THE ASTRO... and Physical Society TORONTO, CANADA

MONTHLY WEATHER REVIEW.

VOL. XXI. WASHINGTON, D. C., MAY, 1893. No. 5.

INTRODUCTION.

This REVIEW is based on reports for May, 1893, from 3,201 regular and voluntary observers. These reports are classified as follows: 167 reports from Weather Bureau stations; 44 reports from United States Army post surgeons; 2,200 monthly reports from state weather service and voluntary observers; 220 reports through the Southern Pacific Railway Company; 540 marine reports through the co-operation of the Hydrographic Office, Navy Department; 30 reports from Canadian stations; marine reports through the "New York Herald Weather Service"; monthly reports from local services established in all states and territories; and international simultaneous observations. Trustworthy newspaper extracts and special reports have also been used.

CHARACTERISTICS OF THE WEATHER FOR MAY, 1893.

The month was cooler than usual, except along the New England and Gulf coasts, and in New Brunswick, Nova Scotia, and the British Northwest Territory. In the north Pacific coast states the mean temperature was the lowest ever reported for May. The frost line was carried to north parts of the south Atlantic and east Gulf states on the 4th and 17th to 19th, and to central Arkansas on the 2d, 3d, and 17th.

PRECIPITATION.

The monthly precipitation was in excess of the May average generally in the middle Atlantic and New England states, the Ohio and middle Mississippi valleys, the interior of the middle and west Gulf states, and from the north Pacific coast over the northeast slope of the Rocky Mountains. At Eastport, Me., along the south Atlantic and immediate Gulf coasts, and from the middle-eastern slope of the Rocky Mountains over the valley of the Red River of the North and the southwestern lake region the monthly precipitation was less than the usual amount. At points on the middle New England coast, and at stations in Pennsylvania, West Virginia, northern Ohio, Tennessee, the southern plateau region, Montana, and Washington the monthly rainfall was the greatest ever reported for May. The monthly snowfall exceeded 20 inches in the mountains of Colorado, northeastern California, Wyoming, Idaho, and Montana, and at points in northern Upper Michigan, and northern Wisconsin. No snow fell in the Atlantic coast states, except trace in Maryland on the 4th.

LOCAL STORMS.

Destructive local storms occurred in the Carolinas on the 3d. At Oxford, N. C., a tornado killed 1 person and destroyed property valued at $16,000. On the 4th violent gales prevailed on the middle Atlantic and New England coasts. Severe local storms occurred in the Ohio Valley and Oklahoma on the 5th, in the Gulf States and Arkansas on the 6th, in Iowa on the 10th, in Texas, Illinois, and Wisconsin on the 11th, and in southeastern Lower Michigan on the 12th. Exceptionally heavy rain fell in northern Ohio and northwestern Pennsylvania on the 15th and 16th. Heavy gales were reported from Colorado over the Dakotas on the 18th. Violent storms occurred in the upper Ohio valley on the 20th, in the Northwestern States on the 21st and 22d, in northeastern and north-central districts on the 23d, in Illinois, Missouri, and Kansas on the 25th, in the Ohio Valley and Tennessee on the 26th, in North Carolina on the 27th, in western Tennessee and Georgia on the 28th, in the south Atlantic states, Indiana, Lower Michigan, and the Northwest on the 29th, in New York, the Ohio Valley, and the Southwest on the 30th, and in New York and the Southwest on the 31st.

FLOODS.

The month opened with the Mississippi, Ohio, and Arkansas rivers high and rising rapidly. During the early part of the month floods occurred in streams in Ohio, Pennsylvania, New York, western New England, and Virginia, and rain and melting snow swelled the streams of Washington and Oregon to a dangerous height. Several breaks occurred in the Mississippi levees in Arkansas, and during the latter part of the month crevasses were reported in East Carroll Parish, La.

DROUGHT.

Drought materially damaged small grain crops in central and western Kansas, and injured grass in the western counties of that state.

ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean atmospheric pressure for May, 1893, as determined from observations taken daily at 8 a. m. and 8 p. m. (75th meridian time), is shown on Chart II by isobars.

Chart VI exhibits the normal distribution of atmospheric pressure and prevailing wind-directions over the United States for May. The publication of the charts of this series is preliminary to the publication by the Weather Bureau of specially prepared data and charts showing meteorological and climatic features and conditions of the United States.

In May, 1893, the mean pressure was highest along the north Pacific coast, where it was above 30.05. The mean pressure was above 30.00 over Georgia, southern South Carolina, and the Florida Peninsula. The mean pressure was lowest on the northeast slope of the Rocky Mountains, over the southwestern plateau region, and in the Saint Lawrence Valley, where it was below 29.85.

In May there is usually a decrease of pressure, except on the north Pacific coast and from the Ohio Valley over the middle Atlantic and New England states. The most marked decrease occurs from the lower Colorado valley over southern California and the San Joaquin and Sacramento valleys, and in the upper Missouri and Red River of the North valleys, where it is more than .05, and the greatest increase is shown over eastern New England, where it exceeds .05.

A comparison of the pressure chart for May, 1893, with that of the preceding month shows a decrease of pressure, except over Washington and in an area extending from Wisconsin and Minnesota to central Texas. The most marked decrease of pressure was shown in the Saskatchewan Valley, and over the greater part of New England, New York, and eastern Pennsylvania, where it was .15 to .20. In central and western California and along the middle and south Atlantic coasts the decrease was more than .10. The greatest increase was noted on the Washington coast, where it was .05 to .07.

The mean pressure was below the normal, except from the middle and north Pacific coasts over the middle Rocky Mountain region. The most marked departure below the normal pressure was noted over New York, New England, and Pennsylvania, where it was more than .10, and the greatest departure above the normal pressure was shown over the northwestern plateau region, where the mean values were .05 to .06 higher than usual.

HIGH AND LOW AREAS.

The paths of areas of high and low barometric pressure over the United States and Canada during May, 1893, are shown on Charts IV and I, respectively, and some of the more prominent characteristics of the areas are given in the table at the end of this chapter.

HIGH AREAS.

Seven high areas appeared, the average number traced for May during the last 19 years being 6.7. Of the high areas traced for the current month 4 advanced from the north Pacific coast, 2 from the British Northwest Territory, and 1 occupied the middle-eastern slope of the Rocky Mountains at the opening of the month. Two of the Pacific coast high areas reached the middle Atlantic coast, 1 disappeared by a decrease of pressure over the southern Rocky Mountain region, and 1 passed north of the Lake region. The high areas from the British Northwest Territory passed southeastward to the Atlantic coast, and the high area from the middle-eastern slope of the Rocky Mountains disappeared north of Lake Superior. The average velocity of the high areas was about 6 miles per hour greater than the average velocity of high areas for May. The following is a description of the high areas traced:

I.—Occupied the middle-eastern slope of the Rocky Mountains at the opening of the month. The morning of the 1st the line of freezing weather extended to extreme northwestern Texas, and frost was reported generally in Kansas. The evening of the 2d this high area extended from eastern Nebraska over the Red River of the North Valley, and during the 3d disappeared north of Lake Superior.

II.—Advanced from Manitoba over the Dakotas during the 5th, with a fall of 10° to 15° in temperature in the middle Rocky Mountain region. During the 6th this high area extended from the middle Rocky Mountain region to Lake Superior, freezing weather was reported in northern Colorado, and in western Colorado tender plants were damaged by frost. During the 7th this high area settled southeastward over the Lake region, and during the 8th the center passed off the middle Atlantic coast.

III.—Occupied the north Pacific coast from the 7th to the 10th. On the 9th a temperature fall of 20° to 30° was reported on the northeast slope of the Rocky Mountains, and the temperature fell 10° to 20° in the Northwest on the 10th. During the 11th the high area advanced to Colorado and the temperature fell 10° to 20° in the lower Missouri and upper Mississippi valleys. On the 12th this high area disappeared by a decrease of pressure over the southern Rocky Mountain region.

IV.—Advanced from Manitoba over the Red River of the North Valley during the 15th, with a temperature fall of 10° to 20° in the central valleys. During the 16th and 17th this high area moved slowly southward to northeastern Texas and passing thence eastward reached the south Atlantic coast on the 19th, its passage being unattended after the 15th by marked changes in temperature.

V.—Appeared off the middle Pacific coast on the 20th and apparently moved slowly northward until the morning of the 22d, when the pressure was 30.40 at the mouth of the Columbia River. On the 21st heavy frost and freezing weather were reported in northern Nevada. During the 22d this high area advanced to Utah, the temperature fell 20° to 40° from northwestern Texas to Lake Superior, and frost was reported in northern Nevada and northern Utah. By the evening of the 23d the high area had advanced to the middle Mississippi valley, the temperature had fallen 20° to 30° in the Lake region and Ohio Valley, and heavy frost was reported in Kansas and Nebraska. Moving eastward this high area passed off the middle Atlantic coast during the 24th, with a temperature fall of about 10°.

VI.—Occupied the north Pacific coast on the 23d, with pressure above 30.30 at the morning report. During the 24th the high area advanced to Montana and the temperature fell about 20° in the Northwest. Passing rapidly eastward this high area reached Wisconsin during the 25th, with a fall of about 20° in temperature from the southwestern Lake region to Kansas, and during the 26th disappeared north of the Lake region.

VII.—Appeared over the northern plateau region on the 26th. On that date heavy frost was reported in northern Utah and southeastern Wyoming. During the 27th this high area advanced to the middle Rocky Mountain region, passed thence to Oklahoma during the 28th, and thence to the south Atlantic states by the 30th, its passage over the Southern States being attended by slight changes in temperature.

LOW AREAS.

The average velocity of areas of low pressure over the United States for May is about 25 statute miles per hour, the average velocity for May, June, and July being the lowest of the year. A large proportion of the May low areas move from the middle and northeast slopes of the Rocky Mountains to eastern Ontario and thence to Newfoundland. An average of less than one low area per month advances from the north Pacific coast and traverses the continent.

The tracks of 11 low areas are plotted on Chart I for May, 1893, the average number traced for May during the last 19 years being 6.8. Of the low areas traced for the current month 3 advanced from the north Pacific coast states, 5 from the Saskatchewan Valley, 1 from the southern plateau region, 1 from the west part of the Gulf of Mexico, and 1 occupied Indiana and Illinois at the opening of the month. One of the low areas from the north Pacific coast reached New England and the other the Gulf of Saint Lawrence. The low area from the south Pacific coast advanced to the lower Rio Grande

valley. Three of the low areas from the Saskatchewan Valley reached the Gulf of Saint Lawrence, 1 the middle Atlantic coast, and 1 occupied the middle Mississippi valley at the close of the month. The low areas from the southern plateau region and the Gulf of Mexico advanced to the Gulf of Saint Lawrence. The following is a description of the low areas whose paths appear on Chart I:

I.—Occupied Indiana and Illinois at the opening of the month, and by the evening report of the 1st had advanced north of the lower lakes, with rain generally east of the Mississippi River, and thunderstorms in Tennessee and northern Georgia. During the 2d this low area apparently disappeared by an increase of pressure north of the Lake region.

II.—Appeared off the Texas coast the evening of the 1st, and during the 2d advanced slowly northeastward to southern Mississippi, with very heavy rain on the middle Gulf coast. During the 3d the center of disturbance passed rapidly northeastward to the Virginia coast with a marked increase in energy. On that date rain fell generally in the Atlantic coast states, gales prevailed from the Georgia to the south New England coasts, and destructive local storms occurred in the Carolinas. The morning of the 4th this low area was central near New York, N. Y., with pressure 29.12, and by the evening report had advanced to the middle Saint Lawrence valley with a decrease in energy. During the 4th the rain area contracted over Pennsylvania, New York, and New England, and an unusually severe wind and rain storm prevailed over New England, New York, and New Jersey. During the 5th the low area moved slowly eastward over New England, and by the morning of the 6th had disappeared over the Gulf of Saint Lawrence.

III.—Occupied the region north of Montana on the 2d, and during the 3d advanced to eastern Montana, with pressure below 29.60, and rain and high winds on the northeast slope of the Rocky Mountains. By the 4th the center of disturbance had passed southeastward to Kansas, with rain in the Missouri and upper Mississippi valleys, and severe local storms in northern Kansas and northwestern Missouri. Moving rapidly eastward this low area reached the middle Atlantic coast the night of the 5th, attended by severe local storms in the Ohio Valley.

IV.—Advanced from the north Pacific coast over British Columbia during the 4th, with rain on the middle and north Pacific coasts. From the 5th to the 9th this low area remained nearly stationary north of Montana, and on the 10th advanced to Manitoba. The evening of the 10th a secondary disturbance appeared over the middle Missouri valley. On that date a marked rise in temperature occurred from the middle Rocky Mountain region over the Great Lakes, rain fell in the middle and upper Missouri and extreme upper Mississippi valleys, the western lake region, and Texas, and local storms were reported in Iowa. During the 11th the low area moved slowly eastward to a position north of Lake Superior, with pressure below 29.50, and rain and local storms occurred from the upper lake region and the Red River of the North Valley to Texas. This low area occupied the upper lake region during the 12th. On that date the rain area extended to the Atlantic and Gulf States, and severe thunderstorms were reported in Michigan. Passing south of east with a marked loss of energy the center of disturbance disappeared off the south New England coast during the 14th, attended by northeast gales on the New England coast during the 13th.

V.—Appeared over the lower Colorado valley during the 4th, and moved thence to western Texas by the evening of the 5th, with pressure below 29.70. Passing southeastward this low area is last located in the lower Rio Grande valley the morning of the 7th. During the 6th and 7th rain and thunder storms occurred in the middle and west Gulf states.

VI.—Appeared over northern Alberta the evening of the 11th, and during the 12th advanced north of Montana, with pressure below 29.60. During the 13th this low area remained nearly stationary north of North Dakota, and during the 14th passed to the upper Mississippi valley, attended by rain from the western lake region to Texas and thunder and hail storms in Illinois and western Michigan. By the evening of the 15th the center of disturbance had reached the upper Ohio valley, the temperature had risen 10° over eastern New York, rain had fallen generally east of the Mississippi River and south of the Lake region, and local storms were reported in the upper Ohio valley.

During the 16th this low area advanced over western New York with a marked increase in energy, the 8 p. m. barometer reading at Buffalo, N. Y., being 29.26. On that date heavy rain fell in the lower lake region, the upper Ohio valley, and middle Atlantic and New England states, and high winds prevailed along the middle Atlantic and south New England coasts, and over the southern lake region. During the 17th the storm-center advanced to the upper Saint Lawrence valley, heavy rain continued in western Pennsylvania and western New York, and high winds prevailed along the New England coast and over the Lake region. By the evening of the 18th this low area had advanced to New Brunswick, and rain had been followed by rapidly clearing weather in New England.

VII.—Occupied the region north of eastern Montana the evening of the 17th. On that date the temperature rose 10° to 12° in the western Dakotas, rain fell in the region north of Montana, and high winds prevailed over the Rocky Mountain and plateau regions. During the 18th this low area advanced to western South Dakota, with pressure below 29.10, the temperature rose about 10° in the middle Ohio valley, the interior of the middle Gulf states, and on the southeast slope of the Rocky Mountains, rain fell in eastern Montana and parts of the middle plateau region, and severe windstorms prevailed in the Northwest.

During the 19th the center of disturbance moved to Manitoba, with pressure below 29.00, the temperature rose 10° to 26° in the Lake Superior region, rain fell in the extreme northwest, and severe windstorms prevailed from the western lake region to the Rocky Mountains. During the 20th the low area moved rapidly eastward north of the Lake region, with a marked decrease in energy, the temperature rose 10° to 15° in areas in the middle Atlantic and New England states and the eastern lake region, the rain area contracted over the middle and upper Ohio valleys and lower lake region, and severe local storms were reported in the upper Ohio valley. During the 21st this low area disappeared over the Gulf of Saint Lawrence.

VIII.—Appeared over Washington the night of the 19th, and during the 20th moved southeastward to the middle Rocky Mountain region, with a rise in temperature of 10° to 20° from the Dakotas to Kansas, and rain from the north Pacific coast over the northern Rocky Mountain region. During the 21st this low area advanced to Nebraska, with pressure below 29.30 at the evening report. On that date rain fell in the Northwest and in areas in the upper Mississippi and Ohio valleys, and severe local storms occurred in Minnesota, Iowa, and South Dakota. By the evening of the 22d the storm-center had advanced to extreme northern Illinois, rain had fallen from the middle Rocky Mountains over the western lake region, the temperature had risen 10° to 20° over the southern lake region, and severe local storms were reported in South Dakota, Iowa, Nebraska, Minnesota, and Wisconsin. During the 23d the center of disturbance moved rapidly eastward to the lower Saint Lawrence valley, rain fell generally east of the Mississippi River, and severe thunderstorms occurred in the middle Atlantic states, the lower lake region, Lower Michigan, and the Ohio Valley. On the 24th this low area disappeared over the Gulf of Saint Lawrence.

IX.—Appeared on the northeast slope of the Rocky Mountains the night of the 22d, and during the 23d advanced to South Dakota, with pressure below 29.60. On that date the temperature rose 10° to 20° from the southern Rocky Mountain region to Minnesota, and heavy rain fell on the northeast slope of the Rocky Mountains. During the 24th the center of disturbance advanced over the upper Mississippi valley, the temperature rose 10° to 15° in the Ohio Valley and the southwestern lake region, rain fell in the northwestern lake region, and high winds prevailed over the Lake region and upper Mississippi and middle Missouri valleys. During the 25th this low area moved rapidly north of east over the Saint Lawrence Valley, and rain fell in northern New York and northern New England.

X.—Appeared over the southern plateau region on the 25th, and passed rapidly eastward to southern Missouri during the night of that date. On the 25th rain fell from the middle Rocky Mountain region over the upper Mississippi valley, and destructive local storms occurred in the evening and at night in Kansas and Missouri. By the evening of the 26th the storm-center had reached the lower Ohio valley, the rain area had extended to the New Jersey and south New England coasts, and severe thunderstorms were reported in Tennessee, Kentucky, and Indiana. During the 27th the center of disturbance moved over the Ohio Valley and thence northeastward over the lower lake region, and thunderstorms were reported in the Atlantic coast states. During the 28th this low area disappeared over the Gulf of Saint Lawrence.

XI.—Was central over Alberta the evening of the 28th, with pressure below 29.50, and during the 29th moved southeastward over eastern Montana, with a rise in temperature of 10° to 15° in the middle Mississippi valley, rain from the north Pacific coast over Montana, thunderstorms in western Iowa and the Dakotas, and high winds over the middle plateau region. By the evening of the 30th the center of disturbance had advanced to Oklahoma, rain had fallen generally over the Western States and in the Ohio Valley, and severe thunderstorms were reported in Arkansas, southern Ohio, and southern Indiana. During the 31st the low area advanced over Missouri, with pressure below 29.50, the rain area covered the middle and lower Mississippi, lower Missouri, and Ohio valleys, and severe local storms were reported in the lower Missouri and lower Mississippi valleys, Tennessee, and Kentucky.

XII.—Appeared over the southern plateau region on the 26th, and passed thence to New Mexico by the evening of the 27th. During the 28th this low area advanced to the lower Mississippi valley, rain fell from the Ohio Valley to the middle and east Gulf states, and severe wind and rain storms were reported in Georgia. By the morning of the 29th the storm-center had reached the Carolina coast with a marked increase in energy, heavy rain fell over the interior of the Gulf States, and destructive local storms occurred in eastern Tennessee, northern Georgia, and the Carolinas. During the 29th the storm-center moved eastward over the ocean, with west to north gales on the south Atlantic coast.

Tabulated statement showing principal characteristics of areas of high and low pressure.

Barometer.	First observed.			Last observed.		Duration.	Velocity per hour.	Maximum pressure change in 12 hours, maximum abnormal temperature change in 12 hours, and maximum wind velocity.									
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.			Station.	Rise.	Date.	Station.	Fall.	Date.	Station.	Direction.	Miles per hour.	Date.
High areas.		°	°	°	°	*Days.*	*Miles.*		*Inch.*			°					
I	1	41	103	48	93	2.5	13	Shreveport, La	.28	1	Buffalo, N. Y	16	2	Winnipeg, Man	ne.	16	2
II	5	48	99	40	77	2.5	26	Valentine, Nebr	.30	5	Miles City, Mont	21	4	Chicago, Ill	ne.	18	6
III	10	47	122	36	101	1.5	40	Denver, Colo	.44	11	.....do	23	10	North Platte, Nebr	nw.	36	11
IV	15	52	100	33	83	4.0	22	Sioux City, Iowa	.28	15	Pittsburg, Pa	17	16	La Crosse, Wis	n.	14	16
V	22	45	123	39	82	2.0	54	Grand Haven, Mich	.60	23	Chicago, Ill	33	23	Amarillo, Tex	n.	34	23
VI	23	47	125	47	84	2.5	37	Rockliffe, Ont	.40	25	.....do	23	25	Chicago, Ill	ne.	38	25
VII	26	45	117	35	83	4.0	23	Hannibal, Mo	.26	27	Springfield, Mo	20	26	Amarillo, Tex	s.	18	29
Mean						2.7	31		.37			22				25	
Low areas.									Fall.			Rise.					
I	1	40	88	44	80	0.5	42	Buffalo, N. Y	.20	1	Erie, Pa	18	1	Saint Louis, Mo	w.	30	1
II	1	27	95	46	67	4.0	24	New York, N. Y	.64	4	Portland, Me	5	4	Sandy Hook, N. J	w.	56	4
III	2	53	115	39	77	3.0	36	Kansas City, Mo	.36	4	Dodge City, Kans	14	3	Valentine, Nebr	nw.	40	5
IV	4	49	125	42	75	10.0	10	Calgary, N. W. T	.46	7	Winnemucca, Nev	23	5	Red Wing, Minn	w.	56	11
V	4	33	115	27	98	2.0	25	El Paso, Tex	.14	5	Abilene, Tex	9	5	El Paso, Tex	w.	40	6
VI	12	54	113	47	66	6.5	19	Qu'Appelle, N. W. T	.46	12	North Platte, Nebr	23	12	Havre, Mont	nw.	48	12
VII	17	52	109	50	69	3.5	30	.....do	.48	17	Duluth, Minn	22	19	Saint Vincent, Minn.*	s.	72	19
VIII	19	52	121	48	69	4.0	31	Alpena, Mich	.42	22	Calgary, N. W. T	22	19	Sioux City, Iowa	nw.	84	21
IX	22	50	110	51	66	3.0	39	Pueblo, Colo	.42	23	Pueblo, Colo	29	23	Pierre, S. Dak.†	n.	38	24
X	25	35	106	48	71	2.5	37	Montreal, Que	.28	27	Kansas City, Mo	12	26	Saint Louis, Mo	se.	42	26
XI	28	51	113	38	92	3.0	28	Calgary, N. W. T	.40	28	Yankton, S. Dak	17	28	Salt Lake City, Utah	nw.	51	29
XII	26	34	113	35	75	2.5	37	Pueblo, Colo	.14	26	Dodge City, Kans	10	28	Wilmington, N. C	nw.	40	29
Mean						3.7	30		.37			17				50	

* Pikes Peak, Colo., w., 88, 18th. † Pikes Peak, Colo., w., 89, 23d.

NORTH ATLANTIC STORMS FOR MAY, 1893.

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

The paths of storms that appeared over the west part of the north Atlantic Ocean during May, 1893, are shown on Chart I. These paths have been determined from reports of observations by shipmasters received through the co-operation of the Hydrographic Office, Navy Department, and the "New York Herald Weather Service."

Over the north Atlantic Ocean the normal pressure for May is highest in a small area southwest of the Azores, where it is above 30.20 (767), and is lowest from southern and eastern Greenland over Scandinavia, where the normal values are below 29.90 (759). In May there is usually an increase of pressure over the north Atlantic Ocean, except in the region of the Cape Verde Islands and over the West Indies and the Caribbean Sea. The greatest increase of pressure, .20 inch or more, occurs over and east of the Banks of Newfoundland. The principal track of May storms is traced from Newfoundland north of east to the region north of the British Isles. Near the 40th meridian a track branches north-