until shortly before noon, when it began to rise steadily. At 8 A.M. (Aug.13) the barometer read 29.22 inches, which was within 0.04 inch of the lowest recorded reading at this station. (Monthly Weather Review, Aug.1899). 61) The schooner "Privateer" came in from down the (Florida) Keys. Monday (Aug.14). The Ball Brothers were out cruising with a friend from Chicago when the storm of last week came up. They went for a shelter behind Long Key where they put out 3 anchors and waited 60 hours for the storm to abate. They report that the wind reached a velocity of 60 mph and that the sea on the reefs was the heaviest they have ever seen (The Miami Metropolis, Aug.18, 1899, p.1, col.4). 62) The report comes from Palm Beach that the upper part of the ocean deck at the Inn was torn off during the storm of last Saturday and Sunday (Aug.12-13) and that the sea reached the ground around the Inn (The Miami Metropolis, Aug.18, 1899, p.1, col.4). 63) The steamer "Lampasas" left Key West at 9 A.M. Aug.12 and 12 hours later ran unto the gale that was blowing from the N.W. and then veered to the W. and S.W. in the Florida Straits. On that Sunday night, when the "Lampasas" got out of the Straits, the storm became worse. Towards morning (Aug.14) the wind blew with tremendous force (The New York Times, Aug.20, 1899, p.7, col.4). 64) Capt. Steven of the steamer "Havana" says that on Monday and Tuesday (Aug.14-15) when the gale was at its height we had to abandoned the course and run to the southward. On Wednesday and Thursday (Aug.16-17) a violent gale blew from the N.W. and the day following (Aug.18), the wind shifted to S.S.E. Yesterday morning the ship ran into another gale from E.S.E. (Monthly Weather Review, Aug.20, 1899, p.7, col.4). 65) The steamer "City of Macon" left Savannah Tuesday (Aug.15) around 1 P.M. A stiff wind from the N.W. was blowing and the following night the wind increased to 30 knots. A N.E. sea was running and all night the ship labored heavily. By noon on Thursday (Aug.17) it was blowing a gale at the velocity of 60 mph, and the ship shipped many seas. The "City of Macon" sighted the "Tallahassee" which had similar experiences (The New York Times, Aug.20, 1899, p.7, col.4). 66) The steamer "Alfred Dumois" came yesterday (to New York) from Santo Domingo. She left that port on Tuesday (?). Soon a storm came from the S.W. and the wind increased in intensity until Wednesday night (Aug.16). The captain had to heave for 4 hours at lat. 36 N., long. 73 W. and the hatches were battered down for 36 hours (The New York Times, Aug.20, 1899, p.7, col.4). Author's note: Aug.8 and Aug.15 were Tuesdays. The ship was at Santo Domingo on the first day because it was there on Aug.9 when the storm hit that island. Based on the content of the narrative above, the "Alfred Dumois" could not have left Santo Domingo on Aug.15 and reach the latitude of Hatteras in about one and a half days. According to information in item 37), the "Alfred Dumois" could not have left Santo Domingo earlier than Aug.12, and it seems that most likely the vessel should have left on that day or on Aug.13. 67) The following information was extracted from 8 A.M.

(E.S.T.) weather maps: Aug.13, center placed just N.E. of Jupiter. Aug.14, center placed to the E. of Jacksonville. Aug.15, several ships showing high winds were plotted. Aug.16, center was placed near lat. 33 N.,long. 75 W., circulation clearly defined by observations from land stations and several ships. Aug.17, circulation center placed near lat. 34 N., long. 73 W. Aug.18, circulation center placed almost over Hatteras, impossible to read data off the map in the vicinity of the center. Aug.19, center placed near lat. 36.5 N., long. 74.7 W. (Historical Weather Maps, Aug, 1899). 68) Extracted from maps displayed in an article by C.O. Paullin, Nautical Expert, United States Hydrographic Office: Aug.17, noon Greenwich Time, Hatteras, wind N. force 10; ship near lat. 35.5 N., long. 74 W., wind N.E. force 11; ship off Cape Lookout, wind N.W. force 8; ship near lat. 36.5 N., long. 73 W., wind E.S.E force 11; ship near lat. 36 N., long. 71.5 W., wind S.E. force 12. Aug.18, Norfolk, wind E.N.E. force 6; ship just E. of the Delmarva peninsula showing wind E. force 8; ship near lat. 37 N., long. 74.3 W., wind S.E. force 10; ship near lat. 37.3 N., long. 73.5 W., wind S.E. force 10; two ships about 60 miles to the S.E. of Cape Hatteras and Cape Lookout both showing wind S. force 10; a third ship a little to the east showing wind S. force 9. (Monthly Weather Review, Sept.1900). Author's note: Mr. Paullin stated in his article that the storm changed it course to N. by W., slowed down during Aug.16-19 to a rate of 3 mph and remained practically unchanged in area. 69) Washington, Aug.14. The West Indian hurricane has modified its intensity and is now designated as a tropical storm. It appears to be moving up to the Atlantic coast and the Weather Bureau has directed that storm warnings be extended to Atlantic City. Today at Savannah it blew 44 mph and at Charleston 40 mph; at Florida the wind fell below 15 mph (The New York Times, Aug.15, 1899, p.4, col.6). Author's note: The above statement was probably issued in the evening of Aug.14. The statement underestimated the actual intensity of the storm. 70) The lowest barometer shown in the morning report (Aug.15) was 29.62 inches at Charleston. The night report gave Wilmington as lowest with 29.66 inches (The New York Times, Aug.16, p.2, col.1). 71) The Atlantic coast storm was central last night beyond the North Carolina coast where N.E. gales prevailed yesterday, extending to the Virginia coast. Kittyhawk and Cape Henry reported a maximum wind velocity of 52 mph from the N.E. (The New York Times, Aug.,17, 1899, p.3, col.2). 72) The tropical storm approached somewhat closer to the North Carolina coast during yesterday and as a consequence dangerous gales has prevailed in that section and on the Virginia coast, moderately high winds reaching as far north as Atlantic City. Cape Henry reported a maximum velocity of 68 mph from the N.E. (The New York Times, Aug.18, 1899, p.3, col.5). 73) The indications now point to the gradual disappearance of the tropical cyclone. Pressure, however, continues low on the Virginia coast and N.E. gales are still blowing at Cape Henry (The New York

Times, Aug.19, 1899, p.2, col.6). 74) Some traces of the storm still remain on the Middle Atlantic coast. During yesterday there were high N.winds from Norfolk to Atlantic City. and the high seas also continued. The wind last night decreased, except at Atlantic City where it remained quite brisk (The New York Times, Aug.20, 1899, p.3, col.4). 75) Extracted from a report by L.N. Jesunofsky, Weather Bureau observer, Charleston: Not a casualty occurred along the coast of South Carolina during the passage of the hurricane center at close range on Aug.15-16, which may be attributed to the timely hoists of the hurricane signal, which caused vessels to seek save harbor. Fortunately the storm tides along the coast reached only 2.8 feet above normal, and the rice and the sea-island cotton crops escaped injury (Monthly Weather Review, Aug.1899). 76) Taken from a report by S.L. Dosher, Weather Bureau observer, Hatteras, N.C.: The wind began to blow a gale from the E. the morning of Aug.16, varying in velocity from 36 to 50 mph, and gradually shifting to N.E. at 6 P.M., with nearly stationary pressure. During the early morning of Aug.17 the wind, increased to a hurricane and at 4 A.M. was blowing at a rate of 70 mph; 10 A.M., it increased to 84 mph; and at 1 P.M. it was blowing 93 mph, with occasional extreme velocity of 120 to 140 mph. The record of wind after 1 P.M. was lost, but it is estimated that it blew with even greater velocity from about 3 P.M. to 7 P.M., and it is believed that between these hours the wind reached a regular velocity of at least 100 mph. The barometer began to fall rapidly about 8 A.M. Aug.17 and at 8 P.M. of that date it had reached the unprecedentedly low reading of 28.62 inches, where it remained about one hour, when it began to rise rapidly and by midnight (Aug.17-18) it had risen nearly one-half inch. From 7:30 to 8 P.M. Aug.17 there was a lull in the gale when it veered to S.E. and began to blow at an estimated velocity of 60 to 70 mph, which continued until well into the morning of Aug.18. The hurricane was the most severe in the history of Hatteras. The scene of Aug.17 was wild and terrific. By 8 A.M. the entire island was covered by water from the Sound, and by 11 A.M. all the island was covered to a depth of 4 to 10 feet. This tide swept over the island at a fearful rate carrying everything movable before it. There were not more than four houses on the island in which the tide did not rise to a depth of 1 to 4 feet; at least half of the people had to abandon their homes and seek safety with those who were fortunate enough to live on the higher grounds. The frightened people were crowded 40 or 50 in a house. All this day the gale, the tide and the sea continued with unabated fury. During the lull in the evening the tide ran off with great swiftness, causing a fall in the water of several feet in less than half an hour (Monthly Weather Review, Aug.1899). 77) On the morning of Aug.17, San Ciriaco swept over the lower banks near Diamond City. Reports of great destruction from Beaufort to Nags Head were later printed in newspapers across the country. In Carteret County, the island communities of Shackleford Banks,

Diamond City and Portsmouth were especially hard hit. Hatteras Island was devastated by the August hurricane of 1899. The Weather Bureau station in Hatteras Village was hard hit, as the entire southern end of the Outer Banks fell within the powerful right-front quadrant of the storm. The station's anemometer was blown away, and no record was made of the storm's highest winds. The barometric pressure was reported as near 26 inches which, if accurate, would suggest that the San Ciriaco hurricane may have reached category-five intensity. The great hurricane of '99 scuttled or sank many ships from Wilmington to the Virginia line. In his book Graveyard of the Atlantic, author David Sticks lists 7 vessels that were wrecked on the North Carolina coast during the storm: "Aaron Reppard", "Florence Randall", "Lydia Willis", "Fred Walton", "Robert W. Dasey", "Priscilla", and "Minnie Bergen". Also the Diamond Shoals Lightship was driven ashore after its mooring lines were broken by the storm's mountainous seas. Six other ships were reported lost at sea without a trace: "John C. Haynes", "M.B. Millen", "Albert Schultz", "Elwood H. Smith", "Henry B. Cleaves", and "Charles M. Patterson" (Barnes, 1995). Author's note: The pressure reading near 26 inches seems to be the product of speculation. The facts that Hatteras experienced a minimum pressure of 28.62 inches and a lull in the evening of Aug.17 do not support such an extremely low pressure. 78) Extracted from an article by C.O Paullin, Nautical Expert, United States Hydrographic Office: Plotted data on a weather map for noon Greenwich time Aug.19 included ship near lat. 36 N, long. 74.7 W., wind S.W. force 8; ship near 37.3 N., 74.7 W., wind N.E. force 6; ship near lat. 35 N., long. 75 W., wind S.W. force 8; ship near lat. 37 N., long. 73.3, wind S. force 8; ship near lat. 38 N., long. 74 W., wind E.S.E. force 8; Norfolk, wind N. force 4. Plotted data on a weather map for noon Greenwich time Aug.20 included ship reports near lat. 38.5 N., long. 71.5 W. Ship at about lat. 38 N., long. 71.3 W. showed wind S.W. force 4; ship near lat. 38.5 N. long. 72. W. showed wind N. force 7; ship near lat. 36.5 N. long. 70.5 W., showed wind W. force 6; ship near lat. 36.5 N., long. 72.7 W, showed wind N.W. force 10; ship near lat. 40 N., long. 71.5 W. showed wind N.E. force 5; ship near lat. 39.5 N; long. 69.5 W showed wind S.S.E. force 4; ship near lat. 39.5 N, long. 68 W, showed wind S.S.E force 6 (Monthly Weather Review, Oct.1900). 79) Information taken from 8 A.M. (E.S.T.) weather maps: Aug.20, center placed near lat. 38.5 N., long. 69.5 W. Aug.21, center placed near lat. 39.7 N., long. 63.7 W., circulation fairly well defined by ship observations. Aug.22, cyclone became extratropical, center near lat. 39 N., long. 54 W.; ship near lat. 41 N., long. 52 W., wind E. force 8, barometer 29.77 inches; ship near lat. 37 N., long. 54 W., wind S.W. force 7, barometer 29.80 inches. Aug.23, ship near lat. 36 N., long. 50 W., wind W. force 9, barometer 29.74 inches; occluded low to the E.N.E. and distant from the ship; trough oriented E.N.E.-W.S.W; several ships with wind N.E. force 6-

8 to the north of trough (the cyclone was probably embedded in the trough and central near lat. 37 N., long. 50 W.). Aug.24, no data; center of the occluded low near lat. 34 N., long. 46 W. Aug.25, ship near lat. 32 N., long. 42 W, wind W.S.W. force 6, barometer 29.91 inches; center of the low near lat. 36 N., long. 43 W. Aug. 26, ship near lat. 37.5 N., long. 42 W., wind E.S.E force 8, barometer 29.91 inches; center of the low near lat. 36 N., long. 44 W.; high to the north near lat. 45 N., long. 45 W. Aug.27, ship near lat. 37 N., long. 45.5 W, wind W. force 8, barometer 29.83 inches; center of the low near lat. 38.5 N. long. 44.5 W. Aug.28, ship near lat. 41 N., long. 49 W, wind N. force 6; ship near lat. 39 N., long. 49 W., wind N. force 6; ship near lat. 40.7 N., long. 43 W., wind S.S.E. force 9 (pressure could not be read off the map); center of the low near lat. 40 N., long. 45 W. Aug.29, ship near lat. 37 N., 45.5 W., wind N. force 6, rain; ship near lat. 43 N., long. 41 W., wind E. force 5, rain ; ship near lat. 40.5 N., long. 38 W., wind S. force 4; ship near lat. 40 N., long. 46.5 W., wind N.N.W. force 6 (pressure could not be read off the map); center of the low near lat. 40.5 N., long. 42.5 W. Aug.30, ship near lat. 41.5 N., long. 43 W., wind N.E. force 6; ship near lat. 37 N., long. 41 W., wind W.S.W. force 2, barometer 29.86 inches; ship near lat. 36 N., long. 40.5 W., wind W.S.W. force 5; center of the low near lat. 40 N., long. 42 W. Aug.31, ship near lat. 40.5 N., long. 38 W., wind E. force 6, barometer 29.94 inches; ship near lat. 37.5 N., long. 40.7 W., wind W. force 7, barometer 29.94; center of the low near lat. 40 N., long. 40 N., although near lat. 39 N., long. 40 W. seems to be a more realistic location (Historical Weather Maps, Aug. 1899). 80) Information extracted from 8 A.M. (E.S.T.) weather maps: Sept.1, low center near lat. 40 N., long. 37 W.; several ships showed N.E. and N. winds, the maximum velocity being force 5; 3 ships showed S.W. winds, the maximum velocity beinf force 5; temperatures reported were in the middle and low 70's; no fronts were drawn in association with the low. Sept.2, ship near lat. 39.5 N., long. 34.5 W., wind N.E. force 7; ship near lat. 37.3 N., long. 38.7 W., wind N.W. force 7, barometer 30.00 inches; ship near lat. 37.7 N., long. 31.0 W., wind S.W. force 9, barometer 29.86 inches; Ponta Delgada (Azores), wind S.W. force 2, barometer 30.01 inches; Horta (Azores), wind S. force 2, barometer 29.99 inches; center of the low near lat. 39 N., long. 31 W. Sept.3, Horta (Azores), wind S.E. force 8, barometer 29.69 inches; center of the low near lat. 37 N., long. 28 W.; some ships around the low showing maximum winds force 5-6; temperatures near the middle 70's. Sept.4, ship near lat. 49.5 N., long. 16 W., wind N. force 6, barometer 29.68 inches; ship near lat. 48.5 N., long. 15 W., wind S. force 6, barometer 29.50 inches; ship near lat. 48.7 N., long. 18 W., wind N. force 8, barometer 29.59 inches; ship near lat. 48.5 N., long. 12.5 W., wind S. force 5, barometer 29.77 inches; center of the low near lat. 49 N., long. 15.5 W., clearly defined by ship observations; cool air around the low, temperatures

in the mid and upper 60's. Sept.5, occluded, extratropical low near lat. 64 N., long. 9 W., with front passing near lat. 50 W., long. 10 W. (Historical Weather Maps, Sept.1899). 81) Taken from an article by C.O. Paullin, Nautical Expert, United States Hydrographic Office: During the week of Aug.24-30 the storm remained almost stationary near the 45 degrees W. parallel, the center on Aug. 26-28 shifting westward and northward. To the east of the Azores the storm moved northeastward, bending to the southward near 5 degrees W. meridian (Monthly Weather Review, Oct. 1900). Author's note: A map which accompanies the article, shows that the storm described a trajectory similar to a letter S over the period Aug.24-30. 82) Also taken from the article by C.O. Paullin; San Miguel (Ponta Delgada), Azores had a barometric reading of 29.08 inches. The storm at this island caused much damage to property, besides with the reported loss of life (Monthly Weather Review, Oct.1900). Author's note: A barograph trace accompanies the article, showing a quite sharp drop in pressure from about 750 millimeters (29.53 inches) at 11 A.M. (presumably local time) to about 737 millimeters (29.02 inches) around 2:40 P.M. Sept.3, then rising to 750 millimeters (29.53 inches) by 6 P.M. Wind directions were plotted on the graph, showing that the wind blew from S.S.E. first, then shifting to S.W and N.W. and finally to N. The graph was furnished the Hydrographic Office through the courtesy of Capt. F.A.Chaves, director of the Meteorological Observatory at Ponta Delgada, San Miguel, Azores. The minimum pressure shown in the graph was slightly lower than the one of 29.08 inches previously given in the text. The storm apparently passed almost over Ponta Delgada, slightly to the northward. 83) Ponta Delgada, Azores, Sept.3. A violent cyclone is at the present raging here. The Portuguese barque "Helena" dragged her anchor and sank, the crew jumping overboard. The cyclone is accompanied by excessively heavy rain and great damage has been done all over the island. Many houses in which pineapples were cultivated are completely wrecked, several roads are interrupted and many telegraph poles are blown down (The Times, London, Sept.4, 1899, p.4, col.3). 84) Ponta Delgada, Azores Islands, Sept.3. A violent storm is raging here, doing much damage to shipping and to property all over the island of St. Michael. Several lives have been lost (The New York Times, Sept.4, 1899, p.7, col.3). 85) Taken from an article by C.O. Paullin, Nautical Expert, U.S. Hydrographic Office: The log of the French steamship "Chateau Lafitte", which vessel met the storm on Sept.6 in lat. 46 N., long. 8 W., shows that on that date it has but little of the severity which it exhibited within the tropics. The "Chateau Lafitte" reports: "At noon the wind blew almost a hurricane from the S.W.; sea very heavy from the same direction, barometer 29.50 inches" (Monthly Weather Review, Oct.1900). 86) Information extracted from 8 A.M. (E.S.T.) weather maps: Sept.6, ship near lat. 46 N., long. 12 W., wind N.W. force 6, barometer 29.62 inches;

ship near lat. 47 N., long. 7 W., wind S. force 8; ship near lat. 49 N. long. 10 W., wind N.E. force 5, barometer 29.94 inches; center of a low pressure area near lat. 47 N., long. 9 W. (Historical Weather Maps, Sept. 1899). 87) Taken from the above mentioned article by C.O. Paullin: On Sept. 9 it (the storm) was central off the coast of Provence, France. Gales prevailed in this region until Sept.12, on which date the storm apparently had united with an area of low barometer covering southeastern Europe (Monthly Weather Review, Oct.1900). Author's note: Provence is located on the Mediterranean coast of France. 88) 1899. The great hurricane of this year was the one that occurred in Aug.7-14. It was so violent and caused such widespread destruction that it will certainly be ranked as a historical hurricane... Suffice to say then, that the wreckage along its path is comparable only to "the gambols of a bull in a china store". The hurricane was peculiar in that it maintained a distinct organized existence for more than one month, finally dissipating in the region of the Mediterranean Sea (Garriott, 1900). 89) Some maximum wind velocities were as follow: San Juan, E. 66 mph on Aug.8; Key West, N.W. 38 mph on Aug.13; Jupiter, N. 52 mph on Aug.13; Savannah, N.E. 44 mph on Aug.14; Charleston, N.E. 57 mph on Aug.15; Wilmington, N.E. 36 mph on Aug.16; Norfolk, N.E. 42 mph on Aug.17; Cape Henry N.E. 66 mph on Aug.17 (Monthly Weather Review, Aug. 1899). 90) Storm of Aug.3-Sept.8, 1899. Cape Verdes, Puerto Rico, recurved off the Atlantic coast. Disastrous at Puerto Rico. Skirted South Atlantic coast; at Hatteras was most violent storm in the memory of oldest inhabitants. (Tannehill, 1938). Author's note: Tannehill (1938) also shows a track for this storm. Such a track exhibited a motion describing a letter "S" in the middle of the Atlantic Ocean, roughly within the area limited by the 37 and 41 degrees N. parallels and the 47 and 40 degrees W. meridians over the period Aug.23-29. the storm then continuing to the Azores Islands on an E.S.E. track. This partial track of the storm is similar to the one shown in the article by C.O. Paullin (item 81). 91) Storm of Aug.12-19, 1899. Minor on the East coast of Florida; very severe offshore. Extreme at Cape Hatteras, N.C.; 7 ships wrecked. Coast of Va., Del. and N.J. Minor; storm center off the coast (Dunn and Miller, 1900). 92) Map showing a partial track for the storm covering the period Aug.7-15. Morning positions read off the tracks were: Aug.7, to the N.E. of Dominica and E.S.E. of Guadeloupe; Aug.8, off the southern coast of Puerto Rico to the S.E. of Ponce (this position appears to be slightly to the S. and W. of the actual one); Aug.9, on the northern coast of the Dominican Republic near Puerto Plata; Aug.10, over the eastern coast of Grand Inagua Island; Aug.11, to the S.W. of Long Island and to the S. of Great Exuma Island; Aug.12, near the eastern coast of Andros Island; Aug.13, about 40 miles to the E.S.E. of Jupiter; Aug.14, near lat. 29 N., long. 80 W., Aug.15, near lat. 31.5 N., long. 80.3 W. A map showing a second track along which the following morning positions

were estimated: Aug.12, near lat. 26 N., long. 78 W.; Aug.13, near lat. 26.7 N., long. 79.7 W.; Aug.14, near lat. 29.5 N., long. 80 W.; Aug.15, near lat. 32.5 N., long. 79 W.; Aug.16, near lat.33.7 N., long. 76.7 W.; Aug.17, near lat. 34.5 N., long. 76 W.; Aug.18, near lat. 35.5 N., long. 75.7 W.; Aug.19, near lat. 37 N., long. 74.7 W.; Aug.20, near lat. 40 N., long. 71 W. (Monthly Weather Review, Aug.1899). 93) An Aug.1899 storm appeared near lat. 16 N., long. 60 W., recurred near lat. 27 N., long. 80 W. and disappeared S. od Nova Scotia. Map showing a track for the storm to the east of Dominican on Aug.7; just off the S.E. tip of Puerto Rico on Aug.8; just a few miles off the northern coast of Hispaniola near the 70 degrees W. meridian on Aug.9; just E. of Great Inagua Island (Bahamas) on Aug.10; near lat. 22.5 N., long. 75.5 W. or to the S.W. of Long Island (Bahamas) on Aug.11; about 45 miles S. of Nassau on Aug.12; about 45 miles to the E.N.E. of Jupiter on Aug.13; near lat. 29.5 N., long. 80 W. on Aug.14; about 60 miles to the S.E. of Charleston on Aug.15; near Cape Lookout on Aug.16 (Garriott, 1900). 94) A storm was first observed near lat. 12 N., long. 36 W. on Aug.3, 1899 and lasted 36 days; it recurved near lat. 29 N., long. 81 W. and it was last observed near lat. 46 N., long. 2 E. (Mitchell, 1924). Author's note: A track which is also included in Mitchell (1924) was found to be quite similar to the one in Neumann et al. (1993) as for Storm 2, 1899. However, while the latter authors ended their track over the northern Atlantic on Aug.24, Mitchell (1924) continued his track to France, having the storm to cross the entire northern Atlantic after describing a track similar to a letter "S" at midocean. In that sense, the track in Mitchell (1924) is closer to the one shown by C.O. Paullin in the Monthly Weather Review, Oct. 1900 than to the one in Neumann et al. (1993).

On the basis of information in the above items, the author of this study decided to introduce some modifications along the storm track given in Neumann et al. (1993) as for Storm 2, 1899 and to extend such a track eastward into the eastern Atlantic Ocean. A careful analysis of the observations taken by the "Grangense" (item 1) and ship information for Aug.3 in item 2) allowed the author of this study to adjust eastward the 7 A.M. Aug.3 position in Neumann et al. (1893) by about 120 miles to near 12.0 degrees N., 34.0 degrees W. The above mentioned adjustment suggested the need for an adjustment in the 7 A.M. Aug.4 position in Neumann et al. (1993) in order to keep space-time continuity along the track; this adjustment was made, resulting in the author's 7 A.M. Aug.4 position near 12.7 degrees N., 40.3 degrees W., which was found to be about 50 miles to the E. of the corresponding position in Neumann et al. (1993). The 7 A.M. Aug.5 position in Neumann et al. (1993) was found to keep a good space-time continuity with their 7 A.M. Aug.6 position for which some support could be derived from a ship observation for that day (item 2). In addition, meteorological

information contained in items 2) through 32) was found to support the 7 A.M. positions for Aug.7 and Aug.8 shown in Neumann et al. (1993). Consequently, 7 A.M. positions for the period Aug.5-8 in the above mentioned publication were kept unchanged. The 7 A.M. Aug.9 position in Neumann et al. (1993) was adjusted a few miles to the N.E. to near 19.7 degrees N. 69.7 degrees W. in order to fit a better space-time continuity with the author's position for next day, and at the same time to keep the center of the storm moving along the N.E. coast of the Dominican Republic having barely touched at Cape Samana and Cape Frances Viejo but definitively avoided the hilly terrain to the east of Puerto Plata as suggested by the track in item 93). The author's 7 A.M. Aug.10 position was estimated near 21.0 degrees N., 73.0 degrees W. on the basis of an analysis of information in items 39) through 41), 43), 92) and 93). This position was found to be about 40 miles to the N.E. of the one shown in Neumann et al. (1993). The author's 7 A.M. Aug.11 position was estimated near 23.0 degrees N., 76.0 degrees W. on the basis of an analysis of information in items 42), 52), 53), 92) and 93). This position was found to be about 50 miles to the N.N.E. of the corresponding one in Neumann et al. (1993). The author's 7 A.M. Aug.12 position was estimated near 24.5 degrees N., 78.0 degrees W. on the basis of information contained in items 48) through 52), 92) and 93), although the position along the second track in item 92) was discarded; this position was found to be about 50 miles to the E.S.E. of the corresponding position in Neumann et al. (1993). 7 A.M. positions for Aug.13-14 in Neumann et al. (1993) were found to be supported by information contained in some of the above items, and, therefore, were kept unchanged; however the 7 A.M. Aug.15 position in their publication was slightly adjusted to the S.E. to near 31.7 degrees N. 78.7 degrees W. in order to fit a better space-time continuity with the author's position for next day. The author's 7 A.M. Aug.16 position was estimated near 33.0 degrees N., 75.5 degrees W., primarily on the basis of information for that day contained in item 67); this position was found to be about 80 miles to the E. of the corresponding one in Neumann et al. (1993). The author's 7 A.M. Aug.17 position was estimated near lat. 34.5 N., long. 74.5 W. on the basis of an analysis of information in items 67), 68) and 76); this position was found to be about 60 miles to the E.N.E. of the corresponding one shown in Neumann et al. (1993). The 7 A.M. Aug.18 position in Neumann et al. (1993) was kept unchanged because it was found to be supported by information contained in several items, particularly in item 68). The author's 7 A.M. Oct.19 position was estimated near 36.5 degrees N., 74.7 degrees W. on the basis of information for that day contained in items 67) and 78); this position was found to be about 90 miles to the S.W. of the corresponding one in Neumann et al. (1993). The author's 7 A.M. Aug.20 position was estimated near 38.7 degrees N., 71.0 degrees W. and was based on information for that day in items 78) and 79); such a position was found to be

slightly to the S.W. of the corresponding one in Neumann et al. (1993). The author's 7 A.M. positions for the period Aug.21-24 were as follows: Aug.21, near 39.7 degrees N., 63.5 degrees W.; Aug.22, near 38.7 degrees N., 54.3 degrees W.; Aug.23, near 36.7 degrees N., 50.0 degrees W.; Aug.24, near 34.3 degrees N., 46.0 degrees W. The above positions were based on information for the respective days in item 79) and were found to be about 40 miles to the N., about 180 miles to the E.N.E., a few miles to the S. and about 140 miles to the S. W. of the corresponding positions in Neumann et al. (1993). The author of this study decided to extend the track in Neumann et al. (1993) beyond Aug.24 on the basis of information in items 79) through 84). By using information in item 79), he estimated the following 7 A.M. positions for the period Aug.25-31: Aug.25, near 35.3 degrees N., 43.0 degrees W.; Aug.26, near 36.5 degrees N., 43.5 degrees W.; Aug.27, near 37.7 degrees N., 44.5 degrees W.; Aug.28, near 40.0 degrees N., 45.0 degrees W.; Aug.29, near 40.5 degrees N., 43.0 degrees W.; Aug.30 near 40.3 degrees N., 41.5 degrees W.; Aug.31, near 40.0 degrees N., 40.0 degrees W.; the above positions resulted in a track describing a letter "S" which. in a sense, was similar to the ones presented by C.O. Paullin (item 81), Tannehill (item 90) and Mitchell (item 94), although it differed from those in details pertaining to times of storm positions and to the actual shape of the letter "S". On the basis of information in item 80), the author of this study estimated positions near 40.0 degrees N., 37.0 degrees W. for 7 A.M. Sept.1 and near 39.0 degrees W., 32 degrees W. for 7 A.M. Sept.2. The author's 7 A.M. Sept.3 position was estimated near 37.3 degrees N., 28.7 degrees W., and was based on an analysis of meteorological information for the Azores Islands (items 80 and 82). The author of this study decided to terminate his track for Storm 3, 1899 in the vicinity of 39.0 degrees N., 24.0 degrees W. because of uncertainties about the evolution followed by the storm after the storm center passed practically over Ponta Delgada (item 82). On one hand, there is a strong likelihood that the storm had accelerated to the N.E., being the low pressure center located near 49.0 degrees N., 15.5 degrees W. on the morning weather map for Sept.4 (item 80); that system seemed to have been absorbed in the circulation of the huge extratropical cyclone which was located near 64.0 degrees N., 9 degrees W. on Sept.5 (item 80). On the other hand, C.O.Paullin stated that the storm was encountered by the "Chateau Laffite" at 46.0 degrees N., 8.0 degrees W., on Sept.6 (item 85), that it bent southward near the 5.0 degrees W. meridian (item 81) and that it was central off the coast of Provence (France) on Sept.9 (item 87). Meteorological information for Sept.6 in item 86) confirms the existence of the storm encountered by the "Chateau Lafitte" (item 85) but, in the author's opinion, this storm was unrelated to the one which passed over Ponta Delgada on Sept.3 (item 82) and probably developed along the frontal boundary which passed through 50.0 degrees N., 10.0 degrees W. on the

morning map of Sept.5 (item 80). However, the author of this study could not produce any evidence which entirely disproved any relationship between the two storm. This was the reason he had for terminating his track on Sept.3 and, by so doing, he avoided the risk of having introduced a portion of the track which was never described by Storm 3, 1899. The author's track for the storm is displayed in Fig.2.

The hurricane status which Neumann et al. (1993) gave to this storm as for Storm 2, 1899 was confirmed by information contained in many of the items above. Pressures well below 28.50 inches, reaching as low as 27.45 inches at Monserrat (item 7) and 27.75 inches at Puerto Rico (item 24) clearly indicate that the storm was a major hurricane which attained great intensity in the Caribbean Islands. The classification of the storm as extreme in the Hatteras area given by Dunn and Miller (item 91) indicates that the storm attained great intensity on the North Carolina coast as well. Late on Aug.5, Neumann et al. (1993) introduced hurricane status along their track; the author of this study found this to be reasonable and decided to start denoting hurricane intensity along his track in the vicinity of 14 degrees N., 49 degrees W. as the above mentioned authors did. The hurricane status was kept along the author's track until the storm reached the vicinity of 40 degrees N., 60 degrees W.,late on Aug.21. A change to an extratropical stage was introduced on Aug.22 as fronts were drawn in association with the cyclone on the morning map corresponding to that day, declaring the storm extratropical (item 79); however, an observation taken a by ship on the morning of Aug.23 still suggested the fairly tight wind structure which is typical of tropical cyclones. No fronts were drawn in connection with the cyclone on the map corresponding to Aug.26 and the author decided to replace the extratropical stage with that of a tropical storm on that day; the reasoning behind so doing was that the extratropical stage of the storm had been probably overestimated and that the system had started to move northward, approaching the warmer waters of the Gulf Stream. The tropical storm status was changed to a hurricane on the basis of the lowest pressure of 29.02 inches at Ponta Delgada (item 82), the tight pressure gradients which were inferred from a barograph trace (item 82) and the damage done on the island of San Miguel Azores (items 83 and 84). Hurricane intensity was maintained until the author's track for Storm 3, 1899 was terminated in the vicinity of 39 degrees N., 24 degrees W. late on Sept.3.

Storm 4, 1899 (Aug.29-Sept.8), H.

This storm corresponds to Storm 3, 1899 in Newmann et al. (1993).

The following information was found about this storm: 1) This disturbance was of moderate strength throughout a course which lay from a point E. of Guadeloupe on Aug.29 to a position S. of Santo Domingo on Aug.31, thence N.W. and N. over western Haiti, and thence N.E. to the vicinity of Bermuda Islands by Sept.4. Shipping and other interests were advised of the approach and character of this disturbance and precautions which were justified by reports. It appears that while the storm possessed but moderate intensity over the Caribbean Sea, Santo Domingo and Haiti it acquired greater strength after it recurved northward and northeastward over the ocean (Monthly Weather Review, Sept. 1899). 2) The tropical storm central E. of the island of Guadeloupe is moving N. by W. This storm has not yet developed dangerous force but all the interested parties throughout the West Indies have been notified of the facts and advice given that shipping interest should take all necessary precautions (The New York Times, Aug.30, 1899, p.2, col.7). Author's note: This statement was probably issued in the evening of Aug.29. 3) The tropical storm is tonight (Aug.30) central in the Middle Caribbean Sea, S. of San Juan, moving W.N.W. It has increased in energy since Tuesday night (Aug.29) and the following maximum velocities and reported: Santo Domingo 24 mph from S.E., St. Kitts 30 mph from S.E., San Juan 32 mph from E. (The New York Times, Aug.31, 1899, p.2, col.7). 4) Observations taken at 8 A.M. (E.S.T.) which were extracted from weather maps: Aug.29, Dominica, wind S.W. force 1, barometer 28.88 inches; Barbados, wind S. force 2, barometer 29.88 inches, two ships near the extreme N.E. Leeward Islands showing winds from E.N.E. force 5. Aug.30, St. Kitts, wind E. force 6, barometer 29.81 inches; Antigua (or ship nearby), wind E.S.E. force 7; St. Thomas (or ship nearby), wind E. force 4 (pressure could not be read off the map); San Juan, wind N.E. force 3, barometer 29.89 inches; Dominica, wind S.E. force 1, barometer 29.86 inches. Aug. 31, Santo Domingo, wind N. force 3, barometer 29.85 inches; St. Kitts, wind E. force 4, barometer 29.92 inches; Kingston, wind N.E. force 3, barometer 29.87 inches; ship near lat. 17.2 N., long. 75.5 W., wind N.E. force 5, barometer 29.94 inches (probably too high); ship near lat 15.5 N. long 67 W., wind S. force 11, barometer 29.77 inches (Historical Weather Maps, Aug. 1899). Author's note: The 8 A.M. (E.S.T.) Aug. 31, 1899 map placed the storm center near lat. 15.5 N., long. 70 W., a position which seems to be too far west. 5) Kingston, Jamaica, Aug 31. The storm is to the S. of Santo Domingo and moving to Jamaica, where it is expected on Saturday, Sept. 2 (The Times, London, Sept. 1, 1899,

p.4, col. 3). 6) The tropical storm has moved to the S.W. of Santo Domingo, It showed a slight further increase in intensity. San Juan reported a maximum wind velocity of 48 mph from the S.W. and St. Kitts 28 mph from S.E. (The New York Times, Sept.1, 1899, p.2, col.7). Author's note: This statement was probably issued the evening before its publication date. The S.W. wind direction at San Juan seemed to be either a typographic error or the result of local thunderstorm activity. 7) The month (Sept. 1899) opened with a tropical cyclone S.E. of Santiago de Cuba. Advisory information regarding the disturbance was received at the West Indian forecast district (Havana) the evening of Aug.31. The following message was received from Washington the evening of Sept.1: "Storm center 4 P.M. S. and near Santiago de Cuba, moving W.N.W.; slightly increased energy. Vessels sailing from Cuban ports and those W. from Santo Domingo and Haiti should take every precaution". This information was telegraphed to all regular and display stations on the Island of Cuba and to Santo Domingo, and to all newspapers that could be reached. At 1:44 P.M. Sept.2 the following was received from Washington: "Tropical storm near Windward Passage; continued strong N.E. winds on Florida and north Cuban coasts for a day or two; high seas". The following was received from Washington at 9 P.M. (Sept.2): "Storm apparently recurved and centered N. of Santo Domingo and Haiti, moving northward; little energy. Caution advised vessels sailing in that direction; stations notified" (Monthly Weather Review, Sept. 1899). Author's note: The above information was taken from the report of the West Indian forecast district office of the Weather Bureau (Havana) which is included in the Monthly Weather Review (Sept. 1899). Versions of the evening weather statements of Sept.1 and Sept.2 were also published in The New York Times, Sept. 2, 1899, p.2, col.7 and in The New York Times, Sept. 3, 1899, p.3, col.7, respectively. 8) The tropical storm recurved near the Windward Passage on Saturday (Sept.2) and moved up to the N.without developing a force of consequence, and during yesterday the barometer rose throughout the West Indies, except over western Cuba (The New York Times, Sept.4, 1899, p.2, col.6). Author's note: Information contained in the next item, clearly indicates that the storm had reached hurricane intensity by Sept.3; therefore, the statement "without developing a force of consequence" was found to have seriously underestimated the actual intensity of the storm at its time of issuance, which was probably in the evening of Sept.3. 9) Observations taken on the U.S. transport "Kilpatrick" on Sept.3, when in about lat. 25 N., long. 68 35 W., show that hurricane winds were encountered in that position (Monthly Weather Review, Sept.1899). 10) Observations taken at 8 A.M. (E.S.T.) which were extracted from weather maps: Sept.1, Santiago de Cuba, wind N. force 4, barometer 29.78 inches; Port-au-Prince, wind E. force 3, barometer 29.73 inches; Santo Domingo, wind N.E. force 1; San Juan, wind S.E. force 2, barometer 29.90 inches; ship near lat. 20 N., long. 70 W., wind S. force 5,

barometer 29.86 inches; ship near lat. 16 N., long. 74.5 W., wind N.N.W. force 2. Sept.2, Port-au-Prince, wind N.W. force 2, rain, barometer 29.74 inches; Santo Domingo, wind W, force 2, rain, barometer 29.75 inches; Santiago de Cuba, wind N. force 2, barometer 29.77 inches; Kingston, wind N.N.E. force 2, barometer 29.80 inches; ship near lat. 23 N., long. 74 W., wind E., force 5, barometer 29.71 inches. Sept.3, Port-au-Prince wind; N.W. force 2, barometer 29.82 inches; Santo Domingo, wind S.W. force 2, barometer 29.81 inches (not clearly read off the map.); San Juan, wind S.E. force 2, barometer 29.86 inches; ship near Caicos, wind N.N.E. force 2, barometer 29.71 inches; ship near lat. 25.3 N., long. 73.5 W., wind N.N.E. force 2; ship near lat. 25 N., long. 67.5 W., wind S.E. force 10 (barometer could not be read off the map); ship near lat. 26 N., long. 66 W., wind E. force 7. Sept.4, ship near lat. 30 N., long. 69 W., wind N.E. force 9; ship near lat. 30 N., long. 63.7 W., wind S.S.E. force 10; storm center shown on the 8 A.M. (E.S.T.) Sept.4, 1899 map at lat. 29.5 N., long. 67.5 W. Sept.5, extratropical low shown near lat. 35.5 N., long. 59.5 W. on the corresponding map for that day (Historical Weather Maps, Sept. 1899). 11) Winds of hurricane force blew over Bermuda in a 12 hours storm on Sept.4, 1899, doing considerable damage (Tucker, 1982). Author's note: Tucker (1982) believes that this hurricane occurrence was one of the reasons the inhabitants of the island did not prepare for a second hurricane which affected Bermuda on Sept.12-13, 1899. She stated that "the inhabitants had only caught their breath after it when this second, and far more lethal, one struck". 12) Storm of Aug.29-Sept.10, 1899. Puerto Rico, Bahamas (Tannehill, 1938). Author's note: It should be mentioned that Salivia (1972) does not mention this storm as having seriously affected Puerto Rico, and that only the S.E. Bahamas felt the effects of the storm. 13) Map showing a track for the storm. The following morning positions were extracted from the map: Aug.30, near lat. 15.3 N, long. 63.5 W.; Aug.31, near lat. 16.7 N., long. 70.5 W.; Sept.1, near lat. 18.7 N., long.73.3 W.; Sept.2, near lat. 20.7 N., long. 73.5 W.; Sept.3, near lat. 24.5 N., long. 71.5 W.; Sept.4 near lat. 29.5 N., long. 67.7 W., having the storm passed just to the N.W. of Bermuda later on that day (Monthly Weather Review, Sept.1899). 14) Map practically reproducing the same track which was published in the Monthly Weather Review, Sept.1899 and described in the item above (Garriott, 1900). 15) A storm was first observed at lat. 16 N., long. 58 W. on Aug.29, 1899 and lasted 16 days; it recurved at lat. 22 N., long. 72 W and it was last observed at lat. 65 N., long. 13 W. (Mitchell, 1924). Author's note: A track for this storm which is included in Mitchell (1924) was found to bring the storm over the N.E. tip of Puerto Rico and then to the north of Hispaniola. This track was found to be quite similar to the one in Neumann et al. (1993); however, it was found to be very different from the tracks in items 13) and 14).

After having carefully examined the content of items 1) through 14), the author concluded that a major modification of the storm track in Neumann et al. (1993) was necessary for the period Aug.30-Sept.5, and that the modification to be implemented for the first half of such a period was so dramatic that it was preferable to prepare an entirely new track. After having kept unchanged the 7 A.M. Aug.29 position in Neumann et al. (1993) because it was found to fit a good space-time continuity as applied backwards from the first position estimated by the author of this study, the following 7 A,M, positions were estimated by him: Aug.30, near 16.7 degrees N., 63.0 degrees W., primarily on the basis of the morning observation taken at St. Kitts on that day (item 4); this position was found to be 70 miles to the S.W. of the corresponding one in Neumann et al. (1993). Aug.31, near 16.5 degrees N., 68.0 degrees W., primarily on the basis of the morning observation provided by a ship, having reported a wind S. force 11 in the eastern Caribbean Sea on that day (item 4); this position was found to be about 200 miles to the S.W. of the corresponding one in Neumann et al. (1993). Sept.1, near 17.5 degrees N., 72.0 degrees W., primarily on the basis of meteorological morning reports from Port-au-Prince which showed the lowest pressure of 29.73 inches with a wind E. force 3 and a ship in the central Caribbean Sea, which showed a wind N.N.W. force 2 on that day (item 10); this position was found to be about 200 miles to the S.W. of the corresponding one in Neumann et al. (1993). Sept.2, near 20.7 degrees N., 71.7 degrees W., based on mornings meteorological observations for that day (item 10); this position was found to be about 80 miles to the S. of the corresponding one in Neumann et al. (1993). Sept.3, near 24.5 degrees N., 70.0 degrees W., primarily on the basis of meteorological information provided by ships in the vicinity of lat. 25 N., and between long. 66 and 67.5 W. in the morning of that day (item 10) and by the "Kilpatrick: (item 9) and, to a lesser extent, by the remaining data for Sept.3 which are contained in item 10); this position was found to be about 120 miles to the S.S.E. of the corresponding one in Neumann et al. (1993). Sept. 4, near 29.5 degrees N., 67.5 degrees W., based on morning meteorological information for that day (item 10); this position was found to be about 80 miles to the S.E. of the corresponding one in Neumann et al. (1993), and later on Sept.4 the storm center was made to pass just to the N.W. of Bermuda as supported by track information in items 13) and 14). Sept.5, near 35.5 degrees N., 59.5 degrees W., based on information for the morning of that day contained in item 10); this position is roughly 120 miles to the east of the corresponding one in Neumann et al. (1993). 7 A.M. positions for the period Sept.6-8 in the above publication (as for Storm 3, 1899) were kept unchanged. The author's track for Storm 4, 1899 is displayed in Fig.2.

The hurricane status which Neumann et al. (1993) attributed to