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 ormed 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, Oreg., 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, Oreg., 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-