came to pass through the Surigao Strait between Surigao and the southern coast of Samar. After 10 p. m. of the 2d the typhoon moved again to WNW. and W. by N. toward the central part of Leyte and the northern part of Cebu and Panay Islands. From Panay the typhoon moved northwest toward the southern coast of Mindoro and then into the China Sea, when it gradually filled up on the 5th or 6th in the neighborhood of the Paracels.

The barometric minimum reported from our stations was that of Dumalag, Capiz, 737 mm. (29.02 ins.) with winds veering from NW. to N., NE., E., and S. Relative calm was observed at Tuburan, Cebu, between 8.30 and 8.40 a. m. of the 3d.

The rate of progress of this typhoon was far from being uniform; because while from 2 to 6 a. m. of the 3d it moved at the heavy rate of about 20 miles per hour, from 6 a. m. to 2 p. m. of the same day the rate was slightly over 11 miles per hour.

The approximate positions of the center of this typhoon from December 31 to January 5 were as follows:

December 31, 6 a. m., 142° 20′ longitude E., 9° 20′ latitude N.
December 31, 11 p. m., 138° 15′ longitude E., 9° 50′ latitude N.
January 1, 6 a. m., 135° 45′ longitude E., 10° 10′ latitude N.
January 2, 6 a. m., 130° 45′ longitude E., 10° 40′ latitude N.
January 2, 10 p. m., 126° 25′ longitude E., 10° 10′ latitude N.
January 3, 2 a. m., 125° 40′ longitude E., 10° 25′ latitude N.
January 3, 6 a. m., 124° 20′ longitude E., 10° 50′ latitude N.
January 3, 2 p. m., 122° 50′ longitude E., 11° 10′ latitude N.
January 4, 6 a. m., 120° 40′ longitude E., 12° 25′ latitude N.
January 5, 6 a. m., 116° 50′ longitude E., 15° 30′ latitude N.

BUCKET OBSERVATIONS OF SEA-SURFACE TEMPERATURES

By GILES SLOCUM

STRAITS OF FLORIDA AND CARIBBEAN SEA

With the January, 1931, issue of the MONTHLY WEATHER REVIEW is initiated the monthly publication of a summary of Greenwich mean noon "Bucket observations" of temperatures at the surface of the water for the month one year preceding the date borne by the issue, in the Straits of Florida and the Caribbean Sea.

The "Caribbean Sea" is here defined as the area included between the American Continents on the south and west and the Greater Antilles and outermost Lesser Antilles on the north and east. The entire Mona Passage, the Windward Channel south of 20° N., and the Yucatan Channel north to 22° N., west on this parallel to 87° W., and south to the Yucatan Peninsula, are included, but observations from Lake Maracaibo are omitted.

The "Straits of Florida" data refer to the area bounded on the east by the eightieth meridian, on the north by the twenty-fifth parallel, on the west by the eighty-fourth meridian, and on the south by the Cuban coast.

As is well known, the method of taking bucket observations consists of drawing up with a canvas bucket thrown over the side of the ship a sample of the water near the surface. The temperature of this sample is immediately taken with a mercurial thermometer and recorded on the proper form. In a small but unknown number of cases other methods, such as measurement of the temperature at the condenser intake, are used by the mariners.

The variation of weather conditions from day to day have modifying effects on the temperatures of the water surface and, while the number of measurements of these temperatures within a stated area in any one day is, to a considerable degree, due to elements of chance, and subject to wide fluctuations. The truest mean temperature, then, will not result from weighting equally either the individual observations or those collectively of the single days, and a longer unit-period of time is needed.

The month, therefore, has been divided into four nearly equal "Quarters," each quarter embracing a period of either seven or eight days, as shown in Table 1. The mean of the averages of the four quarters is adopted as the mean temperature for the area during the month.

This gives a uniform method of computing the means for months of unequal length. The quarter-month is a period short enough to practically exclude, in tropical and subtropical latitudes, any seasonal march between its beginning and its end, but is yet long enough to smooth out daily chance fluctuations in the number of observations taken, and to make their number within each period of the same order of magnitude, justifying the assigning of roughly equal weights to them.

In computing the means for each 5-degree square in the Caribbean, however, the use of this refinement is not possible, and the means used are the sums of the temperatures for the months divided by the numbers of observations.

From this, it is obvious than an even greater number of observations than is available would be highly desirable, and, lacking this greater number, it is important that no genuinely pertinent information be neglected to round out the data, but such observations as are taken in port are not used because of various factors affecting their direct comparability with those taken on the open seas.

On this basis, and subject to these limitations, Table 2 shows the mean temperature for the Caribbean Sea and the Straits of Florida for January of each year from 1919 to 1930, inclusive, and Table 3 summarizes the temperature for the month in the same area, including the departures of the January, 1930, means from the 11-year means for January (1920–1930), and the changes from the temperatures for the preceding month of December, 1929.

The means for 1919, it will be noted, are not used in the computations or comparisons, the poor distribution and dearth of data for that year making them somewhat unreliable.

The chart at the end of this article shows the number of observations taken during the month of January, 1930, within each 1° square; the mean temperatures of the Straits of Florida and of each 5°[1] square in the Caribbean Sea; the 11-year means (1920–1930), for these areas; and the local mean time corresponding to Greenwich mean noon, at which time the mariners are instructed to make the temperature readings.

TABLE 1.—*Lengths of "Quarter months" used in computing mean sea-surface temperatures*

Length of month	Days of month included in quarter			
	I	II	III	IV
28 days	1–7	8–14	15–21	22–28
29 days	1–7	8–14	15–21	22–29
30 days	1–7	8–15	16–22	23–30
31 days	1–7	8–15	16–23	24–31

[1] In three cases, indicated on the chart, the observations from small, little traveled, and unimportant areas have been treated as parts of the contiguous 5° squares.

TABLE 2.—*Mean surface temperatures in the Caribbean Sea and the Straits of Florida for January, 1930*

Year	Caribbean Sea		Straits of Florida	
	Number of observations	Mean temperature	Number of observations	Mean temperature
1919 [1]	14	78.7	11	75.4
1920	115	79.2	22	73.6
1921	192	78.8	58	75.2
1922	216	79.0	79	74.9
1923	270	78.0	74	75.1
1924	353	78.7	87	75.8
1925	272	79.0	123	75.8
1926	314	79.7	133	74.5
1927	318	79.3	156	74.6
1928	403	79.0	134	73.7
1929	519	79.2	136	75.2
1930	538	78.7	153	75.6
Mean (1920–1930)		79.0		74.9

[1] Not used in computations because of insufficient data available.

TABLE 3.—*Mean sea-surface temperatures (°F.), and number of observations, January, 1930*

Quarter	Period	Caribbean Sea				Straits of Florida			
		Number of observations	Mean (° F.)	Departure from 11-year mean (1920–1930) (° F.)	Change from preceding month (° F.)	Number of observations	Mean (° F.)	Departure from 11-year mean (1920–1930) (° F.)	Change from preceding month (° F.)
I	Jan. 1–7	124	79.0	------	------	43	75.3	------	------
II	Jan. 8–15	131	78.8	------	------	42	75.8	------	------
III	Jan. 16–23	135	78.8	------	------	34	76.3	------	------
IV	Jan. 24–31	148	78.2	------	------	34	74.9	------	------
Month		538	78.7	−0.3	−1.4	153	75.6	+0.7	−1.1

CLIMATOLOGICAL TABLES

DESCRIPTION OF TABLES AND CHARTS

Table 1 gives the data ordinarily needed for climatological studies for about 184 Weather Bureau stations making simultaneous observations at 8 a. m. and 8 p. m. daily, seventy-fifth meridian time, and for about 32 others making only one observation. The altitudes of the instruments above ground are also given.

Beginning January 1, 1928, movement and velocity of the wind are printed as recorded by the 3-cup anemometer, which has replaced the 4-cup pattern.

Table 2 gives, for about 37 stations of the Canadian Meteorological Service, the means of pressure and temperature, total precipitation, depth of snowfall, and the respective departures from normal values except in the case of snowfall. The sea-level pressures have been computed according to the method described by Prof. F. H. Bigelow in the REVIEW of January, 1902, **30:** 13–16.

CHART I.—*Temperature departures.*—This chart presents the departures of the monthly mean surface temperatures from the monthly normals. The shaded portions of the chart indicate areas of positive departures and unshaded portions indicate areas of negative departures. Generalized lines connect places having approximately equal departures of like sign. This chart of monthly surface temperature departures in the United States was first published in the MONTHLY WEATHER REVIEW for July, 1909, but smaller charts appear in W. B. Bulletin U for 1873 to June, 1909, inclusive.

CHART II.—*Tracks of centers* of ANTICYCLONES; and

CHART III.—*Tracks of centers* of CYCLONES. The Roman numerals show the chronological order of the centers. The figures within the circles show the days of the month, the location indicated being that at 8 a. m., seventy-fifth meridian time. Within each circle is also an entry of the last three figures of (Chart II) the highest barometric reading, or (Chart III) the lowest reading reported at or near the center at that time, in both cases as reduced to sea level and standard gravity. The intermediate 8 p. m. locations are indicated by dots. The inset map of Chart II shows the departure of monthly mean pressure from normal and the inset of Chart III shows the change in mean pressure from the preceding month.

The use of a new base map for Charts II and III began with the January, 1930, issue.

CHART IV.—*Percentage of clear sky between sunrise and sunset.*—The average cloudiness at each regular Weather Bureau station is determined by numerous personal observations between sunrise and sunset. The difference between the observed cloudiness and 100 is assumed to represent the percentage of clear sky, and the values thus obtained are the basis of this chart. The chart does not relate to the nighttime.

CHART V.—*Total precipitation.*—The scales of shading with appropriate lines show the distribution of the monthly precipitation according to reports from both regular and cooperative observers. The inset on this chart shows the departure of the monthly totals from the corresponding normals, as indicated by the reports from the regular stations.

CHART VI.—*Isobars at sea level, average surface temperatures, and prevailing wind directions.*—The pressures have been reduced to sea level and standard gravity by the method described by Prof. Frank H. Bigelow in the REVIEW for January, 1902, **30:** 13–16. The pressures have also been reduced to the mean of the 24 hours by the application of a suitable correction to the mean of 8 a. m. and 8 p. m. readings at stations taking two observations daily, and to the 8 a. m. or the 8 p. m. observation, respectively, at stations taking but a single observation.

The diurnal corrections so applied, except for stations established since 1901, will be found in the Annual Report of the Chief of the Weather Bureau, 1900–1901, volume 2, Table 27, pages 140–164.

The sea-level temperatures are now omitted and average surface temperatures substituted. The isotherms can not be drawn in such detail as might be desired, for data from only the regular Weather Bureau stations are used.

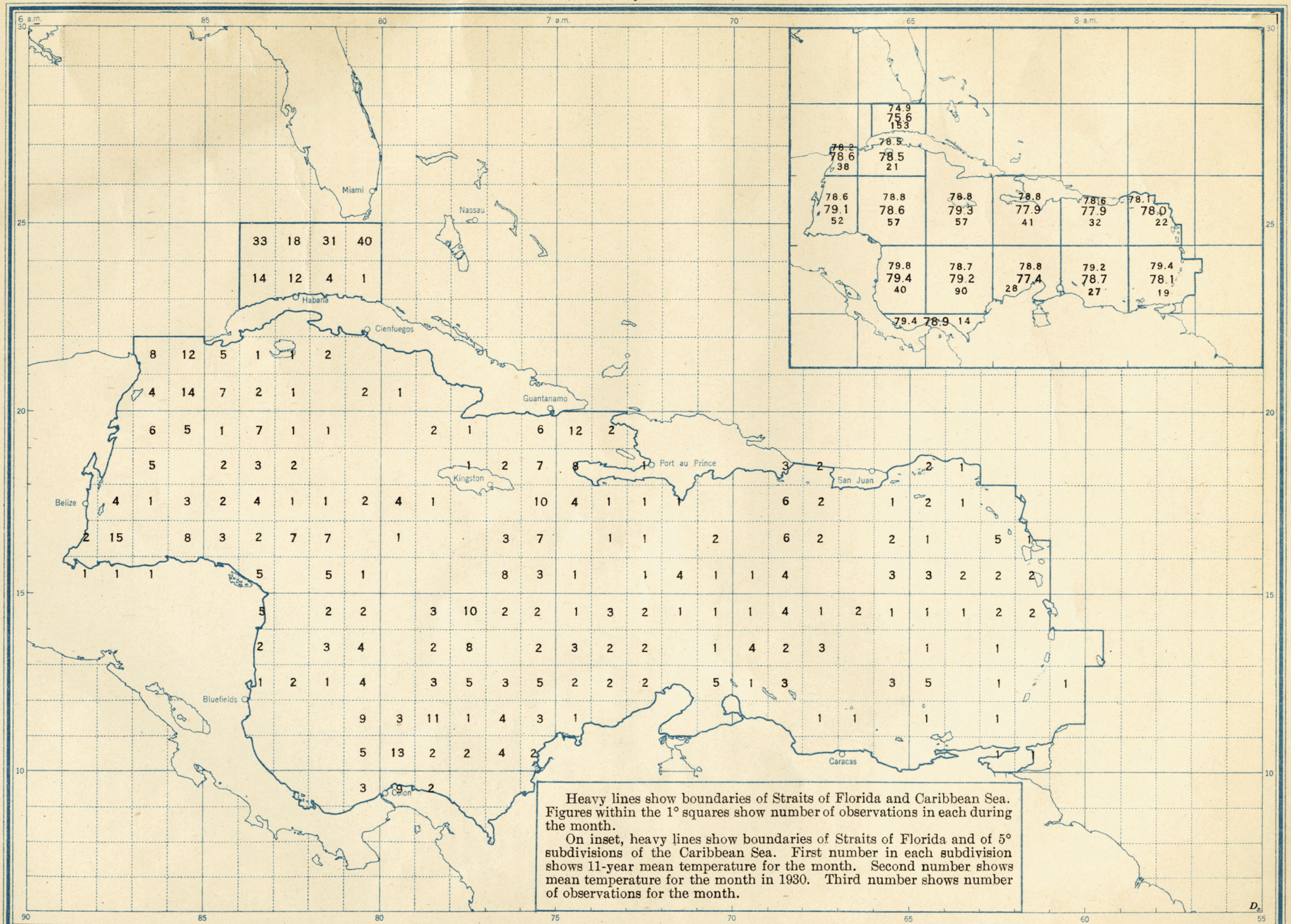
The prevailing wind directions are determined from hourly observations at almost all the stations. A few stations determine their prevailing directions from the daily or twice-daily observations only.

CHART VII.—*Total snowfall.*—This is based on the reports from regular and cooperative observers and shows the depth in inches of the snowfall during the month. In general, the depth is shown by lines connecting places of equal snowfall, but in special cases figures also are given. This chart is published only when the snowfall is sufficiently extensive to justify its preparation. The inset of this chart, when included, shows the depth of snow on the ground at the end of the month.

CHARTS VIII, IX, etc.—*North Atlantic Weather maps of particular days.*

Distribution of Greenwich Mean Noon Bucket Observations of Sea-Surface Temperatures, January, 1930

(Plotted by Giles Slocum)



Heavy lines show boundaries of Straits of Florida and Caribbean Sea. Figures within the 1° squares show number of observations in each during the month.

On inset, heavy lines show boundaries of Straits of Florida and of 5° subdivisions of the Caribbean Sea. First number in each subdivision shows 11-year mean temperature for the month. Second number shows mean temperature for the month in 1930. Third number shows number of observations for the month.