

ing in an easterly course it passed over Lake Superior during the 23rd, and was central the morning of the 24th in Ontario, whence by a southeasterly path it passed off the Maine coast at midnight of the latter date. No signals were displayed during its passage. The area was one of but little energy; high winds (from 25 to 27 miles) occurred only at three widely separated stations in the Lake region.

No. X.—During the 23rd the pressure steadily decreased on the North Pacific coast. On the morning of the 24th the barometer at Portland, Or., was 0.23 below the normal. The pressure remained slightly below the normal until the 30th. During the prevalence of this area no rain fell on the Pacific coast.

No. XI.—Apparently central at midnight of the 23rd in Manitoba the centre of this area moved south-eastward and remained over the Lake Superior region during the 24th. Central the morning of the 25th in northern Michigan, it reached the valley of the St. Lawrence by midnight, and passing down that valley it disappeared over the Gulf of St. Lawrence on the 26th. No signals were displayed during the passage of this area. But four cases of brisk winds, at widely separated stations, were reported during its passage.

No. XII.—This area, central in Manitoba the morning of the 26th, reached eastern Minnesota at midnight. Moving slowly in an easterly course, it was central over the Upper Lake region until the 28th, on the afternoon of which day it reached the province of Ontario and thence passed down the valley of the St. Lawrence. Brisk SW. winds, ranging from 26 to 30 miles, were generally reported from the Lower Lake region on the 28th. On the Atlantic coast Cautionary Signals were ordered on the afternoon of the 28th from Portland, Me., to Chincoteague, Va. The signals were lowered the next morning, having been justified by velocities ranging from SW. 26 at Barnegat, to N. 29 at Cape May, and SW. 31 at Thatcher's Island.

No. XIII.—From midnight of the 29th the pressure fell from Kansas to Texas until midnight of the 30th, at which time the barometer at Dodge City was 0.19 below the normal.

## INTERNATIONAL METEOROLOGY.

Three International Charts, Nos. IV, V and VI, accompany the present REVIEW. They are for the months of *May*, 1880, and *October*, 1878.

On Chart No. IV will be found the probable course of the principal low pressure areas over the North Atlantic Ocean during the month of May, 1880. As during the preceding month (*April*, 1880) the weather over the North Atlantic has continued remarkably fine and free from severe or protracted storms. The month opened with a belt of high pressures extending over Europe, from the Black Sea to the British Isles and France, and thence over the Atlantic to Newfoundland and the Bermudas: on the 1st, over the western portion of the Atlantic, barometric readings above 30.40 in. or 772.1 mm., were reported over a region extending from 50° N. 25° W. to 35° N. 53° W. Ship *Hippolyta*, in 42° N. 45° W., on the southeastern margin of this ridge of high pressures, reported, during the night of April 30th and May 1st, a very heavy N. to E. gale, with high sweeping sea: from 2 to 3 a. m. the gale was furious, force 11, but moderated towards day-break. From the 1st to the 11th this area of maximum pressures appears to have moved northeastward, with more or less regularity, and on the latter date to have covered northwestern Europe and the Atlantic for some distance to the westward, over which latter region high pressures continued until the 17th, and caused the continued northeasterly winds which prevailed during this period (10th to 17th) over the Eastern Atlantic near the parallel of 50° N. The first protracted storm of the month followed the track shown on the present chart as area No. I, and was fully described as low area No. I in the May REVIEW. On the 7th it passed eastward over Newfoundland, and on the 8th was encountered by S. S. *Nederland* in 43° N. 42° W., barometer 29.86 or 758.4, temperature 62° Fahr., wind SSW., force 4, high SSW. sea. On the 9th it was followed over this region by a return to high pressure and a rapid fall in temperature; the *Nederland*, in 41° N. 47° W., reported barometer 30.19 or 766.8, temperature 46° Fahr., NNW. 2. It is probable that this low area remained during the 9th and 10th near 50° N. 40° W., and is the same as that to be described as area No. IV, but reports at present to hand do not warrant the joining of the two tracks. The second storm (No. II, Chart IV,) apparently developed off the coast of Portugal on the 4th, and subsequently moved eastward over the Mediterranean. On the 8th a small depression (No. III, Chart IV,) was central to the southwest of Ireland, which subsequently moved southeastward over the Bay of Biscay and southern France. Ship *Hippolyta* reported, "on the 8th, in 49° N. 15° W., 8 p. m., strong NE. gale, force 11, and high cross-sea; midnight (8th-9th) gale moderating." No. IV appeared over mid-ocean on the 11th. On the 12th and 13th, U. S. S. *Saratoga*, near the Azores, recorded the following very low pressures for this region: 12th, 39° N. 24° W., 29.43 or 747.5, calm, heavy rain-squalls; 13th, 39° N. 20° W., 29.49 or 749.0, WSW. force 7, fair. On the 14th, the easterly winds on the northern margin of this area increased in force and S. S. *Indiana*, in 51° N. 15° W., recorded ESE. 8, barometer 29.89 or 759.2. On the 16th, the barometer at the Madeiras (Funchal) read 29.61 or 752.0, and from the 17th to the 21st this area appeared to spread eastward over the Mediterranean to the Black Sea region. No. V is a continuation of low area No. IV, already described in the May REVIEW; on the 14th, S. S. *Scythia*, in 41° N. 59° W., reported barometer 29.67 or 753.6, wind NNW. 4, light rain, and on the 16th, in 44° N. 45° W., 29.35 or 745.4, WSW. 9, heavy rain, heavy swell from WSW. High winds, occasionally described as of hurricane force, were experienced over the western portion of the Atlantic during the 15th and 16th, but by the 17th only moderate gales. During the 18th and 19th there was a gradual return to high pressures, and very low temperatures were recorded; thus, on board the S. S. *Hibernian*, the thermometer fell from 40° F. on the 17th, in 49° N. 39° W., to

30° F. on the 19th in 47° N. 51° W., and on board the S. S. *Celtic*, from 54° F. on the 16th in 46° N. 40° W. to 33° F. on the 18th in 42° N. 52° W. During the 17th the area of high pressures over northwestern Europe and adjacent portions of the Atlantic Ocean commenced to move in rear of low area No. IV. Until the 23rd this movement was southerly over the eastern Atlantic Ocean towards the Spanish Peninsula, after which high pressures spread eastward over southern Europe. Low areas Nos. VI and VII moved eastward to the north of the British Isles on the 23rd and 26th, respectively, the former being followed by westerly gales to the west of Ireland—S. S. *Britannic* on the 23rd, 51° N. 23° W., reported barometer 29.85 or 758.1, wind W. force 7, rain, heavy WNW. swell. From the 26th to the 29th, low pressures also prevailed in the region of Newfoundland, but as far as present reports show were not accompanied by high winds.

The following account of a severe storm off Buenos Ayres is reported by U. S. S. *Marion*: "February 14th, 1880, 35° 56' S. 53° 28' W., 4 p. m., barometer 29.77 falling, NE. moderate breeze, threatening. 15th, 36° 23' S. 54° 08' W., wind increasing in heavy rain-squalls, force 3 to 6 from NE. until 3 a. m., barometer 29.54, when the wind hauled to N. and W.; noon, barometer 29.35, wind NW., 6 to 7; 2 p. m., barometer 29.26, lowest reading, wind W. by N., 5 to 8; 4 p. m., barometer 29.32, wind SW. by S., 7 to 9; hove to in 37° S. 54° 16' W.; 4 to 8 p. m., wind SW. by S., force 7 to 10; 8 p. m., barometer 29.41, wind SW., force 10 to 11; ship laboring in heavy, rough, confused sea; 9 p. m. to 2 a. m., of 16th, barometer rising from 29.40 to 29.62, wind WSW., 8 to 10. 16th, 2 a. m. to 1 p. m., wind SW. by W., subsiding in squalls; 1 p. m., barometer 29.91, wind SW., force 6, clear sky and rough sea."

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 October, 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. Upon comparing the *distribution of atmospheric pressure* for the month (October, 1878,) at present under consideration, with that for the preceding month (September, 1878,) the most marked changes are found to be a continued and large increase in pressure over the whole of Asia, including Japan, and the eastern and extreme southern portions of Europe, and a remarkable decrease over western Europe, eastern half of North America (except near the Gulf of Mexico) and over almost the whole of the North Atlantic. A decided increase, however, is found over Sweden and Norway (except extreme southern portions), Iceland and southern Greenland—the region of maximum decrease during September. The *increase* of pressure over the various regions referred to above, amounts to 0.15 inch at Godthaab, 0.17 at Stykkisholm, about 0.10 in northern portions of Norway and Sweden, northern and western Russia, and from the Black Sea to Tunis, while over southeastern Russia and thence eastward to Japan it is about 0.25. It amounts to 0.32 at Barnaul, 0.28 at Zi-Ka-Wei, 0.26 at Nagasaki and 0.20 at Tokio. In Hindostan it ranges from 0.08 at Belgaum and Chittagong to 0.11 at Sibsigar and 0.18 at Lahore, and at Nikolaievsk on the Amoor the increase amounts to 0.05. The *decrease* over the Atlantic and neighboring land areas amounts to about 0.12 for the region of the Great American Lakes to Newfoundland, gradually increasing thence eastward until it reaches 0.30 over the eastern Atlantic from 45° to 55° N. and 10° to 20° W.; over the British Isles it is 0.31 at Valentia, 0.19 at Great Yarmouth and 0.18 at Sandwick; thence northward, eastward and southward, it gradually, but rapidly, falls to 0.11 at Thorshavn and 0.06 at Copenhagen and Madrid. The most important change in the distribution of pressure is thus seen to be a large decrease (0.30 inch) over the northeastern Atlantic Ocean (*i. e.* to the west of France and Ireland) and a corresponding increase over central Asia. The general direction of the *winds* during October, 1878, at 7:35 a. m., Washington mean time, may be summarized as follows: From the Rocky Mountains to Hudson's Bay, along the immediate North American coast, from Chesapeake Bay to Cape Cod, and over the centre of the Atlantic, *northwesterly*; from Texas and the interior of the Gulf States to the Lakes and St. Lawrence valley, and from the Azores and Madeiras to the Faroë Islands and thence over nearly the whole of Europe and northern Asia, *southwesterly*; in Iceland, southern Greenland, Newfoundland and thence to the West Indies and Florida, *northeasterly*. In Hindostan, calms predominated, except the continued westerly monsoon on the Bombay coast, (rainfall at Bomba 4.92 and Belgaum 6.64 inches,) and over the Gulf of Bengal. Along the Japan and China coasts the northeast monsoon was fully established, the direction being northerly at Tokio, northeast at Shanghai and east at Hong Kong. Over the regions of southerly winds the mean *temperature* of the month was generally above the normal; thus, in the St. Lawrence valley, the temperature was 5° above the mean; in Ireland and southern England 3° to 3°.5 above; and in Germany, at Freiburg, and in eastern Russia, at Penza, nearly 6° above.

On chart No. VI are traced the paths of twenty-eight of the principal storm-areas which traversed the Northern Hemisphere during the month of October, 1878. Nine of them, namely Nos. II, IV, VII, VIII, XI, XII, XV, XVIII and XXVI, originated to the south of the 30th parallel, while the rest probably developed over the temperate zone and moved in a general easterly course. The most violent storms of the month, in connection with these areas, may be briefly summarized as follows. As area No. I moved slowly eastward, from the 1st to the 7th, it was attended by hurricane winds over the Atlantic, between the parallels of 40° and 50° N. No. II, the continuation of No. XXI of the September, 1878, chart, moved from the region of the Bahamas on the 1st, northeastwards between the Bermudas and Newfoundland to the British Isles by the 10th, as a severe tropical cyclone; during the 8th, however, the region of low pressure

increased in area and the attending winds became somewhat less violent. No. III caused the following high velocities in the Behring's Sea region: St. Michael's, 6th, E. 52 miles; St. Paul's Island, W. 45, and Unalaska Island, terrific SW. gale. No. IV, a typhoon moving westward from the Philippine Islands to Hainan. U. S. Flagship *Monocacy*, stationed at Hong Kong, reported in connection with this storm as follows: "On the 8th, a very heavy gale was experienced in the vicinity of Hong Kong, evidently due to a moderate typhoon, the centre of which was passing in a southwesterly direction along the coast of China, leaving Hong Kong on its right; incoming vessels reported very heavy gales south of Formosa on the 7th and off Hainan on the 9th; numerous vessels dismasted and several wrecked." Much damage resulted at Hong Kong, Canton and Macao. No. V was attended by a destructive tornado in Iowa and by damaging winds in the Lake region and St. Lawrence valley during the 8th and 9th, and by heavy gales over the Atlantic, between 40° and 60° N., from the 10th to 13th. No. VII moved rapidly from the Gulf of Mexico on the 10th and was accompanied by hurricane winds from the 11th to the 14th between the American coast and the Bermudas: at Cape Lookout the anemometer measured a velocity of 72 miles per hour, from the NE., on the 11th, and on the evening of the 12th a severe thunderstorm passed over the Bermudas, during which 2.62 inches of rain fell in two hours. Off the New England and Nova Scotia coasts the storm was exceedingly severe and numerous disasters to shipping resulted. Nos. XI and XII, hurricanes over the Atlantic. No. XVIII, in its passage from Cuba to New England, is one of the severest storms on record: at Havana the wind increased to 35 miles, with violent gusts: at Key West to 46 miles; at Cape Lookout to 100 miles: at Philadelphia and Barnegat to 72 miles: on summit of Mount Washington to 120 miles, and at Portland, Me., (anemometer cup blown away,) estimated, 70 miles. An immense amount of damage to property resulted from this storm. No. XXI, with its subsidiary centres of depression, was attended by severe winds over northwestern Europe from the 22nd to the 30th. No. XXV was attended by very severe winds over Behring's Sea: St. Paul's Island, W. 60 miles, and St. Michael's, E. 37. No. XXVI was attended by very low pressures over an extensive area, reaching from Japan to Behring's Sea, during which the barometer fell to 29.62 at Tokio and 29.08 at Nikolaievsk on the Amoor on Oct. 29th; to 28.93 at St. Paul's Island on the 31st, and to 29.08 at St. Michael's on Nov. 2nd.

## TEMPERATURE OF THE AIR.

The mean temperatures for June, 1880, are shown by isotherms on Chart No. II. The table of average temperatures on that chart shows that east of the Rocky Mountains an excess of temperature generally prevailed, while to the westward deficiencies occurred. The greatest excess prevailed in the Upper Lake region (2.°8 above the normal) and thence eastward to the Atlantic ocean. Deficiencies were reported from the entire Pacific slope and the Plateau districts, reaching 2.°9 in the northern Pacific coast region, and 3.°8 in the northern Plateau district.

*Maximum and Minimum Temperatures.*—Upon charting the maximum temperatures for June, 1880, great irregularities appear. In general they range from 85° to 95°. Temperatures at or above 100° have been reported from nearly every station in Arizona and the Rio Grande valley. Unusually high temperatures were reported as follows: 100° at Jacksonville, Charleston, S. C., Savannah, Wilmington, Ft. Elliott, Tex., and Ft. Keogh, Montana; 101° at Norfolk; 102° Dodge City, 103° at Umatilla—the only station on the Pacific slope exceeding 99°. The highest temperature reported was 117° at Phoenix, Arizona. The following stations reported *maxima* under 85°: Escanaba, 84°; Wood's Holl and Los Angeles, 83°; San Francisco, 82°; Milwaukee, 81°; Buffalo, 80°; Eastport, 79° and San Diego, 73°; Mt. Washington, 63; Pike's Peak, 58°. Minimum temperatures above 70° were reported from Key West (73°) and the lower Rio Grande valley. The following stations report temperatures under 37°: Apache, Ariz., and Olympia, 36°; Pembina, 35°; Pioche, 34°; Santa Fé and Deadwood, 33°; Prescott, Ariz., 32°; Campo, Cal., and Helena, Mont., 31°; Virginia City, M. T., 30°; Winnemucca, 29°; Mt. Washington, 28 and Pike's Peak, 8°. The following list shows the maximum and minimum temperatures in each State and Territory:

*Maximum Temperatures.*—*Maine:* 96° at \*Cornish, 90° at Portland and 79° at Eastport. *New Hampshire:* 98° at \*Dunbarton and \*Grafton, and 63° on the summit of Mt. Washington. *Vermont:* 95° at \*Charlotte, 93° at \*Windsor and 89° at Burlington. *Massachusetts:* 99° at \*Westborough, 94° at Springfield and 93° at Boston. *Rhode Island:* 89° at \*Ft. Adams and 86° at Newport. *Connecticut:* 95° at \*Mystic and 92° at New Haven. *New York:* 98° at \*Schroon Lake, 95° at \*Ardenia, 92° at New York City and 91° at Albany. *New Jersey:* 100° at \*Atco, 99° at \*Linden and 93° at Sandy Hook, Barnegat and Atlantic City. *Pennsylvania:* 97° at \*Milton and Pittsburg, 95° at \*Wellsboro, and 94° at \*Chambersburg and Philadelphia. *Delaware:* 92° at \*Dover. *Maryland:* 95° at Baltimore. *District of Columbia:* 96.°5 at Washington. *Virginia:* 101° at Norfolk. *West Virginia:* 89° at Morgantown and Helvetia. *North Carolina:* 103° at \*Weldon and 100° at Wilmington. *South Carolina:* 100° at Charleston. *Georgia:* 100° at Savannah. *Florida:* 104° at \*Houston and 100° at Jacksonville. *Alabama:* 98° at Montgomery. *Mississippi:* 94° at Vicksburg. *Louisiana:* 94° at \*Point Pleasant and 93° at Shreveport. *Texas:* 108° at Eagle Pass, 106° at Stockton and 100° at Fort Elliott. *Ohio:* 95° at \*Bellefontaine and 93° at Cincinnati. *Kentucky:* 94° at Louisville. *Tennessee:* 96° at Knoxville, Nashville and Memphis. *Arkansas:* 92° at Little Rock. *Michigan:* 94° at Marquette, 91° at Detroit. *Indiana:* 98° at \*Laconia and 91° at Indianapolis. *Illinois:* 97° at Peoria and 93° at Cairo. *Missouri:* 95° at \*Pierce City and 93° at St. Louis. *Kansas:* 102° at Dodge City and 90° at Leavenworth. *Wisconsin:* 94° at Edgerton and 90° at La Crosse. *Iowa:* 96° at \*Glenwood and 93° at Dubuque and Des Moines. *Nebraska:* 100° at