

## 1. INTRODUCTION

While in the process of conducting a historical survey of damaging tropical storms for the state of Virginia, the authors ran across an intriguing cyclone from October 1878. It was a cyclone which developed in the western Caribbean and was not detected by the West Indies hurricane network before its movements west of the isle of Jamaica on October 18. Once its presence was known, the U.S. Signal Corps, a division of the War Department, tracked its progress northward just off the Florida coast into North Carolina and issued signals to warn of its arrival. This is a process the Signal Service had been tasked with since November 1870, and one in which it had enjoyed some limited success. The storm's similarities with other major storms of more recent decades, such as Agnes (1972) and Hazel (1954) led to a more exhaustive search for information about its impact on the Eastern seaboard.

## 2. SOURCES OF INFORMATION

Information for this project was gleaned from books on local history, old articles from Savannah, Charleston, Norfolk, Washington (DC), Wilmington (DE), and Trenton newspapers, as well as other publications stored at the Library of Congress and the National Archives in the District of Columbia. Pressure values were then converted from inches of mercury to hectopascals using the Smithsonian Meteorological Tables (List 1968). Wind data was then converted from five-minute sustained winds to the one-minute sustained winds used in the NHC track database (Powell et. al). Data was then utilized for further research using the Nmap graphics display system, which is part of the n-Awips software used by the Hydrometeorological Prediction Center (HPC) in Camp Springs, Maryland.

## 3. STORM HISTORY



In order to determine was influenced the storm's motion through time, synoptic weather maps were drawn from Signal Service data for the period of October 17-25. The cyclone's impetus for development, even after this re-analysis, remains unknown. It is hypothesized that a tropical disturbance was present around October 16 in the southwestern Caribbean, and was lured northward by an approaching frontal system invading from the Gulf of Mexico. The cold front stalled late on October 19, in the vicinity of Cuba as a surface anticyclone drifted eastward through the Southeast. As the high pressure system continued its march into North Carolina, pressure gradients began to increase over south Florida as the cyclone edged north across Cuba. As the tropical storm moved through the Florida straits on October 21, a coastal front formed off the coasts of the Carolinas and Georgia, acting as a focus for rains well ahead of the storm. Key West sustained 26 m/s winds on that day, and it is likely gale force winds lashed much of the Gold Coast at this time.

An extratropical cyclone in the mid-latitudes was located over the Mississippi Valley on October 21. Its cold front accelerated south into the western Gulf, and the deep southerly flow ahead of the system acted to increase the forward motion of the hurricane into North Carolina late on October 22. As it linked up with a cold front late on October 23, the storm became nontropical, and its track bent to the east as it moved along the main cyclone's triple point. This is also when the heaviest rains shifted from just east of the track to north of the low...in its cold conveyor belt circulation. The storms this cyclone compared the closest to include the September 1893 hurricane (storm 9), the October 1899 hurricane (storm 6), and Hazel in 1954. The track of the Gale is to the right...numbered positions reference location at 1200 UTC. Clicking on the track will give you a better quality image.

#### **4. ACTIONS OF THE U.S. SIGNAL CORPS**

Cautionary signals were ordered for Key West at 0500 UTC on October 20. As winds increased at Key West, signals were ordered for that location by 1600 UTC. By 1700 UTC, signals were ordered up from Jacksonville up the coast to Charleston. Later on October 21, signals were raised from Smithville to Kitty Hawk in North Carolina. At 0500 UTC on October 22, cautionary signals were raised for the Great Lakes from Alpena to Sandusky, then eastward to Oswego later that day. For the East coast, signals were hoisted from Cape Henry to Boston. On October 23, signals rose from Portland to Eastport.

#### **5. LOWEST PRESSURES**

As the hurricane made landfall between Wilmington and Cape Lookout, the pressure fell to 983.8 hPa at Cape Lookout. However, the lowest pressure measured from the center of the storm occurred in the northern Chesapeake Bay, where the lowest sea level pressure of 974.6 hPa was observed. A common technique for analyzing central pressures of cyclones, both at the HPC and the MPC (Marine Prediction Center) is to subtract 1 hPa per 4 m/s (10 kt) of wind. If you apply this rule to Cape Lookout, which measured a five-minute sustained wind of 47 m/s, a reading of 975 hPa is derived as the low moved ashore. It is quite unlikely that the minimum central pressure of the hurricane maintained itself during the eight hour voyage from landfall to the the northern Chesapeake Bay. If the pressure rise reported from surface observations during the low's trek over the succeeding six hours from the Chesapeake into eastern Pennsylvania is correct (a 10 hPa rise), a value of 963 hPa would be extrapolated just before the time of its landfall. Using Atlantic wind/pressure relationship tables derived by Charlie Neumann and Chris Landsea, this perfectly fits the 47 m/s wind observed (Landsea, personal correspondence).

## 6. MAXIMUM EXTENT OF DAMAGING WINDS

To the right shows the area where maximum sustained winds reached gale force (in orange) and hurricane force (in red). It is believed that hurricane force winds lashed the Gold Coast of Florida due to the high winds seen at Key West, and the reports of hurricane conditions in Cuba. Gales extended northward through the Mid Atlantic towards the Great Lakes. Hurricane force winds were seen almost entirely to the east of the track, from approximately Wilmington, NC northward through eastern Virginia, Chesapeake Bay, Philadelphia, Delaware, much of New Jersey, and just off the New England coast. It should be noted that most of the higher winds in New England occurred while the storm was still centered over the Mid Atlantic.

## 7. RAINFALL FROM THE GALE

The 25 mm contour extends diagonally across Florida from north of Port Charlotte north-northeast to Jacksonville and Charleston before going due north across the Appalachians into Lake Ontario (rainfall map to the right...25 mm is approximately equal to an inch). In New England, the northern edge of the precipitation was more dramatic. As the storm became extratropical, a cold conveyor belt circulation formed north of its warm front/occlusion, leading to heavy rains across southern Maine. Regions where 100 mm were measured include southeast North Carolina and much of southern Maine. The highest totals observed were 159 mm at West Waterville, Maine, 127 mm at Emory Grove, Maryland, and 122 mm at Key West.

## 8. COMPARISON TO OTHER HURRICANES

Sixteen hurricanes had similar tracks through the East as the Gale of '78. If you restrict the sample to those which were similar throughout the track, only seven others come close. Of this sample, with the exception of the September Hurricane of 1878, all others formed in late September or October. All produced hurricane force winds significantly inland of their point of landfall. None formed in June, another month climatologically prone to systems accelerating northward out of the tropics. Agnes (1972) did not make the sample as it was much weaker, and swung off the coast before making its final landfall in New England. Hazel's track was included as it was the storm with the closest track (and effects) to the Gale in the Twentieth Century. All other storms in the sample occurred in the Nineteenth Century.



## 9. DAMAGE AND FATALITIES

Seventy-one people perished due to the Gale of '78 (Rappaport et. al. 1995) in the eastern United States. A running tally of the death toll will appear as they are covered in this paper. Those that were lost to the storm were taken due to shipwreck and river flooding. In Philadelphia alone, \$2 million in damage was exacted (Noyes 1878), in 1878 dollars, when over 700 structures failed. Along the coast, the Virginia barrier islands of Smith and Cobb went underwater for the first time in memory, taking all cattle out to sea (Barnes et. al. 1997). The following narrative describes damage and storm effects region by region.

**Cuba.** On the night of the 21<sup>st</sup>, hurricane conditions were reported at Havana. Much damage was done to buildings. Three schooners sank. Pressure reports were missing during the storm's passage over the isle...the lowest pressure noted was 29.67" at 4:25 p.m. on the 21st. Observations were sporadic during the cyclone's passage over the island, therefore the pressure most likely reached lower values than those received at the Washington Signal Office.



**Florida.** At Key West, northeast winds peaked at 24 m/s (54 mph) during the morning of the 21<sup>st</sup>. Their storm total rainfall measured 122.7 mm (4.83"). High north to northeast winds were also witnessed at Punta Rassa. Passing forty miles offshore the Gold Coast, the Gale disrupted shipping (the map to the right shows what was going on over the Southeast at the time). The steamer *Nueva Barcelona* lost its rudder eight miles south of the St. Augustine lighthouse. Off St. Johns Bar, a severe east-northeast gale backed to the north on the night of the 21<sup>st</sup>/22<sup>nd</sup>...though winds did not exceed 8 m/s (17 mph) in Jacksonville. Over a dozen vessels were driven aground between the Florida Straits and Cape Canaveral (Barnes).

**Georgia.** At Savannah, light rain fell through the afternoon and evening on the 22nd. Heavy rain set in by 2:45 a.m. the 23rd and continued until dawn. High winds increased to "almost a gale", before conditions improved later that morning (Estill 1878). Savannah recorded 0.33" of rain and a pressure of 29.60" during the storm.

**South Carolina.** At Charleston, a steady rain fell throughout the 22nd, with occasional squalls. The pressure fell to 29.56". The steamer *Juanita* reported a "terrific northeast gale" between Charleston and Tybee Island during the night of the 2<sup>nd</sup>. The bark *Martha* was abandoned at sea off the South Carolina coast. Charleston only reported 0.43" of rain.

**Louisiana.** In the wake of the cyclone, cold air pooled in Canada was brought southward into the Pelican state. A terrible yellow fever epidemic had been in progress across the South all summer. In New Orleans, it was ended by cooling temperatures behind this storm. The total loss of life in the Crescent City was 3,915 that summer (Every Evening Publishing Company).

**North Carolina.** The cyclone was centered between Wilmington and Cape Lookout at 11 p.m. on the 22<sup>nd</sup>. The map to the right shows the conditions over the Mid Atlantic at that time. At Wilmington, the storm began at 3 p.m.. The maximum sustained wind of 16 m/s (36 mph) was reached at 10:40 p.m., with the lowest pressure of 986.1 hPa (29.12") reported at 11:56. At Cape Lookout, the pressure fell to 983.8 hPa (29.05") at 11:02 p.m., when the wind went southeast at 30 m/s (68 mph). The highest winds in the last 5 ½ hours reached 45 m/s (100 mph) ...a rain total of 103.1 mm (4.06") was measured. In Portsmouth, winds reached 37 m/s (82 mph) from the southeast at 11:04 p.m.. Smithville peaked at 14 m/s (32 mph) from the east during the day of the 22<sup>nd</sup>. Kitty Hawk greeted the storm at 6:30 p.m. on the 22<sup>nd</sup>. The winds reached 39 m/s (88 mph) by 2 a.m. on the 23<sup>rd</sup>, just before the anemometer was blown away. The pressure fell to 984.1 hPa (29.06").

One mile south of Cape Hatteras, the schooner *Altoona* went ashore at 11:45 p.m., proving a total loss. The schooner *Magnolia* wrecked in the Albemarle Sound that night; its captain drowned (1). The first officer of the *Mary A. Hood* was washed overboard (2) off Hatteras. At 1:30 a.m. on the 23<sup>rd</sup>, the steamer *Florence Witherbee* went ashore. The schooner *William Collyer* went ashore six miles south of Barnegat at 2:40 a.m.. Two went overboard from the schooner *Wyoming* trying to enter Beaufort (4). The steamship *Gen. Barnes* foundered off Cape Hatteras on the morning of the 23<sup>rd</sup>, also a total loss. The steamship *City of Galveston* was reported lost in the storm on the 23<sup>rd</sup>. The steamer *City of Houston* encountered the gale on the night of the 22<sup>nd</sup>, and was lost off Frying Pan Shoals after it was abandoned by her crew (\$200,000).

**Virginia.** The five minute sustained wind reached 38 m/s (84 mph) at Cape Henry, while Norfolk experienced a 20 m/s (44 mph) gale and a lowest pressure of 994.2 hPa (29.36"). Many of Virginia's life saving stations were damaged, with one lifted from its foundation and moved half a mile. An account of the storm's effects in the Norfolk area was provided by the Norfolk Landmark.

"....Only strong willed people could sleep while dwellings so violently oscillated with the ravings of the tempest Tuesday night (22<sup>nd</sup>). At an early hour a severe gale sprung up from the northeast and by 9 o'clock old Boreas was knocking things around town in a lively style. The rain came down in torrents and the streets at times were a driving sheet of water. Yesterday morning (23<sup>rd</sup>), after the abatement of the storm it was found that considerable damage and loss was involved in the destruction of various sorts of property around the city and vicinity. The maddening fury of the elements will long be remembered as making one of the most severe storms in the annals of our city's experience...."

There is another first hand account of the storm from Mr. Bolton, an employee of the U.S. Signal Service, an early version of the National Weather Service. Mr. Bolton was a repairman of the telegraph line between Cape Henry and Kitty Hawk and was stationed at the Life Saving Station No. 3 in False Cape.

"....I was at the station when the gale, which proved so disastrous to human to human life commenced. A severe rain storm has prevailed all day Tuesday (22<sup>nd</sup>) but the gale did not reach the station until 9 p.m. It rapidly increased in velocity until it almost became a hurricane. The members of the crew at this station, whose duty it is to patrol the beach that night, performed their duties with the utmost difficulty, as they could scarcely make any headway against it, and often had to cling to some stationary object like a telephone pole to prevent themselves from being carried away at the mercy of the fearful tempest..."

The *A.S. Davis* went ashore at Virginia Beach, killing 19 (23). Gale force winds were experienced by 8 p.m. on the 22<sup>nd</sup>, with the ship running ashore at 2 a.m. the next morning. Mr. Bolton described the wreckage of the ship:

"....The debris was thickly scattered along the beach for a distance of fully 4 miles....I proceeded to Cape Henry, Virginia to assist the Signal Officer there. The body of one of the crew was there. About 1 ½ miles south of Cape Henry the bodies of eleven of the crew had been washed ashore.....During the heaviest part of the gale, the wind at Kitty Hawk, North Carolina registered 100 mph. The instrument itself was finally blown away and therefore no further record was made. It was the severest gale that had occurred on this coast for sometime."

A heavy rain and wind blew through Richmond for several hours after midnight on the 23<sup>rd</sup>. Winds became "almost a hurricane." It was considered the hardest storm in years. Trees, fences, and telegraph lines were downed across the city. The schooner *Brewster* saw one of its passengers drown near Nanjemoy Beach (24). One of the crew of the steamer *Everman* was washed overboard and lost (25). Cobb and Smith Islands were completely submerged during this storm...higher than seen in at least 20 years. All livestock was swept clean from the islands. The steamer *Theodore Weems* lost its rudder and some of her joiner work. At least 22 ships met their demise in this hurricane.

**Washington, D.C..** Winds increased at 1 a.m. on the 23<sup>rd</sup>. The peak of the cyclone was seen in Washington, D.C. at 4:40 a.m. on the 23<sup>rd</sup>. After that, winds swung around the compass a couple times before settling on northwest by 7:15 a.m....the pressure fell to 975.3 hPa (28.80") at that time. Trees were uprooted and buildings unroofed during the storm. Fields of corn were submerged in the ensuing flood around the District of Columbia. Rock Creek became a raging river, but produced little damage. Many young shade trees in the city were leveled. Telegraph lines were felled between Baltimore and New York. Flooding from the Potomac inundated many basements downtown along Pennsylvania Avenue. County roads crossing the Stickfoot branch of the Anacostia River were washed out.

**Maryland.** Annapolis saw the winds swing from northeast to southeast at 5:45 a.m., blowing with great violence. Its lowest pressure of 976 hPa (28.82") was measured at 7:30 a.m.. Baltimore measured a maximum sustained wind of 20 m/s (45 mph) at 5 a.m., and a lowest pressure of 976.3 hPa (28.83"). The storm was compared by some to a tornado. All telegraph communication was cut off, except to the District of Columbia. Many homes were unroofed; several were destroyed. Waters in Jones' Falls began rising during the storm, and flooded the surrounding sections of Baltimore. Wharves were submerged. Horse racing at Pimlico was suspended due to the weather. The map to the right shows the extensive area of rain... at this time spreading from Virginia westward to Ohio, and northward into New York and Connecticut.

On the Chesapeake Bay, the storm was

considered "terrific", and was felt worst between the mouth of the Patuxent River and Barren Island. Winds began to freshen at midnight, reaching gale force from the east to southeast at 2 a.m.. Immense waves broke over the upper deck of the steamer *Express*. Winds reached hurricane force at 4 a.m.. The ship then wandered through the middle of Chesapeake Bay. The barometric pressure fell to 974.6 hPa (28.78"). Shortly after 5 a.m., when the winds shifted to the southwest, waves tore away the saloon deck and flipped the ship on her side. After rolling completely over, survivors gathered timber to make a tiny escape craft. It sank immediately near Point No Point in St. Mary's county in Maryland. The Quartermaster was rescued at noon that day, twenty miles from the scene of the wreck. Five lives from the vessel were lost (30).

The steamboat *Shirley* was driven ashore Barren Island. A schooner in Chesapeake Bay was reported to have drifted into the woods. The schooner *John Russell* was blown ashore at St. Jerome's Bay, just north of the mouth of the Potomac, left high and dry in a corn field. Four or five other steamers along with many other schooners were driven ashore in that vicinity.

**Delaware.** On Delaware Bay, this storm was one of the worst ever experienced up to that time. Large numbers of vessels, of all shapes and sizes, were driven ashore. The tempest was very destructive in the First State. Many trees and fences fell victim. Telegraph lines failed. Buildings were unroofed statewide. High winds led to floods along the Delaware, Christiana, and Brandywine Rivers. Light rain began on the evening of the 22nd. Winds increased overnight, becoming a "terrific gale" by morning. Winds relaxed by late morning.

Much of South Wilmington was flooded; flood waters reached as high as midway up the first floor. A large area southeast of the city was described as a "vast sea." Buoys from the Government wharf at the lighthouse were seen floating upriver. Two houses in Pickelville floated off their foundations with their occupants along for the ride. A washout at Shellpot delayed trains on the P., W., and B. railroad north of Wilmington. The Knowles' woolen mill in New Castle burned to the ground (\$30,000 damage).

The schooner *J. Dever* was struck by the Gale while sailing up the Christiana for harbor. The ship capsized, taking two of her crew to the bottom (33). Six goats drowned. Port Penn eclipsed its highest tide ever known by four feet. Schooners floated up to 1 1/2 miles inland. The tug *W. P. Bolton* was left a complete wreck near the lighthouse. Its captain perished, as well as a boy aboard (35). The *Estelle Bright* wreck 1/4 mile opposite New Castle around 6:00 a.m. when a heavy gale and sea suddenly arose. Three aboard drowned (38). Seven perished when the *Buckeye* foundered off Tasker's Iron Works, near Fort Delaware, on Pea Patch Island (45).

In Middletown, damage was done to the Presbyterian church, Episcopal church, and the Delmarva Drying House. The long bridge over the St. Augustine creek and surrounding marsh was destroyed. Hundreds of bushels of corn was swept down river, as well as several homes (\$3,800 damage). It was considered of shorter duration than the September 1876 cyclone, but more severe as tides rose 2 feet above the 1876 benchmark. Odessa saw many of its barns prostrated. and many heads of cattle perish. Several vessels were driven ashore. Everything except the hotel was swept away from Collin's Beach (\$10,000 damage).

Dover totaled \$1,100 in damage to new carriages, which were smashed to pieces. Everything at the fairgrounds was in ruin. Four drowned in Leipsic when the tide rose so quickly that the men inside could not escape (49). At Lewes, it was the worst storm in forty years. The storm began at that location at 2:00 a.m.. A seven foot storm surge was measured at the beach, an event that hadn't been witnessed in at least fifty years. At Rehoboth, the beach eroded away. The railroad track bed at Maull's Glades was washed away. All

bathhouses along the beach disappeared.

Mispillion Light lost all their stock when the tide swept it away from the base of the lighthouse. Cattle, horses, corn, and hay all were flooded away along Mispillion Creek. A large tree fell through a building in Milford, splitting it in two. Frederica saw its Methodist church leveled. Twenty-four oyster boats were beached at Clayton, but no lives were lost. The railroad pier at Bombay Hook was nearly obliterated. Eighteen lives were lost statewide. Almost \$45,000 in damage was seen across Delaware.

**Pennsylvania.** Damage from this hurricane was widespread. At Scranton, trees were uprooted, houses were "dismantled", and many residences lost their roofs. In Philadelphia, a strong east wind raged from 2 a.m. to 8 a.m., before shifting to the south. Half-hourly observations were taken at the Signal Corp office between 5 a.m. and noon. These revealed the lowest pressure measured as 986.1 hPa (29.12") and a southeast wind of 32 m/s (72 mph) at 7:40 a.m.. Oaks fell throughout downtown. At least 700 buildings were destroyed while nearly fifty churches lost their spires. Train sheds at the Pennsylvania Railroad Depot in West Philadelphia were demolished (\$32,000 damage).

Flooding submerged the first stories of buildings along the river front; the height of the flood occurred at noon on the 23rd. Great damage was done to buildings and the dykes around League Island, at the junction of the Schuylkill and Delaware Rivers. The bridge at the falls of the Schuylkill was swept away (\$30,000 damage). The tide around the island exceeded the highest known before by a foot by 10 a.m....almost the entire island was submerged. The ship house on the isle was a "wooden mass" after the storm passed by. The sloop *Helen* became a complete wreck in its vicinity. High floods washed away the Madison bridge near Pottstown (\$100,000 damage). Nine canal boats sank in its vicinity. Much of the oyster fleet was sunk during the tempest, taking two lives (51). Five mules perished. At Media, a house was leveled, trapping its owner in the ruins; he was later rescued.

Wilkes-Barre reported one life lost (52) and several injuries. A tornado struck at 10:30 a.m., lifting up and moving a building bodily through the air. At Reading, two more casualties were reported (54). Seventeen vessels were sunk and twenty-two others were badly damaged. Chester estimated \$40,000 in damage as 90-100 buildings were unroofed; fifteen homes were destroyed. Damage was estimated near two million dollars in Philadelphia. Pottstown tallied more than \$100,00 in damage. Extensive property damage occurred in the Schuylkill, Lehigh, Lackawanna, Lebanon, and Wyoming Valleys. Seven lives were lost in Philadelphia (61). At Erie, winds reached 15 m/s (32 mph) in the cyclone. A schooner was totally wrecked. Damage totaled \$2,140,000.

**Ohio.** Even in Ohio, the storm's wrath could be felt. In the pressure gradient behind the low, winds reached 16 m/s (35 mph) at Cleveland, where heavy rain prevailed.

**New Jersey.** Camden suffered greatly with 150 buildings unroofed. The storm set in at 2 a.m. with strong east winds, waking up the populace. By 7 a.m., increasing winds began to unroof buildings, topple smoke stacks, down telegraph lines, and level sturdy buildings. The spire to the Fourth Presbyterian Church crashed through the place of worship. The pressure there fell to 29.40" between 8 p.m. and 2 p.m. on the 24th. Damage throughout town totaled \$16,200.

Along the Camden & Burlington railroad, considerable damage was witnessed around Moorestown. A train was lifted from the tracks below Kaigh's Point by flood waters, and capsized. The roof of the hotel at Wenonah blew off, as well as several other buildings in town. A grove near the train depot in Gloucester was leveled. Gloucester City's Iron Works had its roof peeled off by the winds (\$3,000). A similar event led to another \$3,000 loss at the Anaconda Print Works. The mills of the Washington Manufacturing Company suffered \$500 in damage. The West Jersey railroad was undermined along the Newton Creek Flats.

Big Timber Creek overflowed its banks,

inundating thousands of acres of land. Considerable damage was also reported from Union, Essex, Salem, and Hudson counties. Trees were uprooted at the Salem Presbyterian Church, which also saw its share of destruction. Near Sharpstown, a man was killed when his chimney crushed him on his front doorstep (62). A brick house near Hancock's bridge was blown down; one child fell victim to its collapse (63). Woodbury's town hall was unroofed.

Cape May sensed the beginning of the cyclone at 1 a.m., when a good northeast breeze developed. When winds reached 65 m.p.h., an "extraordinarily high tide" invaded the area. The highest winds preceded the storm, as easterly winds of 38 m/s (84 mph) were measured at 5:45 a.m.. This drove the increasing tides between the city and the mainland, covering the railroad track with three feet of saltwater. Barnegat Inlet commenced feeling the force of the cyclone at 6 a.m. on the 23rd. Barnegat recorded a southeast wind of 32 m/s (72 mph) while Atlantic City reached a peak wind speed of east at 25 m/s (56 mph). Very high tides ravaged the coast as the storm approached.

Six miles south of Barnegat, the schooner *William Collier* came ashore at 9:40 a.m. on the 23rd. Disaster struck the schooner *J. R. Chambers* and its load of potatoes. Her stern was stove in, rudder unshipped, and the sails were torn away while off Stony Point. The schooner *Julia* was driven ashore on the flats a few miles from Sedge Island while the *Samuel Carlton* grounded on the north shore of Barnegat Inlet. The schooner *H.F. Potter* was totally wrecked at Five-mile Beach; two drowned (65). Near Peck's Beach, the schooner *Sarah Clark* was demolished, four were lost (69). Vessels at Point Breeze broke from their moorings. The Russian corvette *Europe* collided with a pier, doing considerable damage. Numerous other vessels also went ashore. On the storm's backside, tides dropped so much due to the offshore flow that Barnegat Inlet became impassable.

**New York.** At 7 a.m., 22 m/s (50 mph) winds began in New York City, which lasted several hours. In New York City, one of the windows of Tiffany's was blown in (\$1,500). Considerable damage was reported. Oswego peaked at 13 m/s (29 mph). Rochester had 13 m/s (28 mph) winds sustained at 2:30 p.m.. High tides led to significant damage at the coast. The steamer *Massachusetts* went ashore Drum Point. The steamer *Louisa* went ashore the Middle Ground.

**Connecticut.** New Haven reported east winds of 18 m/s (40 mph) at 11 a.m.. The storm was considered very severe. The schooner *Mary Tyce* wrecked, which led to two casualties (71). New London experienced east winds of 27 m/s (60 mph)...their most severe storm in forty years.

**Massachusetts.** Boston reported southeast winds of 18 m/s (40 mph) as the low slid back offshore. Western sections of the state recorded over 75 mm (3 in.) of rain... with 87.6 mm (3.45") measured in Mendon. The map above shows the then extratropical low (the southern of the two lows) moving southeast through Massachusetts. The steamer *Ide* and 23 other schooners went ashore along the coast. The schooner *Joseph Fitch* went to pieces off Stonington.

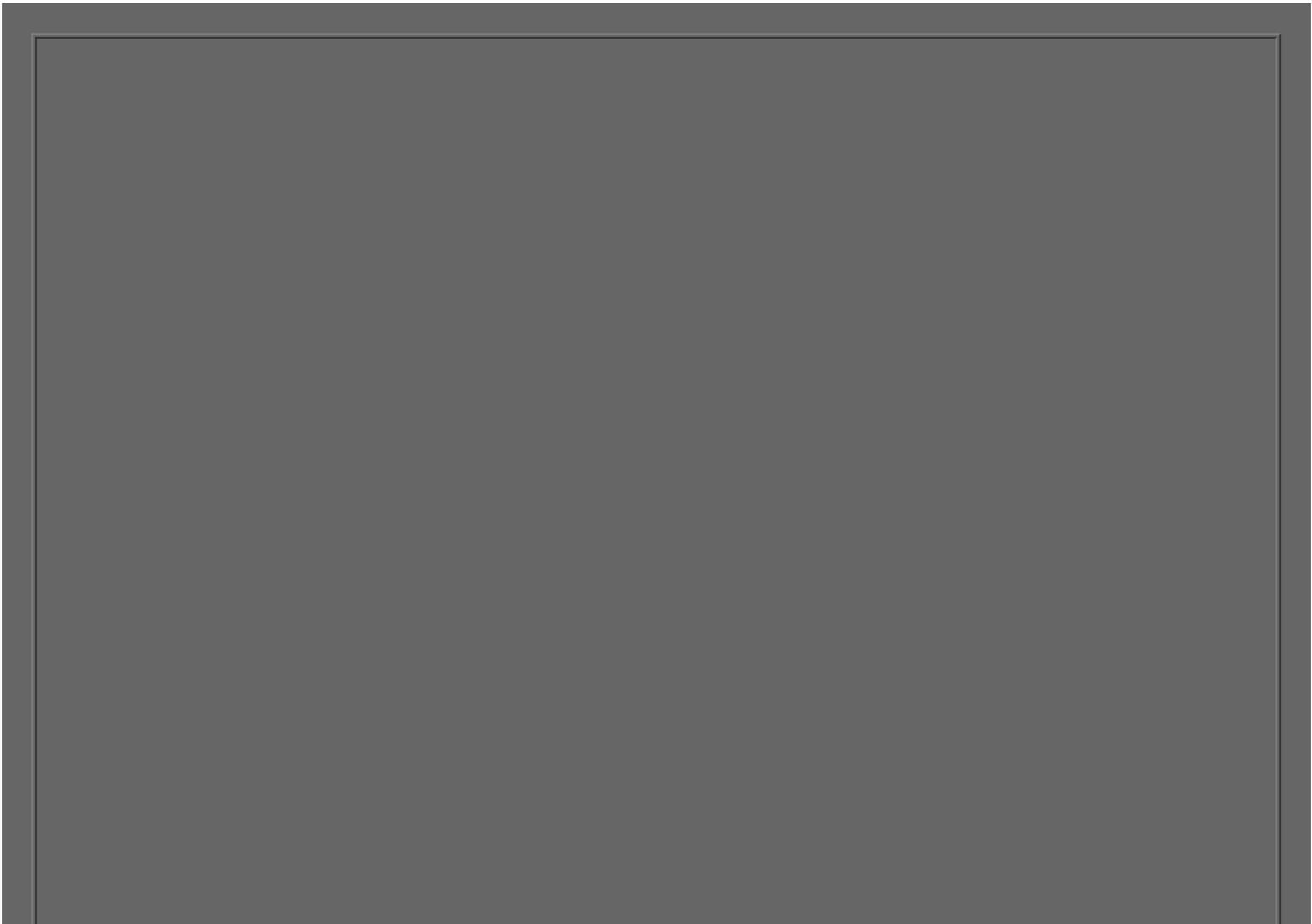
**New Hampshire.** At Mount Washington, at 6000 foot elevation above sea level, 54 m/s (120 mph) winds lashed the observatory at 4:57 p.m. on the 23<sup>rd</sup>. At Dunbarton, 87.6 mm (3.45") of rain fell.

**Maine.** Winds at Portland reached 31 m/s (70 mph); the anemometer was destroyed. A deluge fell across southern Maine, with 160 mm (6.30") measured at West Waterville....the highest total for any known location associated with this cyclone.

## 10. PROPOSED SMOOTH TRACK OVER THE UNITED STATES

The following chart was created from all the data compiled from the U.S. Signal Corps (Myer 1878) and the previously known track (Fernandez-Partagas et. al. 1995). Surface maps were made for the time period prior to, during, and slightly after the cyclone traversed the United States. From the positions derived at map time, and winds observed by the Signal Service, the following synoptic data were created for its passage over the United States.

Date	Time (UTC)	Latitude (N)	Longitude (W)	Max. Wind (m/s)	Central Pres. (hPa)
10/23	0600	35.7	77.0	47	965
10/23	1200	39.0	77.2	45	975
10/23	1800	41.5	75.4	31	985
10/24	0000	42.7	73.6	29	990
10/24	0600	42.9	71.4	22	995
10/24	1200	42.5	68.8	18	999



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The eleventh storm of the 1878 Hurricane Season. Date: October 22, 1878. Lowest Pressure: 29.09 inches of Mercury, 985.1 millibars. After impacting Eastern North Carolina, the Gale of 1878 earned its historic name by pounding the Mid-Atlantic and Northeastern United States, producing hurricane force gusts and substantial tidal flooding through Virginia into New Jersey. Winds as far north as Portland, Maine reached 70 mph. James Hudgins reports from his research that the Outer Banks received a significant impact from this storm including reports of 100 mph winds at Cape Lookout. Research by David Roth and Hugh Cobb: Reanalysis of the Gale of '78. Hudgins, James E.: Tropical Cyclones Affecting North Carolina Since 1586, "The Gale off the Port of Balaklava. 14 Nov 1854" by R Carrick, 1855. Photo Credit- National Army Museum Copyright. In 1853, Britain was embroiled with its allies in an invasion of the Crimean peninsula in order to destroy the naval base at Sevastopol. It was four on one fight of Britain, France, the Ottoman Empire and Sardinia against Russia, which was making territory incursions into Moldavia and Wallachia in the Balkans. This war turned into a three year slog which was characterized as a "notoriously incompetent international butchery" by historian Alexis Troubetkoy. By the fall of 1854, th

Hurricane Harvey was the first major hurricane of the 2017 hurricane season. Starting as a slow-moving tropical storm, Harvey gained power as it moved through the Gulf of Mexico. On August 25, Harvey hit Rockport, Texas, as a Category 4 storm. Hurricane Harvey broke the national record for the largest amount of rainfall in a single storm, accumulating over 27 trillion gallons of rain, and flooding one-third of Houston.<sup>3</sup> More than 50 counties were almost completely submerged in water, resulting in destroyed houses, businesses, and cars.<sup>4</sup> This devastation displaced 39,000 individuals from their homes and destroyed 203,000 residences. The satellite images were scary: Hurricane Irma, for a long time a Category 5 storm (the highest category), blew across the Caribbean islands towards Florida last week. Just the eye of the storm was larger than many of the islands that Irma hit. The satellite images were scary: Hurricane Irma, for a long time a Category 5 storm (the highest category), blew across the Caribbean islands towards Florida last week. Just the eye of the storm was larger than many of the islands that Irma hit. 11.09.2017. Peter H  ppe. About this article. The 1878 Atlantic hurricane season lasted from the summer through much of the fall. Records show that 1878 featured a relatively active hurricane season. A total of twelve storms were observed during the year. There were two tropical storms, eight hurricanes and two major hurricanes. However, in the absence of modern satellite and other remote-sensing technologies, only storms that affected populated land areas or encountered ships at sea were recorded, so the actual total could be higher. This season caused a total of 108 fatalities. The most notable hurricane of the 1878 Atlantic season was Hurricane Eleven or the Gale of 1878. This hurricane caused at least 72 fatalities in Cuba and the United States.<sup>[5]</sup> Estimated damage from this storm amounted to \$2 million.