>Lorenzo P. Baker</i>	Warren F. Wiley.
Fr. s. s. <i>Chateau Yquem</i>	C. F. Journiel.	<i>Saale</i>	H. Richter.	<i>Madrid</i>	N. Houge.
<i>Bristol-City Line.</i>		<i>Trave</i>	W. Willigerod.	<i>Manuel L. Villaverde</i>	M. Garson.
Br. s. s. <i>Brooklyn City</i>	W. Fitt.	<i>Weser</i>	H. Bruus.	<i>Mexico</i>	Claudio Parales.
<i>Crowell Line.</i>		<i>Occidental and Oriental Steamship Co.</i>		<i>Monk Seaton</i>	John Taylor.
Am. s. s. <i>Hudson</i>	H. R. Freeman.	Br. s. s. <i>Gaelic</i>	W. G. Pearne.	<i>Navarro</i>	M. Carnout.
<i>Louisiana</i>	E. V. Gager.	<i>Oceanic</i>	H. Davison.	<i>Olbers</i>	J. N. Bouzlay.
<i>Canard Line.</i>		<i>Ocean Steamship Company.</i>		<i>Pocomo</i>	S. de Adococca.
Br. s. s. <i>Armania</i>	W. H. P. Hains.	Am. s. s. <i>City of Augusta</i>	J. W. Catharine.	<i>Saint Roman</i>	Her. Lahnmeier.
<i>Catalonia</i>	Edward Wylie.	<i>Old Dominion Steamship Company.</i>		<i>Serra</i>	G. Evans.
<i>Coplandia</i>	Henry Walker.	Am. s. s. <i>Manhattan</i>	Frank Stevens.	<i>Verminus</i>	Henry Campbell.
<i>Gallia</i>	M. Murphy.	<i>Oregon Railway and Navigation Co.</i>		<i>Victoria</i>	F. de Luzarraga.
<i>Samaria</i>	T. Roberts.	Am. s. s. <i>Columbia</i>	Fred Bolles.	<i>Viola</i>	C. E. Cook.
<i>Servia</i>	H. McKay.	<i>Pacific Coast Steamship Company.</i>	E. Polenann.	<i>New York Herald Weather Service.</i>	
<i>Edoard Carr's S. S. Line.</i>		Am. s. s. <i>City of Chester</i>	J. Wallace.	Br. s. s. <i>Albano</i>	H. R. Hughes.
Ger. s. s. <i>Amalfi</i>	Julius Bahr.	<i>Orizaba</i>	John N. Ingalls.	<i>Alene</i>	E. J. Selders.
<i>Australis</i>	G. Franck.	<i>Pacific Mail Steamship Company.</i>		<i>Alvo</i>	D. Williams.
<i>Polaria</i>	Johannes Schade.	Am. s. s. <i>Acapulco</i>	C. S. Coyle.	<i>Baltic</i>	R. E. Bence.
<i>Polynesia</i>	A. Kuhn.	<i>City of Para</i>	D. Dexter.	<i>Bothnia</i>	T. Hobson.
<i>Furness Line.</i>		<i>City of Peking</i>	H. C. Dearborn.	<i>Caracas</i>	W. M. Hopkins.
Br. s. s. <i>Borker</i>	F. Manley.	<i>City of Rio de Janeiro</i>	W. B. Cobb.	<i>City of Chicago</i>	Fred Watkins.
<i>Durham City</i>	D. D. Gullbraith.	<i>Colon</i>	Chas. C. Lima.	<i>City of Puebla</i>	John Deakon.
<i>Ripon City</i>	John Jenkins.	<i>Granada</i>	J. L. Lockwood.	<i>Crescent City</i>	J. H. Lockwood.
<i>Stockholm City</i>	K. Doyle.	<i>Newport</i>	W. G. Shackford.	<i>Elder</i>	H. Helmers.
<i>General Trans-Atlantic Steamship Co.</i>		<i>San Blas</i>	Thos. Chapman.	<i>Elysa</i>	James Brown.
Fr. s. s. <i>La Bourgogne</i>	E. Franguel.	<i>Ypana Line.</i>		<i>Leasing</i>	B. Voss.
<i>La Bretagne</i>	M. de Jousselin.	Br. s. s. <i>Notley Abbey</i>	H. N. Vyvyan.	<i>Republic</i>	P. J. Irving.
<i>La Champagne</i>	E. Truab.	<i>Quebec Steamship Company.</i>		<i>San Marco</i>	Ch. Off. A. B. Cornot.
<i>La Gascogne</i>	Santoli.	<i>Orinoco</i>	G. S. Locke.	<i>Saratoga</i>	Capt. M. de Jousselin.
<i>La Normandie</i>	G. de Kerabiec.	<i>Trinidad</i>	J. S. Garvln.	<i>Switzerland</i>	H. Buschmann.
<i>Great Western S. S. Line.</i>		<i>Red "D" Line.</i>	W. J. Fraser.	<i>Sailing vessels.</i>	
Br. s. s. <i>Warwick</i>	J. H. James.	Am. s. s. <i>Philadelphia</i>	Sam. Hoss.	Br. bg. <i>Abyssinian</i>	John Hughes.
<i>Gaika Line.</i>		<i>Philadelphina</i>	W. Woodrick.	Am. schr. <i>Anna B. Hutcheson</i>	D. Zolner.
Br. s. s. <i>Alaska</i>	Geo. S. Murray.	<i>Valencia</i>		<i>bg. Aret</i>	J. W. Cates.
<i>Arizona</i>	S. Brooks.	<i>Red Star Line.</i>		<i>bk. Artemis</i>	E. E. Moo.
<i>Wisconsin</i>	E. Bentley.	<i>Norland</i>	W. A. Beynon.	Am. schr. <i>Benjamin Hale</i>	John Hull.
<i>Wyoming</i>	C. L. Rigby.	<i>Noordland</i>	A. J. Griffin.	<i>C. B. Church</i>	N. A. Anderson.
<i>Hambury-American Line.</i>		<i>Pennland</i>	H. E. Nickels.	<i>Chas. S. Whitney</i>	Geo. D. Spicer.
Ger. s. s. <i>Gotthilf</i>	C. Kordell.	<i>Rhyland</i>	Rud. Weyer.	Am. schr. <i>Comet</i>	W. A. Aldrich.
<i>Moravia</i>	O. Pexoldt.	<i>Waesland</i>	J. C. Jamison.	<i>sp. E. B. Sutton</i>	C. O. Carter.
<i>Rhætia</i>	H. Vogelgsang.	<i>Westernland</i>	J. Ueberweg.	<i>schr. Edward R. Emerson</i>	A. H. Child.
<i>Rugia</i>	A. Alberts.	<i>Rotterdam Line.</i>	Com. W. G. Randle.	<i>bk. Errante</i>	A. G. Nicolleh.
<i>Suevia</i>	C. Ludwig.	<i>Leerdam</i>		<i>Am. Ethel</i>	W. Thompson.
<i>Harrison Line.</i>		<i>P. Caland</i>	Capt. P. Sliere-dregt.	<i>schr. Florence Rogers</i>	J. S. F. McLeod.
Br. s. s. <i>Counsellor</i>	Wm. Lang.	<i>Rotterdam</i>	F. H. Boujer.	<i>sp. Friederike</i>	Th. Tiedken.
<i>Iama Line.</i>		<i>Schedam</i>	G. J. Vis.	<i>Georg</i>	G. Schultz.
Br. s. s. <i>City of Berlin</i>	Francis S. Land.	<i>W. A. Scholten</i>	A. Potjer.	<i>bk. Grundloven</i>	O. G. Ellingson.
<i>City of Chester</i>	A. Lewis.	<i>Zaandam</i>	G. Bakker.	<i>Helena</i>	T. T. Verbeec.
<i>City of Richmond</i>	A. Redford.	<i>Royal Mail Steamship Co.</i>	H. v. d. Zee.	Am. schr. <i>Henry Waddington</i>	W. H. Megee.
<i>Johnston Line.</i>		Am. s. s. <i>City of Dallas</i>	C. W. Read.	<i>bk. Iodine</i>	Adam Smith.
Br. s. s. <i>Neasmore</i>	John Inch.	<i>Royal West India Mail Steamship Co.</i>		<i>bkt. Josephine</i>	Chas. Brown.
<i>Lampert & Hall's Steamship Company.</i>		Dtch s. s. <i>Orange Nassau</i>	J. A. J. Lacrooy.	<i>bk. José E. More</i>	Amos Lenhard.
Br. s. s. <i>Riela</i>	Fred Graham.	<i>State Line.</i>		<i>sp. Komander Svend Foyu</i>	John Bryde.
<i>Dalton</i>	J. Russell.	Br. s. s. <i>State of Georgia</i>	G. Moodie.	Am. bg. <i>L. & W. Armstrong</i>	A. Alexander.
<i>Humboldt</i>	Jas. Grimes.	<i>State of Pennsylvania</i>	A. J. A. Mann.	<i>bk. Leocadia</i>	John Stoffl.
<i>Others</i>	Jas. Clark.	<i>State of Nebraska</i>	A. G. Brues.	Am. bkt. <i>Lovauter</i>	G. F. Gerry.
<i>Nasmyth</i>	Thos. T. Farrell.	<i>State of Nevada</i>	J. A. Stewart.	<i>bg. Lillian</i>	H. T. Schive.
<i>Leyland Line.</i>		<i>Thiappella Line.</i>		<i>schr. Maggie Abbott</i>	D. C. McIntosh.
Br. s. s. <i>Bavarian</i>	J. Oseinak.	Dan. s. s. <i>Gelsor</i>	C. W. Müller.	<i>N. fund</i>	R. Hebe.
<i>Bulgarian</i>	E. Parry.	<i>Island</i>	W. Skjoldt.	<i>bgt. Pearl</i>	John B. Zimmer.
<i>Iranian</i>	T. H. Fox.	<i>Twain Screw Line.</i>		<i>bk. Pillau</i>	G. Gerlach.
<i>Virginian</i>	M. Fitt.	Br. s. s. <i>Richmond Hill</i>	A. Hyde.	<i>Nor. Ovon</i>	G. Olson.
<i>Mallory Line.</i>		<i>Tower Hill</i>	F. Archer, R.N.R.	<i>bk. Richard</i>	A. von Suggert.
Am. s. s. <i>Alamo</i>	Sam Risk.	<i>Type and Wear Steamship Co.</i>		<i>bkt. Rossard</i>	John Collie.
<i>Colorado</i>	Jas. Daniels.	Br. s. s. <i>City of Newcastle</i>	R. Townsend.	<i>bk. Sarah Doe</i>	B. S. Moryman.
<i>Lampusau</i>	M. B. Crowell.	<i>Warren Line.</i>		<i>Sarah</i>	L. R. Wale.
<i>Mediterranean & New York S. S. Co.</i>		Br. s. s. <i>Iowa</i>	Samuel Walters.	<i>bk. Tuck Sing</i>	Geo. N. Ryder.
Br. s. s. <i>Pontiac</i>	Ch. Off. R. Blyth.	<i>Kansas</i>	W. Gleig.	<i>sp. Wilhelm</i>	W. Wilmsou.
<i>Ponce</i>	Capt. W. Bowen.	<i>Norseman</i>	E. Maddox.		

MONTHLY WEATHER REVIEW.

VOL. XV.

WASHINGTON CITY, FEBRUARY, 1887.

No. 2.

INTRODUCTION.

This REVIEW contains a general summary of the meteorological conditions which prevailed over the United States and Canada during February, 1887, based upon the reports of the regular and voluntary observers of the Signal Service, and co-operating state weather services.

Descriptions of the storms which occurred over the north Atlantic Ocean during the month are also given, and their approximate paths shown on chart i. In tracing the centres of the paths of these storms, data from the reports of one hundred and eighty-three vessels have been used. The weather over the north Atlantic during the month was very unsettled, and barometric pressure ranging below 29.00 (736.6) was reported on six days.

Icebergs and field ice were encountered in large quantities over the Banks of Newfoundland, and isolated bergs were passed southward to the fortieth parallel, and westward to Sable Island.

On chart i for this month are traced over the United States and Canada the paths of eleven areas of low pressure; the average number for February during the past thirteen years is 11.6. The most severe storms of the month occurred on the 11th, 17-18th, and 26-28th; the effects of the latter depression were felt in the vicinity of the Lakes and New England for over three successive days; it was accompanied by high winds with rain and snow. The storm of the 18th was peculiar, in being attended by very severe thunder-storms, for the season, in parts of New England, the middle Atlantic and west Gulf states, and the upper Mississippi valley.

Light frosts occurred in Florida and the Gulf States on the 28th.

A noteworthy feature in connection with the meteorology of the month is the unusually low temperature that prevailed in Montana and Dakota, the mean for the month in these territories being from 10° to 20° below the normal.

An excess over the average precipitation for February occurred in the greater part of the country.

In the preparation of this REVIEW the following data, received up to March 20, 1887, have been used, viz., the regular tri-daily weather-charts, containing data of simultaneous observations taken at one hundred and thirty-three Signal Service stations and twenty-one Canadian stations, as telegraphed to this office; one hundred and fifty-nine monthly journals; one hundred and sixty monthly means from Signal Service stations; twenty-one monthly means from Canadian stations; two hundred and eighty-seven monthly registers from voluntary observers; fifty-four monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the publishers of "The New York

Maritime Register;" monthly weather reports from the local weather services of Alabama, Arkansas, Illinois, Indiana, Kansas, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New England, New Jersey, North Carolina, South Carolina, and Tennessee; and of the Central Pacific Railway Company; trustworthy newspaper extracts, and special reports.

ATMOSPHERIC PRESSURE.

[Expressed in inches and hundredths.]

The distribution of mean pressure for February, 1887, determined from the tri-daily telegraphic observations of the Signal Service, is shown by isobarometric lines on chart ii.

Two areas of high pressure appear on chart ii; the first covers the greater part of Minnesota, Dakota, and Montana, within this area the mean pressure of the month is 30.20 or more; in the extreme northern part of Montana and Dakota it is 30.25. The second area of high pressure extends over the middle and south Atlantic states, where the mean of the month is also 30.20 or more; in the eastern part of North Carolina the high mean of 30.25 is attained. Two areas of comparatively low pressure appear on the chart; the first extends along the coast of Washington Territory, and is shown by the isobar of 29.90; the lowest mean pressure of the month occurs within this area, one station, Tatoosh Island, Washington Territory, giving a mean of 29.89. From this area southeastward the pressure increases rapidly until the isobar of 30.00 is reached at Portland, Oregon. The second low area covers the greater part of the middle plateau, and shows a mean of 29.95 or less.

The departures from the normal pressure are given in the table of miscellaneous meteorological data, and are also shown on chart iv by lines connecting stations of equal departure. The pressure of the month is above the normal over the valleys of the Mississippi and Missouri rivers, and from thence eastward to the Atlantic. In the plateau region of the Rocky Mountains, and along the Pacific coast, it is considerably below the normal. The larger departures in excess of the normal occur in Maine and the Canadian Maritime Provinces, where they range from .11 at Portland, Maine, to .16 at Halifax, Nova Scotia. The pressure is also largely in excess of the normal in the northern part of Minnesota, Dakota, and Montana. The greatest departures below the normal occur in the middle plateau region, the pressure of the month at two stations within this area, Salt Lake City, Utah, and Winnemucca, Nevada, being .18 and .17, respectively, below the normal.

The mean pressure of February, 1887, exceeds that of January, 1887, in all districts of the United States, except in the middle and southern plateau regions of the Rocky Mountains and along the Pacific coast. The increase in the northern districts, especially in Montana, is large; at one station, Fort Assinaboine, Montana, the pressure of February is .28 above that of January. In the upper Mississippi valley, the Lake region, and New England, the increase averages about .18. In Utah, Nevada, Oregon, and northern and central California, the pressure of February is about .15 below that of January.

BAROMETRIC RANGES.

The monthly barometric ranges at the various Signal Service stations are given in the table of miscellaneous data. An examination of the table will show that they are unusually large in all parts of the country, and especially in New England and the middle Atlantic states; this is due to the very high pressure that prevailed on the 3d, 4th, and 5th, and the

low pressure of the 11th and 18th. The following are some of the extreme monthly ranges:

Greatest.		Least.	
	Inch.		Inch.
Mount Washington, New Hampshire.....	2.24	Key West, Florida.....	0.39
Omaha, Nebraska.....	1.92	San Diego, California.....	0.52
Albany, New York.....	1.87	Sanford, Florida.....	0.58
Yankton, Dakota.....	1.84	Cedar Keys, Florida.....	0.59
Alpena, Michigan.....	1.84	Los Angeles, California.....	0.68
Portland, Maine.....	1.83	Yuma, Arizona.....	0.70
Port Huron, Michigan.....	1.82	Jacksonville, Florida.....	0.70

AREAS OF HIGH PRESSURE.

Eight areas of high pressure were observed within, or near the limits of, the stations of observation during the month of February. These areas were generally first observed in the extreme northwest north of Montana and Dakota, and their general course was to the eastward north of the Lake region, the southern portions extending over the United States. Two of these areas first appeared on the Pacific coast, one of which passed eastward north of the United States, and the other passed southeastward to the Gulf of Mexico. Of the areas which were first observed in the Northwest, two passed southeastward to the upper Mississippi valley, and one of these moved eastward, while the other disappeared by gradual decrease of pressure. The following is a detailed account of the meteorological conditions attending the movements of these areas:

I.—On the morning of the 1st the barometric pressure exceeded 30.80 in the regions north of Minnesota, with temperatures ranging from -28° to -35° . This area of high pressure extended eastward to the Atlantic and westward to Idaho, while the southern limit was bounded by the thirty-eighth parallel, extending from Virginia to Colorado. An area of unusually low pressure extended over the central Rocky Mountain and plateau regions, where the temperature was above freezing. The 7 a. m. report of the 2d indicates that this extended high pressure to the northward had divided, one portion moving directly eastward to the Saint Lawrence Valley, where the pressure exceeded 30.90; the other portion moved slightly southward to the upper Missouri valley, where the pressure exceeded 30.70, with temperatures ranging from -30° to -46° in Montana and Dakota. Immediately to the south of the high area central in the mountain regions, the area of low pressure previously referred to was observed in central and western Colorado; the barometric gradient being marked between northern Colorado and southern Montana, the range of pressure being 29.55 at Montrose, Colorado, to 30.61 at Fort Custer, Montana. During the succeeding day the eastern portion of this high area disappeared off the north Atlantic coast, while that portion over the northern Rocky Mountain region remained almost stationary in Montana, where the pressure increased to 30.87 and above, attended by temperatures ranging from -30° to -48° . This increase of pressure was attended by a rapid flow of cold air from the northern and central Rocky Mountain slopes to the Missouri Valley. On the following day it was central in Minnesota, where the pressure exceeded 31.00. The cold wave attending this area of high pressure extended southward to the Gulf States on the morning of the 4th, and eastward over the Lake region and Ohio Valley. The succeeding reports during the 5th and 6th indicate that this area moved directly eastward, with a slight variation in barometric pressure at the centre. It passed off the New England coast on the night of the 5th and was central east of Nova Scotia on the 6th, leaving a secondary high area over the south Atlantic states.

II.—This area of high pressure was apparently a part of the preceding one and was separated from it by a slight depression, within which the barometer fell to 30.20, north of the Lake region. When central in the region north of Montana it was attended by pressures ranging from 30.70 and above. It passed eastward during the 6th and 7th along the fiftieth parallel.

The temperature changes attending this high area were not as marked as those observed during the transit of number i in the interior, but the weather was cooler in the Maritime Provinces on the morning of the 8th, when the centre of greatest pressure was near to, and east of, the coast line.

III.—This area was first observed in the region north of Montana. The morning report of the 9th indicated the approach of a cold wave from Manitoba, where the temperature had fallen to -30° , while at the centre of the greatest pressure, the Saskatchewan Valley, it was ranging from -7° to -22° . In this case the lowest temperature being to the east of the centre of greatest pressure, was apparently an indication that the high area extended far to the northward, and that it would increase in energy and intensity. The trough of low pressure bounded the southern quadrants of this high area on the 10th, and extended from the upper Saint Lawrence valley to northern Texas, and thence northwestward to Oregon. The cold air from the region of highest pressure flowed rapidly southward over the eastern Rocky Mountain slope and the central valleys, apparently forcing the area of low pressure in the mountain regions to the south and west, and finally causing it to disappear by gradual increase of pressure. The barometric trough to the east contracted and developed great cyclonic energy, the winds being strongest from the west, owing to the rapid advance of this high pressure, attended by a cold wave which extended over regions eastward of the Mississippi during the 11th and 12th. After reaching the lower Missouri valley the direction of movement was to the east, the pressure increasing as the centre approached the Atlantic coast. When first observed this area was enclosed by the isobar for 30.50, and when last observed, passing off the New England coast, it was bounded by the isobar for 30.90. The entire Atlantic coast from Sydney to Florida was within its limits.

IV.—This area also first appeared in the region north of Montana, the a. m. report of the 14th indicating its movement to the southward. The centre was located in the region of the high mountain stations, and although the maximum pressure observed was only 30.34, the area was well defined and apparently possessed considerable energy, but after moving southeastward, without producing marked changes in temperature, it disappeared by gradual decline of pressure while passing over the central valleys and before reaching the coast.

V.—This area of high pressure approached from the Pacific, apparently moving northeast during the 16th and 17th, and it was probably central on the north Pacific coast on the morning of the 18th. A secondary area of high pressure developed east of the Rocky Mountains during the 18th, and moved eastward, north of the Lake region, during the 19th, 20th, 21st, and 22d, when it extended over the Maritime Provinces as a well-defined contracted area of high pressure, the barometer having risen at the centre over .20 in its passage over the centre of the continent to the coast line.

VI.—This area was observed north of Dakota on the afternoon of the 21st, and passed rapidly eastward, reaching the New England coast on the afternoon of the 23d, after which it disappeared rapidly, owing to the advance of the severe storm over the Lake region and the Saint Lawrence Valley. The temperature changes attending this and the preceding area were slight, and in each case light snows, followed by fair weather, were observed in the Northern States.

VII.—When this area appeared in the Northwest on the morning of the 23d, a low area was central in northern Texas and a second depression was approaching Washington Territory from the Pacific. The storm in the Southwest moved rapidly toward the Lake region, and was followed during the 24th by the advance of this high area over the central valleys, attended by clear and cold weather. The first movement was to the southward, the centre of greatest pressure reaching the forty-second parallel in the upper Mississippi valley, after which the movement was easterly over the Lakes during the 25th and 26th, when it disappeared to the east of Nova Scotia.

VIII.—This area appeared on the central Pacific coast on

the 25th, and, extending over the plateau region, was a well-defined area, remaining over the central Rocky Mountain region until the 27th. It then apparently caused the formation of a secondary high area to the southeastward over the Rio Grande Valley and the west Gulf during the 27th, after which the wind shifted to southerly in the Rocky Mountain regions, where the temperature rose and the barometer fell slowly until the end of the month.

AREAS OF LOW PRESSURE.

Eleven areas of low pressure were traced on the tri-daily weather charts during the month of February. In the region of greatest barometric disturbance, extending from the Saint Lawrence to the upper Mississippi valley, four well-defined depressions were traced from the Pacific coast over the Rocky Mountain region, and thence eastward to the north Atlantic coast. Three barometric disturbances passed eastward over the Rocky Mountains to the eastern slope, and were followed by secondary depressions which developed in the Mississippi Valley. These secondary areas moved eastward and developed greater energy as they approached the coast. The direction of movement of all areas in the Rocky Mountain regions was slightly to the southeast, and the direction of movement to the east of the one hundredth meridian was, in all cases, to the north of east. The only depression traced over the Southern States during the month was a secondary formation, with but slight energy.

The following table shows the latitude and longitude in which each area of low pressure was first and last observed, and the average hourly velocity of each:

Areas of low pressure.	First observed.		Last observed.		Average velocity of translation in miles per hour.
	Lat. N.	Long. W.	Lat. N.	Long. W.	
No. I.....	43 00	117 00	38 00	110 00	15.0
II.....	44 00	125 00	40 00	99 00	14.0
III.....	45 00	90 00	48 00	62 00	33.0
IV.....	42 00	116 00	38 00	104 00	46.0
V.....	42 00	90 00	47 00	59 00	37.0
VI.....	39 00	126 00	51 00	67 00	45.0
VII.....	38 00	126 00	50 00	66 00	28.0
VIII.....	38 00	107 00	29 00	100 00	25.0
IX.....	32 00	92 00	35 00	77 00	55.0
X.....	45 00	123 00	47 00	59 00	40.0
XI.....	47 00	125 00	48 00	65 00	38.0

Average rate of movement, 34.4 miles per hour.

The following is a brief description of the more important areas of low pressure traced during the month:

I.—The telegraphic reports received at 7 a. m. on the 1st indicated the presence of an extended area of low pressure central over the central plateau regions and reaching eastward to Colorado. These conditions continued until the morning of the 2d, when the low area had moved to the eastward from western Colorado, and the pressure had increased rapidly at the northern Rocky Mountain stations, there being a marked barometric gradient between southern Montana and northern Utah. In western Colorado the wind continued from the southwest during the 1st, and 2d, with high velocities, and, during this continued southwest wind, the pressure was increasing rapidly to the northeast, and the high area was moving southward over the Rocky Mountains, apparently crowding the low area to the westward; the direction of the wind at Montrose, Colorado, was perpendicular to the isobars during the 2d, and toward the region of greatest pressure. This condition was also observed at Cheyenne, Wyoming, during the 2d, and continued until the 3d, when a cold wave extended southward as far as Texas, over the eastern Rocky Mountain slope. The low area over the plateau regions gradually filled up, but the attending southerly winds in the eastern quadrants caused continued high temperatures over western Colorado, the boundary line of the cold wave apparently extending over central Colorado southward to the southeast portion of New Mexico. The temperature was unusually low in Wyoming as far west as Fort Bridger, while at Salt Lake City, Utah, and neighboring sta-

tions generally, it did not fall below 20° at the regular tri-daily report during the continuance of the severe cold to the east and north of Salt Lake City.

II and III.—Number ii was observed on the northern California coast at midnight of the 3d, and it passed slowly eastward over the central plateau region, becoming well defined during the 4th and 5th, and remaining almost stationary over Nevada until the afternoon of the 6th. The storm-track on chart i is approximately given, showing the position of the centre of this disturbance, and indicating an apparent westerly movement during the 5th, when an area of unusually high pressure extended over the northern Rocky Mountain stations. The easterly movement of this area was resumed, and corresponded to the easterly movement of the high area above referred to, during the 6th and 7th, the former passing over the Rocky Mountains and the eastern slope along the fortieth parallel, and finally disappearing after the 10 p. m. report of the 7th, while central over Kansas. It filled up and a secondary area developed, which has been traced as number iii, and which was central in central Wisconsin at the report above referred to. This secondary area developed great energy as it passed over the Lake region, attended by general rains in the south and east quadrants; the rain-area extending southward to the Gulf States. The pressure decreased rapidly at the centre as this disturbance passed down the Saint Lawrence Valley, and reached the minimum on the morning of the 9th, when the barometer at Anticosti, Gulf of Saint Lawrence, was reported as 29.18. Strong westerly gales prevailed after this disturbance moved over the north Atlantic, and the precipitation was heavy in the Maritime Provinces.

IV and V.—On the 9th a low area formed over the central plateau region and was apparently forced slowly to the southeastward by the advance of a cold wave over the northern Rocky Mountain regions, attended by an unusually high barometer. As this low area moved southeastward it became compressed, and, in the form of a barometric trough, extended from southeastern Colorado to Oregon. It was forced southward over Colorado and New Mexico during the 10th, and by midnight of that day it had been replaced by the rapid flow of the cold air from the north, along the eastern slope. This movement from the north was accelerated by the formation of a secondary depression in the central Mississippi valley, which has been traced as low area number v. In advance of this low area, at stations east of the lower Mississippi valley, the temperature was unusually high; at midnight of the 10th there was a difference of 60° between the temperatures observed in southeastern and northern Kansas. Area number v moved northeasterly over the lower lake region and thence to the New England coast, the pressure decreasing rapidly at the centre. A cold wave followed quickly to the westward, attended by strong westerly winds and violent storms on the coast north of Hatteras. The barometer reached its minimum, 29.01, at Yarmouth, Nova Scotia, at midnight of the 11th. The strongest gales on the New England coast occurred on the 12th, when the centre of lowest pressure was northeast of Sydney, Nova Scotia. The precipitation was heavy in the lower lake region and the Ohio and lower Missouri valleys as the centre of the disturbance passed over these sections, while light showers occurred in the northern portions of the Gulf States and light snows in the Northwest.

The following notes from Signal Service observers are of interest:

Springfield, Illinois: heavy rain fell during the early morning of the 11th; at 9.40 a. m. snow began falling and continued until 8.40 p. m. High northerly and westerly winds prevailed all day, attaining at 6.30 and 7.30 a. m. a velocity of thirty-two miles per hour from the west.

Columbus, Ohio: the morning of the 11th opened with heavy clouds and occasionally light rain, with barometric pressure 29.32 at 7 a. m. Shortly after this hour a high wind set in from the southwest; it then veered to northwest, and moved with the velocity of a gale. The wind continued to increase in force until it reached its maximum velocity, fifty-four miles per hour, at about 1 p. m. The high velocity of from thirty-five to forty-five miles per hour was retained until 6 p. m., when the gale began to subside. Light and heavy rain fell during the prevalence of this gale, and light snow from 7.30 to 9.15 p. m. No

serious loss resulted from the storm, but telegraph and telephone companies experienced considerable delay in work. During the afternoon a tornado occurred at Carrollton, twenty-five miles southeast of Columbus, destroying considerable property.

Saint Louis, Missouri: from 5 a. m. until 9.20 p. m. of the 11th a northwesterly gale prevailed, the velocity of the wind being over forty miles per hour. Numerous signs, trees, fences, and roofs in different parts of the city were blown down. Light rain fell from 1.45 until 3.30 a. m., and light snow from 10.10 until 11.55 a. m.

Pittsburg, Pennsylvania: during the 11th the barometer fell rapidly until 10 a. m., when it stood at 29.82, after which it rose slowly. Brisk south and southwest winds prevailed in the morning; during the afternoon the wind shifted to northwest and blew hard.

Philadelphia, Pennsylvania: during the 11th the barometer fell rapidly until 2.40 p. m., when it stood at 29.26. In the afternoon the wind blew a gale of thirty to thirty-eight miles per hour from the southwest; at 2.40 p. m. it shifted to the northwest and diminished in force. After sundown the wind again increased in force, and from 7.30 until after 10 p. m. blew at the rate of from thirty-two to forty-four miles per hour from the northwest.

Baltimore, Maryland: on the 11th a heavy wind storm began at 8 a. m. and continued throughout the day, attaining at 8.15 p. m. a maximum velocity of thirty-four miles per hour from the northwest. Several houses were unroofed or otherwise damaged, and trees, awnings, and wires blown down. Vessels arriving on the 12th report the storm of the preceding day as having been very severe on the Chesapeake Bay. A tow of twelve canal boats loaded with coal encountered the storm when near Pooles Island; four of the boats were sunk and the rest beached.

VI.—This area of low pressure developed in the Pacific and was first observed west of northern California on the morning of the 12th. It apparently moved rapidly northward and was central north of Washington Territory by midnight of the 12th; after this date its movement was easterly, first to the southeast during the 13th, the centre reaching the Missouri Valley near Yankton, Dakota, it then moved northeastward north of Lake Superior, and thence followed the general course of the Saint Lawrence Valley, crossing the continent in eighty hours, the centre being located between the forty-fifth and fiftieth parallels of latitude. It developed but slight energy and was attended by no unusual changes in the meteorological conditions within the limits of the United States.

VII.—This area appeared on the Pacific coast west of northern California on the morning of the 14th, and apparently moved southward along the coast line, after which it passed over southern California to Nevada during the 15th. It became well defined as an area of low pressure while on the Pacific coast, and the location of the centre of disturbance has been given for each telegraphic report from the time of its first appearance until it finally disappeared over the Gulf of Saint Lawrence; it crossed the Rocky Mountains near the fortieth parallel and was apparently retarded in its movements until it reached the Missouri Valley, after which the easterly movement was more rapid. The average velocity during its entire course, while under observation, was twenty-eight miles per hour. The barometric pressure was unusually low at the centre while passing over the eastern Rocky Mountain slope, and it was below 29.00 in the lower Missouri valley; the depression was almost circular in form, and when in the central Mississippi valley was bounded by eight continuous isobars, ranging from 29.1 to 29.8. After moving over the Lake region the pressure increased slightly at the centre of this storm, which evidently reached its maximum energy while crossing the upper Mississippi valley. The rain-area attending this disturbance included all sections of the United States, except the lower Rio Grande valley, although the precipitation was not unusually heavy, except on the southern Pacific coast.

The following notes relate to this low area:

Larned, Pawnee county, Kansas: a very heavy gale began at 5.30 a. m. of the 17th and continued about thirty hours. Considerable damage was done to buildings in course of construction in Larned and throughout Pawnee county.

Columbus, Ohio: light and heavy rain fell during the night of the 17-18th, with very low barometer; lowest reading, 29.29, at 9.40 a. m. of the 18th. At 10 a. m. the wind changed from southeast to southwest and blew hard, attaining at 10.40 a. m. the velocity of a gale; maximum velocity, forty-five miles per hour, at 1.50 p. m. The gale continued until 1.55 a. m. of the 19th.

Pittsburg, Pennsylvania: rain fell at intervals on the 18th until 10 a. m. At 1.38 p. m. rain, with thunder and lightning, set in; direction of wind before the storm commenced, south; after the storm had ended, west. For about ten

minutes, before 2 p. m. hail fell, the stones being about the size of a pea. During the day the barometer fell rapidly, reaching 29.80 at 2 p. m.

Buffalo, New York: a severe gale, with rain, set in at 7.30 a. m. of the 18th and continued until 6.35 p. m. of the 19th, reaching at 2 a. m. of the 19th a velocity of sixty miles per hour from the southwest. Considerable damage was done in this city and over the surrounding country; trees, signs, fences, and two large houses were blown down by this gale, which was one of the most severe of the winter.

VIII and IX.—The telegraphic reports of the 18th indicated that a depression was forming in the central Rocky Mountain regions, and the succeeding reports show that this depression was moving slowly southeastward toward the Rio Grande Valley. The depression was slight, and the movement can only be approximately traced. It disappeared apparently in the lower Rio Grande valley, and was followed by the formation of a slight disturbance in the lower Mississippi valley at midnight of the 19th. This slight barometric disturbance was attended by heavy rains throughout the Gulf States during the 19th, and light rains over the states east of the Mississippi on the 20th. The depression moved rapidly to the eastward and passed off the coast near Hatteras, and probably disappeared by increase of pressure.

X.—This area was observed on the Pacific coast on the morning of the 21st, and moved directly southeastward, crossing the Rocky Mountains to northern Texas, where the direction changed to the northeast, and finally disappeared over New England on the 25th. Like the storms previously traced from the Pacific coast during this month, the location of the centre of disturbance is given for each eight hours from the time of first observation until the last telegraphic report received during the transit of the storm. In this case the time occupied in crossing the continent was four days. It appeared in the west and disappeared in the east near the forty-fifth parallel, but its centre moved as far south as the thirty-fourth parallel while passing over the eastern slope of the Rocky Mountains. It increased in energy as it moved eastward, the barometer reaching the minimum, 28.86, at Sydney, Nova Scotia, on the morning of the 25th. The most severe gales occurred on the New England coast during the 24th, but high westerly winds continued on the 25th.

XI.—This area also appeared on the north Pacific coast, and was first observed at midnight of the 23d west of Washington Territory. It moved over a path almost parallel to that described for the previous storm and about 5° of latitude to the north, except in the eastern portions of the United States, where the tracks approach each other. Its southeasterly course continued from Washington Territory to western Kansas, and its northeasterly course from western Kansas to the lower Saint Lawrence valley. This storm occupied eighty-eight hours in crossing from the Pacific to the Atlantic coast, moving with an average hourly velocity of thirty-eight miles; while the preceding storm crossed the continent in ninety-six hours, with an average hourly velocity of forty miles. This storm also increased in energy as it approached the Saint Lawrence Valley, and the minimum pressure of the storm, and of the month, was observed at Anticosti, Gulf of Saint Lawrence, on the afternoon of the 27th, when the barometer fell to 28.73. The westerly gales on the Atlantic coast were unusually severe on the 27th, and extended as far south as Georgia. After reaching northern New England the direction of movement apparently changed from east to northeast, and at the close of the month it had disappeared to the northeast of Newfoundland, followed by cold northwesterly winds and clear weather along the Atlantic coast.

The following notes, from Signal Service observers, are of interest in connection with the description of this severe storm:

Port-Huron, Michigan: at 11 p. m. of the 25th a heavy easterly wind set in and continued to blow hard until 2.20 a. m. of the 26th; at 5.30 p. m. of the 26th it shifted to the southwest and increased in force; reaching a maximum velocity of fifty-two miles per hour from the southwest at 7 p. m. The gale during the 26th was accompanied by heavy snow until 7.40 a. m., when light rain began falling.

Columbus, Ohio: heavy rain fell during the early morning of the 26th. At

3.15 p. m. a southwesterly gale set in and increased in force until 10 p. m., when it reached a velocity of sixty miles per hour.

Sandusky, Ohio: light rain and snow, with southwesterly winds, prevailed during the early morning of the 26th. From 5.15 a. m. until 10 a. m. the wind blew at the rate of from twenty to twenty-five miles per hour, attaining at one time a velocity of thirty-five miles per hour. At 10 a. m. it veered to the west and increased in velocity. The gale continued during the remainder of the day, throughout the 27th, and until 6 a. m. of the 28th. On the 27th it frequently attained a velocity of thirty to forty-six miles per hour, with snow squalls at intervals. The observer states that the wind storm was more severe and continued longer than any other that has occurred since the establishment of this station.

Buffalo, New York: rain and snow fell at intervals throughout the 26th. A severe southeasterly gale set in at 12.40 p. m. and continued until after midnight. The observer at this place states that this was the most destructive storm that has occurred here for several years. Six houses in course of construction were levelled to the ground, and one person killed; a number of persons were injured by falling signs, trees, etc. The gale continued throughout the night of the 26-27th and until 9.35 a. m. of the 28th, reaching at 6.55 a. m. of the 27th a velocity of sixty-one miles per hour.

Rochester, New York: during the night of the 25-26th the barometer fell rapidly, from 30.02 to 29.40; at 8 a. m. the wind increased in force and began blowing a gale from the south, reaching at 2 p. m. a velocity of fifty-four miles per hour. The gale continued during the day, but shifted after midnight to the west and northwest.

Pittsburg, Pennsylvania: from 4 to 5.15 a. m. of the 26th heavy snow fell, from 5.15 a. m. until 3.30 p. m. rain fell, also from 6.35 to 9 p. m.; total precipitation, 2.01 inches. High easterly winds prevailed during the greater part of the day; late in the afternoon a westerly gale set in, maximum velocity, forty miles per hour, at 7.40 p. m. The high wind damaged property to the extent of several thousands of dollars. Brisk westerly wind continued to blow all day of the 27th, attaining at 2.40 a. m. a velocity of thirty-two miles per hour.

Erie, Pennsylvania: on the 26th a very severe wind storm set in at 12.45 a. m., attaining at 2.10 p. m. a velocity of forty-four miles per hour from the south; for five minutes, at about 12.30 p. m., the wind blew at the rate of fifty miles per hour. Snow fell during the night of the 26-27th. On the 27th the wind blew hard all day from the northwest, greatest velocity forty-three miles per hour. The gale continued until 4.15 a. m. of the 28th. This gale was continuous for fifty-one hours and thirty minutes, and raised the water in the harbor higher than has been known for years, doing considerable damage to property on and about the wharves. Several light buildings were blown down, and one person killed.

Louisville, Kentucky: clear weather, high temperature, and heavy westerly winds prevailed during the 27th; in the afternoon the wind blew a gale and did considerable damage, especially along the river. The steamers "Residence" and "Hibernia" were thrown together by the force of the gale, the former was sunk and the latter badly damaged. The exposition buildings were also injured to the extent of about \$1,000.

NORTH ATLANTIC STORMS DURING FEBRUARY, 1887.

[Pressure in inches and millimetres; wind-force by Beaufort scale.]

The paths of the depressions that have appeared over the north Atlantic Ocean during the month are determined, approximately, from international simultaneous observations furnished by captains of ocean steamships and sailing vessels; abstracts of ships' logs and other data collected by the Signal Service agencies at the ports of New York, Boston, and Philadelphia; reports received through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the proprietors of the "New York Maritime Register," and from other miscellaneous data received at this office up to March 21, 1887.

Twelve depressions are traced, of which six passed eastward over Newfoundland; one apparently developed south of Nova Scotia, and five first appeared over mid-ocean. The general course of direction of the depressions was east-northeast to northeast, the exceptions being number v, which moved northwest from northward of the Azores, and number vii, which passed north-northeast over mid-ocean.

The month opened with a deep depression central over mid-ocean in about N. 54°, which caused unsettled weather and gales from the Banks of Newfoundland to the British Isles. To the southward of Newfoundland, and over the entire ocean south of the fortieth parallel, the barometric pressure was high. During the 2d and 3d low pressure, with north to west gales and rain, continued over the ocean east of the Banks, while off the American coast and to the southward of the fortieth parallel the barometer was high. On the 4th, under the influence of a depression which passed eastward over the Gulf of Saint Lawrence and Newfoundland, there was a decided de-

crease in barometric pressure, and strong south to west gales and rain off the coasts of the United States and Canadian Maritime Provinces and south of the Banks; there was also an appreciable decrease in pressure over, and to the eastward of, the Azores. On the 5th fresh to strong gales encircled a deep depression which had advanced over mid-ocean from Newfoundland, and the barometer had risen rapidly west of the fiftieth meridian and over, and to the westward of, the Azores. By the 6th the centre of disturbance had moved northeast and the pressure continued high over the western portion of the ocean, exhibiting a barometric maxima off the coast of the United States, where rain and fresh gales indicated the approach, or development of, a cyclonic area.

By the 7th there had been a rapid increase in pressure over the ocean to the eastward of the Banks, and an area of low pressure, which evidently developed in the vicinity of Nova Scotia, was central south of Newfoundland. By the 8th the depression had advanced rapidly northeastward from the southern edge of the Banks of Newfoundland, accompanied by violent disturbances, which were encountered southward to the thirtieth parallel; over the eastern and western portions of the ocean the barometer was high. On the 9th two depressions, one to the northward of the Azores and the other over the Gulf of Saint Lawrence, contributed to cause stormy weather west of the twentieth meridian; over the British Isles the pressure was high. On the 10th two depressions appeared, one, of considerable depth, having moved southeast over the Banks from the Gulf of Saint Lawrence, and the other, relatively shallow, having advanced from the southeastward over mid-ocean; over the British Isles and off the coast of the United States the pressure was high.

On the 11th a depression of moderate depth was central over mid-ocean and the barometer was falling rapidly over, and to the southward of, the Canadian Maritime Provinces; over the eastern portion of the ocean the pressure continued high. On the 12th a depression central south of Newfoundland caused heavy gales over the Banks and southward to the thirtieth parallel; over the eastern half of the ocean the barometer was high, with generally settled weather. By the 13th a depression had advanced northeast over mid-ocean from south of Newfoundland, accompanied by fresh to strong gales and rain; the depression, while not exhibiting unusual barometric minima, dominated the wind-directions from coast to coast, and the barometric gradient was steep to the eastward and westward. On the 14th the pressure was generally high from coast to coast. On the 15th a depression of slight depth appeared to the eastward of the Banks; over the balance of the ocean the pressure was high. On the 16th a shallow depression was central off the coast of the United States, in N. 39°, and a cyclonic area of slight energy was located over mid-ocean in N. 50°; to the eastward of the twenty-fifth parallel and southeast of the Banks the pressure was high. On the 17th a depression central over the Gulf of Saint Lawrence caused unsettled weather over, and to the southward of, Newfoundland; over all other portions of the ocean the pressure was high and the weather generally settled.

By the 18th the passage of a shallow depression northward of the fiftieth parallel caused fresh gales and rain over the Banks, while over the eastern half of the ocean and off the coast of the United States the pressure was high. During the 19th and 20th the pressure continued high over the ocean, except that on the latter date the barometer fell rapidly over Newfoundland and the adjacent ocean, with winds shifting to southerly over the Banks, indicating the approach of a barometric depression from the westward. By the 21st a storm-area of considerable energy had passed rapidly northeast over mid-ocean from the Gulf of Saint Lawrence, and the barometer had fallen rapidly from the forty-fifth meridian to the British coasts. From the 22d to the close of the month the meteorological conditions over the ocean were very unsettled, and the depressions which appeared daily over mid-ocean were characterized by disturbances of pronounced strength.

For February, 1886, the paths of eleven depressions were traced, of which, four were continuations of storms which first appeared over the North American continent; one apparently developed off the coast near Cape Hatteras; one was traced from the Caribbean Sea, and five were first shown over the ocean. The general direction of movement of the depressions was northeastward, excepting one, whose course was about south-southeast.

As compared with the corresponding months of previous years, the weather over the north Atlantic Ocean during February, 1887, was seasonable; the depressions traced corresponded closely in number and character with those charted and described for previous years, and phenomena of an unusual nature were not reported.

The following are brief descriptions of the depressions traced:

1.—This storm was central on the 1st in about N. 54°, W. 35°, whence it moved ene. to N. 57°, W. 22° by the 2d, after which it passed to the northward of Scotland, where it was apparently central on the 3d. The depression exhibited considerable energy throughout its course, and central pressure ranging below 29.00 (736.6) was indicated during the 2d and 3d.

The following special reports have been rendered relative to disturbances encountered within the area of this depression:

Third Officer H. Mayer, of the s. s. "Hermann," Capt. A. Kohlmann, commanding, reports: "1st, in N. 48° 13', W. 30° 25', from 7 p. m., had nearly a full hurricane from w; lowest barometer 29.61 (752.1); wind moderated after midnight." Capt. W. Rea, of the s. s. "Bassano," reports a whole gale from sw. to nw.; lowest barometer, 29.13 (739.9), at 8 p. m. of the 2d, in N. 54° 11', W. 18° 28'. Capt. E. Maddox, of the s. s. "Norseman," reports a fresh westerly gale from the 1st to the 3d; lowest barometer, 29.20 (741.7), at 12 noon of the 2d, in N. 51° 13', W. 23° 42'. This gale was attended by severe hail squalls throughout, and rain and sleet at times, and high seas. Captain Trinick, of the s. s. "Milanese," reports a strong westerly gale during the 1st and 2d; lowest barometer, 29.48 (748.8), at noon of the 2d, in N. 47° 57', W. 25° 52'.

Capt. B. Gleadell, of the s. s. "Germanic," reports a whole sw. gale on the 2d; lowest barometer, 29.49 (749.0), at 4 a. m., in N. 48° 5', W. 41° 17'. Capt. C. Heibich, of the s. s. "Wieland," reports a westerly storm; lowest barometer, 29.67 (753.6), at 3 a. m. of the 2d, in N. 45° 3', W. 43° 26'. Capt. G. de Kersabiec, of the s. s. "La Normandie," reports a westerly storm from the 1st to the 3d; lowest barometer, 29.06 (738.1), at 3 p. m. of the 2d, in N. 48° 50' W. 34° 45'. During this storm the sea was monstrous, and often dangerous, the ship laboring badly even at reduced speed. Capt. W. Pearce, of the s. s. "Italy," reports a whole westerly gale during the 1st and 2d; lowest barometer, 29.32 (744.7), at 4 p. m. of the 2d, in N. 50° 09', W. 33° 02'. Capt. J. Ueberweg, of the s. s. "Waesland," reports a strong wsw. gale during the 2d and 3d; lowest barometer, 29.45 (748.0), at 1 a. m. of the 3d, in N. 50° 0', W. 17° 15'. The gale was accompanied by heavy hail squalls.

2.—This depression appeared in N. 55°, W. 20° on the 4th, whence it passed eastward over the British Isles by the 5th, without evidence of marked energy.

3.—this storm passed eastward from Newfoundland during the 4th and was central on the 5th in N. 51°, W. 38°, with strong gales and rain over a considerable area; from this position the centre of depression moved northeast to N. 58°, W. 27° on the 6th, after which it passed northeast beyond the region of observation.

The following special reports indicate the general character of this depression:

Capt. C. Heibich, of the s. s. "Wieland," reports a whole s. to nnw. gale during the 4th and 5th; lowest barometer, 29.72 (754.9), at 3 p. m. of the 4th, in N. 41° 36', W. 57° 15'. Capt. C. J. Lindall, of the s. s. "Vancouver," reports a whole westerly gale during the 4th and 5th; lowest barometer, 29.40 (746.7), at 8 a. m. of the 5th, in N. 44° 45', W. 50° 50'. The s. s. "Norseman" encountered a strong s. to w. gale from the

4th to the 6th; lowest barometer, 29.30 (744.2), at 12 noon of the 5th, in N. 48° 55', W. 37° 38'. Capt. A. McDougall, of the s. s. "Prussian," reports a fresh westerly gale on the 6th; lowest barometer, 29.53 (750.0), at 4 p. m., in N. 54° 38', W. 20° 0'. Capt. A. Potjer, of the s. s. "Schiedam," reports a whole s. to w. gale on the 5th and 6th; lowest barometer, 29.45 (748.0), at 3 a. m. of the 6th, in N. 49° 0', W. 29° 40'.

4.—This depression apparently developed in the vicinity of Nova Scotia during the 6th and moved eastward to N. 43°, W. 53° by the 7th, whence it circled rapidly northeast to N. 53°, W. 32° by the 8th, after which it passed northeast beyond the region of observation. The storm attained great strength during the 8th, with pressure ranging below 29.00 (736.6).

The following special reports are descriptive of the general meteorological conditions which attended the depression:

Capt. L. A. Müller, of the s. s. "Sorento," reports a hurricane on the 7th and 8th; wind backed from sw. to se. and veered to nw.; lowest barometer, 28.38 (720.8), at midnight of the 7th, in N. 48° 20', W. 34° 0'. While the wind was blowing with hurricane force from the se. at midnight of the 7th, a heavy thunder-storm prevailed, with vivid lightning. Capt. J. Ueberweg, of the s. s. "Waesland," reports a strong gale on the 7th and 8th; wind backed from ne. to n.; lowest barometer, 29.45 (748.0), at 10 p. m. of the 7th, in N. 46° 40', W. 39° 15'. Mr. James Lynch, observer on the s. s. "Spain," Capt. W. A. Griffiths, commanding, reports: "7th, midnight, strong and increasing breeze, falling barometer, hard squalls, with rain, wind ne. 8th, wind increased to a strong gale, with heavy confused sea, hard squalls, and vivid lightning; 8 a. m., wind blowing with hurricane force and veering to sw.; lowest barometer, 28.55 (725.2), in N. 49° 24', W. 33° 58'; after the storm the wind veered to northward."

Capt. R. F. Jones, of the s. s. "Galileo," reports a strong gale on the 8th; wind veered from s. to w.; lowest barometer, 29.66 (753.4), at 10.20 a. m., in N. 49° 12', W. 26° 29'. The gale blew strongest between s. and ssw. from 8 a. m. to 4 p. m. Capt. Wm. Rea, of the s. s. "Bassano," reports a whole gale on the 7th and 8th; wind backed from wsw. to se. and shifted suddenly to nnw.; lowest barometer, 28.62 (726.9), at 4 a. m. of the 8th, in N. 49° 08', W. 36° 35'. The wind blew hurricane force, with shift to nnw., accompanied with hail and sleet. Capt. J. H. Jones, of the s. s. "Rydal Water," reports a hurricane on the 7th and 8th; wind veered from s. to wsw.; lowest barometer, 29.30 (744.2), at 4 a. m. of the 8th, in N. 45° 43', W. 33° 13'. Capt. H. Parsell, of the s. s. "Adriatic," reports a strong to whole gale on the 7th and 8th; wind backed from se. to ne.; lowest barometer, 29.74 (755.4), at 10 a. m. of the 8th, in N. 47° 55', W. 37° 10'. Capt. A. Albers, of the s. s. "Rugia," reports a whole gale from the 7th to the 9th; wind backed from sw. to se., then, at 3.10 a. m. of the 8th, shifted suddenly to n., with force 11; lowest barometer, 28.60 (726.4), at 3 a. m. of the 8th, in N. 48° 9', W. 35° 58'.

Capt. W. Fitt, of the s. s. "Brooklyn City," reports having encountered a hurricane on the 8th, in N. 51° 20', W. 27° 0'; wind veered from se. to ssw.; ship hove-to nine hours in a very heavy sea. Capt. W. A. Griffiths, of the s. s. "Spain," reports a hurricane on the 8th; wind set in se. a whole gale, veered to sw. and calm, then to nw. hurricane; sea very high, and ship's head could not be seen for drifts; lowest barometer, 28.55 (725.2), at 10.10 a. m., in N. 49° 24' W. 33° 58'. Capt. T. Jungst, of the s. s. "Ems," reports a hurricane on the 8th; wind backed from sw. to n.; lowest barometer, 28.58 (725.9), at 2 a. m., in N. 47° 50', W. 37° 10'. From 1.30 a. m. till nearly 2 a. m. it was nearly calm, then the gale set in and occasioned a violent cross sea, in which the vessel labored fearfully. Capt. A. Potjer, of the s. s. "Schiedam," reports a heavy storm on the 7th and 8th; wind backed from se. to n. and nnw.; lowest barometer, 28.65 (727.8), at 2 a. m. of the 8th, in N. 47° 40', W. 37° 10'.

Capt. W. McNay, of the s. s. "Palmyra," reports: "February 8th, 1.45 a. m., in N. 48° 10', W. 36° 0', during thunder and lightning, a meteoric rock, resembling a ball of bluish electric light about one and one-half feet in diameter, shot

across the ship's bridge about ten feet overhead, moving from se. to nw., and fell in the sea with a sizzling noise; sparks of fire flew from the rock in its passage, leaving a bluish trail of light and a strong smell of sulphur. At the time this phenomenon appeared the wind was ssw., force 8; barometer 29.58 (751.3).

5.—This depression first appeared to the northward of the Azores on the 9th, and, moving northwest, passed north of the region of observation after the 10th. The depression, although of but moderate depth, occasioned gales attaining hurricane force during the 10th, of which the following reports are brief descriptions:

The s. s. "Kansas" encountered a hurricane on the 10th; wind veered from ene. to s., w., and nnw.; lowest barometer, 29.60 (751.8), at 8 a. m., in N. 48° 24', W. 34° 40'. Capt. A. Potjer, of the s. s. "Schiedam," reports a whole gale from the 9th to the 11th; wind veered from sse. to nw.; lowest barometer, 29.27 (743.5), at 5 a. m. of the 10th, in N. 45° 10', W. 47° 45'. Capt. E. Bentley, of the s. s. "Wisconsin," reports a whole gale on the 10th and 11th; wind shifted from sw. to wnw.; lowest barometer, 29.10 (739.1), at 8 p. m. of the 10th, in N. 47° 0', W. 39° 30'.

6.—This depression moved ese. over Newfoundland during the night of the 9th and was central on the 10th in N. 45°, W. 47°, with central pressure about 29.40 (746.7), whence it circled ene. to N. 48°, W. 34° by the 11th, after which it apparently continued an ene. course and gradually filled up. While no special reports have been rendered relative to this depression, fresh to strong gales and rain were recorded with the regular observations of the 11th within its area.

7.—This depression moved from south of Newfoundland on the 12th to N. 51°, W. 39° by the 13th, after which it apparently passed northeast and dissipated. The depression was of moderate depth throughout, and, as is shown by the following special reports, occasioned hard gales to the southward of Nova Scotia and Newfoundland during the 11th and 12th, while central to the westward of Newfoundland.

Capt. E. Maddox, of the s. s. "Norseman," reports a terrific nw. gale during the night of the 11-12th, when sixty miles east of Boston; on approaching land the wind abated. Captain McKee, of the s. s. "Mercedes," reports a strong gale on the 11th and 12th; wind veered from sw. to n. by e.; lowest barometer, 29.70 (754.4), at 12 midnight of the 11th, in N. 35° 18', W. 72° 0'. Capt. G. Turnbull, of the s. s. "Ella Sayer," reports a strong sw. to nw. gale on the 11th; lowest barometer, 29.80 (756.9), at 8 p. m., in N. 36° 39', W. 69° 2'. Capt. J. Ueberweg, of the s. s. "Waesland," reports a strong sw. to nw. gale on the 11th and 12th; lowest barometer, 29.38 (746.2), at 12 midnight of the 11th, in N. 41° 15', W. 63° 0'. Capt. A. Renflew, of the s. s. "Scandinavia," reports a storm attaining force 11 during the 11th and 12th; wind veered from sw. to nnw.; lowest barometer, 29.41 (747.0), at 8 a. m. of the 12th, in N. 42° 30', W. 55° 30'.

Capt. Edward Bentley, of the s. s. "Wisconsin," reports a strong gale on the 12th and 13th; wind veered from sw. to n.; lowest barometer, 29.20 (741.7), at 4 p. m. of the 12th, in N. 43° 45', W. 48° 50'. Capt. D. D. Galbraith, of the s. s. "Durham City," reports a strong gale on the 13th and 14th; wind veered from s. to nnw.; lowest barometer, 29.11 (739.4), at 4 a. m. of the 14th, in N. 47° 24', W. 32° 0'. The gale was attended by heavy rain and high seas, and blew strongest, force 9, from s., from midnight of the 13th to 6 a. m. of the 14th, then veered suddenly to nnw. and moderated at 7 a. m.

8.—This depression appeared in N. 47°, W. 36° on the 15th and moved nne. to N. 50°, W. 35° by the 16th, without evidence of special energy, after which it disappeared to the northward.

9.—This storm was central over the Gulf of Saint Lawrence on the 17th, whence it passed northeast to N. 53°, W. 42° by the 18th, from which position it moved northeast beyond the region of observation. The depression was of slight depth and occasioned moderate gales and rain.

10.—This depression passed over the northern extremity of Newfoundland during the 20th and was central in N. 55°, W. 33° on the 21st, whence it moved slowly east to W. 24° by the 22d, thence passing ene. the centre of depression is located in N. 52°, W. 16° under date of the 23d, after which it apparently advanced to the north of Scotland. The storm augmented energy as it advanced eastward, as is shown by the following special reports:

Capt. R. P. Moore, of the s. s. "Siberian," reports a whole westerly gale on the 21st and 22d; lowest barometer, 29.11 (739.4), from 8 p. m. to midnight of the 21st, in N. 53° 0', W. 22° 35'. The gale was accompanied by rain and very high seas. Capt. P. J. Irving, of the s. s. "Celtic," reports a whole gale on the 20th and 21st; wind veered from sse. to wnw.; lowest barometer, 29.27 (743.4), at noon of the 21st, in N. 49° 14', W. 32° 0'. Captain Vögelgesang, of the s. s. "Rhaetia," reports a whole gale on the 21st and 22d; wind veered from sw. to wnw.; lowest barometer, 29.40 (746.7), at 4 a. m. of the 1st, in N. 46° 36', W. 38° 22'. Capt. M. de Jousselein, of the s. s. "La Bretagne," reports a strong gale from the 21st to the 23d; lowest barometer, 29.10 (739.0), at 4 a. m. of the 23d, in N. 48° 27', W. 30° 0'; wind shifted from s. to nw. Capt. H. Richter, of the s. s. "Saale," reports a storm on the 22d and 23d; wind veered from nnw. to nne.; lowest barometer, 29.36 (745.7), at 3 p. m. of the 22d, in N. 45° 11', W. 39° 32'.

Capt. J. W. Massam, of the s. s. "Principia," reports: "21st, in N. 49° 34', W. 22° 0', at 4 a. m. of the 22d, strong gale, veering and backing from sw. to w., with heavy rain and high seas; 1 p. m., backed to ssw.; 8 p. m., backed to se.; midnight, barometer 28.78 (731.0). 23d, 1 a. m., wind se., force 9, vivid lightning, and heavy rain; 1.30 a. m., backed to ne., force 11, very heavy confused sea; 4 a. m., in N. 49° 10', W. 27° 40', barometer 28.50 (723.9); 5 a. m., backed to n., force 9, high seas and terrific squalls; 6 p. m., backed to nw., force 9, heavy rain squalls; moderated at midnight." Capt. George Moodie, of the s. s. "State of Georgia," reports: "23d, in N. 53° 51', W. 24° 7', wind s. to sw., force 4 to 7, rain at times; 9 a. m., wind shifted to nw. and blew with hurricane force for two hours, accompanied with heavy rain; wind then backed to westward and moderated; lowest barometer 28.42 (721.9); heaviest sea from southward."

11.—This depression first appeared in N. 49°, W. 35° on the 24th, whence it had advanced from the southwestward; from this position it moved slowly northeastward to N. 51°, W. 31° by the 25th; thence passing northeast to N. 55°, W. 17° by the 26th the depression disappeared in the direction of the north Scottish coast. This area was accompanied by disturbances of pronounced violence, and barometric pressure ranging below 28.50 (723.9) was shown on the 25th.

The following special reports have been made in connection with the passage of this depression:

Mr. J. H. Newman, observer on the s. s. "Denmark," Capt. R. S. Rigby, commanding, reports: "24th, 17 hours 29 minutes, in N. 49° 15', W. 22° 21', barometer 29.32 (744.7) and falling, wind sse., moderate, increasing gale, with heavy passing clouds and rough sea from sse.; 20 hours 30 minutes, barometer 29.00 (736.6), wind s. by e., strong gale with overcast sky and misty rain, very heavy southerly sea running, causing the vessel to labor heavily and ship large quantities of water fore and aft; brought ship's head to the wind; noon, barometer 28.90 (734.0), blowing a whole gale from s. by e., with a very dangerous sea running. 25th, 4 hours 33 minutes, in N. 49° 3', W. 23° 17', barometer 28.84 (732.5), lowest reading, gale moderating and sky clearing; during the balance of the day the barometer rose steadily, and the wind veered to wsw. and wnw., afterwards becoming variable between s. and wsw., with violent squalls, heavy showers of rain, and a high confused sea."

The s. s. "Siberian" experienced a whole gale from 8 p. m. of the 24th to 2 p. m. of the 25th; wind backed from ne. to nne.; lowest barometer, 28.89 (733.8), at 10 p. m. of the 24th, in N. 47° 39', W. 37° 35'. Capt. G. Moodie, of the s. s. "State

of Georgia," reports: "24th, the wind for the last eight hours has been baffling all around the compass, the barometer at the same time going down rapidly. In the afternoon the wind settled about ne. and increased to force 11, and at 3 a. m. of the 25th the barometer stood at 28.88 (733.5); 6 a. m. the wind began to back to northward, with constant blinding rain; then backed to nw. and moderated, with clearing weather; heaviest sea from ne.; barometer lowest in N. 50° 56', W. 35° 12', on the 25th." Capt. W. P. Couch, of the s. s. "Ontario," reports: "24th, 8 a. m., wind freshening from northward and veering to nne., barometer 29.80 (756.9); noon, in N. 45° 44', W. 39° 35', strong breeze from nne., with hail squalls; 4 p. m., strong gales, heavy squalls with hail, barometer 29.50 (749.3); 6 p. m., heavy gale, hail and sleet, barometer 28.97 (735.8), heavy sea, wind nne.; during the a. m. of the 25th the barometer rose, and the gale moderated, backing to nw."

Capt. C. Ludwig, of the s. s. "Servia," reports: "25th, in N. 49° 56', W. 12° 56', at noon; in the forenoon, fair; at noon the wind suddenly freshened; 5 p. m., storm and heavy sea from ssw.; during the night heavy gale from the s. and tremendous sea; the ship labored heavily and shipped much water; from 4 to 8 a. m. of the 26th, in N. 49° 46', W. 19° 34', at noon, storm decreased and veered to westward." Commodore W. G. Randle, of the s. s. "Westernland," reports a whole gale on the 24th and 25th; wind veered from sse. through w. to n.; lowest barometer, 28.42 (721.9), at 1 a. m. of the 25th, in N. 45° 54', W. 35° 57'. The gale was accompanied by violent rain squalls, thunder, and lightning.

Capt. G. Meier, of the s. s. "Elbe," reports a westerly storm from the 24th to the 26th; lowest barometer, 28.21 (716.5), at 7 a. m. of the 25th, in N. 47° 14', W. 31° 50'. The s. s. "Principia" encountered a hurricane, attaining greatest force at midnight of the 24th, in N. 47° 25', W. 36° 30', when barometer stood 28.77 (730.7). Capt. Samuel Walters of the s. s. "Iowa," reports a whole gale on the 25th; wind veered from sse. to nw.; lowest barometer, 28.28 (718.3), at 6.46 a. m., in N. 47° 20', W. 33° 25'. Capt. H. C. v. d. Zee, of the s. s. "Zaandam," reports a storm on the 25th and 26th; wind veered from sse. to sw.; lowest barometer, 29.10 (739.1), at 3 p. m. of the 25th, in N. 49° 2', W. 23° 27'.

12.—This depression was central off the southwest coast of Newfoundland on the 25th, whence it passed east to N. 48°, W. 45° by the 26th; by the 27th the storm-centre had moved to N. 50°, W. 30°, after which it passed northeast beyond the region of observation. Disturbances of great violence accompanied the passage of this depression, and the following special reports refer to storms encountered previous, and subsequent, to its passage eastward from Newfoundland:

Capt. C. W. Möller, of the s. s. "Geiser," reports: "24th, at noon, in N. 41° 57', W. 58° 56', calm, with clear sky, barometer 29.93 (760.2); in the afternoon a breeze sprang up from sse., gradually increasing, sky overcast, barometer falling rapidly; 7 p. m., barometer 29.29 (744.0), wind sse., force 8 to 10, heavy-rain showers; 8.20 p. m., in N. 41° 45', W. 60° 53', barometer 29.10 (739.0), wind sse., force 10, blowing with terrible gusts; 9 p. m., the barometer read lowest, 29.06 (738.0); in a squall of fearful violence the wind shifted to w. by n. and wnw., and the weather cleared. 25th, 3 a. m., the wind increased to hurricane force from wnw., with snow squalls and rising barometer; noon, in N. 41° 27', W. 62° 25', barometer 29.37 (746.0), wind nw., force 9 to 11; during the afternoon the barometer continued to rise and the gale moderated."

Capt. T. Young, of the s. s. "Mareca," reports a storm from the 24th to the 26th; wind veered from se. to nw.; lowest barometer, 29.31 (744.5), at 8 p. m. of the 24th, in N. 43° 0', W. 62° 30'. Capt. G. J. Vis, of the s. s. "Rotterdam," reports a storm from the 24th to the 26th; wind veered from se. to n.; lowest barometer, 29.00 (736.6), at 10 p. m. of the 24th. Capt. G. Evans, of the s. s. "Peconic," reports: "24th, in N. 39° 55', W. 62° 41' (at noon); in the p. m. the wind veered to southward; 4 p. m. (Greenwich mean time), heavy gale from s., with high sea running, and rain; barometer fell to 29.43 (747.5);

6 p. m., gale gradually veered around to westward." Capt. M. de Jousselin, of the s. s. "La Bretagne," reports a storm on the 25th and 26th; wind veered from s. to nw.; lowest barometer, 29.29 (744.0), from 7 to 9 a. m. of the 25th, in N. 42° 35', W. 54° 0'.

Captain Vogelgesang, of the s. s. "Rhaetia," reports: "25th, 4 a. m., in N. 43°, W. 57°, barometer 29.27 (743.4), vivid lightning to the westward; the wind suddenly shifted in a heavy rain squall from sse. to w. and increased to a storm; at 12 noon the barometer read lowest, 29.21 (741.9), and the wind was blowing a storm, with heavy squalls from the westward; the barometer commenced to rise slowly, but gale and sea increased, the wind hauling to northerly; during the afternoon and night of the 25th it blew a heavy storm from nw., with snow squalls of hurricane force, and a high nw. sea; during the 26th the storm moderated and subsided to a strong breeze, in N. 41° 57', W. 60° 50', at 4 p. m." Capt. J. Sumner, of the s. s. "Egypt," reports a whole gale on the 25th and 26th; wind veered from se. to w., with very heavy sw. sea; lowest barometer, 29.20 (741.7), at 11 p. m. of the 25th, in N. 42° 26', W. 53° 10'.

The s. s. "Siberian" encountered a whole gale on the 26th and 27th; lowest barometer, 29.05 (737.9), at noon of the 26th, in N. 43° 55', W. 44° 46'. The gale was accompanied by terrific squalls and high seas, and blew strongest from nnw. from 2 a. m. to 10 a. m. of the 27th, during which time the ship was hove-to. Capt. G. Meiers, of the s. s. "Elbe," reports a whole n. veering to s. gale on the 26th and 27th; lowest barometer, 28.90 (734.0), at midnight of the 26–27th, in N. 44° 19', W. 41° 50'. Capt. Horlor, of the "Jersey City," reports: "26th, 13 hours 28 minutes, in N. 44° 55', W. 42° 10', blowing a moderate gale from w., with violent squalls, accompanied with hail and sleet; wind suddenly fell calm and a large black mass of clouds rose on the horizon, extending from nw. to nnw., and suddenly disappeared in the sw. The calm lasted ten to fifteen minutes, the barometer in the meantime falling from 29.10 (739.1) to 29.05 (737.9) and then went up to 29.20 (741.7), when the wind veered to n. and blew a perfect hurricane for forty minutes, then veered to ne. and subsided into a strong gale."

OCEAN ICE.

The following table shows the comparison between the southern and eastern limits of the ice area for February, 1887, and the same month of the four preceding years:

Southern limit.			Eastern limit.		
Month.	Lat. N.	Lon. W.	Month.	Lat. N.	Lon. W.
February, 1883.....	0 /	0 /	February, 1883.....	0 /	0 /
February, 1884.....	42 01	52 46	February, 1884.....	46 19	45 44
February, 1885.....	42 00	50 00	February, 1885.....	46 50	43 45
February, 1886.....	41 50	51 10	February, 1886.....	47 52	42 00
February, 1887.....	46 10	47 15	February, 1887.....	48 00	44 47
February, 1887.....	40 00	48 00	February, 1887.....	46 26	41 50

On chart i are also exhibited the eastern and southern limits of the region within which icebergs and field ice have been observed during February, 1887. These limits have been determined from reports furnished by shipmasters, and from data collected by the Signal Service agencies.

The easternmost ice was passed on the 23d, in N. 46° 26', W. 41° 50', by the s. s. "Egypt," and the southernmost ice reported was observed in N. 40°, W. 48° on the 8th, from the s. s. "Sarnia." Icebergs were most frequently encountered over, and along the east and southeast margins of, the Banks of Newfoundland, and isolated bergs were observed as far west as Sable Island.

In January, 1887, the only ice reported was a medium sized berg which was observed in N. 48° 30', W. 46° 0' on the 30th.

As compared with the record of ice encountered during the corresponding month of 1886, the limits of the area within which ocean ice has been reported for February, 1887, are extended about three degrees eastward and eight degrees southward. In February, 1886, the quantity of ice observed over,

and in the vicinity of, the Banks of Newfoundland, when compared with the average for four years, was largely deficient; in February, 1887, the amount reported corresponded closely to the average.

Icebergs and field ice were reported, as follows:

7th.—The s. s. "Norseman," in N. 46° 25', W. 46° 45', at 9.45 p. m., passed a small iceberg. The s. s. "Hibernian," in N. 46° 28', W. 46° 47', passed large quantities of field ice; had to steer south about ten miles to avoid coming into contact with it.

8th.—The s. s. "Sarnia," in N. 40°, W. 48°, passed forty miles of field ice and numerous icebergs. The s. s. "City of Chester," at 7 a. m., in N. 46° 20', W. 46° 40', fell in with field ice; at 6 a. m. the temperature of the air was 26°, and of the water 42° (Fahr.); the course of the vessel was changed about fifty miles sw. to clear the ice; two medium-sized icebergs and several smaller ones were passed soon after falling in with the field ice. The s. s. "Hekla," at night, between N. 47° 30', W. 47° 0', and N. 45° 30', W. 48° 0', fell in with great ice fields and several icebergs; had to turn back and steer east for some hours to get clear of it. The s. s. "Wyoming," at 9.25 a. m., in N. 46° 40', W. 48° 0', till 2.40 p. m., in N. 46° 52', W. 47° 10', passed through large quantities of field ice, and in N. 46° 10', W. 47° 10', passed four icebergs.

9th.—The s. s. "England," in N. 44° 22', W. 48° 38', at 10.50 a. m., passed through several fields of ice. The s. s. "Hibernian," with Sable Island bearing south distant seventy miles, passed a quantity of field ice.

10th.—The s. s. "Ethiopia," from N. 48° 13', W. 44° 29' to N. 47° 50', W. 45° 03', passed an iceberg and quantities of field ice. The s. s. "Spain," in N. 46° 50', W. 45° 17', passed an iceberg; also passed field ice and small bergs from N. 46° 33', W. 46° 22', to N. 45° 05', W. 48° 20'; had to steer south twenty-five miles to clear field ice. The s. s. "Rugia," in N. 44° 30', W. 48° 49', at 5 a. m., passed a narrow and very long field of snow ice, which drove in direction from north to south. The s. s. "Ems," in N. 44° 50', W. 48° 47', at 2 p. m., passed young ice.

11th.—The s. s. "Bassano," in N. 44° 37', W. 48° 20', at 2.15 p. m., passed an iceberg. The s. s. "Prussian," from N. 46° 55', W. 45° 3', to N. 46° 52', W. 45° 43', between 2.40 and 3.20 p. m., passed a number of large and small icebergs. The s. s. "Ethiopia," encountered icebergs and large quantities of field ice from N. 47° 21', W. 46° 44' to N. 44° 59', W. 48° 9'. The s. s. "Critic," from N. 46° 45', W. 47° 16' on the 11th, to N. 43° 14', W. 54° 14' on the 14th, passed masses of field ice and occasional icebergs.

12th.—The s. s. "Prussian," in N. 46° 20', W. 48° 50', passed several icebergs. The s. s. "British Queen," in N. 46° 15', W. 47° 12', passed through some heavy field ice, and had to run south to clear it, and from N. 45° 04', W. 57° 30' to N. 44° 48', W. 61° 13', passed through field ice, mostly light. The s. s. "British Crown," in N. 46° 52', W. 47° 38', fell in with large tracks of broken field ice; at 1 p. m. the ship was hove-to, heading sw., owing to heavy seas and field ice.

13th.—The s. s. "British Crown," at 6 a. m., passed nine icebergs and field ice; the southeast margin of the ice being in N. 46° 20', W. 46° 45'.

14th.—The s. s. "Brooklyn City," in N. 47° 20', W. 46° 0', passed a large iceberg; also passed a large berg in N. 47° 0', W. 46° 10', and in N. 47° 06', W. 46° 30' passed large fields of detached ice and numerous icebergs, both large and small, extending north and south as far as the eye could see; had to steer back se. to get clear of it. The s. s. "City of Berlin" passed a large iceberg in N. 46° 34', W. 46° 15'; 7.15 p. m., passed a quantity of pack ice; 8 p. m., passed field ice in N. 46° 20', W. 46° 30'.

15th.—The s. s. "Brooklyn City" passed an iceberg in N. 44° 10', W. 49° 30'. The s. s. "Britannic," between N. 46° 3', W. 46° 33' and N. 44° 41', W. 48° 51', passed fifteen icebergs, several very large; also large quantities of field ice to the northward. The s. s. "City of Berlin," at 2.12 a. m., saw

field ice in N. 45° 30', W. 48° 30'; temperature of air 19°, of water 21° (Fahr.). The s. s. "Gothia," between N. 45° 14', W. 44° 50' and N. 48° 8', W. 48° 40', from 1.30 p. m. to 4 p. m., passed eight ice mountains. The s. s. "Trave," in N. 44° 48', W. 47° 35', at 2.40 p. m., passed two large icebergs and one small one.

16th.—The s. s. "Trave," in N. 44° 48', W. 47° 35', passed three icebergs. The s. s. "Lord Gough," in N. 45°, W. 49°, passed several large icebergs and light field ice. The s. s. "Bohemia," between N. 44° 50', W. 48° 34' and N. 44° 24', W. 49° 15', from 3 to 4 p. m., passed fourteen icebergs from twenty to fifty feet high, and field ice.

17th.—The s. s. "Bolivia," in N. 47° 33', W. 43° 31', passed an iceberg. The s. s. "La Bourgogne," in N. 44° 54', W. 48° 34', at 5.04 a. m., passed an iceberg. On this date vessels arriving at New York from Newfoundland reported very heavy fields of ice from Mizzen Bank to Sable Island. The s. s. "Victoria," in 44° 40', from W. 48° 50' to W. 49° 0', passed a large iceberg and field ice.

18th.—The s. s. "Bolivia," in N. 45° 43', W. 47° 52', at 9 a. m., passed an iceberg, and in N. 45° 23', W. 47° 06', also passed a berg; in N. 44° 40', W. 47° 56', at 9 p. m., fell in with field ice. The s. s. "State of Pennsylvania," in N. 47° 49', W. 43° 26', passed icebergs.

19th.—The s. s. "Rhyndland," at 22 h. 29 m. (Greenwich mean time), sighted field ice to the westward, extending north to south as far as the horizon. Entered same in N. 44° 34', W. 48° 44', and steered s. 67° w. true ten miles and cleared it. The s. s. "Hekla," in N. 44° 30', W. 49° 0', saw several ice fields and passed through quantities of small ice. The s. s. "Bolivia," in N. 43° 26', W. 49° 23', at 6 a. m., cleared field ice. The s. s. "Fulda," in N. 44° 40', W. 48° 43', at 12.45 a. m., passed ice fields. The s. s. "State of Pennsylvania," from N. 46° 5', W. 46° 26' to N. 42° 44', W. 49° 24', on the 20th, passed heavy field ice and numerous icebergs, some being very large ones. The s. s. "Ems," between N. 43° 8', W. 49° 13' and N. 43° 16', W. 49° 2', from 1 to 1.45 p. m., passed a number of icebergs.

20th.—The s. s. "Fulda," in N. 44° 40', W. 48° 43', passed a large ice field, and steered south for six hours.

21st.—The s. s. "Greece," in N. 42° 54', W. 49° 50', passed several large icebergs. The s. s. "Palestine" passed a number of icebergs, some very large, from N. 44° 50', W. 48° 20' to N. 44° 20', W. 49° 20', between 1 a. m. and 10 a. m. The s. s. "Mareca," in N. 43° 4', W. 49° 55', at 2 p. m., passed a large iceberg. The s. s. "Geiser," on the 21st and 22d, between N. 44° 8', W. 48° 14' and N. 43° 40', W. 50° 8', passed six icebergs.

22d.—The s. s. "Rotterdam," from N. 46° 4', W. 46° 10' to N. 44° 57', W. 48° 27', passed ten medium sized icebergs and several pieces of floating ice.

23d.—The s. s. "Rotterdam," in N. 43° 49', W. 52° 27', passed five miles south of a large iceberg. The s. s. "Egypt" passed an iceberg in N. 46° 26', W. 41° 50', at 5 p. m. The s. s. "Rhaetia," between N. 44° 21', W. 47° 24' and N. 44° 15', W. 48° 3', passed four medium sized and four small icebergs; passed one large berg in N. 44° 10', W. 48° 40', and one in N. 44° 8', W. 48° 57'.

24th.—The s. s. "Celtic," at 7 a. m., passed seven miles south of a large iceberg one hundred and sixty feet high; position of berg, N. 43° 40', W. 48° 01'; air temperature, 24°; temperature of water, 35° (Fahr.); at 10 a. m. passed one-fourth of a mile north of a large iceberg eighty feet high; position of berg, N. 43° 22', W. 48° 53'; air temperature, 22°; temperature of water, 30° (Fahr.); between 10.30 a. m. and 11.30 a. m. passed through a quantity of sludgy field ice; temperature of the air, 23°, of the water 28° (Fahr.). The s. s. "La Bretagne," in N. 43° 37', W. 47° 26', at 3 p. m., passed an iceberg. The s. s. "Egypt" passed an iceberg in N. 44° 24', W. 47° 20', at 2 p. m., and one in N. 44° 5', W. 47° 34', at 4 p. m.

25th.—The s. s. "Bulgarian," in N. 46° 9', W. 44° 59' at 6 p. m., passed an iceberg.

26th.—The s. s. "Bulgarian," from N. 45° 10', W. 47° 0' to N. 45° 0', W. 47° 35', from 8 a. m. to 12.30 p. m., passed several medium-sized icebergs.

27th.—The s. s. "State of Georgia," in N. 44° 5', W. 47° 20', at 6 p. m., passed two small icebergs.

FOG.

The following shows the positions of fog-areas encountered on the north Atlantic Ocean during February, 1887, as reported by shipmasters:

16th.—The s. s. "Kansas," in N. 42° 50', W. 62° 0', had dense fog from 6.15 a. m. to 10.40 a. m. The s. s. "Galileo," in N. 42° 15', W. 65° 04', had a dense fog from 5 a. m. to 10 a. m.

18th.—The s. s. "Durham City," in N. 42° 29', W. 49° 20', had dense fog from 7.30 a. m. to 10.30 a. m.

20th.—The s. s. "Manitoban," in N. 42° 38', W. 52° 12', had dense fog from 8 a. m. to 10.45 a. m. The s. s. "Mareca," in N. 44° 30', W. 45° 30', had dense fog from 5.30 p. m. to 8.15 p. m.

In each of the instances above cited the fog-areas were encountered in the second, or southeast, quadrant of areas of low barometric pressure, and along the southern edge of the ice-field, with wind blowing from the southwest quadrant along the course of the Gulf Stream. It would therefore appear that the causes which contributed to the formation of fog during this month existed, as in previous months, in the southeast quarter of cyclonic areas; while an additional and obvious cause of fog formation appeared in the intermingling of warm, humid air from the Gulf Stream and the colder air over, and along the southern edge of, the ice-field.

TEMPERATURE OF THE AIR.

[Expressed in degrees, Fahrenheit.]

The distribution of mean temperature over the United States and Canada for February, 1887, is exhibited on chart ii by the dotted isothermal lines; and in the table of miscellaneous data are given the monthly mean temperatures, with the departures from the normal, for the various stations of the Signal Service. On chart iv the departures from the normal are illustrated by lines connecting stations of normal or equal abnormal values.

The mean temperature of the month is below the normal in Maine, the upper lake region, and from thence westward to the Pacific; it also below in Nevada, California, and western Arizona. In the southern and southeastern districts of the United States it is above the normal. The most noteworthy feature in connection with the temperature of the month is the unusually cold weather that has prevailed in Dakota, Montana, and Idaho; at stations in these territories the mean temperature of the month ranges from 10° to 20° below the normal. The mean of the month is also largely below the normal in Washington Territory, Oregon, and California. The greatest departures in excess of the normal occur in the south Atlantic and Gulf states, Tennessee, and Florida, in this region the means of the month average about six degrees higher than the usual February temperature.

RANGES OF TEMPERATURE.

The monthly, and the greatest and least daily, ranges of temperature, are given in the table of miscellaneous meteorological data.

The following are some of the greatest and least monthly ranges at Signal Service stations:

Greatest.	Least.
Fort Assinaboine, Montana..... 101.5	Key West, Florida..... 23.4
Holena, Montana..... 101.5	Galveston, Texas..... 27.5
Fort Maginnis, Montana..... 98.1	Tatoosh Island, Washington Ter..... 32.3
Fort Buford, Dakota..... 88.4	Hatteras, North Carolina..... 33.4
Bismarck, Dakota..... 88.0	San Diego, California..... 33.5
Poplar River, Montana..... 87.8	San Francisco, California..... 33.9
Deadwood, Dakota..... 86.9	Nash Bay, Washington Ter..... 35.0

DEVIATIONS FROM NORMAL TEMPERATURES.

In the table below are given, for certain stations, as reported by voluntary observers, the normal temperatures of

February for a series of years, the mean temperature for February, 1887, and the departures from the normal:

Station.	County.	Normal temperature for February.	Number of years.	Mean temperature for Feb., 1887.	Departure.
<i>Arkansas.</i>					
Lead Hill.....	Boone.....	38.8	5	43.3	+ 4.5
<i>California.</i>					
Fall Brook.....	San Diego.....	48.1	11	48.5	+ 0.4
Sacramento.....	Sacramento.....	49.7	21	43.7	- 6.0
<i>Connecticut.</i>					
Middletown.....	Middlesex.....	26.8	29	28.4	+ 1.6
New Haven.....	New Haven.....	28.2	101	29.8	+ 1.6
Thompson.....	Windham.....	25.2	30	24.8	- 1.4
Waterbury.....	New Haven.....	27.6	12	26.1	- 1.5
<i>Florida.</i>					
Archer.....	Alachua.....	58.6	4	58.9	+ 0.3
<i>Illinois.</i>					
Collinsville.....	Madison.....	31.6	8	36.6	+ 5.0
Mattoon.....	Coles.....	31.3	7	38.0	+ 6.7
Peoria.....	Peoria.....	29.4	31	32.7	+ 3.3
Riley.....	McHenry.....	21.8	26	21.6	- 0.2
Sycamore.....	De Kalb.....	21.9	6	23.4	+ 1.5
<i>Indiana.</i>					
Lafayette.....	Tippecanoe.....	29.2	8	31.5	+ 2.3
Logansport.....	Cass.....	28.5	33	32.9	+ 4.4
Mauzy.....	Rush.....	28.1	7	32.6	+ 4.5
Vevay.....	Switzerland.....	35.9	21	41.3	+ 5.4
<i>Iowa.</i>					
Cresco.....	Howard.....	17.8	10	13.1	- 4.7
Monticello.....	Jones.....	21.4	34	19.5	- 1.9
Muscataine.....	Muscataine.....	24.4	49	23.4	- 1.0
<i>Kansas.</i>					
Independence.....	Montgomery.....	35.1	16	35.2	+ 0.1
Wellington.....	Sumner.....	32.3	9	34.9	+ 2.6
<i>Louisiana.</i>					
Grand Coteau.....	Saint Landry.....	54.6	4	64.6	+ 10.0
<i>Maine.</i>					
Belfast.....	Waldo.....	22.3	28	20.3	- 2.0
Cornish.....	York.....	22.5	30	19.1	- 3.4
Gardner.....	Kennebec.....	20.5	51	19.8	- 0.7
Orono.....	Penobscot.....	18.9	19	17.8	- 1.1
<i>Maryland.</i>					
Fallston.....	Harford.....	31.9	16	35.3	+ 3.4
<i>Massachusetts.</i>					
Cambridge.....	Middlesex.....	26.1	65	26.8	+ 0.7
Fitchburg.....	Worcester.....	24.1	31	24.1	0.0
New Bedford.....	Bristol.....	28.9	75	29.4	+ 0.5
Somerset.....	Bristol.....	27.4	17	30.1	+ 2.7
Springfield.....	Hampden.....	25.7	20	26.7	+ 1.0
Taunton.....	Bristol.....	28.0	16	30.1	+ 2.1
Williamstown.....	Berkshire.....	22.4	34	24.0	+ 1.6
<i>Nevada.</i>					
Carson City.....	Ormsby.....	32.9	8	27.5	- 5.4
<i>New Brunswick.</i>					
Saint John.....	Saint John.....	18.1	27	18.1	0.0
<i>New Hampshire.</i>					
Concord.....	Morrismac.....	24.4	19	24.0	- 0.4
Hanover.....	Grafton.....	18.8	24	18.2	- 0.6
<i>New Jersey.</i>					
South Orange.....	Essex.....	29.8	17	32.7	+ 2.9
<i>New York.</i>					
Factoryville.....	Tioga.....	23.9	5	28.9	+ 5.0
North Volney.....	Oswego.....	22.1	19	22.8	+ 0.7
Palermo.....	Oswego.....	21.1	33	20.9	- 0.2
<i>Ohio.</i>					
Wauseon.....	Fulton.....	25.4	17	28.3	+ 2.9
<i>Pennsylvania.</i>					
Dyberry.....	Wayne.....	22.6	23	25.9	+ 3.3
<i>South Carolina.</i>					
Stateburg.....	Sumter.....	51.1	7	54.1	+ 3.0
<i>Texas.</i>					
New Ulm.....	Austin.....	56.0	14	59.2	+ 3.2
<i>Vermont.</i>					
Lunenburg.....	Essex.....	17.2	39	15.0	- 2.2
Newport.....	Orleans.....	17.6	12	15.0	- 2.6
Strafford.....	Orange.....	17.9	12	17.5	- 0.4
<i>Virginia.</i>					
Bird's Nest.....	Northampton.....	41.9	19	44.4	+ 2.5
Dale Enterprise.....	Rockingham.....	35.3	7	42.0	+ 6.7
Variety Mills.....	Nelson.....	38.5	10	40.6	+ 2.1
Wytheville.....	Wythe.....	37.1	23	40.0	+ 2.9
<i>West Virginia.</i>					
Helvetia.....	Randolph.....	34.9	10	42.0	+ 7.1
<i>Wisconsin.</i>					
Delavan.....	Walworth.....	16.4	4	21.4	+ 5.0

* From the "Bulletin of the New England Meteorological Society."

The following notes, in connection with this subject, are furnished by voluntary observers:

Arkansas.—Lead Hill, Boone county: the mean temperature of the winter of 1886-'87, 36°.7, is 1°.3 above the winter average of the past five years.

Illinois.—Riley, McHenry county: the mean temperature of the winter of 1886-'87, 16°.0, is 4°.5 below the mean of twenty-four winters past; the winters only of 1872-'73, 1874-'75, 1878-'79, 1880-'81, 1882-'83, and 1884-'85 were colder. Highest temperature of the past winter, 50°.4, on December 11th; lowest, -24°.9, on January 7th; range for the winter, 75°.3.

Indiana.—Mauzy, Rush county: during February of the past seven years the highest monthly mean, 38°.2, occurred in 1882; the lowest mean, 14°.8, in 1885.

Kansas.—Wellington, Sumner county: during February of the past nine

years the highest monthly mean temperature, 40°.1, occurred in 1882; the lowest mean, 24°.6, in 1885; the maximum temperature of the present month, 78°.0, is the highest that has occurred in February during that time; the lowest temperature for February, -15°.5, occurred in 1883.

Maryland.—Fallston, Harford county: during the past sixteen years the coldest February occurred in 1875, mean temperature, 23°.7; the warmest in 1880, mean, 37°.8.

New Jersey.—South Orange, Essex county: the mean temperature of the past winter, 30°.3, is 0°.5 above the average of the past seventeen years.

New York.—Palermo, Oswego county: during the past thirty-three years the coldest February occurred in 1875, mean temperature, 12°.7; the warmest in 1859, mean, 27°.8.

North Volney, Oswego county: during February in the past nineteen years the highest monthly mean, 28°.4, occurred in 1882, the lowest mean, 12°.4, in 1885; the mean temperature of the winter of 1886-'87, 21°.1, is 1°.9 below the average of the past nineteen years.

Ohio.—Wauseon, Fulton, county: the highest February mean temperature in the past seventeen years, 35°.4, occurred in 1882; the lowest mean, 11°.3, in 1875; the February extremes for that time are 62°.7, in 1880, and -24°.3, in 1885. The mean temperature of the past winter, 22°.6, is 2°.4 below the average.

South Carolina.—Stateburg, Sumter county: the following table shows the mean, maximum, and minimum temperatures of February for seven years:

	1881.	1882.	1883.	1884.	1885.	1886.	1887.
Mean	51.9	55.0	54.7	55.2	41.8	44.7	54.1
Maximum	70.0	74.0	78.0	75.0	64.0	68.0	74.0
Minimum	26.0	29.0	34.0	21.0	16.0	14.0	31.0

Texas.—New Ulm, Austin county: the extreme temperatures for February during the past fourteen years, are 88°.0, in 1883, and 16°.0, also in 1883.

Vermont.—Strafford, Orange county: during the past twelve years the highest February mean temperature, 25°.7, occurred in 1877; the lowest mean, 11°.0, in 1885.

Virginia.—Dale Enterprise, Rockingham county: during the past seven years the warmest February mean temperature, 42°.4, occurred in 1883; the coldest mean, 23°.9, in 1885.

Variety Mills, Nelson county: during February of the past ten years the highest monthly mean temperature, 48°.4, occurred in 1884; the lowest, 29°.6, in 1885. The mean temperature of the winter of 1886-'87, 34°.7, is 1°.8 below the average for the corresponding period of the last ten years.

In the following table are given the mean temperatures for the several geographical districts, with the normals and departures, as deduced from Signal Service observations:

Districts.	Average for February, Signal-Service observations.		Comparison of Feb., 1887, with the average for several years.
	For several years.	For 1887.	
New England	26.4	26.4	0.0
Middle Atlantic States	35.6	39.2	+ 3.6
South Atlantic States	49.7	54.8	+ 5.1
Florida Peninsula	64.9	67.9	+ 3.0
Eastern Gulf States	54.4	59.1	+ 4.7
Western Gulf States	51.3	56.2	+ 4.9
Rio Grande Valley	62.0	67.6	+ 5.6
Tennessee	43.2	49.8	+ 6.6
Ohio Valley	35.3	39.1	+ 3.8
Lower Lake region	26.8	27.7	+ 0.9
Upper Lake region	20.0	18.5	- 1.5
Extreme Northwest	8.7	1.0	- 7.7
Upper Mississippi Valley	27.9	26.5	- 1.4
Missouri Valley	22.8	15.5	- 7.3
Northern slope	22.3	9.2	- 13.1
Middle slope	32.5	33.5	+ 1.0
Southern slope	44.9	47.2	+ 2.3
Southern plateau	45.9	45.7	- 0.2
Middle plateau	34.1	31.5	- 2.6
Northern plateau	31.6	24.3	- 7.3
North Pacific coast region	41.2	32.4	- 8.8
Middle Pacific coast region	50.7	45.0	- 5.7
South Pacific coast region	56.2	53.5	- 2.7

The following are some of the most marked departures from the normal temperature at Signal Service stations:

Above normal.	Below normal.		
Mobile, Alabama	8.2	Walla Walla, Washington Territory	20.2
Knoxville, Tennessee	8.1	Fort Assinaboine, Montana	19.5
Sanford, Florida	7.5	Helena, Montana	18.6
New Orleans, Louisiana	7.4	Fort Bidwell, California	15.7
Kitty Hawk, North Carolina	7.3	Bismarck, Dakota	14.7
Montgomery, Alabama	7.2	Fort Buford, Dakota	14.7
Pensacola, Florida	7.1	Valentine, Nebraska	14.0
Nashville, Tennessee	6.9	Fort Maginnis, Montana	11.3

Table of comparative maximum and minimum temperatures for February.

State or Territory.	Station.	For 1887.		Since establishment of station.			
		Max.	Min.	Max.	Year.	Min.	Year.
Alabama	Mobile	80.5	36.0	78.0	1883	19.3	1886
Do	Montgomery	78.7	34.0	81.2	1883	14.4	1886
Arizona	Prescott	71.0	12.2	80.0	1879	11.0	1880
Do	Fort Apache	71.5	12.6	74.0	1881	9.0	1880
Arkansas	Fort Smith	75.1	19.9	78.4	1883	7.6	1885
Do	Little Rock	72.0	23.0	77.0	1882	7.6	1885
California	San Francisco	67.0	33.1	71.0	1884, 1886	35.0	1883, 1884
Do	San Diego	76.0	38.5	82.6	1883	35.0	1880
Colorado	Denver	70.9	2.6	72.0	1879	22.0	1883
Do	Pike's Peak	46.9	23.0	29.0	1876	30.0	1884
Connecticut	New Haven	53.0	8.0	65.0	1880	7.7	1880
Do	New London	53.6	9.8	62.0	1880	7.7	1880
Dakota	Fort Buford	47.2	41.2	57.0	1882	40.0	1883, 1884
Do	Yankton	50.4	22.4	58.0	1876	24.8	1886
District of Columbia	Washington City	72.0	18.6	78.0	1874	2.3	1886
Florida	Jacksonville	81.6	38.2	83.0	1876, 1883	24.3	1886
Do	Key West	81.0	57.6	87.0	1874	52.3	1886
Georgia	Atlanta	73.8	28.9	74.5	1883	6.0	1885
Do	Savannah	79.7	34.9	80.0	'76, '80, '83	10.0	1886
Idaho	Boise City	53.4	6.1	65.4	1886	8.5	1884
Illinois	Cairo	72.4	11.5	74.0	1883	2.6	1886
Do	Chicago	58.0	7.0	63.0	1880	13.7	1885
Indiana	Indianapolis	66.2	10.5	72.0	1883	9.0	1885
Indian Territory	Fort Sill	71.6	8.1	79.0	1879, 1882	5.0	1886
Iowa	Dubuque	50.6	12.5	67.2	1880	31.0	1875
Do	Des Moines	53.6	15.0	68.0	1880	23.0	1883
Kansas	Dodge City	75.0	8.2	78.0	1876	20.0	1883
Do	Leavenworth	68.4	6.0	73.0	1876	16.2	1885
Kentucky	Louisville	77.9	19.2	77.5	1883	1.3	1885
Louisiana	New Orleans	81.5	44.0	80.0	1883	25.0	1886
Do	Shreveport	78.2	34.5	83.5	1876	14.6	1885
Maine	Enstport	47.2	4.2	47.0	1874, 1878	20.0	1876
Do	Portland	41.9	2.5	58.0	1880	10.2	1886
Maryland	Baltimore	72.2	20.9	78.0	1874	1.1	1886
Massachusetts	Boston	47.6	5.2	64.0	1880	6.6	1886
Michigan	Marquette	36.5	13.0	69.0	1877	27.0	1875
Do	Grand Haven	46.0	7.3	58.0	1880	24.0	1875
Minnesota	Saint Vincent	28.5	38.0	49.5	1886	39.2	1885
Do	Saint Paul	42.8	26.7	59.0	1880	32.0	1875
Mississippi	Vicksburg	79.6	37.7	82.0	1880	16.0	1886
Missouri	Saint Louis	74.1	3.9	73.2	1882	7.9	1886
Montana	Fort Assinaboine	46.1	55.4	63.2	1886	47.0	1873
Do	Helena	61.0	40.5	62.1	1886	32.0	1883
Nebraska	North Platte	59.0	16.1	68.3	1882	29.0	1883
Do	Omaha	59.0	15.5	66.0	1880	24.9	1883
Nevada	Winnemucca	51.2	1.2	69.0	1879	17.0	1882
New Hampshire	Mount Washington	33.2	26.0	43.0	1883	42.0	1876
New Jersey	Atlantic City	57.8	16.7	71.0	1880	5.0	1875
New Mexico	Santa Fe	61.8	8.7	75.0	1879	3.0	1879, 1880
New York	Buffalo	54.1	6.3	63.8	1883	13.0	1875
Do	New York City	63.0	16.6	69.0	1874	4.0	1873
North Carolina	Charlotte	70.8	25.7	76.5	1883	5.9	1886
Do	Wilmington	75.0	27.2	81.0	1880	10.0	1886
Ohio	Cincinnati	70.0	14.7	73.0	1883	9.6	1885
Do	Sandusky	60.5	8.5	70.0	1883	28.0	1884
Oregon	Portland	63.0	9.1	65.0	1886	7.0	1883
Do	Roseburg	70.0	7.0	72.1	1886	3.3	1884
Pennsylvania	Pittsburg	66.6	15.1	76.5	1883	10.0	1875
Do	Philadelphia	65.6	18.0	75.0	1874	2.4	1886
Rhode Island	Block Island	54.1	11.8	54.0	1884	1.0	1886
South Carolina	Charleston	80.4	33.9	78.0	1876, 1880, 1882, 1883	13.3	1886
Tennessee	Knoxville	72.8	21.6	79.0	1871	4.1	1886
Do	Memphis	74.0	26.0	79.0	1883	5.8	1886
Texas	Brownsville	80.8	40.0	84.6	1884	27.0	1883
Do	Fort Elliott	77.2	3.1	78.0	1880	10.0	1883
Utah	Salt Lake City	53.4	13.0	68.0	1879	13.0	1884
Virginia	Lynchburg	72.2	20.0	75.0	1874	1.3	1886
Do	Norfolk	75.0	26.8	81.0	1871	3.5	1886
Washington Ter.	Spokane Falls	52.6	11.0	55.3	1886	17.8	1884
Do	Olympia	53.5	2.4	61.0	1886	2.0	1884
Wisconsin	La Crosse	44.5	18.6	65.0	1882	34.0	1875
Do	Milwaukee	48.6	9.4	60.0	1882	23.6	1885
Wyoming	Cheyenne			59.0	'79, '80, '81	28.2	1884

FROSTS.

Frosts occurred in the various districts on the following dates:

- New England.**—1st to 28th.
- Middle Atlantic states.**—1st to 28th.
- South Atlantic states.**—1st, 5th, 12th, 14th, 17th, 23d, 25th, 27th, 28th.
- Florida.**—Archer, Alva, and Duke, 28th.
- East Gulf states.**—Atlanta, Georgia, 12th, 13th; Tallahassee, Florida, 16th; Greensborough, Livingston, and Mobile, Alabama, Pensacola, Florida, and Vicksburg, Mississippi, 28th.
- West Gulf states.**—1st to 4th, 21st, 22d, 27th, 28th.
- Tennessee.**—1st, 3d, 4th, 5th, 11th, 12th, 13th, 19th, 22d, 25th, 27th, 28th.
- Ohio Valley.**—1st to 6th, 9th to 15th, 17th to 28th.
- Lower lake region.**—1st to 28th.
- Upper lake region.**—1st to 28th.
- Extreme northwest.**—1st to 28th.

Upper Mississippi valley.—1st to 28th.
Missouri Valley.—1st to 28th.
Northern slope.—1st to 28th.
Middle slope.—1st to 28th.
Southern slope.—3d to 6th, 8th, 9th, 11th to 15th, 17th to 28th.
Southern plateau.—1st to 5th, 7th to 28th.
Middle plateau.—1st to 28th.
Northern plateau.—1st to 28th.
North Pacific coast region.—1st to 28th.
Middle Pacific coast region.—2d, 3d, 5th, 6th, 7th, 10th, 14th to 20th, 22d, 23d, 25th to 28th.
South Pacific coast region.—Riverside, California, 3d, 4th, 5th, 11th, 12th, 17th, 18th, 20th, 21st, 23d, 24th; Fall Brook, California, 3d, 4th, 12th, 17th, 21st; Los Angeles, California, 4th, 21st to 25th; San Diego, California, 17th, 19th.

ICE.

Ice formed on calm water in the southern districts of the country on the following dates:

Arizona.—Maricopa, 21st, 23d.
California.—Sacramento, 3d, 7th, 16th, 19th, 25th, 26th; San Francisco, 20th, 22d, 25th, 26th; San Diego, 19th; Nicolaus, 25th.
Texas.—San Antonio, 4th.

LOW TEMPERATURES.

Fort Assinaboine, Montana: on the 2d the barometer was high, and almost stationary; mean reduced for the day 30.79, which is the highest on record at this station; on the night of the 2-3d the minimum thermometer registered $-55^{\circ}.4$; this is the lowest temperature on record at this station. Reports from the cattle ranges state that many cattle were dying from the effects of extreme cold weather. Stage coaches were delayed three or four days on account of deep snow drifts. The observer at Fort Maginnis, Montana, states that on the 2d and 3d very high pressure, with heavy northwest winds and low temperature, prevailed; minimum on the 2d $-42^{\circ}.0$, the lowest known at this place. In the vicinity of Fort Maginnis, and over the entire territory, large numbers of cattle perished from cold and starvation. At Poplar River, Montana, the temperature on the 2d was $-26^{\circ}.9$, and on the 3d $-44^{\circ}.6$, with strong westerly winds prevailing. Numbers of cattle in the vicinity perished from cold.

PRECIPITATION.

[Expressed in inches and hundredths.]

The distribution of precipitation over the United States and Canada for February, 1887, as determined from the reports of about six hundred stations, is exhibited on chart iii, and in the table of miscellaneous data are given, for Signal Service stations, the total precipitation, with the departures from the normal.

The precipitation for February, 1887, is above the normal in all parts of the United States, except South Carolina, Georgia, Florida, Louisiana, Montana, and parts of Texas, Arkansas, Washington Territory, and Oregon. The excess is especially large in California and southern Oregon; in the former state the precipitation of the month is about twice the usual amount for February. A large part of this excessive precipitation fell on the 3d-4th, 8-9th, and 14th, a number of stations in California reporting on these dates a fall of over two inches, and several of over three inches, in twenty-four hours. The excess is also large in the Lake region and Ohio Valley, in the former district the precipitation of the month is more than twice the normal amount, a considerable part of this fell during the prevalence of low-area number v on the 10th and 11th; on those days a number of stations reported a fall of over two inches in less than thirty-six hours. The greatest deficiency of rainfall occurs in Florida, where the amount for the month is very small, few stations reporting over 0.90.

The following are some of the most marked departures from the normal precipitation at Signal Service stations:

Above normal.		Below normal.	
	Inches.		Inches.
Los Angeles, California.....	5.75	Portland, Oregon.....	4.58
Sandusky, Ohio.....	5.62	Olympia, Washington Territory.....	4.52
San Francisco, California.....	5.60	Hatteras, North Carolina.....	3.57
Port Huron, Michigan.....	5.40	Cedar Keys, Florida.....	3.19
Erie, Pennsylvania.....	5.24	Jacksonville, Florida.....	3.06
Cleveland, Ohio.....	5.10	Charleston, South Carolina.....	1.30
Toledo, Ohio.....	4.96	Norfolk, Virginia.....	1.29

DEVIATIONS FROM AVERAGE PRECIPITATION.

The following table shows, for certain stations, as reported by voluntary observers, the average precipitation for the month of February for a series of years, the precipitation for February 1887, and the departures from the average:

Station.	County.*	Average precipitation for Feb.	Number of years.	Precipitation for Feb., 1887.	Departure.
		Inches.		Inches.	Inches.
<i>Arkansas.</i>					
Lead Hill.....	Boone.....	6.43	5	4.68	- 2.35
<i>California.</i>					
Fall Brook.....	San Diego.....	3.74	12	5.65	+ 1.91
Sacramento.....	Sacramento.....	3.19	21	5.89	+ 2.70
Santa Barbara.....	Santa Barbara.....	3.89	20	5.64	+ 4.75
<i>Connecticut.</i>					
Canton *.....	Hartford.....	3.84	25	5.37	+ 1.53
Hartford *.....	Hartford.....	3.72	15	5.62	+ 1.90
Middletown *.....	Middlesex.....	4.15	29	7.56	+ 3.41
Wallingford *.....	New Haven.....	4.35	29	7.16	+ 2.81
<i>Florida.</i>					
Archer.....	Alachua.....	2.74	4	0.38	- 2.36
<i>Illinois.</i>					
Collinsville.....	Madison.....	3.04	5	4.60	+ 1.56
Mattoon.....	Coles.....	5.15	7	4.25	- 0.90
Peoria.....	Peoria.....	2.15	31	5.45	+ 3.30
Riley.....	McHenry.....	1.68	24	4.82	+ 3.16
Sycamore.....	De Kalb.....	2.82	6	4.50	+ 1.68
<i>Indiana.</i>					
Lafayette.....	Tippecanoe.....	3.53	8	2.94	- 0.59
Logansport.....	Cass.....	2.75	33	5.15	+ 2.40
Mauzy.....	Rush.....	4.89	7	6.28	+ 1.39
Vevay.....	Switzerland.....	3.65	21	8.28	+ 4.63
<i>Iowa.</i>					
Cresco.....	Howard.....	0.95	15	1.88	+ 0.93
Monticello.....	Jones.....	1.92	34	4.62	+ 2.70
Muscatine.....	Muscatine.....	1.77	40	4.12	+ 2.35
<i>Kansas.</i>					
Independence.....	Montgomery.....	2.17	15	1.55	- 0.62
Wellington.....	Sumner.....	1.12	9	1.18	+ 0.06
<i>Maine.</i>					
Gardiner *.....	Kennebec.....	3.59	49	5.62	+ 2.03
Orono *.....	Penobscot.....	3.99	19	5.89	+ 1.90
<i>Maryland.</i>					
Fallston.....	Harford.....	4.00	16	4.46	+ 0.46
<i>Massachusetts.</i>					
Cambridge *.....	Middlesex.....	3.60	46	4.96	+ 1.36
Chestnut Hill *.....	Middlesex.....	4.44	12	4.44	0.00
Framingham *.....	Middlesex.....	4.14	13	5.07	+ 0.93
Lake Cochituate *.....	Middlesex.....	3.65	36	5.34	+ 1.69
Lynn *.....	Essex.....	3.94	13	4.98	+ 1.04
Mystic Lake *.....	Middlesex.....	4.15	12	4.43	+ 0.28
New Bedford *.....	Bristol.....	3.28	74	6.25	+ 2.97
Somerset.....	Bristol.....	3.63	17	3.92	+ 0.29
Springfield *.....	Hampden.....	3.53	40	5.23	+ 1.70
Waltham *.....	Middlesex.....	2.71	58	4.66	+ 1.95
Williamstown *.....	Berkshire.....	2.59	21	4.50	+ 1.91
<i>Nevada.</i>					
Carson City.....	Ormsby.....	1.43	8	3.27	+ 1.84
<i>New Brunswick.</i>					
Saint John *.....	Saint John.....	4.77	17	7.60	+ 2.83
<i>New Hampshire.</i>					
Concord *.....	Merrimac.....	2.66	31	4.86	+ 2.20
Hanover *.....	Grafton.....	2.11	22	7.67	+ 5.56
<i>New Jersey.</i>					
South Orange.....	Essex.....	3.75	17	5.07	+ 1.32
<i>New York.</i>					
Factorville.....	Tioga.....	2.05	5	2.88	+ 0.83
Menand's.....	Albany.....	2.16	4	3.40	+ 1.24
Palermo.....	Oswego.....	2.93	33	2.03	- 0.90
<i>Ohio.</i>					
Wauseon.....	Fulton.....	2.77	13	7.19	+ 4.42
<i>Pennsylvania.</i>					
Dyberry.....	Wayne.....	2.85	18	4.89	+ 2.04
<i>South Carolina.</i>					
Kirkwood.....	Kershaw.....	3.46	20	2.27	- 1.19
Stateburg.....	Sumter.....	2.21	6	1.89	- 0.32
<i>Texas.</i>					
New Ulm.....	Austin.....	4.53	15	2.60	- 2.53
<i>Vermont.</i>					
Lunenburg *.....	Essex.....	2.91	39	3.80	+ 0.89
Newport *.....	Orleans.....	2.89	12	4.75	+ 1.86
Strafford.....	Orange.....	3.04	12	5.90	+ 2.86
<i>Virginia.</i>					
Bird's Nest.....	Northampton.....	3.61	18	3.85	+ 0.24
Dale Enterprise.....	Rockingham.....	3.47	7	4.72	+ 1.25
Variety Mills.....	Nelson.....	3.61	8	3.91	+ 0.30
Wythoville.....	Wytho.....	3.32	22	3.50	+ 0.18
<i>West Virginia.</i>					
Helvetia.....	Randolph.....	4.80	10	7.68	+ 2.88

* From the "Bulletin of the New England Meteorological Society."

The following notes, in connection with this subject, are furnished by voluntary observers:

Arkansas.—Lead Hill, Boone county: the precipitation of the past winter, 6.92, is the least that has fallen in any winter during the past six years, and is 6.91 below the average.

California.—Santa Barbara, Santa Barbara county: the total precipitation of the past winter, 11.07, is 1.84 below the average for the same period during the past twenty years.

Illinois.—Riley, McHenry county: the total precipitation of the winter of 1886-'87, 9.54, is 8.95 more than the mean of twenty-three winters past; it is also the greatest amount that has fallen in any winter during that time.

Indiana.—Mauzy, Rush county: the precipitation of February, 1888, 8.81, is the greatest, and that of 1886, 1.14, the least that has fallen in February during the past seven years.

Maryland.—Fallston, Harford county: the largest February precipitation in the past sixteen years, 7.01, occurred in 1884; the least, 1.50, in 1872.

Massachusetts.—Worcester, Worcester county: the precipitation of the month was unusual. There were twelve days on which 0.01 or more of rain or melted snow fell. On the 18th there was a heavy thunder shower. The aggregate of rain and melted snow was 4.89, or more than an inch above the average. There were nine snow storms, with an aggregate fall of 15.27, or nearly 4.00 more than the average, while the aggregate snowfall this winter is 70.27.

Nevada.—Carson City, Ormsby county: the total rainfall and melted snow of the past winter, 5.95, is 1.89 below the average.

New Jersey.—South Orange, Essex county: the total precipitation of the winter of 1886-'87, 12.12, is 0.78 in excess of the winter average of the past seventeen years.

New York.—Palermo, Oswego county: during the past thirty-three years the largest February snowfall, 58.00, occurred in 1866; the least, 1.00, in 1877.

Ohio.—Portsmouth, Scioto county: the month was remarkable for its heavy rainfall, total, 9.28; during the past twenty-seven years this amount has been exceeded once only, viz., 10.59, in May, 1865.

Texas.—New Ulm, Austin county: during the past fourteen years the greatest February precipitation occurred in 1882, total, 10.94; the least in 1885, total, 1.06.

Vermont.—Poultney, Rutland county: the snowfall of this vicinity since November 7, 1886, is unprecedented; total amount, 117.8 inches.

In the following table are shown, for the several geographical districts, the normal precipitation for February, the average for February, 1887, and the excess or deficiency, as compared with the normal:

Average precipitation for February.

Districts.	Average for Feb., Signal-Service observations.		Comparison of Feb., 1887, with the average for several years.
	For several years.	For 1887.	
	Inches.	Inches.	Inches.
New England.....	4.20	4.91	+ 0.71
Middle Atlantic States.....	3.46	3.75	+ 0.29
South Atlantic States.....	3.70	2.55	- 1.15
Florida Peninsula.....	2.75	0.63	- 2.12
Eastern Gulf States.....	4.73	5.43	+ 0.72
Western Gulf States.....	4.34	3.78	- 0.56
Bio Grande Valley.....	1.48	0.66	- 0.82
Tennessee.....	5.20	7.67	+ 2.47
Ohio Valley.....	3.57	6.18	+ 2.61
Lower lake region.....	2.58	6.19	+ 3.61
Upper lake region.....	1.99	3.41	+ 1.42
Extreme northwest.....	0.73	0.55	- 0.18
Upper Mississippi Valley.....	2.21	3.34	+ 1.13
Missouri Valley.....	0.86	1.17	+ 0.31
Northern slope.....	0.78	0.57	- 0.21
Middle slope.....	0.57	0.20	- 0.37
Southern slope.....	0.92	0.42	- 0.50
Southern plateau.....	1.30	1.19	- 0.11
Middle plateau.....	1.76	1.48	- 0.28
Northern plateau.....	2.44	1.54	- 0.90
North Pacific coast region.....	6.76	4.44	- 2.32
Middle Pacific coast region.....	3.44	6.91	+ 3.47
South Pacific coast region.....	2.13	4.59	+ 2.46

SNOW.

Fort Buford, Dakota: on the 1st heavy snow, accompanied by an easterly gale, fell from 5.07 to 11.20 p. m., causing deep drifts which blockaded all roads. Reports from Fargo, Jamestown, and numerous other places throughout the territory, speak of heavy snows and high winds, with extremely low temperature, as prevailing during the first part of the month. Great losses have been incurred by cattlemen, the stock perishing from the effects of cold and lack of food, the dead grass upon which they feed during the winter being covered to a greater depth than usual with crusted snow. The continued succession of "blizzards" and deep snows, with very low tem-

peratures even for this region, have been disastrous to every interest, especially along the line of the Northern Pacific Railroad in Dakota and Montana, where heavy mortality among cattle has occurred.

Huron, Dakota: owing to the heavy snow storms and high winds that prevailed during the first decade of the month many trains on the Chicago and Northwestern Railroad were delayed. On the 11th the road to the eastward of Huron became completely blockaded by heavy compact snow, and on the 13th no trains arrived from any direction. The road between Huron and Chicago remained blockaded until the end of the month; on the 28th the railroad officials stated that it would probably be two weeks before the road could be opened toward the east, the snow drift being too compact to yield to the force of the snow plows.

Sau Francisco, California: heavy rain fell during the night of the 4-5th and until 5.50 a. m. of the 5th, when light snow began falling; from 6.25 until 8.10 a. m. the snowfall was very heavy. Snow and rain fell until 2.45 p. m.; from that hour until 5.20 p. m. light snow fell. At 12.45 p. m. the snow in the eastern part of the city was 3.7 inches in depth; in the western part the depth was fully seven inches, and did not all disappear until the afternoon of the 7th. The storm was accompanied by low temperature, the minimum, 33° 1, being the lowest on record since the establishment of a signal office at San Francisco. The observer reports this to be the heaviest snowfall on record for this place.

Oroville, Butte county, California: the voluntary observer at this place gives the following statement in regard to heavy snowfall in that vicinity:

On the 3d a snow storm commenced in the mountains, and, with but slight cessation, raged for ten days. This has been the most severe storm experienced since the winter of 1867-'68. Much damage has been done from the great weight of snow crushing in houses and barns. The table below will give some idea of the severity of this storm, with the depth of snow in the several places named, and altitude above sea level:

	Miles from Oroville.	Depth of snow, Feb. 13th.	Elevation above sea-level.
		Feet.	Feet.
Oroville.....	0	0.0	171
Berry Creek.....	18	1.0	1,750
Galena Ranch.....	22	3.0	2,500
Mount Cottage.....	26	5.0	3,400
Mount House.....	27	6.5	2,500
Merrimac Mills.....	33	7.5	3,961
Buckeye.....	35	9.5	4,500
Forbestown.....	22	5.5	2,770

Durango, La Plata county, Colorado: during the night of the 16-17th, and on the 17th, high wind and light snow prevailed. At Durango the total fall was only about three inches, but on the adjacent mountains it fell to a depth of sixteen and eighteen inches and drifted badly. A large snow slide occurred in the Animas Cañon, between this town and Silverton, which completely filled the cañon, covering to a depth of more than seven hundred feet a railroad that passed through it.

Saint Paul, Minnesota: light and heavy snow fell on the 14th, 15th, 17th, 18th, and 19th; on the 18th and 19th high winds prevailed, drifting the snow badly and filling railroad cuttings, delaying trains from two to six hours. On the 25th and 26th light snow fell, accompanied by heavy west and north-west winds which caused it to drift badly. Trains on the Sioux City branch of the Omaha Railroad were abandoned, and those on other lines delayed several hours. On the morning of the 26th nearly all lines in the state reported a blockade from snow. In some places the drifts were many feet deep, causing more delay than any previous snow storm this winter.

Marquette, Michigan: during the afternoon of the 17th and night of the 17-18th a heavy snow storm, accompanied by high wind, prevailed; maximum velocity of the wind, thirty-three miles per hour from the east, at 3.04 a. m. This was one of the worst storms of the winter, the snow drifting in places to a depth of from six to twelve feet. Travel of all kinds was impeded and telegraphic communication interrupted. The

Chicago and Northwestern Railroad was blockaded several hours; on the Detroit, Mackinaw, and Marquette Railroad several trains were abandoned.

Roseburg, Oregon: cattlemen in the Umpqua Valley and surrounding country have suffered considerable loss in sheep and cattle during February on account of the heavy snowfall, the total depth for the month at Roseburg being 27.2 inches, which is an unusually large amount for this station.

Saint Vincent, Minnesota: light snow fell on the night of the 24-25th and until midnight of the 25th. On the early morning of the 26th the wind increased in force, and at 5.45 a. m. a gale set in from the northwest and continued until 4.50 p. m., attaining at 2.45 p. m. a velocity of thirty-two miles per hour. The snow which had fallen on the previous day was swept into large drifts, and numerous fences and small buildings were blown down. On the 25th the north bound train reached this place fourteen hours late.

Duluth, Minnesota: light and heavy snow fell on the 23d, 24th, 26th, and 27th; on the 26th the snow was accompanied by a high northwest wind which reached at 11 a. m. a velocity of thirty-two miles per hour, drifting the snow badly and interrupting travel of all kinds. The railroad between Saint Paul and Duluth was completely blockaded by snow, no trains arriving at the latter place until the afternoon of the 28th.

La Crosse, Wisconsin: on the 26th light wind blew from the northwest until 7 a. m., when it suddenly increased in force and during the afternoon blew a gale; maximum velocity twenty-nine miles per hour. The high wind drifted the snow that covered the ground, delaying, and in many cases entirely suspending, railroad traffic.

The dates on which snow fell in the various districts are as follows:

New England.—1st to 11th, 13th to 27th.

Middle Atlantic states.—1st to 8th, 11st to 15th, 18th to 28th.

South Atlantic states.—Stateburg, South Carolina, 1st; Lenoir, North Carolina, 14th.

West Gulf states.—Fort Gibson, Indian Territory, 3d, 11th; Fort Smith, Arkansas, 4th.

Ohio Valley.—1st to 5th, 11th, 12th, 18th to 23d, 24th, 26th, 27th, 28th.

Lower lake region.—1st to 7th, 9th to 13th, 15th to 28th.

Upper lake region.—1st to 28th.

Extreme northwest.—1st to 7th, 9th, 10th, 11th, 13th, 14th, 16th to 20th, 22d, 23d, 25th, 26th, 27th.

Upper Mississippi valley.—1st to 7th, 9th, 10th, 11th, 14th, 15th, 17th to 23d, 25th, 26th.

Missouri Valley.—1st to 11th, 13th to 23d, 25th, 26th.

Northern slope.—1st to 10th, 12th, 13th, 14th, 16th to 26th.

Middle slope.—1st to 7th, 10th, 11th, 13th, 15th to 23d, 25th, 26th.

Southern slope.—3d, 4th, 5th, 11th, 20th.

Middle plateau.—1st to 25th.

Northern plateau.—1st to 27th.

North Pacific coast region.—1st to 14th, 16th to 25th, 28th.

Middle Pacific coast region.—Fort Gaston, California, 1st, 2d, 3d, 7th, 13th, 14th, 20th, 21st, 24th, 25th; Susanville, California, 1st, 2d, 3d, 5th to 9th, 12th to 15th, 19th, 20th, 21st, 24th; San Francisco, Angel Island, Benicia Barracks, Presidio of San Francisco, and Princeton, California, 5th; Salinas, California, 21st.

MONTHLY SNOWFALLS.

[Expressed in inches and tenths.]

The following stations report a monthly snowfall of ten inches or more:

California.—Cisco, 228.5; Summit, 207; Emigrant Gap, 188; Boca, 127; Truckee, 122.5; Towles, 116; Susanville, 88; Fort Bidwell, 49; Tehichipa, 42; Colfax, 38; Keene, 30; Mojave, 16.

Connecticut.—Canton, 22; Collinsville, 20.6; Hartford, 20; Southington, 16.5; New London, 14.5; Middletown, 14; Bethel, 12.8; New Haven, 10.5

Dakota.—Parkston, 17.5; Webster, 16.5.

Illinois.—Lake Forest, 16.8; Windsor, 14; Rockford, 12.5; Waukegan, 11.5; Aurora, 10.8; Cedarville, 10.5; Riley, 10.

Iowa.—West Milton, 10.1.

Maine.—Kent's Hill, 45; Cornish, 43; Lewiston, 37.7; Solan, 35.7; Gardiner, 34.8; Orono, 33.5; Belfast, 25; Portland, 24.9; Eastport, 15.9.

Maryland.—New Midway, 11.

Massachusetts.—Rowe, 37; Gilbertville, 28; Fitchburg, 26.8; Springfield, 24; Newburyport, 23.5; Amherst and Fitchburg, 22.5; Dudley, 22; Ludlow, 21.8; Lawrence, 21.5; Williamstown, 21; Concord, 20.8; Monson, 19.5; Williamstown, 19; Westborough, 18.8; Mansfield and Taunton, 16.2; Worcester, 15.4; Worcester, 15.2; Beverly Farms and Blue Hill Observatory, 15; Fall River, 12.5; Boston, 12; Somerset, 11.8; South Hingham, 11.5; Milton, 11.2; Taunton, 10.

Michigan.—Alpena, 38.1; Traverse City, 33; Harrisville, 31; Mackinaw City, 22.4; Marquette, 15.5; East Saginaw, 15; Escanaba, 10.8; Lansing and Grand Haven, 10.

Minnesota.—Minneapolis, 22.2; Northfield, 21; Mankato, 17.6; Rochester, 15; Albert Lea, 13; Excelsior, 12.4; Saint Cloud and Duluth, 12; Spring Valley, 11; Red Wing, 10.

Montana.—Helena, 11.2; Fort Maginnis, 10.5.

Nebraska.—York, 16.5; Tecumseh, 13.5; Tacoma, 12.5; North Platte, 12.2; Stockham, 11.5; Marquette and Brownville, 10.1.

Nevada.—Carson City, 43; Reno, 29; Wadsworth, 22; Palisade, 21.2; Carlin, 20; Halleck and Hawthorn, 18.5; Hot Springs, 18; Winnemucca, 17.1; Otego, 17; Elko, 16; Toano, 15; Browns, 12.9; Humboldt, 12.5; Beowawe, 12; Battle Mountain, 11.5.

New Hampshire.—Quincy, 50.8; Berlin Mills, 40; Shelburne, 35; Grafton and Hanover, 34; Walpole, 32.1; Concord, 29; Manchester and Stratford, 27; West Milan and Manchester, 26; Nashua, 22.8; Antrim, 22.7; Mount Washington, 15.4.

New Jersey.—Dover, 16.4; Paterson and Roseland, 13; South Orange, 12.5.

New York.—Lebanon Springs, 21.5; Cooperstown, 21; North Concord, 20.8; Menands, 19.9; Rochester, 18.4; Auburn, 16.5; Ithaca, 15.9; Albany, 15.4; Penn Yan and White Plains, 15; Boyd's Corners and Humphrey, 13; Oswego, 12.7; Factoryville, 12.6; New York City, 11.9.

Oregon.—Eola, 32; Roseburg, 27.2; Albany, 26; Portland, 17.9; Astoria, 17.5; La Grange, 11.5; Mount Angel, 10.6.

Pennsylvania.—Dyberry, 23; Zionsville, 15.1; Wellsborough, 14.4; Grampian Hills, 14; Blooming Grove, 13.8; Easton, 13.2; Catawissa, 12.9; State College, 12.5; Erie, 11; Phillipsburg and Quakertown, 10.

Rhode Island.—Providence, 14.5; Bristol, 12.8; Olneyville, 12.5; Providence, 12.

Utah.—Salt Lake City, 15.5; Frisco, 14.3; Ogden, 12.8; Corinne, 11.

Vermont.—Strafford, 61; Chelsea, 42.5; Jacksonville, 39.7; Townshend, 37.8; Newport, 36.8; Brattleborough, 35.7; Marlborough, 33.6; Lunenburg, 33; Charlotte, 29.5; Vernon, 28; Poultney, 25.5; Burlington, 21; Post Mills, 16.

Virginia.—Dale Enterprise, 10.

Washington Territory.—Port Angeles, 48.8; Walla Walla, 27; Tatoosh Island, 20.3; Blakely, 19.5; Tacoma, 16.7; Kennewick, 12.6; Fort Canby, 12.5.

Wisconsin.—Green Bay, 28.9; Wausau, 26.5; Embarras, 23.5; Milwaukee, 18.2; Manitowoc, 13.5; Fond du Lac, 12; Delavan and La Crosse, 11.

Wyoming.—Camp Sheridan, 46.5.

DEPTH OF UNMELTED SNOW ON GROUND AT END OF MONTH.

[Expressed in inches and tenths.]

California.—Susanville, 12; Fort Bidwell, 9.

Colorado.—Pike's Peak, 2.

Connecticut.—Hartford, 6; Southington, 5; Bethel, 4; New Haven, 1.5.

Dakota.—Fort Totten, 17; Parkston and Fort Buford, 12; Deadwood, 10; Huron, 6; Highmore, 5; Bismarck, 3.

Illinois.—Sycamore, 2.

Iowa.—West Union, 14; Cresco, 10; Independence, 8 to 12; Monticello and Dubuque, 6; Bancroft, 4; Cedar Rapids, 1.5; Clinton and Muscatine, 1.

Kansas.—Wakefield, trace.
Maine.—Cornish, 48 (in the woods); Portland, 24; Gardiner, 22; Orono, 15; Eastport, 4.
Maryland.—New Midway, 6; Cumberland, 4; Fallston, 2.5; Baltimore, 0.5; Woodstock, trace.
Massachusetts.—Williamstown, 9; Amherst, 6 to 8; Dudley and Worcester, 4; Westborough and Boston, 3; Blue Hill Observatory and Milton, 1; North Truro, trace.
Michigan.—Traverse City, 40; Mackinaw City, 25; Alpena, 20; Escanaba, 15; Marquette, 13; Grand Haven, 7; East Saginaw and Kalamazoo, 5; Swartz Creek, 3 to 10; Detroit and Port Huron, 2; Birmingham, 1; Lansing a, 0.5; Lansing b, trace.
Minnesota.—Saint Vincent, 16; Duluth and Saint Paul, 12; Minneapolis, 4; Moorhead, 3.
Montana.—Poplar River, 15; Fort Maginnis, 10; Helena, 6; Fort Assinaboine, 5.2.
Nebraska.—Valentine, 1; Marquette, trace; Hay Springs, drifts.
Nevada.—Carson City, 8; Winnemucca, 2.
New Hampshire.—Antrim, 23; Mount Washington, 14; Nashua, 6.
New Jersey.—South Orange, 6; Dover, 5; Paterson, 4; Beverly, trace.
New York.—North Volney, 22; Cooperstown, 18; Palermo, 12; Menands, 9; White Plains and Albany, 6; Auburn, 4; Oswego and Factoryville, 3; Humphrey, 2; New York City, 1; Rochester, 0.6; Buffalo, 0.5; Le Roy, trace.
Ohio.—Hiram, 2; Cleveland a, Garrettsville, and Sandusky, 1; Cleveland b and Toledo, 0.5; Wauseon, 0.4; Napoleon, 0.2; Ruggles and Tiffin, trace.
Oregon.—La Grande, 0.5; Albany and Astoria, trace.
Pennsylvania.—Dyberry, 12 to 15; State College and Gram-pian Hills, 6; Quakertown, 5; Zionsville, 4; Wellsborough, 3.7; Catawissa and Phillipsburg, 3; West Chester, 1.2; Pittsburg and Erie, 1.
Utah.—Frisco, trace.
Vermont.—Strafford, 48; Newport, 40; Brattleborough and Poultney, 36; Post Mills, 30; Charlotte, 24 to 36.
Virginia.—Dale Enterprise, trace.
Washington Territory.—Port Angeles, 4; Spokane Falls, 3.
West Virginia.—Middlebrook, 4; Helvetia, 1.
Wisconsin.—Embarras, 42; Wausau, 25; Green Bay, 22; Fond du Lac, 14; La Crosse, 11; Delavan, 7; Franklin and Madison, 6; Milwaukee, 5; Prairie du Chien, 2.
Wyoming.—Fort Bridger, 1.

HAIL.

Hail fell in the various states and territories during the month on the following dates:
California.—Nicolaus, 6th, 12th, 21st; Los Angeles, 6th, 14th; Fall Brook, 7th; Benicia Barracks, 12th; Sacramento, 13th, 21st, 24th; San Francisco, 13th, 14th, 16th, 21st; Oakland and Oroville, 21st; San Diego, 16th.
Connecticut.—New London, 18th.
Dakota.—Parkston, 17th.
Illinois.—Windsor, 1st, 10th, 25th; Charleston and Mattoon, 10th; Pekin and South Evanston, 23d.
Indiana.—Vevay, 1st, 3d; Fort Wayne, 25th.
Iowa.—Keokuk, 8th; Cedar Rapids, 12th, 23d; Monticello, 17th.
Kansas.—El Dorado and Wakefield, 10th.
Kentucky.—Harper's Ferry, 26th.
Maine.—Cornish, 3d, 8th, 11th.
Maryland.—McDonogh, 2d; New Midway, 2d, 5th, 14th, 26th; Baltimore, 18th.
Michigan.—Swartz Creek, 5th; Grand Haven, 7th; Kalamazoo, 26th.
Missouri.—Centreville, 1st, 2d, 3d, 25th.
Nebraska.—Brownville, 6th, 10th; Tacoma and Tecumseh, 10th; North Platte, 17th.
New Hampshire.—Berlin Mills, 3d.
New Jersey.—Moorestown, 1st, 2d; Dover, 2d.

New York.—Brooklyn a, 1st, 22d, 26th; Fort Columbus and New York City, 2d; Brooklyn b, 2d, 22d; Setauket, 2d, 6th, 7th, 18th; Factoryville, 2d, 13th, 14th, 24th, 26th; West Point, 6th, 7th.
North Carolina.—Weldon, 5th.
Ohio.—College Hill and West Milton, 1st; Sandusky, 1st, 2d; Elyria, 1st, 2d, 10th; Jacksonborough, 1st, 14th, 18th, 20th; Yellow Springs, 18th; Garrettsville, 18th, 26th.
Oregon.—East Portland, 1st, 9th.
Pennsylvania.—Quakertown, 1st, 2d; Dyberry, 2d, 7th, 23d; Catawissa and Wellsborough, 2d, 26th; Pittsburg, 18th; Gram-pian Hills, 26th.
South Carolina.—Spartanburg, 14th.
Texas.—Cleburne, 3d; Silver Falls, 4th.
Virginia.—Bird's Nest, 5th; Dale Enterprise, 5th, 14th, 26th; Wytheville, 14th; Chincoteague and Bruington, 23d.
Washington Territory.—Fort Townsend, 18th; Neah Bay, 24th.
Wisconsin.—Embarras, 5th; La Crosse, 6th; Delavan, 17th.
Wyoming.—Fort Washakie, 10th.

SLEET.

Sleet occurred in the various states and territories on the following dates:
Arizona.—Fort Bowie, 7th.
California.—Fort Gaston, 1st, 7th, 13th; Princeton, 6th, 21st.
Connecticut.—Bethel, 3d, 5th, 6th, 7th, 26th.
Dakota.—Huron, 17th.
District of Columbia.—Washington City, 2d, 14th.
Illinois.—Springfield, 1st, 2d; Cairo, 4th; South Evanston, 10th; Chicago and Geneseo, 11th.
Indiana.—Fort Wayne and Mauzy, 1st; Butlerville, 1st, 5th, 14th; Sunman, 1st, 5th; Indianapolis, 1st, 18th.
Indian Territory.—Fort Sill, 4th.
Iowa.—Clinton, 5th; Dubuque, 6th, 7th; Des Moines a and Oskaloosa, 10th; Des Moines b, 11th.
Kansas.—Globe, 4th; Fort Riley and Wakefield, 10th; Leavenworth, 10th, 11th; Salina, 10th, 15th, 24th.
Kentucky.—Louisville, 1st.
Maine.—Portland, 3d, 8th; Eastport, 3d, 18th, 19th, 24th.
Maryland.—Baltimore, 2d, 5th, 20th.
Massachusetts.—Wood's Holl and Boston, 2d, 3d; New Bedford, 6th, 7th, 8th, 18th.
Michigan.—Detroit and Mottville, 2d; Alpena, 7th; Fort Brady, 7th, 8th; Mackinaw City, 8th; Marquette, 14th.
Missouri.—Saint Louis, 1st, 4th.
Nebraska.—Orete, 5th; De Soto, 7th; Omaha, 10th; North Platte, 17th.
New Hampshire.—Manchester, 3d, 11th.
New Jersey.—Atlantic City, 1st; Beverly, 1st, 2d, 3d, 18th; Moorestown, 2d; Clayton, 2d, 6th.
New York.—New York City and Brooklyn, 2d; Oswego, 2d, 3d, 6th, 7th, 11th, 26th, 27th; Palermo, 3d, 6th, 7th, 8th, 11th, 24th, 28th; Fort Columbus, 3d, 6th, 8th, 22d; Albany, 2d, 3d, 8th, 26th; Buffalo, 6th, 7th; Palmyra, 6th; Le Roy, 7th, 11th, 18th, 27th; Factoryville, 14th; Setauket, 18th.
North Carolina.—Charlotte, 14th.
Ohio.—Cincinnati, Columbus, and West Milton, 1st; Cleveland, 1st, 2d; Wauseon, 1st, 2d, 5th, 14th, 18th, 23d, 26th; Garrettsville, 2d; Toledo, 2d, 3d.
Pennsylvania.—Pittsburg, 1st; Philadelphia, 1st, 2d; Erie, 2d; Phillipsburg, 2d, 6th, 14th; Wysox, 3d, 18th.
Rhode Island.—Narragansett Pier, 3d, 7th.
South Carolina.—Aiken and Charleston, 13th.
Tennessee.—Nashville, 3d, 4th; Memphis, 4th.
Texas.—Silver Falls and Midland, 3d; Abilene and Cedar Hill, 3d, 4th, 5th; Galveston, 4th; New Ulm, 27th.
Utah.—Salt Lake City, 16th.
Virginia.—Lynchburg, 5th, 14th, 15th; Variety Mills, 23d, 26th.
Washington Territory.—Walla Walla, 17th.
Wisconsin.—Milwaukee, 2d, 5th, 6th, 10th; Green Bay, 7th, 14th; Wausau, 18th, 26th.

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

Table with columns: Station, Specially heavy (Date, Amt.), Largest monthly (Amount), Station, Specially heavy (Date, Amt.), Largest monthly (Amount). Lists stations across various states including Alabama, Arkansas, California, Indiana, Iowa, Kentucky, Louisiana, Maine, Massachusetts, Michigan, Missouri, Nevada, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Virginia, and Wisconsin.

Table of excessive and greatest monthly precipitation for February—Cont'd.

Continuation of the precipitation table, listing stations in Tennessee and Wisconsin with their respective precipitation amounts.

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 February, 1887.

Table with columns: Station, Temperature at bottom (Max, Min), Range, Average depth, Mean temperature of the air at station. Lists various stations across the United States and their corresponding water temperature data.

a Frozen throughout the month.

b Record for 27 days.

c Record for 7 days; lake frozen during remainder of month.

d Record for 21 days.

e Record for 19 days; lake frozen during remainder of month.

WINDS.

The most frequent directions of the wind during February, 1887, are shown on chart ii by the arrows flying with the wind; they are also given in the table of miscellaneous data. In New England, the Lake region, the upper Mississippi valley, the Missouri Valley, Dakota, and Minnesota, the wind blew generally from the west or northwest; in the Gulf States the prevailing direction was from the south; in the middle plateau from the southwest. In other parts of the country the wind was variable.

HIGH WINDS.

[In miles per hour.]

Wind-velocities of fifty or more miles per hour, other than the maximum velocities for the month, which are given in the table of miscellaneous data:

Mount Washington, New Hampshire, 54, nw., 1st; 58, nw., 3d; 71, w., 5th; 63, nw., 6th; 101, w. 8th; 100, w., 9th; 72, w., 10th; 76, sw., 11th; 78, nw., 12th; 82, nw., 13th; 60, w., 14th; 100, w., 15th; 51, w., 16th; 74, nw., 17th; 76, se., 18th; 92, nw. 19th; 86, nw., 20th; 60, sw., 22d; 72, nw., 23d; 119,

nw., 24th; 104, nw., 25th; 110, s., 26th; 112, nw., 27th; 112, nw., 28th.
 Pike's Peak, Colorado, 52, sw., 1st; 70, w., 4th; 76, sw., 5th; 52, sw., 6th; 62, w., 8th; 74, sw., 9th; 52, sw., 10th; 74, w., 11th; 72, sw., 13th; 68, w., 14th; 62, sw., 15th; 64, w., 16th; 64, nw., 17th; 56, sw., 21st; 60, sw., 24th; 76, w., 25th; 86, nw., 26th; 74, n., 27th.
 Dodge City, Kansas, 51, sw. and nw., 17th.
 Fort Elliott, Texas, 52, w., 17th.

Columbus, Ohio, 54, w., 11th.
 Rochester, New York, 52, s. and sw., 27th.
 Buffalo, New York, 60, sw., 18th and 19th; 61, sw., 26th, 27th, 28th.
 Fort Maginnis, Montana, 68, nw., 13th; 52, w. 17th; 60, w., 28th.
 Valentine, Nebraska, 51, nw., 25th.
 Fort Canby, Washington Territory, 50, se., 10th; 52, s. 27th; 52, s., 28th.

Report of tornadoes for the month of February, 1887, by Lieut. John P. Finley, Signal Corps, U. S. Army, Assistant.

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.
Kilbourne, Ohio a	10	7.20 a. m.	ne.	Column of smk.	None.	None.	Feet.				Mrs. D. A. Knapp, Kilbourne, Ohio.
Neshannock and Mercer, Pennsylvania	11	11 a. m.	no.				1,320 to 2,640			Very destructive.	J. Bridget, Neshannock, and John Albin, Mercer, Pennsylvania.
Huntingdon, Pennsylvania	11	About 12 m.	easterly						One large distillery, one large factory, several houses.	Many thousands of dollars.	New York "World," Feb. 12, 1887.
Tyrone, Pennsylvania	11	do	no.							Very destructive.	G. J. Kellogg, Janesville, Wisconsin.
Greenburr, Pennsylvania	11	11 a. m.	no.		None.	None.	Narrow			do	G. J. Kellogg, Janesville, Wisconsin.
Tionesta, Pennsylvania	11	11 a. m.	no.						Worst storm since 1851.	do	S. H. Haslet, Tionesta, Pennsylvania.
Canton and Louisville, Ohio b	11	A. M.	easterly	Water-spout.	None.	Several	2,640			\$100,000	J. G. Sherman, Wakeman, Ohio, and New York "World," Feb. 12, 1887.
Akron, Ohio	11	A. M.	no.		None.	None.	Very narrow		Many buildings; very destructive.		J. G. Sherman, Wakeman, Ohio.
Vanattasburg, Ohio	11	A. M.	no.		None.	None.	do	Many sheep and cattle.	Many farm buildings; very destructive.		L. M. Heiston, Pleasantville, Ohio, and J. G. Sherman, Wakeman, Ohio.
Carroll and Lithopolis, Ohio c	11	7.45 a. m.	no.		None.	Several	2,640 to 3,960		Many	Very destructive.	L. M. Heiston, Pleasantville, Ohio, and J. F. Stallsmith, Lithopolis, Ohio.
Centrebureg, Ohio	11	8 a. m.	e.				Narrow			Destructive.	L. M. Heiston, Pleasantville, Ohio.
Lancaster, Ohio	11	9 a. m.	no.				do			Very destructive.	L. M. Heiston, Pleasantville, Ohio.
Wellsville, Ohio	11	A. M.	no.		None.	Several	do			do	J. G. Sherman, Wakeman, Ohio.
Mount Hor, Kentucky	11	6 p. m.	no.	Funnel	None.	None.	2,640			Very destructive.	Dr. J. W. Jacobs, Mount Hor, Kentucky.
Factoryville, New York d	11	11.30 a. m.	e.	Funnel	None.	Several	150 to 1,720		Many	Very destructive.	J. P. Yates, Factoryville, New York.
Lowmanville and Wellsburg, New York e	11	11.30 a. m.	easterly	Funnel	None.	Several	2,640			Many thousands of dollars.	J. B. Gasseple, Vandalla, New York, and New York "World," Feb. 12, 1887.
New Midway, Maryland	11	1.15 p. m.	no.		None.	None.	Narrow			Most violent storm ever visited this place in winter.	G. F. Smith, New Midway, Maryland.
Shelbyville, Indiana f	11	4 a. m.	no.	Funnel							J. G. Kellogg, Janesville, Wisconsin.
Four miles north of Colorado Springs, Colorado g	16	3 p. m.	easterly			Several	Narrow				Virgil Smith, Reed's Corner, New York.
Athens, Kansas	17	2 p. m.	easterly							Very destructive.	L. F. Davis, Athens, Kansas.
Cuthbert, and near Fort Gaines, Georgia	18	Afternoon	no.	Funnel	Several	Several	1,320 to 2,640			Very destructive.	J. E. Willet, Macon, Georgia.
Near Oroville, California	21	Evening	no.				40			do	New York "Tribune," Feb. 23, 1887.
Eatonton, Georgia h	26	4.15 p. m.	no.	Funnel	Two.	Seven.	150 to 230			do	B. W. Hunt, Eatonton, Georgia, and "Macon Telegraph."
Near Worthville and Jackson, Georgia	26	4 p. m.	no.	Funnel	None.	Several	600 to 1,320		Six houses and several barns.	do	H. T. Barnes, Worthville, Georgia.
Elk Creek, Kentucky	26	9 a. m.	no.		None.	None.	Narrow			Most destructive for years.	Robert J. Jewell, Elk Creek, Kentucky.
Wallace Post Office, Louisiana i	26	11.50 a. m.	easterly		None.	Several	Very narrow		Very destructive.	\$15,000	Geo. H. Tassin, Wallace, Louisiana.
Tyler Creek, West Virginia	26	5 p. m.	no.		None.	None.		Many	Houses and barns.		F. M. Swain, Tyler Creek, West Virginia.

a The cloud appeared as a column of smoke rolling through the air quite near the ground, and at places touching the ground, tearing up trees, &c.
 b The cloud approached with an ominous roar, like a train of cars. In the cemetery dozens of large marble monuments were prostrated. The roof of a large building was carried upward two hundred feet.
 c Trees two feet in diameter broken off.
 d The wind was accompanied by a dark cloud, so that it seemed like twilight as it passed over us, and in this streak there was a large white cloud like smoke, and somewhat illuminated, situated between the earth and the black cloud envelope. It moved with the destructive centre gyrating, bounding, bursting asunder, gathering together again and whirling.
 e The force of the wind backed up the water in Chomung river, and raised a column of it high in the air, so that the bed of the river was nearly dry. The river at this place is five hundred feet wide and over twenty deep.
 f Everybody in town was awakened by a whirling, twisting motion, and a sound like the explosion of a bomb, and complete demolition of a large brick barn.
 g An express train consisting of six coaches, was blown from the track, also a freight train of twenty cars was derailed. When about two miles from the city a train of three coaches was blown from the track, and near Coma, on the same road, an express train was blown from a bridge.
 h Cloud spout did not reach the ground but passed overhead in the air. About twenty minutes before the tornado, clouds were moving from all points to a common centre in the southwest.
 i At Willow Bend, on the Mississippi river the force of the wind raised a column of water fifty feet high.

INLAND NAVIGATION.

STATE OF WATER IN RIVERS AND HARBORS.

Mississippi River.—Cairo, Illinois: from the 1st to 8th the river at this point was filled with heavy floating ice, closing navigation between Cairo, Illinois, and Saint Louis, Missouri. On the 3d the river was thirty-seven feet above low-water mark, and rising steadily. The lowlands, both north and south of the city, were submerged, and lumbermen and farmers were busy moving their property to higher ground. On the 5th

numerous landings between here and Paducah, Kentucky, were under water. The river reached the danger line, forty feet, on the night of the 6-7th. On the 7th the steamers "David R. Powell" and "Helena" attempted to push through the ice to Saint Louis, Missouri, but were forced to return. On the 8th navigation between the two cities was resumed, the steamboats "City of Providence" and "Baton Rouge" departed for Saint Louis, and were successful in pushing through the ice back of the city. From the 8th to the 16th large quantities of ice

passed down the river; on the 16th it became quite heavy and interfered to a considerable extent with the movements of the railroad transfer boats at Bird's Point, Missouri. The river rose steadily from the first to the last day of the month; on the 1st it was 34.4 feet above low-water mark; on the 28th, 47.2.

Keokuk, Iowa: the ice in the river remained frozen solid until the 10th, on that date high temperatures and heavy rain prevailed, and the ice in the river broke up and began moving down rapidly at 2 p. m. Ice moved down the river until the 14th; from the 14th until the 24th it was free of ice; from the latter date until the end of the month considerable newly formed ice moved down.

Saint Louis, Missouri: on the 1st, 2d, and 3d, the river was filled with heavy flowing ice; considerable ice passed down the river every-day from the 3d until the end of the month. The water was at its lowest stage on the 6th; from that date it rose gradually until the 15th, when it was 17.8 feet above low-water mark.

At Saint Paul, Minnesota, La Crosse, Wisconsin, and Dubuque, Iowa, the river remained frozen over from the 1st to 28th.

Ohio River.—Pittsburg, Pennsylvania: the Ohio River rose steadily from the 1st to 12th, when it was 21.9 feet above low-water mark; from the 12th to the 24th it subsided slowly, and on the latter date was only 9.0 feet above low-water mark. The heavy rain of the 26th and 27th caused the river to rise rapidly, and at 2 p. m. of the 27th it was 21.4 feet above. When the water was at its height several coal barges were broken from their wharves and carried down the river; one was sunk; loss about \$4,000.

Cincinnati, Ohio: from the 1st of the month until the 5th the river rose steadily, attaining on the latter date a depth of 56.3 feet above low-water mark; from the 5th to the 10th it fell very slowly, but began rising again after the 10th, reaching on the 18th a height of 50.4 feet. From the 18th until the end of the month the river fell very slowly, or remained stationary.

Louisville, Kentucky: on the 1st, 2d, and 3d very heavy rain fell and the river rose rapidly until the 6th, when it was 32.6 feet above low-water mark; the flood remained nearly stationary until 2 p. m. of the 7th, when it began to fall slowly. On the 3d the water rose at the average rate of three inches per hour, and fears of a serious flood were entertained. On the 4th several houses in the lower part of the city were flooded. On the 28th the river at this point was again high, 30.6 feet, and still rising.

Missouri River.—Leavenworth, Kansas: the river at this point was frozen over from December 26, 1886, until the 17th of the present month, when the ice broke up and began floating down, doing no damage. On the afternoon of the 18th the river was clear of ice; from the 19th until the close of the month large quantities floated down.

Fort Buford, Dakota: the river remained frozen over from the 1st to 28th.

Omaha, Nebraska: river frozen from the 1st to 28th.

Red River.—Shreveport, Louisiana: the river at this point rose steadily from the 1st to 28th; on the latter date it was 15.6 feet above low-water mark. On the 14th it had become navigable as far as the principal river ports on the upper part of the river.

Lake Michigan.—Milwaukee, Wisconsin: the numerous rains and heavy gales of the month broke up the ice in the southern part of Lake Michigan to a considerable extent, and the line boats between the east and west shore ports were making their regular trips at the end of the month.

Lake Huron.—Alpena, Michigan: the lake at this point was frozen from the 1st to 28th.

Lake Superior.—Duluth, Minnesota: the lake at this point was frozen over from the 1st to 28th.

In the following table are shown the danger-points at the various river stations; the highest and lowest depths for February, 1887, with the dates of occurrence, and the monthly ranges:

Heights of rivers above low-water mark, February, 1887.
[Expressed in feet and tenths.]

Stations.	Danger-point on range.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
<i>Red River:</i>						
Shreveport, Louisiana.....	29.9	28	15.6	8	4.6	11.0
<i>Arkansas River:</i>						
Fort Smith, Arkansas.....	22.0	16, 17	6.3	6	0.0	6.3
Little Rock, Arkansas.....	23.0	16	13.1	7	2.5	10.6
<i>Missouri River:</i>						
Yankton, Dakota.....	24.0					
Omaha, Nebraska a.....	18.0					
Leavenworth, Kansas b.....	20.0	28	6.5	18	5.0	1.5
<i>Mississippi River:</i>						
Saint Paul, Minnesota a.....	14.5					
La Crosse, Wisconsin a.....	24.0					
Dubuque, Iowa a.....	16.0					
Davenport, Iowa a.....	15.0					
Keokuk, Iowa a.....	14.0	11	13.3	28	4.9	8.4
Saint Louis, Missouri.....	32.0	15	17.8	6	5.0	12.6
Cairo, Illinois.....	40.0	28	47.2	1	34.4	12.8
Memphis, Tennessee.....	34.0	26, 27, 28	35.6	1	24.4	11.2
Vicksburg, Mississippi.....	41.0	28	41.9	1	18.0	23.9
New Orleans, Louisiana.....	13.0	26	13.0	1	3.7	9.3
<i>Ohio River:</i>						
Pittsburg, Pennsylvania.....	22.0	12	21.9	24	9.0	12.9
Cincinnati, Ohio.....	50.0	5	56.3	2	41.0	75.3
Louisville, Kentucky.....	25.0	6, 7	32.6	2	19.8	12.8
<i>Cumberland River:</i>						
Nashville, Tennessee.....	40.0	28	43.7	14	13.5	30.2
<i>Tennessee River:</i>						
Knoxville, Tennessee.....		4	14.3	14	3.6	10.7
Obattanooga, Tennessee.....	33.0	28	27.3	14	8.6	18.7
<i>Monongahela River:</i>						
Pittsburg, Pennsylvania.....	29.0	12	21.9	24	9.0	12.9
<i>Savannah River:</i>						
Augusta, Georgia.....	32.0	22	17.8	14	7.0	10.8
<i>Mobile River:</i>						
Mobile, Alabama.....		26	16.6	12	14.8	1.8
<i>Sacramento River:</i>						
Red Bluff, California.....		12	18.3	1, 2, 3, 4	1.6	16.7
Sacramento, California.....		14	18.6	2, 3, 4	10.3	8.3
<i>Willamette River:</i>						
Portland, Oregon.....		1	15.8	18	1.4	14.4

a Frozen throughout the month.

b For 11 days.

FLOODS.

Evansville, Vanderburg county, Indiana: on the 1st, 2d, and 3d the Ohio River rose rapidly, covering the bottom lands and lower portion of several river towns in this county. On the 3d large portions of Knight and Union townships were under water, and the inhabitants driven into the second stories of their houses. The track of the Louisville, Evansville, and Saint Louis Railroad at Rockport was several feet under water. The effects of the flood were severely felt at the town of Enterprise, where the first floor of all the houses was flooded, and farmers in the vicinity lost considerable stock and corn.

Wheeling, West Virginia: on the 4th several of the rivers of West Virginia were above the danger point, and serious damage was done to the farming and lumber interests along the valleys of the Cheat, Big Sandy, Little and Great Kanawha, Elk, Monongahela, and other rivers. In the neighborhood of Elk River much fencing and lumber was carried off and railroad property injured; at Clarksburg the river was reported to have been higher than at any time since 1875; at Grafton the water was higher than at any other time during the past ten years, and many families were compelled to move to the upper stories of their houses. Railroad traffic in parts of the state was seriously interfered with by high water during the first half of the month.

Birmingham, New Haven county, Connecticut: during the first five or six days of the month an ice gorge was forming in the Housatonic River at Zoar Bridge, a town a few miles above this place, and on the 6th the rising water and floating ice had completely surrounded the dwellings on the banks of the river, isolating them from communication with dry land. Numerous barns, out-houses, and fences were floated from their foundations and carried down the river. A gorge formed on the 5th and 6th in the Connecticut River at Windsor Locks, the water forcing the ice up to a height of twenty feet.

Buffalo, New York: during the 7th and 8th a severe north-easterly gale prevailed, with high temperature, maximum on

the 8th, 54°.1, and heavy rain at intervals. The gale continued until 5 p. m. of the 9th. The high northeasterly winds raised the water of the lake to an unusual height, this, in conjunction with the heavy rain and high temperature, caused Buffalo Creek to overflow and submerge a portion of the lower part of the town, and forced a large number of families to vacate their homes. Thirty feet of the Buffalo, New York, and Philadelphia Railroad, and about the same space on the Nickle Plate Railroad, were washed out, causing a temporary suspension of travel. A number of vessels in winter quarters were compelled to change position.

Tiffin, Seneca county, Ohio: the Sandusky River was unusually high on and after the 8th, overflowing its banks in several places and doing some damage. The river was free of ice throughout the month.

Delavan, Walworth county, Wisconsin: much damage was done in this vicinity by high water, especially after the storms of the 7th and 8th. Turtle Creek, which rises near this station, in its course of about thirty-five miles wrecked a flour mill, two railroad bridges, and several wagon road bridges, entailing a loss of about \$10,000.

Rochester, New York: during the night of the 9-10th the Genesee River rose five and one-half feet, and on the morning of the 10th was one inch higher than it has been for several years. The tracks of the Erie Railroad were submerged and a number of cellars and basements flooded. Reports from Genesee state that considerable damage was done by the flood in that vicinity, but no more than is caused by the ordinary spring freshet. The tracks of the Erie Railroad were under water at Mount Morris for a short time, causing trains to run irregularly. Between Genesee and Dansville the river was twenty feet above low-water mark, and within two feet of the flooring of some of the bridges. From Fowlerville to Dansville, a distance of twenty-eight miles, the flats were entirely submerged. At Avon the flats for miles were flooded, and the road to the town of Cattaraugus for a distance of three miles was covered with water, making communication in that direction impossible. At the town of Lyons, in Wayne county, the flood in Clyde Creek, caused by heavy rains of the 10th and 11th and melting snow and ice, was reported to have been more extensive than any other that has occurred for many years. Thousands of acres of land were flooded, covering the wheat and rye crops with mud and débris. Many residences and business places in the lower part of the town were surrounded by water, and much damage done to property in cellars and basements.

Chicago, Illinois: on the night of the 9-10th the heavy ice that had been running in the South Branch of the Chicago River gorged and the water began rising rapidly. At the same time three gorges formed in the North Branch and remained immovable until the 11th, although repeated attempts were made to break up the ice by the use of dynamite. On the 10th the southwest and northwest portions of the city and the western side of the suburb of Lakeview were overflowed. At this time the waters of the North and South Branches of the Chicago River were from four to six feet above high-water mark, and all the flat prairie land back of the city was flooded. On the 11th the river was still rising slowly, doing considerable damage to property in cellars and basements, especially in the southwest portion of the city. During the afternoon the water in the North Branch began falling rapidly, but at midnight there were still large areas overflowed.

Wilkesbarre, Luzerne county, Pennsylvania: on the 10th the water of the Susquehanna River was twenty feet above low-water mark, and the flat land on the west side of the river was covered with water to a depth of three feet. In the afternoon a large ice gorge that had formed above the town began moving out, but gorged again at Coxtton. On the same date a heavy gorge formed above Pittston. The gorge that formed in the Susquehanna below Port Deposit, Maryland, in January did not break up until after the 10th of February, although on that date the flood had subsided considerably. All of the lower

parts of the town, including the coal yards, were covered to a depth of several feet with water and ice from the 28th of January to the 11th of February. A large gorge five miles south of Columbia, Pennsylvania, broke up at 5.15 p. m. of the 10th and moved rapidly down the river, carrying away a wooden bridge at Conestoga Creek, and destroying other property.

Pittsburg, Pennsylvania: during the 10th the barometer fell rapidly, with rising temperature and southeasterly wind. At 5.45 p. m. a thunder-storm set in, accompanied from 6 to 8 p. m. by heavy rain. The heavy fall of rain did some damage to streets, and impeded traffic on several of the railroads entering this city.

Cairo, Illinois: on the 11th the river at this point was 43.9 feet above low-water mark, and rising steadily. Reports from the lowlands between this place and Memphis, Tennessee, state that many persons had been driven to the highlands by the rising water. River men arriving on the 13th stated that the lower part of the town of Hickman, Kentucky, was submerged, and boats were landing above the town.

Los Angeles, California: heavy rain fell on the 12th, 13th, and until noon of the 14th; light rain fell from noon until 9 p. m. of the 14th, when it began falling heavily, accompanied by high south wind; at 9.57 p. m. the storm was accompanied by thunder and lightning, with hail. During the storm a barn in the southwestern part of the town was struck by lightning. The observer at this place states that he measured the precipitation several times during the day and found that 3.00 inches fell between 12.07 and 9 p. m.; 0.40 inch was found in the gauge at 4.30 p. m., and 1.50 inches at 9 p. m.; 2.56 inches fell between 4.30 and 9 p. m., the greater part of this fell from 6 to 8.30 p. m. This unusually heavy fall of rain flooded the streets, many of them becoming impassable, and street-car travel was generally suspended on account of damaged tracks. The river rose rapidly from the large volume of water poured into it from the neighboring mountains and hills, and by midnight had become a rapid torrent, damaging bridges and flooding the lowlands and the greater part of the city. The storm caused numerous washouts on the railroads both to the east and north, and telegraph poles were prostrated in many places. A severe southeasterly gale prevailed off the coast, wrecking two vessels at San Pedro.

Nashville, Tennessee: on the 14th the Cumberland River was 13.5 feet above low-water mark; from that date until the end of the month the water rose steadily, measuring on the 28th 43.7 feet above. The first floors of over three hundred small houses in the lower part of the city were submerged, and many families were compelled to move to higher ground. It is reported that many square miles of farming land along the river were overflowed and large quantities of fencing carried away. The wheat crop in the overflowed districts sustained serious injury.

Grand Haven, Michigan: during the 14th warm weather and light rain prevailed, causing the ice in the Grand River to break up and move down rapidly. Numerous ice gorges formed in the river at various places and flooded large areas of land along its banks. A large gorge formed below Lyons on the morning of the 11th, causing the river to overflow its banks and flow through the streets of the town; in some places the water was four feet deep. Twenty buildings were carried away and many more moved from their foundations or otherwise damaged by floating ice and timber.

Memphis, Tennessee: at the beginning of the month the river was 24.4 feet above low-water mark, and rising steadily, which it continued to do until the end of the month, when it was 35.6 feet above, having reached the danger line, 34 feet, on the 16th. The damages caused by this high stage of water, at the end of the month were as follows: In the upper portion of the city four lumber yards were partially inundated, damaging property to the extent of about \$6,000; two sawmills had ceased operations on account of the high water by which they were surrounded; in the same part of the city, and along the bayou, one hundred and twenty-five houses were partly sub-

Table of miscellaneous meteorological data for February, 1887—Signal Service observations.

Table with columns for Stations, Elevation, Atmospheric pressure, Temperature of the air, Humidity, Winds, and various meteorological data points for February 1887.

Table of miscellaneous meteorological data for February, 1887—Signal Service observations—Continued.

Table with columns for Stations, Elevation above sea-level, Atmospheric pressure (in inches and hundredths), Temperature of the air (in degrees Fahrenheit), Humidity, Precipitation, and Winds. Rows are grouped by region: Upper Miss. Valley, Missouri Valley, Northern slope, Middle slope, Southern slope, Southern plateau, Middle plateau, Northern plateau, and S. Pac. coast region.

* Record for 27 days; † 23.9, record for 27 days. ‡ Record for 25 days. § 101.5. ¶ Record for 25 days. || Record for 27 days, 0.26.

Meteorological record of voluntary observers and Army post surgeons, February, 1887.

The maximum and minimum temperatures at stations marked thus (*) are from readings of other than standard instruments.

Table with columns for Stations, Temperature (Maximum, Minimum, Mean), and Precipitation. Includes entries for Alabama, Arizona, Arkansas, California, Colorado, Connecticut, Dakota, District of Columbia, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Jersey, New Mexico, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, West Virginia, Wisconsin, Wyoming, and various Army posts.

Meteorological record of voluntary observers, etc.—Continued.

Continuation of the meteorological record table, including stations from Oregon to Wyoming and various Army posts, with columns for Stations, Temperature, and Precipitation.

merged by the back water from the river; the bed of the Chesapeake and Ohio Railroad, which is the first track next to the river, was washed away, and about one hundred and eighty feet of the embankment along the Arkansas side of the river had been carried away by the flood. In the vicinity of the town of Dickson, in Dickson county, very heavy rain fell on the 23d, causing creeks to overflow their banks and carry away nearly all the fences in the lowlands. Land on hillsides, especially where ploughed or not in grass, was badly washed.

ATMOSPHERIC ELECTRICITY.

AURORAS.

The most brilliant and extensively observed aurora of the month was that which appeared on the night of the 19-20th; it was visible, except in the lower lake region, from Eastport, Maine, to Fort Buford, Dakota, and as far south as the fortieth parallel. The sky in the lower lake region was generally obscured by clouds, but several stations in that district report auroral lights as being visible for a few seconds through breaks in the clouds. An aurora of moderate intensity was observed on the night of the 12-13th in New England and the upper lake region; it was also faintly visible in southern Ohio, southern Indiana, and northern Dakota. This display was probably as extensive as that of the 19th, and was also reported from a number of stations between Eastport, Maine, and Fort Buford, Dakota, but, owing to cloudy weather, was not seen at stations in New York, Pennsylvania, the lower lake region, and the upper part of the Mississippi and Missouri valleys. On the night of the 13-14th an aurora was reported from a number of stations in New England, New York, and northern Michigan; it was not reported from other sections of the eastern part of the United States, although clear weather prevailed east of the Mississippi River and north of Tennessee and North Carolina.

The following is a short statement of the weather conditions attending the more important of the remaining displays of the month. On the night of the 11-12th an aurora was visible at Nashua, New Hampshire, Woodstock, Maryland, and at stations in the northern part of Minnesota, Dakota, and Montana; the sky on the night of the 11-12th was cloudy in New England, the middle Atlantic states, and the lower lake region, and clear from that district westward to Montana. A faint aurora was seen on the 16th at two stations in New England, and at a few scattering stations in the extreme northern districts; clear weather prevailed, except in New England. An aurora was visible on the night of the 21st-22d at stations in the northern part of New England, Michigan, Minnesota, and Dakota; in these districts the sky was clear; in the remainder of the northeastern quarter of the country the sky was overcast. On the night of the 2-3d an aurora was visible at Franklin, Wisconsin; on that date cloudy weather, with rain or snow, prevailed over the greater part of the eastern districts of the country.

The following are descriptions of the more important displays, as observed from different places:

Rochester, New York: at 9.50 p. m. of the 11th, while light snow was falling, an aurora, in the form of an arch of light extending from east to west through the northern half of the sky, was seen. The display was obscured by clouds at 10.07 p. m.

Cambridge, Middlesex county, Massachusetts: on the 12th a double auroral arch was visible from 7 to 11 p. m.; a few faint streamers were seen. On the 13th a faint auroral light, with some appearance of streamers, became visible at 9 p. m. and had not all disappeared at 11.30 p. m. Auroral lights were also visible on the 14th, 19th, and 25th.

Amherst, Hampshire county, Massachusetts: an aurora was visible at different times during the evening of the 12th, at intervals rapidly changing streamers were visible, shooting up to an altitude of 30°. An auroral light was also visible during the night of the 13-14th. At 8.30 p. m. very brilliant streamers, extending to an altitude of 20°, appeared.

Eastport, Maine: an auroral arch was visible from 7 to 9 p. m. of the 12th; on the 13th a faint auroral light appeared at 8 p. m. and remained visible until midnight. Faint auroral displays were observed on the 17th from 10 to 11 p. m., and on the 19th from 9 p. m. until after midnight.

Escanaba, Michigan: faint auroral lights were seen on the nights of the 12-13th and 13-14th. On the night of the 19-20th an aurora of moderate brilliancy was visible from 8.30 p. m. until 3.30 a. m., when it became obscured by clouds; the display appeared in the form of a luminous arch rising over a dark segment; altitude, 12°; azimuth, 160° to 200°. At mid-

night it increased in brilliancy, and straw-colored streamers shot up to an altitude of about 30°. An auroral display was also observed on the night of the 20th-21st from 8 p. m. until 2 a. m.

Fort Buford, Dakota: an aurora was visible from 10.28 to 11.30 p. m. of the 12th; it consisted of an imperfect arch extending from northwest to northeast and to an altitude of about 15°. On the 19th an aurora of a pale white color, and having the appearance of an illuminated cloud, was visible from 9.33 to 11.30 p. m., when it became obscured by clouds.

Buffalo, New York: at 6.50 p. m. of the 12th a white auroral arch became visible, having an altitude of 9°. The display gradually increased in altitude until at 7.25 p. m. it had attained its maximum, 25°, with an azimuth of 110° to 120°. At 7.33 p. m. the arch began to waver and grow dimmer on its eastern side and shortly after entirely disappeared. The display was quite brilliant and attracted considerable attention.

Oswego, New York: on the 19th, at 9.45 p. m., a faint auroral light was observed through breaks in the clouds that nearly covered the sky. The light was completely hidden from view by clouds at 10.45 p. m., but was visible at intervals between midnight and 1.30 a. m. of the 20th.

Dover, Morris county, New Jersey: an auroral display was visible on the 19th between 9 and 10 p. m.; it consisted of a very bright light, extending to altitude 15°, and 35° east and 15° west of north.

Bismarck, Dakota: an auroral light was seen at 11.15 p. m. of the 19th; the display attained its maximum at 12.30 a. m. of the 20th. At that time it consisted of a bright yellow light, extending from azimuth 125° to 235°, altitude 60°. At 4 a. m. the light was covered by clouds.

Saint Vincent, Minnesota: at 9 p. m. of the 19th an auroral light became visible in the northern sky. When first observed it had the form of an undulating ribbon of yellowish light of about 3° altitude and 90° azimuth. The aurora remained in this form about half an hour, after which a few faint beams of light ascended toward the zenith; these gradually increased in number and brightness, the larger ones showing a combination of brilliant colors, varying from a deep orange yellow at the base to green at the tips. At the time of greatest brilliancy distinct shadows of buildings or other objects were cast on the snow. The display ended during the early morning of the 20th.

Marquette, Michigan: an aurora was visible from 8.20 to 11.30 p. m. of the 19th. When first observed it consisted of an arch extending from azimuth 80° to 180°; at 9.30 p. m. a second arch made its appearance, and shortly after a few bright streamers shot upward to a height of about 50°. The aurora began fading at 10.30 p. m., and at 11.30 p. m. had entirely disappeared. The observer at this place states that on the night of the 20th-21st an aurora was observed that was almost a counterpart of that of the previous night. It was visible from 8.30 p. m. until after midnight.

Poplar River, Montana: auroral lights were visible in the northern sky on the 10th from 10.30 to 11.50 p. m.; on the 11th from 10.30 p. m. until the early morning of the 12th; during the morning of the 13th from 12.10 until 4 a. m.; in the early morning and after sunset of the 14th until 4 a. m. of the 15th; on the 16th from 1 to 4 a. m.; at 9 p. m. of the 20th; from 2 to 4 a. m. of the 22d. On the 23d the aurora appeared in the form of an arch of yellow light, with streamers shooting up to an altitude of 15°; the display was visible from 12.30 to 5 a. m.

The above displays were also observed at the following places:

2d.—Franklin, Wisconsin.

4th.—Bethel, Connecticut.

11th.—Fort Totten and Webster, Dakota; Woodstock, Maryland; Duluth, Minnesota; Nashua, New Hampshire.

12th.—Voluntown, Connecticut; Butlerville, Indiana; Cornish and Gardiner, Maine; Boston, Amherst, Blue Hill Observatory, Dudley, Fall River, Milton, North Truro, Somerset, and Westborough, Massachusetts; Alpena, Mackinaw City, Swartz Creek, and Traverse City, Michigan; Nashua, New Hampshire;

Moorestown, New Jersey; Le Roy, New York; College Hill, Ohio; Lunenburg, Newport, and Strafford, Vermont; Madison and Prairie du Chien, Wisconsin.

13th.—Southington, Connecticut; Cornish, Gardiner, and Orono, Maine; Amherst, Blue Hill Observatory, Fall River, Milton, and North Truro, Massachusetts; Mackinaw City, Michigan; Berlin Mills, New Hampshire; Factoryville and Palermo, New York; Lunenburg, Post Mills, Newport, Strafford, and Brattleborough, Vermont.

14th.—Fort Totten, Dakota; Cornish, Gardiner, and Orono, Maine; Blue Hill Observatory, Fall River, and North Truro, Massachusetts.

15th.—Cresco, Iowa.

16th.—Fort Totten and Webster, Dakota; Mackinaw City, Michigan; Newport and Brattleborough, Vermont.

18th.—Fort Madison, Iowa.

19th.—Bethel, Southington, and Voluntown, Connecticut; Parkston, Bismarck, Webster, and Fort Totten, Dakota; Riley, Illinois; Cresco, Fort Madison, and Monticello, Iowa; Cornish and Gardiner, Maine; Boston, Vineyard Haven, Blue Hill Observatory, Dudley, Fall River, North Truro, and Somerset, Massachusetts; Alpena, Michigan; Duluth and Moorhead, Minnesota; Nashua, New Hampshire; Setauket, New York; Sandusky, Napoleon, and Wauseon, Ohio; Block Island, Rhode Island; Lunenburg and Brattleborough, Vermont; Manitowoc, Wisconsin.

20th.—Fort Totten and Webster, Dakota; Traverse City, Michigan; Block Island, Rhode Island.

21st.—Fort Totten, Dakota; Gardiner, Maine; Marquette, Michigan; Duluth, Minnesota.

22d.—Mackinaw City, Michigan.

23d.—Fort Totten, Dakota; Lunenburg, Vermont.

24th.—Manitowoc, Wisconsin.

25th.—Fort Totten, Dakota; Cornish, Maine; Nashua, New Hampshire.

26th.—Lunenburg, Vermont.

28th.—Pekin, Illinois.

THUNDER-STORMS.

Paterson, Passaic county, New Jersey: a very heavy thunder storm from the southwest occurred on the afternoon of the 18th. The thunder was loud and the lightning vivid and constant, several houses and barns were struck and burned. This was an unusually destructive storm for this season of the year. It was more severe at Moorestown than any other winter thunder-storm of the past twenty-three years, the electrical discharges were almost constant and the thunder very violent. The storm continued two hours; 1.54 inches of rain fell, washing fields badly.

Dover, Morris county, New Jersey: on the 18th strong easterly wind and snow prevailed between 6 and 8 a. m., this was followed by heavy rain during the remainder of the day. At 6 p. m. a thunder-storm set in and continued for an hour, the lightning was vivid and almost continuous, the thunder sharp and loud.

Somerset, Bristol county, Massachusetts: the atmospherical disturbance of the 18th and 19th was, in this vicinity, a succession of thunder-storms. The lightning was sharp and frequent and the thunder heavy and rolling.

New York City: the 18th was warm for the season, with heavy showers of rain at times. From 6.15 to 9.25 p. m. the rain was accompanied by thunder, lightning, and high easterly winds; the gale did considerable damage to chimneys and telegraph wires. During the storm a warehouse on Staten Island was struck by lightning and burned, together with several other large buildings and their contents, mostly cotton, entailing a loss of about \$350,000.

Laconia, Harrison county, Indiana: the observer at this place states that the most notable feature of the month was the unusually large number of heavy thunder-storms for this season. On the 1st light rain and sleet set in at 4 a. m. and continued throughout the day; between 7 and 8 p. m. the storm

was accompanied by vivid lightning and heavy rolling thunder. Thunder was also heard during the night of the 1st-2d, on the afternoon of the 2d, and on the morning of the 3d. On the 26th, at 7 a. m., a strong southwesterly gale, attended by heavy rain, thunder, and lightning, set in, and did considerable damage, prostrating trees, fences, and light buildings.

Thunder-storms were also observed in the various states and territories during the month, as follows:

Alabama.—Livingston, 15th, 18th, 20th, 26th; Mobile and Greensborough, 26th.

Arkansas.—Lead Hill, 2d, 26th; Little Rock, 14th, 17th.

California.—Los Angeles, 14th; Oroville, 21st.

Connecticut.—Bethel and Southington, 18th.

District of Columbia.—Washington City and Kendall Green, 18th.

Florida.—Limona, 15th; Archer, 15th, 18th, 24th, 26th, 27th; Duke, 24th, 26th; Cedar Keys, 24th, 26th, 27th; Tallahassee, 26th.

Georgia.—Athens, 1st, 26th; Savannah, 18th; Atlanta and Milledgeville, 20th, 26th; Forsyth, 20th, 24th, 26th.

Illinois.—Windsor, 1st, 2d, 10th, 11th, 17th, 25th; Mattoon, 1st, 2d, 10th, 17th, 25th; Collinsville, 1st, 2d, 25th, 26th; Springfield, 1st, 17th; Sandwich, 7th, 10th, 17th, 23d; Riley, 8th; Chicago, 8th, 17th; Pekin and Peoria, 10th; Charleston, 10th, 25th, 26th; Geneseo, 17th; South Evanston and Sycamore, 27th, 23d; Cairo, 23d, 25th.

Indiana.—Jeffersonville, 1st, 2d, 17th, 25th, 26th; Vevay, 1st, 3d, 10th, 26th; Lafayette, 1st, 7th; Fort Wayne and Logansport, 1st, 10th; Indianapolis, 1st, 25th, 26th; Sunman, 2d, 3d, 10th, 23d, 25th, 26th; Laconia, 2d, 3d, 26th; Mauzy, 2d, 23d; Butlerville, 2d, 10th, 23d, 26th; La Grange, 8th, 10th.

Indian Territory.—Fort Reno, 10th; Fort Sill, 10th, 19th; Fort Gibson, 25th.

Iowa.—Clinton, 5th, 7th, 17th; Dubuque, 6th; Monticello and Cedar Rapids a, 6th, 17th; Cedar Rapids b, 7th; Muscatine, 7th, 11th; Dubuque, 7th, 17th; Oskaloosa a, 7th, 25th; Keokuk, 8th, 10th, 17th; Fort Madison, 10th, 17th; Oskaloosa b, 25th.

Kansas.—Wellington, 7th, 10th; Leavenworth, 8th; Wyandotte, 8th, 10th; Globe, 8th, 10th, 25th; El Dorado and Emporia, 20th.

Kentucky.—Louisville, 1st, 2d, 3d, 17th, 26th; Harpers Ferry, 1st, 2d, 17th, 25th, 26th.

Louisiana.—New Orleans, 20th, 21st, 22d, 25th; Shreveport, 14th, 17th, 19th, 23d; Grand Coteau, 19th, 20th, 21st.

Maryland.—Fort McHenry, 17th; Fallston, New Midway, and Woodstock, 18th.

Massachusetts.—Wood's Holl, Amherst, Cambridge, Deerfield, Dudley, Fall River, Milton, New Bedford, Taunton, Westborough, and Worcester, 18th.

Michigan.—Mottville, 7th, 10th; Grand Haven, 7th, 23d; Kalamazoo, 8th, 23d; Swartz Creek and Thornville, 23d; Lansing, 24th.

Mississippi.—Vicksburg, 18th, 19th, 20th.

Missouri.—Saint Louis, 1st, 2d; Centreville, 1st, 2d, 3d, 25th; Central College, 8th, 10th, 17th; Conception, 9th, 25th; Springfield, 17th, 24th.

Nebraska.—Stockham, 8th.

New Hampshire.—Manchester, Antrim, and Nashua, 18th.

New Jersey.—Beverly, Clayton, Lakewood, Readington, Roseland, and South Orange, 18th.

New York.—Humphrey, 3d; Oswego, 3d, 24th; Brooklyn, Factoryville, Menands, Setauket, and White Plains, 18th; North Volney, Palermo, and Utica, 24th.

North Carolina.—Raleigh, 1st, 26th; Lincolnton, 23d; Kitty Hawk, 27th.

Ohio.—Portsmouth, 1st, 2d, 3d, 25th, 26th; Columbus and Westerville, 2d, 3d; Tiffin, 2d, 3d, 7th, 10th, 14th, 23d; Elyria and Garrettsville, 2d, 3d, 10th, 23d; College Hill, 2d, 3d, 26th; Napoleon, 2d, 7th, 10th; Cleveland a, Sandusky, and Toledo, 2d, 10th; Cleveland b, 2d, 10th, 23d; Yellow Springs, 2d, 11th, 23d, 25th, 26th; Ruggles, 3d, 7th; Wauseon, 7th, 10th, 18th; Jacksonborough, 10th, 23d, 26th; North Lewisburg, 23d.

Oregon.—Bandon, 23d.
Pennsylvania.—Phillipsburg, 1st, 2d, 3d; State College, 2d, 24th; Grampian Hills, 3d; Pittsburg, 3d, 10th, 18th; Erie, 3d, 11th, 18th; Zionsville, 15th, 26th; Philadelphia, Blooming Grove, Dyberry, and Quakertown, 18th.
Rhode Island.—Narragansett Pier, 18th; Block Island, 18th, 19th.
South Carolina.—Stateburg, 9th, 18th; Spartanburg, 20th, 26th; Charleston, 24th.
Tennessee.—Nashville, 1st, 2d, 3d, 17th, 18th, 23d, 24th, 26th; Milan, 1st, 2d, 3d, 17th, 23d, 26th; Ashwood, 1st, 17th, 23d; Knoxville, 1st, 2d, 24th; Memphis, 2d, 3d, 17th, 23d, 26th; Chattanooga, 23d, 24th, 26th.
Texas.—New Ulm, 2d, 3d, 25th; Silver Falls, 4th, 7th; Fort Davis, 18th; Cleburne, 14th; San Antonio, 17th; Palestine, 19th; Galveston, 26th.
Virginia.—Rappahannock, 9th, 10th, 13th; Bird's Nest, Dale Enterprise, University of Virginia, Variety Mills, and Wytheville, 18th; Bruington, 26th.
West Virginia.—Middlebrook, 1st, 2d, 3d, 10th, 18th; Clarksburg, 2d; Helvetia, 2d, 17th.
Wisconsin.—Madison, 6th; Milwaukee, 7th; Delavan, 7th, 17th.

ELECTROMETER READINGS.

Observations of the electrical potential of the air were made as usual during the month of February, 1887. At Washington City, in addition to the regular series of observations, a set of simultaneous observations were made at the Signal Office, elevation 45 feet, and at the top of the Washington Monument, elevation 500 feet. The following table shows, in brief, the results:

Time.	Monument.	Signal Office.	Difference.	Time.	Monument.	Signal Office.	Difference.
1887.				1887.			
Feb. 9, 11.30 a. m.	1525	66	1459	Feb. 9, 2.15 p. m.	1725	102	1623
11.35 a. m.	1500			2.20 p. m.	1750	78	1672
11.40 a. m.	1375			2.25 p. m.	1600	90	1510
11.45 a. m.	1600	96	1504	2.30 p. m.	1875	66	1809
11.50 a. m.	1675	90	1585	2.35 p. m.	1750	90	1660
11.55 a. m.	1625	84	1541	2.40 p. m.	1825	78	1747
12 m.	1700	90	1610	2.45 p. m.	1750	72	1678
12.03 p. m.	1750	102	1648	2.50 p. m.	1600	84	1516
12.04 p. m.	1800	102	1698	3 p. m.	1950	90	1860
12.05 p. m.	1800	96	1704	Feb. 11, 11.30 a. m.	+250		
12.06 p. m.	1750	96	1654		+250	84	
12.07 p. m.	1750	102	1648	11.35 a. m.	+375		
12.08 p. m.	1800	96	1704		-375		
12.09 p. m.	1800	102	1698	11.45 a. m.	-175	84	259
12.10 p. m.	1800	102	1698	11.50 a. m.	350	78	272
12.11 p. m.	1750	96	1654	11.55 a. m.	300	84	216
12.12 p. m.	1700	90	1610	12 m.	300	78	222
12.13 p. m.	1725	84	1641	12.01 p. m.	200	78	297
12.14 p. m.	1700	84	1616	12.02 p. m.	375	72	253
12.15 p. m.	1825	96	1729	12.03 p. m.	325	72	303
12.22 p. m.	1850	96	1754	12.04 p. m.	375	72	353
12.25 p. m.	1850	90	1760	12.05 p. m.	425	72	353
12.30 p. m.	2050	84	1966	12.06 p. m.	350	72	278
12.35 p. m.	1950	96	1854	12.07 p. m.	375	84	291
12.40 p. m.	1925	102	1823	12.09 p. m.		72	
12.45 p. m.	1900	96	1804	12.10 p. m.	350	72	278
12.50 p. m.	2125	102	2023	12.20 p. m.	475	60	415
12.55 p. m.	2200			12.30 p. m.	400	48	352
1 p. m.	1925	84	1741	12.40 p. m.	575	72	503
1.05 p. m.	1875	90	1785	12.45 p. m.	550	72	478
1.10 p. m.	1900	84	1816	12.55 p. m.	575	72	503
1.15 p. m.	2425	96	2329	1 p. m.	600	60	540
1.20 p. m.	2425	90	2335	1.05 p. m.	567	66	521
1.30 p. m.	1725	84	1641	1.10 p. m.	525	72	453
1.35 p. m.	1900	84	1816	1.15 p. m.	600	66	534
1.40 p. m.	2250	90	2160	1.20 p. m.	575	30	545
1.45 p. m.	1750	84	1666	1.25 p. m.	575	36	539
1.50 p. m.	1875	84	1791	1.30 p. m.	525	54	471
2 p. m.	2050	84	1966	1.35 p. m.	575	48	527
2.05 p. m.	1950	72	1478	1.40 p. m.	400	54	346
2.10 p. m.	1625	78	1547	1.45 p. m.	450	54	396

February 9th was a remarkably clear day, following a spell of damp and foggy weather; the wind from the northwest and light, and a few cirro-stratus clouds in the north and northwest. February 11th was a cloudy day, with strong southwesterly winds, with a light rain in the afternoon and change of wind from south to northwest. Of the regular series of observations, negative values were obtained on the 11th, beginning about fifteen minutes in advance of light rain, and varying from positive to negative during the rain; on the 18th, during light rain; on the 20th, very high positive, changing to

high negative, during snow; on the 23d, during heavy snow; on the 26th, high negative values, becoming positive, during snow and rain. The dates of negative values are almost identical with the dates of stormy or broken weather. During clear and settled weather positive indications are given, for the most part, increasing with decrease in temperature.

Of the observations made at New Haven, Connecticut, negative values were obtained on the following dates: On February 2d, during heavy snow, 394 volts, turning to positive 402 volts, during continuance of snow; falling to low positive after ending of snow. On February 3d, variable values during rain. On the 7th rain ended at 8.0 a. m., began again at 1.15 p. m., turning to sleet at 3 p. m., and ending at 11 p. m.; the readings at the four observations were, respectively, -3.5 volts, 4.9 volts, 11.4 volts, and -24.8 volts. On the 8th negative values occur during rain; on the 15th, during heavy rain; on the 18th, -91 volts, during snow and light sleet, at 9 a. m., turning to low positive at 11 a. m., the snow ending at 10.45 a. m., becoming high positive at 1 p. m., with the beginning of rain, and turning to negative during the rain. This was the first thunder-storm of the season noted, and the variations in potential at New Haven, from 7.15 p. m., are shown graphically on chart vi. The times of the different lightning flashes were 7.14 30 p. m., 7.16 20, 7.18, 7.19 30, 7.24 30, 7.26 26, 7.28, 7.31 30, 7.35 40, 7.37 35, then an apparent cessation for about twenty minutes, after which thunder and lightning occur as follows, the last lightning noted above being recorded as near:

Time.	Potential.	Weather.	Time.	Potential.	Weather.
P. M.	Volts.		P. M.	Volts.	
7.40	+150	Rain increasing.	8.33 30	-250	
7.40 30	+200		8.34	-180	
7.41	+350		8.35	-100	
7.41 30	+300		8.38 25	-100	Lightning.
7.42	+250	Light rain.	8.36 30	-250	
7.42 30	+90		8.37	-200	
7.43	+55		8.38	-205	Lightning.
7.43 30	+20		8.38 30	-450	Rain increasing.
7.44	-30		8.39	+70	
7.44 30	-90		8.40	+140	Thunder.
7.45	-130		8.40 30	+75	
7.45 30	-160		8.41	+400	Lightning.
7.46	-180		8.41 30	+140	
7.46 30	-200	Light rain.	8.42	+500	
7.47	-220		8.44	+400	Vivid lightning.
7.48	-240		8.45	-150	
7.49	-230		8.46 30	+450	
7.50	-230		8.47 15	+50	Vivid lightning.
7.51	-220		8.47 30	+50	
7.52	-220		8.48	+250	
7.57	-100	Light rain.	8.48 30	+440	Rain increasing.
8.02	-147		8.49 10		Vivid lightning.
8.03	-130	Light rain.	8.49 30	-75	
8.04	-185	Thunder.	8.50	+75	
8.04 30	-250		8.51	+400	Vivid lightning.
8.05	-150		8.52	-130	
8.05 30	0	(?)	8.53	+100	
8.06	-400		8.54	+600	
8.07	-688	Lightning.	8.55	+560	
8.08	-500		8.55 40	+400	Vivid lightning.
8.08 30	+300	Rain increasing.	8.56	-120	
8.09	+450	Lightning.	8.57	-175	
8.10	-50		8.58	-200	
8.10 30	-200	Rain increasing.	9	-230	
8.11	-300	Lightning.	9 01	+500	
8.12	+550		9.02	+580	Lightning.
8.12 30	+470		9.02 20	+450	
8.13	+410		9.03	-500	
8.13 30	+150	Thunder.	9.03 20	-750	Vivid lightning.
8.14	-150	Lightning.	9.04	-370	
8.14 30	-450		9.05	-480	
8.15	-500	Thunder.	9.06	-400	
8.15 30	-370		9.07	-750	
8.16	-300		9.08	-670	
8.17	-60	Lightning.	9.09	-540	
8.17 30	+150		9.10	-400	
8.18	+300		9.11	+600	Thunder.
8.19	+250		9.12	+520	
8.20	+50		9.12 40		Lightning.
8.20 30	-200	Thunder.	9.13	+200	
8.21	-500		9.14	+260	
8.22	-360		9.15	+230	
8.23	+400	Lightning.	9.16	-100	Light rain.
8.23 30	+500		9.17	-580	
8.24	+470		9.18	-450	
8.25	+400		9.19	-150	
8.26	+350		9.20	+250	
8.27	+250		9.21	+450	
8.28	+50		9.22	+150	
8.30	+60		9.23	+125	
8.32	+180		9.24	+90	
8.33	+300	Vivid lightning.	9.25	+100	

An investigation of this table will show that this winter thunder-storm presented, as regards the electrical conditions, the same general features as the storms of the previous summer. Among many other points, we may notice briefly the rapidly fluctuating character of the curve; the disturbances in the potential, due to the inductive action of the clouds, the values increasing with the cloud's approach and decreasing with its passage; the character of these fluctuations, compared with those due to other causes, being marked by a steadiness of movement in one or the other direction; the rapid changes in value, immediately after, or simultaneous with, flashes of lightning; and, finally, the fluctuations due to rain drops. With regard to the lightning, it would seem that certain discharges occur, which, while not seen, are indicated by the electrometer. For a short time immediately preceding a flash of lightning there occurs a quick, steady rise in the potential, until the electrical tension becomes so great that a disruptive discharge occurs. (It might, incidentally, be remarked that, according to Thomson, air at ordinary pressure and temperature can support an electric tension of 9,600 grains weight per square foot before a spark passes.) With the passage of the spark the electric tension ceases and equilibrium is restored. With every flash of lightning the potential immediately falls to zero, to begin slowly to increase, then more rapidly, until the disruptive discharge again occurs. From all this it must be seen that in the electrometer we have but the first application of certain principles in electricity, which can be made of practical service in warning us of the probability of lightning strokes, as well as the advent of the storm.

Other negative values occurred at New Haven on the 22d, with the change of snow into rain, while heavy snow was accompanied with positive values on the 2d, 22d, and 26th.

At Boston, Massachusetts, during the month of February, 1887, negative values occurred on the 6th, at 9 a. m., preceding light rain; on the 10th, preceding threatening weather; on the 11th, preceding rain; on the 18th, at 2.15 p. m., during heavy snow; on the 19th, at 9 a. m., preceding clearing weather, and on the 26th, preceding snow. Snow with positive values occurred on the 1st, 2d, 3d, 18th, 23d, 25th, and 27th. The highest positive potentials occur during clear, cold weather.

At Ithaca, New York, during heavy snow at 9 a. m. of the 1st, high positive values were obtained; on the 2d, during snow throughout the day, the values at the different observations were 1,300, -150, -600, -420 volts. On the 3d rain began at 9.00 a. m., and ended at 2.30 p. m., accompanied by negative values, changing to positive after the ending of the rain; on the 4th low positive during light snow, turning to negative. Snow began on the 7th at 10 a. m., turning to rain at 11.30 a. m., with the following values, -177, -1,215, -308, -205. Negative values occur also on the 8th, during cloudy weather; on the 9th, during fair weather; on the 11th, during fog and rain; on the 12th, preceding and during, snow; on the 13th and 14th, during fine weather; on the 15th, during cloudy weather; on the 17th, during cloudy and clear weather, but preceding snow; on the 19th, preceding, and during, snow; on the 20th, during cloudy weather; on the 21st, during threatening weather, and preceding snow; on the 22d, following snow; and on the 25th, during clear weather, but preceding snow.

ELECTRICAL PHENOMENA.

Fort Maginnis, Montana: cloudy and comparatively warm weather, with light to fresh westerly winds prevailed during the 13th until 2 p. m., when the wind suddenly shifted to northwest and blew a gale of increasing violence until 8.10 p. m., reaching a velocity of eighty-four miles per hour. During the storm the atmosphere was thoroughly charged with electricity, as indicated by the imperfect working of the telegraph instruments.

Dodge City, Kansas: on the 17th high southwest and northwest winds prevailed, blowing down several chimneys and small houses. Light rain fell from 2.10 to 2.25 p. m. The ob-

server at this station states that while the gale was at its height the air was highly charged with electricity, so much so that the battery at Dodge City being disconnected and the wire grounded at Ashland, a town about fifty miles distant, messages were sent between the two points. The observer also at Fort Supply, Indian Territory, states that on the 17th the telegraph instruments worked very badly on account of atmospheric electricity, and during the afternoon he was unable to raise any station except Fort Elliott, Texas. Heavy westerly wind and cloudy weather prevailed.

OPTICAL PHENOMENA.

SOLAR HALOS.

Solar halos were observed at stations in Montana, Dakota, and the Missouri Valley on the 2d. On the 3d and 4th they were reported from a number of stations in the central valleys, the Lake region, and New England. The storm that prevailed over the northeastern quarter of the country on the 11th was preceded on the 9th in the Missouri and upper Mississippi valleys and on the 10th in New England and the Lake region, by solar halos, and was accompanied on the 11th by halos in the Lake region and upper Mississippi valley. From the 12th to the 18th a few halos were reported from widely separated stations. The low area which prevailed over the Lake region and upper Mississippi valley on the morning of the 18th was accompanied and succeeded by solar halos; they were reported from a number of stations in the upper Mississippi valley on the 18th, and from stations in the Gulf States, Mississippi Valley, and Lake region on the 19th. Solar halos were observed at numerous places in New England and the Lake region on the 20th and 23d. The storm that prevailed on the 25th and 26th was preceded on the morning of the 25th by solar halos which were reported from a large number of stations in New England, the Lake region, and upper Mississippi valley.

LUNAR HALOS.

Lunar halos were noted at numerous stations from the 2d to 9th. On the 3d they were observed in the Lake region and at nearly every station in the Missouri and upper Mississippi valleys; in these districts very high pressure and low temperatures prevailed at the time; they were also reported on that date from a few stations in the Ohio Valley, Tennessee, California, and from numerous stations in Arizona. On the 4th a large number of stations in New England, the middle Atlantic states, Ohio Valley, and Lake region reported lunar halos; these were also accompanied or followed by very high pressure and low temperature. On the 28th they were reported from a number of stations in the upper Mississippi valley, the Lake region, and the middle Atlantic states.

The phases of the moon (Washington mean time) during February, as given in "The American Ephemeris and Nautical Almanac" for 1887, are as follows: New moon, 22d, 4 h. 32.1 m.; full moon, 7th, 17h. 5.9 m.; last quarter, 14th, 8h. 23.8 m.; perigee, 8th, 19.3 h.; apogee, 24th, 0.9 h.

MIRAGE.

Saint Vincent, Minnesota: during the morning of the 9th a mirage was seen over the prairie to the south of this place. A track of land, ten miles distant and beyond the line of vision, appeared to be raised in the air, sloping toward the north at an angle of about 45°. All objects, such as houses, barns, and trees, were plainly visible.

Webster, Dakota: mirages were seen on the mornings of the 14th, 16th, and 27th; on the 14th the phenomenon occurred before sunrise, apparently bringing the image of distant objects very near.

Willcox, Arizona: the phenomenon of mirage was seen nearly every day of the month.

Mirages were also seen at Parkston, Dakota, on the 5th and 27th; Henry, Dakota, on the 27th, and Marquette, Nebraska, 28th.

MISCELLANEOUS PHENOMENA.

FOREST AND PRAIRIE FIRES.

Forest and prairie fires occurred at the following places:
 Pike's Peak, Colorado: on the 9th a prairie fire of small extent was burning on the plains toward the southeast.
 Fort Reno, Indian Territory: prairie fire, 25th.
 Comfort, Texas: prairie fires, 26th, 27th, 28th.
 Duke, Florida: forest fires, 9th, 18th.

METEORS.

Meteors were observed on the following dates:
 Florida.—Merritt's Island, 2d, 27th; Archer, 9th; Limona, 11th; Alva, 26th.
 Illinois.—Jacksonville, 21st.
 Iowa.—Monticello, 28th.
 Maryland.—Woodstock, 1st, 11th, 13th, 15th, 16th, 19th, 25th; Fallston, 16th.
 Massachusetts.—Blue Hill Observatory, 12th; Vineyard Haven, 19th.
 New Hampshire.—Nashua, 28th.
 Wisconsin.—Manitowoc, 19th, 21st.

MIGRATION OF BIRDS.

Geese flying northward.—Fort Reno, Indian Territory, 9th; Saint Louis, Missouri, 17th; Fort Madison, Iowa, 12th, 17th; Augusta, Georgia, 18th; Globe, Kansas, 20th; Rappahannock, Virginia, 23d, 27th, 28th; Manhattan, Kansas, 26th; Brownville, Nebraska, 27th, 28th; Erie, Pennsylvania, 28th.
Geese flying southward.—Augusta, Georgia, 14th; Manhattan, Kansas, 17th; East Portland, Oregon, 20th, 22d, 24th; Mottville, Michigan, 21st; Dale Enterprise, Virginia, 23d, 24th, 26th.
Ducks flying northward.—Pekin, Illinois, 8th, 15th, 25th; Jacksonville, Illinois, 23d; Tatoosh Island, Washington Territory, 25th; Manhattan, Kansas, 27th.
Ducks flying southward.—Memphis, Tennessee, 2d; Jacksonville, Illinois, 11th; Davenport, Iowa, 17th.

POLAR BANDS.

Polar bands were reported from the following stations:
 Arkansas.—Lead Hill, 26th.
 California.—Keeler, 22d.
 Florida.—Archer, 18th, 26th; Duke, 17th.
 Illinois.—Pekin, 25th; Riley, 10th, 25th.
 Indiana.—Laconia, 4th.
 Kansas.—Salina, 25th, 27th.
 Maine.—Gardiner, 5th.
 New Jersey.—Beverly, 9th; Moorestown, 16th.
 North Carolina.—Hatteras, 27th.
 Ohio.—Napoleon, 3d, 9th, 25th; Wauseon, 25th, 28th.
 Pennsylvania.—Catawissa, 4th, 25th.
 Virginia.—Dale Enterprise, 24th, 25th; Wythville, 6th, 9th, 19th, 22d.
 Washington Territory.—Tatoosh Island, 14th.

SUN SPOTS.

Mr. H. Govey, of North Lewisburg, Champaign county, Ohio, reports having observed sun spots on the 4th, 18th, 19th, 24th, 26th, and 28th.

SAND STORMS.

Salt Lake City, Utah: brisk to high south and northwest winds prevailed during the 1st, attaining at 4.30 p. m. a velocity of thirty-three miles per hour; at 5 p. m. the wind backed to northwest and increased in force; in the afternoon, and at night the air was filled with alkali dust from the desert west of the Great Salt Lake, covering all exposed objects with a white coating.

Sand storms occurred also at the following stations:

Abilene, Texas, 10th.
 Rio Grande City, Texas, 26th, 27th.
 Yuma, Arizona, 15th, 22d.
 Fort Grant, Arizona, 22d.

WATER-SPOUT.

Capt. E. O. Clark, of the barkentine "Josephine," reports: "18th, at 1.36 p. m., Greenwich mean time, in N. 29° 57', W. 79° 45', sighted a large water-spout about sixteen degrees above the horizon and about one mile wnw. from the vessel; the spout moved gradually to the northward, with a squall going in the same direction."

VERIFICATIONS.

INDICATIONS.

The predictions for February, 1887, were made by 1st Lieutenant Thomas M. Woodruff, 5th Infantry, Acting Signal Officer and Assistant, and were verified by 2d Lieutenant F. M. M. Beall, Signal Corps, U. S. Army, Assistant.

The detailed comparison of the tri-daily indications for February, 1887, with the telegraphic reports of the twenty-four hours for which the indications were prepared, shows the general average percentage of verifications to be 72.74. The percentages for the different elements are: Weather, 70.74; wind, 67.01; temperature, 76.68. By states, etc., the percentages are: For Maine, 76.88; New Hampshire, 72.50; Vermont, 71.01; Massachusetts, 75.12; Rhode Island, 73.87; Connecticut, 70.74; eastern New York, 76.19; western New York, 78.81; eastern Pennsylvania, 73.93; western Pennsylvania, 75.83; New Jersey, 76.16; Delaware, 73.22; Maryland, 77.64; District of Columbia, 74.10; Virginia, 75.50; North Carolina, 71.99; South Carolina, 69.43; Georgia, 73.81; eastern Florida, 68.72; western Florida, 71.32; Alabama, 74.79; Mississippi, 71.25; Louisiana, 70.18; Texas, 66.70; Arkansas, 67.08; Tennessee, 69.76; Kentucky, 74.11; Ohio, 70.89; West Virginia, 71.79; Indiana, 74.82; Illinois, 72.80; eastern Michigan, 73.65; western Michigan, 72.00; Wisconsin, 71.81; Minnesota, 71.34; Iowa, 75.71; Kansas, 70.57; Nebraska, 69.76; Missouri, 74.11; Colorado, 72.23; east Dakota, 65.00.

There were nine omissions to predict, out of 9,996, or 0.09 per cent. Of the 9,987 predictions that have been made, seven hundred and seventy-eight, or 7.79 per cent., are considered to have entirely failed; seven hundred and thirty-one, or 7.32 per cent., were one-fourth verified; 2,266, or 22.69 per cent., were one-half verified; 1,556, or 15.58 per cent., were three-fourths verified; 4,656, or 46.62 per cent., were fully verified, so far as can be ascertained from the tri-daily reports.

Below are given for the Pacific coast the percentages of indications verified for January, 1887; this data was received too late for publication in the REVIEW of that date. From the 1st to the 3 p. m. report of the 8th the predictions were made by 2d Lieutenant W. A. Glassford, Signal Corps, U. S. Army, Assistant, during the remainder of the month by 2d Lieutenant J. E. Maxfield, Signal Corps, U. S. Army, Assistant. They they were verified by 1st Lieutenant Thomas M. Woodruff, 5th Infantry, Acting Signal Officer and Assistant. The percentages for the different districts are: Washington Territory, 78.05; Oregon, 78.06; northern California, 78.12; southern California, 84.64.

CAUTIONARY SIGNALS.

Of the total number of signals ordered during February, 1887, it was practical to determine the verifications of two hundred and seven; of these, one hundred and sixty-nine, or 81.64 per cent., were fully verified both as to direction and velocity. Number of signals ordered for on-shore winds, seven; verified, six, or 85.71 per cent. Number of signals ordered for northeast winds, ten; fully verified both as to direction and velocity, seven, or 70.00 per cent. Number of signals ordered for northwest winds, one hundred and two; fully verified both as to direction and velocity, seventy-eight, or 76.47 per cent; verified as to velocity only, seven, or 6.86 per cent. Number of signals ordered for winds without regard to direction, eighty-eight; verified, seventy-eight, or 88.64 per cent. Number of signals ordered late, *i. e.*, after the verifying velocity had begun, seventeen, or 8.21 per cent.

In addition to the above, three hundred and ninety-eight sig-

nals were ordered at display stations, the verifications of which it was impracticable to determine.

In twenty-eight instances winds were reported which would have justified the display of cautionary signals, but for which no signals were ordered, and in one instance a wind which would have justified the display of on-shore signals, but for which no signals were ordered.

COLD-WAVE SIGNALS.

Total number of cold-wave signals ordered, the verifications of which were determined, two hundred and fifty-eight; verified, one hundred and eighty-nine, or 73.26 per cent. Fifty-four signals were ordered, the verifications of which it was impracticable to determine.

In addition to the above, in one thousand and thirty-five instances, the signals ordered from this office were repeated by the observers at the regular stations to towns in their vicinity. The verifications of these it was impracticable to determine.

RAILWAY WEATHER SIGNALS.

P. H. Mell, jr., director of the "Alabama Weather Service," in the report for February, 1887, states:

The verification of predictions for the whole area was 89 per cent. for temperature, and 80 per cent. for weather.

The following corporations comprise this system: South and North; Montgomery and Mobile; Mobile and Girard; Georgia Pacific; East Tennessee, Virginia and Georgia system in Alabama; Memphis and Charleston; Columbus and Western; Atlanta and West Point of Georgia; Northeastern of Georgia; Western and Atlantic; East Tennessee, Virginia and Georgia system in Georgia; Montgomery and Eufaula; Pensacola and Selma; Pensacola and Atlantic; the cities of Milledgeville, Georgia, and Talladega, Alabama.

The following is from the "Bulletin of the New England Meteorological Society" for February, 1887:

Verification of weather signals at New Haven was 85.7 per cent. for temperature, 92.9 for weather.

STATE WEATHER SERVICES.

The following is an extract from the February, 1887, report of the "Alabama Weather Service," P. H. Mell, jr., of the Agricultural and Mechanical College, Auburn, director:

The mild weather during a portion of February, and the high temperature until the last few days, exerted an invigorating influence upon vegetation; and in many portions of the state blossoms and leaves burst forth very early in the month. The temperature was 7° above the normal.

Rains were frequent during the month but thunder-storms were of rare occurrence, even though the temperature remained so high. On the 11th, 18th, and 26th strong winds occurred, but of such moderate force as to commit no damage. Severe storms and tornadoes were warded off from the state because of the high pressure that prevailed during the entire month, with the exception of the 20th, when a low wave passed over the state, producing an unusually heavy precipitation at all stations. The rainfall of the month was 0.61 of an inch below the normal.

The temperature for the winter months just ended indicates a slight range above the normal, 1° 8; while the precipitation was 2.23 inches below the normal.

Summary.

Mean temperature, 56° 8; highest temperature, 81°, at Eufaula, on the 18th; lowest temperature, 20°, at Gadsden, on the 28th; range of temperature, 61°; greatest monthly range of temperature, 54°, at Florence and Gadsden; least monthly range of temperature, 39°, at Selma and Troy; mean daily range, 11° 3; greatest daily range of temperature, 37°, at Eufaula, on the 11th; least daily range of temperature, 0°, on the 22d, at Mount Willing.

Mean depth of rainfall, 4.18 inches; mean daily rainfall, 0.146 inch; greatest depth of monthly rainfall, 9.40 inches, at Trinity; least depth of monthly rainfall, 2.35 inches at Bermuda; greatest daily local rainfall, 2.95 inches, at Eufaula, on the 20th.

Average number of days on which rain fell, 8; average number of cloudy days, 16; average number of fair days, 6; average number of clear days, 6; warmest days, 18th and 23d; coldest day, 28th; prevailing direction of wind, southeast.

The following is an extract from the February, 1887, report of the "Arkansas Weather Service," Mr. George R. Brown, of Little Rock, director:

Hail was reported from Mount Ida the 2d, and from Fayetteville the 14th and 25th.

A general sleet prevailed throughout a greater part of the state on the 4th, being reported from Fayetteville, Springdale, Osceola, and Little Rock, also from Memphis and Cairo.

The largest amounts of rainfall in one day were on the 13th, at Conway, 1.7; Fayetteville and Osceola, 1.5; and on the 14th, at Russellville, 3.55; Mount Ida, 2.0.

Thunder-storms occurred at Little Rock the 14th and 17th; Mount Ida, 17th and 23d; Conway, 23d, and at Fayetteville, 25th. During the storm of the 17th at Little Rock a house was struck by lightning, which was also struck about the same time last year, although in the interval it had been fitted up with lightning-rods. The damage this time was not as great as last year.

High winds prevailed generally on the 12th, 25th, and 26th, and several points report more or less damage done by the wind on those days.

The highest temperatures occurred at Fayetteville University, 85°, on the 28th; at Eureka Springs, 81°, on the 16th; at Mount Ida and Conway, 74°, on the 28th.

The lowest temperatures at Springdale, 18°, and Eureka Springs, 14°, on the 3d. The month was generally warmer than usual.

There were three cold-wave signals ordered during the month. The most severe wave was one which entered the state at the northwestern part on the evening of the 3d, and during the night and next day prevailed over the entire state. It was most noticeable in the central portion, the temperature at midnight, the 3d, being above 60° and next morning 23°.

The following is an extract from the February, 1887, "Monthly Review of the Illinois Weather Service," Col. Charles F. Mills, of Springfield, director:

The month was noted for its mildness, excessive cloudiness, and precipitation in the form of rain. The mean temperature of the state averaged 2° above the normal for the month. The highest temperatures were recorded from the 7th to the 10th, and the lowest on the 4th. The lowest monthly mean temperature reported was 20° 7, from Galena, and the highest, 43° 4, from Golconda, a range of 22° 7 from the extreme northwest to southeast sections of the state—within 0° 2 of the January range of mean temperature covering the same extent of territory.

The precipitation was heavy and evenly distributed, averaging 1.4 inches above the normal for the month. The snowfall was barely appreciable, except in the extreme northern counties, where it averaged nearly 10 inches. With but three exceptions, all stations reported the monthly precipitation in excess of the February normal. The exceptions were Springfield, 0.18; Mattoon, 0.78; and McLeansborough, 0.05 below the normal. The most marked departures above the normal are as follows: Riley, 3.08; Davenport, 3.12; Peoria, 3.28; Keokuk, 3.28, and Makanda, 4.27. The average snowfall in the state for the month was 2.9 inches; for the northern counties, 6.3 inches; central counties, 0.9 of an inch, and southern counties, 0.6 of an inch. The greatest total snowfall was 16.8 inches at Lake Forest; the least, inappreciable, throughout the central and southern counties.

West to northwest gales were reported on the evening of the 26th and morning of the 27th, caused by a severe storm moving easterly over the Lakes.

The sunshine did not exceed 33 per cent. for the month.

The cold-wave predictions of the 2d-4th, 8-9th, 10-12th, 23d-25th, and 26-27th were fully justified; that of the 14-15th was not justified, the temperature falling but 10°. Although the temperature was sufficiently low for frost on nearly every day of the month, yet its formation was retarded by excessive cloudiness, foggy mornings, and great percentage of humidity.

Thunder-storms, with hail and sleet, were frequent.

Summary of the winter of 1886-'87.

The mean temperature of the past winter for the state was 24° 5; the highest temperature reported was 75°; the lowest, -32°. The average precipitation was 8.29 inches. Prevailing direction of the wind, northwest. There were 25 clear, 25 fair, 40 cloudy, and 26 days on which appreciable precipitation fell.

The following is an extract from the February, 1887, report of the "Indiana Weather Service," Prof. H. A. Huston, of Purdue University, Lafayette, director:

The mean pressure for the month was considerably above the normal, while the range was the greatest recorded in sixteen years. The barometer was very high at the beginning of the month and continued rising until the 4th, when the highest point was reached—30.901 at Lafayette. From the 4th it continued falling until the 10th, when there was a rapid rise until the 18th, after which the downward motion began again and continued until the 18th, when the lowest point was reached—29.180 being recorded at Fort Wayne. There was another very rapid rise until the normal was reached on the 19th; then a very decided fall on the 26th, followed by a decided rise on the 27th. The month was thus characterized by great and abrupt fluctuations in the pressure, the extent of which has seldom been equalled.

The temperature was from four to six degrees above the normal, with about the average range. Four cold waves passed over the state, on the 1st, 4th, 12th, and 27th, corresponding with the "highs" of the barometer. The highest temperature was on the 10th, immediately followed by the lowest on the 12th and 13th, making a range of 72° in two days.

The precipitation was everywhere above the normal from four to six inches, according to locality, and was unusually heavy on the 2d and 3d all over the state, and again on the 26th. It was nearly all in the form of rain, only little snow being reported, and that only from the northern part of the state.

The following is an extract from the February, 1887, report of the "Kansas Weather Service," Mr. J. T. Lovewell, Topeka, director:

The mean temperature has been below the average. Cold waves were frequent and were invariably announced by the Chief Signal Officer from twelve to twenty-four hours in advance.

Precipitation in measurable quantities occurred in western Kansas on the 8th, 17th to 21st, and on the 26th, and in Logan county, where the greatest fall in this part of the state occurred, almost continuously during the latter half of the month. In the middle counties the greatest rainfall of the month occurred from the 17th to 21st. In the eastern counties precipitation was quite frequent, and, except in the southwestern portion where it was light, exceeded the average of past years.

This has been a windy month, reports showing the total movement to be above the average. The most notable blow occurred on the 16th, 17th, 18th, and was accompanied by snow, with very low pressure.

Thunder-storms occurred in the eastern counties on the 8th, 9th, and 10th.

The following is an extract from the report of the Michigan State Board of Agriculture for February, 1887. The state weather service is in charge of N. B. Conger, Sergeant, Signal Corps, U. S. Army:

The service up to this date has progressed very rapidly, and weather and temperature signals are now displayed in one hundred and two cities and towns in the state, and applications are being filed for an increase in this valuable aid in placing the daily indications furnished by the Signal Service within the reach of hundreds of thousands of the citizens of Michigan.

The appropriation granted by the legislature has made it possible to extend these indications into the state by telephone and telegraph to many towns that otherwise could not be supplied.

* * * * *

This month has been remarkable for the excess of snow and rainfall, it being about 1.25 inches above the normal. The latter part of the month, especially, had heavy storms which caused heavy rains and thunder-storms in the southern portion of the state, while the northern half received a heavy snowfall which, with the heavy wind, drifted badly along the railroads, causing some damage and detention.

There were two thunder-storms during this month, which is unusual, one on the west shore on the 7th, and one on the 23d which was general throughout the state. Damage was reported from Saginaw City, the Methodist Episcopal church spire being struck and damaged about \$100.

Two prominent storms passed the state during the month, one, on the 17th and 18th, showed a very low area, the barometer at the central office reading 29.179 (corrected and reduced) at 7 a. m. of the 18th, and began rising in the evening and rose rapidly during the 19th.

The rainfall was heavy during the early morning of the 18th and changed to snow in the afternoon. The total precipitation during the storm was 1.13 inches. The maximum velocity of wind was thirty-six miles southwest on the 18th.

The storm of the 26th and 27th was remarkable for the changes from snow to rain during the night and to snow again in the afternoon of the 26th. A high wind accompanied this storm (southwest thirty-four miles on the 26th, and northwest thirty-four miles on the 27th at this office), and considerable damage was done to telegraph and telephone wires in the state. At Grand Rapids the damage was estimated at about \$3,000.

Five cold waves passed over the state during the month. Cold-wave signals were displayed from twenty-four to forty hours in advance of these waves, and the signals were all justified by a fall of from 19° to 30°. The most prominent wave passed over on the 24th and 25th; the fall was 28°. The signal was ordered at 6.30 p. m. of the 23d.

The following is an extract from the February, 1887, report of the "Minnesota Weather Service," Prof. Wm. W. Payne, Carleton College, Northfield, director:

The month was notable for its very low temperature. The high winds which characterized a number of days caused several severe snow-drifts, impeding railroad travel to a considerable extent. There were five periods of general precipitation throughout the state, these occurring from the 1st to 2d (inclusive), 7th to 11th, 17th to 19th, 22d and 23d, and 25th and 26th. The greatest amount was precipitated during the storm occurring from the 17th to 19th.

Temperature.—The mean for the month was 6°.7, which is 6°.4 below that of the corresponding month of the year previous. The periods of greatest cold prevailed principally on the 1st, 3d to 6th, 8th to 12th, 20th to 24th, 26th and 27th. The mean daily temperature was considerably below zero over the entire state on the 1st, 3d, and 4th. The minimum for the month was 41°.8 below zero, and occurred at Park Rapids on the 12th, while on the 4th it was 38°.0 below at Saint Vincent. At Saint Paul the mean was 7°.9 below the average of the corresponding month for seventeen years, and the lowest since February, 1875, when it was 2°.7 below zero. At Saint Vincent it was 6°.8 below the average; Moorhead, 6°.5 below; Duluth, 5°.5 below; La Crosse, 5°.3 below. The maximum temperature for the month was recorded at La Crosse on the 8th, and was 44°.5. The highest temperatures occurred mainly in the latter portion of the month, during the prevalence of a "chinook" wind or warm wave that followed the "blizzard" of the 26th, and which caused the snow to disappear rapidly.

Precipitation.—This was mainly in the form of snow. At Saint Vincent it was 0.40 (in inches) above the average, while elsewhere throughout the state it was generally below the normal. In the southern portion the precipitation averaged an inch less than for the corresponding month of last year, while in the northern portion it was about the same. The greatest amounts that fell were 2.06 at Rochester, and 2.02 at Mankato and Northfield; sta-

tions reporting the least amount were Morris, 0.20; Grand Forks, 0.40; Moorhead, 0.58; Park Rapids, 0.65, and Albert Lea, 0.77. In the extreme north-western portion of the state, 7.5 inches more of snow remained on the ground at the close of the month than at the end of the corresponding month of 1886, while in a narrow belt running across the state from Moorhead to Duluth there was two inches less; immediately to the south of this belt was another, extending as far south as Saint Paul, in which about nine inches more remained on the ground. In the southern portion of the state the snow was irregularly distributed and in some localities averaged about the same as last year.

The following is from the February, 1887, report of the "Mississippi Weather Service," Prof. R. B. Fulton, of the University of Mississippi, Oxford, director:

Mean temperature, 58°; highest, 81°, at Artonish, on 9th; lowest, 28°, at Batesville, on the 4th; monthly range, 58°.

Average rainfall, 4.98 inches; greatest monthly rainfall, 8.37; least monthly rainfall, 3.50 inches; average number of days on which rain fell, 10.

Frost occurred on one day only during the month, the 28th, and was reported from Batesville, Palo Alto, Loch Leven, Biloxi, Waynesborough and Starkville.

Thunder-storms occurred at Lamar on the 2d, 18th, 26th; Batesville, 3d, 24th; Vicksburg, 19th, 20th, 26th; Palo Alto, 1st 23d; 26th; Artonish, 14th, 22d; Biloxi, 15th, 19th, 20th, 21st; Oxford, 1st, 14th, 23d.

Sleet fell at Lamar and Batesville on the 4th.

The following is from the February, 1887, report of the "Missouri Weather Service," Prof. Francis E. Nipher, of Washington University, Saint Louis, director:

The observations of Dr. Engelmann from 1837 to 1882 resulted in showing that when December was abnormally cold there was a high degree of probability that January and February would also be cold, although he also noted exceptions to this rule. In the winter just ended the cold December was followed by a cold January, but February has had an average temperature of 38°.7, which is a little over three degrees above the normal temperature. The average for the whole winter was, however, 31°.4, or about two degrees below the normal winter temperature. The lowest temperature of the month was 8°.5, on the 4th, and the highest 72°, on the 10th. The mean temperatures of the decades were 38°.5 for the first, 38° for the second, and 39°.7 for the third. The temperature fell to, or below, 32° on twelve days, and on four days it did not rise above 32°.

The rainfall at the central station was 8.78 inches, which is 1.28 inches above the normal. Heavy thunder was observed as early as the 1st of the month. The 5th was remarkable for the unusual darkness prevailing in the morning until about noon of that day. At 12 m. it seemed as dark as night. The phenomenon was local.

The highest temperatures were generally observed on the 10th, and the lowest on the 4th of the month.

The rainfall was greatest in the extreme north and south and along the Mississippi River, where it was over four inches, while in the central and western parts the fall was between two and three inches.

The following is from the February, 1887, report of the "Nebraska Weather Service," Prof. Goodwin D. Swezey, Doane College, Crete, director:

The month of February has been in no way a marked month, except that the temperature has been somewhat below the normal.

Precipitation.—The average snowfall has been about eight inches, which is two more than the normal for February. Measured as precipitation or melted snow it has been less than half an inch over all of the state, except in the southeastern sections and portions farther north along the Missouri and west along the Platte. Two small areas of the state, the extreme southeast corner and a large area along the Platte, have from an inch to an inch and a half.

Temperature.—No severe cold waves occurred; most of the cold-wave tracks for the United States lying almost due east from Montana to Maine. The mean temperature of the month has been 19°; the mean noon temperature, 25°.8; the highest reported was 68°.8, at Crete; the lowest, —24°.3, at Hay Springs.

Wind.—Rather severe winds have been felt, the highest velocity being sixty miles an hour at Lincoln.

Crop report.—Reports from various localities indicate that the season everywhere is well advanced and spring grain is being sown.

The following extracts are from the February, 1887, report of the "New England Meteorological Society," Prof. Wm. H. Niles, of the Institute of Technology, Boston, Massachusetts, president:

Reports for the month were received from one hundred and fifty-one observers.

The weather for the month was variable, being controlled by the passage of nine cyclonic storms. The precipitation in southern New England was generally snow, turning to rain; the heaviest rain was during the thunder-storm of the 18th; the heaviest snow fell on the 26th, and remained on the ground over the end of the month. The total precipitation was decidedly in excess of the normal.

The periods of general cold were also those of very high pressure, on the 5th and 14th; the warmer days were on the 8th, 11th, 16th, 18th or 19th, and 24th,

when the pressure was falling, with southerly winds. The mean temperature of the month was below the normal in north, and above in the south.

There was light snow and rain on the first three days of the month, during the rise and fall of pressure that preceded the passage of the first cyclonic storm down the Saint Lawrence Valley on the 3d; the temperature rose to a maximum of 26° to 40° a little after midnight of the 3d and 4th, and then fell continuously as the storm moved away with high westerly winds on the 4th, reaching a calm minimum on the morning of the 5th (12° to -18°) at a time of very high pressure, the highest on record at several stations. Lunar halos were generally seen on the evenings of the 1st and 4th. On the 8th the third cyclonic storm passed down the Saint Lawrence, with general snow and rain and rising temperature, again reaching a maximum with southerly winds about midnight of the 8-9th, followed by clearing weather, westerly winds, and falling temperature through the 9th to a moderate minimum in the early morning of the 10th. The fourth cyclonic storm passed centrally over New England; it gave solar halos about noon of the 10th, snow and rain on the 11th; the temperature being moderate and almost constant over the cloudy night; the rain ended with a sudden brief rise of temperature in the evening of the 11th, followed quickly by high northwest wind and rapid cooling through the night. This was succeeded by three days of fine cold weather, during the passage of a large anti-cyclone; the highest pressure came on the morning of the 14th, giving the general minimum temperature for the month (5° to 15° in the south, -20° to -30° in the north).

The approach and northern passage of a poorly developed cyclonic storm, the fifth of the month, caused a warm wave (40° to 50°) on the 15th and the 16th, with moderate snow or rain on the 15th. There was a slight fall of temperature with the passage of an area of high pressure on the night of the 17th, succeeded by a rise again as a well developed cyclone passed down the Saint Lawrence on the 18th and 19th; a thunder-storm, with heavy wind and rain, occurred in the evening of the 18th in southern New England. There were then slight weather changes until the 24th; the seventh barometric depression, on the 22d, being very faintly marked. The storm of the 24th came rapidly from Texas, and moved down the Saint Lawrence, giving general snow the night before, rain in the morning, and clearing at noon.

The 26th was suddenly clouded and gave heavy snow in the afternoon and night during the passage of the ninth and last storm of the month; the temperature rose through the night with southerly winds and fell from the morning or noon of the 27th as the clouds cleared away, with westerly wind and snow squalls, thus closing the month with a windy cold wave on the 28th, reaching a minimum temperature on the morning of March 1st.

Thunder-storm of the 18th.—The fifth cyclonic storm of the month was attended by local thunder-storms south of its path, during its passage from Iowa over the Great Lakes to the Saint Lawrence. While the cyclonic centre crossed Lake Huron, a thunder-storm traversed southern New England, entering from New York about 19h. and passing eastern Massachusetts between 21h. and midnight; it had little force north of Massachusetts, but was violent towards the southern coast, where the morning had brought a chilling snow storm, changing to sleet and rain in the afternoon, with rapidly falling pressure, and to heavy rain, with thunder and lightning and strong, warm southeasterly winds in the evening, at the time of lowest pressure. Several buildings were struck by lightning.

The following is an extract from the February, 1887, report of the "New Jersey Weather Service," Prof. George H. Cook, of the Agricultural College, New Brunswick, director:

The thunder-storm of the 18th was the most remarkable phenomenon of the month. It was a summer thunder-storm in all its characteristics. The temperature was high, the rain came down in torrents, the lightning was frequent and the clearing up as sudden as anything that ever happened in the middle of July. Every station in the state, except Atlantic City, experienced the same storm, and quite a number of the observers gave the time it began. In general its progress was from southwest to northeast. At Union the flashes were vivid, averaging three a minute; seventy terrific flashes were counted, and there was a greater number of fainter flashes.

The mean temperature as given at New York City, Philadelphia, Moorestown, New Brunswick, Princeton, Somerville, South Orange, Readington, and Salem, when compared with normals determined for those stations, shows an average excess in temperature of 3°.8 for the month. The daily range of temperature was quite even. Mr. Spader, at New Brunswick, reports that on nineteen days the range was less than 10°.

Rainfall.—Twenty stations report rain or snow to have fallen on an average of 12.6 days of the 28. The precipitation was excessive in amount, but quite evenly distributed throughout the several counties. The mean rainfall, as compared with normals determined at eight stations, shows an average excess of 2.40 inches. Sixteen stations noting amount of cloudiness show an average of thirteen days when the amount of cloudiness averaged eight or more on a scale of zero to ten. Union, Red Bank, and Clayton report the most sunshine.

The following is from the February, 1887, report of the "South Carolina Weather Service," Hon. A. P. Butler, Commissioner of Agriculture for South Carolina, director:

The first part of the month was characterized by rather high temperature, but from the 12th until the close of the month there was a slight decrease in the daily means, accompanied by cold rains at frequent intervals. The mean temperature of the month was, however, slightly above the average in the middle and lower counties of the state, and about normal in the upper division,

For the state it was 12°.5 above the mean for January. The minimum temperature of the month occurred at all stations on the 28th, and ranged from 24° in the upper counties to 34° on the coast. The highest temperatures occurred during the first part of the month, except in Anderson, Abbeville, and Spartanburg counties, where the maxima were reported on the 18th.

The greatest amount of rain fell in the upper counties during the latter part of the month. In that section of the state it was probably slightly in excess of the average for February, but in the absence of records for comparison this cannot be clearly determined. In the middle and lower counties the rainfall for the month was below the average. The mean depth of rainfall for the state was 0.61 inch greater than that of the preceding month, January.

The cold waves were not as severe nor as frequent, and did not extend as far southward, as those of the preceding month.

Summary.

Mean temperature, 52°.6; highest temperature, 80°, at Charleston, on the 9th; lowest temperature, 24°, at Yorkville, on the 28th; range of temperature, 56°; greatest daily range of temperature, 40°, at Cheraw, on the 1st; least daily range of temperature, 3°, at Columbia, on the 23d, and at Yorkville, 8°, on the 21st.

Mean depth of rainfall, 3.41 inches; greatest monthly rainfall, 5.40 inches, at Spartanburg; least monthly rainfall, 1.51 inches, at Marion; greatest daily rainfall, 1.55 inches, at Anderson, on the 14-15th. Rainfall exceeding one inch in twenty-four hours occurred as follows: Due West, 14th; Abbeville, 15th and 20th; Spartanburg, 18th; Anderson, 19-20th; Yorkville, 20th and 26th; Pacolet, 20th; Anderson, 24th. Least daily rainfall (inappreciable), at several stations, on the 1st, 3d, 7th, and 18th.

Frosts.—Frosts occurred generally on the 28th, and in the upper and middle counties on the 13th, 14th, 17th, 26th, and 27th. From the reports it is believed that fruit and vegetables suffered no material injury from frost during the month.

Sleet was reported on the 12th and 14th.

The following is from the February, 1887, report of the "North Carolina Weather Service," Dr. Charles W. Dabney, jr., of Raleigh, director:

Eastern district.

Temperature.—February has been a comparatively warm month; the temperature for the eastern district, 50°.4, is 5° higher than the normal, 45°.3. The greatest daily range, 39°, was noted at Cape Henry, Virginia, on the 12th. The least daily range, 3°, was noted at Smithville on the 19th. The mean daily range was 17°.4. The highest temperature, 77°, was noted at New-Berne, on the 11th; abnormally high temperatures also prevailed at all points on the 1st, 2d, 7th to 11th, inclusive, 15th to 20th, inclusive, 24th and 26th. The lowest, 20°, was noted at Lynchburg, Virginia, on the 14th; abnormally low temperatures on the 5th, 13th, 14th, and 28th, at other points in this district were recorded. The absolute range, 57°, was 10° less than the general range for the state.

Precipitation.—Although the rainfall in this district has been reasonably fair, and generally well distributed, yet the official records at five Signal Service stations show a deficiency of 1.17 inches as compared with the general average computed for a series of thirteen consecutive years.

Central district.

Temperature.—The monthly mean temperature, for all points, stands at 48°.4, while the normal for nine years at Charlotte is 45°.6—an excess of 3° for the current month. The greatest daily range, 46°, was noted at Maxton, on the 14th, but this record is questionable, the second greatest, 37°, at Goldsborough, on the 17th, looks more reasonable. The least daily range, 5°, on various dates, was noted at Charlotte, Raleigh, Kinston, Davidson College, Salem, Mount Pleasant, and High Point. The mean daily range was 20°.1. The highest temperature, 79°, on the 1st, was noted at Chapel Hill, and at various other points abnormally high temperatures were noted on the 1st, 2d, 7th to 11th, inclusive; 16th to 19th, inclusive; 24th and 26th; the lowest, 12°, on the 14th, was at Reidsville, and on the 5th, 6th, 12th to 14th, inclusive; 20th to 23d, inclusive; 27th and 28th, abnormally low temperatures prevailed; the absolute range was 67°.

Precipitation.—The monthly average precipitation was 4.02 inches, this, compared with the general monthly average, 4.45 inches, determined by the official records at Charlotte, for a series of nine consecutive years, shows a small deficiency, 0.43 inch, for the month of February, 1887. As the February record at Charlotte is above the general average for all other points in the central district, these figures, although not satisfactory, can be accepted as a fair comparison. Four days, the 8th, 13th, 25th, and 28th, were remarkable for an entire absence of rain.

Western district.

Temperature.—Mean temperature, 49°.2; highest, 74°, on the 10th, at Chattanooga, Tennessee; lowest, 12°, on the 27th, at Chattanooga; absolute range, 62°; greatest daily range, 39°, on the 1st, at Asheville; least, 8°, on the 21st, at Marion. Mean daily range, 19°.2.

Precipitation.—Whether the average rainfall on the western slope of the Smoky Range Mountains is a fair standard by which we can estimate the probable rainfall for the eastern slope, is an unanswered question; future developments, can, however, prove this. Official statistics on record at Chattanooga and at Knoxville, Tennessee, covering a period of nine consecutive years, show an average rainfall of 5.11 inches for the month of February—5.35 inches at Chattanooga and 4.87 inches at Knoxville.

These averages, compared with the actual amount of rainfall collected at

these points, show an excess of 1.81 inches at Chattanooga, and 1.80 inches at Knoxville.

Summary.

Mean temperature, 49°.2; highest temperature, 79°, on the 1st, at Chapel Hill; lowest temperature, 12°, on the 27th, at Asheville; greatest daily range, 39°, on the 1st, at Knoxville, Tennessee; least daily range, 8°, on the 19th, at Smithville; mean daily range of temperature, 18°.9.

Average monthly rainfall, 3.85 inches.
Prevailing directions of wind, northeast and southwest.

Average number of clear days, 4; average number of fair days, 11; average number of cloudy days, 13.

Record of sunshine at Experiment Farm, two miles west of Raleigh, North Carolina.

Date.	Number of hours of possible sunshine.		Number of hours recorded by instrument		Degree of intensity.	Time of day during sunshine.	Remarks.
	h.	m.	h.	m.			
1887. Feb. 1	10	7	5	30		9.30 a. m. to 12.15 p. m., 1 p. m. to 3.45 p. m.	
2	10	9	0	0	Faint	1.15 p. m. to 2 p. m., 3 p. m. to 5 p. m.	Foggy all day.
3	10	10	3	0			
4	10	12	0	0			Cloudy.
5	10	15	0	0			Rainy.
6	10	17	0	0			Do.
7	10	20	4	45	Interrupted	11.30 a. m. to 4.15 p. m.	
8	10	22	4	0	Bright	12.30 p. m. to 4.40 p. m.	
9	10	25	2	45	Faint	9.30 a. m. to 12.30 p. m.	
10	10	27	2	0	Faint haze	1.15 p. m. to 2.15 p. m.	
11	10	29	6	30	Faint	9.45 a. m. to 4.15 p. m.	
12	10	31	6	0	do.	9.45 a. m. to 3.45 p. m.	
13	10	34	7	0	Bright	9.15 a. m. to 4.15 p. m.	
14	10	36	0	0			Cloudy.
15	10	39	0	0			Do.
16	10	42	6	15	Bright	11 a. m. to 5.15 p. m.	
17	10	44	7	0	do.	9 a. m. to 4 p. m.	
18	10	46	1	30	Faint	Various intervals	
19	10	49	6	30	Bright	9.30 a. m. to 4 p. m.	
20	10	51	0	0			Cloudy.
21	10	55	0	0			Do.
22	10	57	0	0			Do.
23	11	00	0	0			Do.
24	11	7	5	15	Faint	12.30 p. m. to 5.30 p. m.	
25	11	6	5	15	Bright	9.15 a. m. to 2.30 p. m.	
26	11	8	0	0			Cloudy.
27	11	10	7	45	Bright	9 a. m. to 4.45 p. m.	
28	11	12	8	0	do.	9 a. m. to 5 p. m.	
Average..	10	39	3	9			

The following is an extract from the "Tennessee State Board of Health Bulletin" for February, 1887, prepared under the direction of J. D. Plunkett, M. D., President of the State Board of Health. The weather report is prepared by H. C. Bate, Director of the State Meteorological Service:

The month of February was characterized by an abnormally high temperature with an excessive amount of rainfall and high winds, also for the absence of snowfall.

The mean temperature was 49°.3, more than four degrees above the highest February mean of the past four years, and as much as 15°.5 above the 1885 mean, which was the lowest of the period named. The highest temperature, 76°, recorded on the 2d and 10th, was the greatest maximum in February of the past four years, being 2° above that in 1884—the next highest. The lowest temperature, 25°, recorded on the 18th and 28th, was the highest minimum recorded in February of the past four years, the next highest being 4° below zero in 1885. It was 42° above the February minimum in 1886—a remarkable difference. The general ranges of temperature were small compared with those of the two preceding years. During the month, four cold waves extended over the state, three of which were verifications of the predictions, and one a partial verification. The first was announced on the 3d, temperature 35°, minimum reached 26°.3 on the 4th. This warning was partially verified. The second was announced on the 8th, temperature 67°, minimum 42° on the 9th. The third was announced on the 11th, temperature 57°, minimum 22°.7 on the night of the 12th and morning of the 18th. The fourth was announced on the 26th, temperature 60°, minimum 28° on night of the 27th and morning of the 28th. The last three were fully verified.

The mean depth of rainfall was 8.03 inches, more than two inches greater than the February mean of the past four years, and not quite half an inch less than the mean of February, 1884, which was abnormally great. It was 5.64 inches greater than the mean in 1885, and 4.23 inches greater than that in 1886. Of this amount the eastern division received an average of a little more than seven inches, the middle division about eight and three-fourths inches, and the western division nearly seven and a half inches. The greatest monthly rainfall was 13.08 inches, reported at Riddleton, which also reported the greatest February rainfall in 1884 and 1885. The least rainfall was 5.35 inches, reported at McKenzie. The greatest local daily rainfall was 4.38 inches, reported at Dickson on the 23d. The days of greatest rainfall were the 3d, 14th, 23d, and 26th; the greatest fall being on the 23d, when an average of about an inch and a half of rain fell throughout the state. The rain of the 14th was very nearly as great. The 10th, 27th, and 28th were the only days re-

ported without rain. Most of the rains during the month were general, though many of them were light. The proportion of cloudiness was abnormally great. A marked feature was the entire absence of snowfall. The winds during the latter half of the month were high, and destructive to timber and fencing. Several severe electric storms accompanied the rains. Frosts occurred on about ten days, and about half of them were killing frosts.

Summary.

Mean temperature, 49°.3; highest temperature, 76°, on the 2d, at Hohenwald, and on the 20th, at Riddleton; lowest temperature, 20°, on the 18th at Hohenwald, and on the 28th, at Greeneville, Cookeville, and Manchester; range of temperature, 56°; mean monthly range of temperature, 47°.7; greatest monthly range of temperature, 56°, at Hohenwald; least monthly range of temperature, 41°, at Rogersville; mean daily range of temperature, 14°.2; greatest daily range of temperature, 41°, on the 3d, at Milan and Memphis; least daily range of temperature, 2°, on the 6th, at Waynesborough; mean of maximum temperatures, 72°.3; mean of minimum temperatures, 23°.9.

Average number of clear days, 4.7; average number of fair days, 7.1; average number of cloudy days, 16.2; average number of days on which rain or snow fell, 12.5.

Warmest days, 2d, 10th; coldest days, 13th, 28th.

Prevailing winds, south and southwest.

NOTES AND EXTRACTS.

BAROMETRIC PRESSURE DURING HIGH WINDS.

The following report by Sergeant D. J. Carr, observer at Mount Washington, New Hampshire, has been received by the Chief Signal Officer in reply to a communication directing that special observations of the mercurial and aneroid barometers be made at that station for the purpose of ascertaining, approximately, the effects of high winds and gusts on barometric pressure within a room like that of the station at Mount Washington:

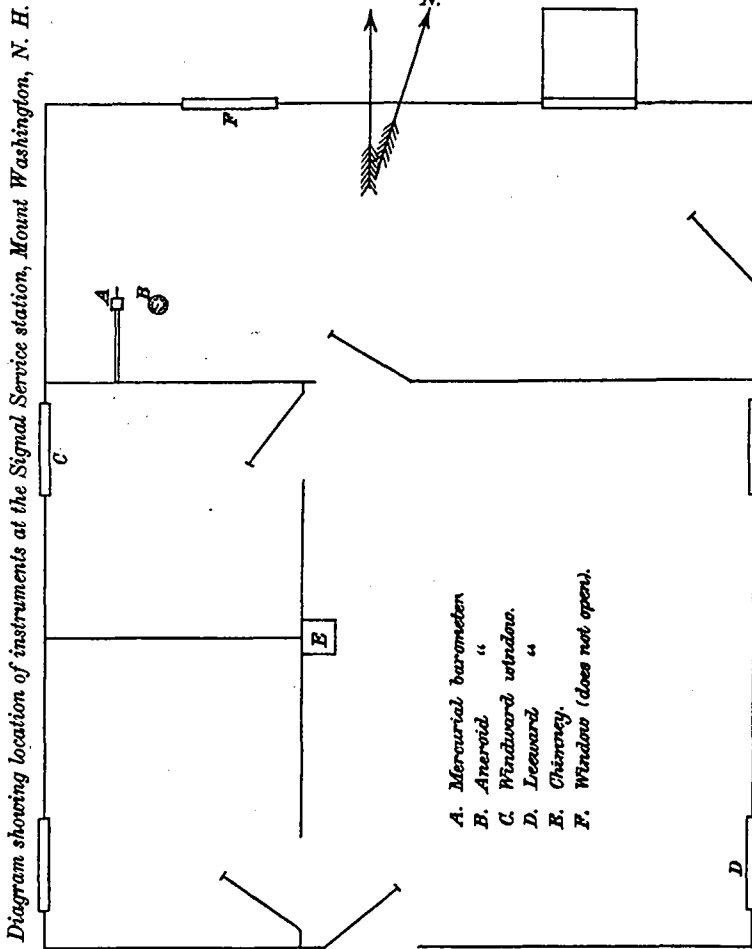
I have the honor to report that the observations have been made as directed and the utmost care taken to secure reliable data. The construction of this building rendered it impossible to obtain direct exposures of the barometers to the windward, and the leeward window used to obtain data is southeast, twenty-four feet distant, and in a different room from where the barometers are situated, as may be seen by consulting the attached diagram. From the data obtained, I would make the following reply to the questions contained in your letter:

1st. "When very violent winds are blowing, does the mercurial barometer fluctuate or pump noticeably; if so, what is the range and what is the duration of the fluctuations, and how are they related to gusts of wind?" Answer: Rapid fluctuations of the barometer are always noticed during the prevalence of high winds, but the extent of these fluctuations are dependent upon the ingress or egress furnished the air, if all windows and doors are closed the fluctuations do not exceed .003 of an inch, but they are practically continuous and are due to the air escaping through the open door of the stove; to obviate this is impracticable, as it is necessary to keep the drafts closed; it is also believed, too, that the swaying or trembling of the building has a slight effect upon the column of mercury in the barometer. The fluctuations of pressure during high winds when either a windward or leeward window is open are very marked, and will be referred to.

2d and 3d. "Do these fluctuations consist principally in a dropping below an average or in a rise above; which occurs first, the drop or the rise? What is the difference in character and extent of these fluctuations under the following different conditions: Doors and windows all shut and the chimney draft and stove closed as much as possible; doors and windows shut and the chimney draft opened wide; chimney closed and a leeward window open; chimney closed and a windward window open?" Answer: the curve of fluctuation depends upon whether the air is admitted to the room by opening a windward window, or an escape to the leeward furnished it. If a windward opening is made an increased pressure is immediately noted, the increase being proportional to the velocity of the wind; if a leeward window is opened a decreased pressure is shown. There is, however, a difference both in the character and extent of the fluctuations under the above conditions. The opening of a windward window and the increase of pressure are synchronous, while if a leeward window is opened an interval of time elapses before a decreased pressure is noted; this interval is very small, probably not more than a second, and is caused, perhaps, by the immediate surcharging with air of the room when a windward opening is made, while when a leeward window is opened the air lacks, as it were, the force to push it out at once. With doors and windows closed and the chimney drafts open there are slight fluctuations, a wind of 100 miles per hour causing a rise or fall in the barometer of not more than .006 of an inch, the fall generally occurring first, although the opposite has been occasionally noticed.

4th. "Besides the changes in fluctuations, possibly due to the opening of windows, is there any difference in the general height of the barometer due to open and closed windows and chimney?" Answer: Yes; the general height of the barometer during high winds, excluding fluctuations, is sensibly affected by the opening of a windward or leeward window; in the former case it is above and in the latter below the normal, the effect being greater under the former conditions, and in both cases the extent is governed by the velocity of the wind, being, in fact, proportional to its velocity.

In making the observations, the aneroid barometer was placed on a tripod, two feet distant from, and the same elevation given it as, the cistern of the mercurial barometer. It is intended to investigate further next summer the effects of wind gusts upon barometric pressure at this station by other and somewhat different observations, and it is believed interesting data will be secured.



KRAKATOA SMOKE AND THE SKY-GLOWS.

[By Junior Prof. H. A. Hazen.]

Professor Kiessling, of Hamburg, has recently published an important paper on this subject (see Sitzungsber der Kgl. Preuss. Akad. d. Wiss. zu Berlin, p. 529, 1886). Perhaps the most significant part of the paper is a partial denial of the commonly-held view that the remarkable sky-gloWS, beginning in the latter part of August, 1883, were due to the effect of fine volcanic ashes thrown into the upper atmospheric layers by the very violent outburst of Krakatoa on August 27, 1883. Professor Kiessling writes: "It is easy to show that air which is full of extremely fine dust, or artificially ground Krakatoa dust, has very little influence in the development of homogeneous clouds, or clouds consisting of uniform water-drops, in comparison with the powerful cloud-forming action which comes from such gases of combustion as are beyond direct optical observation."

Granting that it is possible to infer from the results of a laboratory experiment what may be the probable action of similar forces in nature's vastly greater laboratory, it is gratifying to see that Professor Kiessling has abandoned the theory of the sufficiency of Krakatoa ashes to produce the sky-gloWS, which is beset with insurmountable difficulties. It would seem, however, that in attributing the same effect to the smoke of the volcano, he has introduced difficulties far more serious than any to be met in the original view. The following are a few of the more serious objections to the theory that the sky-gloWS were caused by Krakatoa smoke or gases.

1st. If any one will project the various first appearances of the glows upon a map he will find that, even after making due allowance for lack of records, for non-uniformity in the scale of intensity, etc., it is still impossible to connect them by any reasonable hypothesis with smoke clouds coming from Krakatoa.

2d. The facts require that there be two currents in the upper atmosphere,

starting from Krakatoa, and running in opposite directions at a velocity about forty metres per second (eighty-nine miles per hour). This is clearly impossible.

3d. There is unquestioned evidence that the movement of the upper atmosphere is from west to east, which is contrary to the movement of the bulk of the supposed Krakatoa smoke current.

4th. No velocity even approximating to forty metres per second, can be admitted. The highest average August velocity on Pike's Peak, which is more than 2,500 miles north of the equator, and 14,134 feet above sea-level, is ten metres per second, and on the highest mountains near the equator, where we have observations, it is somewhat less than that. The motion of the highest cirrus clouds is from the west, and, while in the neighborhood of storms, there have been estimated velocities of forty metres, per second, for a short time, yet it is highly probable that the average velocity in the summer season is not over ten metres, per second. Professor Kiessling cites Prof. W. Siemens as authority for the theory that the earth rotates on its axis without carrying the upper air strata with it. It may be safely said that this theory is utterly untenable.

5th. That the sky-gloWS were largely dependent on meteorological conditions was very apparent in the higher latitudes. They were only seen in perfection in the evening, when there was a marked area of high pressure to the west. It was frequently remarked that on some clear nights, when the conditions appeared favorable for the manifestation, provided it was dependent upon a cloud of smoke, there were no glows to be seen.

6th. It is highly probable that no possible velocity of propulsion could carry smoke or gas to anything like the height needed for explaining the phenomena, but granting that this smoke reached the higher regions of the atmosphere, say twenty kilometres (nearly thirteen miles), it will be admitted, I think, that it would be diffused throughout the whole upper regions with a velocity approaching that of sound, and in a few seconds the resulting density would be altogether too slight to produce any marked effect on the sun's light. This last consideration shows how utterly wide of the mark is the theory that there could be anything approaching even a cloud of this smoke.

There are many other objections to the theory that these glows could have been produced by any direct ejecta from Krakatoa, but the above views are sufficient to show its great weakness. There seems to be a gradual settling down of meteorologists to the view that the glows were an extraordinary intensification of ordinary sunrise and sunset phenomena, which we know are due to the presence of water or ice particles in the atmosphere. It is probable that an unusual electrical activity, possibly concomitant with the Krakatoa outburst, was in part needed, and, in addition, it was necessary that the meteorological conditions be favorable. A combination of all these elements would produce the glow in all its intensity, and an absence or diminution of any one or more would give a less effect.

The following table, furnished by Capt. M. W. Wood, Assistant Surgeon, U. S. Army, and forwarded by 2d Lieut. D. L. Brainard, 2d Cavalry, U. S. Army, is a recapitulation, by months, of meteorological data observed at Fort McPherson, Nebraska, from 1870 to 1878, inclusive. The force of wind is estimated on a scale of 1 to 10, counting 1 for a light breeze and 10 for a gale of fifty miles per hour:

From 1870 to 1878.	Temperature.						Precipitation.									
	Highest maximum.	Lowest minimum.	Highest monthly range.	Lowest monthly range.	Average monthly mean.	Average monthly mean.	Mean No. of days on which rain or hail fell.	Mean No. of days on which snow fell.	Total No. of days on which rain, hail, or snow fell.	Highest precipitation.	Lowest precipitation.	Average precipitation.	Total for eight years.	Average force of wind.		
January	78	30	48	64	74.2	33.3	7.7	23.8	0.5	4.1	37	1.28	0.02	0.31	2.48	2.6
February	78	24	54	53	70.4	38.7	18.6	31.4	1.1	3.5	37	0.45	0.08	0.23	1.85	2.4
March	83	4	79	67	75.4	45.7	33.4	36.1	1.6	4.6	42	2.25	0.07	0.52	7.35	2.9
April	96	5	91	55	75.2	53.3	34.4	46.7	4.6	4.6	56	4.72	0.34	1.30	18.45	3.1
May	96	25	71	55	61.2	65.5	55.7	58.3	10.1	10.1	87	4.11	0.82	3.34	30.71	2.8
June	104	33	71	52	59.4	78.9	67.7	72.6	7.9	9.1	63	5.56	0.64	3.08	24.68	2.7
July	115	35	80	49	59.2	83.3	74.4	77.6	9.1	7.4	73	4.22	0.74	2.63	21.04	2.5
August	110	38	74	51	59.8	83.3	71.1	75.2	7.4	6.9	59	3.12	0.48	1.76	14.13	2.4
September	102	19	79	60	69.1	66.7	62.2	64.5	6.9	2.0	55	5.48	0.06	2.14	17.17	2.5
October	100	6	91	60	73.9	55.7	47.1	52.4	2.0	1.1	25	1.06	0.01	0.54	4.35	2.3
November	80	12	64	74	70.6	40.3	32.0	35.3	1.4	2.0	27	0.84	0.00	0.52	4.18	2.5
December	74	20	50	58	72.3	35.9	19.2	26.7	0.9	3.6	36	3.20	0.10	0.64	5.16	2.1
For eight years...	115	30	97	49	68.7	83.3	7.7	50.3	594	8.56	0.00	1.58	151.59	2.6

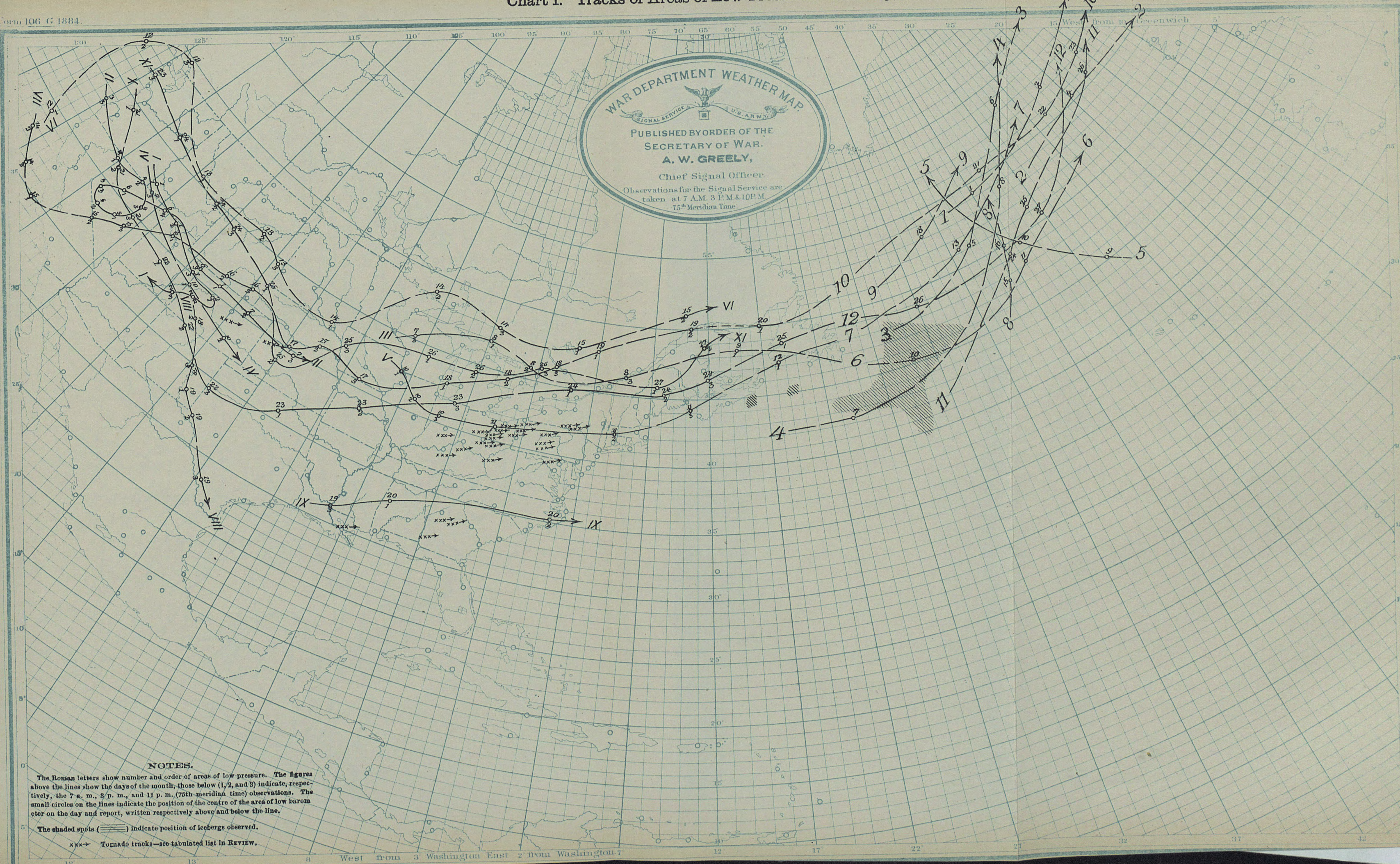
Observations of barometric pressure during high winds on Mount Washington, New Hampshire.

Date.	Reading of barometer with windows, doors, and chimneys closed.		Reading of barometer with the chimneys only opened.		Reading of barometer with everything closed.		Reading of barometer with only a leeward window open.		Reading of barometer with everything closed.		Reading of barometer with only a windward window open.		Reading of barometer with everything closed.		Wind.
	Mercurial	Aneroid.	Mercurial	Aneroid.	Mercurial	Aneroid.	Mercurial	Aneroid.	Mercurial	Aneroid.	Mercurial	Aneroid.	Mercurial	Aneroid.	
1886. Sept. 29.....	10.30 a. m. 23.633	10.32 a. m. 23.719	10.34 a. m. 23.627	10.35 a. m. 23.702	10.38.30 a. m. 23.630	10.39 a. m. 23.708	10.43 a. m. 23.622	10.44 a. m. 23.704	10.49 a. m. 23.643	10.50.30 a. m. 23.720	10.52 a. m. 23.672	10.52.30 a. m. 23.742	10.54 a. m. 23.643	10.55 a. m. 23.703	Velocity 65 miles an hour, gusts estimated 85 miles an hour; direction, wnw.
Sept. 29.....			Slowly and slightly pumping. Diminishing pressure first.	To and fro slightly.		Slightly trembling.	Violently pumping.	To and fro quickly.			Slight rise with every gust.	Nearly stationary.			
Sept. 29.....	11.25 a. m. 23.621	11.25.30 a. m. 23.699	11.27.30 a. m. 23.627	11.28 a. m. 23.700	11.35 a. m. 23.629	11.35.15 a. m. 23.698	11.36.30 a. m. 23.624	11.37 a. m. 23.696	11.39 a. m. 23.616	11.40 a. m. 23.701	11.42 a. m. 23.670	11.42.30 a. m. 23.725	11.47 a. m. 23.635	11.47.30 a. m. 23.705	Velocity 70 miles an hour, gusts estimated 85 miles an hour; direction, wnw.
Sept. 29.....			Very slight pumping.	To and fro slightly.	Slowly pumping; .009 depression with gust.	To and fro slowly; extreme fluctuation, .017.	Pumping rapidly between 23.612 and 23.635.	To and fro quickly from 23.678 to 23.713.			Pumping rapidly between 23.663 and 23.680; rising with every gust.	To and fro quickly between 23.712 and 23.738.			
Oct. 15.....	10.07 a. m. 23.479	10.08 a. m. 23.520	10.09 a. m. 23.483	10.10 a. m. 23.520	10.11.30 a. m. 23.475	10.12 a. m. 23.520	10.13 a. m. 23.465	10.13.30 a. m. 23.514	10.14 a. m. 23.477	10.15 a. m. 23.529	10.16.30 a. m. 23.520	10.17.30 a. m. 23.572	10.19 a. m. 23.473	10.20 a. m. 23.528	Velocity 70 miles an hour, gusts estimated 85 miles an hour; direction, wnw.
Oct. 15.....			No perceptible pumping.			Pumping slowly.	Pumping slowly down first.	To and fro slowly.			Pumping up .021 and falling .014 below normal.	To and fro quickly; extreme fluctuation, .038; .020 above and .018 below normal.			
Oct. 21.....	9.59 a. m. 23.574	10.00 a. m. 23.608	10.04 a. m. 23.574	10.04.30 a. m. 23.621	10.06 a. m. 23.568	10.06.30 a. m. 23.620	10.11 a. m. 23.552	10.12 a. m. 23.605	10.14.30 a. m. 23.571	10.15 a. m. 23.622	10.18 a. m. 23.634	10.19 a. m. 23.680	10.22 a. m. 23.574	10.23 a. m. 23.621	Velocity 65 miles, gusts estimated 80 miles an hour; direction, wnw.
Oct. 21.....							Pumping rapidly .015 at every gust.	To and fro from 23.590 to 23.616.	Slightly pumping .011.	To and fro slowly .009.	Violently pumping .030 between 23.614 and 23.644.	To and fro quickly between 23.662 and 23.690.			
Oct. 22.....	9.47 a. m. 23.655	9.48 a. m. 23.701	9.50 a. m. 23.644	9.50.30 a. m. 23.697	9.52 a. m. 23.650	9.52 a. m. 23.705	9.53 a. m. 23.625	9.53.10 a. m. 23.680	10.00 a. m. 23.651	10.00.10 a. m. 23.701	10.05 a. m. 23.684	10.06 a. m. 23.748	10.08.30 a. m. 23.653	10.09 a. m. 23.708	Velocity 70 miles, gusts estimated 90 miles an hour; direction, nnw.
Oct. 22.....							Pumping .006 with gusts.	To and fro slowly.			Violently pumping between 23.673 and 23.693.	To and fro quickly between 23.450 and 23.472.			

NOTE.—Mercurial barometer corrected at each observation for temperature and instrumental error, and aneroid corrected for instrumental error. Pike aneroid No. 195 and Signal Service mercurial No. 595 used in making the above observations.

Chart I. Tracks of Areas of Low Pressure. February, 1887.

Form 106 G 1884.



WAR DEPARTMENT WEATHER MAP
 SIGNAL SERVICE U.S. ARMY
 PUBLISHED BY ORDER OF THE
 SECRETARY OF WAR.
A. W. GREELEY,
 Chief Signal Officer.
 Observations for the Signal Service are
 taken at 7 A.M. 3 P.M. & 10 P.M.
 75th Meridian Time.

NOTES.

The Roman letters show number and order of areas of low pressure. The figures above the lines show the days of the month; those below (1, 2, and 3) indicate, respectively, the 7 a. m., 3 p. m., and 11 p. m. (75th meridian time) observations. The small circles on the lines indicate the position of the centre of the area of low barometer on the day and report, written respectively above and below the line.

The shaded spots (▨) indicate position of icebergs observed.
 xxx→ Tornado tracks—see tabulated list in REVIEW.

West from 3 Washington East 2 from Washington 7

Chart II. Isobars, Isotherms, and Winds. February, 1887.

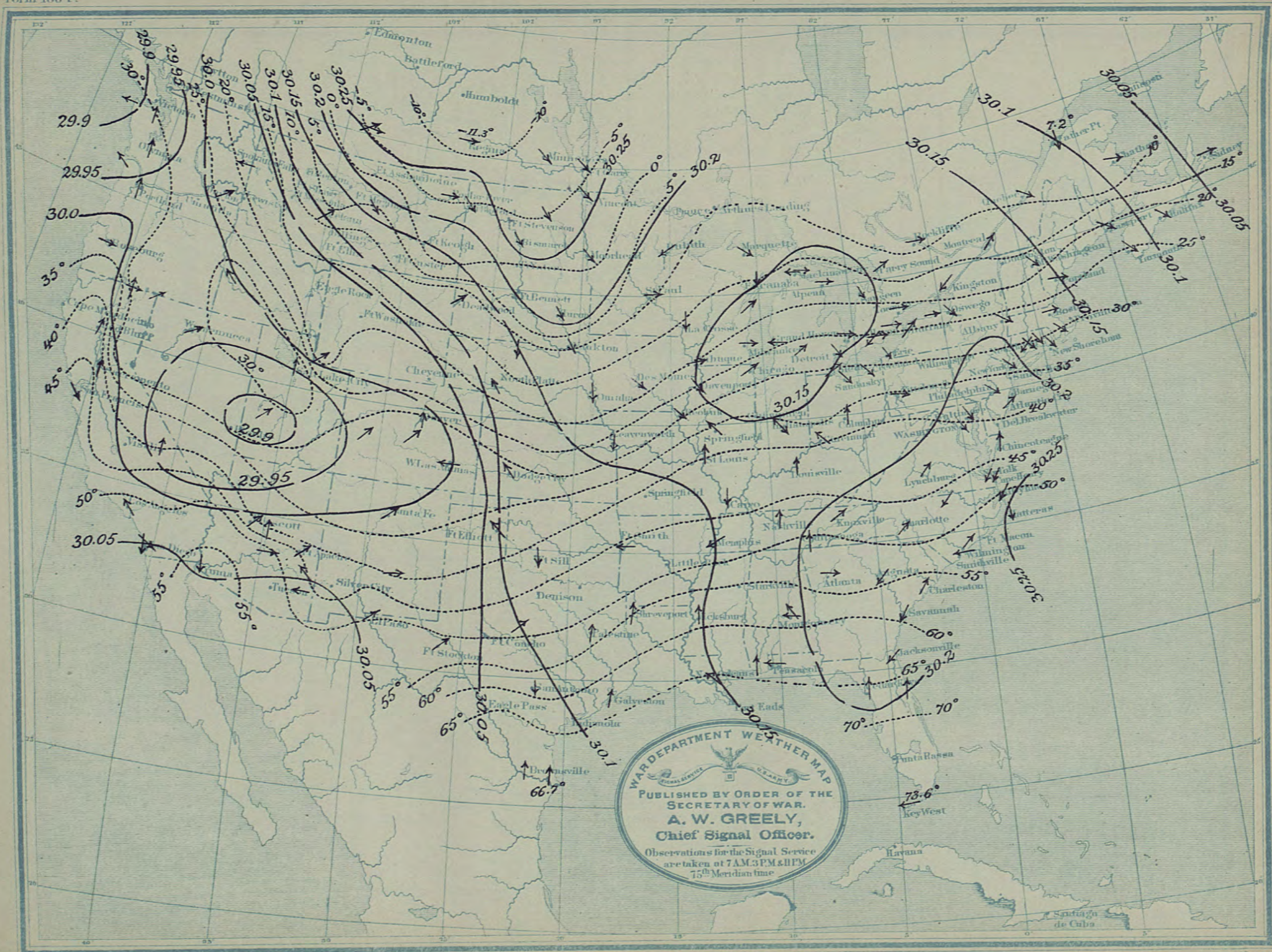


Chart III. Precipitation, February, 1887.

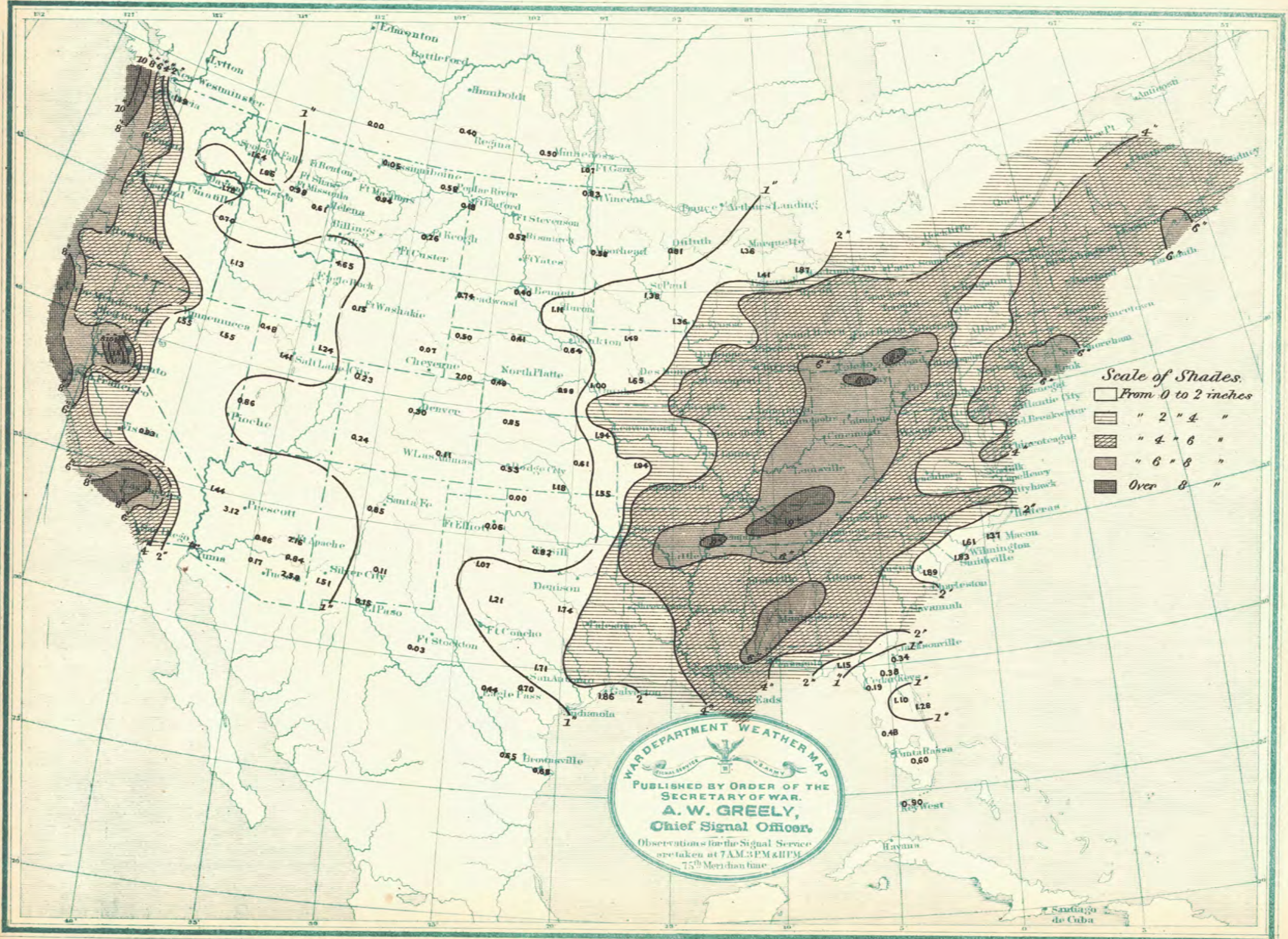
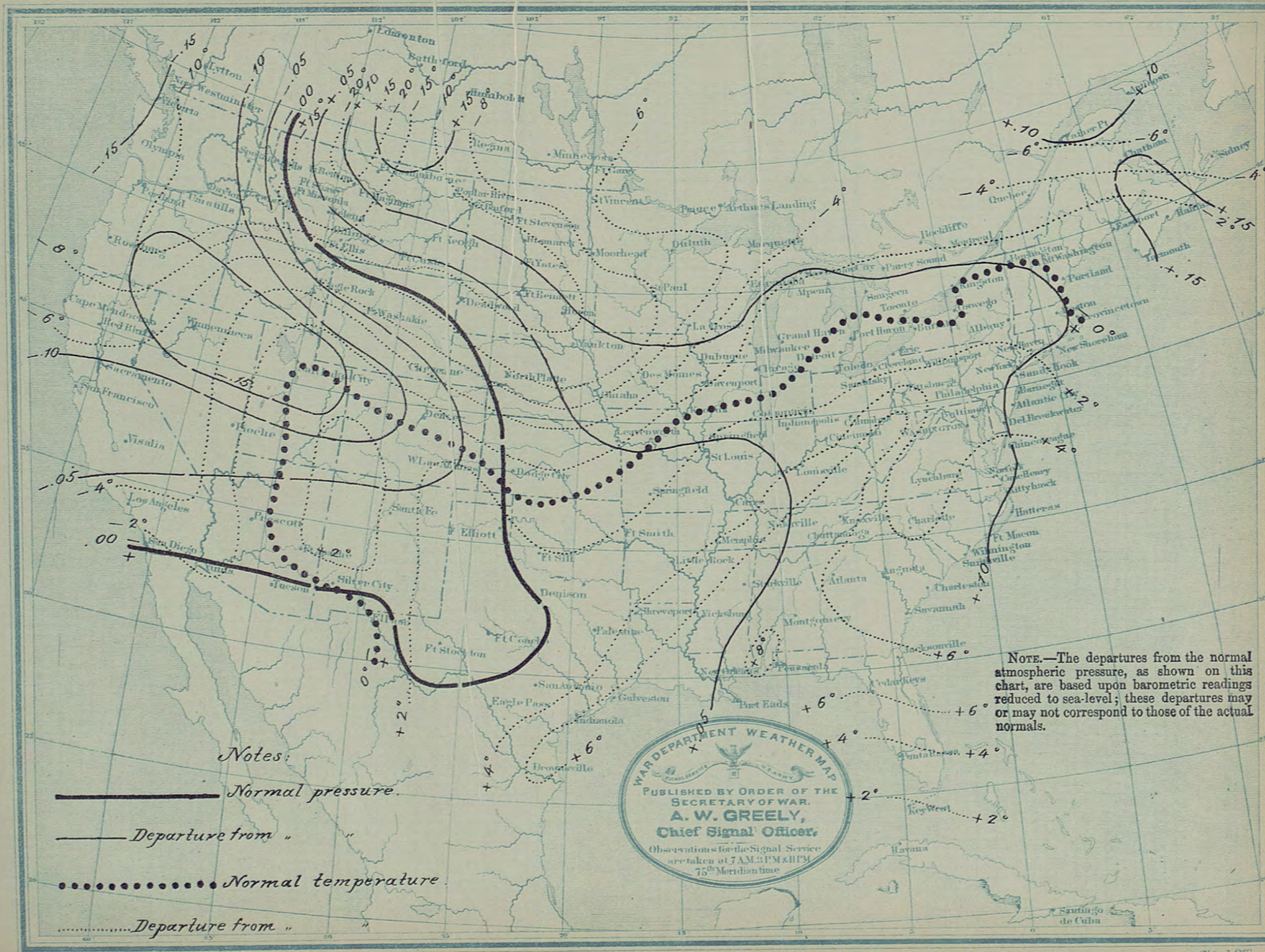


Chart IV. Departures from Normal Atmospheric Pressure and Temperature. February, 1887.

Form 106 F.



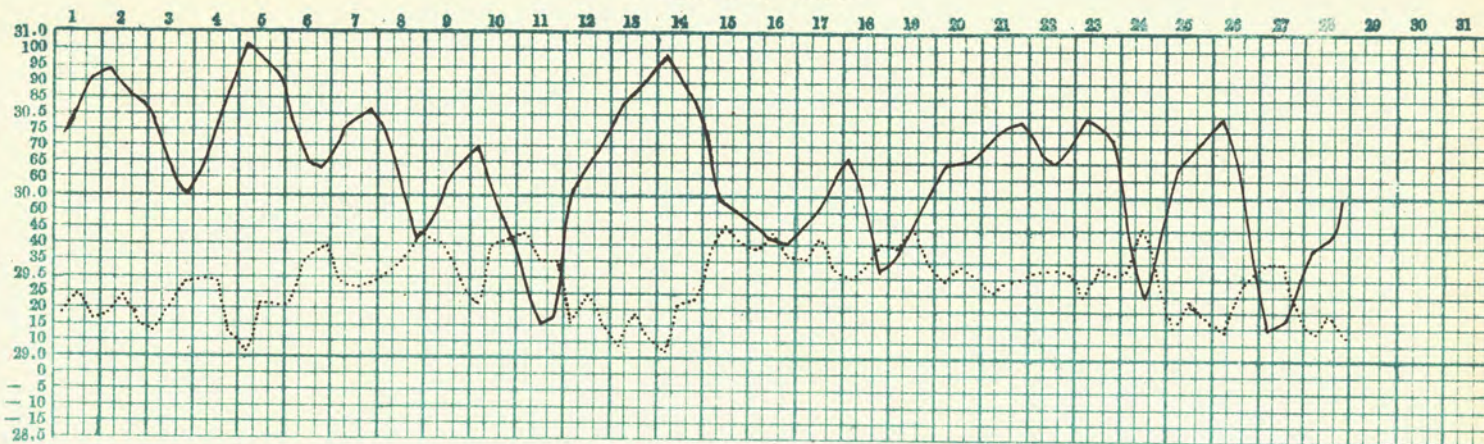
NOTE.—The departures from the normal atmospheric pressure, as shown on this chart, are based upon barometric readings reduced to sea-level; these departures may or may not correspond to those of the actual normals.

Notes:

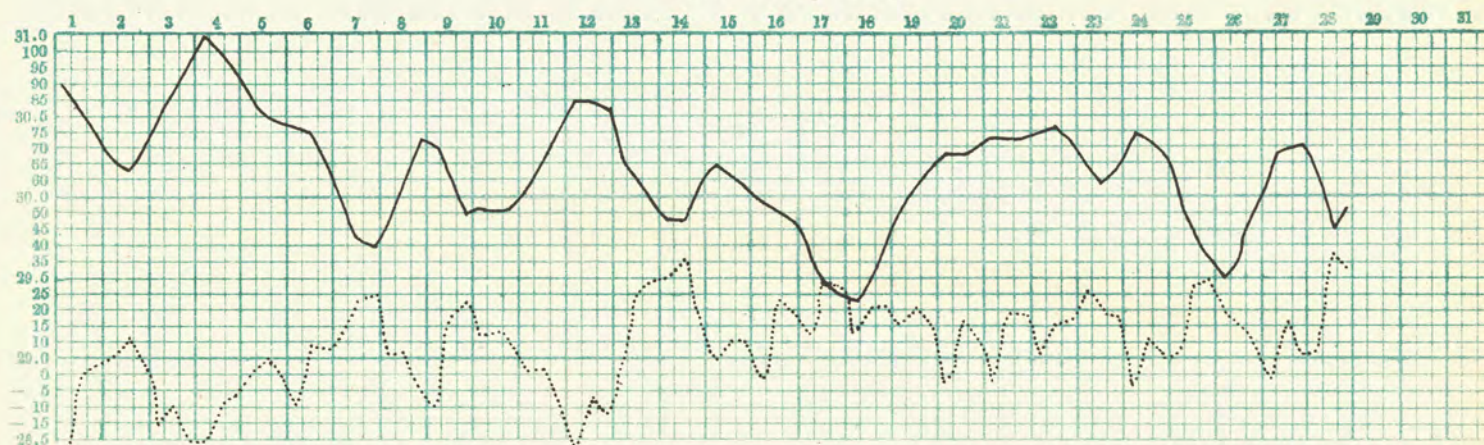
- Normal pressure
- Departure from " "
- Normal temperature
- Departure from " "

Chart V. Pressure (—) and Temperature (.....) Curves. February, 1887.

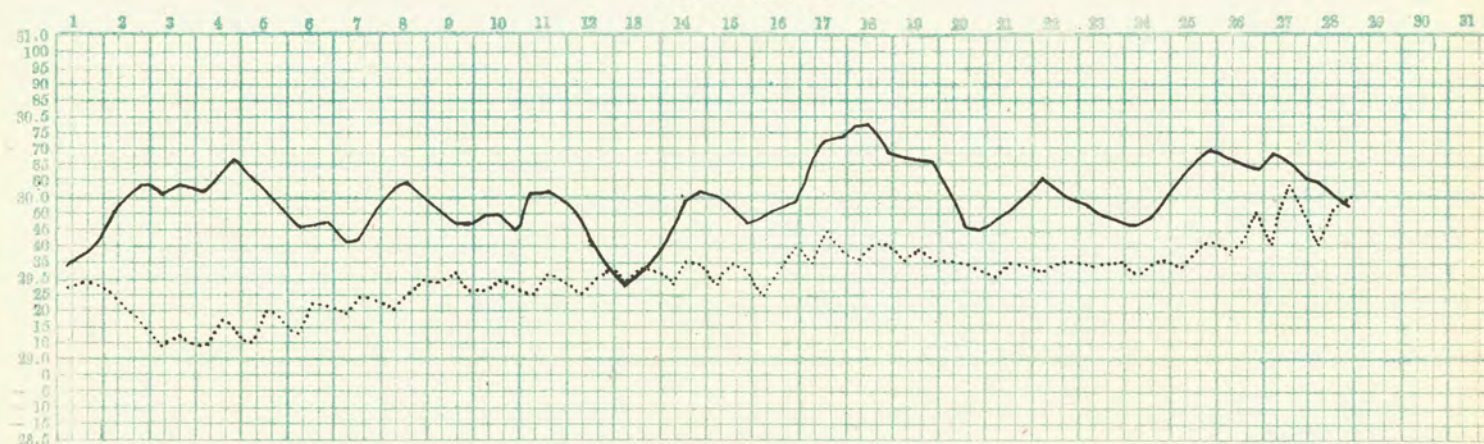
BOSTON, MASS.



SAINT PAUL, MINN.



PORTLAND, OREG.



NEW ORLEANS, LA.

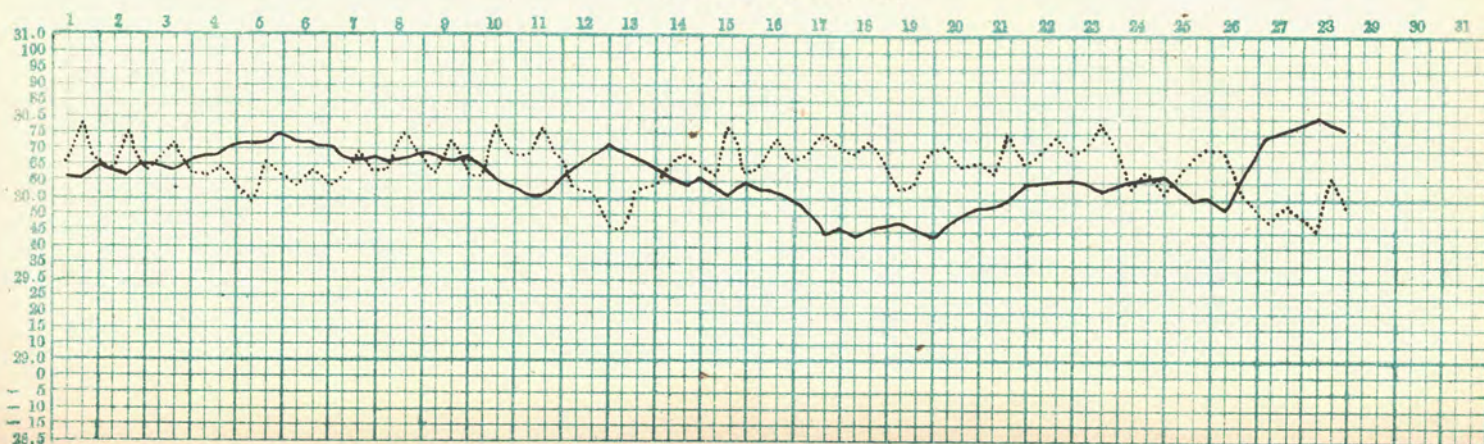
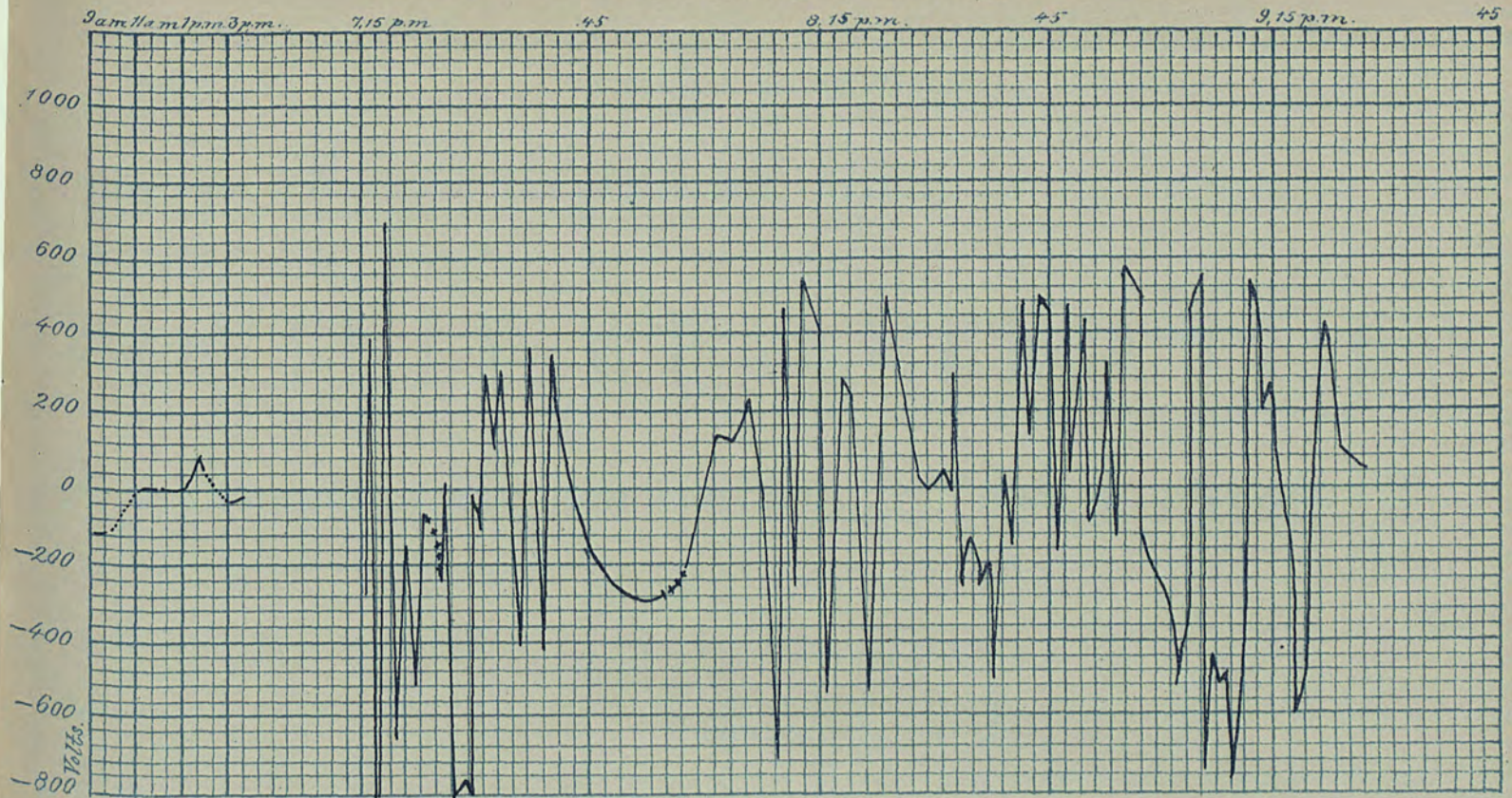


Chart VI. Curves showing Electrometer Readings.



Thunder storm at New Haven, Conn., February 18, 1887.

