*Missouri:* Louisiana, 31st, cisterns generally empty and creeks dried up; Glasgow, 31st, many springs stopped running. "The Missouri Weather Service" reports drought very severe in the north, northeast and central sections of the State, vegitation damaged.

*Rainfall during June, received too late to be used in June Review.—Arizona:* Whipple Barracks, Ft. McDowell and Ft. Mojave, none; Ft. Lowell, 0.20 inch.; Ft. Bowie, 1.50: Ft. Verde, 0.14; Ft. Apache, 0.53; Camp Thomas, 0.55. *California:* Benecia Barracks, Angel Island, Presidio, Oakland and Poway, none. Ft. Gaston, 0.12. *Colorado:* Ft. Lyons, 0.55; Ft. Collins, 0.86. *Dakota:* Ft. Stevenson, 4.10; Ft. Sisseton; 6.00; Ft. Sully, 2.35; Ft. Totten, 3.17. *Idaho:* Ft. Lapwai, 1.15; Lewiston, 1.07. *Montana:* Ft. Benton, 4.50; Ft. Shaw, 2.39; Ft. Ellis, 8.01; Ft. Keogh, 0.51; Ft. Logan, 0.49; Ft. Assinniboine, 2.44. *Oregon:* Ft. Stevens, 3.15; Ft. Klamath, 0.38. *Washington Territory:* Ft. Canby, 2.58; Ft. Townsend, 0.92; Dayton, 1.00; Neah Bay, 1.27; Bainbridge Island, 2.21.

## RELATIVE HUMIDITY.

The percentage of mean relative humidity for the month ranges as follows: New England, from 62 to 87; Middle Atlantic States, 59 to 88; South Atlantic States, 62 to 80; Eastern Gulf States, 65 to 73; Western Gulf States, 64 to 76; Ohio valley and Tennessee, 60 to 76; Lower Lake region, 61 to 71; Upper Lake region, 67 to 77; Upper Mississippi valley, 61 to 69; Missouri valley, 59 to 62; Red River of the North valley, 69 to 73; Eastern Rocky Mountain Slope, 54 to 73; Texas, 62 to 77; Middle Plateau, 17 to 33; California, 31 to 82; Oregon, 57 to 69. *High stations* report the following averages not corrected for altitude: Pike's Peak, 71; Mt. Washington, 82; Virginia City, 37; Denver, 47; Santa Fe, 40.

## WINDS.

The *prevailing directions of the wind* during July, 1880, is shown by arrows, flying with the wind, on chart No. II. To the east of the Rocky Mountains the predominating winds have been *southerly*, with an easterly trend over Texas, and a westerly one from the Eastern Gulf and Atlantic coasts to the Lake region. At the Rocky Mountain stations, over the Middle and Northern Plateau Districts and North Pacific region, the directions are *northwesterly*. On the summit of Mt. Washington, N. H., the direction is NW, and the continuous record of the wind velocity shows a total monthly movement of 17,943 miles; the maximum hourly velocity during the month was NW. 72 miles on the 10th, The same data for the summit of Pike's Peak is SW., 8,493 miles, and SW., 44 miles on the 10th. Maximum velocities exceeding 50 miles per hour were recorded at Umatilla (SW., 52, on the 18th); North Platte, (NW., 80, on the 3rd) and Chincoteague, (SW., 53, on the 1st.)

*Total Moremens of the Air.*—The following are the *largest* total movements in the variious districts: Mt. Washington, (summit of) 17,943 miles; Cape Lookout, 10,964; North Platte, 9,643; Rio Grande City, Tex., 9,594; San Francisco, 9,186; Cape Hatteras, 8,904; Chincoteague, Va., 8,768; Indianola, 8,554; Delaware Breakwater, 8,510; Pike's Peak, (summit of) 8,439; Umatilla, Or., 8,392; Portsmouth, N. C., 8,365; Wood's Holl, 7,892; Thatcher's Island, 7,822. The *smallest* are: Lynchburg, 1,364 miles; La Mesilla, N. M., 1,440; Augusta, 2,013; Silver City, N. M., 2,057; Visalia, Cal., 2,378; Nashville, 2,342; Des Moines, Iowa, 2,406; Morgantown, 2,543; Springfield, Mass., 2,777; Socorro, N. M., 2,872; Knoxville, 2,940; Cincinnati, 2,997.

*Local Storms.*—Jacksonburg, Ohio, 2nd, 4 p. m., small tornado passed two miles south of village in a direction from SW. to NE., width of track about 60 rods. "There were two inverted cones of vapor, one reaching from the clouds nearly to the earth and then joining the apex of the lower one extending upward from the ground. During its passage it was accompanied by a noise similar to the violent escape of steam. Sheaves of wheat and many other objects were drawn upwards and quickly lost sight of. The ground over which the storm passed appeared as if drenched by a flood." Cairo, Ill., 2nd, 1:35 p. m., very heavy wind-storm, lasting about 15 minutes, unroofing buildings and blowing down fences and trees. Chattanooga, Tenn., 2nd, severe wind-storm, blowing down trees and fences; 3rd, 6:25 to 6:47 p. m., severe NW. storm, during which the wind reached a velocity of 60 miles per hour for a period of 5 minutes, and averaged 48 miles for 15 minutes, unroofing buildings and uprooting trees, damage $1,500. Reports from Walker and Catoosa counties, in northern Georgia, show exceedingly violent storms on this date, and great loss to agricultural interests. Columbia, S. C., 5th, violent tornado, unroofing buildings, uprooting trees and destroying crops and fences. Clear Creek, Neb., 7th, 4:30 p. m., violent tornado approached from the southwest, passing about 3 miles north of station; 15 to 20 buildings were destroyed and great damage caused to crops. A large quantity of water was reported to have been taken out of Platte river as the storm crossed it. Hanover, N. H., 16th, afternoon severe tornado passed over southeastern part of village; "many buildings unroofed, several literally torn to pieces; trees all along the course of the storm were torn up by the roots and large branches were twisted off and carried long distances; course, SW. to NE. and path of destruction about two miles long and 200 rods wide;" Portsmouth, N. C., 28th, 5:30 p. m., whirlwind struck the beach on south side of inlet forming dense pillar of sand with rotary motion from right to left and moving from SE. to NW., a distance of three miles. It then suddenly receded southeastward to the sea where it disappeared. Diameter of whirl 30 yards.

The observer at Yreka, Cal., reports the following heavy local storms near that place:—July 5th, from 3:30 to 7 p. m., a violent storm passed from S. to N., about 4 miles wide, deluging the country with water; it then seemed to turn and pass to the S., and when about 4 miles east of this place the precipitation was so great that the water seemed to roll along, through, otherwise dry and nearly level gulches, to the depth of 4 or 5 feet, washing everything before it. The storm seemed to extend about 10 miles in length. Shasta river rose two feet in a few minutes; July 16th, heavy storm 15 miles northeast of this place, "cloud bust," moving rocks weighing over one thousand pounds; and on 17th, another heavy fall of water in the same place.

On the 18th a severe thunder-storm passed eastward from northeastern Oregon into Idaho, during the progress of which a destructive "cloud burst" occurred on west Butter (or Bitter) creek, near Pendleton, which will be found noted under *Floods*. The observers at the surrounding Signal Service stations report as follows: Umatilla, Or., "sand-storm set in from the southwest at 3:50 p. m., and for 15 minutes the wind velocity reached 52 miles per hour; rain fell from 3:58 to 4:25 p. m., and several flashes of lightning were observed." Dayton, Wash. Ty., light rain from 3:30 to 5 p. m., "a heavy thunder-storm passed over the mountains about 15 miles south of station at 5 p. m." Pomeroy, Wash. Ty., "sudden heavy wind from 5:30 to 6 p. m." Boise City, Idaho, "light rain from 4:10 to 4:15 p. m., accompanied by zigzag lightning and loud thunder."

*Waterspouts.*—Key West, 12th, at 6 p. m., a waterspout formed to the southeast of station, in connection with a very heavy thunder-storm then prevailing. Kittyhawk, N. C., 18th, at 8:30 a. m., a waterspout formed over Albemarle Sound, four miles from station. It remained stationary until 8:55 a. m., and no rotary motion could be discerned. During this time two smaller ones partly formed near to the main one, reaching nearly to the clouds, and, after swaying backwards and forwards for a short time, finally disappeared. Portsmouth, N. C., 28th, at 5:15 p. m., three waterspouts formed in Ocracoke Inlet, making a complete column of spray, extending from sea to cloud, and moving slowly from SW. to NE. New Bedford, Mass., 29th, 5 p. m., a waterspout formed in the cove between Sconticut Neck and Mattapoisett Neck. Was at first very regular and straight, and connected with the western edge of a cloud, which was the scene of a thunder shower of moderate extent and force. Diameter 30 to 40 feet, and altitude about 3,000 feet, composed of spray which strongly contrasted with the dark cloud. It moved slowly to the southeast, and the portion midway from cloud to bay advanced faster than either the bottom or top, causing the column to bend forward and to drag the lower portion. It disappeared in about 20 minutes, being apparently drawn upward into the clouds.

*Sand-storms.*—Visalia, Cal., 25th; Burkes, Ariz., 7th, 10th, 15th, 17th, 24th.

## VERIFICATIONS.

*Indications.*—The detailed comparison of the tri-daily indications for July, with the telegraphic reports for the succeeding twenty-four hours, shows the general percentage of verifications to be 87.2 per cent. The percentages for the four elements are: Weather, 87.0; Direction of the Wind, 77.8; Temperature, 87.3; Barometer, 88.6 per cent. By geographical districts they are: for New England, 81.8; Middle States, 82.6; South Atlantic States, 90.2; Eastern Gulf States, 88.1; Western Gulf States, 91.8; Lower Lake region, 84.5; Upper Lake region, 81.2; Tennessee and the Ohio valley, 89.4; Upper Mississippi valley, 83.0; Lower Missouri valley, 76.8; Northern Pacific coast region, 88.4; Central Pacific coast region, 100.0; Southern Pacific coast region, 96.0. There were 24 omissions to predict out of 3,713, or 0.65 per cent. Of the 3,689 predictions that have been made, 27, or 0.74 per cent. are considered to have entirely failed; 138, or 3.75 per cent. were one-fourth verified; 445, or 12.06 per cent. were one-half verified; 435, or 11.79 per cent. were three-fourths verified; 2,644, or 71.67 per cent., were fully verified, so far as can be ascertained from the tri-daily reports.

*Cautionary Signals*—68 Cautionary Signals were displayed during the month, of which 56, or 82.4 per cent., were justified by winds of 25 miles per hour or over at, or within a radius of 100 miles of the station. No Off-shore Signals were displayed. The above does not include signals ordered for 49 display stations, where the display is only estimated.

## NAVIGATION.

In the table on the right-hand side of chart No. III are given the highest and lowest stages of water in the various rivers, as recorded on the Signal Service river gauges, during July, 1880. From an examination of this table it will be seen that the highest waters were generally recorded during the first half of the month, while in a majority of cases they occurred during the first few days. The lowest readings, with one or two exceptions, occurred during the last days of the month. The only cases in which the water exceeded the danger-point on gauge were at Omaha, Davenport, Keokuk and Portland, Or. At Davenport and Keokuk the highest water occurred on the 1st; this freshet was fully noted in the June *Review*. At Omaha the highest water occurred on the 9th, and submerged the railroad tracks in the vicinity. At Portland, Or., the highest water in the Willamette river occurred on the 1st and 2nd, and the damage resulting therefrom will be found noted under the head of "Floods."