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A quarterly journal of Maritime Meteorology

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THE
MARINE OBSERVER

A Quarterly Journal of Maritime Meteorology
prepared by the Marine Division of the
Meteorological Office

Vol. XXXV

1965

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A QUARTERLY JOURNAL OF MARITIME METEOROLOGY PREPARED BY THE MARINE DIVISION OF THE METEOROLOGICAL OFFICE

VOL. XXXV **No. 207** **JANUARY 1965**

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Letters to the Editor, and books for review, should be sent to the Editor, "The Marine Observer," Meteorological Office, London Road, Bracknell, Berkshire

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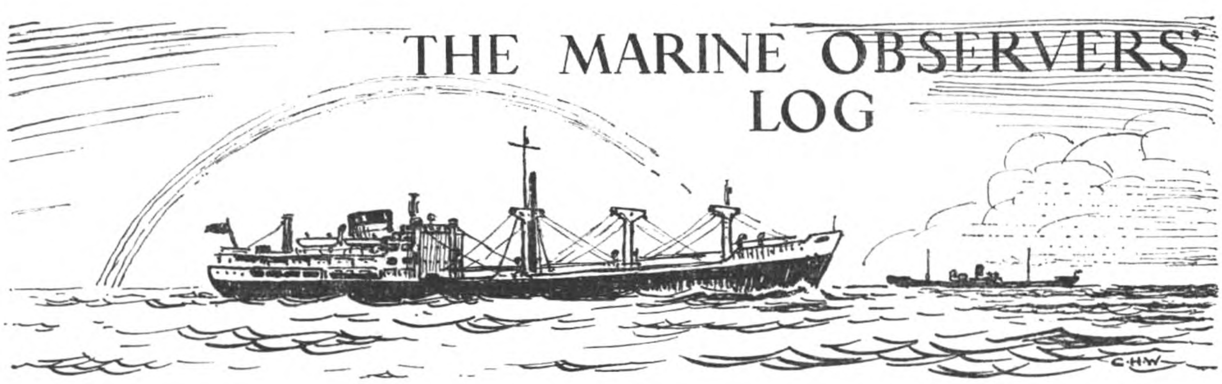
in estimating the height of a wave—and this again is of pratical use to a seaman, in case, for example, a boat has to be lowered in heavy weather—but it does need practice and patience; practising wave observations at the lowest available position in the ship should help. Series of photographs, similar to those for portraying the appearance of the sea at various wind forces, might provide a little guidance, but the height appearance of a wave is so much complicated by the length of the wave that a very large number of photos would be needed.

It is perhaps a comforting thought that the waves of eighty feet or more, which one sometimes reads about, are probably a myth. The highest wave so far recorded in the North Atlantic—by a wave recorder aboard a weather ship—was only of sixty-seven feet. Sixty-seven feet is quite a height and it is fortunate that it is rare; any shipmaster would be prudent to avoid such waves if he could!

In the January number of *The Marine Observer* we like to send New Year greetings to our readers; we wish smooth passages to all who go to sea in 1965 and good fortune to you all, whether at sea or ashore.

C. E. N. F.



January, February, March

The Marine Observers' Log is a quarterly selection of observations of interest and value. The observations are derived from the logbooks of marine observers and from individual manuscripts. Responsibility for each observation rests with the contributor.

It sometimes happens that we are unable to offer an explanation for phenomena reported. In such cases we shall be very glad to hear from any reader who can put forward an authoritative or a possible explanation, which could be published in this journal. We should also be glad to hear from any reader who has witnessed a similar phenomenon in the past, but which has not previously been communicated to us.

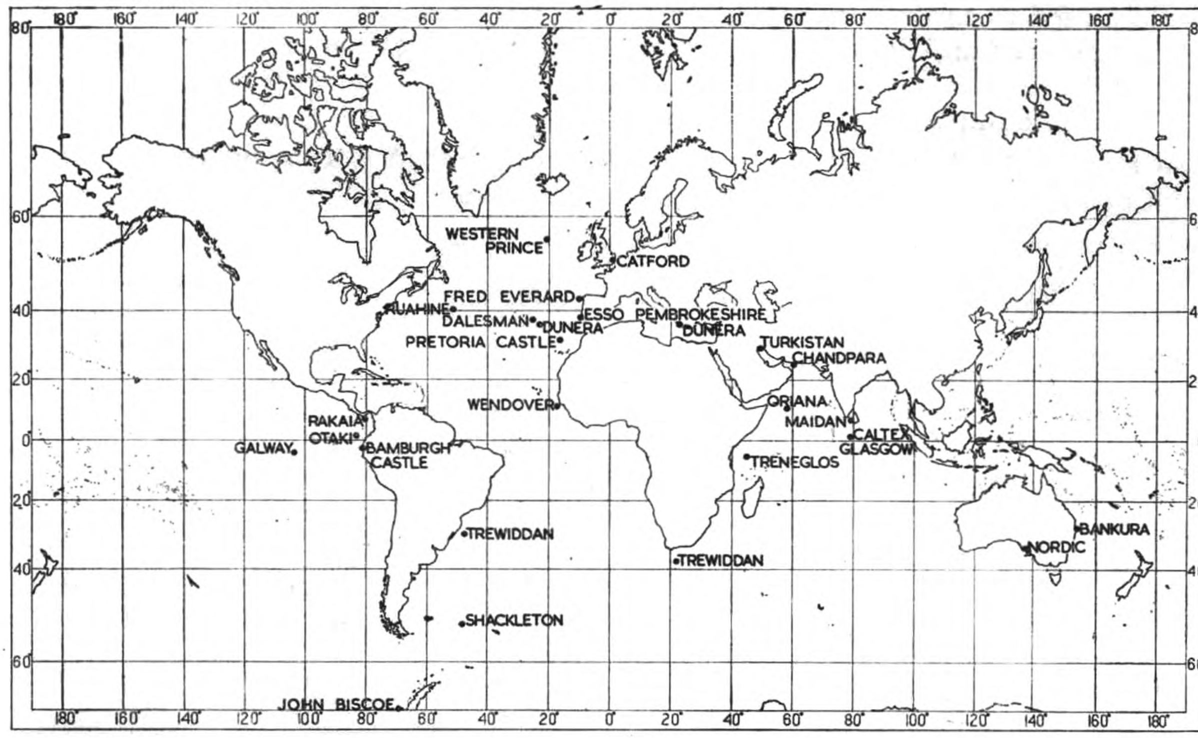
ST. ELMO'S FIRE

Arabian Sea

s.s. *Oriana*. Captain C. Edgecombe, R.D. Observers, Mr. M. D. Rushan, Senior 2nd Officer and Mr. R. M. Eaton, 4th Officer.

7th November 1963 at approx. 1900 GMT. As the vessel entered a light shower, the following phenomenon was observed on the starboard 10 in. signal projector.

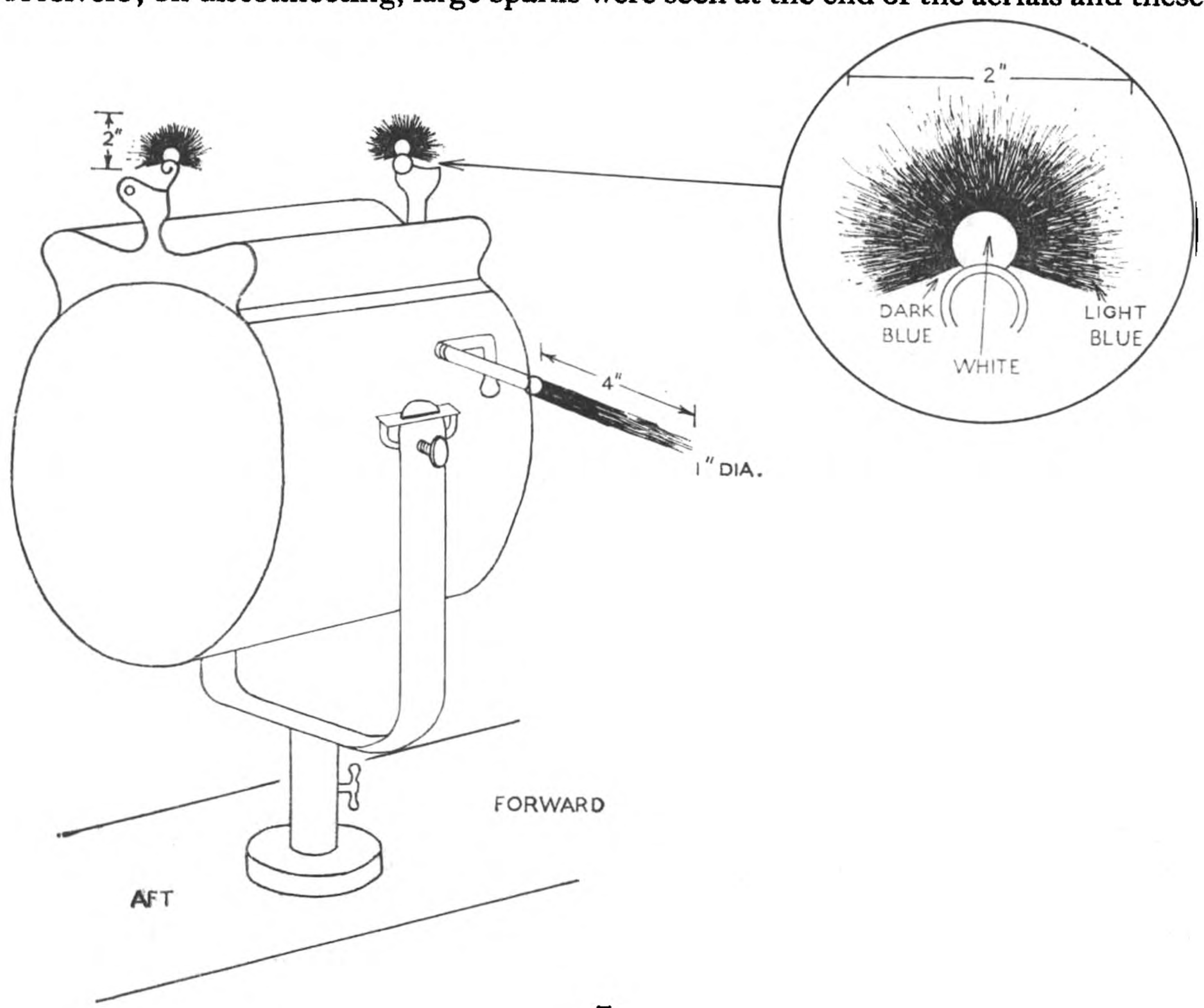
Two stationary, luminous, bluish brush discharges some 2 in. in size and shaped like a fan, were radiating from the two telescope supports on top of the projector. Also, a number of bluish discharges 4 in. to 5 in. long were being emitted horizontally from the insulated shutter lever, producing a hissing sound which was similar to that made during arc-welding. The phenomenon disappeared 5 minutes later when the rain cleared. From 1800–1930 distant sheet lightning was seen but no thunder heard. Cloud $\frac{5}{8}C_L3$ at 1000 ft. Air temp. 82°F.



Positions of ships whose observations are recorded in the "Marine Observers' Log".

In the radio office the following observations were made by Mr. D. A. Nott, 4th Radio Officer and Mr. M. D. Zappert, 5th Radio Officer.

Severe crackling was heard coming from aerials connected to communication receivers; on disconnecting, large sparks were seen at the end of the aerials and these



could be fed to earth without adverse effect on installation. Reception on H.F. was greatly reduced and atmospherics increased to such an extent as to almost blot out all signals.

Position of ship: 10° 45′N, 58° 20′E.

Note 1. Dr. J. A. Chalmers, Department of Physics, University of Durham, comments:

"A typical example of St. Elmo's Fire, apparently with no local lightning."

Note 2. *Oriana* is an observing ship on the Canadian Fleet List.

North Atlantic Ocean

m.v. *Western Prince*. Captain J. R. Stephens. Baie Comeau to Ellesmere Port. Observers, Mr. M. I. Bowen, 3rd Officer and Cadet C. B. Mills.

21st November 1963. During a torrential thundery shower of rain and hail, which passed over the ship at 0030 GMT, the main aerial was lit up along its whole length of 250 ft by a yellowish sheath of light. Occasionally, sparks of a whiter light were seen to radiate from the aerial in places. The phenomenon lasted for a few minutes and stopped abruptly before the squall had passed off. Any deviation of the magnetic compasses which might have occurred at the time could not be ascertained owing to the erratic swinging of these cards as the vessel pitched and rolled. Air temp. 49·5°F, sea 51°. Wind SW, force 7. $\frac{3}{8}C_L3$.

Position of ship: 55° 50′N, 21° 38W′.

Note. Dr. Chalmers comments:

"This is another typical report of St. Elmo's Fire, again in conditions which did not reach the state for local lightning. The currents would have been too small to give noticeable magnetic effect."

RAPID FALL OF AIR AND SEA TEMPERATURE

North Atlantic Ocean

m.v. *Ruahine*. Captain A. Hocken. Bermuda to Southampton.

25th March 1964. At 0042 GMT the vessel encountered a line squall lying ENE-WSW and the wind which had been light and variable at midnight increased to force 6 from NW. The air temperature, which was 55°F at midnight, fell gradually during the night to 52°, but there was a sudden drop at 0515 to 47°, and during the next 45 min there was a further fall to 40°. Fog was encountered between 0700 and 0800, with visibility going down to 1000 yd. The sea temperature, which had been 61° at midnight, fell rapidly to 43°. Soon after 0800 the air temperature began to rise again and the fog cleared.

Position of ship at 0000: 40° 06′N, 51° 00′W.

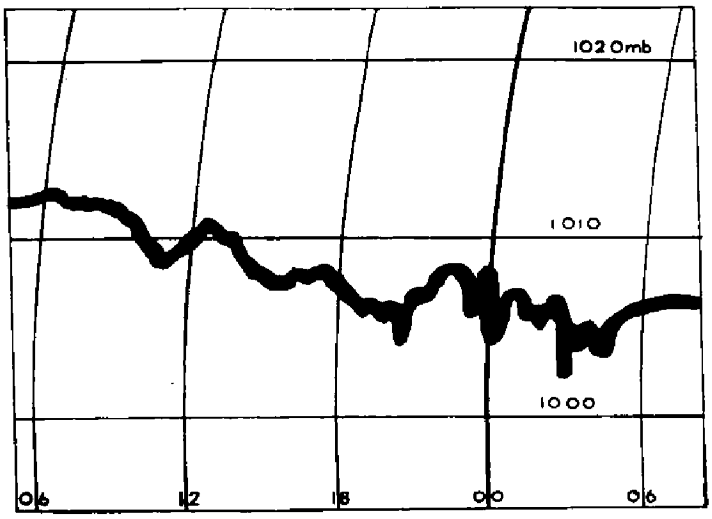
Note. At 0000 the vessel was on the south side of, and very near to, the centre of the southernmost of two depressions forming a complex trough of low pressure. The north-eastwards movement of this centre caused the wind to veer to NW and increase to force 6 (later it became force 8). The sharp fall of air temperature was due to the cold NW-NNW airstream, in the rear of the system, quickly replacing the warm air which had been coming from SW. The period of fog may be accounted for by the passage of the warm moist air over the cold sea. In this area of the N. Atlantic Ocean there is normally a very rapid fall of sea temperature with increasing distance northwards due to the confluence of the North Atlantic Drift and the Labrador Current.

SEVERE STORM

off Cape Malea

m.v. *Dunera*. Captain R. Baker. Palermo to Piraieus.

27th February 1964, 0000–0330 GMT. While rounding Cape Malea, the barograph trace which had been falling very unsteadily was observed to drop almost vertically by 4–5 mb in approx. 30 min. The wind, previously NE'ly, swung round to the NW, force 8–9, and lightning was seen in the SW. At 0300, during a period of comparative calm, with the wind still NW'ly, the barograph trace again fell suddenly by 4·5 mb



in an even shorter time than before, and the wind increased to force 10. Thunder and lightning occurred directly overhead and to the eastwards. Sometimes the lightning and thunder were simultaneous. Exceptionally heavy hail fell, which, together with spray, seriously affected the visibility. Just before the barograph began to rise again the wind increased to force 12 and gusted for about 10 min but the sea nevertheless was not unduly rough, the force of the wind apparently flattening down the waves. At 0000: Air temp. 50·8°F, wet bulb 49·7°, sea 57·8°.

Position of ship at 0000: 36° 30′N, 23° 18′E.

Note. At 0000 GMT a rather intense, warm-sector depression which was moving slowly eastwards was centred a short distance to the south of Crete, with the occluded part of the frontal system extending from south of Cape Malea towards Sicily. The occlusion must have passed over the vessel in the Cape Malea area, thus bringing about the wind changes described. It is probable that the heavy thunderstorms and hail associated with the front were intensified by the mountains in the neighbourhood. They must also have been responsible for the large, erratic pressure changes recorded by the barograph. Ascending currents of air would have brought about a fall of pressure, while descending air would have had the opposite effect. Erratic changes of pressure of this sort are typical of thundery conditions.

VIOLENT SQUALLS
off Madeira

s.s. *Pretoria Castle*. Captain J. P. Smythe, D.S.C., R.D. Southampton to Madeira.

8th March 1964. While the vessel was rounding Madeira on passage to Funchal, the wind, which had been SSW, force 3, gradually veered to WSW, force 3. Between 0750 and 0815 GMT it increased to force 12 with violent rain squalls, which, together with spray, reduced visibility to zero. Other squalls of force 7–8 were experienced. During the squalls the direction was W'ly but immediately the squall passed, the wind backed slightly and decreased to force 3.

Position of ship: approaching Funchal.

Note. Examination of our synoptic charts for the morning of the 8th March shows that a rather slow-moving cold front crossed the Madeira area between 0600 and 0900 GMT. It appears probable that the rapid forced ascent of the unstable air at the front, up and over the high ridge to the north of Funchal, would account for the excessively heavy rain and the violence of the squalls.

LIGHTNING
South Atlantic Ocean

m.v. *Trewidden*. Captain G. A. McKay. Las Palmas to River Plate. Observers, the Master, Mr. I. Smith, 3rd Officer and Mr. A. J. Norman, Radio Officer.

16th February 1964. Between 0030 and 0130 GMT very vivid lightning was observed to the westward, shooting upwards from a bank of Cb cloud, as shown in

the sketch. Air temp. 78·2°F, wet bulb 76·5°, sea 82°. Wind, light and variable.
Position of ship: 30° 00′S, 47° 12′W.

Note. Dr. Chalmers, Department of Physics, University of Durham, comments:

"This is an interesting observation as *upward* lightning is not often observed and some experts have thought it does not occur. It would be interesting to know if *downward* flashes occurred at about the same time, and if so, whether before, simultaneous with, or after, the upward flashes."

SUDDEN GALE

South of Agulhas Bank

m.v. *Trewidden*. Captain G. A. McKay. Buenos Aires to Mauritius. Observer, Mr. I. Smith, 3rd Officer.

19th March 1964. From 1310–1430 GMT the vessel experienced one of the localised gales peculiar to the area. The wind during the morning had been steady W'S, force 5, and the barometer had shown no marked change. At 1310 the first indication of the storm to come was a large following swell which suddenly broke over the vessel. The swell remained very high and by 1330 the wind had backed to the SW and increased to force 8. The sea then became very confused and tumbling, causing the vessel to roll violently and ship heavy water. Although wind and swell were mainly from the SW, throughout, a very strong southerly set was experienced. At 1415 there was a moderate shower of rain and thereafter the wind and sea gradually moderated. It was noted that between 0600 and 1200 GMT the sea temp. rose from 69·3°F to 74·8° while the air temp. changed only from 68·8° to 70·2°. The wet bulb remained unchanged at 66°. Bar. 1016–1017 mb.

Position of ship: 38° 05′S, 21° 46′E.

Note. Reference to the 1200 GMT synoptic weather chart issued by the South African Weather Bureau suggests that the sudden swell which was experienced at 1310 had been generated by the gale-force SSW winds which were blowing over hundreds of miles of sea to the south (and east) of the vessel, but which were not yet occurring in the vicinity of the ship.

As *Trewidden* proceeded on her course she was heading into a region where strong to gale force SSW-SW winds were occurring in the rear of a depression moving eastwards along the parallel of 35° S. As the depression was moving away rather quickly, the strong winds associated with it very soon moderated.

UNUSUALLY COLD WEATHER
Persian Gulf

m.v. *Turkistan.* Captain R. L. Cain. In port. Observer, Mr. J. S. Catlow, 2nd Officer.

18th January 1964. During the morning the wind freshened from the SE and the sky became generally overcast. In the afternoon the sky cleared and the wind decreased, falling to calm by evening. At about 2300 LMT the wind sprang up from NW, increasing very quickly, until by midnight and during the early hours of the following day, a strong gale was blowing, accompanied by much driving sand and a few snow flurries; the latter occurred between 0400 and 0500. The wind eased considerably on the morning of the 19th, but it was bitterly cold. Although no exact record of the initial drop in temperature was made, it was estimated that there was a fall of about 20°F between 2300 on the 18th and 0100 on the 19th; the temperature at 2100 on the 18th had been 50°.

Readings taken on the 19th and 20th were as follows: 19th/0700, 27°; 19th/1700, 35°; 20th/0700, 22°; 20th/1700, 30°. During this time the sky was clear with no clouds and the wind NW'ly, force 4, and decreasing very slowly. There was hard frost day and night. This weather persisted for the better part of two weeks, though becoming less severe each day. Conditions ashore became very bad. The water supply was frozen and there was a general lack of fuel and warm clothing among the inhabitants, which more or less brought the port to a standstill for three days. It was generally regarded by the local inhabitants as the coldest weather within living memory, and it certainly was so, in the experience of the officers of this ship who have been engaged in this trade for very many years.

Position of ship: In port of Bandar Shapur.

Note. At 0300 LMT a depression was centred at about 300 nautical miles to the NE of Bandar Shapur. The cold front associated with this depression crossed the head of the Persian Gulf at about 2300, allowing a cold NW'ly airstream to spread over the area. The very low temperatures experienced are to be accounted for by the fact that the air had its origin over the Arctic and North Russia. At Abadan, the lowest temperature so far recorded in January is 26°F, and that at Basra is 24°F.

BRICKFIELDER
South Australia

m.v. *Nordic.* Captain H. J. Pirie. Observers, Mr. J. Wade, 2nd Officer and Mr. M. Ogilvy, 3rd Officer.

14th March 1964. At 0630 GMT (1600 local time) the difference between the wet and dry bulbs was noted to be 31°F. Dry bulb temperature 97·5° and wet bulb 66·5°. Wind N, force 4.

Position of ship: at Whyalla, South Australia.

Note 1. We have received the following comment from the Australian Commonwealth Bureau of Meteorology:

"Early in the nineteenth century, brickfields occupied a considerable portion of the district south of the sparsely settled shores of Port Jackson and whenever a strong southerly wind, typical of this region in summer, struck the infant city, its approach was heralded by a cloud of reddish dust from the brickfield area—hence the name Brickfielder. But from time to time the name has also been given to the hot dry northerlies over south-east Australia in summer. The above report from the *Nordic* is typical of such conditions. Some extreme values of this kind were recorded over south-east Australia on 13th January 1939. In Melbourne on this date the maximum temperature was 114·1°F and the 0500 GMT (1500 local time) reading of dry bulb 113·0°, wet bulb 71·8° gave a relative humidity of 8 per cent. The application of the name to these northerly winds has in all probability arisen from the fact that they represent tropical continental air, dry and unstable due to strong surface heating, with a minimum of relative humidity during the day due to advection over arid regions and intense eddy transfer in the vertical. Under such conditions red dust from the interior is not infrequently borne aloft and carried over the south-eastern states, thus giving a brickfielder condition although on a much larger scale than was provided by the local brickfielder at Port Jackson over a century ago."

Note 2. An article on the Australian brickfielder, from which the above comment is taken, will appear in the April 1965 number of *The Marine Observer*.

SEA TEMPERATURE CHANGE

South Atlantic Ocean

R.R.S. *Shackleton.* Captain D. H. Turnbull. South Georgia to Port Stanley. Observer, Mr. R. Lapthorn, 3rd Officer.

13th November 1963, 1635 GMT. The sea temperature rose from 34°F to 38° in 15 min. Lost sounding on the echo sounder. Air temp. 35°. Wind ESE, force 7.

Position of ship: 52° 34'S, 48° 30'W.

Note. Between S. Georgia and Port Stanley, at this time of the year, there is a rather rapid rise in temperature with increasing distance westwards especially between Long. 40° and 45°W. The normal mean sea temperature in November in the position of the observation is 39°F.

CURRENT RIPS

Indian Ocean

m.v. *Treneglos.* Captain W. Phillips. Dammam to Cape Town.

20th January 1964. Between 0930 and 1330 GMT the vessel passed through, and near to, several patches of very turbulent water, so much so that they had the appearance of boiling. These disturbances did not appear to be caused by the wind which was mainly NNE–NE, force 3–4. Previously the vessel had been set in all directions from N to S and E to W. There was a low–moderate N'ly swell. Sea temp. 83°F.

Position of ship: 6° 00'S, 45° 00'E.

Note. Dr. J. C. Swallow of the National Institute of Oceanography comments:

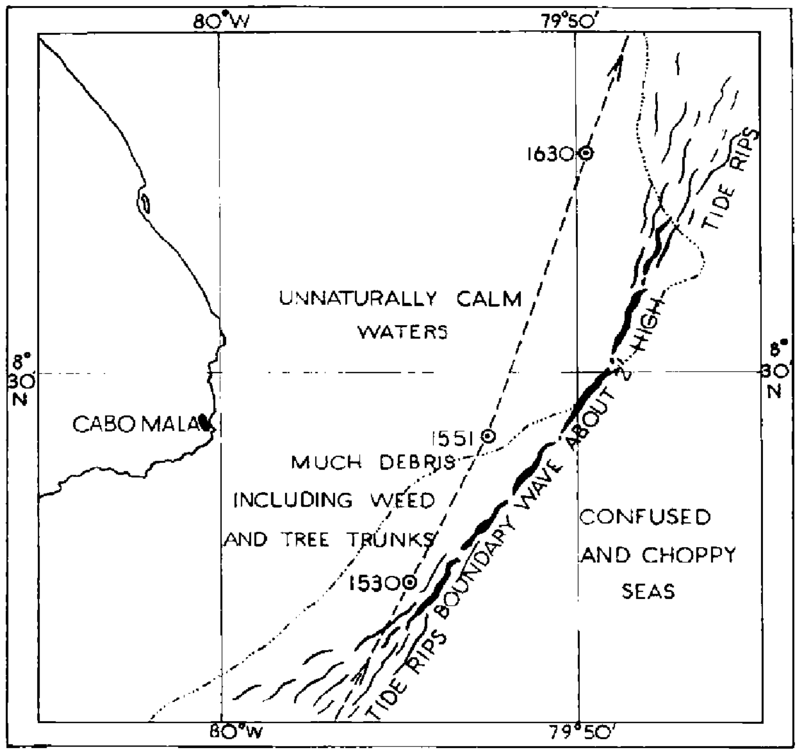
"It seems most likely that this disturbance was in the zone of convergence between the south equatorial current and the equatorial countercurrent, from the variable sets encountered. It is interesting how the convergence manifests itself in such strong and relatively small-scale turbulence. A similar disturbance was noticed by the R.R.S. *Discovery* off Cape Guardafui in August 1964, and it was thought to be due to cold water from the Somali current moving northwards under a thin layer of warm water from the Gulf of Aden, and occasionally breaking through it. But in the case reported here, the temperatures of the surface waters in the converging currents would not be expected to differ much. The passage from the Gulf of Oman to South Africa should afford particularly valuable opportunities for observing the currents of the western Indian Ocean, and any observations of current made in that voyage and on future occasions would be very welcome."

off Cape Mala

m.v. *Rakaia.* Captain P. A. Ogden, R.N.R. New Plymouth to Balboa. Observers, Mr. P. King, 3rd Officer and Cadet B. Fenn.

3rd November 1963. Between 1520 and 1630 GMT while the vessel was passing Cape Mala, a strong current rip was observed about a mile to the east of the vessel. It approximately followed the 50 fm line. The rip began some 8 miles to the SSE of the lighthouse, as a fairly broad area of cross currents and confused disturbances. Then for a length of about 10 miles the rip took the form of a single wave some 2 ft high, which dissolved into rips and eddies 12 miles to the ENE of the lighthouse. The sea to shoreward of the boundary wave was unnaturally calm and much debris was seen in the form of tree trunks, patches of scum and weed. To seaward, the waters were choppy and confused. No sets were experienced while in the calm waters. At 1510 GMT the wind dropped from SW'W, force 3, to light airs which persisted to 1630, when the wind began to freshen, becoming W'N, force 3, by 1700. To the S and E throughout the period heavy squalls were seen to seaward of the tide rips. Sea temp. 81·5°F.

Position of ship at 1500: 7° 24'N, 80° 06'W.



Note. Mr. A. R. Gordon, Jr. Director of the Oceanographic Analysis Division of the U.S. Naval Oceanographic Office comments:

"Our records show that rips are common in the region off Cape Mala and, in fact, have been reported previously in the same location. The observation of the boundary wave two feet high and ten miles long is rather unusual. Without additional information on current velocities and swell directions over the entire area at the time, it is virtually impossible to explain the phenomenon which was observed. Some speculations by our oceanographers on the phenomenon are given in the following paragraphs.

The tide was in a condition of maximum spring range and near perigean range on the day of observation. Current speeds would be expected to be near 3 kt at time of strength. However, the transit of the vessel was at time of low water at Cape Mala and theoretically since the tide in this region more nearly resembles a standing wave, this should be the time of slack water. This may explain the calm water region shoreward of the boundary wave and also perhaps the occurrence of debris since it was slack following ebb.

The rips are probably caused by current shear (variation in currents in contiguous areas) rather than shoaling. Seaward of the boundary wave the tidal current could still be ebbing and accelerated by the southerly general circulation. A sharp density gradient may have existed between the brackish coastal water and the more saline oceanic water, the observed boundary wave marking the convergence of the two waters. The boundary zone would be slightly elevated but gives an appearance of a higher elevation because of the difference in the reflection of light by the smooth and rough surfaces. In addition, debris could be packed and aligned at the margin providing a shadow zone.

The bottom topography suggests that refraction and shoaling of long period swell (greater than 12 seconds) could produce a region of crest peaking near the 50 fm contour. Long period swell, from the westerly wind belt of the Southern Hemisphere, is common in this region and the effects are especially pronounced around points where shoaling is rapid and at underwater ridges which tend to focus the energy. Shoreward of the 50 fm zone and north of the Cape these crests would decay."

DISCOLOURED WATER
off the Makran coast

m.v. *Chandpara.* Abadan to Karachi.

8th March 1964. While on passage off the Makran coast the vessel encountered strips of reddish coloured water 5 ft in width and up to 2,000 ft in length. In places where the concentration was greatest the colour was a bright orange. A sample of the water was taken and found to contain thick plankton, each micro-organism containing an orange pigment granule. When the bottle containing the sample was agitated at night, the plankton gave off vivid phosphorescent flashes, and remained alive for 48 hours, after which it died and settled. An attempt was made to have the sample identified at Karachi but unfortunately this was not possible. Sea temp. 75°F.

Position of ship: 25° 00′N, 60° 00′E.

Note 1. m.v. *Chandpara* is an Australian Selected Ship.

Note 2. The above report was submitted by the Commonwealth Bureau of Meteorology, Melbourne, to the Commonwealth Scientific and Industrial Research Organisation, who comment as follows:

"The observer has described very well a phenomenon generally called a 'red tide'. Without seeing any material, the micro-organism responsible in this case could not be named, but it was probably one of the dinoflagellates, a group of single-celled organisms often responsible for dense concentrations discolouring the sea. One of these, *Noctiluca*, whose cells reach 1·5 mm in diameter, is strongly luminescent, as its name suggests."

Gulf of Guayaquil (Ecuador)

m.v. *Bamburgh Castle*. Captain P. L. Johnson. San Juan (Peru) to Rotterdam. Observer, Mr. G. Bagnall, 2nd Officer.

27th February 1964. From 1700–2100 GMT the vessel encountered frequent large patches of discoloured water, which varied in hue from brown to strong rust or red. There was a slight smell of decay and numerous schools of fish were seen. Air temp. 79°F, sea 74°. Wind SW'ly, force 2.

Position of ship at 1800: 2° 36′S, 81° 12′W.

Note. Dr. T. J. Hart of the National Institute of Oceanography comments:

"This sounds more like a dinoflagellate bloom, or swarming ciliate protozoa, than other types of micro-plankton concentrations, all known types of which, however, may occur at times off the coast of Peru and Ecuador."

SUBMARINE EARTH TREMOR

South Pacific Ocean

m.v. *Galway*. Captain R. Willcocks. Panama to Wellington.

6th February 1964. At 1413 GMT the ship was shaken all over for approx. 2 min by a violent concussion which was strong enough to activate the alarm bells and cause the barograph to register a series of vertical lines on the chart. There was no disturbance of the sea surface. A vessel about 40 miles to the south reported that she did not experience any sort of concussion. Wind, SE'ly, force 3. Slight sea and low S'ly swell.

Position of ship: 4° 03′S, 103° 56′W.

Note. Mr. J. Piegza, seismologist at Kew Observatory, comments:

"The concussion was caused by an earthquake which, according to U.S.A. Coast and Geodetic Survey, occurred at 14h. 13m. 10·8s. at 4·0°S, 103·9°W. The earthquake was a shallow one and of magnitude 5·0 and as the *Galway* was exactly over its epicentre therefore it experienced the maximum of its seismic vibration transmitted through the water. Because the accelerations of seismic waves decrease rapidly when one moves away from the epicentre meant that the other ship, which was at the time about 40 miles to the south, did not experience any concussion. This was because it received only about 5–10% of the accelerations experienced by the *Galway*. These could easily pass unnoticed among a ship's considerable normal vibrations."

PHOSPHORESCENCE

off Ecuador

m.v. *Otaki*. Captain I. Y. Bateley. Napier to Panama Canal. Observers, Mr. R. A. Laycock, 3rd Officer and Mr. A. Duncan, Junior 3rd Officer.

6th January 1964. At 0200 GMT large amounts of phosphorescence were observed in breaking waves. To test the theory that radio waves can activate phosphorescence, the radar was switched on, but no change was seen. Sea temp. 79·6°F. Wind sw'ly, force 2.

Position of ship: 1° 45'N, 82° 55W.

Indian Ocean

s.s. *Caltex Glasgow.* Captain W. E. Smith. Cochin to Calcutta. Observer, Mr. J. Brewster, 2nd Officer.

13th March 1964. About 1930 GMT my attention was drawn to a flashing light on the port bow and on looking through binoculars I observed patches of light in the sea about 1 mile ahead. As the vessel approached, it was seen that these patches covered all the sea and appeared to be coming up from beneath the surface. They were roughly circular in shape, about 100 ft across and whitish green in colour. Some were very faint and indistinct but others gave off a considerable amount of light. About every 30 sec. one or more patches seemed to 'explode', becoming very bright in the centre and then rapidly expanding outwards, as the shock waves of an explosion would, increasing in size to approx. 400 ft. The bright light would be maintained for several seconds and then fade away to nothing. When the ship's searchlight was shone into the centre of one of the faint patches of light it immediately 'exploded' in the manner previously described. Upon shining the light into the water between patches, the sea appeared to be a very pale powder-blue shade instead of the usual dark colour seen at night. After one or two seconds, the water illuminated by the beam for a distance of approx. ¼ of a mile from the ship, started to glow in a manner similar to the bright patches of light. The searchlight beam was played around the ship forming lines of brightly glowing light in the water, about 20 ft wide. Sometimes the lines ran and joined up two patches of light; others expanded in both length and width to form elongated shapes, but the majority remained their original shape and size. When the bow passed through a patch of light it was noticed that the bow waves and ripples produced were silhouetted against the light under the surface. A bucket of sea water revealed nothing to the naked eye, but once or twice a swarm of small oblong objects about 2 in. long appeared in the beam of the searchlight, glowing with a far greater intensity than the surrounding water.

Gradually the patches of light stopped appearing and by 2010 GMT the water was no longer being stimulated into activity by the searchlight. About 20 min later, the cycle started again, in exactly the same manner as before and lasted until 2230 when it finally died away. Sea temp. 82°F. Wind NE, force 4. Moderate sea and swell. Speed 13·8 kt.

Position of ship: 6° 55'N, 78° 43'E.

Note. Dr. R. H. Kay of the University Laboratory of Physiology, Oxford, writes:

"These observations are included to illustrate two problems for which we could soon collect a wealth of relevant data.

The first is the *effect of light on bioluminescence.* This has already been touched upon in my notes for the July and October 1964 numbers of *The Marine Observer* and many useful observations—more than there is space for in *The Marine Observer*—are now coming in and are being studied. It seems that shining an Aldis lamp on the sea presents no problem and I wonder whether this could always be done and the following recorded:

(i) increase/decrease/initiation/abolition *or* no change in an existing luminescence and for how long any change persists after turning off the light,

(ii) initiation of luminescence in previously dark parts of the sea, or no change, after illumination,

(iii) distances from the ship at which the Aldis is effective in initiating a change,

(iv) time for which the Aldis is trained in a particular patch of water *or*, when the Aldis is held steady with respect to the ship and not trained on one place, what is the forward speed of the ship,

(v) state of sky light, moonlit/starlit/overcast,

(vi) state of sea,
(vii) power output of the Aldis lamp in watts or candle power.

The second problem concerns the more difficult problem of the reported ***influence of radar in luminescence***; it is difficult to explain how this could happen and what reports we have are very few.

Perhaps shipmasters may sometimes allow some radar observations exactly similar to the Aldis measurements above to be made, whenever this can be done without hazarding the proper navigation of the ship. Reports should be made in a similar way with added information which specifies the wavelength in addition to the power output of the radar. When a choice of observation has to be made, I think that the optical experiment should take precedence over the radar one.

If ever an effect of the Aldis light is found very close to the ship, it would be of great assistance if a bucketful of sea could be sampled at the same time and any organisms present described or, if these should be too small to be easily visible, what sort of luminescence is observed when the water is agitated with the hand. (The latter should be done in a rather dark part of the ship before the sample is brought into bright light for inspection.) As in all visual observations, two simultaneous observers are better than one!"

WHALE SHARK
off Colombo

s.s. *Maidan*. Captain D. A. Keller. At anchor. Observer, Mr. J. I. Clucas, 2nd Officer.

27th March 1964. While anchored 1½ miles off Colombo, a large fish, positively identified as a whale shark, was observed swimming very slowly around the ship. It was estimated to be about 20 ft. long and about 6 ft. between the tips of each pectoral fin, light brown in colour with white spots on the head and white crosses and spots on the body.

It was first sighted on the previous day swimming around a sister ship anchored about 2½ miles north of us, but was not noticed here until 1530 next day, when it was continuously in sight for about two hours. A bucket of galley waste, consisting mainly of tea leaves and bread crusts, was thrown overboard and the fish was seen to take part of this. Immediately it dived and headed away from the ship at high speed. 45 minutes later it re-appeared, swimming slowly round the ship as before, but it never again took any notice of the galley waste.

It stayed around the ship until 2130 on the 28th, roughly 30 hours. During the day it was visible most of the time, but at night it appeared to come up from the depths, do one patrol up and down the port side of the ship which had more lights shining on the water, and then disappear for about one hour. During the night from 0130 until dawn it appeared regularly at exactly half past the hour. During the hours of darkness it seemed to like the lights shining on the water, though this may have been due to the presence of the small fish which were also attracted.

I may add that at the time of sighting, we had been anchored for 39 days and had a considerable growth of weed and barnacles on the ship's hull. Our sister ship had only been there for 18 days and thus did not have as much marine growth. There were also 13 other ships at anchor who had been there for varying periods of time, but we have not been able to find out if they had seen the fish as well, except for a Polish vessel anchored for 38 days which did not sight it at all.

Position of ship: 6° 56′N, 79° 48′E.

Note. Dr. P. H. Greenwood of the Natural History Museum comments:

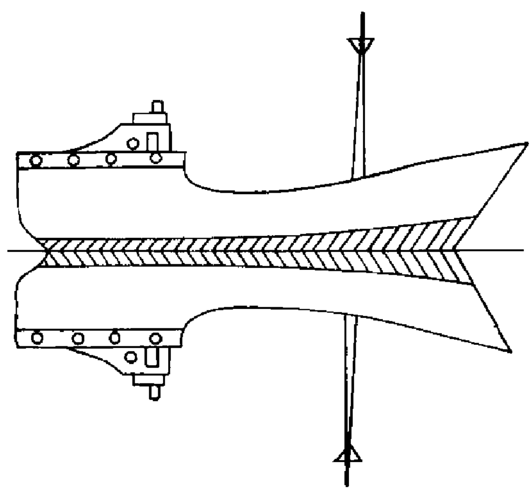
"As far as I can see, there is no published account of a shark attaching itself, as it were, to one ship for this period of time. I can offer no explanation for its regular surfacing at hourly intervals, but the appearance and disappearance at short intervals appears to be a characteristic behaviour pattern of the species. I think Mr. Clucas is quite correct in his surmise that the fish was attracted to the lights on one side of the ship because of the concentration of potential food there. The lights would attract small invertebrates which would be the food of small fishes, and would also be the food (together with the small fishes) of the whale shark. Despite its great size, this fish is only capable of swallowing small organisms, and although fish have been recovered from the stomach contents, they occur less frequently than do the smaller planktonic crustacea. The heavy growth of weed and barnacles would not attract a shark directly, since it would be incapable of feeding on those creatures, but they would attract potential food organisms for the whale shark. I cannot see any obvious reason why the *Maidan* should have been singled out for this shark's attention, especially since it had not been sighted by the Polish ship. The shark's reaction to galley waste seems reasonable enough from my experience of this material, and the fact that it never attempted to feed on it again is interesting, since it seems to indicate a rapid learning process."

ABNORMAL REFRACTION

Thames Estuary

m.v. *Catford*. Captain E. Clarke, M.B.E. London to Hartlepool. Observers, the Master, and Mr. L. Thompson, 2nd Officer.

8th March 1964. At 1315 GMT, ships in a WNW direction, at about 5 miles distance, appeared double, with a mirror-image below the true object, as shown in the



accompanying sketch. The phenomenon lasted for only a few minutes but it was very pronounced. Air temp. 39°, sea 37°. Wind ENE, force 6. Visibility excellent. ⅛ Cu.

Position of ship: 51° 30′N, 0° 55′E.

Note. A mirage such as this can occur when the sea is warm in comparison with the air above it. The rays of light coming from the ship had impinged on the sea surface at a sufficiently inclined angle to cause them to undergo a sudden deviation, and the effect is almost the same as if they had been reflected from a mirror. The value of sea temperature observed on this occasion is perhaps not entirely representative of the area: in the Estuary there can be considerable variation of sea temperature with distance.

off Cape Byron, N.S.W.

m.v. *Bankura*. Captain W. S. Howcroft. Sydney to Brisbane.

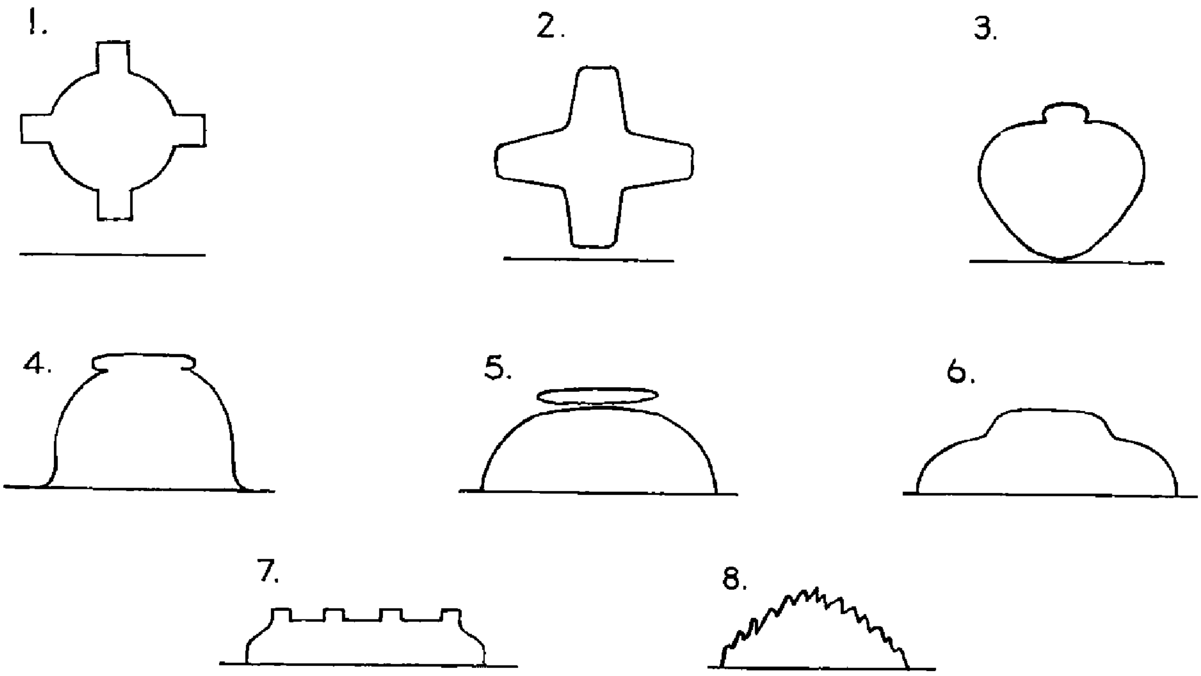
20th November 1963. At 0945 GMT when Cape Byron bore NW at a distance of 2 miles, its light was seen looming in the SE, apparently below the horizon. The loom continued on the reciprocal bearing of the light until 1025, when Cape Byron bore SW at 10½ miles. Air temp. 72°F, wet bulb 69°. Visibility very good: wind ENE, force 2–3. ⅛ Cu.

Position of ship: 28° 36′S, 153° 36′E.

vicinity of Adelaide Island

m.v. *John Biscoe*. Captain W. Johnston. Anvers Island to Adelaide Island (Base 'T'). Observers, Mr. R. N. Cumbers, 2nd Officer and Mr. A. B. Joubert, 3rd Officer.

29th February 1964. The sun was observed at 2110 LMT to be about to set,



being approx. 15′ above the visible horizon, and had almost reached its position of theoretical sunset, with its centre in the rational horizon. At this time we began to notice that abnormal refraction was causing the sun to be distorted in an extraordinary manner, as shown in the accompanying eight sketches. The whole process took about 10 min and as the last vestige of the sun finally passed from sight we looked for, but saw no flash. The weather was fine and clear, with air pressure high for these regions at this time of year (994 mb) and the air temperature below freezing for most of the day. The wind was SE'ly. This weather lasted for 5 days and on each day we noticed excessive distortion of the mountains of Graham Land and Alexandra Land. Mirages were also seen. The effects were most pronounced in the mornings and late evenings. The numbered notes below, refer to the sketches:

(1) At first the shape resembled that of a gyroscope.

(2) This gradually became distorted into the shape of a cross.

(3) Now it became the shape of a spinning top with a small button on the upper part.

(4) At this stage the lower limb of the distorted image began to fall below the visible horizon and the base began to broaden out. Simultaneously the button on top began to broaden and give off a faint blue-green light.

(5) When the sun's centre was apparently on the visible horizon, the elongated button-shape became separated from the main body of the sun by a thin translucent line and became a brilliant ultramarine colour. The button-shaped part reformed and separated a second time.

(6) As the sun began to set, this top part began to merge once again with the main body of the sun and the ultramarine colour became less brilliant.

(7) The top of the sun's disc assumed a castellated appearance for a minute.

(8) Just before passing from sight the sun lost all semblance of its original shape and became a pyramid of flaming ultramarine coloured vapour which gradually sank below the horizon at 2120.

Position of ship: 67° 30′S, 69° 15′W.

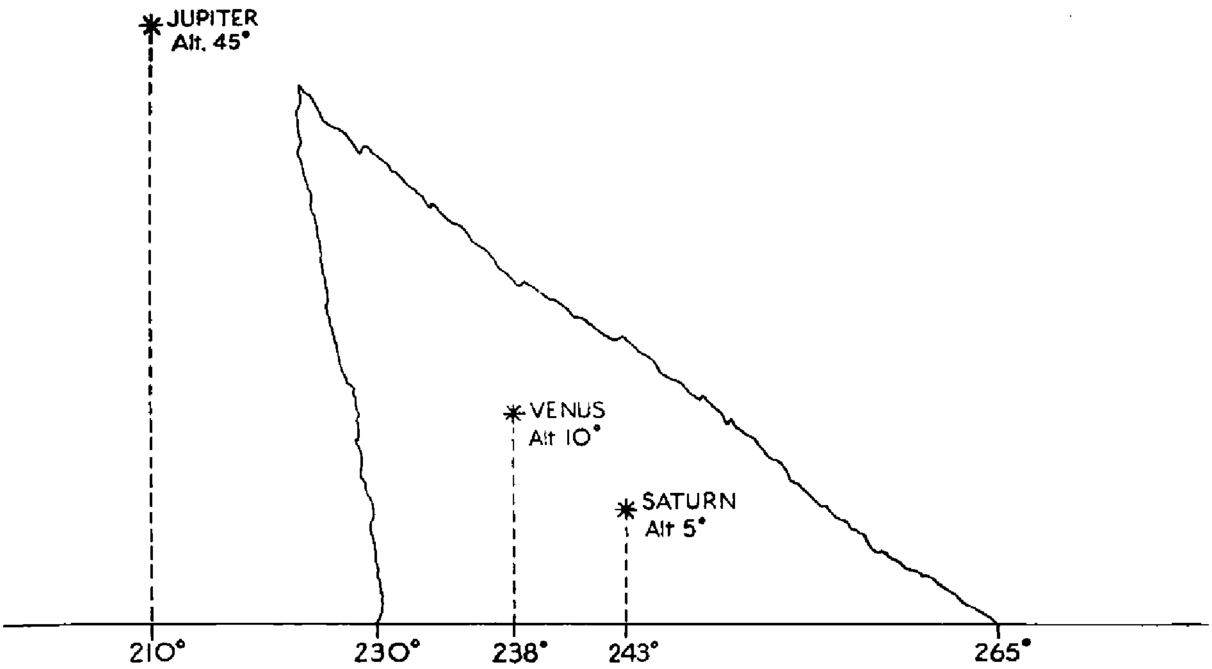
Note. The changes in the appearance of the sun's disc are due to sudden bends in the light rays as they strike various layers of discontinuity of density in the atmosphere. As a result 'blind' strips often develop which cause the sun to break up into curious shapes. At sunset (and sunrise) the yellow and orange rays are largely absorbed by the water vapour in the atmosphere, while the violet rays are weakened by scattering. The red and blue-green rays are left, and the latter being the most refracted are the last to be seen as the sun sets (and the first as it rises).

ZODIACAL LIGHT

North Atlantic Ocean

m.v. ***Fred Everard.*** Captain W. G. Hunt. Brixham to Casablanca. Observers, the Master and Mr. J. London, Chief Officer.

16th January 1964. At 1900 GMT the Zodiacal light was observed in the WSW, the apex of the cone being at about 35° altitude, while the width of the base was



also 35°. It was estimated to be about twice as bright as the Milky Way, and the fact that Venus and Saturn were in the centre of the cone did not detract from its brightness. The cone gradually became lower and fainter, until by 2130 GMT it was barely visible. There was a cloudless sky and visibility exceeded 30 miles.

Position of ship at 1900: 42° 48′N, 9° 36′W.

17th January. Observers, the Master and Mr. J. Tweddle, 2nd Officer.

The same phenomenon was again observed at 1900 GMT, but this time a three-day old crescent moon was inside the cone at an angular distance of 3° from Venus.

Position of ship: 38° 45′N, 9° 38′W.

Note. The zodiacal light is caused by the scattering of sunlight from a cloud of particles lying in the ecliptic; this is the plane in which the apparent orbit of the sun lies. The composition and origin of these particles, whether of dust or molecules or electrons, solar or terrestrial, is not yet certain.

LOOMING OF LIGHTS

North Atlantic Ocean

m.v. *Dalesman.* Captain W. S. Eustance, O.B.E. London to Barbados. Observer, Mr. D. Skillander, 3rd Officer.

11th February 1964. At 0100 GMT, the loom of the light on the Island of Santa Maria, 50 miles to the south, was observed. That of Porta do Arnel light was seen at 48 miles. The lights of ships could also be seen at 18 miles. Air temp. 57·5°F, wet bulb 54·5°, sea 62°. Moderate SE's breeze. Sky cloudless.

Position of ship: 37° 45′N, 25° 00′W.

Note. Conditions which favour the occurrence of 'looming' are: (a) a sea surface much colder than the air above it, and (b) a weather situation in which the temperature in the lowest layers of the atmosphere increases rapidly with height—a temperature inversion.

In the present case these conditions apparently were not fulfilled and the fact that 'looming' was visible seems to have been due to the considerable height of the light, the clarity of the atmosphere and the presence of cloud in the vicinity of the island.

METEOR

North Atlantic Ocean

m.v. *Esso Pembrokeshire*. Captain S. R. Dance. Milford Haven to Tripoli. Observers, Mr. W. A. Bernard, 2nd Officer and Mr. Corcoran, Seaman.

15th March 1964. At 0250 GMT, a meteor, blue in colour and with a yellow-orange tail, hit the sea approx. 50 yd. off the port bow. It was estimated to be somewhat larger than a football. Visibility was excellent at the time.

Position of ship: 38° 19'N, 9° 40'W.

UNIDENTIFIED OBJECT

off West Africa

m.v. *Wendover*. Captain A. M. Brown. Dakar to Cape Town. Observers, the Master, Officers and many of ship's company.

27th November 1963. At 1925 GMT something which was taken to be an artificial satellite or space vehicle was observed. At first a small, white spherical cloud with a bright centre was seen bearing 230° at an altitude of 40°. It rapidly enlarged and assumed the form of perfectly defined concentric circles of light. The circles reached a maximum of 5° radius from altitude 40° to 50° and the greatest brightness was equal to that of a full moon. As the object passed across the sky, heading approx. 310°–130°, the concentric circles became elliptical, with a 'catherine wheel' effect, which gave the impression of anticlockwise rotation. When the body passed ahead of the vessel, the surrounding cloud of light dissolved and became the single bright white light usually associated with artificial satellites. The body was lost sight of at about 1930.

Position of ship: 11° 42'N, 17° 19'W.

Note. This is yet another report of the early life of the American rocket *Centaur* 2, from Cape Kennedy, reported by three ships in the October 1964 number of this journal.

AURORA

The auroral observations made in British ships during the first three months of 1964 and m.v. *Manchester Trader's* report for 30th October 1963 are listed briefly opposite. They have been received at the Balfour Stewart Auroral Laboratory of the University of Edinburgh. We thank the observers who have recorded these observations and the Meteorological Office, Bracknell, and the Ocean Weather Ship Base, Greenock, for forwarding the reports to the Laboratory.

There were many cloudy nights during the period, and for February only one ship's report was received, describing a short-lived aurora seen on 14th February by an observer in m.v. *Laksa* from a position near Bergen. This aurora was reported too from Shetland and Finland, but not from any station further west.

In January and March, in spite of cloud, quite a number of auroral reports came from ships stationed in higher latitudes, and *Weather Adviser* made a very detailed record of the displays on January 16–17 and 17–18. These displays were also seen in Finland, and briefly in the Faroes and North of Scotland on 16–17.

In March the Netherlands ship on duty at Weather Station 'Alfa', and later *Weather Surveyor* reported aurora on 9 nights in all. Displays on two of these nights were seen also from *Weather Adviser* and s.s. *Caslon*. A helpful list of high frequency interference times was made out by the Communications Officer of *Weather Surveyor*, so that we were able to compare these with auroral reports from other areas even when visual observations from the ship were hampered by cloud. These complete or partial fade-outs in radio communications are, like aurora, associated with the increase in ionization of the upper atmosphere and are another of the problems being investigated.

The work of collecting data on the geographical distribution of aurorae and their characteristics still depends largely on visual observations. Cameras on the ground and in rockets or satellites, photometers and other means of recording auroral data, can only supplement the information. Our work, therefore, attains a high degree of accuracy only if every auroral appearance is reported. May we stress again that in large areas in both hemispheres where auroras are likely to be seen, the information can come only from ship or aircrew observers. Next year the number of auroral occurrences is likely to begin to increase quite rapidly, and observers in lower latitudes will soon be able to see the more colourful displays as the sunspot activity builds up once more to maximum.

Date (1963)	Ship	Geographic Position	Λ	Φ	I	Time (GMT)	Forms
30th Oct.	*Manchester Trader*	56°20'N 31°40'W	050	65	+73	0100	RA, RR
(1964)							
3rd Jan.	*Weather Surveyor*	59°00'N 19°20'W	070	65	+72	2000	N
						2315–2345	RR, N
8th	*Weather Surveyor*	59°10'N 19°20'W	070	65	+72	2145–0015	HA, N
9th	*Weather Surveyor*	59°20'N 19°20'W	070	65	+72	0140–0555	HA, RR, N
11th	*Weather Adviser*	62°05'N 33°50'W	060	70	+76	0300	N
						2140–2400	HB, N
15th	*Weather Adviser*	62°00'N 33°30'W	060	70	+76	0001–0600	HA, N
16th	*Weather Adviser*	62°05'N 33°30'W	060	70	+76	2145–2245	HA, HB, RB, RR, P, N
17th	*Weather Adviser*	62°05'N 33°30'W	060	70	+76	0022–0445	HA, HB, RA, RB, V, N
						2250–0315	HA, RA, RB, RR
18th	*Weather Adviser*	62°00'N 33°05'W	060	70	+76	0600	P
20th	*Weather Adviser*	61°55'N 32°50'W	060	70	+76	0600	N
23rd	*Weather Adviser*	61°55'N 32°50'W	060	70	+76	0400	RR, N
24th	*Weather Adviser*	62°00'N 32°50'W	060	70	+76	0300	RB
14th Feb.	*Laksa*	60°04'N 04°09'E	090	62	+73	2307–2320	RR, N
1st Mar.	*Weather Adviser*	58°40'N 19°05'W	070	64	+72	0600	N
5th	*Caslon*	54°30'N 24°30'W	060	62	+71	0001–0142	HA, RA, RB, RR, N
	Weather Adviser	59°05'N 19°10'W	070	65	+72	0045–0245	RA, RB, RR, N
6th	*Weather Adviser*	59°10'N 18°50'W	070	65	+72	0001–0300	RR, N
25th	*Weather Surveyor*	62°05'N 33°10'W	060	70	+76	2336–2357	HB, RB
26th	*Weather Surveyor*	62°05'N 33°10'W	060	70	+76	0026–0030	HB
29th	*Weather Surveyor*	62°00'N 33°10'W	060	70	+76	2300	N
30th	*Weather Surveyor*	61°50'N 33°10'W	060	70	+76	0130	HA
						2310	RR
31st	*Weather Surveyor*	62°00'N 33°35'W	060	70	+76	0100	N

KEY: Λ = geomagnetic longitude; Φ = geomagnetic latitude; I = inclination; HA = homogeneous arc; HB = homogeneous band; RA = rayed arc; RB = rayed band; R(R) = ray(s); P = patch; V = veil; N = unidentified auroral form.

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Meteorological Observations aboard R.R.S. "Discovery"

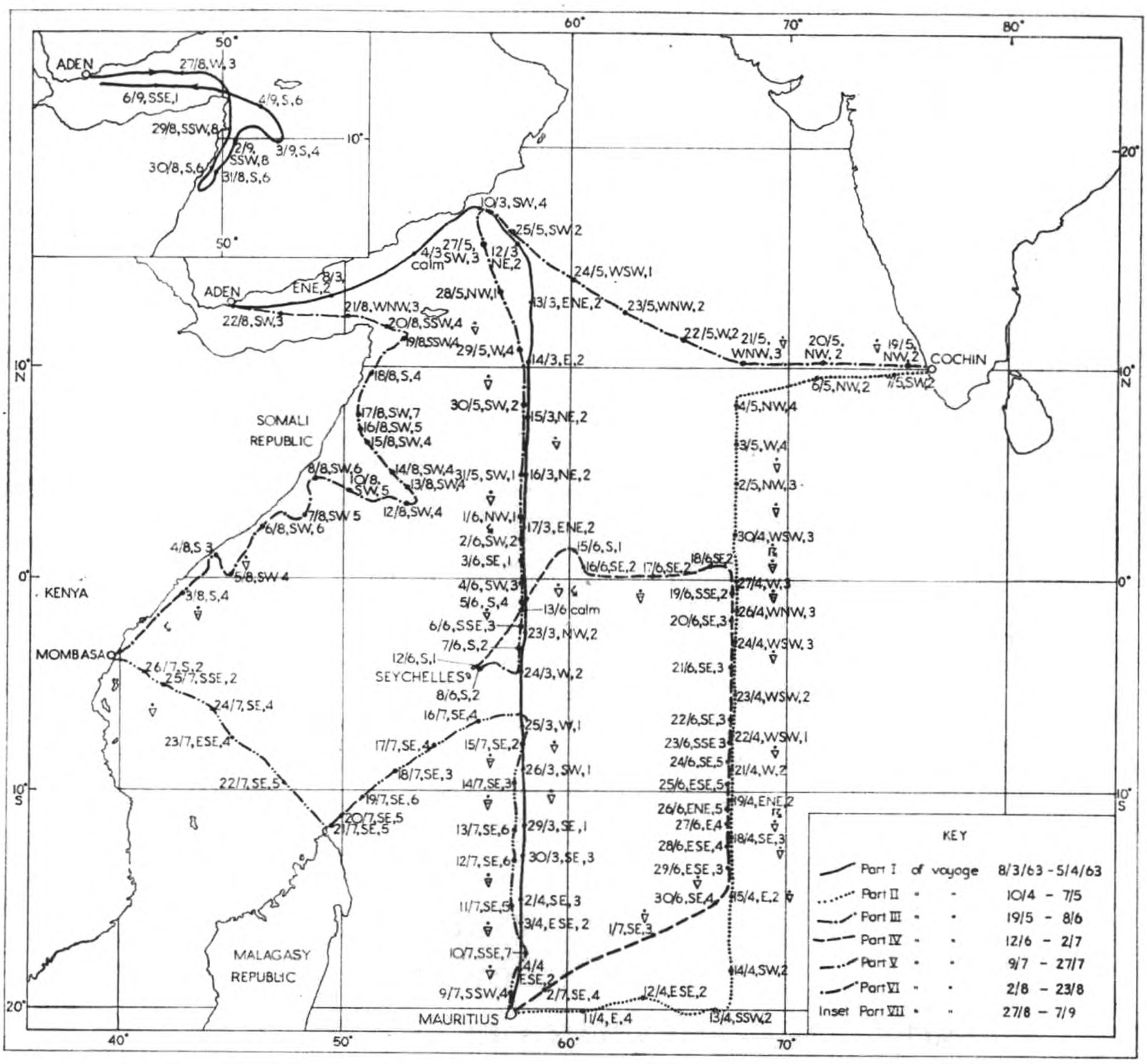
INTERNATIONAL INDIAN OCEAN EXPEDITION

By W. J. Cox

(Mr. Cox was the meteorologist who sailed aboard *Discovery* during her 2nd voyage to the Indian Ocean. He is employed by the Meteorological Office and has had about 15 months' service in Ocean Weather Ships. He is now stationed at a radio sonde station near Dundee.)

Before the commencement of the IIOE[1] in 1963 large expanses of the Indian Ocean were completely blank as regards meteorological information. Until then observations were confined to continental coast stations, ships and aircraft travelling along their regular routes and to islands such as Mauritius, Seychelles, Cocos and the Maldives. This left large areas uncovered, so the oceanographic vessels participating in the IIOE were able to provide much additional information while cruising in these regions. The main purpose of this second voyage of *Discovery* for which she carried 18 scientists was an oceanographic survey of the NW Indian Ocean, particularly the Equatorial Current and the Somali Current. The article describes the meteorological work only.

While taking part in this international project R.R.S. *Discovery*[2] has been equipped with extra meteorological equipment to provide as much information as possible. For making normal surface observations she is more comprehensively equipped than the normal 'selected ship'. Two anemometers are mounted one on each side of the foremast and the associated wind speed and direction indicators are placed in the wheelhouse. Thermometer screens are fitted on each side of the bridge deck and contain electrical distant-reading thermometers in addition to the usual wet- and dry-bulb thermometers. These record on a 'Speedomax' recorder in the plotting office. Additional to the Kew Pattern marine barometer, a precision aneroid of comparatively new design is also carried. An open scale barograph, a thermograph



Discovery's 2nd voyage in the Indian Ocean.

for recording sea temperature, measured at the engine room intake, and a wave-recorder are also fitted.

For measuring solar radiation a Moll Gorcynski solarimeter,[3] on a gimballed mounting, is situated on top of the wheelhouse. Basically, this consists of a thermopile, the blackened surface of which is exposed to the radiation. This surface is covered with two concentric hemispherical glass domes to shield it from the weather and to reduce the tendency for convection currents to form. The top surface of the instrument case between the two domes is highly polished to reduce the absorption of radiation and the remainder of the instrument is protected from direct radiation by a surrounding circular guard-plate which can be adjusted so that its top surface is exactly level with the blackened surface of the thermopile; thus the casing is kept near the ambient air temperature. When the temperature of the blackened surface is raised, an electromotive force is set up which can be measured as a function of the intensity of radiation.

Radiation balance meters are fitted to booms which permit the instruments to be swung outboard, one on each side of the boat deck. These measure the balance between incoming short wave radiation and long wave radiation from the sea surface. Both these and the solarimeter record on the same 'Speedomax' as the distant reading thermometers.

It is intended that this equipment will remain aboard *Discovery* to be used on other voyages.

Radio Sonde

For the IIOE, where upper air information was desirable, the ground equipment for radio sonde ascents was fitted in the meteorological office situated in the after compartment of the funnel. This consists of radio receiver, tuning fork, oscillator, oscilloscope and ancillary instruments for testing and calibrating the transmitters before flight. Sufficient sondes, balloons and other airborne equipment were provided to maintain a programme of one ascent a day while operating in the Indian Ocean.

The radio sondes used[4] consist of a miniature radio transmitter, the carrier wave of which is modulated by an audio-frequency oscillator. The frequency of this is controlled by three variable inductors operated by the meteorological elements. Each inductor is similar and consists of two coils with a mumetal core and a moveable mumetal armature the position of which is controlled by an aneroid capsule in the pressure element, a cylindrical bi-metal strip in the temperature element and a strip of goldbeater's skin in the humidity element. Changes in these elements vary the gap between the armature and the core of the inductor thus altering the frequency of the oscillating circuit. Each element is switched into the circuit in turn by means of a double-pole, three-way switch operated by a windmill which rotates as the transmitter ascends. The signals are received on a ground radio and the modulated frequency measured by matching it with the note produced by a calibrated variable oscillator. The receiver output is applied to one pair of plates of an oscilloscope and the output from the variable oscillator to the other pair. When the two frequencies are equal, the trace on the cathode ray tube takes the form of a stationary loop. In this way the oscillator can be rapidly set to the frequency of the transmitted signal and the value noted, in practice to the nearest ·25 c.p.s. Individual calibration curves provided with each radio sonde then enable the operator to convert these frequency readings into measurements of pressure, temperature and humidity.

The battery powering the radio sonde is made up of 36 cells for the HT supply and a single large cell for the LT in a polythene container, providing working voltages of 85 and 2·3 volts respectively. Both HT and LT cells have lead dioxide positive plates and amalgamated zinc negative plates. Dilute sulphuric acid is added to provide the electrolyte just prior to use. This is then covered with thick oil to prevent spillage and the battery lagged with cellulose wadding to contain warmth when operating in cold temperatures aloft. Further protection is given by containing the whole in a polythene bag.

Natural rubber balloons filled with hydrogen are used to carry the radio sonde aloft at speed of approximately 1000 ft/min. When fully inflated the balloons can lift 1,050 gms to a height of about 60,000 ft. When they reach that height the balloon bursts because of the reduced pressure and the instruments fall to earth. The balloons used aboard *Discovery* were not the largest available but their size was limited by the amount of hydrogen it was possible to stow on board. Initially 66 cylinders were loaded and a further 25 were picked up at Mauritius in July. This was just sufficient to last throughout the cruise.

R.R.S. *Discovery* left Plymouth on 15th February and after fuelling at Falmouth left the same day for Aden via Suez. During the outward passage surface weather observations were made at main synoptic hours (00, 06, 12 and 18 GMT) in the role of a normal 'selected ship'. One radio sonde ascent was made in the Bay of Biscay to test the equipment.

Arriving at Aden on the 4th March we left two days later to begin the IIOE programme. This was to be one radio sonde ascent each day at 1130 GMT and surface observations every three hours; normally the Ship's Officers did those at main synoptic hours and the meteorologist the intermediate ones.

Cruise 1. Aden to Mauritius

After leaving Aden we went along the Arabian coast to the Kuria Mura islands and from there SE to longitude 58°E and then due S to Mauritius. Winds were mainly light E'ly or NE'ly until reaching the equator where it was mostly calm. From 2°S it became light W'ly backing to SE'ly at 10°S and continued from that direction until reaching Mauritius. Except for one or two showers at 6°N, presumably on the inter-tropical convergence zone, no weather phenomena were experienced until reaching 7°S although small amounts of large cumulus were observed most days. From 7°S showers became more frequent but winds remained light never exceeding 15 kt except for occasional gusts up to 25 kt during the heavier showers. The sea was mainly slight with a moderate S–SE'ly swell in evidence south of 7°S. After a cruise lasting thirty days we arrived at Port Louis on 5th April.

While in Mauritius an interesting visit was made to the Cyclone Warning Centre at Vacoas and a party of the local meteorologists were shown around the ship.

Cruise 2. Mauritius to Cochin (India)

We left Port Louis on 10th April and proceeded eastwards to 67½°E and then N on that line as far as 8½°N, thence through the 9° Channel to Cochin. Moderate E'ly winds were encountered as far as 65°E. It was then light variable as far as 15°S where it became mainly E'ly veering to give a mainly W'ly component just north of 10°S. This became moderate further north and veered further to NW'ly during the run into Cochin. More variable weather was experienced on this cruise than at any other time during the expedition. Slight showers occurred soon after leaving Mauritius and during the run northwards showers of varying intensity were recorded almost every day until reaching 5°N. Near 10°S and on the equator thunderstorms with heavy precipitation occurred whilst lightning was observed in the distance on numerous occasions. During the heavier showers the wind gusted up to 40 kt. Except during these occasions the sea waves were mainly slight and the swell after being slight from SE to S became SW'ly very abruptly at 2°S. Cochin was reached on the 7th May.

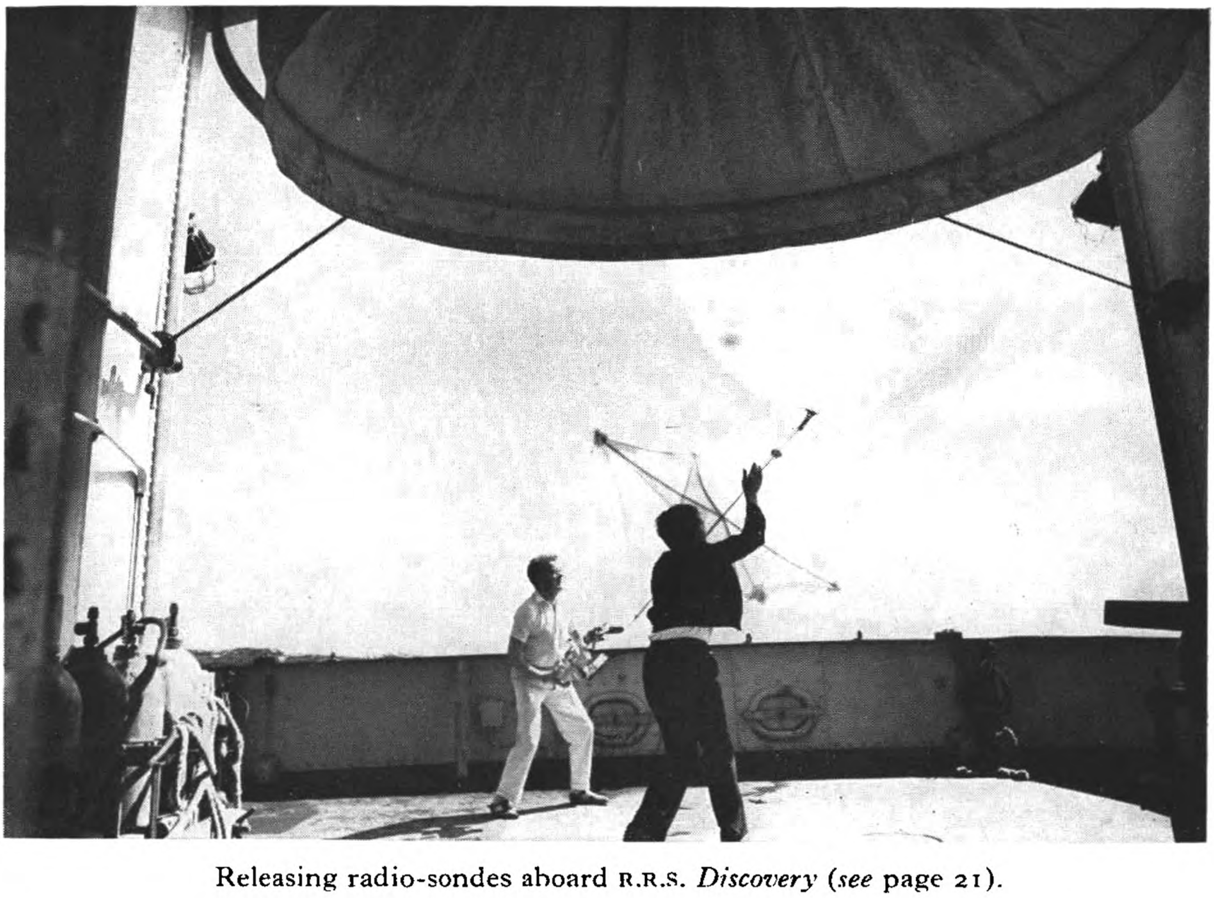
At Cochin a party of officers from the local Naval Meteorological Service were shown the meteorological set-up aboard *Discovery* and visits were made to their Naval Air Station and aboard the R.I.N. Survey Ship *Sutlej*. The opportunity was taken to do a barometer comparison.

Cruise 3. Cochin to Seychelles

We sailed from Cochin on 12th May to continue the expedition but after steaming westwards along the 10° Channel as far as 70½°E, a fault developed in the engine room which necessitated our return to Cochin for repairs. We eventually left again on the 19th to go back to the Kuria Mura islands. From there we again went south on longitude 58°E as far as the Seychelles. Winds continued to be mainly light NW'ly, backing to SW'ly near the Arabian coast and remained so until the equator. There they backed further to S and SE, this being almost reciprocal of those experienced on the earlier cruise. After a few showers and a thunderstorm during the first few days out from Cochin no further significant weather was observed until reaching the Arabian coast. Here shallow patches of fog formed over up-welling cold water. This lifted into low stratus soon after sunrise and was almost completely dispersed by the time we left during mid-morning. Occasional rain and showers were experienced as far as the equator, just south of which the showers became more frequent with the odd thunderstorm. During the whole cruise the sea remained slight with the swell from the SW becoming S'ly at 1°N.

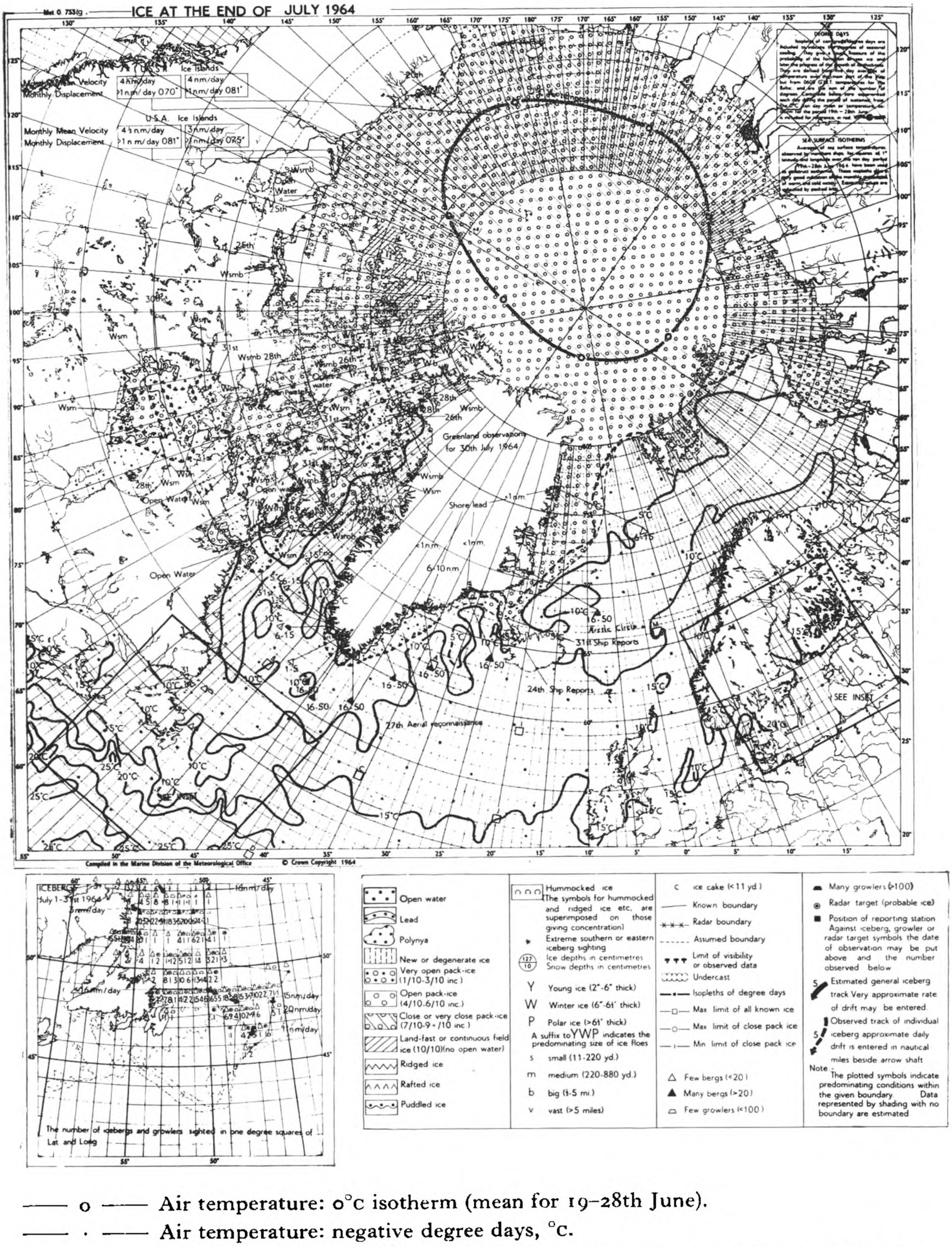
Whilst in the 10° Channel, one day out from Cochin, bands of plankton in a N–S direction were observed covering a wide area. This was identified by the biologists as *trichodesmium* and appears to be a common feature of the locality. During this cruise the only waterspout observed during the whole voyage occurred near the equator. It was seen to form under a large cumulonimbus about five miles from the ship and lasted for about ten minutes but did not fully develop before dissipating.

(*Opposite page 24*)



Releasing radio-sondes aboard R.R.S. *Discovery* (*see* page 21).

(*Opposite page 25*)



—— o —— Air temperature: 0°C isotherm (mean for 19–28th June).

—— · —— Air temperature: negative degree days, °C.

———— Sea temperature, °C, for 19th–28th June. These isopleths give an indication of the monthly movement of warm and cold water.

— — — Sea temperature, as above, but only estimated values.

Note. The notes in this article (see page 39) are based on information plotted on ice charts each month, similar to the map above, but on a much larger scale (39 in. × 27 in.). They are available at the price of reproduction on application to the Director-General, Meteorological Office (Met.O.1), London Road, Bracknell, Berks. Alternatively, they may be seen at any Port Meteorological Office or Merchant Navy Agency.

Cruise 4. Seychelles to Mauritius

After spending four days in the Seychelles, from 8th to 12th June, the fourth cruise was commenced which took us north back to the equator, then eastwards to 67½°E. We continued south on that line as far as 15°S then turned SE'wards, returning to Mauritius on 2nd July.

Until reaching 67½°E, the winds were very light and variable but on the run south became SE to E freshening further south. Showers of varying intensity were experienced on the equator and although no thunderstorms occurred near the ship, lightning was seen on numerous occasions in the vicinity. On the way south showery conditions prevailed but thunderstorm activity appeared to die out as no lightning was observed after leaving the equator. The sea was slight to moderate and the swell was consistently moderate from the SE until 13°S where it became SSW'ly.

Soon after leaving Seychelles, phyto-plankton was observed, again in bands running approximately N–S. Near the equator the visibility was exceptionally good. On one occasion just the anvil tops of distant cumulonimbus clouds were very clearly visible above the horizon.

Cruise 5. Mauritius to Mombasa

Leaving Mauritius on 9th July we returned N on longitude 58°E as far as 6°S then turned SW'ly until reaching the northern coast of Madagascar. From there we then went NW to Mombasa. Except for brief periods after leaving Mauritius and near Mombasa, where the wind was S'ly, we were in moderate to strong SE'ly Trade Winds for the whole of this period. Again the weather was mainly showery as far as Madagascar but the showers became less frequent on the run up to Mombasa. Both sea and swell were consistently from the SE, mainly moderate but on occasions combining to give wave heights in the region of 18 to 20 ft.

Cruise 6. Mombasa to Aden

A period from the 27th July to 2nd August was spent in Mombasa before starting on this cruise which consisted of a series of zig-zags up the Somali coast as far as Socotra before rounding Cape Guardafui and thence to Aden. During this period *Discovery* was co-operating with the American oceanographic vessel, *Argo*, in investigating the Somali current.

This is probably the fastest ocean current in the world and although its existence has been known for a long time it had not been properly investigated before.

From Mombasa to just north of the equator the wind was S'ly and then became SSW'ly, averaging force 5. This held until a little south of Socotra where it backed to S'ly, still maintaining force 5. Inside the Gulf of Aden it became light and variable before again becoming moderate SW'ly near Aden. The weather was again showery as far as 4°N but thereafter it became mainly fine.

The main meteorological feature of this cruise was the large variations in sea temperature encountered from 8°N onwards.[5] The minimum temperature measured, by thermometer in insulated bucket, was 13·1°C (55·6°F) at approx. 9°N. In this area many dead fish were observed floating on the surface, apparently as a result of the drop in sea temperature. These were mainly comprised of small 'puffer' fish but other species, some quite large, were also seen. These variations in sea temperature continued all the way up the Somali coast and is a result of up-welling caused by the fast current. This is probably most developed during August when the SE Trades, south of the equator and the SW monsoon northwards have been effective for about three months in transporting large amounts of water along the African coast.

Cruise 7. Aden to Somali Coast

After three days in Aden we returned to the Somali coast to investigate that area more fully.

The winds were again light variable in the Gulf of Aden and the sea slight until reaching Cape Guardafui. Here the effects of the Somali current were again noticeable in a large drop in sea and air temperature and numerous current rips. Large numbers of dolphin and sea birds were observed, apparently feeding in the area. On rounding the Cape the wind became s'ly veering to ssw'ly further south and averaging 30 kt. The weather remained fine during the whole period, only small amounts of medium and high cloud occurring.

We returned to Aden on 7th September, leaving the same day for Plymouth via Suez.

During the expedition radio sonde ascents were carried out each day when the ship was more than one hundred miles from land and on some occasions closer inshore when parachutes were included in the rig. Flights were missed on two occasions due to faults in the ground equipment caused by the high working temperatures in the meteorological office (41°C, 106°F, when on the equator during the first cruise), and once because of strong beam winds, gusting to 40 kt. when it was impossible to bring the ship into wind as bottle sampling was in progress. Normally with a strong wind blowing a point or so on either bow, sufficient shelter was provided by the lifeboats and superstructure to permit inflation and launching of the balloon without having to rig the canvas shelter provided. It is essential during daytime ascents that the transmitter be suspended at a considerable distance from the balloon otherwise local heating caused by the balloon itself will affect the recorded temperatures. In less than 20 kt it was possible to provide this suspension with 40 metres of sisal string but in stronger winds an unwinder device was used. This enables a short suspension to be used during the launch and then allows sufficient string to be paid out to lower the transmitter to its correct position. The whole process of making a radio sonde ascent by one man (assisted perhaps by one other person—often the chief steward—for a few minutes) for the actual release of the balloon, from the beginning of the preparation of the radio sonde (calibration, etc.) to the time the message has been coded and handed to the radio officer, averaged about three hours. At a radio sonde station ashore or aboard weatherships where more staff are available, this process usually takes about two hours.

Regrettably, upper winds could only be investigated on very few occasions and then not very successfully. As *Discovery* is not equipped with wind finding radar the method used was by following the balloon visually and taking elevations every minute with a sextant and reading off the azimuth from the gyro-compass repeater at the same time. On most occasions this was impossible due to cloud conditions or else the Deck Officer was busy on other duties and was unable to assist.

During the expedition some 28,000 miles were steamed; 136 successful radio sonde flights were made and 1,135 surface observations recorded. All the upper air messages and three-quarters of the surface observations were transmitted for synoptic purposes. The Deck Officers are to be congratulated on the diligence with which they did the observations and the Radio Officer for clearing so many of the messages, causing him much extra work. I would also thank the Scientists, Officers and Crew of R.R.S. *Discovery* for so willingly assisting with the filling and launching of balloons and the other odd tasks which required more than one person to carry out and for making the cruise so enjoyable.

REFERENCES

[1] See *Marine Observer*, April 1963 and July 1964.
[2] See *Marine Observer*, July 1963.
[3] See Handbook of Meteorological Instruments, Part I.
[4] See Handbook of Meteorological Instruments, Part II.
[5] See *Marine Observer*, October 1963.

551.509.335

Long Range Weather Forecasting

By M. H. Freeman, O.B.E., M.Sc.
(Assistant Director (Synoptic Climatology) in the Meteorological Office.)

The main tool used by the short range forecaster in the preparation of shipping forecasts and gale warnings is a series of synoptic charts drawn at three-hourly intervals. He studies the movements of depressions, anticyclones and fronts, predicts their future movement and development and forecasts the accompanying weather and wind accordingly. This method works pretty well for a period of 24 hours ahead, and it can be extended to give outlooks for two or three days, but soon after that the existing depressions etc. will have died or moved away and new features as yet unborn will have taken their place. Although we may be able to say that a certain region is favourable for the formation of depressions, we cannot say just where or when the next one will develop. This means, firstly, that we have to use different methods for long range forecasting, and secondly that the amount of detail that can be provided is much less in a forecast for a month than in one for a day ahead.

Our understanding of the physical processes which control the large scale pattern of weather is far from complete, and so far efforts to base long range forecasts solely on physical or mathematical arguments have met with little success. Since a general solution of the problem is at present beyond us, one way of tackling it is to examine the ways in which nature has solved similar problems when they have arisen in the past.

The first step is to determine the essential features of the present situation, and then to examine past records to find occasions which were similar in essentials. The sequels to these analogous occasions are studied; if they are in agreement it is reasonable to assume that the present situation will develop in a similar way and to form the forecast accordingly. If the sequels do not agree some reselection on the basis of other features will be needed or some other argument must be invoked to choose between the sequels. There are at least two major difficulties associated with this analogue method of long range forecasting. The first has already been indicated, namely the problem of recognising what are the essential features of the present situation. The second is the labour of acquiring an adequate library of records of past occasions. Suitable records for some meteorological elements can be obtained for the past 100 years, or even longer. Conditions over the sea are undoubtedly important to long range forecasting, just as they are for the shorter forecasts and it is fortunate that mariners in the past recorded their observations of sea and air temperatures, pressure and wind. The sailors of the nineteenth century can hardly have guessed how much attention would be paid to their reports some sixty or more years later. Who knows what use will be made in 2000 A.D. of the meteorological observations recorded on ships today? Even a hundred years' data are less than we would like; in order that we may hope to find good analogues a much larger population to choose from is really required. Observations of some elements, such as upper air temperatures, are available for a mere 20 or so years, and there is little doubt that some of the essential features must be looked for in the upper air.

In spite of these difficulties the United Kingdom has developed a series of techniques for long range forecasting in which analogues play an important part. If justification is needed it can be found in the fact that a measure of success has been obtained from the techniques employed. Analogous years are selected in three different ways. Charts of the monthly mean temperature anomaly (which show the areas which are unusually warm or cold for the time of year) covering most of the northern hemisphere have been drawn for every month of each year back to 1881, and for a more limited area in the vicinity of the British Isles, back as far as 1761. The chart for the current month is matched against those for the same month in previous years and those showing a similar pattern of warm and cold regions are selected as analogues. If a good degree of resemblance is obtained it is reasonable to suppose that the distribution of warm and cold areas may have been brought about by somewhat similar developments in the analogue years.

In a very similar way monthly mean sea level pressure charts covering the northern hemisphere and going back to 1873 are compared with the current month's chart and analogues are selected. Charts showing the anomalies (the differences from the long period normal) are available to aid the selection, and for the months of January and July only a series of maps covering a smaller area have been drawn for the years as far back as 1750. A third method of matching is based on daily weather types over the British Isles. Over 33,000 charts have been classified as cyclonic, north-westerly or anticyclonic etc. to give a catalogue dating back to 1873. This is supplemented by another catalogue referring to London rather than the British Isles as a whole, which has been extended back (with some gaps) to 1723. The salient features of the sequence of weather types in the current month are assessed and the records are searched to find years in which the same month had a similar weather sequence, and which can therefore be used as analogues.

The selection of analogue years by all three methods is done subjectively by an experienced team of meteorologists. They are, however, assisted by having available objective selections made by computer. The objective matching of sequences of daily weather types (in which a shift of several days either way is allowed) has already reached the stage where it gives results comparable to the subjective selection, and it should soon be possible for this part of the work to be left to the computer. The matching of temperature anomaly patterns objectively is much more difficult, since more weight is put on the pattern than on the absolute values of the anomalies, but current work on this problem is very promising.

Each of the three methods of selection results in a list of five to ten possible analogue years. Some years may appear on all three lists, others on one only. A short list is compiled of the more promising years which show similarity on more than one count, and daily synoptic charts are then examined to compare the sequence of weather types over a wide area around the British Isles in these years with that in the current year. The poorer matches are rejected to leave a short list of about two to four acceptable analogues. The sequels in these years are then examined, but it is rare for them to be completely mutually consistent and so give an unambiguous indication for the forecast. A final conference is held to assess the relative merits of various analogues and at this stage a wide range of physical arguments is introduced.

Account is taken of anomalies of the state of the earth's surface. The extent and position of areas of warm or cold sea have a bearing on the wind circulation patterns. Because of the large heat capacity of water, sea temperatures change only slowly and anomalies tend to persist and thus have some predictive value. Regular measurements are made by ocean weather ships of the water temperature at various depths down to 150 fathoms, and a knowledge of these temperature profiles helps in the estimation of likely changes in surface temperature. The extent of the arctic ice may be important; a larger than usual cold source region is likely to have some effect on wind flow and temperature distribution in middle latitudes; so again we are dependent on reports from mariners. In winter, anomalies in the depth and extent of snow cover on land have to be taken into account similarly.

The recent behaviour of the surface and upper flow patterns and how they are likely to persist or change are discussed, and for this purpose sets of five-day mean charts are prepared, with the aid of the computer, to show for the previous month 500 mb contours, 1,000–500 mb thickness and surface isobars. These are supplemented by charts of the tracks of depressions and anticyclones. The weather at the beginning of the period in the analogue years is compared with the current short and medium range forecasts for the immediate future.

On the basis of all the evidence available the panel of meteorologists arrives at a coherent picture of the likely weather for the month ahead. The forecast that is issued will include a statement on whether the temperature for Great Britain as a whole for the period as a whole is expected to be much above, above, near, below or much below the average for the time of year. The limits chosen for these five classes are such that in the past each class occurred equally frequently. Rainfall has proved more difficult to forecast and the total rainfall expected for the month is given as one of three equally likely classes, namely above, near or below average. Sometimes the indications may be sufficiently clear to justify some subdivision of the area or period by the inclusion of phrases such as "rainfall is likely to be above average in the south-west and near average elsewhere" or "the month is expected to start cool and become warmer later." If the incidence of fog, frost, gales, snow etc. is expected to be notably different from usual some indication of this may be given.

The long range forecast for Great Britain and Northern Ireland is published by the Meteorological Office twice a month in the "Monthly Weather Survey and Prospects".* At the beginning to the month the document includes climatological information as to what can be expected if the month is an average one. The forecast indicates the ways in which it is expected that the month will differ from the average. In the middle of each month a new forecast is issued for the ensuing 30 days.

The statements that can be made in the forecasts are necessarily only rather general ones, referring for the most part to the month as a whole, certainly not to individual days. During the first ten months of issue three-quarters of the forecasts have proved to be in good or moderate agreement with the weather that occurred, but the remaining quarter was poor. Research into the difficult subject of long range forecasting is continuing, and as the existing techniques are improved and extended it is to be hoped that there may be some small improvement in the amount of detail that can be included and in the accuracy attained.

Editor's note. The long range forecast for the British Isles for October 1964, issued on 30th September 1964, is representative and reads as follows:

WEATHER PROSPECTS IN BRITAIN FOR OCTOBER 1964

Predominantly dry anticyclonic weather is expected to persist for much of the first three weeks of October with many mild, but some cold nights and occasional foggy nights and mornings. During this period any rainy intervals should be brief, but the latter part of the month is likely to become more stormy and unsettled especially in Scotland.

In all areas the rainfall for the month will probably be below average, and the mean monthly temperature is expected to be above the October average.

Beneath each long-range forecast appears the following note:

The statement on the prospects of weather in the coming month is regarded as a reasonable inference in the light of modern knowledge. The methods employed are experimental and liable to be changed. The confidence that can be placed upon the conclusions is consequently less than for forecasts of weather for a particular locality for short periods ahead.

551.507.2 : 551.508.4 : 311.214

The Measurement of Atmospheric Pressure at Sea

By W. R. Sparks

(Mr. Sparks is in the Instrument Development branch of the Meteorological Office.)

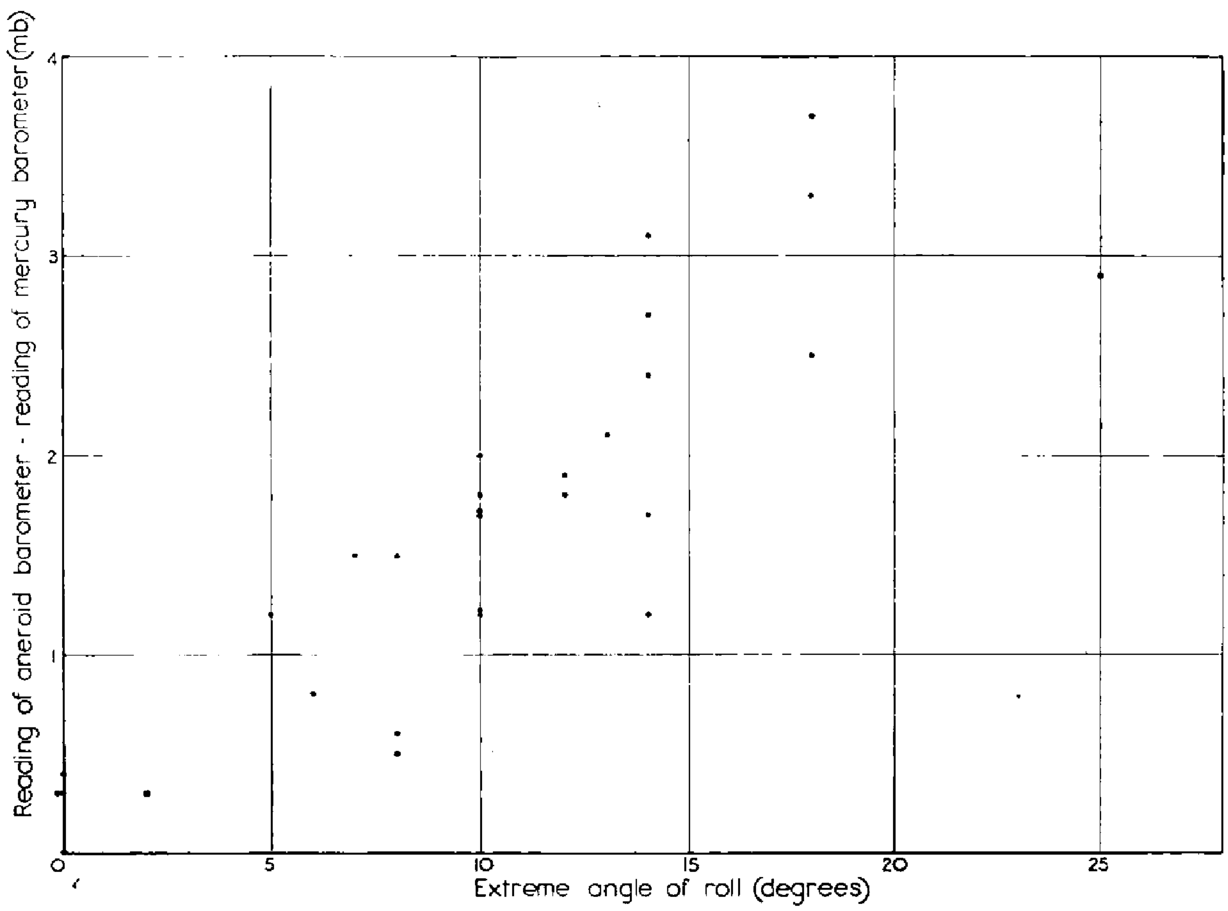
The instrument development branch of the Meteorological Office is investigating the causes and the magnitude of errors in the measurement of atmospheric pressure on ships at sea. The investigations are not yet completed, but some results of practical importance have already been obtained.

The causes of error can be conveniently grouped under two headings:

(*a*) The effect of the motion of the ship on the performance of the barometer.

(*b*) The 'exposure' error, i.e. the difference between the static pressure in the undisturbed airstream and the pressure at the point where the barometer is hung.

* Price 13/6 per year post free from Meteorological Office (MWS), London Road, Bracknell, Berks.



The effect of the motion of a ship on the performance of a barometer

The effect of the motion of a ship on the performance of a barometer depends upon the construction of the barometer and the method of mounting it in the ship.

Two types of instruments have been considered; the Kew type marine mercury barometer which is mounted in gimbals, and the precision aneroid barometer which has an anti-vibration mounting. (See *Marine Observer*, April 1962, for description.) Both types of barometer are subject to error if they are accelerated but an important difference in their response to accelerations arises from the method of damping used. Damping of mercury barometers is achieved by making part of the tube of very small bore. This system damps the response of the instrument to pressure changes and to acceleration changes. It is therefore the mean of the acceleration over a period of several minutes that may cause error in the reading of a mercury barometer. The response of the aneroid barometer to pressure changes is damped by restricting the flow of air in and out of the case; this does not damp the response of the instrument to acceleration changes. The barometer is protected from very rapid changes of acceleration by its anti-vibration mounting; but since the acceleration changes produced by movements of a ship are of low frequency any error in the instrument reading is proportional to the actual acceleration at the instant of reading and not the mean acceleration over a period of time. The sensing element of the precision aneroid barometer is a stack of three aneroid capsules fixed to the inside wall of a metal box and the instrument is only measurably affected by acceleration in the direction of the axis of the capsule stack, in that direction the sensitivity is approximately 1·6 mb per 'g'.

Almost all movements of a ship cause some acceleration of a barometer but the most serious effects are caused by vertical motion, pitch and roll.

Linear accelerations in the vertical, which depend to some extent on the position of the barometer in the ship, may be of the order of $\pm\frac{1}{2}$ g but the mean over a period of several minutes can never be large.

The effect of this acceleration on a mercury barometer is to cause 'pumping' of the mercury column. With vertical accelerations of $\pm\frac{1}{2}$ g pumping would be approximately $\pm 1{\cdot}5$ mb about the true mean pressure.

The precision aneroid barometer is mounted with the axis of the capsule stack horizontal so that vertical accelerations will not affect it unless the ship is pitching or rolling at the same time. In the extreme conditions of vertical accelerations of $\pm\frac{1}{2}$ g combined with a roll of 30° either side of vertical the aneroid will be subject to 'pumping' of approximately 1·4 mb about the true mean pressure.

Calculations of the effect on the readings of a mercury barometer of vertical accelerations when combined with pitching and rolling are rather complex, but it can be shown that the accelerations along the tube of a barometer mounted in gimbals do not average out to zero and that in some conditions the average acceleration can be sufficient to cause considerable error in the pressure readings.

This error cannot be detected by the observer, for the effect is to cause the mercury to pump about a mean pressure which is not the correct pressure.

Precise calculations have been made in two simplified sets of circumstances. Stokes[1] has calculated the error when a barometer swings in its gimbals relative to the vertical; for a standard Kew type marine barometer swinging 5° either side of the vertical the error is $+0{\cdot}9$ mb. Giblett[2] has calculated the error produced in the readings of a barometer hung in a ship which is rolling steadily with no other motion. He has shown that the error increases with the amplitude of the roll and the height of the barometer above the axis of roll and decreases with the period of the roll.

Giblett's calculations show that if a Kew barometer is mounted 50 ft above the axis of roll in a ship rolling 10° either side of the vertical with a period of 15 secs the error would be $-0{\cdot}6$ mb; if the angle of roll increased to 15° the error would become $-1{\cdot}3$ mb and if the period decreased to 10 secs with the roll returning to 10° the error would be $-2{\cdot}9$ mb.

The calculations of Stokes and Giblett have been verified by laboratory experiments, but they cannot be used in practice to determine corrections to be applied to marine barometers because the actual motion of a barometer in a ship at sea is far too complex.

The importance of the theoretical work is in demonstrating that the sort of accelerations received by a mercury barometer mounted in a ship can cause significant errors in its readings and in telling us which ship movements have the most effect.

Simultaneous readings of aneroid and mercury barometers were made daily over a period of several months aboard the British weather ships *Weather Watcher* and *Weather Observer*. These readings showed that the type of error suggested by Giblett does in fact occur.

The diagram shows the results obtained from one voyage of the *Weather Observer* (11.12.59–12.1.60). In spite of the scatter of the points it can be clearly seen that, as predicted by Giblett's theory, the difference between the barometers increases as the angle to which the ship's roll increases.

The scatter of the points is not really surprising when it is remembered that the error in the readings of the mercury barometer depends not only on the angle of roll but also in the period of roll, the angle and period of pitch and to some extent on the wave height.

Exposure error

In the previous section it has been assumed that the air pressure at this point where the barometer is hung is the atmospheric pressure that we want to measure. In some circumstances this may not be so.

The pressure that the barometer is measuring obviously varies as the ship rises and falls; this variation is easily dealt with by damping the response of the barometer to rapid pressure changes and no systematic error is introduced by doing that. Less easy to allow for are the variations of pressure produced by the ship's ventilation system and by the dynamic wind pressure.

The effect of a ship's forced ventilation system is so dependent on the design of the ship that almost nothing can be said about it in general except that the more powerful the system the larger the error is likely to be.

The error produced by natural ventilation is also dependent on the construction of the ship but is unlikely to be greater than the full dynamic pressure of the wind, which is $\frac{1}{2} \rho V^2$ where ρ is the density and V is the wind speed.

For a wind speed of 40 kt the dynamic pressure is about 2·4 mb. The measured pressure will be below atmospheric pressure if there is a door open on the lee side and above atmospheric pressure if there is an open door on the weather side.

Measurements of the exposure error have been made on board the British weather ship *Weather Adviser* by comparing the pressure given by a static pressure head, i.e. an open pipe connected to the casing of the barometer and led to a position high on the mainmast, with the pressure in the ship's meteorological office.

The meteorological office on the *Weather Adviser* is ventilated by an extractor fan and has two natural air vents. When the ship is at sea the fan is normally on and the vents are open, but in very rough weather the vent may be closed to prevent the ingress of water. During installation tests of the static head and pressure recorder, the pressure in the office, with the fan on, was found to be 0·4 mb below the outside pressure when both natural vents were open, 0·7 mb below when one vent was closed and 2·2 mb below when both vents were closed.

While the ship was at sea the vents were kept open and the pressure in the office was found to be 0·4 mb below the outside pressure in light winds, but fell to about 1·5 mb below the outside pressure when the wind speed increased to 40 kt. The pressure in the meteorological office depended not only on the wind speed, but also on the wind direction relative to the ship.

Conclusions

Most measurements of atmospheric pressure at sea are quite accurate, whether made with a mercury barometer or a good aneroid barometer. However, in bad weather measurements made with a mercury barometer are subject to error because of the motion of the ship and measurements made with either type of barometer are subject to 'exposure' error.

To determine the atmospheric pressure at sea with the greatest possible accuracy under all weather conditions measurements should be made with a good aneroid barometer which is sealed from the pressure in the ship and vented to a well equipped static pressure head.

A suitable aneroid barometer is already available,[3] and efforts are being made to design a reliable and rugged static pressure head.

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[1] Stokes, G. G. Min. Met. Coun., London, 14 March 1879.

[2] Giblett, M. A. The effect of the rolling of a ship on the readings of a Marine Mercury Barometer, Phil., MAE, London, 46, 1923, p. 707.

[3] L. B. Philpott and L. Bird. A new barometer for observing ships. *The Marine Observer*, Vol. XXXII, No. 196, April 1962.

(*Opposite page 32*)

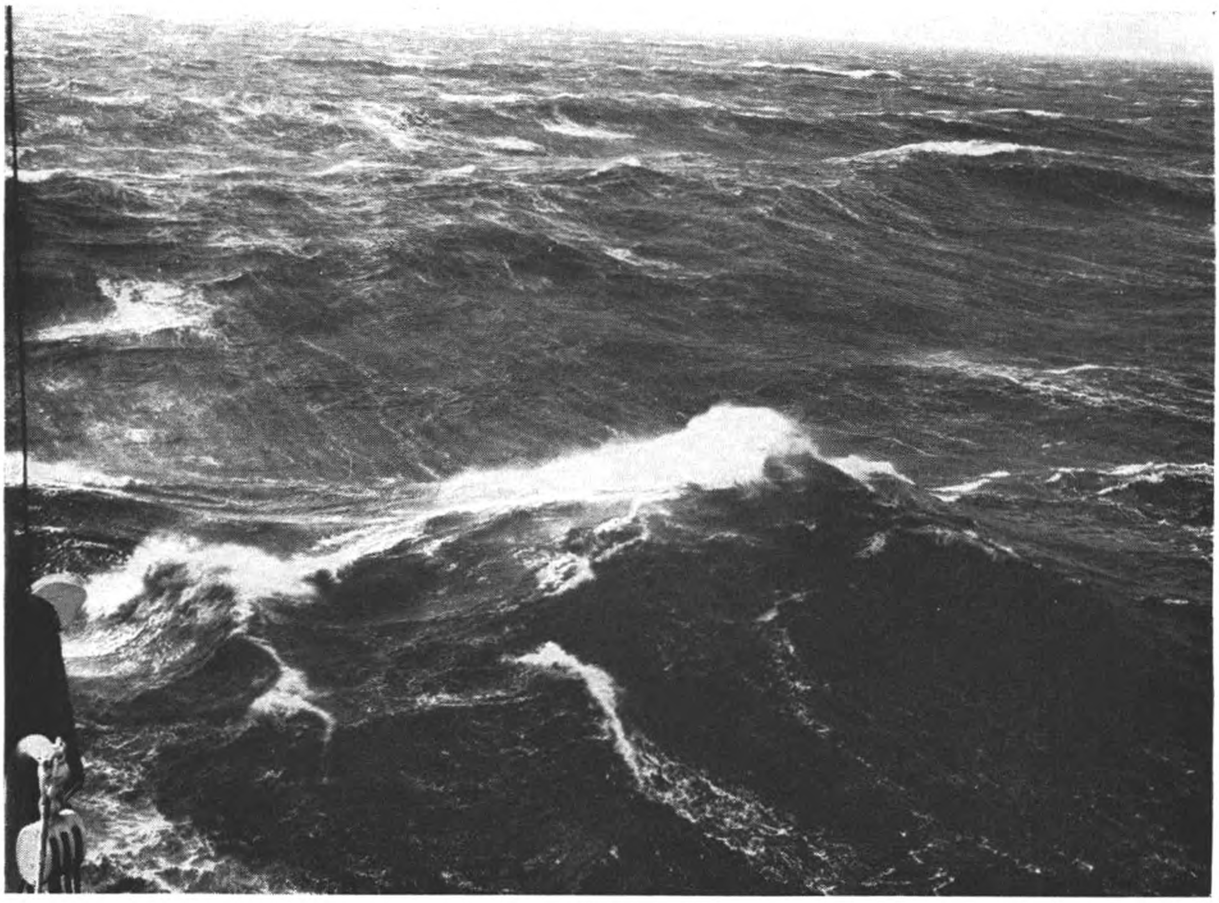

Fig. 1.

Fig. 2.

Photographs taken from H.M.T.S. *Monarch* showing state of sea in shallow water (*see* page 37).

(*Opposite page 33*)

Fig. 3.

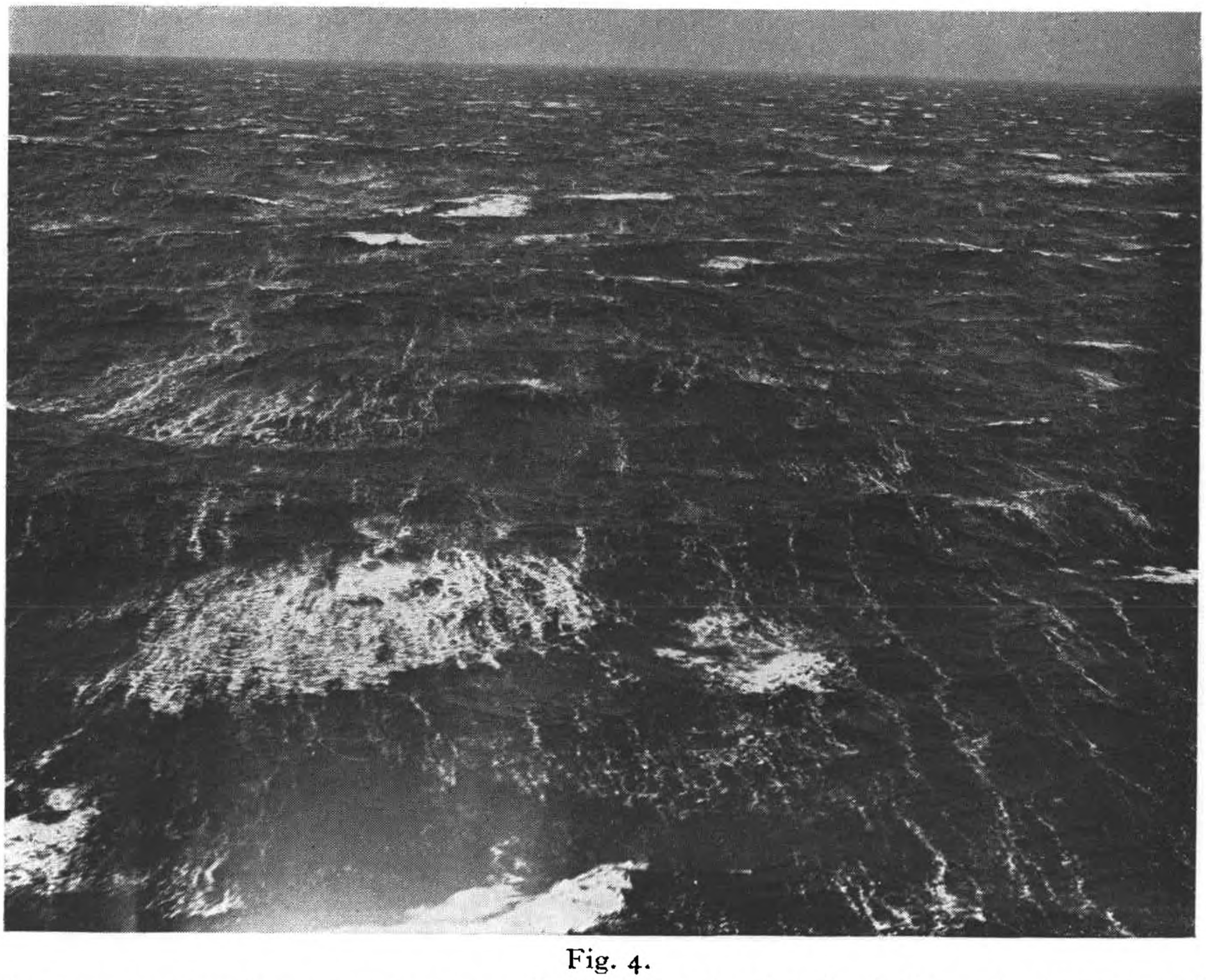

Fig. 4.

Photographs taken from H M.T.S. *Monarch* showing state of sea in shallow water (*see* page 37).

551.526.6: 551.556.8: 551.465.5: 551.465.63 (468.2)

Summer Sea Surface Temperatures at Gibraltar

BY B. RAMSEY

(Mr. Ramsey is Officer in Charge, East Africa Meteorological Department, Kenya Region)

Well known to all seafaring people are the strong and variable currents encountered in the Straits of Gibraltar. Not so well known perhaps are the great changes in sea surface temperature that result from the turbulent mixing produced by these currents. The following is a brief survey of temperatures taken during the months June to September inclusive for 1959, 1960 and 1961.

The readings, 574 in all, were taken on the frequent sea surface temperature 'runs' made by R.A.F. rescue launches to the three positions indicated around the Rock in Fig. 1. They are: E, east of the runway, S south of Europa Point light, and W to west of the runway. These positions will always be referred to in that order and the sea temperatures throughout are in °F. Temperatures were plotted together with the surface wind (either east or west) at midday at the middle of the airstrip, on the Control Tower. Also marked were the four-day periods from one day before, to three days after, the full or new moon, to indicate the times of strongest tidal streams at 'springs'.

There were 82 spells of either east or west winds of two days duration or less. These short-lived variations were often of light winds and it was often not possible to find temperature readings on consecutive days. Therefore, only east or west winds of three days or more duration were regarded as significant.

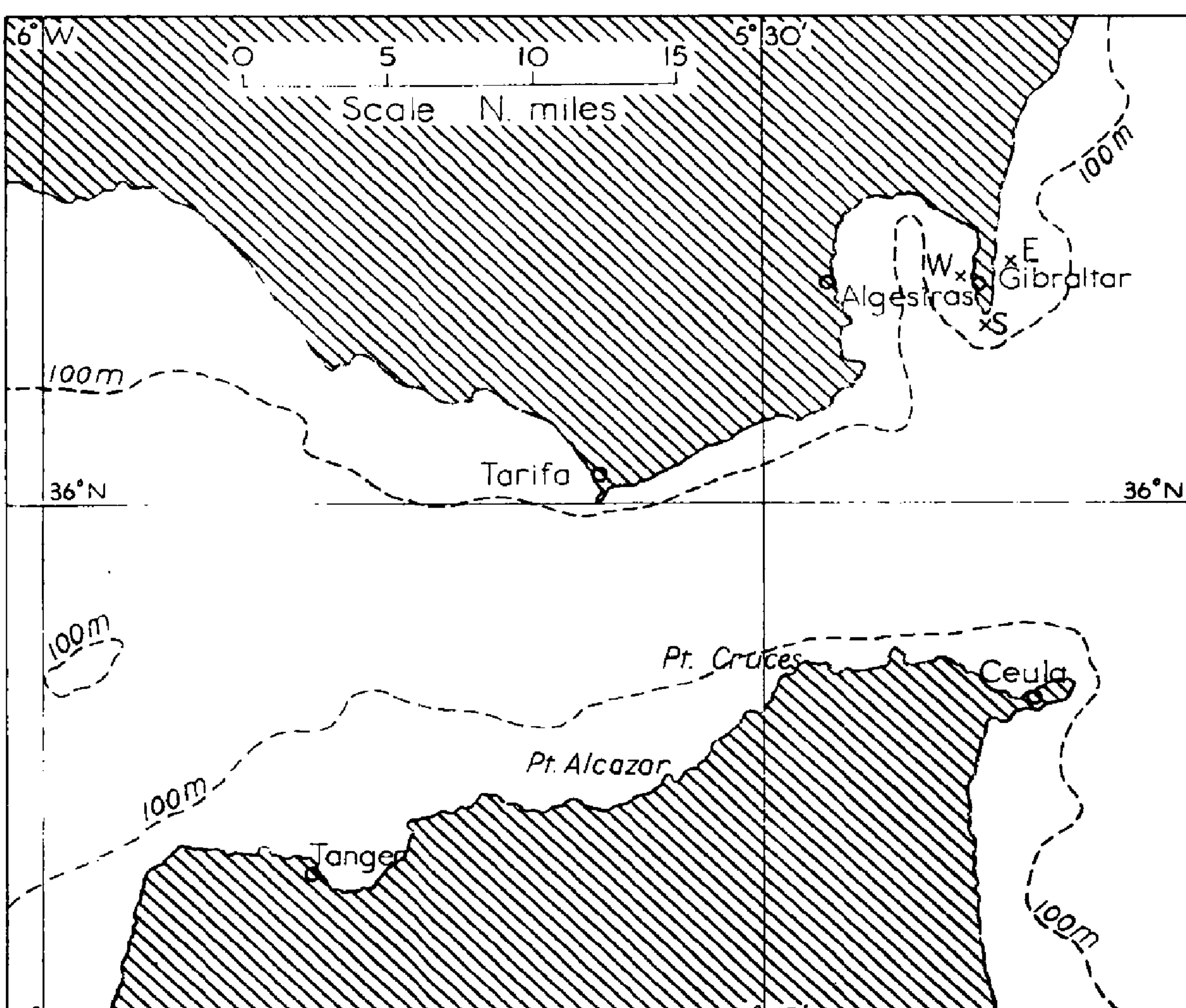

Fig. 1.

205 observations were made in east winds, 67 at E and 69 each at S and W. Average temperatures for the positions were 68·5°, 67·3° and 67·3° respectively, making an overall average of 67·7°F. What is termed the 'Rock' effect to the lee of the Rock, which will be mentioned again, was a lowering of temperature by 1·2°F at S and W.

87 observations were made in west winds, 29 at each position. The average temperatures were 64·9°, 64·8° and 66·1° respectively, the overall average being of 65·3°, or 2·4° lower than in east winds. The leeside 'Rock' effect, in this case at positions E and S, lowered temperatures again by 1·2°. Based purely on winds, the greatest change is at E, 3·6° colder with westerlies blowing.

To show the effect of stronger tidal streams, independently of wind, temperatures were averaged at each position at the beginning and the end of the Spring tide period mentioned above. These averages, again in order E, S and W were at the beginning 67·4°, 66·1° and 67·0°, an overall average of 66·8°. At the end of the period they were 66·0°, 65·5° and 65·9°, a decrease of 1·4° at E and an average cooling of 1·0°.

To add the wind effect to the tide, the temperatures were averaged at the same times but sub-divided according to wind direction. Although this gave an overall average of 65·9° at position E, S and W respectively, averages with east winds at the start of the four-day period were 68·8°, 67·5° and 67·5°, the lee 'Rock' effect at S and W being 1·3°. If winds remained east the averages at the end of Springs were 67·6°, 67·4° and 66·9°, an average cooling of only 0·6° although at E it was as great as 1·2°. There was a small 'Rock' effect of 0·7° at W due to continued east winds but a greater cooling at E due to the heavier tide partially overcoming the wind current.

If winds were west to begin with, averages were 65·3°, 65·2° and 65·7° giving a slight (0·4°) 'Rock' effect at E. However, persistent westerlies at Springs resulted in averages down to 62·6°, 62·1° and 64·3° respectively at the end of Springs—a marked 'Rock' effect being evident at E and S of 2·7° and 3·1° respectively when wind and tide were together.

When winds changed from east to west during Spring tides the falls in temperature at E, S and W average 6·2°, 5·5° and 3·2° respectively, again greatest at E. On the other hand, west winds changing to east gave increases of 2·3°, 2·2° and 1·8° respectively.

The greatest rise in temperature during the whole period under review occurred in September 1960. On the 7th, just after the end of a four-day westerly and at the end of a Spring tide period, temperatures at E, S and W were 61°, 60° and 62°. By the 14th, at the end of a spell of 10 to 16 kt easterlies during neap tides, the temperatures were 71°, 70° and 69°, increases of 10° at E and S and 7° at W. The greatest fall was from 29th August 1959, when at the end of a six-day spell of 15–25 kt easterlies, during neap tides, temperatures were 75°, 71° and 73°, to 6th September, when at the end of eight days of westerlies, and at the end of Spring tides, the temperatures reached 62°, 61° and 65° respectively!

The foregoing would seem to verify in figures the statement on Admiralty Chart No. 142 that "prolonged east winds may cause a reversal, at the surface, of this large east going current". Both Sverdrup[1] and Peluchon[2] note temperatures below the surface layer steady at about 55°F in the Straits. It is not surprising that currents of up to 4 or 6 kt create sufficient turbulent mixing to reduce temperatures so sharply.

Further evidence of the strong mixing and cooling produced by the general east-going Straits currents is shown by comparing the monthly average temperature at W with that in the open Atlantic west of the Straits. The deficit at W is, June 2·8°, July 4·8°, August 5·6° and September (when sea surface temperatures normally reach a maximum) 3·3°.

Low sea-surface temperatures resulted in rather frequent fogs in the area; 49 days of fog were noted during the period. All coincided with east winds and a favoured time of occurrence was with the change from west to east winds, when sea temperatures were lowest. Fogs also occurred during easterly winds, however, especially (twelve occasions out of seventeen) at Spring tides, when the stronger tidal streams undoubtedly overcame the wind drift from east. The remaining five occasions were in light east winds, when the tidal stream was stronger than the wind effect.

Fog was not reported with east winds over 13 kt. This may indicate the wind speed at which the wind current eliminated tidal effects and maintained higher water temperatures. In fact, it was noted that the longer strong east winds persisted, the clearer the weather became as sea temperatures approached normal Mediterranean values.

REFERENCES

[1] Sverdrup: Oceanography for Meteorologists.
[2] Peluchon: Travaux Oceanographiques de l'Origny à Gibraltar.

551.46.062.7 (261) : 551.46.07 (261

INTERNATIONAL ICE PATROL, 1964

(The following account has been received from the Commander, U.S. Coast Guard)

In accordance with the terms of the International Convention on Safety of Life at Sea, London, 1948, the International Ice Patrol was conducted in 1964 by the United States Coast Guard and was the 45th such patrol since 1913. After four successive light iceberg years, 1964 saw a return to normal as an estimated 369 bergs drifted south of 48°N compared to the annual average of 382 since 1900.

The Ice Patrol operated during the period 2nd March to 29th July in the vicinity of the Grand Banks of Newfoundland from its base at the U.S. Naval Station, Argentia, Newfoundland. For the fifth successive season and the 13th of the last 15 seasons the standby patrol vessels were not required.

For the first time the International Ice Patrol was operated by a unit permanently stationed at Argentia. Commander, International Ice Patrol was also Commanding Officer of the U.S. Coast Guard Air Station, Argentia, and U.S. Coast Guard Radio Station NIK, and so had, for the first time, operational and administrative control of all assigned aircraft and personnel, the ice operations office, and the radio station, thus making a more cohesive and effective organization than was possible before.

For the second consecutive year northern ice observation flights were conducted primarily to determine the likely Grand Banks iceberg situation for the coming ice season. An early iceberg survey was conducted 3rd–5th December 1963 along the Labrador and Baffin Island coasts to Cape Dyer, and a second survey was conducted on 27th–28th February from Newfoundland to Cape Chidley, the northern tip of Labrador. Both surveys indicated a greater supply of ice than was available for the 1963 ice season. It is planned to increase the scope of northern ice observation to include a systematic study of the iceberg problem from the source in Baffin Bay to termination at the Grand Banks. As data are annually accumulated, analysed and correlated with meteorological and oceanographic factors, iceberg forecasting should be considerably improved and the Ice Patrol operated more efficiently for the benefit of shipping.

The operations of the Ice Patrol from 2nd March to 29th July included:

(*a*) Ice Patrol aircraft conducted 42 ice reconnaissance flights for the main purpose of keeping a watch on the limits of ice in the vicinity of the Grand Banks and to determine the ice conditions there.

(*b*) Five oceanographic surveys were conducted between 15th March and 19th June for the purpose of collecting oceanographic information affecting the drift and deterioration of ice.

(*c*) A special iceberg drift and deterioration research project was conducted by the oceanographic vessel from 14th to 22nd May.

Although the coastal regions of eastern Newfoundland and the northern Grand Banks contained many bergs from early March to the end of June, the Tail of the

Banks had a relatively light ice year with no bergs drifting south of 43°N. An estimated total of 5 bergs crossed south of 44°N, all within a four-week period from early May to early June. Most important is the fact that the main U.S.–European shipping Tracks (B and C) when in use, remained ice free, although a major threat existed in April and a minor one existed during May and June. These threats did not materialise due to prevailing winds. The sea ice on the Grand Banks was slightly heavier and more extensive than normal.

The pre-season northern iceberg survey on 27th–28th February indicated that the Grand Banks potential was about ten times that of 1963, which was a very light berg year. Climatological conditions upstream along the Labrador Current on the east coasts of Labrador and Baffin Island were generally very favourable for ice drift south and for ice survival during December, January and February. As a result many bergs had drifted to a position about 200 miles north of the Grand Banks by 1st March. Three early bergs had already drifted on to the Grand Banks. There were an estimated 110 bergs south of Belle Isle, 350 from 52°N to 56°N and 410 from 56°N to Cape Chidley, Labrador—a total of about 870 bergs south of Cape Chidley.

The favourable weather conditions for ice survival and drift south persisted into March and April along northern Newfoundland and Labrador (strong cold north-westerly air flow) with the result that considerable ice was rapidly transported toward and on to the Grand Banks during this period. The prevailing winds drove the first wave of bergs out of the main branch of the Labrador Current toward and close along the east coast of Newfoundland and many were thereby prevented from being a threat to the main shipping lanes. Meanwhile, an estimated 88 bergs drifted south of 48°N during March making this the third heaviest March for bergs on record.

April was characterised by two distinct weather patterns with winds averaging strong west by south over the northern Grand Banks during the earlier part and strong northerly over the northern and western Grand Banks the rest of the month. Consequently many bergs located along the coast in early April were driven out to sea into the Labrador Current and drifted at average rates of 25 to 35 miles per day from the combined force of wind and current. By mid-April there were an estimated 300 bergs spread out from the coast to 300 miles eastward, mostly between 48°N and 49°N. Some bergs were driven east out of the Labrador Current to the area north of Flemish Cap. Due to an abrupt change in the weather pattern producing strong northerly winds, bergs were driven south about 130 miles in 11 days with the northern half of the Banks infested with bergs. An estimated 225 bergs drifted south of 48°N during April for a total of 316 for the year thus far. This was the greatest recorded number of bergs south of 48°N during March and April since 1945. By the end of April there were an estimated 275 bergs south of 48°N, only 20 of which remained in the main branch of the Labrador Current on the east slope of the Grand Banks.

Of major concern now were the 20 bergs in the Labrador Current only 200 miles from the Tail of the Banks. However, west-north-westerly winds in this area drove all 20 bergs to the south-east and out of the Current removing them permanently as a threat to Track B. These bergs rapidly deteriorated within 12 days as they entered warmer waters with a couple drifting east to 45° 30′W before perishing. Only a few bergs remained in position west of the Current to re-enter and continue drifting toward the Tail of the Banks. From early May to early June a handful of these bergs did re-enter the Current and five of these managed to drift south of 44°N before deteriorating but none drifted south of 43°N. The deterioration of the many other bergs further west on the Grand Banks was comparatively slow due to abnormally low sea temperatures. Many of these bergs were a threat to ships plying Canadian ports via tracks E and F and ships en route to or from the St. Lawrence Seaway.

Much attention was directed to a group of about 200 bergs located close ashore from Cape Bonavista to 51°N in mid-May. As west-south-westerly winds soon arrived these bergs began to move into the Labrador Current and out to sea along the northern Grand Banks with the leaders reaching the north-east slope by the end of June. As winds averaged south-westerly in June bergs tended to drift east out of the Current and failed to achieve any significant southern drift. By mid-June the deterioration of bergs in this area was exceeding the supply and it was obvious that only a minor threat to Track C existed. One berg managed to reach 45° 45′N, 47° 10′W and a growler was reported 70 miles further south-west in mid-July. This was the southernmost penetration since early June and for the remainder of the year. While no threat developed to Track C, Track F was pestered by a few bergs until late July with one berg persisting until early August. After the deterioration of the latter berg no other bergs were expected to reach the Grand Banks the remainder of the year. While the number of bergs drifting south of 48°N was very heavy during March and April, the May total of 19 was very light and the June and July totals of 28 and 5 were well below normal.

Sea ice conditions on the Grand Banks were about normal on 1st March with local and Labrador winter ice covering the northern Grand Banks north of 47° 20′N and west of 48° 20′W. The sea ice limits generally followed the weather patterns. By mid-March the east limits receded to west of 51°W while the south-west limits expanded to 100 miles south-east of Cape Race. As a result of strong south-westerly winds in the first half of April the south sea-ice limits receded to north of 48°N while a 10–20 mile belt of sea-ice extended about 170 miles to the south-east from the pack at 49° 30′N, 50°W. By the end of April the east limits receded to west of 50°W. Sea-ice persisted along the east coast of Newfoundland from St. John's northward until mid-May and in Notre Dame Bay until the third week of June. Belle Isle Strait was considered navigable by mid-June.

The Gulf of St. Lawrence including Cabot Strait and the North-east Arm experienced a slightly heavier than normal ice year. The steamer track through Cabot Strait and the Central Gulf and into upper St. Lawrence River was not declared navigable until 5th April, although ships were getting through with ice-breaker assistance throughout the winter. Sea-ice persisted along Cape Breton until mid-May.

Ship reports of ice and weather in the Grand Banks area were an indispensable source of ice information and oceanographic and meteorological data which assisted International Ice Patrol in determining ice conditions and disseminating pertinent ice information to shipping.

Annually after termination of the International Ice Patrol and until commencement the following year, ships are requested to transmit ice reports to the U.S. Naval Oceanographic Office, Washington, D.C., for further dissemination. U.S. Coast Guard Radio Station (NJN), Argentia, will be available for relay of ice reports and also for transmission of safety broadcasts when unseasonable ice threatens shipping lanes near the Grand Banks. A permanent nucleus of the International Ice Patrol Office will perform ice observation as advisable after ice patrol terminates and prior to commencement the next year. A plot of ice reports on the Grand Banks and vicinity will be maintained year round and ship requests for ice information will be answered via NJN.

In addition to ice reports, all ships are urged to make regular four-hourly reports to Radio Station NIK during the ice season when between latitudes 39°N and 49°N and longitudes 42°W and 60°W, including ship's position, course, speed, visibility, sea temperature and wind. The importance of these reports cannot be overemphasised. The visibility reports are of considerable value in planning ice observation flights. Sea temperatures are used to construct isotherm charts employed in estimating ice deterioration and detecting shifts in the branches of the Labrador Current. Wind data are useful in estimating set and drift of ice and in forecasting weather for the purpose of planning ice observation flights. When reporting icebergs, ships are requested to include the shape and estimate of size. The berg description is required to identify and track individual bergs and also to estimate their deterioration.

An up-to-date plot is maintained for all reporting ships. These ships can be warned directly when approaching dangerous ice.

The International Ice Patrol will again commence full services about 1st March 1965, depending on ice conditions at the time. Details of the times of broadcasts and frequencies used were published in *The Marine Observer*, January 1964, page 41, and are also contained in *The Admiralty List of Radio Signals*, Vol. 5, p. 84.

STATE OF SEA PHOTOGRAPHS

The 'State of Sea' card Met.O. 688, which gives photographs of the open sea corresponding to each number on the Beaufort wind scale, is undoubtedly well known in all voluntary observing ships. In the October 1963 number of *The Marine Observer* a request was made for similar photographs taken in coastal waters which, apart from their interest to all mariners, would be particularly useful to yachtsmen and coastwise shipping.

Between pages 32 and 33 we publish four photographs taken from H.M.T.S. *Monarch*, Captain O. R. Bates, a Selected Ship, in November 1963 whilst she was working in shallow water off the north German coast. Details of the photographs are as follows:

No. 1. Taken during the forenoon of 18th November 1963 in 53° 12'N, 4° 29'E (Terschelling Bank Lt.-V. bearing 037°, 8 miles). Wind SW by W 45 kt (force 9). Depth of water 15 fathoms. Nearest land Texel, 12 miles to the ESEward. Nearest land to windward, north Kent coast distant about 160 miles. Photograph taken up-wind.

No. 2. Taken on 19th November 1963 in 53° 42'N, 6° 30'E (Borkum Riff Lt.-V. bearing 288°, 16 miles). Wind SW by W 42–45 kt (force 9). Depth of water 8 fathoms. Nearest land, Borkum, 9 miles to the SEward. Nearest land to windward, the low lying islands of Ameland and Terschelling but the nearest land to windward which would break the wind would again be the Kent coast, now distant about 250 miles. Photo taken up-wind which had been blowing at this strength for about one hour.

No. 3. Taken 20th November 1963 in 53° 47'N, 7° 05'E (Nordeney Lt.-V. bearing 031°, 9 miles). Wind NNW 35 kt (force 8). Depth of water 10 fathoms. Nearest land, Nordeney 5 miles to the SSEward. No land to windward for several hundred miles. Taken up-wind which had been blowing at this strength for about 20 hours.

No. 4. Taken 21st November 1963 in 53° 46'N, 6° 48'W (Nordeney Lt.-V. bearing 060°, 18 miles). Wind SW by S 45 kt (force 9). Depth of water 10 fathoms. Nearest land, around the River Ems Estuary about 16 miles to the SSEward. Nearest land to windward, the north German coast distant about 26 miles. Taken up-wind.

In comparing these photographs with those for similar wind strength on the 'State of Sea Card' it will be noticed that the actual appearance of the sea surface differs very little except that the waves engendered in shallow water are less pronounced.

The effect of the tidal stream on the appearance of the sea surface should be borne in mind. Unfortunately, with the exception of No. 4 which was taken at 1320 GMT, about the time of high water at Dover, when the east-going stream would be turning to the westward and consequently weak, the times of taking the photographs were not recorded.

We shall hope to receive photographs of shallow seas under the influence of winds of other strengths from observers as and when opportunity offers. If the photo is taken in tidal waters it will be helpful if the time (GMT) and the estimated strength and direction of the tide be given—or the time alone is given so that we can work out the tide. After their publication in *The Marine Observer* it is probable that requests will be received for their publication in other journals. Against such an eventuality, it would be very much appreciated if observers would, in their covering letter, state their willingness to surrender the copyright of their photographs to the Crown. This is largely a formality but if it is not done it means that every time we receive a request for the publication of a photograph in another journal, we have to ask permission from the original photographer. Unhappily we rapidly lose touch with many officers and after the lapse of years it may be impossible to trace them. When this happens, if the Crown does not hold the copyright, the photograph may not legitimately be reproduced.

L. B. P.

551.326.7 (261)

NOTES ON ICE CONDITIONS IN AREAS ADJACENT TO THE NORTH ATLANTIC OCEAN FROM JULY TO SEPTEMBER 1964

JULY

Relevant Weather Factors. Atmospheric pressure was on average below normal from Baffin Bay to Western Europe and over the Polar Basin. There was great cyclonic activity over this area with pressures on average 11 mb below normal in the latter half of July. By the middle of the month almost everywhere experienced above zero temperatures, although the general level of surface atmospheric temperatures over the Polar Basin was 4°C below normal over considerable areas.

Canadian Arctic Archipelago including Baffin Bay, Hudson Bay and Hudson Strait. The break-up of ice developed rapidly everywhere except in Hudson Bay and Foxe Basin. The area of open water in Baffin Bay generally and in the connecting waterways of the islands of the far North was greatly in excess of normal.

Davis Strait and Labrador Sea. The great mass of ice off South-East Baffin Island occupying half the width of the Strait was slow to clear. South of 65°N sea temperatures were above normal and all coastal pack-ice dispersed. Small numbers of icebergs (less than 20 at a sighting) were observed on both the Greenland and Labrador coasts.

Belle Isle Strait. The Strait was free of pack-ice throughout the month; numerous icebergs existed in the entrance and in the approaches west of 50°W. The southerly drift of icebergs was concentrated approximately along the 53°W Meridian. (See Table 1.)

Great Bank and East Newfoundland Coast. The whole of this area remained free of pack-ice. Scattered bergs were distributed over the whole area north of 47°N while isolated bergs penetrated south of 45°N over the eastern side of the Great Bank.

Greenland Sea. The area of arctic pack off eastern Greenland was slightly in excess of normal but the west coast of Spitsbergen was free of ice.

Denmark Strait. The area of arctic pack south of Scoresby Sound was greatly in excess of normal throughout the month. At times this abnormally large area of pack approached within 20 to 50 miles of North-west Iceland. To the south, however, the extent of the pack-ice against the Greenland Coast was normal. Sea temperatures over most of the Strait were considerably above normal. Due west of Iceland sea temperatures were up to 6°C above normal.

Barents Sea. Sea temperatures appeared to be 2° to 5°C above normal generally. To the north the arctic pack retreated substantially. Most of the south-east coasts of Spitsbergen were ice free. There was no pack-ice within 150 miles of Bear Island. The White Sea and all coastal regions of the south-east Barents Sea were ice free. This is a normal situation.

AUGUST

Relevant Weather Factors. Conditions were dominated by a large area of abnormally high pressure over Greenland and adjacent areas of Canada, the Polar Basin and the Greenland Sea. Sea temperatures in the Norwegian Sea and southern Barents Sea reached between 6° and 9°C which is above the average of the last three years.

Canadian Arctic Archipelago, Baffin Bay, Hudson Bay and Strait. The break-up of ice continued rapidly everywhere including among the islands of the north and north-east. Hudson Bay and most of Baffin Bay were clear of ice apart from isolated icebergs. Heavy pack-ice persisted in Foxe Basin and among the islands of the north-west. Seasonal changes were developing rapidly after a slow start to the 'break-up'. Conditions were about normal.

Davis Strait and Labrador Sea. Sea temperatures in the south were above 5°C. The great mass of fast- and pack-ice off the south-east of Baffin Island broke up moving away towards the west Greenland Coast. Towards the end of August ice that had persisted off Baffin Island for some years broke away. The resulting ice situation was again approximately normal but there was evidence from bergs sighted later off Belle Isle and from aerial reconnaissances of abnormally large numbers of icebergs in small groups (less than 10 at a sighting) drifting southwards off the Labrador Coast. Off the West Coast of Greenland small numbers of bergs only were reported (except off Disko Island). Individual land stations reported less than 15 icebergs drifting northwards off the coast.

Belle Isle Strait, Great Bank, and East Newfoundland Coast. Throughout the month the whole of this area was free of pack-ice but icebergs were widely distributed over a large area west of 50°W, covering the northern half of the Great Bank and approaches to Belle Isle with some penetrating Belle Isle Strait into the Gulf of St. Lawrence.

Greenland Sea and Denmark Strait. During August the area of arctic pack- and winter pack-ice decreased but the resulting situation differed little from normal. The northward penetration of Atlantic water towards the Greenland Sea appeared to cause mixing with Arctic water on a very large scale. The abnormal situation south-east and south of Scoresby Sound returned slowly to normal.

Barents Sea. No evidence of any abnormality.

SEPTEMBER

Relevant Weather Factors. The conditions of August persisted but with the area of high pressure slowly subsiding and the abnormally warm water of the Barents Sea being gradually replaced by the seasonal southward movement of Arctic water.

Canadian Arctic Archipelago, Baffin Bay, Hudson Bay, Hudson Strait, Davis Strait and Labrador Sea. The situation with regard to pack-ice remained essentially normal. Distributed over a very large area off Baffin Isle, over the whole of Hudson Strait, and off the Labrador Coast were many groups of up to 20 icebergs. Off the Belle Isle Strait up to 29 icebergs at a single sighting were reported while bergs penetrated into the Gulf of St. Lawrence.

Great Bank and East Newfoundland Coast. Scattered bergs remained over the Great Bank north of 49°N. Otherwise the area was free of ice.

Table 1. Icebergs sighted by merchant ships in the North Atlantic

(This does not include growlers or radar targets)

LIMITS OF LATITUDE AND LONGITUDE		DEGREES NORTH AND WEST								
		60	58	56	54	52	50	48	46	44
Number of bergs reported south of limit	JULY	*	> 754	> 753	> 712	> 329	> 167	> 31	1	0
	AUGUST	*	*	> 149	> 147	67	10	1	0	0
	SEPT.	*	*	31	29	18	2	1	0	0
	Total	*	*	> 933	> 888	> 414	> 179	> 33	1	0
Number of bergs reported east of limit	JULY	> 754	> 751	> 715	> 554	> 396	> 115	> 59	12	0
	AUGUST	*	> 149	> 137	77	41	8	7	0	0
	SEPT.	31	30	27	10	1	0	0	0	0
	Total	*	> 930	> 879	> 641	> 438	> 123	> 66	12	0
Extreme southern limit	JULY	45° 45′N, 47° 10′W on 12.7.64								
	AUGUST	47° 59′N, 46° 14′W on 9.8.64								
	SEPT.	47° 19′N, 59° 40′W on 30.9.64								
Extreme eastern limit	JULY	49° 20′N, 44° 28′W on 4.7.64								
	AUGUST	47° 59′N, 46° 14′W on 9. 8. 64								
	SEPT.	50° 05′N, 50° 05′W on 9.9.64								

* Probably large numbers, but none sighted in excess of those reported in further south positions or in further east positions.

> ('greater than') has been inserted where there is some doubt as to the actual number of icebergs at some of the sightings, but the true value is probably greater than the value given.

Greenland Sea. Atlantic water east of 5°E penetrated to 81°N flowing round the north of Spitsbergen. There was very little fast-ice off East Greenland but the area of heavy arctic pack extending almost to 5°W north of 75°N was considerably in excess of normal. A narrow belt of this arctic pack extending out about 100 miles from the coast moved southwards to south of Scoresby Sound. The large mixing zone between Atlantic and Arctic water continued in the Greenland Sea. Most of the waters around Spitsbergen and Bear Island were ice free. Only on the north-east side of Spitsbergen was arctic pack apparent.

Denmark Strait. At the end of September the whole of this area was ice free. Individual land stations reported up to 15 icebergs and growlers moving south-westwards off the coast.

Barents Sea. The arctic pack moved southwards off East Spitsbergen east of 25°E but there was little ice south of 77°N. Ice also appeared to be moving southwards off the coast of Novaya Zemlya. Sea temperatures in the south of the Barents Sea remained high with large areas with temperatures more than 5°C.

G. A. T.

A REPLY TO MANY LETTERS

Everyone who regularly goes to sea realises the advantage of a knowledge of the weather that is likely to occur in the next few hours, and some merchant ships are now 'weather routed' to take advantage of the information obtained from the various meteorological services. Many people ashore may not realise how much weather information comes from merchant ships. The British Meteorological Office, in particular, needs observations from the sea—especially from the Atlantic—so that weather systems can be located; their intensity, direction and rate of movement can be judged and their future activities can be forecast. Without ship observation we should know virtually nothing of the approaching weather until it reached our shores and the unfortunate areas in the west of the country would very rarely get a forecast at all. It is as a small token of our appreciation of the time spent and care taken over the observations that awards are made each year for the 100 best-kept logbooks received during the year and we have received many letters from Captains, Observing Officers and Radio Officers in reply to a letter notifying them of their award and requesting an address to which we can forward it. Many writers said that they were glad to be of use in this way and hoped to continue the good work in the future. One writer says, "it is very pleasing to know that all our reports are appreciated and used, although we wonder about the latter after seeing the weather reports that we receive for our area"—the reports are certainly appreciated, and if the forecast is wrong it is probably because some system changed direction unexpectedly, and, of course, the forecaster gets the blame! A writer says that making the observations is an interesting way of spending some of the time on long passages, and a radio officer suggested that the messages "with the groups of figures that someone kept leaving in the Radio-room" were a scheme for playing Bingo by radio! A number of writers mention the 'team effort' that resulted in the logbook winning an award; one mentions the keenness of the radio officer who was willing to transmit reports when off duty and another tells of enthusiasm aroused by a captain experienced in meteorological work. We can't reply individually to all the letters that we have received, but would like to say "Thank you", through *The Marine Observer*, for the letters we have received and to everyone who has helped in making and transmitting observations for us.

C. E. A.

Book Reviews

Sea Fishing for Pleasure and Profit, by R. C. O'Farrell. $5\frac{3}{4} \times 8\frac{3}{4}$ in. pp. 122. *Illus.* Fishing News (Books) Ltd., London, 1964. 21*s.*

Today, though more and more people are taking to boats and small craft in their leisure hours, comparatively few are yet aware of the virtually unlimited riches which lie beneath the surface of the sea on which they take their pleasure. Mr. O'Farrell, retired from the Army at an early age as a result of a riding accident, found that his inbred love of the sea and small boats led him to adopt the profession of inshore fisherman where, though he found that the going was tough and results at times very poor he feels justified in regarding himself as "the richest man I know".

This book is largely autobiographical and he tells us, in nine admirably written chapters, how, from the buying of a small yawl in which with his mother as crew he set out to explore the possibilities of fishing the coastline, he ultimately, though not without hardship and many setbacks, found not only pleasure but good solid profit from sea fishing. He describes methods of catching different species of fish, the five boats which he has built or has had built to his specification, three of which were too small and one of which was too clumsy, the equipment needed and the various markets he has found for his catch. Agreeably mixed with the wealth of information which he gives covering all aspects of fishing, he writes of some of the rugged characters he worked with and from whom he learned the job. In the chapter "Many Ways of Catching Fish" he goes back into history and shows that some methods have changed but little in application since pre-historic times. As for the future, your reviewer was particularly glad to read "with world population growing at its present rate, the time will undoubtedly come when we shall have to harvest the oceans in real earnest", for this is a point which we have persistently emphasised since, at the request of the National Institute of Oceanography, we asked voluntary observing ships to record the incidence of discoloured water during their voyages and whenever possible to send in a specimen of the same for analysis, as a means to this end.

"Some are Weatherwise, some are otherwise", said Benjamin Franklin. Surprisingly for an inshore fisherman, Mr. O'Farrell apparently belongs to the latter class for he says "I have never felt particularly friendly towards the barometer and it seldom enters into my calculations . . . though I must say that on a few occasions when the bottom suddenly fell out of it, it gave us an hour or two to retrieve our gear". Perhaps he listened overmuch to his first mentor, an Irishman named Twm who, when asked for a forecast, invariably replied "That's God's business. Let's be after taking what He sends". . . . "And we did", says the author. But he is wise enough to remark about the old rhymes (Red sky at night etc.) that "what they portend can vary from district to district".

This is a wholly readable book and though few deep-sea sailormen will be able to put its tenets into practice, it will undoubtedly form the basis of many an agreeable pipe dream and lead to a greater appreciation of yet another of the many sides of the profession of the sea.

L. B. P.

Descriptive Physical Oceanography, by G. L. Pickard, M.A., D.Phil. 7¾ in. × 5¼ in. pp. 194. *Illus.* Pergamon Press, London, 1964. 25*s.*

This is a valuable introduction to descriptive oceanography and gives the background of that part of the subject which corresponds in meteorology to air mass analysis.

It gives the reader the tools for water mass analysis which is quite as fundamental to oceanography as the concept of air mass is to meteorology. Convective exchanges in the oceans have to take place from the surface downwards and as water is so much more viscous than the atmosphere some of the deep water masses can exist undisturbed for centuries. There are therefore considerable differences in the time scales of fluctuation and exchange in the oceans from those in the atmosphere. Dr. Pickard in this small book has given a very simple and readable account of the methods and materials of analysis, condensed from a huge mass of basic literature.

The introductory chapter gives brief notes on the history of oceanography. This includes a discussion of the terms 'synoptic' or 'descriptive' oceanography. These terms apparently correspond with the 'climatological' sub-division of meteorology. One wonders what the oceanographers will call a truly synoptic oceanographical chart or map.

Chapter 2 gives the physical dimensions and the geological structure of the ocean bottom which allows the reader to get the oceans into a true 'perspective'. The magnitude of the great deeps and the extent of continental shelves are all described. For example the great 11,000 metres of the Marianas Trench is compared with the 8,840 metres of Mount Everest.

The magnitudes of physical and chemical parameters measured instrumentally are given in chapter 3. The magnitudes of density, temperature and salinity are given with some indication of their importance in the analysis of the oceanic circulation. The complex nature of what the oceanographer understands as salinity, its relationship to chlorinity and electrical conductivity are explained with the limitations of the latter in the rapid and accurate measurement of salinity. These techniques require an accuracy of measurement quite beyond that used by meteorologists. It is also pointed out how valuable are other characteristics of the sea like the oxygen content, the colour, and the diffraction of sound waves in investigating the oceanic current circulations at all depths.

Chapter 4 summarises the results of thousands of observations giving the world-wide distribution of the characteristics of the oceans, and their variation with time. For example it is shown diagrammatically that there is on average a maximum of temperature, and minima of density and salinity, at the equator, but salinity maxima only, in the two tropical zones of the oceans. It is shown that the surface temperatures and salinities are influenced by the weather, ocean currents and the vertical exchanges within the ocean. The oxygen content of the sea is an important tracer element for detecting the age of a water mass but minimum values in the upper 1000 metres in the equatorial Atlantic and eastern Pacific are not yet fully understood.

Chapter 5 shows how conservation principles may be applied to the sea. For example the conservation of salt can be used to analyse the flow in estuaries. Conservation of heat energy can also be applied to the oceans. The greater part of the chapter contains heat budget equations with parameters and measurements familiar to meteorologists. Instruments, physical and chemical measurements and oceanographic diagrams are described in chapter 6. The descriptions of instruments are efficient and brief but more diagrams and photographs with some of the associated techniques would have been helpful. The techniques associated with oceanographical diagrams for the study of oceanic circulations are more fully discussed.

Chapter 7 augmented by chapters 8 and 9 is the heart of the book. It is difficult to do justice to them in a review, so much is covered, including the results of much recent work, analysis and thinking that one has to read the chapters with greatest care to absorb all the details. The very significant role of arctic water masses and their convergences are explained with the three-dimensional exchanges within the oceans. Included also are brief accounts of sea ice and the oceanic jet stream—the Cromwell current.

The book does not have a very durable cover which started to disintegrate while being read by the reviewer. It would help the reader if references to figures were given with the appropriate page number. A fuller bibliography would be helpful particularly if references to classical works were put at the end of each chapter.

I can recommend this book to mariners and scientists requiring a concise account of modern oceanography, as a preparation for more advanced studies.

G. A. T.

Personalities

OBITUARY.—We regret to report the tragic death of CAPTAIN F. W. GRIST on board m.v. *Woodford* in the Northern Philippine port of Aparri on 18th July 1964.

Frank William Grist was born in Pangbourne in 1904 and first went to sea as an apprentice with Turner Brightman & Co. in 1920. From 1924 he served with various shipping firms until 1928 when he joined Watts Watts as 2nd officer in the *Twyford.* From 1935 to 1943 he served with Blue Star Line after which he rejoined Watts Watts. He was appointed to his first command, the *Chertsey*, in 1945 and had been in command of all the Watts Watts ships until his untimely death, caused by a shooting incident.

Captain Grists' association with the Meteorological Office goes back to 1937 when he sent in his first logbook from the *Tudor Star.* In 13 years observing he submitted 24 logbooks 13 of which were classed as 'excellent' and he received excellent awards in 1937, 1952, 1958 and 1959.

Captain Grist was a bachelor and we offer our sympathy to his near relatives.

J. C. M.

OBITUARY.—We regret to record the sudden death of Captain P. R. Legg, M.B.E., at the early age of 48. He died at his home at Tynemouth on 30th October 1964. Captain Legg had been the Meteorological Office Merchant Navy Agent in the Tyne area since June 1955.

Philip Roland Legg served his apprenticeship with Headlam & Son of Whitby and then joined the Ellerman Lines as a junior officer, serving with them in all grades to Master.

During most of the Second World War his ship was employed on the strenuous run between the Humber and Sweden. For his meritorious service he was awarded the M.B.E.

He came ashore in 1948 to join F. B. West & Co., cargo surveyors of Newcastle-on-Tyne, and in 1955 became senior partner of the firm on the death of the founder Captain West.

We offer our sincere sympathy to his widow and two sons.

A. D. W.

RETIREMENT.—COMMODORE A. HOCKEN, completed his last voyage to sea on 11th August 1964 when he sailed into London in s.s. *Ruahine.*

Albert Hocken was born in Kelowna, British Columbia, in 1903 and commenced his sea-going career as an apprentice with the New Zealand Shipping Company in 1919. He was appointed fourth officer in 1923 and was appointed to his first command, the *Tekoa* in 1942 subsequently commanding *Samkey*, one of the first 'Sam' ships, *Empire Windrush, Devon, Otaki, Durham, Otaio, Rangitoto* and finally *Ruahine.*

On 15th June 1963 he was appointed Commodore of the combined New Zealand Shipping Company and Federal Line fleets.

During the Second World War, at the height of the U-boat campaign, Commodore Hocken, when in command of the *Tekoa*, performed a meritorious rescue service. In a North Atlantic convoy in March 1943, 12 of the ships were sunk by U-boats; there was no rescue ship in the convoy, but the *Tekoa*, although in grave danger of attack stood by for four hours to pick up 146 survivors from two ships sunk close by.

Commodore Hocken's association with the Metorological Office dates back to 1928 and in 25 years he has sent 52 logbooks 43 were classed as 'excellent' and he received Excellent Awards in 1951, 1956, 1957, 1959, 1961, 1962, 1963 and 1964.

We wish him health and happiness in his retirement in Australia.

J. C. M.

RETIREMENT.—CAPTAIN L. H. HOWARD, R.D., retired as Commodore of the P. & O. Orient Line when he brought the *Himalaya* into London in August last.

Leonard Henry Howard received his early training at the Nautical College Pangbourne from whence he passed out as Probationary Midshipman RNR and did his first naval training as such in H.M.S. *Orion*. He completed the requisite sea-time as a Cadet in the P. & O. and passed for Second Mate in 1925. He joined the *Nankin* as 4th officer the same year.

Captain Howard passed for Master in 1935 and continued in the service of the P. & O. Company until his retirement. His first command in the Company was the *Socotra*.

During the Second World War he commanded various of H.M. ships, the first one being the *Embroise Peree*, a former French gun boat and he finished the war in command of Tank Landing Ships.

Captain Howard's association with the Meteorological Office goes back to 1934 when he sent us his first meteorological logbook from the *Rawalpindi*. In eleven observing years he sent us 25 meteorological logbooks, seven of which received the excellent classification.

We wish him health and happiness in his retirement.

L. B. P.

RETIREMENT.—CAPTAIN WILLIAM PHILLIPS, Commodore Master of the Hain S.S. Co., is now retiring after 44 years of service with the same shipping company. He first went to sea as a Cadet in the Hain S.S. Co.'s vessel *Pruth* in 1920 and attained his first command with the company in 1950 when he was appointed Master of their s.s. *Trevelyan*.

Captain Phillips endured the hardships of life at sea during the last World War in full, he was serving in the m.v. *Jeypore* when she was sunk by torpedo attack in the Indian Ocean, and as Chief Officer of m.v. *Bihar* was taken prisoner by the Japanese when this vessel was sunk by Japanese cruisers in the Java sea in 1943. He was held a prisoner of war from 1943 until the cessation of hostilities.

Captain Phillips' association with the Meteorological Office commenced in 1949 when he was in the *Tresilian*. He has in all sent us ten meteorological logbooks, eight of which have been assessed 'excellent'. He received Excellent Awards in 1963 and 1964.

We wish him good health and happiness in his retirement.

F. G. C. J.

Notices to Marine Observers

RADIO WEATHER MESSAGES THROUGH BRAZILIAN STATIONS

As from 1st November 1964 Rio radio and other Brazilian coastal stations have allocated 10-minute periods after each synoptic hour especially for the reception of ships radio weather messages.

The periods are: 0010–0020, 0610–0620, 1210–1220 and 1810–1820. Messages should be prefixed OBS to ensure their reception.

RADIO WEATHER BULLETINS AND FACSIMILE TRANSMISSIONS

The table overleaf is intended to show in convenient chronological form, for the benefit of ships crossing the Atlantic, all the radio weather bulletins for shipping issued from the U.K. (G.P.O. and B.B.C.) and the main oceanic ones issued by the U.S.A. Suitable facsimile transmissions both from the U.K. and U.S.A. are included in the same table.

Map on which Based	Facsimile Transmission and Type of Map			Coastal B.B.C. Bulletin	Coastal G.P.O. Bulletin	N. Atlantic Bulletin
0000	U.K.	U.S.A.				
		0130	Sea level prognosis (30 hr.)	0645–0650		
		0244	Wave analysis			0730 (Forecast-U.S.A.)
		0306	Wave prognosis		0803 (R.T.) }*	
	0435		Sea level prognosis		0833 (R.T.) }	
	0513		Sea level analysis		0830 (W.T.) }*	
		0708	Sea level analysis		0848 (W.T.) }	
		1004	Sea level prognosis (24 hr.)			0930 (W.T.)* (U.K.)
0600	1035		Sea level prognosis	1155–1200		1130 (W.T.) (Coded analysis-U.K.)
	1113		Sea level analysis	(Sundays)		
		1450	Wave analysis	1355–1400		1230 (coded analysis-U.S.A.)
		1512	Wave prognosis			
1200		1344	Sea level prognosis (30 hr.)	1758–1800		
	1535 (1635 in	winter)	Sea level prognosis		2003 (R.T.) }*	1930 (Forecast-U.S.A.)
	1713		Sea level analysis		2033 (R.T.) }	
		1914	Sea level analysis		2030 (W.T.) }*	
		2210	Sea level prognosis (24 hr.)		2048 (W.T.) }	2130 (W.T.)* (U.K.)
1800	2235		Sea level prognosis			0035 (Warnings and coded analysis U.S.A.)
	2313		Sea level analysis	0202–0207		

* 24 hr. forecast at these times

Notes. (1) About 600 observations are plotted on a main chart.
(2) The latest available chart is also consulted before the forecast is issued.
(3) All forecasts need to leave the Meteorological Office about 1 hr. before being broadcast.
(4) Times of B.B.C. broadcasts are all clock time.

Fleet Lists

Corrections to the lists published in the July 1964 and October 1964 numbers of *The Marine Observer*

GREAT BRITAIN (Information dated 21.10.64)

The following vessels have been recruited as Supplementary Ships:

Name of Vessel	Date of Recruitment	Skipper	Observer/ Wireless Operator	Owner/Manager
St. Dominic ..	16.9.64	S. Sparks ..	K. Massey ..	Thomas Hamling & Co.
St. Giles ..	10.6.64	T. Sawyer ..	R. Gill ..	Thomas Hamling & Co.
St. Matthew ..	3.6.64	P. E. Craven	D. L. Verity	St. Andrews Steam Fishing Co. Ltd.
Stella Leonis ..	16.9.64	R. Waller ..	R. Laing ..	Charleston Smith Trawlers Co. Ltd.
Stella Orion ..	2.7.64	G. Whur ..	A. Ramsay ..	Charleston Smith Trawlers Co. Ltd.

The following coasting vessels (Marid Ships) have been recruited:

Name of Vessel	Captain	Owner/Manager
Gaelic Ferry	J. C. Cowie..	Atlantic Steam Nav. Co. Ltd.
Killingholm	W. J. Mair	Shell Mex & B.P. Ltd.
Treviscoe	H. S. Shugar	Channel Shipping Ltd.

The following vessels have been deleted:
Bolton Abbey, Cormead, Loch Mor, Mountstewart, May, Woodwren, Yewarch.
The following skippers and radio operators have been added to the Trawler Fleet List

Skipper	Radio Operator	Trawler Owner-Manager
T. Chearman	C. Knagg	Kingston Steam Trawling Co. Ltd.
W. Fry	C. Knagg	Kingston Steam Trawling Co. Ltd.
W. March	J. Black	Hellyer Bros., Ltd.
A. Osler	R. T. Murphy	Kingston Steam Trawling Co. Ltd.
E. Revell	A. J. Nettleship	Hellyer Bros. Ltd.

Great Britain (contd.)

The following ships have been recruited as Selected Ships:

Name of Vessel	Date of Recruitment	Captain	Observing Officers	Senior Radio Officer	Owner/Manager
Benarmin	3.4.64	J. G. Harvey	N. A. Ross, E. P. Anderton, I. A. Hamilton	T. Shannon	Ben Line
Cape Howe	25.5.64	P. Smith	C. McLean, P. Cooney, T. Readman	W. Bryce	Lyle Shipping Co., Ltd.
Crystal Crown	15.5.64	L. B. Fleming	B. E. Evans, D. Roberts, J. K. Appleton	B. Kelly	Sugar Line
Crystal Diamond	28.5.64	V. Charles	S. Bayman, D. Thomson, R. M. Pitts		Sugar Line
Crystal Gem	14.4.64	R. M. Hall	D. E. Mawhinney, P. Harry, G. Spencer	E. C. Burke	Sugar Line
Crystal Sapphire	2.6.64	S. Correll	D. Mercer, R. Bristow, M. Rushbroom	P. Sitine	Sugar Line
Geestbay	31.8.64	D. G. Powell	J. Milner, O. Springett, H. de Villiers	D. Tunnicliffe	Geest Industries Ltd.
Halifax City	8.9.64	W. Stoodley	K. Miller, N. Childs, P. Hickling	A. Baker	Bristol City Line
Hinea	17.9.64	W. F. Thompson	R. G. Brown, T. Storey, R. Allen		Shell Tankers (U.K.) Ltd.
Ivernia	28.4.64	K. D. A. Lamb	E. J. Walpole, R. Wadsworth, G. Coker	M. G. Maclean	Cunard Line
Kinpurnie Castle	11.5.64	H. D. T. Lockyer	I. McKendrick, J. S. Catterall, W. F. Sutherland	D. Morris	Union Castle Line
Manchester Renown	15.10.64	W. E. G. Oliver	D. Martin, S. Bashford, J. Illingworth	K. Lancashire	Manchester Liners
Photina	25.5.64	R. J. Freeman	J. W. Spence, W. H. Seekirk, J. B. Baker	K. T. Jones	Stag Line
Port Sydney	29.4.64	L. J. Skailes	A. L. Macaskill, J. Burtt, K. F. Speirs	L. V. O'Sullivan	Port Line
Port Wimbledon	2.9.64	E. W. Pierce	D. Freestone, P. Fletcher, A. Cameron		Watts, Watts & Co., Ltd.
Silkworth	4.9.64	N. Thompson	R. Henson, W. Beattie, S. A. Ajmal		R. S. Dalgliesh, Ltd.
Sir Lancelot	27.5.64	E. C. Plowman	L. D. Wood, E. A. Oram, J. Cork	W. Duguid	British India Line
Sugar Refiner	12.10.64	J. R. Cassidy	J. P. B. Clark, R. Edwards, V. R. Gibbson	B. Kenny	Sugar Line
Staffordshire	18.9.64	T. Cooper	C. R. Tiller, S. R. Dyer, R. Weir, M. Case	G. Hopwood	Bibby Line

The following ships have been deleted:
Ajana, Athelsultan, Australian Star, British General, British Cygnet, Debrett, Devis, Dryden, Empress of Britain, Great City, Hubert, Isaac Carter, Martand, Monarch, Nordic, Port Fairy, Royal Crown, Runa, Sacramento, Sanguity, Wendover.

BRITISH COMMONWEALTH

AUSTRALIA (Information dated 1.10.64)

Centaur (A. Holt & Co.) has been recruited as a Selected Ship
Mittagong (Australian National Line) has been recruited as a Supplementary Ship
Selected Ship *Nardana* has been renamed *Baradine*
The following vessels have been deleted:
Charon, Gorgon, Koorawatha, Trienza

CANADA (Information dated 9.9.64)

The following vessel has been recruited as a Selected Ship:
Silvia (Saguenay Shipping Ltd., Montreal) (Agents)
The following vessels have been recruited as Supplementary Ships:
Gosforth (Federal Commerce and Navigation) (Agents)
Thorscarrier (A. S. Thor Dahl, Sandefjord, Norway)
The following vessel has been deleted:
C.C.G.C. *Relay*
Canada has 27 Ocean-going Auxiliary Ships and 31 Auxiliary Ships operating on the Great Lakes.

HONG KONG (Information dated 9.10.64)

The following vessels have been recruited as Selected Ships:
Cape St. Mary (Fisheries Research Station, Hong Kong)
George Anson (Jebsen & Co. Ltd.)
Hoi Kung (K. Larssen & Co. Ltd.)
Tai Lung Shan (Shun Cheong S.N. Co. Ltd.)
Tai Po Loy (Shun Cheong S.N. Co. Ltd.)
The following vessels have been deleted:
Fengning, Heinrich Jessen, Henrik, Hervar and *Funing*

INDIA (Information dated 19.10.64)

The following vessels have been recruited as Selected Ships:
Dumra (British India S.S. Co. Ltd.)
Jalaganga (Scindia S.N. Co. Ltd.)
*Indian Security** (India S.S. Co. Ltd.)
*Indian Success** (India S.S. Co. Ltd.)
*State of Bihar** (Shipping Corporation of India Ltd.)
*State of Maharashtra** (Shipping Corporation of India Ltd.)
* Previously a Supplementary Ship.

The following vessels have been recruited as Supplementary Ships:
Jag Ratna (Great Eastern Shipping Co. Ltd.)
Jag Kranti (Great Eastern Shipping Co. Ltd.)
Jalgouri (Scindia S.N. Co. Ltd.)
Jalagomati (Scindia S.N. Co. Ltd.)
Jalduta (Scindia S.N. Co. Ltd.)
Jag Laadki (Great Eastern Shipping Co. Ltd.)

The following vessels have been deleted:
Daressa, Umaria, Nalanda, Subadar, Jag Rani

MALAYSIA (Information dated 16.10.64)

Cable Enterprise (Cable and Wireless Ltd., Singapore) has been recruited as a Selected Ship
Recorder has been deleted

PAKISTAN (Information dated 14.10.64)

Ocean Energy (AQVB) has been recruited as a Supplementary Ship

Printed in England for Her Majesty's Stationery Office by
William Clowes and Sons Ltd., London and Beccles

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Meteorological Office (Marine Division) Atlases

The following are published by the Marine Division of the Meteorological Office and may be purchased from the bookshops of Her Majesty's Stationery Office at any of the addresses on the title page. Copies are available for reference by shipmasters and shipowners in the offices of Port Meteorological Officers.

Meteorological Atlases

Monthly Meteorological Charts of the Atlantic Ocean. Met.O.483, 1948, reprinted 1959. (60°S–70°N, 80°W–40°E) (19½″×24″) £9 (£9 3*s.* 3*d.*)

Monthly Meteorological Charts of the Western Pacific. Met.O.484, 1945, reprinted 1956. (60°S–60°N, 100°E–155°W) (16¾″×23¾″) £5 5*s.* (£5 2*s.* 9*d.*)

Monthly Meteorological Charts of the Eastern Pacific. Met.O.518, 1950, reprinted 1956; further reprint in the press. (60°S–60°N, 160°W–60°W) (17½″×24½″) £7 7*s.* (£7 3*s.* 3*d.*)

Monthly Meteorological Charts of the Indian Ocean. Met.O.519, 1949, reprinted 1959. (50°S–30°N, 20°E–120°E) (16½″×22½″) £6 6*s.* (£6 2*s.* 9*d.*)

The above four atlases contain monthly charts of wind, barometric pressure, air and sea temperature, and other meteorological elements including some typical tracks of tropical revolving storms.

Monthly Sea Surface Temperatures and Surface Current Circulation of the Japan Sea and Adjacent Waters. M.O.M.447, 1950. (20°N–47°N, 110°E–150°E) (20″×17″) 7*s.* 6*d.* (8*s.* 3*d.*)

Monthly Sea Surface Temperatures of Australian and New Zealand Waters. Met.O.516, 1949. (50°S–10°S, 100°E–180°E) (19¾″×12¼″) 10*s.* (10*s.* 7*d.*)

Monthly Sea Surface Temperatures of the North Atlantic. Met.O.527, 1949, reprinted 1950. (30°N–68°N, 80°W–15°E) (19¾″×12¼″) 10*s.* (10*s.* 7*d.*)

Monthly Meteorological Charts and Sea Surface Current Chart of the Greenland and Barents Seas. Met.O.575, 1959. (60°N–80°N, 30°W–120°E) £6 6*s.* (£6 8*s.*)

This atlas contains a generalised surface current chart for the area and monthly charts of wind, barometric pressure, air and sea temperature, and other meteorological elements.

Current Atlases

Currents of the Indian Ocean. Met.O.392, 1939, reprinted 1963. (50°S–30°N, 20°E–140°E) (22″×34″) 12*s.* 6*d.* (13*s.* 4*d.*)

South Pacific Ocean Currents. Met.O.435, 1938, reprinted 1959; new edition in the press. (60°S–0°, 140°E–70°W) (22″×34″) 12*s.* 6*d.* (13*s.* 6*d.*)

The above two atlases contain quarterly "current arrow" and "current rose" charts.

Quarterly Surface Current Charts of the Atlantic Ocean. Met.O.466, 1945, reprinted 1962. (60°S–70°N, 80°W–20°E) (22½″×18″) 32*s.* 6*d.* (34*s.*)

Quarterly Surface Current Charts of the Western North Pacific Ocean with monthly chartlets of the China Seas. Met.O.485, 1949, reprinted 1962. (0°–60°N, 98°E–160°W) (21″×16″) 35*s.* (36*s.* 2*d.*)

Quarterly Surface Current Charts of the Eastern North Pacific. Met.O.655, 1959. (0°–60°N, 160°W–65°W) (23″×17″) 15*s.* (15*s.* 10*d.*)

The above three atlases contain current rose charts, predominant current charts and vector mean current charts.

Ice Atlases

Monthly Ice Charts of the Arctic Seas. M.O.M.390a, 1944. (60°N–80°N, 80°W–110°E) (12″×7″) 3*s.* 6*d.* (3*s.* 11*d.*)

Polar ice, mean limits of sea ice, extreme limits of sea ice, extreme limits of bergs.

Monthly Ice Charts of the Western North Atlantic. Met.O.478, 1946. (37°N–53°N, 72°W–35°W) (12″×7½″) 4*s.* (4*s.* 7*d.*)

Mean limits of pack, extreme limits of pack, mean limits of bergs, extreme limits of bergs.

Climatological Charts

Climatological and Sea-Surface Current Charts of the North Atlantic Ocean. Met.O.615, 1958, reprinted 1964. (5°S–60°N, 100°W–40°E) (40″×25″, folded to 13″×8″) 41*s.* the set (42*s.* 3*d.*)

One chart for each month, based on information in Met.O.483, Met.O.466 and Met.O.478 (above).

Prices in brackets include postage

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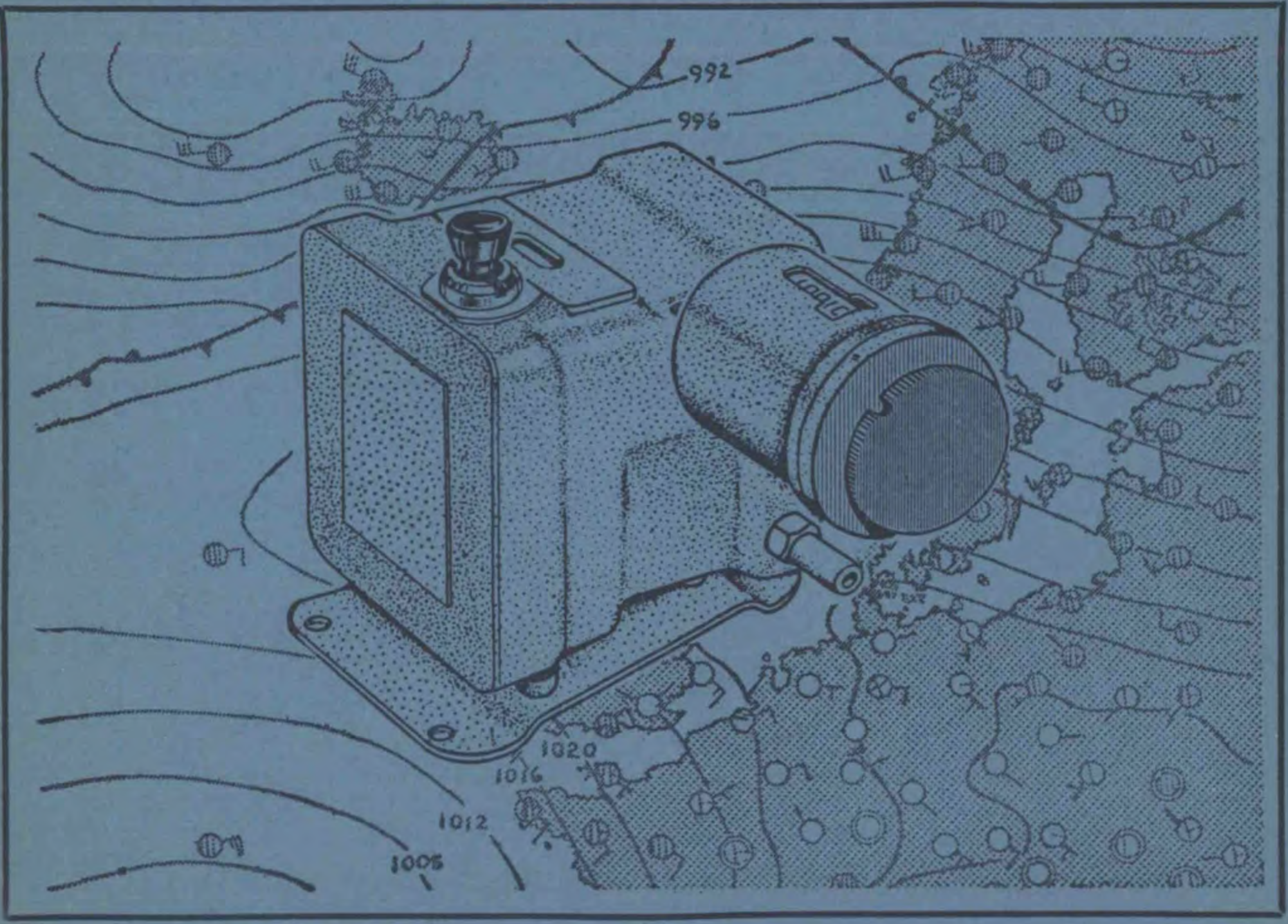

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