

imum velocities: Escanaba and Milwaukee, N. 27; Sandusky, W. 30; Rochester, W. 26; Thatcher's Island, SE. 34; Cape May, N. 25 and Kittyhawk, NW. 36.

No. IX.—As the preceding area moved over the northern portion of the country, southerly winds and high temperatures prevailed over the Southern States; as the low pressures moved eastward, the wind veered to cooler northerly in advance of high barometer area No. V, and a general rain set in, on the 20th, over the Southwest, which during the 21st gradually extended eastward to Tennessee, the Eastern Gulf and South Atlantic States. At 11 p. m. of the latter date a distinct circulation of the winds was observable in East Tennessee, Georgia and the Carolinas. On the morning of the 22nd the lowest pressure 29.93 or 0.08 below normal was observed at Charlotte, N. C., and during the day this area moved northeastwards off the coast as a somewhat severe storm. Cautionary Signals were ordered up along the North Carolina coast at noon, and along the New Jersey coast during the afternoon of the 22nd. They were all justified by the following maximum velocities: Cape Lookout, SW. 37; Cape Hatteras, SE. 33; Kittyhawk, SW. 40; Chincoteague, SW. 50; Delaware Breakwater, NW. 37; Cape May, NE. 28; Barnegat and Sandy Hook, N'y, 30.

No. X.—moved eastward over the British Possessions and Canada during the 25th and 26th and on the 27th covered New Brunswick and New England. The path of its centre was located too far north to allow it to appear on chart No. I. This area produced rainy and threatening weather from the Lake region to the Atlantic coast and on the night of the 25th, brisk southerly winds prevailed for a short time over the western end of Lake Erie and on Lake Huron. On the afternoon of the 26th Cautionary Signals were ordered along the Atlantic coast from Delaware Breakwater to Barnegat, N. J., and from Wood's Holl, Mass., to Portland, Me., which were justified by the following maximum velocities: Philadelphia, SW. 26 and Thatcher's Island, Mass., S. 34.

The two succeeding areas of low barometer, the one covering the extreme Southwest, namely, western Texas and the Rio Grande from the 26th to the 30th, the other the Northwest from the 28th to 30th, were apparently subsidiary to a large area of low pressure which covered portions of the Rocky Mountain region from the 25th to the end of the month. The tracks of these areas are not charted.

No. XI.—From the 26th to the end of the month the barometer over southern Texas and the Rio Grande valley remained slightly below the normal, while the highest pressures during these days were generally to be found over the Lake region. With this distribution of pressure easterly winds predominated over the Southwest and valley of the Rio Grande and cloudy or rainy weather, with heavy local rains, generally prevailed.

No. XII.—This area of low barometer may have originated in southern California on the 26th and have subsequently moved in a NE., direction over the Rocky Mountains to the Northwest, but its characteristics are not sufficiently well marked to allow a track of its path to be charted. On the evening of the 24th, the barometer at Visalia, Cal., fell to 29.64 or 0.12 below the normal, followed on the 25th by a sand storm from the NW. On the 25th and 26th, the lowest barometer, although only slightly below the normal, was transferred to the Western Plateau and Rocky Mountain Region. On the 25th, the observer at Winnemucca, Nev., reported "thunder storms on all sides during the day." During the 26th, 27th, 28th, and 29th, heavy storms of hail, sleet and rain occurred in the Rocky Mountains. On the 28th the lowest barometer was transferred to the Missouri valley, and on the 29th and 30th to the Red River of the North valley, and by the afternoon of the 31st the area of local rains and thunder showers had extended eastward to Illinois and Michigan. In Missouri the rains were quite heavy. Cautionary Signals were ordered for Duluth on the afternoon of the 28th and remained displayed until morning of the 30th, but were not justified.

## INTERNATIONAL METEOROLOGY.

Three International charts, Nos. IV, V and VI, accompany the present Review. They are for the months of *June*, 1880 and *November*, 1878.

On chart No. IV will be found the probable course of the principal low barometer areas over the North Atlantic Ocean during the month of *June* 1880. As during the two preceding months (April and May, 1880) the Northern Atlantic during the month of June continued remarkably free from severe storms. The month opened with areas of low barometer, central over the Gulf of St. Lawrence (No. I chart IV,) near 38 N. 35 W. (No. II), and over the Bay of Biscay (No. III). Elsewhere over the region under consideration (namely the Atlantic Ocean, between the parallels of 35 and 55 N. and the adjacent coasts of America and Europe) high barometer generally prevailed, the regions of maximum pressure being to the south of the Banks of Newfoundland and to the north of Scotland. The low area on June 1st over mid-ocean is based upon the report of ship *British Commodore* and was probably of short duration. This vessel, in 40 N. 39 W. on June 1st reported barometer, 29.68 or 753.8, wind N. force 9, with rain-squalls. On the 2nd the area was apparently filling up and on the 3rd, so far as reports at present to hand indicate, had disappeared. In the mean time the low over the Gulf of St. Lawrence had passed to the north of Newfoundland; the one over the Bay of Biscay had moved toward the Netherlands, while a new area (No. IV on chart IV,) which apparently developed over North Carolina during the 1st, had moved northeastward and was on the morning of the 3rd central between Nova Scotia and the Bermudas—ship *Janna* in

42 N. 63 W. reported barometer 29.89 or 759.2, wind NE. by E. force 8, heavy rain. During the 4th, 5th and 6th, it moved very slowly eastward to about 50 W. while thence eastward to the coast of Europe the Atlantic was covered by an area of very high pressures. On the morning of the latter date (6th) S. S. *Scythia*, in 42° N., 59° W., reported barometer 29.75 or 755.6, wind W. by N., force 4, while high barometers, from 30.45 or 773.4 to 30.60 or 777.2, were reported by several vessels between 40° and 50° N., and 20° and 40° W. Near the latter meridian high southeast winds were experienced. On the 7th the depression was apparently filling up, while the area of high barometer was moving slowly southward and diminishing in pressure. During the 8th the fall became more rapid over the eastern portion of the ocean and by the morning of the 9th a well defined area of low barometer (No. V) existed to the southwest of Ireland. This area having passed eastward the pressure, on the 10th, over the ocean remained near or slightly above the normal. On the night of the 10th, however, a rapid fall again set in over the eastern portion, and an area of quite low barometer (No. VI) moved northward during the 11th, 12th and 13th towards Iceland. S. S. *Britannic*, on the 11th, in 48° N., 29° W., reported barometer 29.74 or 755.4, wind N., force 4. During the 12th, 13th, 14th and 15th the area of low barometer already partly described in the June REVIEW, as low area No. V, moved very slowly eastward from the Gulf of St. Lawrence to the Banks of Newfoundland, the lowest barometer occurring at St. Johns, Newfoundland, at 9 p. m. of the latter date. The lowest barometer for the month at the Bermudas occurred on the 14th, the wind at Gibb's Hill Light continuing from WSW., force 5, from the 13th to the 16th, accompanied by thick, cloudy or hazy weather. On the 13th, S. S. *Pennsylvania*, in 40° N., 53° W., reported barometer 29.59 or 751.5, wind SW. force 6, rain; S. S. *Adriatic*, in 41° N., 53° W., 29.41 or 747.0, SW. force 7, cloudy, rough SW. sea-swell; and S. S. *Hibernian*, in 51° N., 37° W., 29.82 or 757.4, SE. by E. force 7, rain, moderate SE. swell. On the 14th, S. S. *Adriatic*, in 43° N., 46° W., 29.55 or 750.5, SSW. force 3. On the 15th, strong gales from the SSW. were experienced in advance of this area in about 40 W., which, with the exception of the occasional gales attending low area No. VI, on the 11th and 12th, may be considered as the first continued gales of the month. From the 16th to the 21st, this area moved slowly eastward across the Atlantic ocean, though not as a very severe storm. The following vessels report low pressures, and serve to indicate the position of the storm-centre on the different days:—S. S. *Pennsylvania*, 17th, 48° N., 27° W., 29.78 or 756.4, SSW. force 5, rain; 18th, 49° N., 21° W., 29.43 or 747.5, SE. by S. force 6, rain, heavy SE. by S. swell. S. S. *Celtic*, 19th, 51° N., 15° W., 29.57 or 751.0, ESE. force 3, fair; 20th, 50° N., 24° W., 29.56 or 750.8, NE. force 4, fair. S. S. *Braunschweig*, 20th, 49° N., 18° W., 29.47 or 748.5, S. force 2, fair. S. S. *Indiana*, 21st, 51° N., 16° W., 29.60 or 751.8, SW. force 2, fair. During the 22nd, and following days, it moved north-eastwards over northern Europe, unaccompanied by high winds, except for a short time along the coasts of Norway and Sweden. Over the western portion of the Atlantic, during the 19th, 20th and 21st, northerly winds prevailed, with occasional heavy rain squalls. On the 22nd, the area of low barometer, described in the June Review as low area No. VII., was central over Nova Scotia. During the 23rd, 24th and 25th, this area moved eastward as shown on the present chart No. IV., in the track designated as No. VIII., and was encountered during these days by the following vessels:—S. S. *Nederland*, 23rd, 41° N., 59° W., 29.51 or 749.5, WSW. force 4, followed on the 24th by NW., 6, squally, high NW. sea-swell. S. S. *Celtic*, 24th, 43° N., 53° W., 29.48 or 748.8, NW. force 3, fair. S. S. *Braunschweig*, 25th, 43° N., 48° W., 29.56 or 750.8, SSW. force 3, fair. S. S. *Indiana*, 25th, 43° N., 42° W., 29.68 or 753.8, WSW. force 9, hard rain during the preceding 24 hours, high WSW. sea-swell; 26th, 41° N., 45° W., 29.80 or 756.9, WNW. force 9, hard rain during preceding 24 hours, high Wly swell. By morning of the 26th, the centre had moved towards the NE., and, continuing in this direction, it passed to the north of the British Isles on the 28th, producing high southwesterly winds in the north of Ireland and Scotland. On the 27th it was encountered by the S. S. *Hibernian*, in 51° N., 34° W., 29.47 or 748.5, NW. by W. force 2, fair, long SW. swell, and by the S. S. *Britannic*, in 51° N., 24° W., 29.76 or 755.9, W. force 4, cloudy and drizzling. On the 23rd, an area of low barometer, No. IX., developed over the Eastern Atlantic—S. S. *Scythia*, 49° N., 22° W., 29.39 or 746.5, N. force 6, gloomy weather, with heavy showers—which from the 25th to the 28th moved eastward over southern Europe. On the 27th and 28th the area, already described in the June Review, as low area No. XI., and appearing on the present chart No. IV. as area No. X., moved slowly eastward, with its centre to the south of Newfoundland, but on the 29th it had apparently dissipated. Thence to the end of June, light winds and moderate pressures were reported.

Chart No. V shows, by isobaric and isothermal lines, the mean pressure and temperature, and, by small arrows, the prevailing direction of the wind, at 7:35 a. m., Washington mean time, over the Northern and portions of the Southern Hemispheres, for the month of November, 1878. The barometer observations have been corrected for temperature and reduced to sea-level. At stations lying outside the area included within the lines, and for those in the Southern Hemisphere, the means are shown by figures indicating the temperature in degrees, Fahrenheit, and the pressure in English inches. A comparison of the *distribution of atmospheric pressure* for the month of November, 1878, with that for the preceding month of October, shows the most marked changes to have occurred over the northeastern portion of the North Atlantic, where a very large increase of pressure is found, and in the Behrings Sea region, where there a corresponding decrease. The increase over Asia has not been as decided as during October, and, so far as the observations show, is found to be greatest over

the Upper Yenisei valley and the Punjab. A marked increase is also observable over the interior of the North American continent, while over the whole of central Europe a decided decrease has occurred. The *increase* over the various regions above referred to was as follows:—Over the North Atlantic, between 40° and 50° N., from 0.15 to 0.25 of an inch; between 50° and 60° N., from 0.20 in the ten degree square included by the meridians of 40° and 50° W. to 0.50 in the square included by the meridians of 20° and 30° W. Over the British Isles it was about 0.20 and at Stykkisholm, Iceland, 0.35. Over the southeastern part of Europe, about the Caspian sea region, it was 0.08. Over Asia it ranged from 0.10 in the Black sea and Bengal regions and at the mouth of the Amoor to 0.15 on the coast of China, 0.20 in the Punjab and 0.25 in the upper Yenisei valley. Over the interior of the North American continent it amounted to about 0.15 in Manitoba. The *decrease* over the Behring sea region amounted to 0.55 at St. Paul's Island, 0.39 at St. Michaels; over the Eastern Atlantic to 0.10 near the banks of Newfoundland and 0.05 at Godthaab, Greenland; and over central Europe to about 0.10. The area of absolute highest barometer (above 30.30 or 769.6, as reduced to sea-level) over the Northern Hemisphere, for the month, is found over the Asiatic continent, stretching in a southeasterly direction from the Sea of Aral, Barnaul and Yeniseisk to the coast of China, while smaller areas of over 30.10 or 764.5 are found over the Atlantic from 45° to 60° N, and 20° to 35° W, and over the southeastern and extreme western parts of the United States. The areas of absolute lowest barometer are found over Behring's sea, where the pressure averages about 29.25 or 743.0 and over the North sea, where it is about 29.65 or 753.1. The general direction of the *winds* during November, 1878, accords well with what might be expected from this distribution of pressure. Over the United States, except in the Rio Grande and Red River of the North valleys, where they were southerly; over the Atlantic, west of the 50th and east of the 25th meridian; over the extreme western portions of Europe; over Hindostan and along the eastern coast of Asia extending over Japan and Behring's sea, the directions were *northerly* or *westerly*; over the Atlantic between the 25th and 50th meridians, and over nearly the whole of Europe and northwestern Asia, *southerly*. The most notable winds of the month were probably the northerly winds over Western Europe and Hindostan, giving to the former region a temperature below the average, and to the latter a complete cessation (about the 12th of the month) to the monsoon rains.

On chart No. VI are traced the paths of twenty-eight of the principal storm-areas of the Northern Hemisphere for the month of November, 1878. Only one of them, (No. XXV, the track of which is doubtful) presented the characteristics of a tropical cyclone. Perhaps the two most striking peculiarities of the storms, during this month, were (1) the recurving of the paths of several of them towards the west, as most plainly shown by areas Nos. I, VI, XI and XX, and (2) the heavy precipitation attending the various storms, during their northeasterly movement over the eastern portion of the United States and Central Europe.

## TEMPERATURE OF THE AIR.

The mean temperature of the air for July, 1880, is shown by isotherms on chart No. II. The table of comparative temperatures given on the right hand side of this chart shows the temperature during July to have been *below the normal* over the whole of the United States, except along the Atlantic coast and at San Francisco. This, in connection with the average high mean temperatures recorded for the majority of districts east of the Rocky Mountains since the month of October, 1879, is very interesting.

*Maximum Temperatures.*—*Maine:* 95° at \*Orono, 94° at Portland. *New Hampshire:* 100° at \*Dunbarton, (62° on summit of Mt. Washington). *Vermont:* 99° at \*Charlotte, 89° at Burlington. *Massachusetts:* 101° at Boston, 100° at \*Somerset. *Rhode Island:* 88° at Newport. *Connecticut:* 97° at \*Mystic, 88° at New London. *New York:* 96° at \*Ardenia, 91° New York City, 85° at Buffalo. *New Jersey:* 99° at Atlantic City and \*Moorestown. *Pennsylvania:* 96° at \*Chambersburg, \*Egypt and \*Wellsboro, 95° at Philadelphia. *Delaware:* 97° at \*Dover. *Maryland:* 99° at Baltimore. *District of Columbia:* 98° at Washington. *Virginia:* 102° at Norfolk. *West Virginia:* 89° at Morgantown. *North Carolina:* 104° at \*Weldon, 98° at Wilmington. *South Carolina:* 97° at Charleston. *Georgia:* 100° at \*Forsyth, 96° at Augusta. *Florida:* 100° at \*Houston, 97° at Key West and Jacksonville. *Alabama:* 100° at Montgomery. *Mississippi:* 97° at Vicksburg. *Louisiana:* 101° at Point Pleasant, 96° at Shreveport. *Texas:* 108° at Eagle Pass, 103° at Laredo, Rio Grande and Edinburg, 102° at Stockton, 101° at Denison, Pilot Point, Concho and Castroville, 100° at Griffin, McKavett and Decatur. *Ohio:* 98° at \*Jacksonburg, 97° at Columbus. *Kentucky:* 95° at Louisville. *Tennessee:* 95° at Memphis, Nashville and Chattanooga. *Arkansas:* 96° at \*Mt. Ida, 95° at Little Rock. *Michigan:* 95° at \*Niles, 93° at Detroit. *Indiana:* 97° at \*Laconia, 93° at Indianapolis. *Illinois:* 100° at \*Louisville, 96° at Springfield. *Missouri:* 98° at \*Corning, 95° at St. Louis. *Kansas:* 103° at \*Ft. Wallace and 95° at Leavenworth. *Wisconsin:* 95° at Ea Crosse. *Iowa:* 98° at Keokuk. *Nebraska:* 98° at \*Genoa, 97° at North Platte and Omaha. *Indian Territory:* 100° at Ft. Gibson. *Minnesota:* 90° at \*Minneapolis. *Dakota:* 98° at Ft. Keogh. *Colorado:* 95° at Denver. *New Mexico:* 107° at La Mesilla. *Wyoming:* 93° at Cheyenne. *Utah:* 95° at Salt Lake City. *Nevada:* 96° at Winnemucca. *Arizona:* 110° at Yuma and Burkes. *Idaho:* 98° at Boise City.