VIII.—Appeared over the eastern part of the Gulf of Mexico the morning of the 15th, and by the evening report of that date had advanced to a position near Jacksonville, Fla., with gales and heavy rain along the south Atlantic coast. During the 16th the storm-center moved slowly northeastward along the south Atlantic coast, with pressure falling below 29.60. The rain area extended to the south New England states, heavy rain fell along the Carolina coast, and northeast gales prevailed along the middle Atlantic and south New England coasts. During the 17th this low area remained nearly stationary off the middle Atlantic coast, apparently decreasing in energy. Rain, followed by clearing weather, was reported in the middle Atlantic and New England states, and northeast gales continued along the middle Atlantic and south New England coasts. During the 18th this storm passed northeastward beyond the region of observation.

NORTH ATLANTIC STORMS FOR JULY, 1893.

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

The paths of storms that appeared over the west part of the north Atlantic Ocean during July, 1893, are shown on Chart I. These paths have been determined from reports of observations by shipmasters received through the co-operation of the Hydrographic Office, Navy Department, and the "New York Herald Weather Service."

Over the north Atlantic Ocean the July normal pressure is highest in an area extending over and southwest of the Azores, where it is above 30.20 (767). The normal values are lowest in an area covering the ocean between Iceland, Greenland, and Spitzbergen, where the normal pressure is below 29.70 (754).

In July there is usually an increase of pressure over the north Atlantic Ocean, except off the middle Atlantic and New England coasts and over eastern and extreme northern portions of the ocean. In regions where the normal pressure is higher than for the preceding month the increase is less than .05 inch. From the British Isles northward the normal readings are .05 to .10 inch higher than for June.

The storms of July advance eastward over the Atlantic Ocean at an average velocity of about 19 statute miles per hour. An average of 1.8 storm per month traverses the ocean from the American to the European coasts. The principal track of July storms is traced from Newfoundland to about north 55°, west 25°, where it divides, one branch passing northeastward to the coast of Norway and the other south of east over the British Isles and the continent of Europe.

Generally fair and settled weather prevailed over the north Atlantic Ocean during July, 1893. Three storms apparently crossed the ocean from coast to coast. One of these storms was central southwest of the Banks of Newfoundland at the opening of the month. During the 2d and 3d this storm moved slowly east-northeastward, and reached mid-ocean north of the 50th parallel on the 4th. Moving thence slowly eastward the storm-center passed north of the British Isles by the 8th. The pressure continued low over the British Isles from the 9th to the 11th, and during the 11th this storm apparently passed eastward over the continent of Europe. The second storm that traversed the ocean appeared off the New England coast on the 13th. By the morning of the 14th this storm had moved south of east to the 60th meridian, with pressure about 29.70 (754), and by the 15th had reached a position south of Newfoundland, with pressure about 29.60 (752). Moving northeastward with a decrease of energy the center of disturbance passed north of the region of observation after the 17th. On that date the storm was joined by low area IV, and reports indicate that the disturbance moved eastward in high latitudes and passed north of the British Isles during the 19th. The third storm that traversed the ocean was the severest of the month. This storm apparently passed eastward from the Gulf of Saint Lawrence on the 19th, reached a position north of the Banks of Newfoundland by the 21st, with pressure below 29.30 (744), increased in energy by the 22d, when the pressure fell below 29.20 (742) and gales of force 11 were reported between the 30th and 40th meridians, and passed thence eastward and disappeared north of the British Isles by the 25th.

A destructive whirlwind crossed eastern Cuba the evening of the 6th. The storm struck the island at Santiago de Cuba, passed thence north of east to a point west of Baracoa, and there recurved and passed inside the north-northeast coast line to a point west of Banes, where it passed to sea. A schooner was wrecked off Santiago de Cuba, and in the district about Banes 10,000 acres of banana plants and property valued at $200,000 were destroyed. The storm reached Santiago de Cuba at 8.30 p. m. At that place the wind shifted from south-southeast to north-northeast, and blew with great fury. A destructive cyclone visited the Bay Islands, off the north coast of Honduras, Central America, July 6th, wrecking a number of vessels, and causing great loss of life and property.

On the 5th low area I occupied the Gulf of Saint Lawrence, and the morning of the 6th was apparently central between Cape Breton Island and Newfoundland. By the 7th the storm-center had passed southeast of Nova Scotia and had been joined by low area II, which had advanced south of east over Nova Scotia during the 6th. On the 8th this storm occupied the west portion of the Banks of Newfoundland, but possessed small strength, and on the 9th moved slowly northeastward along the east Newfoundland coast, where it was joined by low area III, which had passed eastward over the Saint Lawrence Valley during the 8th. By the morning of the 10th this storm had disappeared north of the Grand Banks. On the 20th a storm occupied the ocean northeast of the Banks of Newfoundland. By the 21st this storm had apparently united with a storm previously referred to as having passed eastward from the Gulf of Saint Lawrence during the 19th. The pressure continued low over Newfoundland and the Grand Banks until the 24th. During the 26th and 27th low area V passed north of east from the Saint Lawrence Valley to Labrador, and by the 27th this storm had disappeared north of the region of observation. Over the British Isles the pressure continued high from the 25th to the close of the month.

VII.—This depression first appears on the morning chart of the 17th, when it was central near Cape Breton, but a report from Bermuda dated 4 p. m., 15th, had shown that an Atlantic hurricane was then moving northward between that station and Halifax.

VIII.—This hurricane was first announced by a special dispatch from the observer at Saint Thomas, W. I., on the morning of the 16th, at which time the center was south of that island. The center subsequently passed over Puerto Rico, its track lay midway between the Bahamas and Bermuda, touching Cape Hatteras on the 20th, Cape Cod on the 21st, central over the Bay of Fundy on the 21st, 8 p. m., and thence northeastward over Newfoundland. Subsequent reports trace this hurricane back to the 15th near Martinique, and it probably belongs to the class that are initiated by the flow of dry air northeastward from Venezuela and Guiana into the equatorial region of rain.

As soon as the first dispatch was received from Saint Thomas, a special bulletin, dated 3.30 p. m., 16th, announced:

It is probable that a so-called West India hurricane is moving westward and is about to cross the 65th meridian. The normal track of hurricanes for August would require this to recurve by Monday next (21st) before reaching the south Atlantic coast. Vessels leaving New York for New Orleans should secure sea room by keeping well out from the shore, that is, east of the Gulf Stream. Vessels leaving Gulf ports should obtain the latest telegram from the Weather Bureau observer at Key West.

On the morning of the 18th there were some indications at our south Atlantic coast stations of the presence of this storm-center, although it was then 500 or 600 miles distant, and on the 19th indications of its approach still demonstrated its very considerable distance northeast of Nassau. The general forecast at 8 p. m. of that date states:

The hurricane that was near Saint Thomas on Wednesday is now (Saturday night) apparently central about latitude 30° and longitude 72°, having reached the point of curvature northward. It may, therefore, not strike the south Atlantic coast with much severity. Vessels leaving New York for Bermuda may meet this storm on Monday.

Heavy rain prevailed during Sunday night and Monday on the middle and east Atlantic coasts. The forecast of 8 p. m. Sunday states:

The hurricane center will probably move northeastward by Monday night, after touching the North Carolina coast, and cross latitude 40° on Tuesday (22d).

But actually the center now began to move very rapidly and reached the Bay of Fundy by 8 p. m. Monday, 21st. The maximum wind was: Block Island, ne., 72; Woods Holl, ne., 60; Boston, ne., 30; Eastport, ne., 46.

IX.—On the 21st the northerly winds in the rear of low area VII extended over Florida and the eastern portion of the Gulf of Mexico, where pressure still remained below the normal, and an ill-defined area of low pressure prevailed over that region, apparently moving slowly eastward. The indications of the formation of the storm-center were noted in the general synopsis of 8 p. m., 21st, but it seems to have first begun developing rapidly on the 22d over the Gulf Stream east of the south Atlantic coast.

The storm that was felt at Cape Hatteras the morning of the 23d is now known to have come from latitude 23°, longitude 64° on August 20th, and latitude 14°, longitude 42° on August 16th as a well-defined hurricane that advanced over the mid-ocean without being recognized as such at the West Indian stations. Therefore, its remarkable growth and track until it reached New York, N. Y., were not well foreseen, and were at once checked by the overpowering influence of the land. The path of the center appears to have been northward, passing within less than 100 miles of Cape Hatteras, and then quite exactly over Atlantic City, N. J., and New York, N. Y., at which latter place it was central on the morning of the 24th. After this, the central low pressures rapidly filled up, the winds and rain diminished as the center moved northward through New Hampshire to the mouth of the Saint Lawrence, where it disappeared on the morning of the 25th.

At 2 p. m., 24th, the following special bulletin was issued:

The storm whose center passed over New York early Thursday morning was not heralded from the West Indies, but the map of Monday evening showed a possible storm-center in process of formation, and it is quite probable that this resulted on Tuesday morning in a depression located from 300 to 500 miles east of Florida. At that time high pressure, with northeast winds, prevailed in the middle and south Atlantic states. The whirlwind thus formed then moved north, keeping to the east of Cape Hatteras on Wednesday morning and to the east of the Virginia capes on Wednesday evening, but drawing closer in shore and increasing in intensity, developing lower pressure and higher winds by the time it struck the New Jersey coast and eventually New York. Northeast gales of 52 miles occurred at Atlantic City and 56 miles at New York, shifting suddenly to southwest between midnight and 6 a. m. this morning. No reports have been received from the New England coast, where easterly gales have probably been experienced. At last accounts the storm-center had passed from the ocean on to the land and was traversing southern New England, a route which is quite unusual and will probably facilitate the breaking up of the storm.

X.—The weather map of the morning of August 25th (Friday), not only showed the disappearance of low area IX in Labrador, but also stated that "there are indications of a hurricane-center about 500 miles southeast of Florida, moving toward the northwest;" subsequent reports indicated that the center was then far north of Turks Island, possibly near latitude 25°, instead of being near that island as was at first thought. Marine reports for the 22d show very low pressure and high winds at latitude 22°, longitude 57°, suggesting that the hurricane was even then at a stage of full development. If the approximate track of the center be traced back to latitude 18°, longitude 20° on the 15th (at which time an area of high pressure was central in Germany and extended south over the Sahara), then it becomes plausible that this hurricane belongs to a class that is initiated by the flow of dry air from North African plateaus westward to the ocean.

Special dispatches on the afternoon of Friday (25th) showed that the heavy waves which extend outward in all directions from a hurricane center were already noticeable at Savannah, and probably all along the south Atlantic coast. Storm signals were at once displayed from Savannah to Wilmington, and northeast gales, with rain, predicted for Saturday; both gales and rain reached these signal stations on Sunday, so that, technically speaking, the warnings were somewhat premature, but considering the indefiniteness of our knowledge as to the location of the center of the hurricane, it was doubtless the best that could be done. The center passed 100 miles northeast of Nassau, Saturday morning the 26th, and the general forecast of that date states that:

The track of the hurricane will probably keep to the west of the two preceding tracks and bring more rain to the interior of the Atlantic States.

The special bulletin issued on the afternoon of the same date states:

The hurricane indicated in the general synopsis of 8 a. m. Friday morning as probably existing about 500 miles southeast of Florida has apparently moved west-northwest, and early this morning passed to the north of but near Nassau, in the Bahamas, where high winds prevailed all night, and at 8 a. m. the wind was brisk northwest, with the barometer at 29.56. The course of this storm-center has thus far lain to the westward of its two predecessors, and, as frequently is the case, it should therefore strike the Atlantic coast at a point farther south than did the hurricane of Wednesday last. The heavy ocean swell preceding the storm was reported Friday morning at Savannah. Northeasterly gales and general rains are indicated for Saturday night and Sunday on the coast of the south Atlantic states, including the west coast of the Florida Peninsula.

The Secretaries of the Maritime Exchanges in New York and Philadelphia and the observers at Breakwater, Baltimore, Norfolk, Boston, New York, and Philadelphia were informed

that the storm existing off the coast rendered it unsafe for vessels to leave port for the South until further notice from the Weather Bureau, as dangerous gales were likely to occur during the next forty-eight hours. The observers were notified to be prompt in giving this information to shipping interests.

On the 26th, at 8 p. m., the storm then being central northeast of Jupiter Inlet, it became safe to predict:

The hurricane center will probably strike the coast of the south Atlantic states on Sunday, pass inward, and break up into general rains on Monday.

This prediction of course assumed that the hurricane would not recurve and keep off the south Atlantic coast, and was based partly upon the little knowledge we already had as to its past course and partly upon the distribution of pressure, winds, and clouds then prevailing in the Atlantic States and Lake region, all of which favored the westward motion of the hurricane. This prediction, and the reasoning which led to it, were confirmed by the appearance of the map of Sunday morning (27th), and the general forecast of that date said:

The low center off the Florida coast will move northwest, striking the coast of Georgia Sunday evening or night, and passing inward break up into general rains over the Appalachian Mountains.

The center passed very nearly over Jacksonville and Savannah, and then inward very near to Augusta, which latter point it reached about 6 a. m. of Monday, 28th.

On Sunday special noon reports were called for from stations in the vicinity of the storm's path, and based on these reports a dispatch was sent to the President, then on the New England coast, informing him that dangerous gales prevailed on the south Atlantic coast, that the storm would extend northward and be felt on the middle Atlantic and southern New England coasts on Monday night, and that the northern ports had been warned that it was unsafe for vessels to leave port.

The forecast of 8 p. m., Sunday, although telegraphic reports were missing from Charleston to Key West, ventured on the prediction:

It will move northward over Savannah between Charleston and Augusta into North Carolina. There are indications of its breaking up in that region Monday afternoon.

These indications consisted especially in the fact that the winds which were blowing from the Atlantic coast toward the Appalachians, and those which were blowing from the Lake region, Mississippi, and Ohio valleys also toward the Appalachians, would probably produce two or more extended areas of cloud and rain, such that the heat of Monday's sunshine would spread the isobars apart and break up the storm into two areas of low pressure, one over the lower lakes and the other on the middle Atlantic coast. As the event proved, however, the dispersion thus produced was not sufficient to divide the storm as a whole, and it passed over the Appalachians between 8 p. m. of the 28th and 8 a. m. of Tuesday, 29th, when it was central in the northern part of New York.

The tendency to the formation of a new area of low pressure over the lower lake region (or rather on the western slope of the Appalachians when northerly winds prevail in that region) is almost invariably exhibited when hurricanes prevail on the Atlantic coast, and as a consequence the latter in their journey from Florida toward New Jersey are often divided and sometimes pass entirely over the western side of that range; or again, having reached New Jersey the center is retarded in its progress eastward, and may even break up over New England. These are all illustrations of the general principle that among the features controlling the motion of a cyclonic storm, one of the most important is the location of the area of formation of cloud and rain.

The strong influence of the northeast winds that were about to prevail over the lower lakes (and actually did arrive about between 3 and 8 p. m. on Monday) was anticipated Monday morning, when the weather map showed the storm-center near Augusta, and a trough of low pressure running northward into Canada, while an area of high pressure had steadily advanced southeastward into the upper Mississippi and lower Missouri valleys with cold, dry, northerly winds already prevailing over the upper lakes. The general forecast of Monday morning states:

The hurricane center will probably move north-northeast, keeping east of the Appalachian range, and producing high southeasterly winds backing to northeasterly on the middle Atlantic coast, with general rain in the middle Atlantic states.

A due north-northeast course would have carried the storm center to Oswego, and it would seem likely that after passing more nearly northward, as though it were actually about to cross over to the Lake region, the center then turned a little more to the east and was moving northeastward on the morning of Tuesday, 29th, when it was about 50 miles southeast of Oswego, while the rain areas extended farther to the west, viz., Toledo, than to the east, namely, Boston.

At 3 p. m. of Monday, the 28th, the hurricane center was a few miles northwest of Charlotte, having moved slowly since 8 a. m., but the longer axis of the oval isobars now pointed northward and the center assumed a much more rapid movement. In the afternoon the observers at Atlantic City, New Brunswick, Philadelphia, New York, New Haven, and New London were wired that severe easterly gales, heavy rains, and unusually high tides were indicated for the middle Atlantic and south New England coasts Monday night; they were also instructed to give this information to the public and to telegraph it to any postmaster on the coast where the public might be benefited.

To the postmasters at Cape May, Asbury Park, Sea Isle City, Wildewood, Beach Haven, and Barnegat City telegrams were sent giving similar information, and requesting that said information be given to the public. On the receipt of these telegrams the newspapers in some of these cities issued extra editions in order to disseminate the information, and letters of thanks were afterwards received from the Boards of Trade and public officials, acknowledging the great value of the warning.

The Secretaries of the Maritime Exchanges of New York and Philadelphia, and officials of the Baltimore and Ohio and Pennsylvania railroads in Philadelphia and Baltimore, were notified of the anticipated severity of the storm on the Atlantic coast, and observers at Raleigh, Lynchburg, Charlotte, Norfolk, Harrisburg, Baltimore, and the Chamber of Commerce at Richmond were informed that the rains attending the storm were likely to cause dangerous floods. At 8 p. m. so many observations were missing, owing to the interruption of telegraphic communication, that it was not practicable to make any general prediction of the future course of the hurricane center other than those already made as to its general northeasterly course; but at that moment it was actually raining, with northeast winds, over the whole of West Virginia, western Pennsylvania, western New York, and northeastern Ohio, which condition shows how strong was the tendency toward the formation of low barometer on the west side of that mountain range, while on the south and east sides it was raining, with southeasterly winds, only in a narrow belt from Raleigh to Lynchburg and Washington; the motion of the clouds showed that at that moment the movement of air over the Atlantic States was from the southwest and therefore not tending to especially increase the rainfall, either as to intensity, area, or quantity, and a similar condition prevailed on the west side of the Appalachians, except only over Lake Ontario.

The map at 8 a. m. Tuesday, 29th, was practically blank, as telegraphic communication was cut off in all directions. But the subsequent reports show that the center was at that moment near Oswego, having moved at the remarkable rate of 450 miles in twelve hours, and the elongated isobars suggest that within that interval a long trough of low pressure had been formed, stretching from Lynchburg to Oswego, and that the isobars of 8 a. m., 29th, represent the rapid filling up of the southern end of that trough and the transfer of the

storm-center from Lynchburg to Oswego rather than the movement of a well-defined whirlwind at a rapid rate over this mountainous country. The isobars and winds of Tuesday morning show that we have no longer to do with a symmetrical revolving hurricane, but with two, if not three, systems of winds blowing into the region of low pressure and each striving to set up its own independent whirl, namely, southerly winds from New Jersey to Massachusetts, westerly winds in Pennsylvania, and northeasterly winds in Vermont, the Saint Lawrence Valley, and Lake Ontario. Although, as before stated, the weather map was a blank north and west of Maryland and Virginia, yet it was evident that the storm-center had now rapidly passed northward of Maryland; by prediction it should be at least as far north as the boundary between New York and Pennsylvania, and the following general synopsis and forecast was ventured:

The hurricane is probably central in Pennsylvania. The storm-center will move northeast through New York state into the Saint Lawrence Valley.

The map for 8 p. m., 29th, shows that the center was then a little east of Quebec, and possibly within the border of Maine, having moved about 350 miles or more within twelve hours; the isobars now exhibit the great elongation characteristic of the breaking up of a storm. The general conditions and forecast read as follows:

The central calm area has become a long oval, with southwesterly winds on its east side from Massachusetts to the Gulf of Saint Lawrence, and northeasterly winds on its west side at Canadian stations. The current wind velocities average about one-half of those prevailing Monday night. The storm will probably move northeast to Labrador, and may possibly become again powerful after reaching the Atlantic.

The text on the map of 8 a. m. Wednesday, 30th, states that:

The hurricane has moved northeastward down the Saint Lawrence Valley and is now central near the mouth of that river.

Subsequent marine reports do not show the presence of any special storm-center east of Labrador and Newfoundland, and it is probable that this powerful whirl was broken up as such on the 1st of September.

XI.—While the preceding, low area X, was on the 28th passing from Augusta to Lynchburg, the northerly winds and dry air in the Mississippi Valley and the Southwest extended rapidly southward over the Gulf. We have as yet no evidence of the existence therein of any low barometer and cyclonic winds on Monday, but the moderate norther of Monday in the western Gulf, combined with the southerly winds in the eastern Gulf, favored the formation of a moderate barometric depression in the central Gulf which seemed to have prevailed without any general progressive movement from that time until 8 p. m. of the 31st. During these three days the pressure at Port Eads was generally lower than at New Orleans or Mobile, and the tendency toward local and general storms was daily manifest. At one time it was thought that a hurricane would evolve itself out of this indefinite condition, and accordingly at 8 p. m. of the 30th storm-warning signals were displayed from Port Eads eastward to Savannah, but no general storm resulted, although local gusts, waterspouts, and thunderstorms were reported. These conditions continued over into September.

VI.—This storm in the Gulf of Mexico evidently existed on the morning of the 5th, at which time pressure was diminishing at distant stations on the Gulf coast, but no marine reports are at hand to locate the center more exactly. The increasing northeast winds on the coast of Louisiana and Texas showed that a hurricane was moving northward on the 6th. During Thursday, 7th, the center moved northward over the southeastern portion of Louisiana, doing much damage over a small area, but rapidly breaking up as it moved inland. The course of the center was quite irregular. On the afternoon of the 8th it was central in southeastern Alabama, and the area of revolving winds with rain continued to remain south of Tennessee until the 11th, by which time pressure had become nearly normal and the storm-center had disappeared.

NORTH ATLANTIC STORMS FOR SEPTEMBER, 1893.

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

The paths of storms that passed over the western portion of the north Atlantic Ocean are shown on Chart I, so far as can be traced from information received up to the 25th of October, through the co-operation of the Hydrographic Office and the "New York Herald Weather Service."

The normal pressure for September over the north Atlantic Ocean, as shown by the international simultaneous meteorological observations, is highest, 30.18 (767), in a small oval between parallels N. 33° and N. 39° and meridians W. 22° and W. 38°. The isobar of 30.10 (764) extends from W. 11° to W. 86° and between the parallels N. 23° and N. 43°. Pressure is lowest, 29.70 (754), from N. 58°, W. 25° northward over Iceland, Greenland, and Nova Zembla. As compared with August the normal pressure for September is 0.05 less in the mid-Atlantic over a narrow belt extending from N. 20°, W. 65° to N. 35°, W. 38°.

The tracks of storms for September may be classified as: (I) those that pass from the equatorial Atlantic westward over the West Indies and the Caribbean Sea to the Gulf of Mexico, or at least to Florida, and then recurve toward the northeast, passing over the Atlantic States and Labrador into the north Atlantic region; (II) those that start in the equatorial Atlantic and after passing a short distance northwest recurve to the northeast long before reaching the West Indies or the American coast; these also finally enter the north Atlantic region; (III) those that pass from Bering Sea and the northwest Pacific eastward over the Rocky Mountains and southeastward over the Great Lakes region, thence eastward to the Atlantic Ocean.

The average velocity of movement of storm centers for September, in statute miles per hour, is 26 for the United States when moving westward, and 19 for the Atlantic Ocean. During the process of recurving the West Indian hurricanes move at the rate of only 9 miles per hour. On the average about one storm endures long enough to pass from the North American continent over the Atlantic to Europe.

During September, 1893, the following storms have been traced over portions of the north Atlantic Ocean; the centers are located for Greenwich noon by international simultaneous observations as follows:

A. A low barometer existed northeast of Labrador September 1st, 29.20 being reported at N. 54° and W. 50°, with westerly gales southward to N. 40°. This was undoubtedly the end of the hurricane described in the August REVIEW. It moved slowly eastward, being apparently in W. 40° on the 2d, after which it disappeared from our chart and merged into the general low pressure around Iceland.

B. A low barometer northeast of Labrador on September 5th, with westerly gales to the southward, apparently a continuation of the September low area No. 1. This moved northeast and expanded rapidly into the Icelandic low area, which, on the 7th, was central to the east of Iceland, while severe northwest gales prevailed between N. 45° and 55°, and W. 45° and 55°. On the 8th the low was central over the north Baltic, whence it moved southeastward into Russia.

C. On the 5th the pressure was diminishing at the Isthmus of Panama, and on the 6th in western Cuba, at which time a hurricane center probably existed in the western portion of the Gulf of Mexico. The track of this hurricane is not satisfactorily shown by the marine reports, but it is undoubtedly the same that passed northeastward along the coast of Louisiana until it entered and crossed that state on the 7th and 8th.

D. On the 9th a storm-center passed over the Gulf of Saint Lawrence, and on the 10th was apparently east of Labrador. No further details can be given as to the center of this area of low pressure until on the 13th, when it was apparently east of Iceland.

E. On the 11th a storm-center was apparently central at N. 43°, W. 54°. On the 12th it was at N. 48°, W. 42°. On the 13th, N. 54°, W. 40°, after which it can not be traced, but by the 15th the isobars of the preceding low over the Baltic had stretched westward as though the present low was about to join that one, and on the 16th pressure was again lowest over the Baltic. On the 17th, and thence until the 22d, low pressure was again lowest over the Baltic. On the 17th, and thence until the 22d, low pressure covered the whole of Europe, sometimes presenting several subsidiary low centers. On the 23d pressure rose in southeastern Europe and the principal low center was over Norway. On the 24th and 25th the pressure continued rising in southeastern and southwestern Europe, continuing lowest over Norway and Sweden. On the 26th and 27th pressure slowly recovered, and the low center disappeared in the presence of a still deeper low advancing from the Atlantic.

F. From the 14th to 17th pressure steadily rose in the mid-Atlantic and eastward to Africa and northward to N. 55°. Apparently the low area was passing eastward on or north of N. 60°, and on the 19th low pressure was central east of Iceland, while northwest gales prevailed north of N. 50° and east of W. 30°. This, combining with the low from which Europe was then recovering, caused the low pressure to continue prevailing over Europe until the 28th, as above mentioned. The center of lowest pressure was generally over Norway and Sweden. On the 27th a single report, 29.46, force 11, at N. 54°, W. 46°, shows that a third low center was advancing southeastward from Baffins Bay. On the 28th this was apparently in W. 20°, and on the 29th was near the coast of Scotland, having grown steadily in the extent of its depression. Pressure again fell throughout Europe, while this depression moved northeastward, and on the 30th was central north of the coast of Scotland.

III.—This so-called Gulf hurricane advanced suddenly and unexpectedly northeastward over southeastern Louisiana on the afternoon of the 1st. The early history of this storm, like that of low No. XV, is almost entirely unknown to us at present, but it is plausible that the areas of high pressure that were pushing southward into the Gulf before these storms themselves appeared argue for the existence of a preceding low pressure much farther south, say on the coast of Mexico and Honduras. On the other hand, there often exists on the southern edge of an area of high pressure a long trough of low pressure, at any point of which a whirl may suddenly begin and thence rapidly grow into a storm; this evidently occurred in connection with lows No. XIII and XVI, and very probably explains the sudden appearance of the low No. XV on the afternoon of the 21st. With regard to low No. III, the general distribution of wind at stations along the Gulf coast would suggest that there could have been no antecedent extensive whirlwind system, and that this storm, that was so terribly destructive over a very limited region, had only existed since the morning of the 1st, and had only grown to the size of the largest tornado when it struck the coast of Louisiana.

The observer at New Orleans, La., reports:

October 1st, a severe and destructive storm began about 6.30 p. m., continuing through the night. Much damage was caused throughout the city. About 2,000 lives were lost along the Gulf coast south and east of this section. The storm was severest in the Louisiana Delta and in the Plaquemines Parish, where it was attended with great loss of life and property. A velocity of 48 miles per hour was recorded in the city at 8.20 p. m., after which the record was lost, owing to the anemometer getting out of order. A velocity of 65 miles was attained at West End, when the instrument became unserviceable.

Mr. Kerkam, as Secretary of the Louisiana State Weather Service, reports:

No complete record of the wind velocity or rainfall of the storm can be obtained, since all instruments in the path of the hurricane were blown down, and in the case of Port Eads destroyed. It is evident, however, that the wind must have blown at the rate of 100 miles per hour in the vicinity of Pointe-a-la-Hache and along the islands on the coast. While the wind worked great havoc, yet the immense wave of water that swept over the devastated section engulfed and swept away everything in its path. It is probable that the center of this hurricane passed midway between New Orleans and Port Eads on its northeast course, since the path of greatest destruction was in that neighborhood.

It is said that over 1,500 lives were lost on the coast by drowning; the destruction of property, and the orange, rice, and other crops was very complete.

Crossing Louisiana in a northeasterly direction, the center struck the coast of Mississippi a little west of the Alabama boundary line. The following description by one who must have been very near the center is from Capt. Henry M. Davies, of the schooner "B. Frank Neally," lying at anchor at Moss Point, Miss., N. 30° 25′, W. 88° 34′:

I awoke and found it blowing heavy from east-southeast, barometer 29.90. (During October 1, 1893, the barometer was 29.90, and it was raining all day, with but little wind from the southeast.) I went and looked at the glass and found it at 29.70. I called the mate and told him that we were going to have a gale, the vessel at the time lying at the lumber wharf. We doubled our lines at 5 a. m.; the wind came in gusts and rain 6 a. m.; carried away head lines and dropped anchor, glass at the time 29.30; wind southeast by east, time 7 a. m.; got a hawser from starboard bow on shore. By that time the stern lines gave way, glass 29.00; no change in the wind. At 8 a. m. we were riding to two hawsers from shore and one anchor, glass 28.85, and the weather continued to blow heavier and heavier, glass 28.65, until 9.30 a. m., 90th meridian time, or railroad time, and it abated nearly to calm and gradually went around by south to southwest, and it came out heavy from west-southwest and west at 11 a. m., and continued until 3 p. m. and cleared away. It never went north of west until some time during the night. Nearly calm at 8 p. m.

The observer at Mobile reports:

Rain began 8.25 p. m. of the 1st, with rapidly falling barometer, and by 11 a. m. of the 2d a heavy southeast gale was blowing. The extreme velocity of the wind several times reached 80 miles. The rain continued throughout the day, ending at 7.30 p. m. At 2.15 p. m. the barometer began to rise, and at 2.30 began to rise as rapidly as it had fallen. Great damage was done to property. The prostrated trees lay in one general direction from southeast and south. The water was 4 inches higher than in 1852, the severest of any previous storm recorded. In the marsh truck farm section nearly every house was swept away, and farms were destroyed in Mobile County. Seven lives were reported lost.

The same observer communicates to the "Mobile Register" of October 3d an historical summary, from which we quote the following:

The first storm, accompanied by a high flood in Mobile Bay, was in 1711, when the water overflowed the newly organized town and caused its removal to the present site. 1711, September 11–13, a hurricane destroyed churches and buildings in New Orleans, and was felt at Mobile. 1732, a destructive hurricane. 1740, September 12, a destructive hurricane, lasting 12 hours, from the mouth of the Mississippi to Pensacola. 1746, hurricane on the Gulf coast. 1772, August 31 to September 3, most destructive storm as yet experienced; vessels, boats, and logs driven into the heart of Mobile; sea rose to a prodigious height; all the vessels at the Belize blown on shore; salt spray was carried inland 5 miles. 1779, August 8, hurricane suddenly advanced on New Orleans; the naval squadron of Governor Galvez of Louisiana destroyed. 1780, August 24, a hurricane more furious than that of 1779. 1781, August 23, hurricane desolates Louisiana; Mississippi Delta entirely inundated. Between 1740 and 1800, there were fifteen destructive storms. In 1813, August 19, very destructive hurricane on the Gulf coast. 1819, August 25–28, great destructive hurricane in Louisiana and Alabama. 1852, August 23–25, hurricane and highest flood ever known, except that of 1772. 1856, August 19, hurricane swept the coast of Louisiana, but was not particularly severe on the Alabama and Mississippi coasts; Last Island was submerged and 300 lives lost. 1860, August 11, storm at Mobile; the high-water mark was 18 inches lower than that of 1852. On September 15, of the same year, another storm, whose high-water mark was 12 inches lower than that of 1852; this is the only instance in this century of two autumnal floods in the same year. 1870, July 30, storm at Mobile, the earliest hurricane on record at that place; the high-water mark was about the same as that of 1860. 1888, August 18–20, southeast gale at Mobile, with very high tide about equal to that of 1860. During the storm of the present October, 1893, the water at Mobile rose 3 inches above the flood line of 1852, and all recognize it as the worst that has hitherto been experienced here.

The observer at Pensacola reports:

October 3d, a severe storm struck this place about 4.45 a. m. Rain began at 5.20, accompanied by high wind attaining a maximum velocity of 66 miles southwest at 3.45 p. m. From 6 to 10 a. m. the average hourly velocity was 34 miles, and from 10 a. m. to noon 40 miles per hour were registered. Considerable damage was done, the greatest occurring along the water front. Railroad communication was entirely cut off by washouts, and great damage was done to shipping.

The hurricane center moved slowly northeast over Georgia to Cape Hatteras, and seems to have been dissipated on the 5th; violent winds, heavy rains, and local storms attended its progress through the south Atlantic states.

The observer at Savannah, Ga., reports:

October 3d, rain began early morning and continued at intervals until 6.50 p. m. Between 12.30 and 1 p. m. a funnel-shaped cloud was reported about one mile east of the station. It was composed of inumerable streamers extending downward to within a few feet of the ground. Its rotary motion was from right to left. The time elapsing from its appearance to disappearance was about 4 minutes, and its course was from southeast to north-

northwest. Débris was thrown toward the west and northwest. Heavy rain preceded the cloud. The stern of an iron-clad steamship, moored at the wharf, was blown 20 feet.

X.—This storm was described at the time in the Lake Storm Bulletin No. 2 of 1893. From subsequent data it appears that the early history of this hurricane is even at present very imperfectly known.

The reports from the "Ida" show a high sea October 1st–3d from the southeast, with gloomy weather, at about latitude 15°, longitude 43° to 45°. I locate the hurricane center on October 3d, Greenwich noon, at approximately N. 18°, W. 45°, therefore there is some discrepancy in relation to the swell from the southeast, as reported by the "Ida".

The reports from the "Catalonia" show that a disturbance prevailed on October 3d and 4th in latitudes 19° to 20° and longitudes 48° to 50°, and I locate the hurricane center October 5th, Greenwich noon, at approximately latitude 18°, longitude 49°. On the 5th, at noon, the "Catalonia" was near the center.

The "John B. Coyle" was near the center from noon of 6th to 3 a. m. of 7th, and I locate the center at noon of the 7th as approximately 21° N., 58° W. The center passed northeast of Nassau in the early morning of the 11th, and the steamer "Ciudad Condal" passed through the center at 9 a. m. of the 12th, at which time the center was approximately latitude 27°, longitude 79°.

The following reports from Antigua and Dominica show the slow advance of this hurricane as it passed north of those islands. It should be remarked that the suggestion by the observer at Dominica, that his ocean swell from the west on October 6th was due to the action of a storm in the Gulf of Mexico on October 2d, seems entirely inadmissible, and the editor thinks it more probable that this and similar instances in the West Indies are illustrations of the fact observed by him at the Island of Ascension, *i. e.*, that a heavy swell on the east side creeps around to the other side and there produces rollers that appear to come in from the west. A similar but much feebler illustration of wave phenomena has also been observed by him at Barbadoes.

Government Laboratory, Saint Johns, Antigua. Barometer (corrected and reduced) September 30th, 29.94 but fell steadily to October 5th, 29.70, and October 6th, 29.68 all day, the wind from southwest, force 3 and 4; minimum 29.66 at 3 p. m , southwest, force 5, and stayed low throughout the 7th, south-southwest from 6 diminishing to 4. Rose steadily 8th, 9th, 10th to 29.98 on the 12th, east wind. Large waterspouts on the 10th northwest of Saint Johns from 1–2 p. m. and thunderstorm in the evening working up from the south and west. During the 6th the sky covered with thin haze.

Government House, Roseau, Dominica. Ever since October 1st most unusual weather, very hot; light northerly winds; highly colored sunsets; no rain, abnormal low barometer steadily, falling to minimum, 29.77, on the morning of the 6th, after which it began clearing and the ocean swell was from the westward; the reporter thinks this depression and swell must have come from the storm which was violent in the Gulf on October 2d; he states that on account of the high hills and mountains on the east side of the island the direction of the winds can only be judged of from the apparent movement of the clouds. His own position is on the west or leeward side of the island, having these hills and mountains on the east. At his location the sea is invariably calm when the wind is in the usual direction; his barometer is 90 feet above sea-level. His total rainfall for September is 10.79 inches on 24 days out of 30; the total rainfall for the year up to date is 66.14.

The observer at Santiago de Cuba states that: "The hurricane that originated in the Antilles moved north and was first heard of off Antigua; was north-northeast of Saint Thomas on October 7th in the morning, the outward spirals having touched the hilly lands of Santo Domingo caused the hurricane to pass so far north."

This last report illustrates the impossibility of locating the center and path of the hurricane from a few local reports; the present storm undoubtedly originated a long way east of the Antilles, and was at no time very near those islands or the Island of Antigua; the influence of the hilly island of Santo Domingo on the track of this hurricane is also very much exaggerated; cases are on record in which a hurricane center passing directly over Puerto Rico, Santo Domingo, or Cuba is somewhat deflected by the islands, but when the center, and in fact the whole whirlwind, is over the free ocean the influence of distant islands must be inappreciable.

M. Carmena, captain of the steamer "Ciudad Condal", reports the position of his vessel in the neighborhood of this hurricane center on the 11th and 12th of October. The position of the vessel was, on the 11th, noon, N. 25° 57′, W. 79° 59′; 12th, noon, N. 27° 16′, W. 79° 41′; 13th, at noon, N. 27° 20′, W. 79° 5′. On the first date, 11th, at 9 p. m., the hurricane center was 70 miles east-northeast from the vessel. On the 12th, at 4 a. m., it was 50 miles east of the vessel, and on the 13th, at 4 p. m., it was 30 miles southeast. The barometer at these times read 748, 740, and 729 millimeters, respectively, not corrected for temperature (24° C.); the winds were north-northwest force 9, north-northwest, 11, and southwest, 11; the average speed of the hurricane center was 6 miles hourly toward the N. 70° W. The vessel had a speed somewhat greater; the maximum velocity of the wind was about 80 miles per hour. The vessel, notwithstanding the head wind from north-northwest, gained on the cyclone center and passed ahead to the northward of its track; she was in the Gulf Stream, being on her way from Habana to New York. It is probable that the center of the hurricane was farther from the vessel than the figures above given would indicate.

The high water caused by the easterly winds on the south Atlantic coast was very severe and caused much damage. The hourly record of the height of water, the wind, and other

XV.—As above stated, the country west of the Mississippi was dominated by an area of high pressure from October 13th to 14th, and on the 15th this area was central in the Ohio Valley; on the 16th frosts and northerly winds prevailed in the Gulf States. Undoubtedly this high pressure with northerly winds extended southward over the whole Gulf of Mexico during the 16–17th, and it is not likely that this would have been the case if there had not been a decided deficit of pressure existing still farther to the southward either in Mexico or the Caribbean Sea, or possibly even on the Pacific Ocean south of Mexico. Whatever may have been the ultimate cause of this extensive southward movement of the lower layer of the atmosphere, one of its first results must have been the formation of clouds, rain, and occasional whirlwinds on the coasts of Mexico, Guatemala, and Cuba, and in the Gulf waters themselves. By the 18th this region of cloud and rain had extended northward to our Gulf coasts, the northerly winds became more decidedly easterly, and the barometer began to fall at Nassau and Key West. The conditions were at that time such as generally precede the advance of a hurricane moving westward from the West Indies, but no reports of such hurricanes have reached us. On the 21st, however, a storm-center was certainly central in the afternoon north of the Bahamas, which may very plausibly have been developed as a well-defined whirl for the first time on that day. It moved rapidly northward, becoming a gale on the North Carolina coast on the 22d; it then swerved a little to the west and disappeared in Maryland on the 23d.

D. This is depression No. V in the list of American low areas and may be located on the 6th north of Cuba; after this date it steadily developed both as a whirl and as a low pressure with increasing winds; its path lay northeastward a short distance from the United States coast, while areas of high pressure were central northwest of it over the continent, Lake region, middle, and the east Atlantic states, and southeast of it on the Atlantic Ocean. On the 10th it was in N. 39°, W. 55°, and on the 11th in N. 41°, W. 46°; at this date an area of high pressure was central in northern Ireland and Scotland and another in New England, while the pressure between N. 20° and N. 40° throughout the middle portion

of the north Atlantic was decidedly below the average; easterly gales prevailed from the English Channel and Irish Sea eastward to W. 30° and southeasterly gales between W. 30° and 40°; northerly gales prevailed from Newfoundland southward to N. 30°, the whole constituting a very extensive whirl around the storm-center as above located for this date; there are also evidences of the beginning of an independent whirl south of the principal one.

On the 12th the lowest pressure apparently extended as a long oval northwest and southeastward, with its center at N. 40° and W. 40°. At noon of the 13th the map shows a large area of pressure 29.5 or less, the center being as before, N. 40°, W. 40°, but the barometer had now fallen decidedly over England, the highest pressure had been rapidly transferred to southern Germany, and pressure had also fallen over the Atlantic States and Canadian Provinces. At noon of the 14th the center of lowest pressure and revolving winds was at N. 43°, W. 36°, and at noon of the 15th the low pressure extended as a trough northeast and southwest between N. 40° and N. 50°, the center being at N. 45° and W. 30°, but subsidiary and minor depressions were at this time also central in northern Scotland, France, and northern Russia. On the 16th pressure had recovered over northern and central Europe, but low pressures with attending whirlwinds were central west of Ireland at N. 52°, W. 18°, and on the western portion of the Atlantic in connection with the low center over the Gulf of Saint Lawrence.

From this date, during the 17th, 18th, and 19th, a continuous gale, sometimes of hurricane force, prevailed on the European coast; in the English Channel southeast winds prevailed on the 16th, west winds on the 17th, and northwest on the 18th and 19th, which, by the 20th, had veered to northeast with clearing weather and high pressure; the lowest pressure was central on the 17th at N. 56°, W. 4°; on the 18th at N. 54°, E. 3°, and also at N. 44°, E. 8°; on the 19th at N. 53°, E. 9°, and also at N. 45°, E. 11°; on the 20th at N. 49°, E. 11°, and also N. 43°, E. 12°. On the 21st these latter low pressures had filled up and others had developed in northern and central Russia, respectively.

While this extensive storm area was thus, on the 16th to the 20th, moving slowly eastward through western Europe and while an extensive depression was moving down the Saint Lawrence Valley the pressure rose steadily over the Atlantic Ocean between N. 10° and N. 60°, W. 10° and W. 50°; although a belt of high pressure was thus made to prevail from the south Atlantic states to Algeria yet it may be an open question whether the barometric rise north of this zone should be considered as due to a bodily movement of the zone northward; although southerly winds prevailed for a time in the eastern portion of the Atlantic yet by noon of the 20th the pressure was higher between N. 45° and 60° than it was to the southward, and on the 21st the central highest pressure (30.6 to 30.7) extended from Ireland westward to W. 35°, so that the growth, the location, and the movements of this area of high pressure which, in fact, continued nearly stationary until the 24th, must be attributed to a general descending current over this portion of the Atlantic precisely similar to the descending high pressure areas of the North American continent.