

centre was apparently that afternoon (27th) in southwestern Idaho, at midnight in Utah and on the following morning in western Texas; Stockton barometer at last report 0.34 below the normal. On the afternoon of the 28th the lowest pressure was in the Rio Grande valley 0.32 below the normal. It moved thence eastward across the Gulf of Mexico and passing over northern Florida, followed, during the 29th, a northeasterly path, nearly parallel with, and at some distance from, the Atlantic coast. The lowest pressure noted on that day was at Cape Lookout, p. m. barometer 0.50 below the normal. Off-shore Signals were displayed on the Texas coast from the 26th to the 29th and Cautionary Signals in the Eastern Gulf and along the Atlantic coast as far north as Delaware Breakwater on the 28th and 29th. Cautionary Signals were also displayed from Cape May northward to Eastport, from the afternoon of the 29th to the morning of the 30th. These signals were fully justified by the following maximum velocities: Macon and Cape Lookout, NW. 32 miles; Pensacola, N. 40; Wood's Holl, NW. 43; Thatcher's Island, W. 42; Indianola, N. 51; Cape May, N. 52.

No. XVI.—During the 30th and 31st the pressure gradually decreased over the Gulf States and at midnight of the 31st the barometer at Punta Rasa was 0.11 below the normal.

## INTERNATIONAL METEOROLOGY.

Three International charts, Nos. IV, V and VI, accompany the present REVIEW. No. IV is for the month of *November*, 1880, and Nos. V and VI for *April*, 1879.

*Chart No. IV.*—A *preliminary* chart, which indicates as well as is at present (January 12th, 1881) possible, the tracks of some of the principal storms over the North Atlantic Ocean and adjacent land-areas during the month of *November*, 1880. Up to the 11th the month was remarkably free from severe storms over the region indicated, but from the 12th onward terrific gales were experienced over the eastern portion of the Atlantic, in connection with areas Nos. IV, V, VI and VII, the more complete notice of which storms is reserved until the publication of chart No. VI for this month.

*Chart No. V.*—Upon this chart are shown the mean pressure, mean temperature, mean force and prevailing direction of the wind at 7.35 a. m., Washington mean time, (0.43 p. m., Greenwich mean time) for *April*, 1879, over the Northern and at certain stations in the Southern Hemisphere.

*Pressure.*—High pressures (30.20 in., or 767.1 mm., and above) prevailed only over the Atlantic Ocean, south of the 40th parallel, from near the African coast westward to near the Bermudas; Ponta Delgada 30.20 inches or 767.2 mm.; Bermuda, 30.22 or 767.6 (mean at 12 m. local time); Funchal, 30.27 or 768.9, the last mean being the highest reported during the month. The highest absolute reading reported by co-operating observers occurred at Barnaul, Siberia, on the 8th of the month—30.56 or 776.2. In the *Meteorological Bulletin of the Central Physical Observatory of St. Petersburg*, 30.94 or 785.9 is given as occurring at Irkutsk, Siberia, on the 6th, at 7 a. m. Low pressures (29.80 in., or 756.9 mm., and below) covered Hindostan, the British Isles, the greater part of Europe between the 40th and 60th parallels, the Canadian Maritime Provinces, and Behring's Sea. The lowest means reported were those of Hermannstadt, 29.61 or 752.0; Sitka, Alaska, (nine days only) 29.54 or 750.3. The lowest single pressure reported by a co-operating observer was 28.52 or 724.4 at Halifax, N. S., April 1st. As compared with that of the preceding month, (March, 1879,) the mean pressure over countries in the Northern Hemisphere, represented by international observers, showed a decided decrease. The line of no change ran from northern California on the Pacific coast eastward to Lake Superior, eastward and northward passing between the Faroe Islands, Scotland, to northern Norway, thence southward to the Baltic Sea, southeastward to the Ural Mountains, eastward to the Okhotsk Sea (south of the mouth of the Amoor river), and turning southward crossed central Japan to the Pacific. Northward of this line the pressure increased, the greatest change being reported from Stykkisholm, +0.24 in., or 6.1 mm. Southward of the line the pressure decreased, (except a slight rise over Morocco, the Maderias, Egypt, Asiatic Turkey, Persia, and the regions of the Black and Aral Seas.) In America this decrease—slight on the Pacific coast—was most marked to the eastward, being more than 0.10 inch or 2.5 mm. over the Gulf of Mexico and the southern half of the Mississippi valley. In New England and the Canadian Maritime Provinces the changes exceeded 0.20 in. or 5.1 mm., being —0.34 in. at Halifax, —0.31 at Sydney, Eastport and St. John's, N. F. It is probable that the area of —0.30 inch or 7.6 mm., included the Atlantic Ocean from say 43° to 48° north, and eastward from America to 20° west. The deviations over the Azores were —0.10 inch and over the Bermudas —0.17. In Europe the changes of —0.30, or 7.6 mm., occurred over southern England, the greater part of France, Belgium, Austria, Germany, northern Italy, and Poland in Russia. The most important changes were: Groningen, —0.29 in.; Agram and Greenwich, —0.30; Paris, —0.31; Geneva, Warsaw and Vienna, —0.32; Hamburg, —0.34 and Leipzig, —0.37. In northern Algeria the greatest change was —0.13 at LaCalle. In Asia the decrease was greater than 0.10 in China, northern Hindostan and southern Siberia. The following changes are noted: Zi-ka-wei, 0.15 inch, Pekin, 0.16; Barnaul, 0.18 and Lahore, 0.20.

The *General Barometric Range* during April, 1879, was 2.42 inches, or 61.5 mm., from 30.94 or 785.9 mm., to 28.52 or 724.4, on dates as noted above.

*Temperature.*—In Spain, Morocco, western Algeria and along the Pacific coast of the United States, the mean temperature was the same or *slightly below* that of the preceding month (March,

1879.) Elsewhere the temperature of the northern hemisphere increased. The greatest increase was in the interior of the continents of North America and Asia. In the first-named country changes greater than 10° F. or 5°.6 C. occurred in Canada, Hudson Bay Territory, and the northern part of the United States, (Lake region, the Missouri and Upper Mississippi valleys.) Greatest changes: Godthaab, +16° F.; Rockliffe and Parry Sound, +20°; Forts Buford and Garry, +24° and York Factory, +29°. In Europe the changes were less than 10° F., except in Austria, Russia and parts of Turkey and Sweden: Haparanda, +12° F.; Hermannstadt, +15°; Constantinople, +17°; Kieff and Moscow, +20°; Kasan, +23°; Krotkovo and Lugan, +24°. Over Asia and adjacent islands the increase in temperature was general, and over far the greater part of the continent was more than 10° F.; greatest changes: Nagasaki, +10°; Roorkee, +17°; Lahore, +18°; Barnaul, +19°; Ekaterinburg, +23°. Lowest means were: Nikolaievsk, on the Amoor, 15°.1 F. or -9.4 C., (10:07 P. M., local mean-time) and St. Michael's, Alaska, 14°.2 F. or -9°.9 C. (1:59 A. M. local mean-time.) The temperatures experienced during April, 1879, at the winter quarters of the Vega, 67° 3' N., 171° 32' W., were reported by Lieut. Bove as follows: mean -2°.91 F. or -18°.93 C.; maximum, 23°.97 F. or -4°.96 C.; minimum, -36°.94 F. or -38°.90 C.

*Winds.*—During April, 1879, the winds were most generally from *northwest* to *southwest*: these directions very generally prevailed in Algeria, over the Atlantic Ocean north of the thirty-fifth parallel, in Hindostan, and along the eastern coast of North America. Elsewhere in Asia and America the winds were variable, with the *north* and *south* directions quite frequent in the latter country. In the British Isles, northern Europe (except *southerly* winds in Russia) and the Atlantic Ocean south of the thirty-fifth parallel, *northeasterly* winds prevailed. The strongest winds were over the Atlantic Ocean between 40° and 50° N., and from 10° to 55° W.

*Chart No. VI.*—Upon this chart are traced the paths of the principal storm areas of the Northern Hemisphere during the month of April, 1879. Six prevailed over the Behring Sea region; six first appeared on the Pacific coast of North America, and subsequently crossed the United States; seven first appeared over British America; four seem to have crossed the North Atlantic from America to Europe, while two, Nos. XXXIV and XXXVI, appear to have originated over the ocean. Of the tracks over Europe, six arrived from the ocean and four, Nos. IX, XX, XXV and XXXIII, appear to have developed either over the Mediterranean or in Algeria. Three of the European storms can be traced far into Asia, one of which appears to have reached the mouth of the Amoor. Of the nine storms along the eastern coast of Asia, six came from the interior. No. XXVII was the severe typhoon experienced by the German Bark *Fulda*, and the portion of the track from the 17th to the 23rd is principally based upon a valuable extract of the log of this vessel, as given in the "Annalen der Hydrographie und Maritimen Meteorologie, Heft IV, 1880," the official journal of the German Hydrographic Office and German Naval Observatory. The following is a brief summary of the principal features of each storm. No. I, described in the April REVIEW (1879) as area No. IV, traversed the North American Continent from March 31st to April 5th; on the 31st it was near York Factory; barometer, 29.23. As it approached the Atlantic coast it increased in energy, the wind's velocity at Cape May on the 3rd of April reaching NW. 62 miles and the barometer at Sydney, C. B., on the 4th, falling to 29.02. On the 5th it apparently passed to the northward of Newfoundland. No. II prevailed as a moderate storm from March 31st to April 2nd in the Behring's Sea region. No. III.—From March 31st to April 2nd low pressures prevailed in northeastern Hindostan, which were apparently transferred on the 3rd to China and thence eastward during the 5th and 6th towards and over Japan. No. IV developed on the morning of March 30th in North Carolina and was described in the March and April, 1879, REVIEWS. During March 30th and 31st it moved northeastward from North Carolina to Nova Scotia as the most severe and destructive storm of that month and April in North America; during April 1st and 2nd it passed in the same course over the Canadian Maritime Provinces and Newfoundland; moving in an easterly path over the high latitudes of the North Atlantic, on the 6th it arrived upon the coast of Ireland as a very deep depression. After remaining almost stationary during the 7th, central over the British Isles, it on the 8th again moved rapidly eastward over Europe and Asia, and on the 17th apparently reached the mouth of the Amoor, having traversed 210 degrees of longitude, or about 9,000 miles, in 18 days. During the first half of its existence it was attended by extraordinary low pressures; the lowest recorded of the month, over the northern hemisphere, will be found among the following, which indicate the progress of the storm: *March* 30th, Cape Hatteras, N. C., 29.01; 36° N., 72° W., 28.30; 31st, 200 miles S. by E. of Sandy Hook, 28.37; *April* 1st, Halifax, N. S., 28.52; 2d, St. Johns, Newfoundland, 28.93; 4th, Godthaab, Greenland, 29.30; 6th, Stykkisholm, Iceland, 28.88; 7th, St. Ann's Head, Wales, 28.76; 8th, Stuttgart, 29.13; 9th, Vienna, 29.32; 10th, Kieff, 29.32; 11th, Lugan, 29.56; 12th, Kasan, 29.58; 13th, Ekaterinburg, 29.70; 14th, Barnaul, 29.72; 16th, Nertschinsk, 29.34, and on the 17th at Nikolaievsk on the Amoor, 29.54. Along the American coast and over the western portion of the Atlantic Ocean this storm was exceedingly severe, the wind reaching velocities of 78 miles per hour at Cape Henry and 182 on the summit of Mt. Washington, while hurricane winds were experienced southeastward over the ocean, beyond the Bermudas. During the 6th and 7th it was accompanied by severe southwesterly gales at the entrance of the English Channel. No. V moved southward over the eastern slope of the Rocky Mountains during the 30th and 31st of March, and thence during April 1st rapidly eastward

over the Southern States, followed by a severe "norther" on the Texas coast. It has already been described as areas Nos. XVIII of the March and II of the April REVIEWS, in 1879. No. VI is a continuation of area No. XXXVII, March 1879. No. VII passed eastward on the 2d and was near Shanghai at 4 p. m., and Nagasaki at 9:30 p. m., the minimum barometer readings of the month (29.47 and 29.61, respectively) occurring at these hours. The lowest barometer reading during the passage of this area (29.66) occurred at Tokio at 3:30 a. m. of the 3rd. At Nagasaki and Hiroshima, 3.03 and 2.36 inches of rain were measured during the passage of this storm. No. VIII is a continuation of area No. XXVIII (chart VI) for March. No. IX moved eastward over southern Europe from the Gulf of Lyons on the 2d to the neighborhood of the Caspian Sea on the 8th. No. X moved eastward over the United States from Oregon to the South Atlantic States; it was described in the April, 1879, REVIEW as area No. V. No. XI moved eastward over Behring's Sea, from the 4th to the 6th, preceded by SE. gales at Unalaska and St. Paul's Island, the barometer falling at the latter station to 29.09 at 9 p. m. of the 4th, and at St. Michaels to 29.34 at 2 p. m. of the 5th. No. XII apparently developed over Hudson's Bay territory during the 6th, and moved slowly eastward, probably over Labrador, the lowest barometer at Moose Factory, Hudson's Bay, occurring early on the morning of the 6th and at St. John's, Newfoundland, at 9 a. m. of the 10th. On the afternoon of the 8th, the wind at Father Point, Quebec, increased to SW. 45 miles. During the 11th, it appears to have moved eastward over the North Atlantic ocean, central north of the 50th parallel, and during the 12th and 13th, to have curved southeastwardly, with increasing energy and rapidly diminishing pressure to the Bay of Biscay. On the 14th, it appeared at the mouth of the English channel as a severe storm (Scilly, 8 a. m., wind NE., force 10 of Beaufort scale), but as it moved thence towards the Baltic its energy gradually decreased. No. XIII is an area of low barometer, which appeared to move in the direction shown on chart, along the southern slope of the Himalays, from the 6th to the 11th, the barometer on the latter day falling to 29.52 at Goalpara. The position of this track indicates in a general way, the area covered by the lowest pressures of the month over Hindostan (as reported from the co-operating stations), and in only one case (Lahore on the 20th, 29.42, was a lower pressure than 29.52 reported. No. XIV an unimportant area in Hudson's Bay Territory. No. XV, already described as area No. VII in the REVIEW for April, 1879. It crossed the North American continent from the Pacific to the Atlantic, as a somewhat severe storm, the wind reaching SW., 44 miles per hour at Umatilla, Oregon; SW., 64 on summit of Pike's Peak; NW., 78 at North Platte, Neb., and NE. 56 at Eastport, Me., these being the maximum velocities of the month at the stations named. No. XVI is located over Alaska; on the 7th Unalaska experienced a severe SW. gale, "with fearful gusts from 4 to 9 a. m.;" at St. Paul's the wind backed from E. to N., while at St. Michael's only a slight barometric fall was experienced. No. XVII was a very similar storm to the preceding, but located a little further north, the centre passing almost directly over St. Paul's Island, at which station the barometer reached at 9 p. m. of the 9th, 28.61, the minimum reading of the month; at St. Michael's, the barometer fell to 29.03 on the morning of the 10th and during the day severe northerly winds prevailed over Behring's sea (St. Paul's, N. 52 miles). No. XVIII. moved in an east-northeasterly path at some distance to the south of Japan during the 9th and 10th, the lowest pressure occurring at Nagasaki and Hiroshima at 3:30 p. m. of the 9th, and at Tokio at 3:30 p. m. of the 10th. No. XIX, a storm somewhat similar to No. X, although not attended by such high winds, crossed the United States from the Pacific to the Atlantic; it was described in the April Review as area No. VIII. No. XX, during the first portion of its course moved slowly eastward over southern Europe, but on the 13th, when the pressure at centre (Vienna 29.13) was very low, it curved towards the northeast, and by the 19th reached central Siberia. No. XXI, an unimportant area, moved from Manitoba over the Lake region, and was noticed in the April REVIEW as area No. IX. No. XXII. a large area of low barometer, which apparently moved eastward over the North Atlantic from the 16th to the 19th, and over north-western Europe to the Baltic by the 23rd. No. XXIII moved eastward over the United States, from Washington Territory on the 13th to North Carolina on the 17th, and is described in the April Review as area No. X. As it approached the Atlantic sea-board it increased in severity, and during the 18th and 19th passed in a northeasterly course, central at some distance off the coast as quite a severe storm. Easterly gales prevailed along the coast from New Jersey to Nova Scotia, the highest recorded wind NE. 54, being reported from Boston. This area appears to have crossed the Atlantic as an extensive depression and to have arrived over the British Isles on the 23rd. No. XXIV, like XVIII, moved northeastward off the coasts of China and Japan during the 14th and 15th, the lowest pressures occurring at Shanghai at 5 p. m. of the 14th, at Nagasaki at 3:30 p. m., and Hiroshima at 9:30 p. m. of the 15th, and at Tokio (29.45 the minimum of the month) at 3:30 a. m. of the 16th; at the latter place it was accompanied by the heaviest rain fall (1.51 inches) of the month. No. XXV.—As compared with the other storms of this month, the present track is peculiar, in that it moved in a northerly path from Algeria to Lapland from the 16th to the 21st. No. XXVI passed over the Aleutian Islands during the 17th, the observer at Unalaska reporting "a fearful snow storm all day." At St. Paul's, at 9 p. m., the barometer read 29.37, while the wind was E. 65 miles. This area appears to have passed off in a southeasterly direction, it being hardly felt in St. Michael's, while on the 20th, S. S. Gaelic in 45° N., 162° W., reported barometer 29.48, wind W., force 6, squally. No. XXVII is the approximate path

of the typhoon encountered by the German bark *Fulda*. This vessel, on the 16th, in  $10^{\circ}$  N.,  $132^{\circ}$  W., had barometer 29.75, with SW'yly winds, which latter prevailed, with increasing energy and gradually decreasing pressure until the 18th, when she crossed the track of the typhoon, the lowest barometer 28.76, occurring at noon in  $14^{\circ}$  N.,  $132^{\circ}$  W.; after this, the vessel apparently kept to the eastward of the centre. On the 23rd, the storm curved towards the northeast and passed, during the 24th and 25th eastward to the south of Japan, the minimum barometric reading at Tokio, (29.67,) occurring at 3:30 p. m. of the latter date. Nos. XXVIII and XXX were described in the April REVIEW as areas No. XII and XIII. They entered the United States from the Pacific Ocean on the 17th and 19th, respectively, and having moved eastward to the eastern slope of the Rocky Mountains united on the 22nd, formed one area of low pressure, which, being opposed by high barometer to the east of the Mississippi, afterwards moved northeastwards towards Hudson's Bay, the lowest pressure at Moose Factory occurring on the morning of the 25th. No. XXIX moved from the interior of China to Japan, from the 18th to the 20th, the lowest barometer at Pekin (29.72) occurring about 8:15 p. m. of the 18th; at Vladivostock (29.63) about 9:30 p. m. of the 19th, with wind SE. 45 miles per hour, and at Tokio (29.46) at 3:30 a. m. of the 20th. Heavy rains fell at Nagasaki (1.42) and Tokio (1.11 inches.) No. XXXI passed eastward over Behring's Sea on the 22nd and 23rd, the lowest barometer at St. Paul's (29.63) occurring at 9 p. m. of the former, and at St. Michael's (29.48) at 1 a. m. of the latter date. It was accompanied by severe southerly gales, the wind at St. Paul's attaining a velocity of SW. 40, and at St. Michael's SW. 78 miles per hour; at Unalaska southerly winds and high temperatures continued from the 22nd to the 27th. No. XXXII, probably a branch of No. XXVII, moved northeastward during the 23rd and 24th, over the Sea of Japan. No. XXXIII developed over southern Europe on the 23rd in the south quadrant of area No. XXII and moved northeastwardly into central Siberia by the 29th; it was attended by heavy rains in southwestern Europe. No. XXXIV apparently originated over the Atlantic on the 23rd in the extensive depression left by area No. XXIII and passed slowly eastward, accompanied by strong westerly gales on its southern margin; on the 26th it moved southeastward to France and thence over central Europe as a well-marked storm. No. XXXV is described in the April REVIEW as area No. XV. No. XXXVI.—From the 23rd to the 26th very stormy weather prevailed to the south of Nova Scotia and Newfoundland, and an area of low barometer appears to have moved thence northeastward towards Iceland during the succeeding days of April. No. XXXVII moved eastward over the northern half of the United States from the 28th to the 30th and, has already been described as area No. XVI of the April REVIEW.

## TEMPERATURE OF THE AIR.

The mean temperature of the air for December, 1880, is indicated by isotherms (in red) on chart No. II. The table of temperatures on that chart shows (as deduced from Signal Service observations of the past nine years) the mean temperatures for the various districts, and the departures from such means during December, 1880. As will be observed from that table, the mean in every district east of the Rocky Mountains has been below the normal. Over the country to the westward, the temperature has been slightly above the normal, except at Portland, Oregon, where a deficiency of  $2^{\circ}.2$  prevailed. The temperature has been deficient  $5^{\circ}$  or more over the entire Missouri, Ohio and Upper Mississippi valleys, the Lake region (except northeastern New York), the Middle States, Tennessee and North Carolina. From the Upper Missouri valley deficiencies are reported, ranging from  $10.5^{\circ}$  at Bismarck to  $13^{\circ}.5$  at Ft. Buford and  $18^{\circ}$  at Ft. Shaw. During the past ten years, lower mean temperatures, during December occurred generally east of the Missouri valley in 1872 and 1876—also in 1878 over the Gulf States and in 1879, over the Missouri valley. At Baltimore and Washington alone, have the lowest mean temperatures of the past decade occurred. The following deviations at detached stations not included in the districts, are noted: Mount Washington,  $-0^{\circ}.3$ ; Pike's Peak,  $+1^{\circ}.5$ ; Key West,  $-2^{\circ}.9$ ; Punta Rassa,  $-2^{\circ}.0$ . The following are extracts from reports of voluntary observers: *Kansas*: Lawrence, mean  $3^{\circ}.05$  below that of past twelve years. Holton, month unusually cold. *Maine*: Gardiner, month remarkable not for its extreme cold but for its uniformity of temperature; mean temperature for past 45 years,  $22^{\circ}.10$ , for December, 1880,  $0^{\circ}.25$  below. *Maryland*: Fallston, mean lowest in past ten years, except December, 1876. *Nebraska*: Genoa, month very cold. *New Hampshire*: Lake Village, Lake Winnepiseogee closed by ice on the 24th; one to two weeks earlier than usual. Contoocookville, mean  $2^{\circ}$  below that of ten years. *New Jersey*: Newark, mean  $7^{\circ}.2$  below the average of 35 years; the last decade of the month lower by  $12^{\circ}$  than such average. *New York*: North Volney, mean  $4.85^{\circ}$  below that of December for past ten years. Friendship, coldest weather for years. Hector, month unusually cold. *Ohio*: Hudson, month remarkably cold. *Pennsylvania*: Wellsboro, mean lowest for past ten years; during the last four days of the month the temperature ranged lower than in any preceding December for twenty years. *Virginia*: Dover Mines, mean  $13^{\circ}.1$  lower than in 1879. Wytheville, month very cold. *West Virginia*: Helvetia, coldest in five years. Wellsburg, coldest for many years.

*Maximum and Minimum Temperatures.*—Maximum temperatures exceeding  $80^{\circ}$ , have occurred only in the interior of Texas and at Key West; under  $40^{\circ}$  only in Minnesota and the Lake Superior region. The lowest maximum  $36^{\circ}$ , was observed at Duluth on the 14th and the highest,  $87^{\circ}$  at Key West on the 18th. The temperature of  $58^{\circ}$  was noted at Ft. Benton on the 11th, and of  $60^{\circ}$  at Ft.