Tannehill (1938) mentioned four storms for 1870 and none of the other authors mentioned additional storms for that year. The author of the present study has recently documented seven cases. This contribution brought the number of known storms for 1870 from 4 to 11, which represented an increase by 175 percent.

Storm 1, 1870 (Jul. 30).

This storm has been mentioned by Tannehill (1938), Dunn and Miller (1960) and Ludlum (1963) as having occurred at Mobile. The first author stated that it happened on Jul. 3, Dunn and Miller (1960) indicated that it took place either on Jul. 3 or on Jul. 30 and Ludlum (1963) mentioned that it occurred on Jul. 30. In accordance with the information that the author of this study has gathered, the latter date mentioned (Jul. 30) is the correct one.

The following information pertains to Storm 1, 1870: 1) The storm was brief in duration commencing about noon and being over before 2 P.M. Jul. 30. By 2:30 P.M. the water started to subside. At no time there was water many inches deep in any of the Front Street stores. The Daily Register, a Mobile newspaper, indicated that the pressure fell two inches in two hours, down to 27.50 inches and that the water rose higher than any time since 1860. There was considerable damage from high water along the shore of the bay (Ludlum, 1963). 2) Message from Mobile, Al., Jul. 30. A terrific storm passed over the city today. Houses were uproofed, trees uprooted, goods in the stores damaged and stream boats sunk or were driven ashore. The dry-deck was forced from the moorings and driven up the river for 8 miles. No loss of life has been reported so far. The total damage is about $ 200,000 (The New York Times, Jul. 31, 1870, p.5, col.4).

The pressure drop to 27.50 inches reported by the Daily Register is indeed questionable because Dunn and Miller (1960) has classified the storm intensity as minor and the damages described in items 1) and 2) do not correspond to the very extensive destruction a major hurricane having a central pressure of 27.50 inches would cause.

No track has been determined for Storm 1, 1870, but the storm was placed at Mobile on Jul. 30 (Fig. 6).

Storm 2, 1870 (Aug. 30- Sept. 4).

This is the first storm case that the author of this study has documented for 1870.

The origin of this storm was probably related to the following event: Ship "Daniel Marcy", which has crossed the Equator at long. 31 W. on Aug. 18, had a hurricane from S.E. to N.N.E. on Aug. 22, lasting for 6 hours; went under bare poles for that length of time and lost sails (The New York Times, Oct. 27, 1870, p.8, col. 5). No position was given for the above ship- hurricane encounter and, therefore, the track for Storm 2, 1870 which is shown in Fig. 6 could not be started until Aug. 30.

The following information helped in determining the storm

track: 1) Royal Mail ship "Shannon" left St. Thomas for England on Aug. 29 and experienced a strong gale from W.S.W to N.W. on Aug. 30 (The Times, London, Sept. 13, 1870, p.3, col.1). 2) Bark "Virginia Dave" had a heavy gale off Bermuda on Aug. 31 (The New York Times, Sept. 10, p.8, col.5 and 6). 3) Bark "Neversink" reports damages in a three-day gale south of Bermuda on Sept. 1 (The New York Times, Sept. 10, 1870, p.8, col.5 and 6). 4) Ship "Aurora", lat. 32 N., long. 68 W., experienced a cyclone from E.S.E to N.W. on Sept. 1 and 2 (The New York Times, Sept. 13, 1870, p.8, col.6). 5) Bark "Golden Fleece". Sept. 1, lat. 30 N., long. 69 W., had a heavy N.E. gale, lasting 3 days (The New York Times, Sept. 11, 1870, p.8, col.7). 6) Bark "Carl and Augusta" encountered a gale from E. at lat. 30 38 N., long. 65 45 W. on Aug. 31, increasing in fury until Sept. 2 at lat. 34 26 N., long. 72 56 W. when it became furious with heavy squalls and high seas (The New York Times, Sept. 10, 1870, p.8, col.5 and 6). 7) Bark "Lucida" encountered a heavy S.E. gale on Sept. 2, lasting 10 hours (The New York Times, p.8, col.5 and 6). 8) Schr. "Conrade", lat. 32 30 N., long. 68 30 W., had a hurricane from E.N.E. to W.S.W. on Sept. 1-3, blowing very hard (The New York Times. Sept. 10, 1870, p.8, col.5 and 6). 9) Brig "Favorita" had a heavy N. gale at lat. 31 N., long. 69 38 W. on Sept. 3, lasting for 24 hours (The New York Times, Sept. 16, 1870, p.8, col.6). Author's note: The day is in error; it should read Sept. 1 or else the position could also be in error. 10) Schr. "Pilot's Bride". Sept. 1, had a hurricane from S.E to N.W. off Bermuda lasting 16 hours, during which lost fore and maintop masts and sails and sprung a leak (The New York Times, Nov. 25, 1870, p.8, col.5). 11) Ship "Storkes" had a gale from E. to N.N.W. on Sept. 3 at lat. 40 N., long. 69 W. (The New York Times, Sept. 8, 1870, p.8, col.7). 12) Bark "Union" had a hurricane at lat. 40 N., long. 67 W. on Sept. 4 (The New York Times, Sept. 9, 1870, p.8, col.5). Author's note: It could have been late on Sept. 3 and early on Sept. 4. 13) Ship "Wm. Hunter", at lat. 38 N., long. 70 W., encountered a hurricane from S.E. shifting to N., lasting 6 hours (The New York Times, Sept. 9, 1870, p.8, col.5). 14) Ship "Wm. M. Reed" encountered a circular gale E. to W.S.W. with heavy squalls and high seas (The New York Times, Sept. 10, 1870, p.8, col.5 and 6). 15) Ship "Good Hope" encountered a hurricane from S.E. to S.W. on Sept. 4 (The New York Times, Sept. 10, 1870, p.5, col.6). 16) Ship "Crusader" had a hurricane from S.E. off Sable Island on Sept. 3, lasting for 15 hours (The New York Times, Sept. 10, 1870, p.8, col.5 and 6). Author's note: Sept. 4 fits better than Sept. 3. 17) Bark "Mina" had an E. to W. hurricane at lat. 40 53 N., long. 68 30 W. on Sept. 3, lasting for 16 hours (The New York Times, Sept. 10, 1870, p.8, col.5 and 6). 18) Bark "Wavelet", lat. 41 N., long. 68 W., experienced a hurricane from E. to N.W. lasting 16 hours (The New York Times, Sept. 10, 1870, p.8, col.5 and 6). 19) Bark "Fidelio". Hurricane from E. to N.W. at lat. 40 N., long. 69 W., lasting for 5 hours (The New York Times, Sept. 10, 1870, p.8, col.5 and 6). 20) Bark "Stella" encountered an E.S.E. to W. hurricane off George's bank on Sept. 3 (The New York Times, Sept. 10, 1870, p.8, col.5 and 6). 21) Ship "John Sydney". Sept. 3, lat. 42 N., long. 62 12 W. (midday position), S.E. breeze gradually becoming to gale and to hurricane at 10 P.M. with a tremendous sea (The New York Times,

Sept. 11, 1870, p.8, col.7). 22) Ship "Francis Hillyard". Hurricane from S.E. veering to W. by way of E., at lat. 40 34 N., long 67 43 W. on Sept. 3 (The New York Times, Sept. 11, 1870, p.8, col.7). 23) Ship "John Mann". Sept. 3, lat. 42 N., long. 66 30 W., had a hurricane from E. going to S.W., lasting for 12 hours (The New York Times, Sept. 11, 1870, p.8, col.7). 24) Bark "Uno". Had a hurricane beginning from S.E. and ending from W. on Sept. 3 and 4 (The New York Times, Sept. 11, 1870, p.8, col.7). 25) Bark "Levanter". Sept. 3, off George's Bank at long. 68 W., had a very heavy hurricane setting from E.S.E. and veering to N. and N.W. (The New York Times, Sept. 11, 1870, p.8, col.7). 26) Bark "James Mc Carty", lat. 40 N., long. 68 W., had a hurricane from E. to N.W. lasting 16 hours (The New York Times, Sept. 12, 1870, p.8, col.6). 27) Bark "Lucy Frances" had a heavy gale from S.E. at lat. 44 N., long. 63 30 W. on Sept. 4 (The New York Times, Sept. 12, 1870, p.8, col.6). 28) Bark "Sharpsburg" had a hurricane from E.S.E to S.W. on Sept. 3, lasting 14 hours (The New York Times, Sept. 12, 1870, p.8, col.6). 29) Bark "Palo Alto", lat. 42 30 N., long. 65 W., had a hurricane from S.E. to S.W. on Sept. 3 (The New York Times, Sept. 12, 1870, p.8, col.6). 30) Bark "Demetra". Hurricane from S.E. to S.S.W. off Cape Sable on Sept. 3 (The New York Times, Sept. 12, 1870, p.8, col.6). 31) Brig "Masonie" had a hurricane from E. to S.E on George's Shoals on Sept. 3 (The New York Times, Sept. 12, 1870, p.8, col.6). 32) Ship "N. Boyston" encountered a hurricane at lat. 44 30 N., long. 62 40 W. on Sept. 4; wind S.E. to S.W., lasting 6 hours (The New York Times, Sept. 12, 1870, p.8, col.6). 33) Bark "Blue Nose". Hurricane from E.S.E. ending from W.N.W. at lat. 42 59 N., long. 63 W. on Sept. 3 (The New York Times, Sept. 13, 1870, p.8, col.6). 34) Bark "Iris". Off Halifax on Sept. 3, hurricane from S.E. to W.S.W. lasting 23 hours (The New York Times, Sept. 13, 1870, p.8, col.6). 35) Brig "Mary Ann Palmer", lat. 43 N., long. 60 W., Sept. 4, hurricane from S.E to S.W. (The New York Times, Sept. 13, 1870, p.8, col.6). 36) Brig "Lydia H. Cole". Sept. 3, lat 44 40 N., long. 62 30 W., had a hurricane from E. to S.W., lasting 30 hours (The New York Times, Sept. 14, 1870, p.8, col.6). Author's note: Sept. 3-4 would be better than Sept. 3 alone. 37) Brig "Prairie Rose" had a hurricane from E. to S.W. at lat. 44 30 N., long. 62 55 W. on Sept. 4, lasting for 10 hours (The New York Times, Sept. 14, 1870, p.8, col.6). 38) Brig "Lily" had a heavy gale at lat. 43 50 N., long. 63 W., starting from E.S.E. and ending from W. (The New York Times, Sept. 15, 1870, p.8, col.5). 39) Brig "G. S. Berry". Sept. 4, off Sable Island, encountered a hurricane from E.S.E. to S.W. lasting 12 hours (The New York Times, Sept. 16, 1870, p.8, col.6). 40) Brig "Amelia", lat. 45 40 N., long. 63 10 W., Sept. 4, had a severe hurricane from S.E. to W.S.W., lasting for 10 hours (The New York Times, Sept. 18, 1870, p.8, col.6). Author's note: The location which corresponds to lat. 45 40 N., long. 63 10 W. is over Nova Scotia near the town of River John; therefore, the position given by the "Amelia" is in error.

Although no barometer readings were reported in relation to Storm 2, 1870, all indications are for the storm to have been a fully developed hurricane.

Storm 3, 1870 (Sept. 1-4).

This is the second new storm that the author of this study has documented for 1870. A track for Storm 3, 1870 is shown in Fig. 6.

Documentation of the storm was based on the following information: 1) Bark "Francis", lat. 15 30 N., long. 29 46 W., had a very heavy gale from S. to W. on Sept. 1 (The New York Times, Sept. 26, 1870, p.8, col.6). 2) Ship "Dragon" had a rotatory gale between lat. 19 and 20 N., long. 53 36 W. on Sept. 4, the wind veering from E.N.E. around to N. to W.S.W. and S.W. Barometer fell from 30.00 inches to 29.68 inches (The New York Times, Sept. 22, 1870, p.8, col.6).

Items 1) and 2) allowed one to estimate storm positions for Sept. 1 and Sept. 4, respectively. The track shown in Fig. 6 was based on these estimated positions and also on interpolated positions for Sept. 2 and Sept. 3. The track was terminated on Sept. 4 because no additional information about Storm 3, 1870 was found beyond that day.

Storm 4, 1870 (Sept. 9-13).

Tannehill (1938) has listed this storm as having occurred near Bermuda on Sept. 10. The author of this study has found information about the storm for the period Sept. 9-13 and has produced the track which is displayed in Fig. 6.

The following information was useful in determining the evolution of Storm 4, 1870: 1) Schr. "Frank Howard" (coming to New York from Para, Brazil, in 26 days), had a hurricane at lat. 21 50 N., long. 64 20 W. on Sept. 9. On Sept. 10, spoke brig Montrose" having had the hurricane in which sustained damages. The "Frank Howard" sighted five other vessels badly crippled (The New York Times, Sept. 24, 1870, p.8, col.6). Author's note: The position given by the "Frank Howard" appears to be too far south for a Para-New York passage and the 26 days the vessel claimed to have spent sailing from Para to New York probably resulted from a typographic error. 2) Brig "Unicorn" had a heavy gale at lat. 26 N., long. 65 W. on Sept. 9 (The New York Times, Sept. 24, 1870, p.8, col.6). 3) Brig "Suwanee", lat. 28 N., long. 65 W., had a hurricane from S. to W. on Sept. 9, lasting 16 hours (The New York Times, Sept. 24, 1870, p.8, col.6). 4) Schr. "Mary Seymour" (from Rio Grande in 57 days). Sept. 9-11, encountered a hurricane from S. to S.W. (The New York Times Sept. 26, 1870, p.8, col.6). 5) Bark "Samuele" (from Licata, Italy, Jun. 10). Sept. 10, lat. 29 52 N., long. 53 48 W. (?), had a hurricane from E.S.E. to N. , lasting 36 hours (The New York Times, Sept. 27, 1870, p.8, col.6). Author's note: The longitude given is obviously wrong and should probably read 63 48 W; in addition, the latitude of 29 52 N. appears to be too far south for an Italy to New York passage. 6) Storm of Sept. 10 at Bermuda. The vortex of the hurricane passed at sufficient distance for winds force 11 (64 to 73 miles per hour) to have been registered at the island. The barometer fell seven tenths of an inch, the greatest variation in 10 years. Great destruction has been occasioned to fruit trees, and schooners reported that the sea was running fearfully high at North Rock Channel (Tucker, 1982). 7)

Brig "Johanna", lat. 33 N., long. 60 W., had a hurricane from S., S.W. and N.W. on Sept. 10 (The New York Times, Sept. 24, 1870, p.8, col.6). 8) Brig "Santos", lat. 34 16 N., long. 59 30 W., had a S.S.E. to W. hurricane lasting for 24 hours (The New York Times, Sept. 24, 1870, p.8, col.6). 9) Ship "Victoria" (from Newport in 45 days), lat. 38 N., long. 63 W., had a gale from E.S.E. to W. on Sept. 11 (The New York Times, Sept. 25, 1870, p.8, col.6). Author's note: Long. 63 W. is obviously in error and long. 53 W. would seem reasonable because the ship spent 45 days coming to New York from Newport (England) and arrived in New York on Sept. 24. 10) Bark "Hakon Jarl" had a hurricane on Sept. 12 at lat. 46 N., long. 54 W., lasting 8 hours; wind went from S.E to N.E. (The New York Times, Oct. 2, 1870, p.8, col.6). 11) Ship "W. J. Hatfield", lat. 44 N., long. 49 W., Sept. 12, had a S.E. to S.W. hurricane lasting for 12 hours (The New York Times, Oct. 4, 1870, p.8, col.4). 12) Ship "Italia" had a hurricane from S.E. to S.W. on Sept. 12 (The New York Times, Oct. 5, 1870, p.8, col.5). 13) Brig "Lizzie M. Morell" (from Guttenberg in 46 days). From Sept. 11 to 14 had gales from E.S.E. and veering to all points of the compass until finally moderating from N.W.; the heaviest part of the gale lasted 38 hours and the barometer fell to 28 inches. The vessel reported a position at lat. 44 N., long. 54 W. on Sept. 23 (The New York Times, Oct. 7, 1870, p.8, col.6). 14) Bark "Rhea" (from England in 74 days). Sept. 12, had a gale commencing from W. and going around the compass (The New York Times, Oct. 9, 1870, p.8, col.7). 15) Ship "Isaac Webb", lat. 44 30 N., long. 43 W., Sept. 13, had a severe gale from W. (The New York Times, Oct. 8, 1870, p.8, col.5).

The barometer reading of 28 inches reported by the "Lizzie M. Morell" (item 13) indicates that the storm remained very intense even at high latitudes. However, the fact that the heaviest part of the gale is said to have lasted for 38 hours suggests that the storm had spread over a very large area and that was probably in the process of becoming extratropical when the vessel- storm encounter took place. Because not even a very crude location could be inferred for the encounter on the basis of information in item 13), the author terminated the track for Storm 4, 1870 early on Sept. 13 (Fig. 16) on the basis of the information given by the "Isaac Webb" in item 15).

Storm 5, 1870 (Sept. 17-20).

This is the third storm that the author of this study has documented for 1870. A track for Storm 5, 1870 is shown in Fig. 6.

The following information was considered in studying the evolution of the storm: 1) Bark "Martha Radman". Sept. 18, lat. 39 30 N., long. 71 27 W., had a N.N.E to N.W. hurricane lasting 6 hours (The New York Times, Sept. 22, 1870, p.8,col.6). 2) Bark "Hellespont" (from Buenos Aires, Jul. 30), had a hurricane on Sept. 17 (The New York Times, Sept. 22, 1870, p.8, col.6). 3) Brig "Barracuda" had a N.E. gale off the Highlands on Sept. 18, lasting 16 hours (The New York Times, Sept. 22, 1870, p.8, col.6). 4) Bark "John Mathews", lat. 38 50 N., long. 69 45 W., had a hurricane on Sept. 18; wind going from E.N.E. to N.N.W. (The New York Times, Sept. 22, 1870, p.8, col.6). 5) Bark "Nina" (from Genoa in 68

days), had a S. to S.E. gale on Sept. 18 (The New York Times, Sept. 23, 1870, p.8, col.6). 6) Bark "Uranis" (from Cardiff in 53 days), had a N.E. to N.W. gale on Sept. 17 (The New York Times, Sept. 23, 1870, p.8, col.6). Ship "Artesan", at lat. 41 21 N., long. 66 W., had a S. to N.E. hurricane on Sept. 18, lasting 24 hours (The New York Times, Sept. 24, 1870, p.8, col.6). 8) Brig "Johanna". On Sept. 17 had a very heavy gale from S.E. to E. to N.E. (The New York Times, Sept. 24, 1870, p.8, col.6). 9) Brig "Santos", lat. 36 28 N., long. 69 30 W., had a hurricane from E.S.E. to S.W. on Sept. 17, lasting for 18 hours (The New York Times, Sept. 24, 1870, p.8, col.6). 10) Brig "Gesina" had a heavy gale from S.E. to E. and then to W. at lat. 32 N., long. 69 W. on Sept. 17 (The New York Times, Sept. 24, 1870, p.8, col.6). 11) Schr. "Champion" had a hurricane from S.E. to N.W. on George's Bank on Sept. 19, lasting 6 hours (The New York Times, Sept. 24, 1870, p.8, col.6). 12) Ship "Red Deer" had a hurricane from S.E. to W. off Bermuda on Sept. 19 (The New York Times, Sept. 25, 1870, p.8, col.6). 13) Ship "Victoria" had a hurricane 350 miles S.E. of Sandy Hook on Sept. 17; wind S.E. changing to N.W. by the way of E., accompanied by heavy rain (The New York Times, Sept. 25, 1870, p.8, col.6). 14) Brig "George" had a hurricane from E.S.E. to N. off George's Shoals on Sept. 18, lasting 16 hours (The New York Times, Sept. 26, 1870, p.8, col.6). 15) Schr. "Stetson" (coming to New York from Surinam) had an E.S.E. hurricane on Sept. 16 (The New York Times, Sept. 26, 1870, p.8, col.6). Author's note: Sept. 16 appears to be a wrong date. 16) Schr. "Sarah Fish" encountered a hurricane at lat. 31 52 N., long. 79 10 W. on Sept. 18, coming from Union Island, Ga., Sept. 16; wind E.S.E. to N. (The New York Times, Sept. 26, 1870, p.8, col.6). Author's note: This is suspected to be a wrong report. 17) Bark "Sadie Sinclair", lat. 44 N., long. 64 W., had a hurricane on Sept. 19, the wind coming from all points of the compass (The New York Times, Sept. 27, 1870, p.8, col.6). 18) Bark "Phenix", lat. 43 N., long. 64 W., had a hurricane on Sept. 19 (The New York Times, Sept. 28, 1870, p.8, col.5). 19) Brig "Gambia" encountered an E.N.E. to N. hurricane off Hatteras on Sept. 19, lasting for 30 hours (The New York Times, Sept. 28, 1870, p.8, col.5). Author's note: Date is wrong; it should be Sept. 18. 20) Steamship "Paraguay" (from Le Havre, Sept. 4), had a hurricane in the night of Sept. 19, commencing from S.W. and ending at N.W. (The New York Times, Sept. 29, 1870, p.8, col.5). 21) Brig "Gitana", lat. 39 N., long. 67 30 W., had a hurricane on Sept. 19, lasting 24 hours (The New York Times, Sept. 30, 1870, p.8, col.6). Author's note: The position is highly suspicious because the "Gitana" gave the same position for Sept. 22 and indicated that bark "Desiak" (spoken on Sept. 22) also encountered the hurricane at lat. 39 N., long. 67 30 W. on Sept. 19. 22) Bark "Vincent White". Sept. 18, lat. 42 N., long. 65 10 W., had a heavy gale from S.E. to N.E. (The New York Times, Sept. 30, 1870, p.8, col.6). 23) Bark "Hakon Jarl", lat. 43 13 N., long. 63 45 W., had a hurricane from E.S.E. to N. on Sept. 19, lasting for 12 hours (The New York Times, Oct. 2, 1870, p.8, col.6). 25) Ship "Avon" (from Antwerp in 45 days), had a hurricane from S.E. to N.W. on Sept. 19, 20 and 21 (The New York Times, Oct. 3, 1870, p.8, col.6). Author's note: The hurricane is unlikely to have lasted for three days. 25) Brig "Eolus" (from England in 55 days), had a

hurricane from S.E. to N.N.E. to W. on Sept. 18 and 19. Barometer fell from 30.50 to 28.60 inches. Sept. 20 position: lat. 42 N., long. 60 W. (The New York Times, Oct. 3, 1870, p.8, col.6). 26) Bark "Frances Bournet". Sept.19, lat. 41 05 N., long. 61 30 W., heavy gale from N.N.E. lasting 6 hours (The New York Times, Oct. 3, 1870, p.8, col.6). 27) Ship "Belgate". Sept. 19, lat. 44 30 N., long. 60 W., had an E.N.E. to N. hurricane lasting for 18 hours (The New York Times, Oct. 4, 1870, p.8, col.4). 28) Bark "Jesu". Sept. 18 lat. 41 N., long. 56 W., experienced a hurricane from E.N.E to N. lasting 24 hours (The New York Times, Oct. 4, 1870, p.8, col.4). Author's note: The day should rather be Sept. 19. 29) Bark "Sagadohov". Sept. 18, lat. 42 05 N., long. 60 04 W., had a hurricane from E.N.E. lasting 24 hours (The New York Times, Oct. 4, 1870, p.8, col.4). Author's note: The right day seems to have been Sept. 19. 30) Bark "Stormy Petrel" (from England in 39 days) had a hurricane from S. to N.W. on Sept. 19 (The New York Times, Oct. 5, 1870, p.8, col.5). 31) Bark "Mary Pratt", lat. 47 N., long. 49 W., had a S. to N.W. gale increasing to a hurricane on Sept. 19 (The New York Times, Oct. 7, 1870, p.8, col.6). 32) Bark "J. B. Bradley" had a S.W. to N.W. hurricane at lat. 47 N., long. 48 24 W. on Sept. 19 (the New York Times, Oct. 8, 1870, p.8, col.6). 33) Ship "Isaac Webb". Sept. 19, lat. 43 N., long. 49 W., had a severe gale (The New York Times, Oct. 8, 1870, p.8, col.6). 34) Ship "Minnehaha". Sept. 19, lat. 47 32 N., long. 45 26 W., had a hurricane from S.S.W. to N.W. lasting for 12 hours (The New York Times, Oct. 8, 1870, p.8, col.6). 35) Bark "G. W. Jones". Sept. 20, lat. 49 30 N., long. 41 W., had a hurricane from S.W. to N.W. (The New York Times, Oct. 10, 1870, p.8, col.6). 36) Bark "Moneta" (from Shields in 45 days), lat. 39 20 N. (?), long. 43 W., had a hurricane from E.S.E to W.S.W. lasting for 20 hours (The New York Times, Oct. 10, 1870, p.8, col.6). Author's note: The latitude should be 49 20 N. instead of 39 20 N. 37) Bark "Rhea" (from England in 74 days) had a gale on Sept. 19 (The New York Times, Oct. 11, 1870, p.8, col.6). 38) Ship "Pride of the Ocean" had a hurricane from S.S.W. to N.W. at lat. 51 12 N., long. 36 30 W. on Sept. 20, lasting for 24 hours (The New York Times, Oct. 12, 1870, p.8, col.5). 39) Bark " Milicette". Sept. 20, lat. 52 N., long. 35 W., had a heavy gale from S. to N.W. with a very heavy sea (The New York Times, Oct. 23, 1870, p.8, col.5). 40) Ship "Arlington" had a cyclone from S.W. to N.W. at lat. 55 N., long. 34 W. on Sept. 20, lasting for 16 hours (The New York Times, Oct. 14, 1870, p.8, col.6).

Crude estimates for the morning positions of Storm 5, 1870 resulted from a careful evaluation of the items above, which included the introduction of different weights in accordance to their merit for track purposes and the elimination of those items that proved to be useless. The estimated storm positions for Sept. 17 through Sept. 20 were then connected by a smooth curve to produce the track shown in Fig. 6.

Storm 5, 1870, which apparently attained hurricane intensity, should have been in the process of becoming extratropical while racing northeastward at high latitudes in the North Atlantic Ocean.

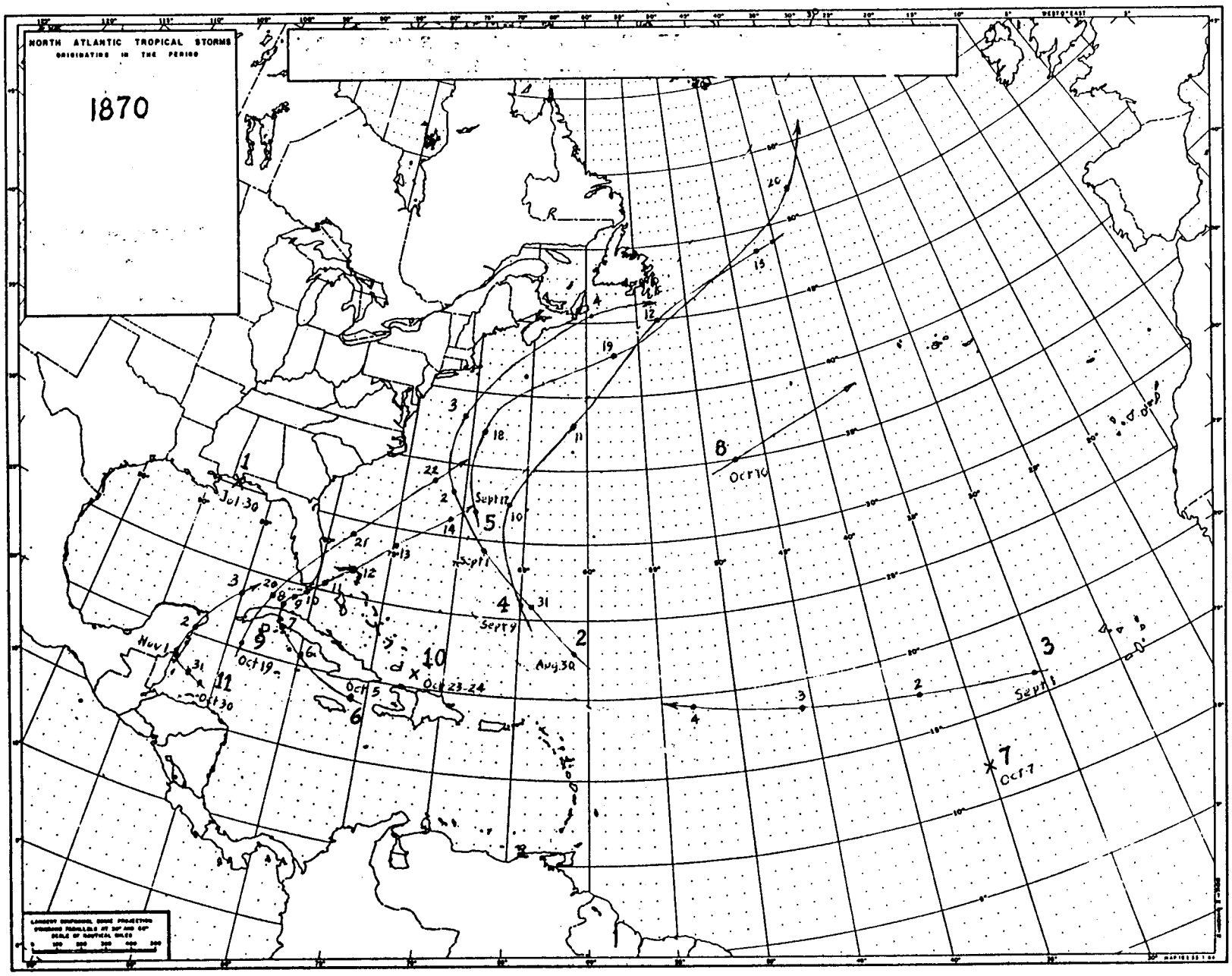
NORTH ATLANTIC TROPICAL STORMS
ORIGINATING IN THE PERIOD
1870
Jul 30
Sept 12
Sept 1
Sept 9
Aug 30
Oct 19
Oct 5
Oct 23-24
Oct 30
Nov 1
Sept 1
Oct 7
Oct 10

Fig. 6

Storm 6, 1870 (Oct. 5-14).

Tannehill (1938) has listed this storm which has also been mentioned by Garriott (1900) and Ludlum (1963). The author of the present study has produced the track for Storm 6, 1870 which is displayed in Fig. 6.

As Rodriguez-Ferrer (1876) has stated that, according to a study performed by Manuel Fernandez de Castro, the storm formed at lat. 19 N. over the channels among the islands of Cuba, Hispaniola and Jamaica on Oct. 5, the storm track (Fig. 6) was started on that day. The storm then moved some distance south of Cuba on Oct. 6 and moved over land on Oct. 7 when it crossed over the swampy area of Cienaga de Zapata. In "Ciclones que han pasado sobre la Isla de Cuba o tan cerca de ella que han hecho sentir en ella sus efectos con alguna fuerza, desde 1865 a 1926", which is published in Sarasola (1928), M. Gutierrez-Lanza has stated that the hurricane moved across Cuba from S. to N. with a slight eastward component and that the center passed to the west of Nueva Paz (a town located at the southeastern corner of the Havana Province) and also to the west of Matanzas. The calm corresponding to the vortex was felt at both places and there were many casualties, particularly in the city of Matanzas, where many houses were driven into the bay carrying their inhabitants with them. According to Ricardo Zenoz, the first assistant at the Havana's physical and meteorological observatory, the minimum pressure recorded at that place was 29.26 inches at 2 A.M. Oct. 8 (Gaceta de la Habana, No. 147, Oct. 21, 1870, p.3, col.1). Quoting Marcos J. Melero in Diario de la Marina, Oct. 9, 1873, Garriott (1900) has stated that the lowest barometer was 29.38 inches and that, according to W.B. Stockman, the maximum force of the hurricane at Havana occurred between midnight and 3 A.M. Oct. 8. According to W. B. Stockman, the barometer read 29.30 inches at 3 A.M. but was lowest at 2 A.M. by the time the wind had backed to the N. While quoting from Fernandez de Castro's work, Rodriguez-Ferrer (1876) has stated that the magnitude of the pressure drop was about 1.35 inches on the basis of observations which were taken at several places. According to The Times, London, Nov. 1, 1870, p.5, col.3, the full force of the destructive hurricane did not reach Havana and the Royal Mail steamer "Tyne" rode the gale in that port on Oct. 8. The Times, London, Nov. 4, 1870, p.5, col.5, published that the most disastrous effects of the hurricane occurred at Matanzas. Communications between Havana and Matanzas were interrupted as an extraordinary rise of the rivers inundated the intervening ground where the railroad depots were located. Heavy rain and wind caused the junction of the San Juan and Yumuri Rivers (Matanzas), overflooding different parts of town. The loss of life was estimated at 2000 persons drowned. Damage at Cardenas was considerable and at Guines many houses has been uproofed, the church tower was blown down and the trees of the plaza were destroyed.

Ludlum (1963) has mentioned that the maximum wind at Key West was force 10 (55-63 miles per hour at 9 P.M. on Oct. 8, 9 and 10 and also at 2 P.M. Oct. 11 and that it blew from N.E. and N. The presence of high winds at Key West for four consecutive days is in an excellent agreement with the very slow storm motion observed for

Storm 6, 1870 over the period Oct. 8-11 (Fig. 6). According to Vines (1895), this storm was a good example of the very slow motion expected in the vicinity of the vertex of the parabola described by the hurricane motion when such a curve exhibits a high concavity, resulting in a relatively abrupt change in direction from a general northwesterly course along the first branch of the parabola to the northeasterly course corresponding to the second branch.

The following marine information was found to have been related to this storm: 1) Schr. "David Millar" had a heavy N.E. gale off Dry Tortugas on Oct. 7 (The New York Times, Oct. 28, 1870, p.8, col.5). 2) Schr."General Grant". Oct. 10, off Cay Sal, had a hurricane from N.W. to S.E. lasting 20 hours; lost fore and main sails and sprung a leak; put into Nassau for repairs (The New York Times, Nov. 22, 1870, p.8, col.5). 3) Steamship "Crescent City". Oct. 12, off Florida between Sombrero and Cape Florida, passed wrecked materials all day (The New York Times, Oct. 18, 1870, p.8, col.5). 4) Steamship "Morro Castle" had a heavy hurricane from S. off Hole in the Wall, Abaco, on Oct. 12, lasting for 5 hours (The New York Times, Oct. 24, 1870, p.8, col.6). 5) Ship "Andrew Johnson" had a heavy S.S.E. gale at lat. 35 N., long. 72 24 W. on Oct. 13 (The New York Times, Oct. 20, 1870, p.8, col.6). 6) Brig "Virginia", lat. 34 N., long. 71 W., experienced a severe N. gale on Oct. 14 (The New York Times, Oct. 20, 1870, p.8, col.6). 7) Brig "Iris". Oct. 14, lat. 31 30 N., long. 72 20 W., had a furious gale from N.E. to N.W., lasting for 4 hours (The New York Times, Oct. 24, 1870, p.8, col.6). 8) Brig "Toronto" had a gale from S.W. to N.E. on Oct. 14, lasting for 12 hours (The New York Times, Oct. 21, 1870, p.8, col.6).

On the basis of information in items 4) through 8) . the hurricane seems to have weakened after leaving the northern Bahamas on Oct. 12.

Storm 7, 1870 (Oct. 7).

This is the fourth storm that the author of this study has recently documented for 1870.

Documentation of this storm was based on the following information: Ship "Horatio Harris", lat. 12 N., long. 35 W., had a S.E. to W. hurricane on Oct. 7 (The New York Times, Nov. 5, 1870, p.8, col.5). This storm could have been the same one encountered by three vessels in the central- North Atlantic on Oct. 10 (Storm 8, 1870). This proposition, however, does not seem to be particularly attractive because it would imply to accept an unusually rapid motion of Storm 7, 1870 towards the N.W. and N. from Oct. 7 to Oct. 10. Therefore, the author of this study decided that it was most reasonable to treat both storms as separate cases.

Storm 7, 1870 is displayed in Fig. 6 as having occurred near 12 degrees North, 35 degrees West on Oct. 7.

Storm 8, 1870 (Oct. 10).

This is the fifth storm that the author of this study has documented for 1870.

Documentation of this storm was based on the following

information: 1) Brig "Redwood" had a hurricane from N.W. to S.E. at lat. 35 N., long. 49 W. on Oct. 10 (The New York Times, Oct. 28, 1870, p.8, col.5). 2) Schr. "Alfred Vittery" had a hurricane from S.W. veering to N.N.E. at lat. 34 22 N., long. 43 40 W. on Oct. 10 (The New Times, Oct. 27, 1870, p.8, col.5). 3) Brig "Veteran" had a S.E. to N.W. hurricane at lat. 36 12 N, long. 40 30 W., having blown violently (The New York Times, Nov. 3, 1870, p.8, col.6).

The one-day track for Storm 8, 1870 which is shown in Fig. 6 has the storm near the "Redwood" early on Oct. 10 and then moves it towards the east-northeast, affecting the "Alfred Vittery" and the "Veteran" later on that day.

Storm 8, 1870 apparently attained hurricane intensity.

Storm 9, 1870 (Oct. 19-22).

Tannehill (1938) has listed this storm and, in addition, Garriott (1900) and Ludlum (1963) have referred to it. The author of this study has prepared the track for Storm 9, 1870 which is shown in Fig. 6.

In "Ciclones que han pasado sobre la Isla de Cuba o tan cerca de ella que han hecho sentir en ella sus efectos con alguna fuerza, desde 1865 a 1926", which is published in Sarasola (1928), M. Gutierrez-Lanza has stated that this strong cyclone crossed Pinar del Rio Province in Cuba, having passed the center over the city of Pinar del Rio and also just west of Bahia Honda where a calm was felt for 15 minutes. The cyclone also affected Havana Province with great intensity. The Gaceta de la Habana, No. 147, Oct. 21, 1870, p.3, col.1, published an article by Ricardo Zenoz, the first assistant at the Havana's physical and meteorological observatory, in which he stated that the wind blew from the E. at Havana until 8 P.M. Oct. 19, from E. and E.S.E. until about 11 P.M. and then from S.E. until 2 A.M. Oct. 20. From 3 A.M. the wind blew from S. and S.S.W., from where it was still blowing at noon Oct. 20. According to Zenoz, a minimum pressure of 29.20 inches was recorded at 4 A.M. Oct. 20. Garriott (1900), quoting Marcos J. Melero in Diario de la Marina, Oct. 9, 1873, stated that the lowest barometer was 29.32 inches. Quoting W. B. Stockman, Garriott (1900) stated a second value of 29.24 inches for the lowest pressure at Havana which he said to have occurred at 3:30 A.M. Oct. 20, with heavy wind gusts from S.S.E. to S.E. The Times, London, Oct. 29, 1870, p.5, col.2, published that a hurricane passed over Vuelta Abajo (Pinar del Rio Province, Cuba) on Oct. 20 and that numerous villages and agricultural property were destroyed. Losses were estimated over a million dollars. According to The Times, London, Nov. 14, 1870, p.12, col.1, the fearful hurricane also occurred at Batabano (a town on the southern coast of Havana Province) on Oct. 19. Much damage was done, the sea washing the town and many houses being placed 4 feet under water.

Ludlum (1963) has published the following observations taken at Key West on Oct. 20, 1870: 7 A.M., wind S.E. force 10 (55 to 63 miles per hour); 2 P.M., wind S.W. force 9 (47 to 54 miles per hour); 9 P.M., wind N. force 7 (32 to 38 miles per hour).

The hurricane caused the disaster of the steamer "Varuna" off the S.E. Florida coast in the night of Oct. 20. According to The

New York Times, Nov. 11, 1870, p.1, col.6, the "Varuna" left New York for Galveston on Oct. 15 and everything went well until Oct. 20 when off the Florida coast the wind shifted to S.E. and blew a perfect hurricane. The gale increased during the evening and it became necessary to throw overboard the deck-load. The gale continued to increase until about 9:30 P.M. when the wind shifted from S.E. to S.W. The vessel came beyond control and the water washed over her from stem to stern and finally a tremendous sea struck her amidships, and washing over her, broke into the engine room. The ship sank carrying most crew and passengers with her. Only seven persons in a boat survived.

The following additional information helped in determining the evolution of Storm 9, 1870 at sea: 1) Bark "Idaho" (from Aspinwall, Panama, in 38 days). Had strong westerly gales in the Caribbean Sea for 6 days and had a hurricane from E.N.E. to N.W. on Oct. 18 (?) at lat. 23 30 N., long. 83 W., lasting for 24 hours (The New York Times, Nov. 6, 1870, p.8, col.7). Author's note: Oct. 18 is a wrong day; it should be Oct. 19-20. 2) Brig "William Muir" (from Jamaica in 37 days). Saw wrecks of two schooners on Florida reefs. Oct. 20, off the south side of Cuba, experienced a heavy gale from E., veering to N.W. (The New York Times, Nov. 20, 1870, p.8, col.7). Author's note: The gale should have occurred primarily on Oct. 19, perhaps continuing on Oct. 20. 3) Steamship "Emily B. Louder" experienced a heavy W. gale off Cape Canaveral on Oct. 20 (The New York Times, Oct. 26, 1870, p.8, col.4). 4) Schr. "Vincent Wallace" had a heavy E.N.E. and N.E. gale over the Gulf Stream on Oct. 20 and 21 (The New York Times, Oct. 26, 1870, p.8, col.4). 5) Ship "Artist" reported that the schooner "E. H. Hatfield" had been dismasted by a hurricane at lat. 33 25 N., long. 74 10 W. on Oct. 21 (The New York Times, Nov. 6, 1870, p.8, col.7). 6) Steamship "Morro Castle". Oct. 21, lat. 33 N., long. 75 W., had a hurricane from S.E. to N.E. lasting 8 hours; barometer 29.20 inches (The New York Times, Oct. 24, 1870, p.8, col.6). 7) Schr. "Hatfield" had a hurricane at lat. 33 N., long. 74 40 W. on Oct. 21; wind blew from S. to N.W. (The New York Times, Nov. 10, 1870, p.8, col.6). 8) Bark "Midas" experienced a S.E. to S.W. hurricane at lat. 33 N., long. 72 W. on Oct. 22 (The New York Times, Oct. 28, 1870, p.8, col.3).

According to the information in items 5 through 8, Storm 9, 1870 retained hurricane intensity off the U.S. coast on Oct. 21 and 22. The lowest pressure in the hurricane was inferred to have been below 29.20 inches on the basis of observations taken in Cuba and on board the "Morro Castle".

Storm 10, 1870 (Oct. 23-24).

This is the sixth storm that the author of this study has recently documented for 1870.

Documentation of the storm was based on the following information: 1) Message from Kingston, Jamaica, Oct. 30. A Spanish bark reports a severe hurricane off the northern coast of Santo Domingo on Oct. 23 (The New York Times, Nov.7, 1870, p.1, col.7). 2) Bark "R. Murray, Jr." (from Port-au-Prince in 16 days). Oct. 24, 30 miles N.E. of Cuba, encountered a terrific hurricane from N.N.E. (The New York Times, Nov. 12, 1870, p.8, col.4). 3) Brig "H. J.

Burion" (from Rio de Janeiro, Sept. 15, via Hampton Road). Oct. 23, off Cuba, had a severe gale (The New York Times, Nov. 16, 1870, p.8, col.4). Author's note: The vessel seems to have been too far south for a Rio de Janeiro- Hampton Road passage. 4) Brig "Madonna" (from Demerara, Guyana, in 33 days). Oct. 23 and 24, lat. 22 N., long. 64 30 W., had a heavy S.E. gale (The New York Times, Nov. 16, 1870, p.8, col.4).

As the author could not produce a track for Storm 10, 1870 due to insufficient information, the storm was arbtrarily placed near 21 degrees North, 72 degrees West on Oct. 23-24 (Fig. 6).

Storm 11, 1870 (Oct.30- Nov.3).

This is the seventh storm that the author of this study has newly documented for 1870. Strickly speaking, the existence of this storm is not entirely new, although it had not been mentioned in the works of any salient author dealing with the history of hurricanes. However, Rodriguez-Ferrer (1876) has mentioned that this storm was one of the three Manuel Fernandez de Castro studied for 1870 and has even indicated the period Oct. 30- Nov. 3 as its life-span.

Although the author of this study started his track for Storm 11, 1870 on Oct. 30, the following information allowed one to recognize that disturbed weather conditions existed in the western Caribbean Sea as early as Oct. 27: The "Dacia" and the "Vestal", which were conducting work related to extending the Jamaica- Panama cable, left Colon for Jamaica on Oct. 24 and proceeded along their course until midday Oct. 27 when a squall and a heavy fall of rain set in. The "Dacia" reported that the cable had broken and a buoy was thrown to mark the spot where the rupture had occurred but, being so dark and rainy it was difficult to find the bouy until Oct. 28, allowing for the "Vestal" to start searching for the cable on that day (The Times, London, Nov. 29, 1870, p.8, col.6).

The track for Storm 11, 1870, which is shown in Fig. 6, was based on the following information: 1) Schr. "Silver Star" (from Roatan, Honduras, in 23 days). Oct. 31, in the Caribbean Sea, had a hurricane from S. to N.E., lasting for 16 hours. Nov. 3, in the Gulf of Mexico, had a hurricane from S. to N.W. (The New York Times, Nov. 23, 1870, p.8, col.6). 2) Schr. "Nymph" (from Omoa, Honduras, via Key West). Oct. 30 and 31, in the Caribbean Sea, had a very heavy gale from W., S.W. and S. Nov. 3, in the Gulf of Mexico, had a hurricane from S.E. to N.E. (The New York Times, Nov. 29, 1870, p.8, col.6).

Estimated morning positions for the storm over the Caribbean Sea on Oct. 30 and 31 were inferred from the pertinent information given by the "Silver Star" and the "Nymph". The position for Nov. 3 over the southeastern Gulf of Mexico was based on the corresponding information given by the vessels for that day as well as on knowledge about their general route. Then the crudely estimated positions over the Caribbean Sea and the Gulf of Mexico were joined by a smooth curve which prescribed the storm to have moved along the eastern coast of the Yucatan peninsula at a slightly accelerated pace on Nov. 1 and 2. The above procedure lead to the achievement of the track for Storm 11, 1870 which is

displayed in Fig. 6.

The "Silver Star" and the "Nymph" have referred to Storm 11, 1870 as a hurricane, but the author believes that, had the storm been indeed a hurricane, it would have been a weak one.