

YEAR 1903

Ten storms were found to have occurred in 1903. Tracks for these storms are presented in Fig. 3.

Storm 1, 1903 (Jul. 21-26), H.

The following information was found about this storm: 1) Data extracted from 8 A.M. (E.S.T.) Historical Weather Maps: Jul. 19-20, no closed cyclonic circulation was suggested by the available data for those days, the lowest pressure for Jul. 20 being 29.92 at San Juan with wind S. f. 1. Jul. 21, Turk Is., N.N.W. f. 3, 29.93. Jul. 22, ship near 23 N., 74 W., S.W. f. 1; ship near 28 N., 74 W., S.E. f. 6, 30.06; ship near 29 N., 79 W., N.N.W. f. 1, 30.00; ship near 26 N., 78 W., N.N.E. f. 3, thunderstorm. Jul. 23, ship near 34 N., 73 W., E. f. 3; ship near 28 N. 79 W., N.N.W. f. 2, 29.97; ship near 27.3 N., 74 W., S.S.W. f. 2; 30.03; ship near 33 N., 74 W., S.S.W. (direction questionable) f. 4, showers. Jul. 24, ship near 35 N., 70 W., N.N.W. f. 10, 29.91; ship near 33 N., 70 W., S.W. f. 5, 29.91; ship near 37.5 N., 72 W., N. f. 5; ship near 34 N., 65 W., S.W. f. 7; center not drawn on the map but probably near 35.3 N., 68.5 W. just ahead of a front. Jul. 25, center probably near 38.5 N, 61.5 W. and getting embedded in the frontal trough; ship near 37 N., 60 W., S.S.W. f. 8 appears to be the closest to the center. Jul. 26, ship near 40 N., 50 W., N.N.W. f. 7, 29.50; ship near 41 N., 47 W., S. f. 9; temperatures reported by the ships were 64 and 69 degrees Fahrenheit, respectively; center of an extratropical system near 41 N., 48.5 W. but the main extratropical low was much farther N. near 50 N., 45 W. (Historical Weather Maps, Jul. 1903). Author's note: Wind forces (f) are on Beaufort scale, pressures are in inches. 2) A storm of Jul. 19-26, 1903 affected Hispaniola (Garcia-Bonnely, 1958). Author's note: As Salivia does not mention this storm in Puerto Rico, its influence on the island of Hispaniola should have been minimal, if any. 2) A storm was first observed near 17 N., 61 W. on Jul. 19, 1903 and lasted 10 days; it recurved near 27 N., 75 W. and it was last observed near 54 N., 9 E. (Mitchell, 1924). Author's note: A portion of the track in the above publication was found to be very similar to the tracks in Tannehill (1938) and Neumann et al. (1993).

Primarily on the basis of information in item 1), the author of this study introduced a number of modifications along the storm track shown in Neumann et al. (1993). As no evidence of a closed cyclonic circulation was found for the period Jul. 19-20, the author decided to start his track on Jul. 21 instead that on Jul. 19 as in the above mentioned publication. Author's estimated 7 A.M. positions were as follows: Jul. 21, near 21.5 degrees N., 70.0 degrees W.; Jul. 22, near 26.5 degrees N., 75.0 degrees W.; Jul. 23, near 31.0 N., 75.0 degrees W.; Jul. 24, near 35.3 degrees N., 68.5 degrees W.; Jul. 25, near 38.5 degrees N., 61.5 degrees W.; Jul. 26, near 41.0 degrees N., 48.5 degrees W.. Differences of these positions with respect to the corresponding ones in Neumann et al. (1993) were found to range from about 200 miles on Jul. 21 to about 60 miles on Jul. 24. The author's track, which was terminated on Jul. 26 because the center that originally possessed

tropical characteristics could not be identified on the Jul. 27 weather map, is displayed in Fig. 3.

The hurricane status which Neumann et al. (1993) gave to this storm was preserved in spite of that it could not be supported by the strongest wind (force 10) reported on Jul. 24 (item 1). Hurricane status was kept only for this latter day and the extratropical stage was introduced along the author's track on Jul. 25. The author's track prior to Jul. 24 denotes the system as a tropical storm.

Storm 2, 1903 (Aug. 6-16), H.

The following information was found in relation to this storm:

1) The first indication of the presence of this storm to the eastward of Barbados was furnished by the morning telegraphic reports of Aug. 8. Martinique appears to have been the only island in the Windward group that suffered serious damage. Reports from Kingston, Jamaica show that the first effects of the storm were felt on the island on Aug. 10 and that the main hurricane center reached the island on the morning of Aug. 11, causing a heavy loss of life and property. Kingston, with the exception to damage to houses and warehouses on the sea front, suffered less than any other place on the island. The storm increased in strength as it advance on a N. of W. course over the Caribbean Sea, and apparently attained its maximum intensity as it approached the Yucatan Channel. Attending its passage, many vessels were cast ashore on the coast of Yucatan; shipping and property were damaged from Yucatan to Tampico and large tracts of the southern Gulf coast were submerged (Monthly Weather Review, Aug. 1903).

2) Data extracted from 8 A.M. (E.S.T.) Historical Weather Maps: Aug. 6, ship near 12 N., 46 W., N.N.E. f. 5, 29.94; ship near 12 N., 41 W., S.E. f. 5; low placed 10 N., 43.5 W. (about 12 N., 43.5 W. might be a better position). Aug. 7, ship near 13 N., 46.7 W., S.S.W. f. 5, 30.00; ship near 13 N., 45.7 W., S.E. f. 2; ship near 10 N., 43.7 W., S.S.W. f. 2. Aug 8, Barbados N.E. f. 2, 29.89; Martinique, N.E. f.2, 29.92; Dominica, E. f. 2, 29.94; ship near 16 N., 60 W., N.E. f. 6, 30.00. Aug. 9, Dominica, S.E. f 5, 29.85; St Kitts, E. f. 5, 29.92; ship near 16 N., 60 W., S.E. f. 12 (wind force obviously wrong), 29.94; San Juan, N.E. f. 4, 29.96; Barbados, S.E. f. 4, 29.89; low placed 14.5 N., 63.8 W. Aug. 10, Port-au-Prince, N.E. f. 4, 29.88; Santo Domingo, N. f. 3, rain, 29.96; San Juan, E. f. 4, rain, 29.95; center placed 15 N., 71.3 W. (maybe too far W. and S.). Aug. 11, Kingston, S.E. (no force given), 29.64; ship or station near 18 N., 78 W., N.E. to N.N.E. f. 3, 29.71; center placed near the southern coast of Jamaica. Aug. 12, no data in the vicinity of the storm; center placed 18 N., 81.3 W. (probably too far S. and E.); central pressure indicated as 960 millibars (28.35). Aug. 13, no data in the vicinity of the storm; center placed 19.5, 86.5 W. (probably too far S. and E.). Aug. 14, ship near 24 N., 88.3 W., E. f. 9, 29.88; ship near 20 N., 93 W., W. f. 6 (or 7); Merida, S.W. f. 3, 29.71; center placed 21.8 N., 92 W. (maybe a bit too far E.). Aug. 15, ship near 23 N., 93.3 W., S.E. f. 10, pressure could not be read; ship near 22 N., 96.2 W., W. f. 6; Brownsville, N.E. f. 2, 29.76; center placed 22.8 N., 94.7 W.

(probably too far E.). Aug. 16, ship near 22 N., 97 W., S.E. f. 8, 29.74 (Historical Weather Maps, Aug. 1903). Author's note: Wind forces (f) are on Beaufort scale, pressures are in inches. 3) The following was extracted from an account of the passage of this hurricane over Martinique by Dr. A. Lahille, who was in charge of the meteorological observations at the Military Hospital, Fort de France: The barometric pressure which, with numerous oscillations, had fallen during Aug. 8, had nevertheless remained as high as 758 millimeters (29.84 inches), or above, until about 9 P.M. From that time, however, the pressure fell rapidly and reached its minimum, 728 millimeters (28.66 inches) at 12:30 A.M. (Aug. 9). At 12:45 A.M. the hurricane recommenced blowing from the S.S.E. At 2:30 A.M. Aug. 9, the pressure was 753 millimeters (29.65 inches) and at 4 A.M., 754 millimeters (29.69 inches). The maximum velocity of the wind, as recorded by the anemometer, was 35 meters per second (78 mph). The amount of rain which fell from 8 P.M. Aug. 8 to 8 A.M. Aug. 9 was 160 millimeters or 6.30 inches (Monthly Weather Review, Aug. 1903). 4) Extracted from a report by H.H. Cousins, in charge of the Jamaica Weather Service: The destructive zone of the cyclone was a little over 35 miles in width. The whole of Jamaica, N. of a line from Spanish Town to Lucea has been devastated. Standing (the barometer at 29.80 (inches) at 10 P.M. Aug 10, a rapid fall took place and by about 5:30 A.M. Aug. 11 the lowest point, 29.05 (inches) was attained. The rise was twice as rapid as the fall and by 11 A.M. the barometer had risen again to 29.80 (inches). At Moy Hall, 14.64 inches of rain fell in 13 hours during the storm. The Kingston records represent for a point estimated to be 16 miles S. of the center of the hurricane (probably an overestimate) and its rotation counterclockwise accounts for the change from the northwesterly winds during the first half to the southerly winds during the final stage of the hurricane (Monthly Weather Review, Aug. 1903). Author's note: The above publication mentioned a second value of 28.80 inches for the minimum pressure recorded at Kingston and indicated that such a value was shown by the barograph trace at 5:30 A.M. Aug. 11; by 6:15 the pressure had risen to 29.36 inches. The anemometer cups were disabled, so no maximum wind was measured but it was estimated at 65 mph. A third reading of 29.10 inches for the minimum pressure at Kingston was reported in a bulletin issued by the Belen College Observatory on Aug. 15, which added that the wind velocity reached 120 mph and that all plantation, except those in western Jamaica, were destroyed (Diario de la Marina, Havana, Aug. 15, 1903, evening edition, p.2, col.1). 5) Later advices indicated that the Cayman Islands were devastated in the evening of Aug. 11. Capt. Hunter of the schooner "Gov. Blake" has furnished notes regarding the storm at Georgetown, Grand Cayman. At 1 P.M. Aug. 11 the barometer read 29.50 inches and the wind was N.E. 30 mph. At 7 P.M. the roaring of the wind began and at 8 P.M., with a barometer reading of 29.00 inches, the wind blew 90 mph in terrific gusts. Then the barometer began to fall so rapidly that the needle of the aneroid could be seen to move. The barometer fell until 10 P.M. when it stood at 28.30 inches, with the wind blowing 110-120 miles from E.N.E. to E.S.E. in gusts. About midnight it became almost calm for about 30 minutes, after which the wind came fiercely from the S.E. At 1 A.M. Aug. 12 the barometer began to

rise and at 6 A.M. it read 29.30 inches and at noon 29.70 inches. About 200 houses were blown down or unroofed, 7 out of 8 churches on the island were destroyed, vessels on the stocks were picked up and dashed to pieces and of the 23 vessels in the harbor of Georgetown but one, the "Gov. Blake", was saved (Monthly Weather Review, Aug. 1903). 6) Belen College Observatory, Aug. 13. The following telegram was just received from the Central Meteorological Observatory of Mexico: "Progreso, barometer 752 millimeters (29.61 inches), wind N.E. 10 meters per second (22 mph), rain. Merida, barometer 751.6 millimeters ((29.59 inches), wind N. 13 meters per second (29 mph). Cyclone to the S. and near the island of Cozumel". L. Gangoiti, S.J. (Diario de la Marina, Aug. 14, 1903, morning edition, p.4, col.2). Author's note: The above observations seem to correspond to the morning of Aug. 13. The location near the island of Cozumel was apparently too far E. 7) The captain of the "Navarre" reports that he left Veracruz at 11 A.M. Aug. 12 with barometer 30.04 inches, fine weather and fresh breeze from E.N.E. At 1 A.M. Aug. 13 while approaching the Triangles on the border of Campeche Banks, the weather began to change, primarily in the N.N.E., where the sky was copper colored. The barometer had fallen to 29.88 (inches), with some heavy showers from the N.N.E. and slight swell from N.E. At 5 A.M., in 21 24 N., 91 40 W., a squall from the N.E. struck the vessel, the sea became heavy, the barometer had fallen to 29.76 inches and the wind increased in strength. At noon, in 21 58 N., 90 05 W., the weather had become stormy. the sea rougher and rougher, and by 2 A.M. the wind had increased to hurricane force from the N.E., the vessel was head on the waves and the barometer had fallen to 29.61 (inches). Between 3 and 6 P.M., when 15 miles S. of the Alacranes, the hurricane was encountered in its full fury, the barometer reading 29.45 (inches) and the sea exceedingly rough. At 7 P.M. the worst of the storm had passed and at 8 P.M., in 22 25 N., 89.05 W., the barometer had risen to 29.65 inches. At 11 P.M. the steamer resumed its usual speed and continued on its course with fair weather (Monthly Weather Review, Aug. 1903). 8) Extracted from a report by Capt. J. Elligers, Jr. of the steamship "Jason", which was forwarded to the Weather Bureau by W.C. Devereaux, Assistant Observer at Havana, Cuba: We sailed from Tampico with a cargo of cattle at 2 P.M. Aug. 13, direct for Havana. At 6 A.M. Aug. 14, when we were about 150 miles E. of Tampico, a gale suddenly blew up from the N., the barometer began to fall rapidly and the sea became very rough. The wind continued blowing from the N. until 9 P.M., but it seemed to be stronger between midday and 4 P.M.; rain fell at torrents, the air was sticky and much warmer than on the previous day. The barometer reached its lowest point at 8:30 P.M., one reading being 29.24 (inches) and the other 29.13 (they were together before the storm). From 9 to 9:20 P.M. there was dead calm; the rain had stopped but the sea was terrible. At 9:30 P.M. the wind turned to S., through E. and the storm came with a sudden rush from that direction and blew with greater force until 6 A.M. Aug. 15. The gale gradually moderated during that day and hatches, which had been closed for three days, were opened on Aug. 16 and 270 dead cattle were removed from a cargo of 613 (Monthly Weather Review, Sept. 1903). 9) Belen College Observatory, Aug. 17, 10 A.M.

The cyclone was located Saturday night (Aug. 15) on the coast of Tamaulipas as indicated by a telegram we received last night (Aug. 16): "Last night (Aug. 15) at 8 P.M., Matamoros, hurricane wind from N.E., heavy downpour, cyclone to the S.E. of Matamoros". This information agrees with what we published Saturday morning. L. Gangoiti, S.J. (Diario de la Marina, Aug. 17, 1903, evening edition, p.2, col.2). Author's note: This was the last of a series of bulletins issued by the Belen College Observatory in relation to this storm, some of which have been referred to above. 10) The tropical storm has probably reached the Mexican coast during Saturday (Aug. 15). Heavy sea swells were reported along the Texas coast but no wind of consequence (The New York Times, Aug. 16, 1903, p.15, col.6). 11) At Martinique the storm unroofed several hundred houses, destroyed crops and damaged a number of sailing vessels (Monthly Weather Review, Aug. 1903). 12) Kingston, Aug. 12. Early yesterday morning the hurricane struck Jamaica with its full force, inflicting enormous damage which will take years to repair. The United Fruit Company's wharves, offices, hotel, and plantations at Port Antonio were demolished. Five of the company's steamers, including the "Simon Dumois", "Alfred Dumois" and "Brighton" were drawn ashore but were lying at easy positions. Port Maria suffered similarly. The steamer "Salvatore di Giorgio" was driven ashore at Annotto Bay and lies in a dangerous position. The entire eastern end of the island has been devastated. Villages have been wiped out and public buildings and churches demolished. The western end of the island also suffered considerably but not to the extent of the eastern end. Thousands of houses in Kingston were damaged, the wharves were battered and several coasting vessels were sunk in the harbor (The New York Times, Aug. 13, 1903, p.2, col.4). 13) On Aug. 12 some destruction by high wind was caused to buildings and crops in the province of Pinar del Rio, Cuba (Monthly Weather Review, Aug. 1903) 14) A storm was first observed near 13 N., 52 W. on Aug. 7, 1903 and lasted for 8 days; it was last observed near 23 N., 100 W. (Mitchell, 1924). Author's note: The corresponding track in Mitchell (1924) was found to have some similarity with the tracks shown in Tannehill and in Neumann et al. (1993); however, the track in the latter publication mentioned was started on Aug. 6 and farther east.

Information included in the above items allowed the author of this study to introduce some modifications along the track for Storm 2, 1903 in Neumann et al. (1993). In order to fit better information in items 2) and 9) and the space-time continuity along the track, 7 A.M. positions for Aug. 6-8 in the above publication were adjusted eastward as follows: Aug. 6, to near 12.0 degrees N., 43.5 degrees W.; Aug. 7, to near 13.5 degrees N., 49.0 degrees W., Aug. 8, to near 14.0 N., 56.0 W. Positions in Neumann et al. (1993) for Aug. 9-10 were kept unchanged but their 7 A.M. Aug. 11 position was adjusted by about 70 miles to the E. to near 18.3 degrees N., 77.3 degrees W. in order to satisfy information in item 4) and its corresponding author's note. On the basis of information given in item 5) and on space-time continuity, the author of this study estimated his 7 A.M. Aug. 12 position near 19.7 degrees N., 82.5 degrees W., which is about 70 miles to the E.S.E. of the corresponding position in Neumann et al. (1993). The 7 A.M. Aug. 13

position in the above publication was found to agree with information in items 6) and 7) and, therefore, was kept unchanged. On the basis of information in items 2) and 8) and on space-time continuity, the author estimated his 7 A.M. Aug. 14 position near 22.0 degrees N., 92.5 degrees W., which is about 60 miles to the W.N.W. of the corresponding position in Neumann et al. (1993). The author's 7 A.M. Aug. 15 position was near 23.0 degrees N., 96.0 degrees W. and was based on information in items 2), 8) and 9); this position was about 60 miles to the W. of the corresponding one in Neumann et al. (1993). Finally, the 7 A.M. Aug. 16 position in the latter publication was adjusted to the S.W. by about 60 miles to fit information for that day in item 2). The author's track for Storm 2, 1903 is displayed in Fig. 3.

Information contained in a number of the items above was found to support the hurricane status that Neumann et al. (1993) gave to this storm. In fact, the pressure as low as 28.30 inches reported by the schooner "Gov. Blake" (item 5) clearly indicated that it was a major hurricane while affecting Grand Cayman. In line with what was shown in Neumann et al. (1993), the author's track denoted tropical storm status on Aug. 6 and hurricane intensity was introduced on Aug. 7. Tropical storm intensity was briefly restored on Aug. 16, followed by a dissipating depression stage over the Sierra Madre Oriental (Mexico) later on that day. While information in items 3) and 4) suggested that the storm was of a short diameter while crossing over Martinique and Jamaica, the storm size increased over the western Caribbean Sea, Yucatan and the Gulf of Mexico.

Storm 3, 1903 (Sept. 9-16), H.

The following information was found about this storm: 1) The Sept. 10 regular morning reports indicated the presence of a disturbance over the eastern Bahamas. By the evening the center of the disturbance had advanced to near Nassau, where a minimum barometer reading of 29.20 inches was reported at 7 P.M. Sept. 10. Between 6 and 7 P.M. the wind at Nassau increased from the E. to a velocity of 60 mph, when the anemometer cups were blown away. The wind then went to S. and reached an estimated velocity of 90 mph. On New Providence Island the fruit crop was destroyed and much damage was caused to small buildings. At Cat Cay (a few miles S. of Bimini), a minimum barometer reading of 28.82 inches was recorded. During Sept. 11 the hurricane center approached the southeast Florida coast. At Jupiter the barometer fell from 29.88 inches at 8 A.M. to 29.63 inches at 6 P.M., and the wind increased from the N.E. to a velocity of 78 mph at 6:45 P.M. and for one minute the wind blew at a rate of 84 mph. The northern limit of destructive winds on the east coast was about 30 miles N. of Jupiter. From West Palm Beach to Miami the property loss amounted to about \$ 100,000. Nine lives were lost in the stranding and braking up of the steamer "Inchulva" at Delray. An oil barge was lost by a tug and blown on the lower end of Lake Worth. The schooner "Martha T. Thomas" was blown ashore near Jupiter. On Sept. 12 the storm center moved N.W. and passed into the Gulf. At Tampa the barometer fell from 29.68 inches at 8 A.M. to 29.42 inches at 1 P.M., and from 10:45 A.M. to

2 P.M. the average wind velocity was about 40 mph, with squalls at a rate of 50-60 mph. The center crossed the extreme N.E. part of the Gulf of Mexico during Sept. 13 and at 8 P.M. was located E. of Pensacola. At St. Andrews (near Panama City) the barometer was reported to have fallen from 29.80 inches at 7 A.M. to 29.08 inches at 4:15 P.M., with N.E. winds that increased in gusts to about 60 mph. From 4:15 to 4:45 P.M. the barometer was stationary and then rose slowly, with wind changing to S.W. The wind had been W. from 3:30 to 4:45 P.M. and at 4 P.M. reached an estimated velocity of 75-80 mph. During Sept. 16 this storm practically dissipated over the East Gulf and South Atlantic States (Monthly Weather Review, Sept. 1903). Author's note: Some of the above information was also published in Tannehill (1938). According to Weather Bureau (1904), the minimum pressure at Tampa was 29.43 inches, which is slightly higher than the one given above. 2) Data extracted from Historical Weather Maps: Sept. 9, ship near 27 N., 74 W., E.N.E. f. 7, 30.06; ship near 24 N., 74 W., W.N.W. (direction probably wrong) f. 4, showers, 29.97; Turk Is., S.S.E. f. 3, 29.99; Santiago de Cuba, N.W. f. 2, 29.99; center placed 22.5 N., 73.5 W. Sept. 10, ship near 24 N., 74 W., E.S.E. f. 8, 29.97; ship near 25.7 N., 74 W., E.N.E. f. 7, 29.97; ship near 27 N., 73 W., E. f. 6; Camaguey, W. f. 1, 29.95; center placed 23.3 N., 75 W., pressure 980 millibars (28.94), apparently a hurricane of a short diameter. Sept. 11, Jupiter, N.N.E. f. 6, 29.88; center placed 25.5 N., 79 W., pressure 985 millibars (29.09), storm of a small diameter. Sept. 12, Jupiter, S.E. f. 5, heavy rain, 29.88; Tampa, N.E. f. 6, 29.69; Key West, S.W. f. 6, 29.90; center placed vicinity of Ft. Myers, pressure 990 millibars (29.24). Sept. 13, Pensacola, N. f. 4, 29.91; Tampa, S.E. f. 2, rain, 29.95; ship near 25 N., 85 W., S.W. f. 5, 30.18 (too high); center placed 27.8 N, 85.8 W. (probably too far S.). Sept. 4, Montgomery, N.E. f. 6, 29.72; Pensacola, W. f. 6, 29.80; Atlanta, E.S.E. to S.E. f. 5, 30.03. Sept. 15, S.E. f. 5, rain, 29.89; Montgomery, W. f. 3, 29.88; center placed over N. Alabama, W of Atlanta. Sept. 16, Atlanta N. f. 3, 29.93; center placed over extreme N.E. Georgia (Historical Weather Maps, Sept. 1903). Author's note: Wind forces (f) are on Beaufort scale, pressures are in inches. 3) Meteorological Station of the U.S. Dept. of Agriculture, Havana office, Sept. 10. The following information was received from Washington at 6:30 P.M.: "Storm signals were ordered at Cedar Keys, Dunnellon, Tampa, Punta Gorda, Punta Rassa, Savannah and Charleston. The tempest is at present over the western Bahamas and increasing in force. Violent and dangerous gusts are indicated on the Florida coast tonight and on the east Gulf and South Atlantic coast tomorrow" (Diario de la Marina, Havana, Sept. 11, 1903, evening edition, p.2, col.1). Author's note: The New York Times, Sept. 11, 1903, p.9, col.2, also published an advisory about the storm which was issued in the evening of Sept. 10. 4) Kingston, Sept. 13, The steamer "John Wilson" of the United Fruit Company arrived here this afternoon and reported having been driven ashore at Island of Conception (Bahamas) on Thursday (Sept. 10) in a hurricane but it was successfully refloated (The New York Times, Sept. 14, 1903, p.1, col.7). Author's note: Conception is a very small island located S. of Cat Island in the central Bahamas. 5) Savannah, Ga. Sept. 13.

The steamer "M.F. Plant", from Tampa for Philadelphia, put in here for repairs. She ran into the West Indian hurricane off the Florida coast near Jupiter Inlet. For 50 hours she was in the blow, with heavy seas sweeping her decks. One boiler sprung a leak (The New York Times, Sept. 14, 1903, p.1, col.7). 6) The steamship "Olueda" arrived in port (New York) yesterday from Havana and other Cuban ports. On Friday last (Sept. 11) the "Olueda" encountered the hurricane off the Florida coast. About 4 P.M. the ship entered the center of the storm. An hour and a half later the hurricane recommenced with very high seas and continued until 2 A.M. Saturday (Sept. 12) when it moderated and by 4 A.M. subsided to a moderate gale. Capt. Hansen estimated the wind at 90 mph at its peak (The New York Times, Sept. 16, 1903, p.1, col.5). 7) Tampa was yesterday visited by a combined hurricane and rain storm, prevailing for the greater of the day. The barometer at the Weather Bureau office began falling at 11 P.M. Friday (Sept. 11). Gusts to 60 mph were recorded several times and velocities of 52 mph were recorded for 5 minutes. The lowest barometer was 29.46 inches at noon yesterday (Sept. 12). The average velocity of the wind from midnight to 3 P.M. was between 45 and 48 mph (The Morning Tribune, Tampa, Sept. 13, p.1, cols.1 and 2). Author's note: The minimum pressure (29.46 inches) reported in this item is somewhat higher than the values of 29.42 and 29.43 inches indicated in item 1) and corresponding author's note. 8) For 8 hours there has raged over this city (Miami) the fieriest storm ever witnessed here by the oldest inhabitants. Last night's train arrived at 6 A.M. this morning and passengers reported that there was considerable desolation at West Palm Beach, many houses being unroofed (The Miami Metropolis, Sept. 11, 1903, p.1, col.4). 9) The storm originated in the Bahama Islands and struck the east coast a broadside all along from Cutler to Fort Pierce, with the center about Delray to Palm Beach, and passed across the peninsula doing considerable damage at Tampa and Punta Gorda and blowing heavy as low (south) as Punta Rassa (The Miami Metropolis, Sept. 18, 1903, p.1, col.4). 10) The fruit schooner "Alexander W. Lawrence" encountered Saturday's storm while enroute to Tampa, about 60 miles off Egmont Key and rode the surging billows with ease. Her cargo of bananas suffered heavy loss (The Morning Tribune, Tampa, Sept. 15, 1903, p.1, col.6). 11) Storm of Sept. 11-13, 1903. S. and N.W. Florida. Minimal, 14 killed and heavy shipping losses (Dunn and Miller, 1960). 12) Map showing a track for this storm extending from near 23 N., 74 W. in the central Bahamas in the morning of Sept. 10 to eastern Georgia in the morning of Sept. 16 (Monthly Weather Review, Sept. 1903). Author's note: From late Sept. 10 to Sept. 12 the above track was found to be somewhat S. of the track in Neumann et al. (1993). No comparison could be made with tracks usually shown by Tannehill (1938) and Mitchell (1924) because these authors failed to exhibit a track for this particular storm.

With the exception of a minor adjustment which was implemented for Sept. 11, the track in Neumann et al. (1993) was found to be reasonable in the light of information in the above items. In order to fit better space-time continuity with meteorological information for Nassau in item 1), the 7 A.M. Sept. 11 position in Neumann et al. (1993) was adjusted by a short distance to the N.W. to about

25.7 degrees N., 78.7 degrees W.. All other positions in the above publication were kept unchanged, and the author's track for Storm 3, 1903 is displayed in Fig. 3.

The hurricane status which Neumann et al. (1993) attributed to this storm was confirmed by the content of several items, particularly item 1).

Storm 4, 1903 (Sept. 12-17), H.

The following information was found in relation to this storm:

1) Data extracted from 8 A.M. (E.S.T.) Historical Weather Maps: Sept. 12, no data near the supposed position of the center. Sept. 13, Bermuda, N.E. f. 1, 30.21; ship near 31 N., 64 W., E.N.E. f.4, 30.18; ship near 27 N., 67 W., N.W. f. 5, 30.03; center placed 28 N., 65 W. (probably a bit far W.). Sept. 14, ship near 30 N., 68 W., E.S.E. f.7, 29.94; ship near 29 N., 69 W., S.W. f. 7, 29.94; center placed 29.5 N. 69.8 W. (probably a bit far W.); cyclone of a very short diameter. Sept. 15, ship near 33.7 N., 75 W., N.N.E. f. 4, 30.09; ship near 31.7 N., 75 W., N. f. 6, 29.94; ship near 33.8 N., 70 W., S.E. f. 4, 30.03; ship near 30 N., 70 W., S.E. f. 8, 30.27; ship near 30 N., 68 W., S.E. f. 5, 30.30; center placed 32.5 N., 73.3 W., 1000 millibar (29.53) isobar drawn on map, small diameter. Sept. 26, over New Jersey coast, S.W. of Atlantic City; difficult to read data near the center but Atlantic City showed a S.E. wind; 990 millibar (29.24) estimated central pressure; small diameter. Sept. 17, extratropical, just S. of Lake Ontario (Historical Weather Maps, Sept. 1993). Author's note: Wind forces (f) are on Beaufort scale, pressures are in inches. 2) The origin of the severe storm that visited the middle Atlantic coast on Sept. 16 is obscure; it is probable, however that it advanced N.W. from the subtropical region S. of Bermuda. Evening reports of Sept. 15 showed the presence of a disturbance off the North Carolina coast. Advancing N. during the night of Sept. 15 the disturbance was central near the southern New Jersey coast on the morning of Sept. 16. During this day wind velocities of more than 60 mph occurred along the New Jersey, New York and southern New England coasts. Although the area of the storm was small, it caused the loss of a number of lives and considerable destruction of property and crops (Monthly Weather Review, Sept. 1903). 3) Washington, Sept. 16. A storm of great intensity but apparently of very limited area moved up the Atlantic coast during Tuesday night (Sept. 15) and reached the New Jersey coast early Wednesday morning. The storm caused severe E. gales in New Jersey, S.E. Pennsylvania and S. New York (The New York Times, Sept. 17, 1903, p.11, col. 1). 4) Yesterday's marine storm, officially described a most unusual tempest by Weather Bureau Forecaster Emery, was no less strange from an unofficial and non-scientific point of view. The wind blew at a rate of 63 mph in the city (New York) and at least 70 mph on the shore. In the 4 hours from 11 A.M. to 3 P.M. (Sept. 16), the wind shifted from E. to S.W. Down the Jersey coast the storm was particularly severe and Atlantic City suffered considerable damage. The storm hit the New Jersey coast prior to its attack on New York, thus demonstrating the character attached to it by Forecaster Emery. He declared it a southern marine storm, not continental,

moving generally in a northerly direction (The New York Times, Sept. 17, 1903, p.1, col.6). 5) Minimum pressure at Atlantic City was 29.45 inches and the maximum wind velocity was S.E. 60 mph (Weather Bureau, 1904). 6) Other maximum wind velocities associated with the storm were: Hatteras, N.W. 60 mph on Sept. 15; Cape Henry, N.W. 54 mph on Sept. 15; Cape May, N.E. 48 mph on Sept. 16 (Monthly Weather Review, Sept. 1903). 7) Storm of Sept. 15-16, 1903. North Carolina, center remained at sea off Hatteras. Middle Atlantic coast. Minor (Dunn and Miller, 1960). 8) Map showing a track for this storm starting at about 27 N., 64 W. in the morning of Sept. 13 and reaching a position E. of Kittyhawk, N.C. by the evening of Sept. 15. It was placed on the New Jersey coast in the morning of Sept. 16 (Monthly Weather Review, Sept. 1903). 9) A storm was first observed near 28 N., 63 W. on Sept. 13 and lasted 6 days; it recurved near 43 N., 78 W. and it was last observed near 60 N., 62 W. (Mitchell, 1924). Author's note: A portion of the track in the above publication was found to be similar to the tracks in Tannehill (1938) and Neumann et al. (1993); however, the authors of the last publication mentioned started their track on Sept. 12, one day earlier than in Mitchell (1993).

On the basis of information contained in the above items, item 1) in particular, the author of this study introduced a number of modifications along the track for Storm 4, 1903 which is shown in Neumann et al. (1993). As no information was available for Sept. 12, their 7 A.M. position for that day was kept unchanged. The author's new 7 A.M. positions were as follows: Sept. 13, near 28.0 degrees N., 64.0 degrees W.; Sept. 14, near 29.5 degrees N., 69.0 degrees W.; Sept. 15, near 32.5 degrees N., 73.3 degrees W.; Sept. 16, near 39.3 degrees N., 73.3 degrees W.; differences of these positions with respect to corresponding ones in Neumann et al. (1993) ranged from about 120 miles on Sept. 13 to about 40 miles on Sept. 14. The 7 A.M. Sept 17 position in Neumann et al. (1993) was kept unmodified. The author's track for Storm 4, 1903 is displayed in Fig. 3.

The hurricane status given in Neumann et al. (1993) was kept unchanged in spite of that, rigorously speaking, it could not be verified in the light of information in the above items because no hurricane winds or sufficiently low pressures to support them were reported by ships or land stations. Indications are that the system was still a tropical storm on Sept. 14 as inferred from winds of only force 7 on the Beaufort scale near the storm center (item 3); therefore, hurricane intensity was not denoted along the author's track until Sept. 15. The hurricane status was changed back to tropical storm intensity after the storm made landfall on the New Jersey coast on Sept. 16, and an extratropical stage was denoted along the portion of the track for Sept. 17.

Storm 5, 1903 (Sept. 19-26), T. S.

The following information was found about this storm: 1) Data extracted from 8 A.M. (E.S.T.) Historical Weather Maps: Sept. 19, Turk Is., S. f. 2, 29.93 (down from 29.96 on the previous day). Sept. 20, ship near 25 N., 74 W., N. f. 3, 29.97; ship near 25 N., 69 W., E.S.E. f. 5, rain; Turk Is., S.W. f. 3, 29.93; ship off

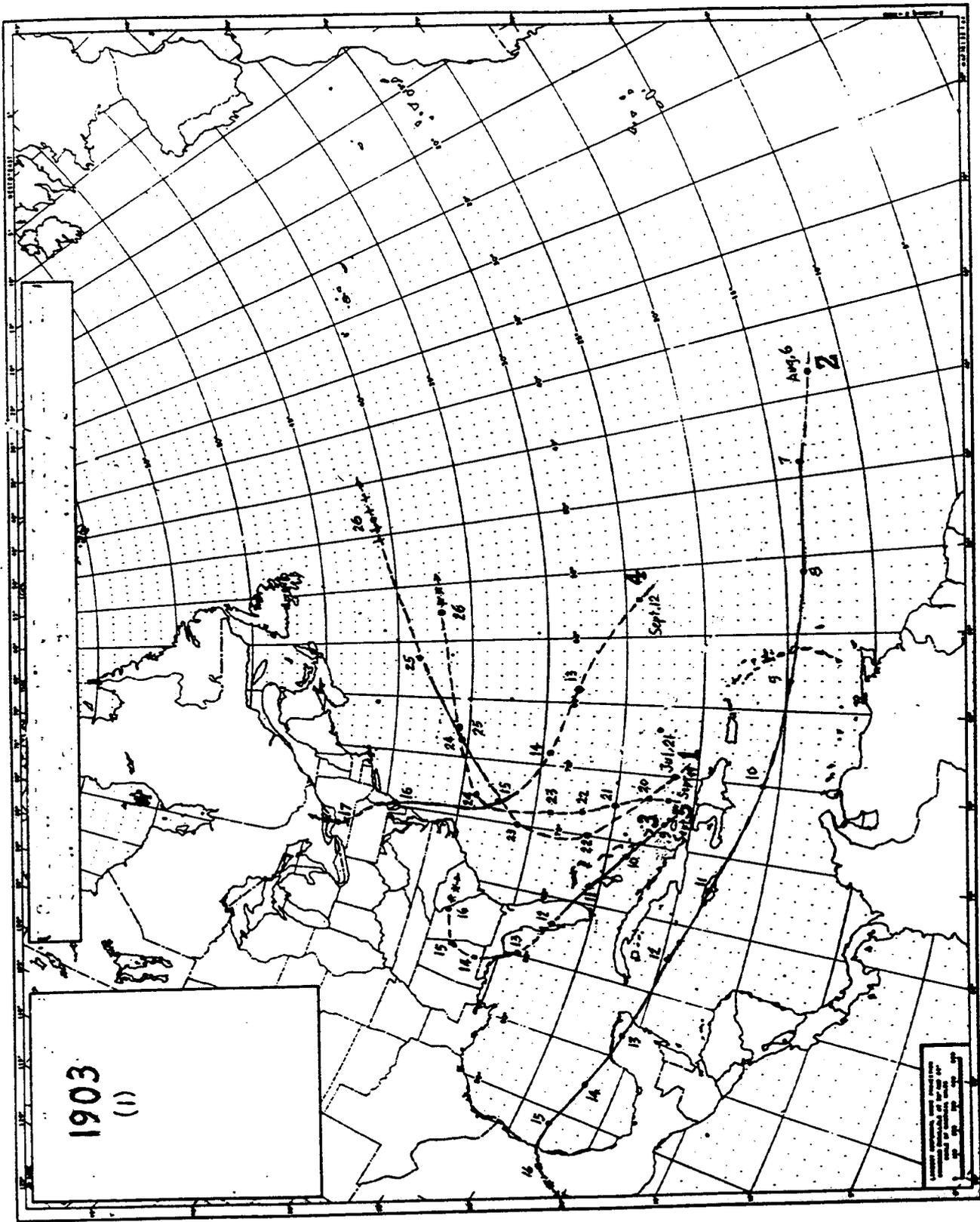


Fig. 3

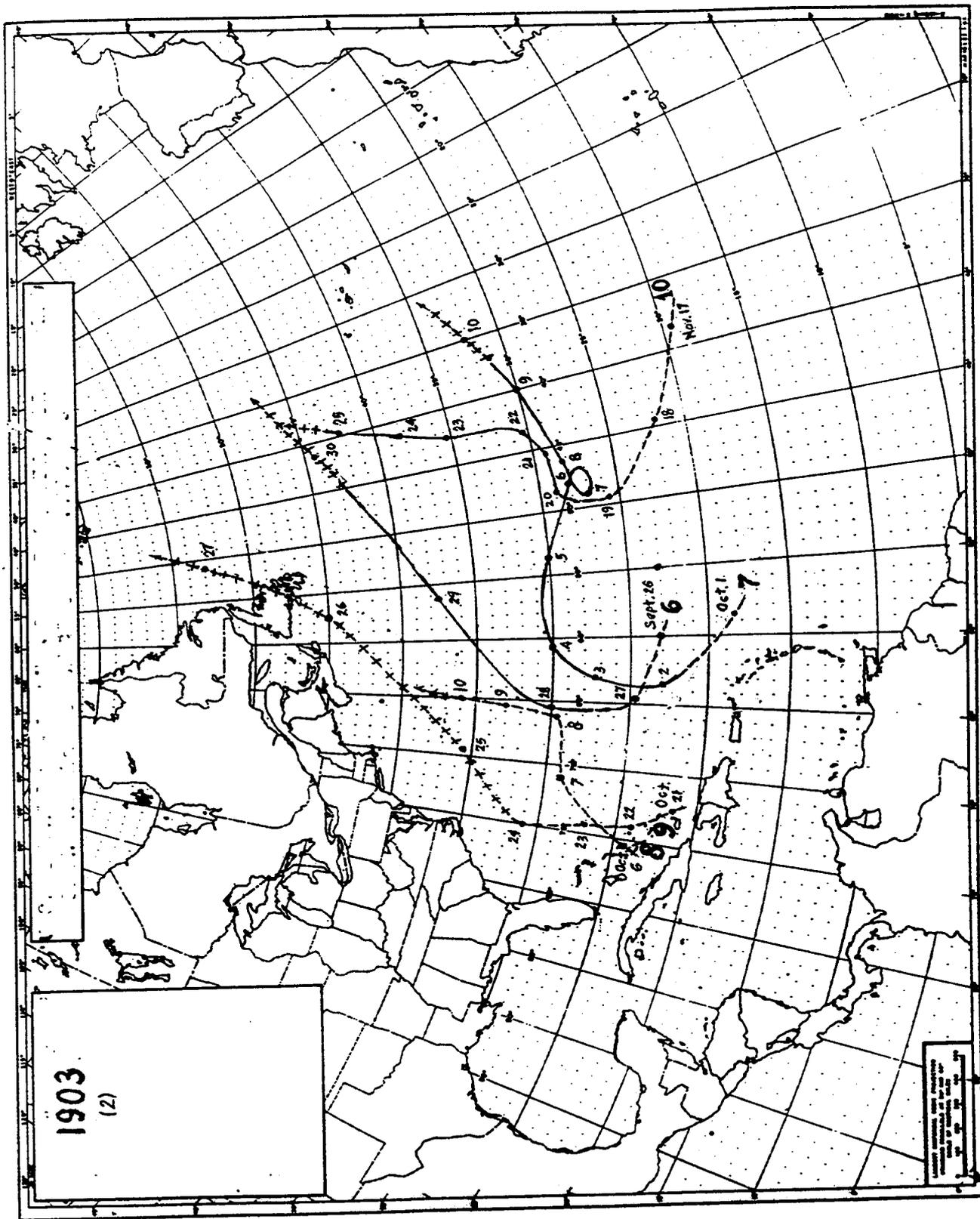


Fig. 3 (continued)

eastern tip of Cuba, N.W. f. 2; Santiago de Cuba, N.W. f. 2, 29.93; ship near 19 N., 75 W., N.E. f. 2, 29.88; center placed 23 N., 73.5 W. (probably too far W.; 23.5 N., 71.5 W. was probably a better position). Sept. 21, ship near 30 N., 75 W., N. f. 3, 29.97; ship near 29 N., 70 W., W.N.W. (direction apparently wrong) no wind speed could be read off the map, rain, 29.86; ship near 23 N., 73.8 W., W. f. 3, 29.91 (pressure difficult to read); Turk Is., S.W. f. 3, 29.89; ship near 22 N., 73.8 W., N.N.W. f. 3, 29.88; center placed 26.7 N., 72.5 W. (too far N.). Sept. 22, ship near 30 N., 74 W., N.E. f. 7, showers, 29.88; ship near 28 N., 74 W., N.E. f. 3, 29.83; ship near 25 N., 74 W., N. f. 1, showers, 29.83; Turk Is., S.W. f. 3, 29.86; ship near 30 N., 64.7 W., S.E. f. 4, showers, 29.88; center placed 26.5 N., 70.5 W. (too far E.). Sept. 23, ship near 31 N., 76 W., N.E. to N.N.E. f. 5, 29.85; ship near 28 N., 74.8 W., N. f. 2, 29.71; ship near 26 N., 74 W., S.W. f. 5, 29.83; ship near 23 N., 74 W., W.S.W. f. 3, 29.86; Turk Is., S.W. f. 3, 29.85; center placed 28.5 N., 72.5 W. (probably a bit far W.). Sept. 24, wind could not be read but it was light, rain 29.70; ship near 33.7 N., 72.3 W., S.W. f. 5, 29.62; ship near 33.7 N., 73.3 W., S.E. (direction probably in error) f. 4, 29.83 (too high); center placed 31 N., 74 W. (near 34 N., 73 W. appears to be a better location). Sept. 25, ship near 26 N., 69 W., N. f. 6, 29.65; ship near 39 N., 67 W., N.E. f. 6, 29.86; ship near 31 N., 70 W.; W. f. 5, 30.00; Bermuda, S.S.W. f. 2, 29.96; center placed 35.5 N., 68 W. (at the tail of a cold front and probably a bit far W.). Sept. 26, low placed 37 N., 57.5 W. (Historical Weather Maps, Sept. 1903) Author's note: Wind forces (f) are on Beaufort scale and pressures are in inches. 2) A storm was first observed near 24 N, 72 W. on Sept. 22, 1903 and lasted 5 days; it recurved near 29 N., 73 W. and it was last observed near 52 N., 25 W. (Mitchell, 1924). Author's note: The track in Mitchell (1924) was started 2 days latter than the corresponding track in Neumann et al. (1993) and some differences were observed when comparing both tracks. However, the track in Tannehill (1938) was found to be quite similar to the one in Mitchell (1924).

On the basis of information in item 1), the author of this study introduced numerous but mostly minor modifications along the track displayed in Neumann et al. (1993). The author's track was started at 7 A.M. Sept. 19 with an estimated position near 21.7 degrees N., 71.7 degrees W.; this beginning was one day earlier than in the above publication. Author's 7 A.M. positions for the period Sept. 20-26 were as follows: Sept. 20, near 23.0 degrees N., 71.7 degrees W.; Sept. 21, near 25.0 degrees N., 72.5 degrees W.; Sept. 22, near 27.0 degrees N., 73.3 degrees W.; Sept. 23, near 29.0 degrees N., 73.7 degrees W.; Sept. 24, near 34.0 degrees N., 73.0 degrees W.; Sept. 25, near 35.5 degrees N., 67.5 degrees W.; Sept. 26, near 37.0 degrees N., 57.5 degrees W. The difference between corresponding positions along the author's track and the ones in Neumann et al. (1993) reached a maximum of about 180 miles on Sept. 24 but was only about 60 miles on all other days. The author's track for Storm 5, 1903 is shown in Fig. 3.

As no wind of force 8 or higher on the Beaufort scale was reported in item 1), the tropical storm status that Neumann et al. (1993) gave to this storm could not be windwise confirmed; however,

that status was maintained by the author of this study because a central pressure below 29.62 inches could be inferred from available data for Sept. 24-25 in item 1). It seems likely that the weather system did not reach tropical storm status until Sept. 23, when the central pressure was apparently below 29.71 inches (item 1); nevertheless, tropical storm intensity was denoted along the author's track starting on Sept. 19.

Storm 6, 1903 (Sept. 26-30), H.

The following information was found in relation to this storm:

1) Data extracted from 8 A.M. (E.S.T.) Historical Weather Maps: Sept. 26, low placed 23.5 N., 60 W.; however, there were no data around the low. Sept. 27, ship near 28 N., 67 W., N.E. to N.N.E. f. 5, 29.83; ship near 24.8 N., 67 W., N.E. to N.N.E. f. 4, 29.86; ship near 30 N., 63 W., S.E. f. 5, 29.94; Bermuda, no wind, 30.14; center placed 25.5 N, 63.5 W. (probably too far N. and E.). Sept. 28, Bermuda, E.N.E. (wind speed could not be read), rain, 29.82; ship near 27.7 N., 67.7 W. N.W. f. 5, 29.83; center placed 30 N., 64.7 W. (probably a bit far E.). Sept 29, ship near 35.7 N., 54.5 W., S.W. f. 10; ship near 37 N., 61.5 W., N.N.W. f. 9, 29.91; center placed 37 N., 57.5 W. (probably a bit far W.), central pressure estimated at 990 millibars (29.24). Sept. 30, ship near 38 N., 44.5 W., N. to N.N.W. f. 9, 29.56; ship near 44 N., 41.3 W., W. f. 9, 28.97; center estimated near 44.5 N., 40.7 W., center wrongly placed near 43.5 N., 40.7 on the weather map, estimated central pressure was 980 millibars (28.94); temperatures of 71-72 degrees Fahrenheit were reported by both ships (Historical Weather Maps, Sept. 1903). Author's note: Wind forces (f) are on Beaufort scale, pressures are in inches. 2) During Sept. 28 a severe hurricane recurved northeastward over Bermuda. At 8 A.M. the barometer at Hamilton was 29.82 inches with a moderate E wind and rain. At 10:30 A.M., 29.60 inches and at 12.20 P.M. 29.20 inches. At 2:20 P.M. a reading of 29.18 inches was reported, with barometer rising rapidly. The wind that has been increasing from the N.E. shifting to E. backed about 2 P.M. to N.W. The wind is reported to have attained hurricane force, uprooting trees, damaging houses and destroying crops. The storm probably approached Bermuda from the E. or S.E., or possibly it developed in the southern end of a trough of low barometric pressure that passed eastward from the middle and north Atlantic coast of the United States during the night of Sept. 27. Moving northeastward from Bermuda this disturbance apparently united with an extensive area of low barometer that covered the British Isles during the closing days of Sept. and the first week of Oct. (Monthly Weather Review, Sept. 1903). Author's note: The storm was found to approach Bermuda from the S. (item 1). Tannehill (1938) quoted some information from this item 2) but wrongly added: "History of this storm before and after it reached Bermuda is not known and no track is given". Independently from Tannehill's saying, Neumann et al. (1993) show a track for this storm. 3) A.E. Verill wrote the following in reference to this storm: "Though it was of comparatively short duration, it did a great amount of damage (at Bermuda). At the height of this storm, which was about noon (Sept. 28), the wind had a recorded velocity of 74 mph from

the N.E.; after it shifted to the N.W. it had a velocity of 40 mph at 3 P.M. It was accompanied by a very heavy rainfall. which washed away the roadbed in many places. Large numbers of cedar trees were uprooted, many large palmettoes were broken off, the banana crop was ruined and numerous public buildings and private dwellings were damaged. A number of stone docks and sea walls were badly damaged or destroyed and many boats were wrecked..." The account of the storm itself appeared in the Royal Gazette, Sept. 29 and described the storm as "a gale of exceptional violence... resulting in injury both to live and limb and considerable damage to property... The extension to the Princess Hotel, which was being erected at a cost of several thousand pounds to afford extra accommodation for the winter tourist season, collapsed like a pack of cards before one o'clock and is now only a mass of debris. Unfortunately the gale was attended by loss of life: an engineer at Ireland Island was drowned, and at St. George's a wall in the vicinity of the Royal Engineer's quarters was blown down and killed an ex-soldier" (Tucker, 1982).

On the basis of information in the above items, the author of this study introduced some modifications along the track for this storm which is shown in Neumann et al. (1993). Positions for 7 A.M. Sept. 26 and 7 A.M. Sept. 27 in the above publication were kept unchanged, but their 7 A.M. positions for the period Sept. 28-30 were modified as follows: The 7 A.M. Sept. 28 position was adjusted by about 40 miles to the W. to near 30.0 degrees W., 65.5 degrees W. in order to fit better information for that day in item 1) and to bring the storm center much closer to Bermuda as suggested by information given in items 2) and 3); the 7 A.M. Sept. 29 position was adjusted by about 90 miles to the N.N.E. to near 37.5 degrees N., 56.3 degrees W. in order to fit better ship information for that day in item 1); the 7 A.M. Sept. 30 position was adjusted by about 70 miles to the N.N.W. by using ship information in item 1) and space-time continuity. The author's track for Storm 6, 1903 is displayed in Fig. 3.

Information in items 2) and 3) fully supported the hurricane status which Neumann et al. (1993) gave to this storm, and suggested that the center passed very close to the S.E. of Bermuda in the afternoon of Sept. 28, when the barometric pressure at Hamilton should have been lower than 29.18 inches (item 2). After showing tropical storm intensity until late Sept. 27, hurricane intensity was introduced along the author's track early on Sept. 28. The extratropical stage was introduced along the author's track by Sept. 30 in spite of that temperatures reported by ships on that day (item 1) suggested that, although the storm was turning extratropical, some tropical structure might have still remained.

Storm 7, 1903 (Oct. 1-10), H.

The following information was found in relation to this storm:
1) Data extracted from 8 A.M. (E.S.T.) Historical Weather Maps: Oct. 1, low placed 18.5 N., 58.5 W.; Martinique and Dominica, N.E. f. 1-2; Barbados, S.S.E. f. 3; ship near 21 N., 56 W., S.E. f. 4. Oct. 2, ship near 21.5 N., 64 W., W.S.W. f. 5, 29.74; ship near 26.5 N., 62 W., N.E. f. 5, 29.94; Bermuda, N.E. f. 2, 30.19; ship

near 21 N., 63 W., S. f. 4, 30.09 (too high); St. Kitts, S. f. 3, 29.94; center placed 23 N., 63.5 W. Oct. 3, center placed 28 N., 62 W., no data in the vicinity of the center which space-time continuity suggests it was too far to the N.E.; however, peripheral data support cyclonic circulation. Oct. 4, ship near 31. N., 61 W., E.N.E. f. 10, 29.74; ship near 29.8 N., 62 W., N.N.W. f. 9, 29.83; center placed 30.2 N., 59.2 W., but a position near 30.3 N., 61 W. would fit better the ship observations. Oct. 5, ship near 32 N., 58 W., N.N.E. f. 6; ship near 26 N., 56 W., W. to W.N.W. f. 4, 30.09 (too high); ship near 31 N., 48 W., E.S.E. f. 6; ship near 30 N., 49.8 W., W. f. 2, 29.88 (meteorological data or position, or both, looked to be in error); ship near 29 N., 56 W., N.W. f. 8; ship near 26 N., 49 W., W. f. 5, 29.94 ; center placed 30.5 N., 50 W. (too far E.). Oct. 6, center placed 28 N., 48 W. supported by peripheral ships. Oct. 7, ship near 26 N., 47 W., S. f. 8; ship near 27 N., 47.8 W., S. f. 8; center placed 27 N., 48.5 W. (maybe a bit far E.). Oct. 8, ship near 26 N., 48 W., W.N.W. f. 8; ship near 31 N., 51 W., N.E. f. 7, 29.86; ship near 30 N., 43 W., E.S.E. f. 8; center placed 29 N., 46.5 W. (maybe a little far to the N.). Oct. 9, ship near 30 N., 42 W., N.N.W. f. 5, 29.86; ship near 25 N., 39 W., W.S.W. f. 4; center placed 29 N., 39 W. (probably too far to the S.E. or S.). Oct. 10, extratropical low hard to be located but ship near 33.7 N., 36 W., N.N.E. f. 6 suggests location near 32.5 N., 34 W. and not near 31.5 N., 38.5 W. as drawn on the map (Historical Weather Maps, Oct. 1903). Author's note: Wind forces (f) are on Beaufort scale, pressures are in inches. 2) A storm was first observed near 23 N., 60 W. on Oct. 1, 1903 and lasted 23 days; it recurved near 29 N. 66 W. and it was last observed near 60 N., 15 E. (Mitchell, 1924). Author's note: The western portion of the track in the above publication was found to be similar to the track in Tannehill (1938) but it was somewhat different from the one in Neumann et al. (1993).

On the basis of information in item 1), the author of this study introduced a number of modifications along the track shown in Neumann et al. (1993). The author's new 7 A.M. positions were estimated as follows: Oct. 1, near 18.5 degrees N., 58.5 degrees W; Oct. 2, near 23.0 degrees N., 63.5 degrees W.; Oct. 3, near 27.3 degrees N., 63.0 degrees W.; Oct. 4, near 30.0 degrees N., 60.7 degrees W.; Oct. 5, near 30.0 degrees N., 53.5 degrees W.; Oct. 6, near 27.0 degrees N., 48.0 degrees W.; Oct. 7, near 27.0 degrees N., 49.0 degrees W. The 7 A.M. Oct. 8 position in Neumann et al. (1993) was kept unchanged but their 7 A.M. Oct. 9 position was adjusted by about 60 miles to the N. to near 30.0 degrees N., 40.0 degrees W. Finally, the Oct. 10 position in Neumann et al. (1993) was kept unmodified. The author's track for Storm 7, 1993 is displayed in Fig. 3.

Although, rigorously speaking, the hurricane status that Neumann et al. (1993) gave to this storm could not be confirmed because no hurricane winds were reported in item 1), the author of this study kept that status unmodified. Tropical storm status was denoted along the author's track on Oct. 1. Hurricane status was introduced on Oct. 2 and the extratropical status was introduced on Oct. 10.

Storm 8, 1903 (Oct. 6-10), T. S.

The following information was found about this storm: 1) Data extracted from 8 A.M. (E.S.T.) Historical Weather Maps: Oct. 6, ship near 23 N., 74 W., S.W. f. 2, 29.91, Turk Is., E. f. 3, 29.95; ship near 29 N., 70 W., E. f. 7; ship near 30.3 N., 74 W., E. f. 5, 30.12; ship near 26 N., 74 W., S.E. f. 4; ship near 26 N., 79 W., E.N.E. f. 4, 29.91; Santiago de Cuba, S. f. 2; Camaguey, E.N.E. f. 2; center placed 26 N., 69 W. without data support; however, 24.5 N., 75.5 W. seems to be a better choice, with a trough extending S. of the proposed position for the center. Oct. 7, ship near 32 N., 73 W., W. f. 5, 30.06; ship near 31 N., 70 W., S.E. f. 6, 30.03; ship 30 N., 68 W., S.E. f. 6; Bermuda, E. f. 2, 30.09; ship near 26 N., 68 W., S.S.W. f. 4; ship near 28 N., 72.7 W., N.W. f. 3, 29.97; center placed 28 N., 69 W., near 29 N., 71 W. seems to be a better location; there was an indication of another low in the central Bahamas embedded in the trough which was between Camaguey and Santiago de Cuba on Oct. 6 and had moved little; however, the maximum vorticity appears to be related to the first low. Oct. 8, Bermuda, E. f. 2, 29.89; ship near 26 N., 66 W., W. f. 4; ship near 28 N., 69 W., W.N.W. f. 6, rain; ship near 29 N., 72 W., N.N.W. f. 4, 29.97; ship near 32 N., 69 W., N. f. 2; center placed 29.7 N., 66.3 W. Oct. 9, Bermuda, S.W. f. 2, 29.46; ship near 33 N., 66 W., N.E. f. 5, 29.44; ship near 32.5 N., 62 W., E. f. 6 (or higher), pressure could not be read; center just N.N.W. of Bermuda and not near 31.5 N., 67.5 W. as indicated on map; other ship and land observations suggest another low developing near 35 N., 73 W, or to the E. of Hatteras, this second low was obviously extratropical. Oct. 10, big extratropical low central near 33.5 N., 73.5 W. with 985 millibars (29.09); however, remnants of the tropical system could still be identified near 36 N., 65 W.; Bermuda, S. f. 2, 29.61; two ships to the N. of Bermuda showing S.W. wind force 4 and pressures 1002-1003 millibars (about 29.60); this system was embedded in a warm front with winds f.8-10 to the N. of the center. Oct. 11, center of extratropical low placed 36.5 N., 71.5 W. Oct. 12, center of extratropical low placed 41 N., 68 W. Oct. 13, low 42.5 N., 64 W. (Historical Weather Maps, Oct. 1903). Author's note: Wind forces (f) are on Beaufort scale, pressures are in inches. 2) During Oct. 8 a barometric depression moved eastward over the Atlantic coast of the United States and during the succeeding three days a storm of great violence occupied the ocean between Bermuda and the American coast. During Oct. 12-13 the center of this storm moved northeastward over the Canadian Maritime Provinces (Monthly Weather Review, Oct. 1903). Author's note: The above statement did not make a distinction between the tropical and the extratropical systems which were discussed in item 1). 3) Map showing a track for this storm meandering off Hatteras between Oct. 9 and Oct. 11 and then moving N.E. off the N.E. coast of the United States late on Oct. 11 and on Oct. 12 and along the Nova Scotia coast on Oct. 13-14 (Monthly Weather Review, Oct. 1903). 4) A storm was first observed near 28 N., 70 W. on Oct. 7, 1903 and lasted 19 days; it recurved near 35 N., 76 W. and it was last observed near 65 N., 19 E. (Mitchell, 1924). Author's note: A portion of the track in the

above publication was found to be similar to the track for this storm in Tannehill (1938). However, the track in Neumann et al. (1993) was found to be different.

On the basis of information in item 1), the author of this study decided to introduce a number of modifications along the track for Storm 8, 1903 shown in Neumann et al. (1993). The author's track was started on Oct. 6 or one day earlier than in Neumann et al. (1993) and new 7 A.M. positions as estimated by the author were as follows: Oct. 6, near 24.5 degrees N., 75.5 degrees W.; Oct. 7, near 29.0 degrees N., 71.0 degrees W.; Oct. 9, near 33.0 degrees N., 65.5 degrees W.; Oct. 10, near 36.0 degrees N., 65.0 degrees W. The 7 A.M. Oct. 8 position was kept unchanged because it was found to satisfy information for that day in item 1), and the author's track was terminated on Oct. 10 based on corresponding information for that day. The author's track is displayed in Fig. 3.

The tropical storm status which Neumann et al. (1993) gave to Storm 8, 1903 was verified by pressures as low as 29.44 inches and by winds of force 8-10 on the Beaufort scale reported on Oct. 9 and 10, respectively (item 1). The author's track denoted that status over the period Oct. 6-10 and changed it to a dissipating depression late on Oct. 10.

Storm 9, 1903 (Oct. 21-27), T. S.

This case has been recently documented by the author and it is a new one in the sense that it is not included in Neumann et al. (1993). However, the Monthly Weather Review (Oct. 1903), Mitchell (1924), Tannehill (1938), Garcia-Bonnely (1958) and The New York Times has referred to this case before.

Documentation of this case was based on the following information: 1) On Oct. 23 a disturbance of moderate intensity appeared over the Bahamas. Increasing in strength this storm moved northward to a position off the North Carolina coast during Oct. 24 and passed then northeastward towards Nova Scotia on Oct. 25 attained by winds that exceeded 50 mph on the North Carolina coast. During Oct. 26 the center of disturbance moved northeastward over Newfoundland (Monthly Weather Review, Oct. 1803). 2) Washington, Oct. 24. The Atlantic coast districts of the United States are on the western margin of a barometric depression of great magnitude, the center of which is apparently off Hatteras where the barometer has fallen rapidly and a velocity of 52 mph is reported. During Saturday (Oct. 25), the Atlantic storm will move northward attended by severe gales off the Middle Atlantic and New England coasts (The New York Times, Oct. 25, 1903, p.17, col.2). Author's note: The above statement and subsequent ones in the New York Times were probably issued the evening before their publication date. 3) Washington, Oct. 25. The center of the disturbance has shifted position to the northward off the southeast coast of New England. The disturbance referred to will continue a northward course toward the Canadian Maritime Provinces (The New York Times, Oct. 26, 1903, p.9, col.3). 4) Washington, Oct. 26. High N.W. winds along the coast N. of Delaware Breakwater has followed the passage of the western Atlantic disturbance over the Canadian Maritime Provinces

(The New York Times, Oct. 27, 1903, p.3, col.2). 5) Data extracted from 8 A.M. (E.S.T.) Historical Weather Maps: Oct. 21, Turk Is., S. f. 4, 29.85; ship near 22 N., 74 W., E.N.E. f. 3, 29.83; Port-au-Prince, W. f. 3, 29.80; ship near 16 N., 72 W., 29.86. Oct. 22, Santiago de Cuba, N. f. 2, 29.85; Camaguey, N.E. f. 1, 29.89; Turk Is. S. f. 2, 29.87; ship near 24 N., 74 W., S.E. f. 1, 29.86; ship near 25 N., 76 W., N.E. f. 4; ship near 25 N., 74 W., E. f. 6, 29.88; ship near 26 N., 71 W., E. f. 6; ship near 20 N., 70 W., S.S.E. f. 2, showers, 29.68 (too low). Oct. 23, ship near 29 N., 74 W., E. f. 4, 29.86; ship near 27 N., 74 W., calm 29.77; ship near 28 N., 79 W., N.E. f. 4, showers; Turk Is., S.W. f. 3, 29.87; ship near 20 N., 72 W., S.W. f. 3, 29.86; ship near 24 N., 69 W., S.S.E. to S. f.5, 29.86; ship near 26 N., 67 W., S. f. 6, 29.89. Oct. 24, ship near 32 N., 74 W., N.E. f. 3, 29.74, temp. 76 F; ship near 32 N., 76 W., calm, 29.88 (too high), temp. 72 F; ship near 31.5 N., 78.5 W., N.N.E. f. 7 (or most likely f. 9), 29.77, temp. 65 F; ship 29 N., 79 W., W. f. 6, 29.80,, temp. 76 F; ship near 31.3 N., 74 W., S.S.W. f. 4, 29.91 (too high); ship near 29 N., 74 W., S.S.W. f. 2, 29.80; ship near 27 N. 73 W., 29.80; Hatteras, N.N.E. f. 6, 29.87, temp. 56 F; Charleston, N. f. 5, 29.94, temp. 48 F; Jacksonville, N.W. f. 3, 29.88, temp. 56 F. Oct. 25, ship near 36.7 N., 68.7 W., E. f. 10, pressure could not be read, temp. 65 F; center placed 35.5 N., 69.5 W. (extratropical). Oct. 26, center placed 45 N., 57.5 W. Oct. 27, ship near 53 N., 49 W., S.S.E. f. 7, 29.00, center placed 53 N., 51 W. (Historical Weather Maps, Oct. 1903). Author's note: Wind forces (f) are on Beaufort scale, pressures are in inches. 6) The storm of Oct. 18-27 affected the island of Hispaniola (Garcia-Bonnely, 1958). 7) Map showing a track for this storm. Estimated morning positions were: Oct. 23, just W. of Santiago de Cuba; Oct. 24, near 29 N., 74.5 W.; Oct. 25, near 37 N., 71 W.; Oct. 26, near 43 N., 61.5 W. (Monthly Weather Review, Oct. 1903). 8) A storm was first observed near 12 N., 53 W. on Oct. 18, 1903 and lasted 10 days; it recurved near 30 N., 75 W. and it was last observed near 57 N., 56 W. (Mitchell, 1924). Author's note: The corresponding track in Mitchell (1924) was found to be similar to the track for this storm in Tannehill (1938). A cyclonic perturbation that the Belen College Observatory announced between Grenada and Barbados in the morning of Oct. 19 (Diario de la Marina, Havana, Oct. 19, 1903, evening edition, p.2, col.1) was found to be along this track, which also made the storm to cross over Haiti in agreement with item 6).

By using information in the above items, particularly in item 5), the author of this study prepared a track for Storm 9, 1903. His track was started just N. of Haiti on Oct. 21; no backward extension of the track to the Caribbean Sea, the Windward Islands and farther east was attempted because it was difficult to establish a reasonable space-time continuity with alleged storm locations in these areas (item 8 and corresponding author's note). Author's 7 A.M. positions were estimated as follows: Oct. 21, near 21.5 degrees N., 72.5 degrees W.; Oct. 22, near 24.0 degrees N., 74.0 degrees W.; Oct. 23, near 27.0 degrees N., 74.3 degrees W.; Oct. 24, near 31.0 degrees N., 75.0 degrees W.; Oct. 25, near 35.5 degrees N., 69.5 degrees W.; Oct. 26, near 45.0 degrees N., 57.5 degrees W.; Oct. 27, near 53.0 degrees N., 51.0 degrees W.

No hurricane winds were found in relation to this storm; therefore, the author of this study decided to classify it as a tropical storm. However, he recognizes that, in reality, the tropical storm status should have lasted only during a late portion of Oct. 23 and early on Oct. 24, before the storm rapidly became extratropical on the latter day mentioned; nevertheless, tropical storm status was denoted along the author's track starting on Oct. 21 to be consistent with the general policy in Neumann et al. (1993) which did not provide for tropical depressions in developing stages prior to 1951. In the author's opinion, the main support for including this weather system as a tropical storm of 1903 was that, at 8 A.M. Oct. 24, a wind of f. 7 (or most likely f. 9) on the Beaufort scale was reported by a ship near 31.5 N., 78.5 W., when the cold air behind a front which was approaching from the W. had not yet reached the inner portion of the storm circulation as suggested by temperatures in the 70's F to the N. of the center (item 5). The extratropical stage was introduced along the author's track later on Oct. 24.

Storm 10, 1903 (Nov. 17-25), H.

This storm corresponds to Storm 9, 1903 in Neumann et al. (1993).

The following information was found in relation to this storm:
1) Data extracted from 8 A.M. (E.S.T.) Historical Weather Maps: Nov. 17, low placed 19.5 N., 38.5 W.; ship near 20 N., 38 W., calm, 29.83. Nov. 18, low placed 22 N., 44.5 W., no data around it. Nov. 19, low placed 25.5 N., 49 W.; ship near 27.7 N., 41.3 W., S.W. f. 4; ship near 26.7 N., 41.3 W., S.W. f. 5, 29.86; the wind direction reported by the last two ships might be in error. Nov. 20, center placed 29.5 N., 49.0 W. (probably a bit far N. and W.); ship near 28.7 N., 46.3 W., S. f. 6, rain; ship near 33.5 N., 48 W., E. f. 4, 30.00; ship near 29.5 N., 51 W., E.N.E. f. 4; ship near 34.5 N., 45 W., E.S.E. f. 5, 30.27 (probably too high). Nov. 21, center placed 29.5 N., 43 W. (probably too far E., central pressure on map estimated at 995 millibars (29.38).; ship near 25.7 N., 42.3 W., S.W. f. 4; ship near 32.5, 42.5, E. f. 4, 30.09. Nov. 22, center placed 31.2 N., 42.5 W. (probably too far N.), central pressure on map estimated at 990 millibars (29.24); ship near 33.7 N., 48.7 W., N.E. to N.N.E. f. 6; ship near 30 N., 45.7 W., N. f. 7; 29.77; ship near 26 N., 38.7 W., S. to S.S.E. f. 7. Nov. 23, center placed 35 N., 42 W., central pressure on map estimated at 985 millibars (29.09); ship near 40 N., 42.5 W., N.E. f. 4, 29.97; ship near 33 N., 41.7 W., S.W. f. 9. Nov. 24, center placed 38.5 N., 41 W., central pressure on the map estimated at 990 millibars (29.24), location supported by ship data along the periphery. Nov. 25, center placed 41.3 N., 39 W., central pressure on map estimated at 995 millibars (29.38), location supported by ship data along the periphery. Nov. 26, center absorbed in a cold front (Historical Weather Maps, Nov. 1903). Author's note: Wind forces (f) are on Beaufort scale, pressures are in inches.

Only two relatively minor modifications were found worthy to be introduced along the track in Neumann et al. (1993) as for Storm 9, 1903. The 7 A.M. Nov. 17 position in the above publication was

adjusted by about 70 miles to the E. to near 19.5 degrees N., 38.5 degrees W. in order to fit better information for that day in item 1). Similarly, the 7 A.M. Nov. 20 position was adjusted by about 60 miles to the E. to near 29.0 degrees N., 48.5 degrees W. in order to fit better information for that day contained in the same item. The remaining positions along the track in Neumann et al. (1993) were kept unchanged. The author's track for Storm 10, 1903 is shown in Fig. 3.

Although no winds of hurricane intensity were reported in item 1), the lowest estimated central pressure (29.09 inches) in that item was found to support the hurricane status that Neumann et al. (1993) gave to this storm as for Storm 9, 1993. As in the above publication, the author's track denoted tropical storm status on Nov. 17-19 and showed hurricane intensity starting on Nov. 20. The extratropical stage was introduced late on Nov. 25.

Special statement.

In addition to the storms which were previously discussed, three possible cases were found for 1903.

A) Case of Jun. 10-12, 1903.

The following information was found about this possible case:
1) Data extracted from 8 A.M. (E.S.T.) Historical Weather Maps: Jun. 10, ship near 26 N., 79.3 W., N.N.W. f. 3, 29.94; ship near 31 N., 79 W., E. f. 6,; ship near 26 N., 74 W., S. f. 3, 30.09; ship near 25 N., 74 W., 30.12; Jupiter, W. f. 2, 29.97; low center placed 28.5 N., 78 W. Jun. 11, Hatteras, N.N.E. f. 6, 29.82; Wilmington, N.W. f. 2, 29.88; Charleston W. f. 4, 24.94; ship 32.7 N., 76 W., N.E. f. 4, 30.00 (too high); ship near 32.7 N., 77 W., N. f. 7; ship near 32 N., 73 W., S. f. 3, 29.77; ship near 28.7 N., 74 W., S.S.W. f. 3, showers; ship near 27.8 N., 78.8 W., W. f. 1, 30.03. Jun. 12, extratropical low placed 39.5 N., 73.5 W. (Historical Weather Maps, Jun. 1903). Author's note: Wind forces (f) are on Beaufort scale, pressures are in inches; the same is valid for Historical Weather Maps which pertain to the remaining possible cases. There is no doubt that a low pressure system moved on a general northerly course off the U.S. east coast during 10-11 and maximum winds reported in connection with this weather system were force 7, which is below tropical storm intensity. The author believes that this system had only a modest chance of having intensified to a tropical storm and this is why he decided to keep it as a possible case.

B) Case of Aug. 20-23, 1903.

The following information was found about this possible case:
1) Data extracted from 8 A.M. (E.S.T.) Historical Weather Maps: Aug. 20, low placed near 20 N., 36 W., no data around it. Aug. 21, ship near 22 N., 40 W., E.S.E. f. 5; ship near 15 N., 44 W., S.W. f. 2; low placed 20.5 N., 42 W. Aug. 22, ship near 23 N., 50 W., N. f. 6, rain, 29.86; ship near 24 N., 56 W., N.N.E. f. 7; ship near 15 N., 45 W., S.W. f. 1; center not drawn on the map but inferred

near 21 N., 46 W. based on curvature of isobars (22 N., 47.5 W. would be a better estimate based on data). Aug. 23 ship near 26.7 N., 50 W., S. f. 6; ship near 25.7 N., 56 W., N. f. 3; ship near 21 N., 55 W., E.N.E. f. 1, 29.88; center not drawn on the map but it was estimated to be near 27 N., 53 W. Aug. 24, center could not be identified but probably absorbed in a weak trough in the westerlies roughly along the 55 W. meridian (Historical Weather Maps, Aug. 1903). The above data showed the existence of a low pressure area which initially moved westward and then gradually turned northward over the middle Atlantic Ocean. Winds of force 6-7 reported to the W. of the center on Aug. 22 suggested the occurrence of some stronger winds to the E. of the center which was moving N.W. to N. However, such winds could not be documented in the light of available data and this is why the author of this study decided to keep this case as a possible one.

C) Case of Nov. 23-26, 1903.

The following information was found about this possible case: Nov. 22, Kingston, E. f. 3, 29.87; Port-au-Prince, S.E. f. 3, 29.89. Nov. 23, Kingston, N.W. f. 2, 29.79; Port-au-Prince, E f. 6. 29.72; Turk Is., E. f. 3, 29.85; San Juan, S.E. f. 3, 29.84; low placed 17.5 N., 73.5 W. and drawn on the map as having a front through it. Nov. 24, Port-au-Prince, W.N.W. f. 1, 29.81; Turk Is., N.E. f. 4, 29.80; San Juan, S.E. f. 3, 29.75; low placed 18.5 N., 68.5 W. (over extreme E. portion of the Dominican Republic), a front was shown to extend to the S. of the low and then to the W. a 1000 millibar (29.53) isobar was drawn on the map. Nov. 25, ship near 21 N., 67 W., N.N.E. f. 5; ship near 23 N., 67 W., N.N.E. f. 4; San Juan, N.N.W. f. 3, 29.79; ship near 20 N., 60.7 W., S. f. 4, 29.68, ship near 21 N., 59 W., S.S.E. f. 5, 29.97 (probably too high); center placed 19.5 N., 63 W., with a front extending to the S. and then to the W. Nov. 26, ship near 18 N., 63 W., W. f. 5, 29.91 (probably too high); San Juan, W. f. 2, 29.82; ship near 21 N., 57 W., S. f. 4, rain, 29.77; low placed 24 N., 60 W., with a front extending to the S. and then to the W. (Historical Weather Maps, Nov. 1903). In spite of that fronts were attached to this weather system on the maps, no significant temperature differences were found and, in reality, the system should have exhibited tropical characteristics. No high winds were found in relation to this disturbance but the possibility that they had existed at one time cannot be entirely ruled out because reported pressures were quite low, a closed isobar of 29.53 inches being drawn on the map for Nov. 24. This is why the author of this study decided to keep this system as a possible case.