

*Exceptional precipitation for one hour or less—Continued.*

Station and state.	Amount.		Date.
	Inches.	h. m.	
Lycippus, Pa.....	1.80	0 35	7, 1894
Bethlehem, Pa.....	3.29	0 40	8, 1894
Monroe, La.....	4.12	0 45	22, 1890
Fort Davis, Tex.....	2.42	0 45	9, 1880
Purcell, Ind. T.....	3.50	1 00	6, 1891
Fort Meade, Fla.....	3.30	1 00	24, 1893
Horse Cove, N. C.....	3.00	1 00	17, 1894
Luling, La.....	9.32	4 10	20-21, 1891

\*Record incomplete.

HAIL.

The following are the dates on which hail fell in the respective States:

Arizona, 2, 30. California, 30. Colorado, 7, 27, 28. Florida, 24. Idaho, 13. Illinois, 3, 7, 8, 9. Indiana, 12, 18. Iowa, 4, 7, 9, 20, 21, 22. Kansas, 1 to 8, 16, 20, 23, 28. Maine, 5. Massachusetts, 10. Michigan, 4, 7, 10, 22, 23, 24. Minnesota, 21. Missouri, 8, 20, 22. Montana, 13, 21. Nebraska, 7, 12. Nevada, 1, 30. New Jersey, 8. New Mexico, 4, 8, 9. New York, 25. North Carolina, 1. North Dakota, 22. Ohio, 8. Oklahoma, 20. Oregon, 12, 26, 27. Pennsylvania, 8, 10. South Dakota, 5, 7. Tennessee, 17. Texas, 5, 20. Utah, 5. Washington, 25, 26. Wisconsin, 7, 9, 14. Wyoming, 30.

SLEET.

The following are the dates on which sleet fell in the respective States:

Colorado, 2, 4, 7, 8, 9, 13, 27, 28, 30. Minnesota, 29. Montana, 12, 13. Nebraska, 14. Nevada, 27, 29, 30. New York, 25. North Dakota, 23, 29. Oregon, 13. South Dakota, 29. Utah, 7, 11.

MONTHLY SNOWFALL.

The depth of snow that fell during the month of September was not sufficient to require its presentation on Chart V. The dates of first snowfall are given in the table of frosts on page 360. The actual depths, so far as reported, together with the amount lying on the ground at the middle and close of the month, are shown in the following table:

By comparison with the normal amount of snowfall for these stations it will be seen that the quantity of snow at high stations in the Rocky Mountain plateau is rather above the normal for September.

*Monthly snowfall and amounts on ground on the 15th and at close of month.*

State and station.	Total.	15th.	30th.	State and station.	Total.	15th.	30th.
<i>California.</i>				<i>Montana—Cont'd.</i>			
Cisco.....	Inches. 7.0	Inches.	Inches.	Kipp.....	Inches. 2.0		
La Porte.....	7.5			Marysville.....	1.8		
Sumnerdale.....			7.0	Virginia City.....	8.5		
Summit.....	5.0			<i>Nevada.</i>			
<i>Colorado.</i>				Austin.....	4.0		4.0
Olimax.....	12.0			Belmont.....	2.1		2.0
Pikes Peak.....	21.2	5.8	0.5	Ely.....	1.0		
Red Cliff.....	3.5			Empire Ranch.....	1.0		
Ruby.....	9.0		1.0	Marlette Lake.....	3.8		2.0
Steamboat Spring.....	4.0		1.0	Osceola.....	2.0		
<i>Idaho.</i>				Palmetto.....	6.0		1.5
Lake.....	6.0			<i>Oregon.</i>			
Paris.....	4.0			Mount Hood.....	6.2		
<i>Montana.</i>				<i>Utah.</i>			
Butte.....	1.5			Grouse Creek.....	3.0		
Hogan.....	6.0			Scotfield.....	1.0		0.5

WIND.

PREVAILING WINDS.

The prevailing winds for September, 1894, viz, those that were recorded most frequently at Weather Bureau stations, are shown in Tables I and VIII; they are not given on Chart II, as has hitherto been the custom, but the resultant winds are published instead.

RESULTANT WINDS.

The resultant winds for the current month, as deduced from the hourly records by self-registers at about 67 regular Weather Bureau stations, are given in Table VIII. Other resultants, deduced from the personal observations made at 8 a. m. and 8 p. m., are given in Table IX. These latter resultants are also shown graphically on Chart II, in connection with the isobars based on the same system of simultaneous observation; the small figure attached to each arrow shows the number of hours that this resultant prevailed, on the assumption that each of the morning and evening observations represents one hour's duration of a wind of average velocity; these figures (or the ratio between them and the total number of observations in this month) indicate the extent to which winds from different directions counterbalanced each other. The original north, south, east, and west components are given in detail in Table IX.

During September the resultant movement was generally from the east and northeast in the south Atlantic and east Gulf States; from the southeast from the Rocky Mountains to the Mississippi River and upper Lake region; from the south in New England and New York.

HIGH WINDS.

Maximum wind velocities of 50 miles, or more, per hour were reported at regular stations of the Weather Bureau as follows; (maximum velocities are averages for five minutes;

extreme velocities are gusts of shorter duration, and are not given in this table):

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
<i>Miles.</i>							
Amarillo, Tex.....	9	54	n.	Key West, Fla.....	25	87	sw.
Block Island, R. I.....	30	60	ne.	Kittyhawk, N. C.....	27	60	ne.
Bismarck, N. Dak.....	22	59	nw.	Pikes Peak, Colo.....	13	86	sw.
Buffalo, N. Y.....	10	50	w.	Do.....	22	82	nw.
Do.....	26	54	se.	Do.....	28	84	sw.
Fort Canby, Wash.....	25	72	se.	Southport, N. C.....	27	54	se.
Do.....	26	54	se.	Tatoosh Island, Wash..	20	51	s.
Huron, S. Dak.....	12	62	se.	Do.....	24	52	e.
Do.....	13	51	s.	Titusville, Fla.....	24	50	se.
Do.....	22	60	w.	Do.....	25	66	ne.
Do.....	25	55	s.	Do.....	26	60	sw.
Jupiter, Fla.....	25	50	ne.	Winnemucca, Nev.....	6	50	nw.
Key West, Fla.....	24	62	ne.				

LOCAL STORMS.

Destructive or severe local storms were reported as follows:  
**1st.**—Near Bailey, N. C., hailstorm. Wichita, Kans., thunderstorm. Salt Lake City, Utah, rainstorm.

**2d.**—Louisville, Ky., Indianapolis, Ind., and Coffeyville and near Wichita, Kans., thunderstorms.

**3d.**—Tampa, Fla., one person stunned by lightning. Near Keesees Ferry, Ark., and Yates Center, Kans., thunderstorms.

**4th.**—Central, S. C., one person stunned by lightning. Near Thornville, Mich., hailstorm. Wyandotte, Mich., and Winfield, Kans., thunderstorms. Near Wichita, Kans., one person killed and 4 shocked by lightning. Metz, Mo., horse killed by lightning.

**5th.**—Yates Center, Kans., thunderstorm. Altoona, Kans., one person killed and one stunned by lightning.

**6th.**—Ovid, Iowa, windstorm. Conception, Mo., and Bismarck, N. Dak., thunderstorms.

**7th.**—Fairford, Ala., rainstorm. Chemung and Woodstock, Ill., stock killed by lightning. Sharon, Wis., and Lexington, Nebr., thunderstorms. In Furnas County, Nebr., man killed by lightning.

**8th.**—New York, N. Y., one person killed by lightning. Bethlehem, Pa., rainstorm. Philadelphia, Pa., and Baltimore, Md., thunderstorms. Akron, Ohio, windstorm. Garden Prairie and Marengo, Ill., thunderstorms. Sycamore, Ill., hailstorm. Newaygo, Mich., one person killed by lightning. Whitehall, Mich., 2 persons killed by lightning. Hanover, Mich., windstorm. Clinton, Mich., and Maryville, Mo., thunderstorms.

**9th.**—Bridgeton, N. J., York County, Pa., and Huntley, Ill., thunderstorms. Rochelle, Ill., one person killed by lightning. Saginaw, Mich., thunderstorm. Berrien Springs, Mich., windstorm. Columbus, Kans., a man and horse killed by lightning.

**10th.**—Leeds, Mass., windstorm. Winchendon, Mass., North Hammond and Buffalo, N. Y., thunderstorms. South Canisteo, N. Y. horse killed by lightning. Near Bayonne, N. J., thunderstorm. Nashville, Tenn., windstorm.

**12th.**—Memphis, Tenn., windstorm; one person killed. Charleston, Mo., windstorm; 2 persons killed.

**13th.**—Pierre, S. Dak., windstorm.

**14th.**—Westfield, Wis., windstorm.

**15th.**—Wahpeton, N. Dak., windstorm.

**16th.**—Columbia, S. C., and Marion, Kans., thunderstorms. Wamego, Kans., hailstorm.

**17th.**—Ashland, Va., thunderstorm.

**18th.**—Chester, N. J., thunderstorm. Madison, W. Va., thunderstorm.

**19th.**—Tampa, Fla., rainstorm.

**20th.**—Des Moines, Knoxville, Logan, and Osceola, Iowa, hailstorms. St. Joseph, Mo., windstorm. Olsburg and Glasco, Kans., thunderstorms. Beloit, Kans., hailstorm.

**21st.**—For description of tornadoes see report by Prof. Hazen.

**22d.**—Near Delphi, Ind., and near Van Wert, Ohio, windstorms. Richland Center, Wis., thunderstorm. New Hartford, Mo., stock killed by lightning. Bratton, Nebr., and Ellendale and Napoleon, N. Dak., windstorms.

**23d.**—Buffalo, N. Y., windstorm.

**25th.**—Malone, N. Y., hailstorm.

**26th.**—Everett, Mich., windstorm.

**27th.**—Delavan, Wis., thunderstorm.

#### THE VIOLENT LOCAL STORMS OF SEPTEMBER 21.

By Prof. H. A. HAZEN.

On this evening and night a very remarkable series of wind-rushes and tornadoes visited the northern part of Iowa, extreme southeast Minnesota, and west-central Wisconsin. It is very rare that destructive storms visit this region later than July; for example, the tornado at Grinnell, Iowa, occurred on June 17, 1882, and the one last year at Pomeroy was on July 6. On September 21, fortunately, no large town was struck, but the aggregate of deaths nearly equaled that at Pomeroy.

The conditions of the general storm, at 8 p. m., gave no inkling of the destruction so soon to be wrought. There were no maximum wind velocities reported from this region. The center of the general storm was very nearly over Sioux City, Iowa, at 8 p. m., and the next morning it was just east or southeast of Marquette, Mich.; its rate of motion was about 44 miles per hour, and its trajectory was about 100 miles to the northwest of the principal violent storms in Iowa. The maximum temperature on this day, at Sioux City, was 80°, and at La Crosse, 76°, which was not at all

abnormal. On the day previous there had been thunderstorms and hail at several points in Iowa and Missouri. These showed an electric disturbance in this region, but of no marked severity.

On the 21st the first signs of violence were noted at Le Mars and Seney, in Plymouth Co., Iowa, at about 7 p. m. A little later Lincoln and Riverton townships, in Clay Co., were visited. A great many towns were struck in a line from this point to the northeast point of Iowa and the southeast corner of Minnesota. There seemed to be two lines of destruction, as follows:

Track I, Ruthven, 7.30; Emmetsburg, 7.30; Cylinder, 8; Whittemore and Algona, 8.15; Wesley, 8.30; Britt, 8.30; Ellington and Hayfield, 9; Concord and Mason City, 9.20; Osage, 10; New Haven, 10.20; Lowther, Elms, Cresco, and Burroak, 11—all in Iowa. This was the best traced line and seemed to show a velocity of 43 miles per hour. It will be noted that this coincides almost exactly with the velocity of the general storm.

Track II passed through the following points: Fenton, 8.30; Burt, 8.00; Forest City, 9.30; Fertile, 9.30; St. Ansgar, 10—all in Iowa. Le Roy, 10; Spring Valley, 10.10; Chatfield, and Laird, 10.30; Eyota, 10.30; Homer, 11—all in Minnesota; Marshland, Wis. This storm turned in its course at Fertile, and moved in an east-northeast direction, at first turning northeast between Le Roy and Spring Valley.

Track III was nearly parallel to II, and struck York and Greenleaf, the later town at 11 p. m.

Track IV passed through Waseca, Otisco, Dodge Center, and Beaver, 9.30 p. m.—all in Minnesota.

There were also destructive storms at Richland Center at 11.30, and Marshall between midnight and 1 a. m., of the 22d.

The characteristics of these storms were the same as have been noted repeatedly before. The earlier tracks lay more to the north and northwest, and as the night wore on the later ones lay further east. The general direction of all the paths was toward the east, or a little north of east.

Fifty-three lives were lost in Iowa and 5 in Minnesota. The earlier reports were very much exaggerated, thus, 50 killed in Winnebago County, 100 in Iowa, etc. The above estimate of 53 is a careful one, and is probably true within 3 or 4.

Losses to buildings were approximately as follows: In Iowa, Cerro Gordo County, \$3,000; Hancock County, \$40,000; Kossuth County, \$30,000 to \$50,000; Emmetsburg, \$7,000 to \$9,000; Fertile, \$1,000; New Haven, \$2,700; Osage, \$9,000; Ruthven, \$1,100; St. Ansgar, \$15,000; Thompson, \$3,500. In Minnesota: Eyota, \$2,000; Greenleaf, \$1,000; Homer, \$2,000; Hutton, \$700; Laird, \$2,000 to \$4,000; Le Roy, \$120,000; Spring Valley, \$59,875. Richland Center, Wis., \$4,000. This makes the total estimated and reported loss as \$312,000; the whole loss was probably less than \$350,000.

Rather full descriptions of these violent storms have been received from 27 stations. Sixteen towns report a funnel cloud, in one place 3 were seen. Twenty-six report lightning in this storm; 16 of them describe it as violent, vivid, sharp, incessant, etc.; 12 report a whirl, 8 counter-clockwise, 2 clockwise.

Sixteen reports mention the distribution of debris, and all describe this as carried with the storm or turned inward toward the track. Three indicate that on the north side objects were carried to northeast and west. One states that the first fall of trees on north side was toward the west and then others were piled on top toward the east. Eight report a glow, or white appearance in cloud; one observer says it looked like a cone of steam; another likens it to a "pillar of fire;" two report that it was very black. Eight state that there were two clouds that came together to the west of the town.

In one place 35 persons were injured, and all these stated