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The *Petula's* Meteorological Logbook

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The voyage of the yacht *Petula* from Dakar to Barbados during the winter of 1953–54 produced a considerable volume of meteorological and hydrographic data, much of which is still under review. The purpose of the present account is to give an outline of only those observations recorded in the yacht's selected ship meteorological logbook. A general account of the voyage has already been given[1]; briefly, it was undertaken to study aspects of biology, meteorology and hydrography close to the sea surface in the Atlantic North Equatorial Current. The yacht, a 12-ton yawl, sailed from Dakar on 26th November, 1953, with a 16-foot raft in tow, and drifting under staysail alone reached Barbados on 16th February, 1954 (see photograph opposite page 216). There was a crew of three aboard.

Before we sailed we foresaw that from this small, slowly-drifting yacht and from the raft we might make meteorological and hydrographic observations of some significance. With this aim in view we approached the Marine Division of the Meteorological Office for advice and assistance in organising our meteorological programme. Standard selected ship instruments were lent to us by the Meteorological Office and items were specially made for us. On passage we made observations regularly in the ship's synoptic code from 29th November to 14th February at midnight, 0600, 1200 and 1800 G.M.T.

Wind

Perhaps the most interesting features of our meteorological logbook are the wind columns. Wind speeds were estimated owing to a power failure on the anemometers. During the early part of the voyage we experienced normal trade winds, but on the western side of the Atlantic we often felt that the wind was unusually strong, and on occasion we encountered squalls in excess of 45 knots. To discover whether the wind was in fact abnormal we have turned to two valuable papers by Professor P. R. Crowe.[2] Following his methods we analysed our wind records for December, January and the first half of February and also for longitudes 30°–40°W. and 40°–50°W. It should be noted that the bounding latitudes of our track were 12½°N. and 15½°N.

Table 1. Wind Speed and Direction

Date 1953–54	Longitude W.	No. of observations	Mean direction	% Trades	Mean wind speed	
					All winds	Trades
1.12–31.12	20°–33°	124	047°	82	11·6	13·6
1.1–31.1	33°–49°	124	070°	94	16·7	17·7
1.2–14.2	49°–55°	55	073°	100	17·2	17·2
23.12–15.1	30°–40°	93	—	83	12·0	13·7
15.1–2.2	40°–50°	73	—	97	18·2	18·6

Trade winds were taken for our purpose to be those winds which blew within 45° of the arithmetical mean wind direction at a speed greater than 6 knots. These directions are generally similar to those obtained from large numbers of observations and shown on climatological charts of the area. Correspondingly there is good general agreement between our records and the very much more numerous records analysed by Crowe. Winds on the east side of the Atlantic were roughly NE. and on the west side roughly ENE. The trades were very constant, perhaps unusually so. There were no calms and wind forces of 1 and 2 became progressively less frequent as the heart of the trade wind system was approached.

Such disagreement as there is lies in the wind speeds. Crowe quotes no figures for 20°–30°W., roughly our December longitude, but interpolation in his graphs gives a figure of about 12·5 knots with which our December trade speed of 13·6 knots agrees reasonably well. In January, however, our trade wind speed had risen to 17·7 knots—which appears high—and in February it remained at almost the same level. In order to make a direct comparison we analysed our records for 30°–40°W., the region which Crowe indicates as the heart of the system at this time of year. Surprisingly, we found the wind speed here to be only 13·7 knots with many light airs recorded. Between these meridians Crowe gives speeds for January–February of 16 knots in 12½°N. and 14·5 knots in 15½°N.

It was not until we examined our wind records for 40°–50°W. that we found the highest figures. Here the speed was not only 3 knots higher than Crowe's January–February maximum, but was more than 2 knots higher than the highest speed quoted by him for any North Atlantic latitude in any season. Thus it appears that the heart of the North Atlantic trade wind system in the winter of 1953–54 not only lay further to the west than usual but was considerably more vigorous. It would be interesting to know what wind speeds were recorded in the same region during March and April of 1954, the months when the North Atlantic trade winds are most highly developed.

Pressure

The barograph was found to be a valuable instrument for presaging wind changes; its trace wandered away from a smooth semi-diurnal rhythm as the wind increased.

Cloud Cover

For most of the voyage the sky was cloudy. Low clouds included typical tropical cumulus and stratocumulus (C_L1, 2, 4, 5 and 8), some cumulonimbus without anvil (C_L3), but almost no stratus or anvilled cumulonimbus. Middle clouds were commonly recorded, almost always as altocumulus (C_M4, 5 and 6); but the most characteristic cloud of all was the thin veil of cirrostratus (C_H7), noted on 140 occasions. This tenuous cloud gave the sky a faded blue appearance by day and dimmed the stars by night, only rarely thickening to show detail and yet persisting for days on end.

Rainfall

Rain was recorded five times in December, 21 times in January and 25 times in February.

Currents

Turning now to current observations we find a total of 74 daily records. Set and drift was estimated each day from the observed and D.R. positions. As we towed no log the ship's speed through the water was measured with a "Dutch" log, a method well known to give accurate results at low speeds. The yacht's speed through the water was only about 1 knot. We used a 27-foot run (1 knot = 16 seconds) and timed the chip with a stop-watch, with very consistent results. The yacht made a lot of leeway and this was estimated by the angle that the warp of the plankton net made with the vessel's fore and aft line.

For Table 2 the figures were treated in the same way as those of the wind, by taking the arithmetic mean of direction and disregarding those sets which lie more than 45° either side of the mean.

Table 2. Current Directions

Date	No. of observations	Mean direction	No. within 45° of mean direction
December	31	258°	24
January	31	263°	27
February	12	289°	12

From Tables 1 and 2 it follows that currents flowed on the average 31° to the right of the wind in December, 13° in January and 36° in February.

For a comparison of current drifts we quote figures abstracted from M.O.466.[3]

Table 3. Drift in miles per day of currents in the predominant quadrant

Longitude w.	*Petula*		M.O.466 November–February. Mean drift
	No. of obs.	Mean drift	
18°–30°	19	16	12
30°–46°	26	13	13
46°–58°	21	15	16

For comparison with the investigation of the relation between current and wind contained in R. F. M. Hay's paper[1] in this journal, the vector means of current and wind were computed for each of 13 periods of three successive days, using currents observed with winds of Beaufort force 2 to 5. The mean angle between wind and current for the 13 cases was found to be 24°, which is in very good agreement with the value found by Mr. Hay for station J. The standard deviation was 15°, which is a measure of the deviation of the individual three-day values from the mean of them all. This value is less than those derived by Mr. Hay for stations I and J; this would be expected owing to the *Petula's* observations having been made in the trade wind region where wind direction is much less variable. The vector mean speed of current in the 13 cases is 0·463 knot and the vector mean wind 11·8 knots. The " wind factor ", the ratio between the speed of the surface current and that of the wind, works out at 0·0193.

Temperature

Air temperatures were closely grouped around the 80°F mark and are in no way remarkable.

Sea temperatures throughout the voyage remained remarkably constant, ranging between 76·5°F and 80·6°F. They agree well with those figured in the November and February sea-surface temperature charts compiled by Schott.[4] Temperatures for the six-hourly weather reports were taken by scooping the water straight into the sea thermometer trough (see photograph opposite page 216). Using this method we found that the temperature on opposite sides of the ship varied on an average by ±0·2°F and sometimes by as much as ±0·6°F. The greatest differences occurred during the day and were probably largely due to differential heating by the ship on the sunny and shady sides. The presence of night differences seems to indicate that shielding of the lee side also played its part in raising sea temperatures.

We always assumed that the lower of the two temperatures was the truer. Fortunately we had a means of checking both air and sea temperatures taken aboard the ship very accurately. On every favourable day we took air and sea temperatures from the raft at levels of 0·10 m, 0·25 m, 0·50 m, 1·00 m and 2·00 m above and below the surface in a survey of energy exchange at the air/sea interface. The air temperatures were taken with an Assmann psychrometer and the sea temperatures with a set of standard earth thermometers mounted on a stalk, each earth thermometer being wax lagged around the bulb to prevent contamination while the stalk was moved through layers of varying temperature. Careful checks showed that both sea and air temperatures were unaffected by the presence of the raft. These temperature records were used to determine the accuracy of shipboard temperatures taken at about the same time.

On 25 occasions we took sea temperatures from the raft within an hour of taking them from the ship. Comparing the raft temperatures at the 0·10 m level with the ship temperatures we find that the latter were on average 0·2°F higher. This difference, due to a number of factors, indicates that even a small, slow, engineless ship distorts the sea temperature in its vicinity. The distortion in a large steamship must certainly be greater.

Conclusion

The *Petula's* selected ship meteorological logbook, although containing only a part of the meteorological observations made during the voyage, is in itself an unusually detailed record of the weather conditions across the width of the Atlantic Ocean in a narrow band of latitude.

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[2] CROWE, P. R. The Trade Wind Circulation of the World. *Trans. and Pap. No.* 15, *Inst. Brit. Geogr.* (1951). The Seasonal Variation in the Strength of the Trades. *Trans. and Pap. No.* 16, *Inst. Brit. Geogr.* (1951).
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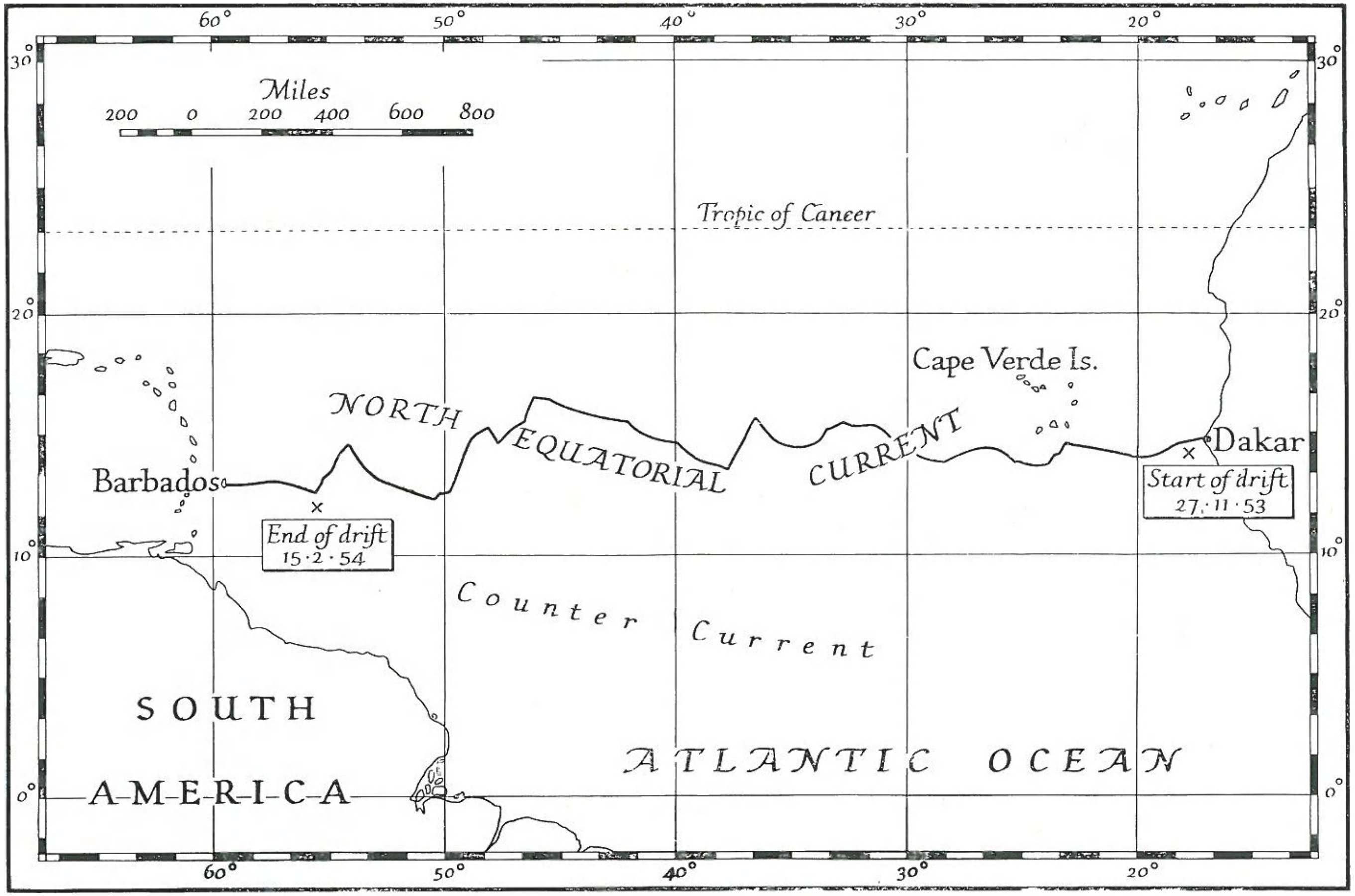
The yacht *Petula* drifting in light airs.


Taking the sea temperature from the yacht.


The Stevenson screen aboard the *Petula*.



[By courtesy of the Institute of Navigation

Track chart of the yacht *Petula*.