the heaviest storm I was ever in. I think that the wind blew fully 120 miles per hour.

Mr. Fred. W. Ramsden, of the British Consulate, Santiago de Cuba, October 15, 1894, writes as follows:

From telegrams I received from the Windward Islands and from San Domingo and Haiti, and from my own observations here, I have reason to believe that the track of the center was as follows: It passed between the islands of Dominica and Guadeloupe about 1 p. m. on the 20th of September; was 150 miles southwest of San Juan de Puerto at 7 a. m. of the 21st; passed almost over and just to the south of the city of San Domingo about 2 a. m. on the 22d; then a little to the north of Port au Prince about midday of the 22d, and south of St. Nicolas Mole the same afternoon, reaching the city of Santiago de Cuba at half past 12 a. m. of the 23d. (Here we had very strong north and north-northwest winds up to that hour, when it became almost calm, veering to the northeast and east, commencing suddenly again to blow violently at 8 a. m. from the southeast.) After passing here its course was just south of Cienfuegos, having begun to slow down for curving at midday of the 23d before reaching that meridian, and, I believe, it then passed up between Habana and Matanzas on the 24th, and thence to Key West, etc.

Mr. Rafael Junquera, Weather Bureau Observer at Santiago de Cuba, writes as follows, November 14, 1894:

September 20, about 1 p. m., the center passed between Dominica and Guadeloupe; at 7 a. m. of the 21st it was southwest of Puerto Rico; on the 22d, at 2 a. m., it entered the mainland at San Domingo to the south of the capital, ransacking this country and Haiti; it passed south of St. Nicolas Mole on the afternoon of the 22d, and the center of the storm area reached Santiago by 12.30 a. m. of the 23d. The storm track became very irregular as soon as it reached the mainland of San Domingo and Haiti, and I believe that the mountains of San Domingo and Haiti changed its course to the south.

The cloud movements in the vicinity of this station showed perfectly well that the storm track would travel to the south of this station. I consider that the northern border of the storm vortex passed very near to this city and that the section of the vortical calms passed to the north of Cape Cruz.

At Merida, Yucatan, Signor Felix Gomez made the following record, which is translated by Mr. Symons from the monthly bulletin for September, 1894, published by the Central Magnetic-Meteorologic Observatory of Mexico, to which institution Mr. Gomez sent a storm warning by telegraph:

On Saturday, September 22, at 4.40 p. m., we observed in the northeast many scattered clouds of a cumulo-nimbus type coming rapidly at a low altitude. This was the first indication which led me to surmise that a storm existed in the southeast, and I immediately began to watch the wind and the barometer; the wind was east-northeast, and the mean pressure for the day was 29.93 inches.

On Sunday, 23d, the sky was occasionally overcast; there were light northerly squalls; the vane pointed steadily to east-northeast until the afternoon, when it went to north-northeast, and the pressure fell to 29.92 inches.

On Monday, 24th, the sky continued overcast at intervals; there were light squalls; the vane kept north-northeast until the afternoon, when it went to north-northwest, and the pressure fell to 29.87 inches.

On Tuesday, 25th, the wind was variable between northwest and west-northwest, and the sky clear; the barometer fell to 29.84 inches, and in the afternoon the wind backed to west-southwest.

On Wednesday, 26th, the wind went round to southwest and the barometer rose to 29.86 inches, and a drizzle gave 0.05 inch of rain.

Though the indications of the barometer were very slight, the aspect of the sky and the backing of the wind showed that Merida was on the western skirt of a cyclone, therefore we reported to the observatory on the 23d and subsequent days that a depression existed to our east.

XIII.—This began on the 20th, p. m., in British Columbia and disappeared on the 24th in Labrador. In the first part of its course it moved rapidly southward into Iowa, and on the 22d it described a retrograde movement on Lake Superior.

In connection with this low area the following signals were ordered: Washington, 22d, 10.02 a. m., information signals on Lake Michigan and in Houghton section; 10.02 a. m., southwest storm signals at Marquette, Sault Ste. Marie, and Lake Huron; 10.20 a. m., information signal at Buffalo; 11.30 a. m., southwest storm signals on Lake Erie; 3.00 p. m., changed from information signals to southwest storm on Lake Michigan; 10.20 p. m., southeast storm signals at Rochester and Oswego section; 10.14 p. m., northwest storm signals at Duluth and Ashland section. 23d, 9.50 a. m., southeast changed to southwest storm signals at Rochester and Oswego section; 10.00 a. m., northwest storm signals at Lakes Huron, Michigan, and Superior (except Duluth and Ashland section); 1 p. m., changed to northwest storm signals on Lakes Erie and Ontario (except Toledo); 10.25 p. m., northwest storm at Newport section, Narragansett section, Woods Holl section, Boston and section, Portland, and Eastport.

XIV.—This appeared on the 24th, a. m., as a depression approaching British Columbia from the southwest. The barometric change on the coast of California and Oregon indicated that an extensive storm had been moving during the 22d and 23d northeastward over the Pacific. The central lowest pressure moved eastward during the 25th and 26th from British Columbia to Saskatchewan and then stretched southeastward, forming, during the 28th and 29th, a long crescent-shaped trough from Colorado to South Dakota and from Kansas to Lake Superior; this was followed on the 29th, p. m., by a well-marked center over Lake Superior, which disappeared on the 30th in Ontario.

In connection with this low area the following signals were ordered: Washington, 25th, 5.31 p. m., southeast storm signals on lakes Pepin, Superior, and Michigan. 26th, 9.00 a. m., southeast storm signals on Lake Huron; 9.40 a. m., southeast storm signals at Detroit, Toledo, Sandusky, Cleveland, Erie, and Buffalo. 28th, 10.20 a. m., information signals on lakes Superior, Michigan, and Pepin. 29th, 10.10 p. m., northwest storm signals on Lake Superior (except Sault Ste. Marie), lakes Michigan and Pepin; 10.10 p. m., southeast storm signals at Sault Ste. Marie and Lake Huron.

XV.—This, like its predecessor, apparently began as a storm area on the Pacific Ocean, moving eastward during the 28th toward Washington, in which Territory it was central on the 30th, a. m., and by the 30th, p. m., it had moved northward into British Columbia. The rest of its path belongs to the month of October.

NORTH ATLANTIC METEOROLOGY.

[*Pressure in inches and millimeters; wind-force by Beaufort scale.*]

NORMAL CONDITIONS.

The normal barometric pressure for September over the North Atlantic Ocean, as deduced from international simultaneous meteorological observations taken at Greenwich noon and not reduced to standard gravity, is highest, 30.18 (766), in a small region between latitudes N. 30° and N. 40° and longitudes W. 25° to W. 40°; it is lowest, 29.70 (754), over an extensive region covering Iceland, Greenland, Spitzbergen, and extending from N. 60°, W. 25° northeastward across the Arctic region to the coast of Siberia at N. 72°, E. 140°. Over the Pacific Ocean high pressure prevails from Oregon southwestward and low pressure from the Gulf of California southward. The lowest pressure in the Pacific is 29.70 in the eastern portion of Bering Sea, and this region is almost continuous with the low pressure in the Atlantic and Arctic oceans.

As compared with August, the normal pressures for September are 0.05 higher over the greater part of North America, and are 0.20 higher over central Asia and southeast Russia, but are lower over the Atlantic, Arctic, and Pacific oceans. The general path of storm centers in September is toward the west-northwest in that portion of the Atlantic and Pacific oceans which is between N. 10° and N. 30°, but toward the east-northeast or east-southeast for latitudes north of N. 35°,

passing, therefore, from the coast of China over Japan, Kamchatka, Bering Sea, British Columbia, Oregon, Stikine, Manitoba, the Lake region, the Gulf of St. Lawrence, the Atlantic Ocean between Iceland and Ireland, central Norway and Sweden, and disappearing in eastern Russia. The normal rate of progress south of latitude N. 35° is from 10 to 16 miles per hour toward the west, but north of that latitude from 16 to 26 miles toward the east.

NORTH ATLANTIC STORMS.

The following paragraphs give some account of the areas of low pressure and strong winds on the North Atlantic Ocean during September, 1894. Daily charts are compiled at the Weather Bureau showing the atmospheric conditions over the United States, Europe, and the Atlantic Ocean, as nearly as practicable at Greenwich noon, and afford a basis for approximating the locations and paths of the more important areas of high and low pressure.

The individual low pressures are enumerated as follows:

A. This was apparently the continuation of the U. S. series No. IV. It was central on the 1st, a. m., north of Manitoba, and on the 2d, a. m., in Labrador; 3d, at N. 50°, W. 50°; 4th, N. 54°, W. 48°; 5th, N. 57°, W. 42°; 6th, N. 53°, W. 45°; 7th, N. 55°, W. 35°. In connection with this storm high winds or very low pressures were reported from the steamships *Buenos Ayrean, Beresford, Ethiopia, Ocean, Aco, Hesper.*

B. This hurricane was apparently formed in the southern portion of the low area attending the preceding storm *A*, and must have been central on the 7th, a. m., at about N. 35°, W. 45°; on the 8th, N. 43°, W. 42°; 9th, N. 49°, W. 40°; 10th, N. 60°, W. 20°, and rapidly expanded over the Atlantic to the northward; on the 11th pressure was very low at about N. 70°, E. 10°, and also in Labrador and Alberta, so that an extensive area of low pressure must have prevailed throughout the entire intermediate region. On the 12th area *B* was central in Lapland, after which it moved southeastward, and on the 14th disappeared in eastern Russia. During the 8th and 9th, while this area was turning from its north to its northeast course, low pressures and hurricane winds near its center were reported by the steamships *Rotterdam, Spree, Tris, Othello* (which reported pressure 27.99), *Queen's More, Peninsula, Ocean, Charlois, Brazilian, Manheim, Burgermeister, Taurie*, and *Christine.*

C. This was a continuation of U. S. low No. VII, which was central on the 9th, a. m., in Manitoba; 10th, a. m., in Ontario; 11th, a. m., on the coast of Labrador; 12th, a. m., at N. 55°, W. 42°; 13th, N. 56°, W. 38°. On the 14th and 15th this was far north of our reports, but on the 15th, noon, when area *B* had apparently disappeared in the Ural Mountains, a new depression, which is apparently *C*, had taken its place in Lapland, and which, following the same course, disappeared on the 17th in eastern Russia.

D. The map of the 14th shows areas of high pressure southwest of Ireland and south of Nova Scotia, with a depression in the middle Atlantic between these two areas, and central at about N. 45°, W. 35°. This rapidly developed into a well-marked storm center, which was central on the 15th at N. 51°, W. 31°; 16th, N. 50°, W. 38°; 17th, N. 52°, W. 32°, after which date we find no further trace of a severe storm. Apparently this cyclonic whirl was broken up in this region. During its prevalence high winds and low pressures were experienced by the following vessels: *Grecian, Ohio, Sachem, Diamant*, and *Virginia* on the 16th, and by the *Kanawha* on the 17th.

E. On the 17th the northwesterly winds attending the preceding depression stretched far to the south of the Azores, and on the 18th the cyclonic whirl was central at about N. 44°, W. 23°. This continued nearly stationary until the 19th, and on the 20th was central at N. 45°, W. 20°, at which time the cyclonic system embraced a region of 20° square, but without violent winds so far as heard from; 21st, noon, the center was moving slowly northeastward and on the 22d had stretched into a trough reaching from Denmark to the Bay of Biscay, after which date it expanded into a large area of depression with several special centers in eastern and western Europe.

F. The small depression (No. XI) that was central in the south Atlantic States on the 19th and in New York on the 20th passed northeastward over Labrador on the 21st and disappeared south of Greenland on the 22d.

G. This is the same as low area No. XII, or the West Indian hurricane of the U. S. series. The first reports of its existence thus far received are those of the 20th, when it passed westward between Guadeloupe and Dominica at N. 15.5°, W. 62°. The pressure had diminished steadily in these islands from 30.03 on the 15th to 29.93 on the 19th, and doubtless the whirlwind was at that time forming far to the east and advancing slowly westward. From the reports that have been received relating to the 20th and subsequent dates the following extracts are taken:

Capt. A. Delanoe, of the steamship *Ville de Tanger*, left Pointe a Pitre for St. Pierre, Martinique, at 9 a. m., 20th; barometer between 758 and 759, weather squally, wind varying from east to northeast, with a little rain. At 12.30 p. m., when four nautical miles northeast of the northern part of San Domingo, the barometer rapidly fell to 753, terrific wind, very high sea, continuous rain. At Port de France, 4 a. m., 22d, the sky was covered with heavy clouds, squalls of little violence, the sea calm, with slight rain.

From Prof. T. Scherer, Port au Prince, Haiti:

During the 21st the barometer fell from 760.1 at 7 a. m. to 758.2 at 9 p. m., with slight rain and feeble southeast wind. On the 22d, at 8 a. m., the wind changed rapidly from east-southeast to west-northwest, and at 9 a. m. was varying between southwest and north-northwest. The lowest barometer occurred between 10 and 11 a. m., and was 755.3, after allowing for the regular diurnal variation; at this time the wind was west-southwest, and the rain ceased; at noon the wind had returned to east-southeast and gradually increased from 4 meters to its normal value at 9 p. m. of 9 meters per second. The cyclone passed over San Domingo during the night, between 11 p. m. of the 21st and 5 a. m. of the 22d; the lowest barometer was 738. More than 500 houses were destroyed and 2 churches. Nearly all the roofs were carried away. The palaces and the principal edifices were unroofed. A part of the fortress fell down. The crops were very generally injured throughout the northern part of the island. At Puerto Plata the tempest raged from 1 to 3 a. m., September 22. At Cape Haitien it was thought that the cyclone was passing by at noon; the barometer had fallen 15 mm. since the preceding day; the sea had overthrown the St. Nicolas Mole. By reason of the general disturbance of the telegraphic work many important points as to the destruction by the storm remain unsettled. The barometric minimum at Port au Prince seemed to occur between 10 and 11 a. m., apparently following the general movement. At the Island of St. Thomas the lowest barometric readings were: September 20, 9.40 p. m., 29.83. 21st, 1.50 a. m., 29.82; 3.55 a. m., 29.82; 5.40 a. m., 29.84; 6.30 a. m., 29.86. Strong puffs of wind and rain all night, mostly from southeast to southwest; a little lightning early in the night. At Martinique, September 20, 2 p. m., barometer 29.7 and wind varying from west to northwest. At Guadeloupe, 2 p. m., barometer 29.89, wind varying from east to northeast. At St. Croix and St. Kitts strong gale from the south and east during the night of the 20th–21st. At Antigua during the 20th a moderate southeast gale. In Cuba the center of the hurricane passed west of Cienfuegos about midday of the 24th, and passed between Habana and Matanzas that same afternoon.

The path of this cyclonic whirl lay to the southward of, but in close proximity to, the highlands and mountains of San Domingo and Cuba, and in accordance with the analogy of vortex whirls moving in the neighborhood of large obstacles, these highlands may have had a slight influence in causing the general track of the storm center to have deviated slightly toward them, but this influence must have been almost inappreciable as the mass of air in motion in the regions above the highlands was too large to have been much affected by them. On the other hand, the local phenomena of wind and pressure experienced at any point near the earth's surface must have been largely influenced by the presence of these highlands, and this doubtless accounts for the comparatively slight diminutions of pressure observed at our West Indian stations in comparison with those noted in

previous hurricanes and, in fact, with those observed in the present hurricane as soon as it left Cuba. The northward path from Cuba into Florida and along the south Atlantic coast presents another illustration of the ease with which the hurricane develops on the ocean or the immediate coast and the difficulty with which it penetrates the interior of the continent. The present whirl appears to have grown in size very slowly and also to have moved quite slowly during its whole path not only in the West Indies, but also after reaching the south Atlantic States. On the 30th, noon, it was southeast of New Jersey, and the rest of its career belongs to October.

H. This was a continuation of low No. XIII that was central in the upper Lake region on the 22d and passed over Labrador on the 24th; it disappeared on the 25th south of Greenland.

I and *K.* A depression (*I*) appeared on the 23d central about N. 38°, W. 22°; it moved northward, reaching N. 47°, W. 23°, on the 25th, while a similar small depression (*K*) stretched southward from this region and another, above described as *E*, moved to the eastward over the British Channel. The whirl, *K*, soon broke up, and *I* disappeared on the 27th without much further movement.

L. This appeared on the 27th central at N. 50°, W. 40°; it is not likely to have been a continuation of area *H*, although it was very nearly in the same place, but is rather an evidence of the extremely unstable condition of the atmosphere at this time and of the ease with which the great flow of upper currents from the tropics initiate short-lived whirls and barometric depressions on the edges of regions of high pressure. By the 28th area *L* had divided into two portions, respectively central at N. 48°, W. 52°, and N. 38°, W. 58°, but the whole of this portion of the atmosphere was in that state of motion known as turbulent flow in the hydraulics of rivers, and the alternations were very rapid from horizontal to ascending or descending motion and from high to low pressures and from rectilinear to whirling motions. By the 28th three or four whirls had formed between the hurricane on our south Atlantic coast and the high area over the North Sea. On the 30th the center was at about N. 50°, W. 27°, and hurricane winds were reported by the *Lackawanna* and *Fonar*.

M. This area was central on the 29th over Newfoundland at N. 49°, W. 55°. By the 30th it had moved southeast as a severe hurricane to N. 48°, W. 44°. Reports of low pressures and high winds in connection with this storm were received from the *Iona* and *Hecla* on the 30th. The map of the latter date presents six low areas between the Ural and the Rocky mountains and between N. 35° and N. 55°, and it must be reserved for the first few days of October to show how the upper current, overflowing from tropical latitudes, was drawn off in different directions, or tapped, as it were, to supply first one and then another of these whirls until finally some subsided while others continued developing as severe storms.

OBSERVATIONS IN THE CARIBBEAN SEA.

The following summaries of observations made at British Colonial Hospitals may throw some light on the weather in the adjoining portions of the Caribbean Sea:

Balize, July, 1894. The barometric range reduced to sea level, maximum, 30.154, on the 4th; minimum, 29.965, on the 16th. The temperature of the air, maximum, 89.9, on the 12th; minimum, 73.0, on the 4th. The relative humidity of the atmosphere varied between 99 and 83 per cent. The prevailing wind for the month was southeast. Rain fell on 13 days, the maximum being 3.18 on the 4th; total rainfall, 7.67, which is about 91 per cent of the normal for July.

Punta Gorda, July, 1894. The temperature of the air, maximum, 94, on 22d; minimum, 69.0, on the 9th. The prevailing wind was northeast. Rainfall on 15 days, the maximum being 5.50 on the 28th; total rainfall, 19.52.

Balize, August, 1894. The barometric range reduced to sea level, maximum, 30.127, on the 10th; minimum, 29.925, on the 26th. The temperature of the air, maximum, 90.9, on the 23d; minimum, 74.1, on the 21st. The relative humidity of the atmosphere varied between 95 and 88 per cent. The prevailing wind was southeast. Rainfall on 11 days, the maximum being 1.31 on the 21st; total rainfall, 3.24, which is about 40 per cent of the normal for August.

Punta Gorda, August, 1894. The temperature of the air, maximum, 87.5, on the 30th; minimum, 70.0, on the 31st. Rainfall on every day of the month, the maximum being 4.28 on the 8th; total rainfall, 26.89. The prevailing wind was northeast.

Balize, September, 1894. The barometric range reduced to sea level, maximum, 30.073, on the 13th; minimum, 29.811, on the 28th. The temperature of the air, maximum, 94, on the 26th; minimum, 70.0, on the 5th. The relative humidity of the atmosphere varied between 98 and 79 per cent. The prevailing wind was southeast. Rainfall on 10 days, the maximum being 2.67 on the 26th; total rainfall, 5.16, which is about 50 per cent of the normal for September.

Punta Gorda, September, 1894. The temperature of the air, maximum, 91, on the 20th; minimum, 71.0, on the 10th, 16th, and 29th. Rainfall on 18 days, the maximum being 3.21 on the 11th. The prevailing wind was northeast.

OCEAN ICE.

The positions of icebergs and field ice reported for September, 1894, are shown on Chart I by crosses.

The following table shows the southern and eastern limits of the regions within which icebergs or field ice were reported for this month during the last twelve years:

Southern limit.			Eastern limit.		
Month.	Lat. N.	Long. W.	Month.	Lat. N.	Long. W.
	° ′	° ′		° ′	° ′
September, 1883	43 25	47 10	September, 1883	49 01	44 33
September, 1884	46 00	53 21	September, 1884	47 39	49 14
September, 1885	45 40	48 22	September, 1885	48 40	46 27
September, 1886	46 40	53 00	September, 1886	48 00	48 40
September, 1887	45 37	40 50	September, 1887	45 37	40 50
September, 1888	Off Cape	Race.	September, 1888	53 00	52 08
September, 1889	46 21	48 22	September, 1889	48 59	46 48
September, 1890 *	45 30	48 00	September, 1890	50 30	46 22
September, 1891	Straits of Belle Isle		September, 1891	53 18	51 20
September, 1892	Straits of Belle Isle		September, 1892	52 04	54 55
September, 1893	44 27	48 29	September, 1893	46 50	45 20
September, 1894	44 00	46 45	September, 1894	48 34	46 18
Mean	45 52	48 15	Mean	49 21	47 44

* On the 4th a large lump of ice 100 feet long and 6 feet above water was reported in N. 36° 49′, W. 42° 18′; this is the lowest latitude in which ice was ever reported in the North Atlantic Ocean.

A reference to the table will show that in the last twelve years there have been but two Septembers (1891 and 1892) for which ice has not been reported south of the fiftieth parallel, and that the eastern limit of ice for the current month is about 1½° east of the average eastern limit for September.

OCEAN FOG.

The limits of fog belts west of the fortieth meridian, as reported by shipmasters, are shown on Chart I by dotted shading. Near the Banks of Newfoundland fog was reported on 15 dates; between the fifty-fifth and sixty-fifth meridians on 11 dates; and west of the sixty-fifth meridian on 11 dates. Compared with the corresponding month of the last six years, the dates of occurrence of fog near the Grand Banks numbered 1 less than the average; between the fifty-fifth and sixty-fifth meridians, 5 more than the average; and west of the sixty-fifth meridian, 3 more than the average.

TEMPERATURE OF THE AIR.

[*In degrees Fahrenheit.*]

The distribution of the monthly mean temperature of the air over the United States and Canada is shown by the dotted isotherms on Chart II; the lines are drawn over the high irregular surface of the Rocky Mountain plateau, although the temperatures have not been reduced to sea level, and the isotherms, therefore, relate to the average surface of the