

Dak., and 24 inches at Williston, N. Dak. On the Great Lakes there were from 4 to 6 inches in the harbors of lakes Ontario, Erie, and Michigan, 8 inches on Lake Huron, and 22 inches on Lake Superior, at Duluth, Minn. These conditions remained with but little change throughout the month. On Monday, the 26th, the reported thickness of ice, in inches, was as follows:

Hudson River.—Albany, N. Y., 14.

Upper Mississippi River.—St. Paul, Minn., 24; La Crosse, Wis., 28; Dubuque, Iowa, 12; Davenport, Iowa, 12; Keokuk, Iowa, 12; Hannibal, Mo., 6.

Missouri River.—Williston, N. Dak., 42; Bismarck, N. Dak., 28; Pierre, S. Dak., 29; Sioux City, Iowa, 18; Omaha, Nebr., 14; Kansas City, Mo., 4.

Arkansas River.—Fort Smith, Ark., 10; Dodge City, Kans., 2.

Platte River.—North Platte, Nebr., 16.5.

Red River of the North.—St. Vincent, Minn., 24.

Atlantic Coast.—Block Island, R. I., 3; New Haven, Conn., 4; Portland, Me., 3.

Lake Ontario.—Oswego, N. Y., 9.5; Rochester, N. Y., 6.5.

Lake Erie.—Buffalo, N. Y., 10; Erie, Pa., 10; Cleveland, Ohio, 6; Sandusky, Ohio, 8; Toledo, Ohio, 6.3; Detroit, Mich., 9.5.

Lake Huron.—Port Huron, Mich., 9.5; Alpena, Mich., 16.

Lake Michigan.—Grand Haven, Mich., 11; Chicago, Ill., 4; Green Bay, Wis., 15.

Lake Superior.—Sault Ste. Marie, Mich., 36; Marquette, Mich., 9; Duluth, Minn., 29.5.

The following special reports have also been collected:

Lake Superior.—Marquette, Mich., 21st, ice moving out of harbor; 22d, harbor clear of ice, except back of breakwater.

Lake Michigan.—Grand Haven, Mich., 20th, for the first time during the winter ice is obstructing navigation; slush ice fills the harbor and extends about 5 miles out into the lake. The steamer *Wisconsin* remained in port, unable to force her way through; 21st, the steamer *Roanoke* is reported fast in the ice 3 miles out; 24th, southeast winds cleared the harbor of ice and enabled the steamer *Roanoke* to enter port; 27th, immense floes of ice cover the lake, and the Milwaukee boat failed to make her way through and returned to port; 28th, navigation stopped by immense fields of ice.

Lake Huron.—Port Huron, Mich., 1st to 5th, floating ice in the St. Clair River; 6th, an ice gorge formed in the St. Clair at Marysville, 6 miles south of Port Huron; 9th and 11th, floating ice in the St. Clair; 22d, an ice gorge formed one-half mile below the city.

Missouri River.—Hermann, Mo., gorge broken on the 7th and ice moving out; 12th, heavy floating ice; 15th, frozen; 18th, opened again; 21st, heavy floating ice.

Illinois River.—Ottawa, Ill., 9th, ice passed out.

Ohio River.—Marietta, Ohio, 1st to 9th, heavy floating ice; 17th to 18th, floating ice. Parkersburg, W. Va., 1st to 6th, floating ice; 26th, floating ice. Wheeling, W. Va., 1st to 8th and 26th to 28th, floating ice; 1st to 4th, floating ice in Allegheny River.

Susquehanna River.—Lock Haven, Pa., 1st, river frozen; 10th, ice moved out; 16th, frozen.

Atlantic Coast.—New York, N. Y., 15th, the first floating ice of the season in the North and East rivers; 27th to 28th, floating ice in North and East rivers. Vineyard Haven, Mass., 25th, harbor frozen over, but ice broken by tide during day. Portland, Me., 23d to 28th, ice in harbor.

OBSERVATIONS ON THE GREAT LAKES.

Owing to the closing of navigation on the Great Lakes during the winter season the Weather Bureau has received reports for the month of February from no vessels and from only 10 U. S. Life Saving stations.

SUNSHINE AND CLOUDINESS.

Although the quantity of sunshine, and probably of heat, received by the atmosphere above the cloud layer is very nearly constant from year to year, yet it varies with the day and the month. On the other hand, at the surface of the earth, the distribution of sunshine and, therefore, the resultant heat with its meteorological and biological consequences depends mostly on the distribution of cloudiness.

Sunshine.—During the month an instrumental record of the amount of sunshine has been kept at 15 stations by means of the photographic sunshine recorder, and at 21 stations by means of the thermometric sunshine recorder. The results of these observations are given in Table IV, which shows the actual sunshine received, on the average, for any hour of local mean time (not seventy-fifth meridian time) during the month; the actual sunshine is tabulated as a percentage of the greatest possible duration of sunshine.

The stations recording the largest percentage of sunshine between the hours of 11 a. m. and 1 p. m., are: Colorado Springs, Colo., 87.5; Denver, Colo., 87; Key West, Fla., 91; Portland, Me., 85.5; Tucson, Ariz., 91. The stations having the least percentage are: Cleveland, Ohio, 45.5; Galveston, Tex., 45.5; Memphis, Tenn., 42; New Orleans, La., 46; Portland, Ore., 28.5; Savannah, Ga., 42.5.

The next to the last column of Table IV gives the general average sunshine for the whole month for all hours of daylight. The highest percentages are: Key West, Fla., 84; Tucson, Ariz., 82; San Diego, Cal., 81. The lowest averages are: Galveston, Tex., 38; Memphis, Tenn., 39; New Orleans, La., 35; Portland, Ore., 23.

Cloudiness.—The number of clear and cloudy days and the average cloudiness between sunrise and sunset (the latter

based on numerous personal observations) are given for each Weather Bureau station in Table I. The complement of the average cloudiness gives the observer's estimated percentage of clear sky, and these numbers are given in the last column of Table IV. On the average these personal estimated percentages are lower by 10.8 than the sunshine recorded by the thermometric registers and lower by 9.1 than the photographic registers.

Although the general average difference between the instrumental registers and personal records is about the same for both classes of instruments, yet this agreement needs an explanation. There is necessarily a systematic difference between the instrument and the observer, resulting from the fact that the observer estimates the average area of the sky covered by clouds at any moment, and his final percentage for the day, therefore, embraces the whole sky, whereas the instrument records essentially the visibility of the sun's disk, from which is derived the percentage of duration of sunshine. It is easily conceivable that a small bank of cloud slowly moving across the sky might keep the instrument in its shadow and cause a record of "no sunshine," whereas the observer viewing the whole sky would record that but a few tenths are covered by clouds. In general, in climates where but few clouds exist, an observer's record of one, two, or three tenths will almost invariably accompany an instrumental record of full sunshine. In this respect the various methods of recording differ among themselves as though they had varying degrees of sensitiveness: on clear and fair days the observer seems to be most sensitive to the presence of cloud, but the instrument less so: in cloudy weather the observer seems most sensitive to the presence of sunshine and the instru-

ment less so. This peculiarity is well brought out by arranging the instrumental and personal records according to the clearness of the sky.

Photographic register.					Thermometric register.				
Sunshine.		Cloudiness.		Difference.	Sunshine.		Cloudiness.		Difference.
Instru-mental.	Per-sonal.	Instru-mental.	Per-sonal.		Instru-mental.	Per-sonal.	Instru-mental.	Per-sonal.	
82	64	18	36	18	84	60	16	40	24
81	61	19	39	20	70	61	30	39	9
75	54	25	46	21	68	54	32	46	14
66	54	34	46	12	67	42	33	58	25
66	53	34	47	13	63	56	37	44	7
56	43	45	57	13	59	45	41	55	14
54	51	46	49	3	45	45	42	55	13
51	46	49	54	5	57	50	43	50	7
50	42	50	58	8	56	43	44	57	13
47	44	53	56	3	54	41	46	59	13
45	38	55	62	7	54	39	46	64	18
42	32	58	68	10	54	37	46	63	17
39	34	61	66	5	52	46	48	54	6
38	38	62	62	0	50	50	50	50	0
23	24	77	76	1	49	40	51	60	9
					48	39	52	61	9
					48	41	52	59	7
					47	36	53	64	11
					44	41	50	59	3
					44	38	56	62	6
					35	33	65	67	2

In the above table the general monthly averages given in the last two columns of Table IV, for February, are thus rearranged separately for the thermometric and photographic re-

cord, and beside the percentages of sunshine, as there given, I have also added the complementary percentages of cloudiness. After smoothing down the local discrepancies we see that in clear climates the observer gives the cloudiness full weight, and possibly overestimates it while the instrument may underestimate it, but for cloudiness of 60 or 70 per cent the observer and instrument agree, and probably would continue to do so very closely for the higher percentages.

There is no necessary agreement between a single instrumental register and the observer at any given station, but, in general, if many registers were closely and uniformly distributed within a few square miles near the observer and under the clouds that he records, then the average of all these registers should agree with the personal record. The practically close agreement between the average of all the personal and instrumental records at our widely-separated stations depends upon the fact that the clouds have an average motion and distribution that are very much the same everywhere, so that the percentage of duration of sunshine at any station and the percentage of geographical area that enjoys the sunshine agree closely in the monthly and annual averages, though they may differ widely on any given day or hour. The local sunshine record is undoubtedly the most important datum in the study of local agricultural or phænological questions. The average percentage of cloudiness is the most important datum for the study of the distribution of temperature and ascending currents in the atmosphere.

NOTES BY THE EDITOR.

SNOW IN NEW ENGLAND.

With regard to the question of diminished snowfall in New England, Miss Ellen D. Larned, of Thompson, Conn., says:

My records have some bearing. In addition to my own forty years' observations I have a family diary dating back to 1817, with some unfortunate lapses. These records give the date and general characteristics of snowfalls, but not usually the the depth or amount. In copying from them I omit the light falls and flurries occurring more or less from October to May, and only note snows covering the ground and definite storms.

1817.—No snow of any perceptible amount till December 21; violent north-erly snowstorm, but not much snow; very cold.

1818.—January 10, first sleighing of the winter; about 4 inches of snow fell; very good sleighing for so little snow; snowed sharp for a few hours; sleighing continued till March 2. March 28, much of a snowstorm; good sleighing for several days. November 18, snowed large and moist; no sleighing the following winter, save a few days after a violent storm of sleet and rain.

1819.—February 25, a succession of moderate snows. Snow on March 6, 8, and 9 made good sleighing. 16th, severe storm; coldest day of winter; excellent sleighing for a week. October 25, snowed all night. November 28, snowed all night and the next day, but no sleighing. December 30, a cold, tedious snowstorm, wind very high. 31st, high cold wind, snow blows violently; poor sleighing.

1820.—January 11, a violent snowstorm. 17th, most violent snowstorm, wind very high. 22d, snowed in the morning; sleighing improved. February 9, most violent storm all day; no stirring about; greatest fall of snow this winter; roads all blocked up. 10th, heavy fall of snow in the night. 11th, snows in the morning; blows hard; roads all filled up. 12th, all hands breaking roads; a thaw follows, but not sufficient to mar the sleighing. March 4, pretty good sleighing. 8th, snow, hail, and rain violent all day. 9th, rain continues. 10th, trees very heavily laden, snow slips off without much damage. 12th, cold and clear; roads have frozen, and crust to bear up horses, sleighs, and teams. 16th, good sleighing. 17th, snows prettily. 19th, snow falls, almost all gone, but it went to return with renewed force in the autumn. November 12, Sunday, snows in the night and all day; a right wintry, cold storm; no meeting; snow about 8 inches or more on the level. 13th, very cold, snowy morning, some rain or sleet, clears off at noon; hard sleighing. 14th, break into the woods with sled and haul two loads of wood; sleighing and sledding continued through the week. This November snowstorm of 1820 was handed down to posterity as exceeding in severity anything ever before experienced by the oldest inhabitant so early in the season, and it is believed that the record in this vicinity, at least, remains unbroken.

1821.—January 7, a terrible, cold snowstorm; first sleighing. 14th, very high, rough storm of snow. 22d, snows about 4 inches in the night. Febru-

ary 6, sleighing gone. 15th, snows again; pretty good sleighing, continuing some days. November 30, snowed all day, light; high wind. December 14, first sleighing, pretty good but rough, duration doubtful.

1822.—Good sleighing reported early in February. 18th, snows all day. 21st, very rainy, high freshet. December 3, snows hard in the night; folks began to sleigh, but could not keep it up.

1823.—January 1, violent blowing storm; resumed sledding. 5th, violent storm of snow and hail. 19th, snow wastes fast; violent rain. February 3, more snow and sleighing. 12th, deep snow and very level. 14-15th, very great snowstorm; a man perished on the meadow. 24th, a violent snowstorm all day; roads terribly blocked up; all hands out to shovel. March 2, threatens to thaw. 3d, cold as Greenland and grows colder all day. 6th, violent rain and snow. 20th, snow; good sleighing.

1823-1829.—For these six years there is no record. It is during this interval that I am inclined to place a snowless term of years referred to in family reminiscences as the time when snowstorms were supposed to have permanently gone out of fashion and people talked of selling their sleighs.

1829.—November 14, snow, changing to rain. 16th, snows considerable; remarkably warm Christmas weather; twelve days all fine and warm.

1830.—January 25, term of snow. February 3, sleigh ride to Woodstock. 10th, great sleigh ride. 22d, sleighing done. March 23, snow. 26th, violent storm of snow all day. December 6, first winter snow. 19th, snow all day; good sleighing.

1831.—January 9, snow all day; no going to meeting. 15th, violent snow-storm, badly drifted; no service in church. 22d, snow all day. 23d, very cold and blowy; no sleighing nor getting about, only on foot. February 1, snow. 3d, another furious storm, some rain; sleighing continues to 25th; children taken to school on horseback. November 22, heavy snow; good sleighing continues till January 15. Coldest December ever known.

1832.—February 5, snow; sleighing till March 1. March 18, snows again. April very cold, with frequent snows to the 26th. Snow December 1 and 15.

1833.—January warm and pleasant. 25th, snow and sleighing. 31st, very hard snowstorm. February 6-7, harder storm. March 1, very severe snow-storm; could not see across the road; no such weather ever before seen in March; coldest of the season. 16th, very muddy. October 30, coldest weather ever known in October. November 4-6, winter like. 25-26th, snows considerable; some sleighing. December 17-18, moderate snows; sleighing.

1834.—January 1, great sleigh ride. 18th, snow gone. February 7, snow all day. April 1, snows violently. 11-17th, extremely warm. October 7, brilliant rainbow in the northwest just after sunrise. 26th, p. m., heavy shower. 31st, snowed several hours. December 13, snows. 14th, more violent snowing. 15th, the thermometer said to be 18½° below zero. 24th and 25th, more snow and sleighing. 29th and 30th, another violent snow-storm.

1835.—January 4, most remarkably cold; said to be 20° below zero. 14th, sleighing gone. February 6, snows. 15-16th, tedious snowstorm; sleighing