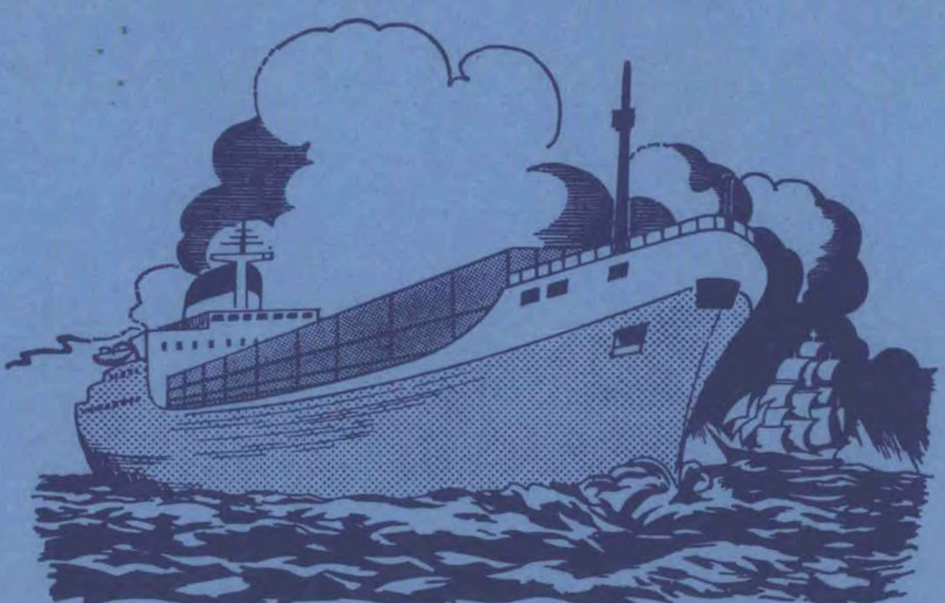
Met. O. 966

The Marine Observer

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

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CONTENTS

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Editorial

A king sat on a rocky brow
Which looks o'er sea-born Salamis;
And ships, by thousands, lay below,
And men in nations; all were his!
He counted them at break of day—
And when the sun set, where were they?

From *Don Juan*
By George Gordon, Lord Byron

Although the sun seems to be setting on so many ships of today's British merchant marine, those ships have at least not suffered the same fate as the defeated Persian fleet at the battle of Salamis in 480 BC, when Athenian ships under the command of Themistocles halted the invasion of Greece so bravely. But there appears little doubt about the continuing inexorable decline in numbers of ships under the red ensign.

The Meteorological Office has been fortunate to experience a lesser depletion in the size of the Voluntary Observing Fleet, though a serious decline nonetheless; however, a noticeable upturn in numbers has occurred since the low of 1982 was reached. In that year the fleet consisted of 499 vessels, including supplementary, coasting and fishing craft as well as selected ships and light-vessels. This was a large reduction from the 1974 high of 670 which is unlikely to be repeated; but by broadening the front from which Port Meteorological Officers at home and abroad can encourage new recruits to undertake weather observing, the fleet has continued to flourish. Thus the June 1985 total of 505 vessels includes not only commercial ships trading world-wide, but also supply and support ships, ferries, oceanographic and other research vessels, cable layers, oil rigs and platforms.

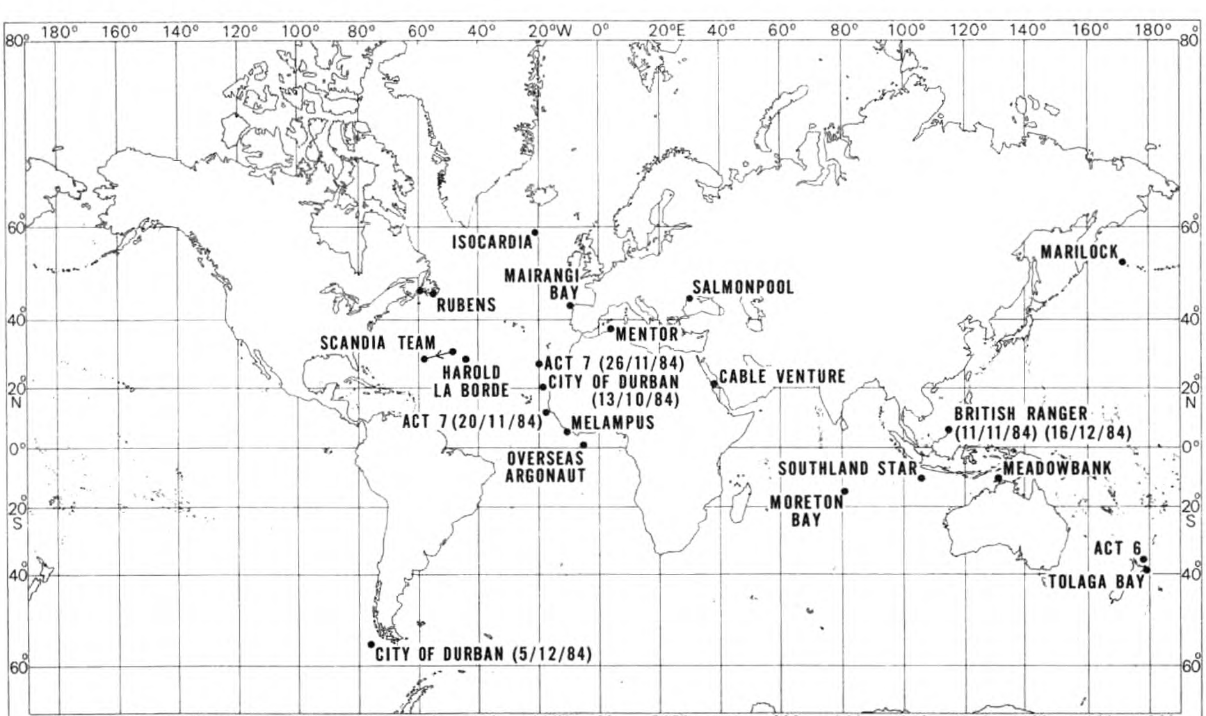
Advances in the scope of observations include the successful trial of the Automated Shipboard Aerological Programme (ASAP) conducted aboard the *C.P. Ambassador* between June and December 1984. During six transatlantic round voyages from Montreal to Felixstowe and Le Havre lasting four weeks each, the Masters and Officers willingly co-operated with the scientists launching radio-sonde balloons from the purpose-built container placed on the after deck of the container ship. Trials were also held on the French container ship the *Fort Fleur d'Epée* of CGM on two voyages between France and the Antilles in April, May and June 1984. ASAP experiments were also carried out in the German research vessel *Meteor* from July to November 1984, based in the eastern North Atlantic. Following the initiative by Canada and the United States in starting up a prototype ASAP system in 1982 aboard the m.v. *Friendship* on North Pacific voyages, an ASAP Co-ordinating Committee is to be set up at the World Meteorological Organisation to discuss future implementation of the project; the WMO representative from Finland is also seeking to co-operate with the UK Meteorological Office in a joint trial using a British ship.

Whilst talking of the future, interesting events from the past may be of passing amusement. We recently received a ship's meteorological logbook in the office 20 years after it was mailed. On 17 May 1984 there arrived in the Marine Division a parcel containing a log from the m.v. *Kista Dan*. The data were a little too old for assessment as they had been compiled in the Antarctic between January and February 1964. Logs are occasionally received after delays of up to 12 months, but the 20-year interval in this case was at first a mystery. Inside the front cover of the log from the *Kista Dan* was a letter from the head of the Met. Office in the Falkland Islands, giving instructions for its transit to the Met. Office in Bracknell. There was also a fine photograph of the ship in the ice field, with measuring and camera equipment in the foreground. We will never know why the logbook was delayed on its journey to Bracknell, but it had been received at the British Antarctic Survey office in Cambridge and lain there until a package of archivable weather records was transferred to Bracknell by agreement in 1984.

The *Kista Dan* was built in 1952, recruited as a weather observer in November 1960 and carried out observing in the Antarctic until 1964. Our next contact with her was after she had been renamed *Benjamin Bowring* prior to her departure on the Transglobe Expedition, in 1979. It was a strange coincidence that the *Kista Dan's* historic log reached us just as awards in the form of Sir Ranulph Fiennes' book about the Transglobe Expedition, *To the Ends of the Earth*, were being despatched.

Every meteorological logbook received from ships of the UK Voluntary Observing Fleet since the first observer joined in 1855, and several earlier ones, repose in the archives of the Met. Office at Eastern Road, Bracknell. Although records of ships and the Officers who observe in them are kept as accurately as possible, without more help from the ships' staff concerned, we remain lacking in respect of many Discharge Book numbers. For this reason, there is included in 'Notices to Marine Observers' later in this edition, a plea for Masters to ensure that all Officers' Discharge Book numbers are always completed inside the back page of the logbook. These will help us to identify certain Officers with similar names and further efforts to issue Excellent Awards to the correct deserving individuals.

J.F.T.H.



Position of ships whose reports appear in *The Marine Observers' Log*

October, November, December

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.

Observing officers are reminded that preserved samples of discoloured water, luminescent water, etc. considerably enhance the value of such an observation. Port Meteorological Officers in the UK will supply instructions on how to preserve and pack such samples on request.

PASSAGE OF HURRICANE 'LILI'

North Atlantic Ocean

m.v. *Scandia Team*. Captain R. MacKenzie. Suez to U.S. Gulf. Observers: the Master and ship's company.

19–21 December 1984. Between these dates, the vessel encountered a storm. The ship's speed was reduced to 11 knots by the weather and the following information has been extracted from the ship's deck log book. All times are in GMT.

19 December, 0700: Wind sw'w, force 5, barometric pressure 1006·6 mb, air temperature 22·5 °C. Vessel rolling and pitching to moderate seas and heavy s'ly swell. Spraying to port. Cloudy/overcast, fine and clear. 1100: Wind sw'w, force 4–5, pressure 1007.0 mb temperature 23.0. Vessel pitching and rolling to moderate beam sea and heavy swell. Spraying to port, mainly overcast and fine, clear.

1500: Wind sw's, force 5, pressure 1006·9 mb temperature 23·0. Position, 31° 10′N, 49° 04′W. Moderate bow sea, heavy swell, vessel rolling and pitching, spraying heavily for'ard. Cloudy, fine and clear.

1900: Wind s'w, force 6, pressure 1002·8 mb, temperature 22·5. Vessel rolling and pitching moderately to rough beam sea and heavy, confused swell. Occasional showers, cloudy/overcast and clear.

2300: Wind s'w, force 6–7, pressure 1003·5 mb, temperature 21·0. Vessel pitching and rolling moderately to rough beam sea and heavy swell. Spraying to port. Mainly overcast with frequent passing showers.

20 December, 0100: Wind sw's, force 7–8, pressure 1002·6 mb, temperature 21·0.

0200: Wind sw, force 8, pressure 1001·7 mb, temperature 21·0.

0300: Wind sw, force 8, pressure 1001·0 mb, temperature 21·0. Rough sea, heavy swell. Vessel rolling and pitching moderately. Spraying heavily for'ard. Mainly overcast with heavy rain showers.

0400: Wind sw, force 8, pressure 1000·1 mb, temperature 21·2.

0500: Wind sw's, force 8–9, pressure 998·9 mb, temperature 21·2.

0600: Wind SSE, force 9, pressure 997·2 mb, temperature 21·6.

0700: Wind SSE, force 9–10, pressure 995·3 mb, temperature 21·6. Vessel rolling and pitching heavily to rough seas and heavy, confused swell. Spraying heavily over-all. Frequent showers with continuous rain latterly.

0800: Wind s'w, force 9, pressure 992·8 mb, temperature 21·5.

0900: Wind s, 9–10, pressure 988·3 mb, temperature 21·5.

1000: Wind SSW, force 9–10, pressure 985·2 mb, temperature 21·5.

1100: Wind w's, force 9–10, pressure 979·5 mb, temperature 21·0. Vessel pitching and rolling heavily to very rough head sea and heavy, confused w'ly swells. Spraying heavily over-all and shipping occasional seas on deck. Overcast with continuous rain and squalls.

1200: Wind w's, force 11, pressure 982·1 mb, temperature 20·5.

1300: Wind NW, force 12, pressure 984·4 mb, temperature 20·0.

1400: Wind NW'N, force 12, pressure 988·3 mb, temperature 20·0.

1500: Wind NNW, force 12, pressure 992·3 mb, temperature 20·0. Position, 30° 29'N, 52° 58'W. Very rough beam sea, heavy, confused swell. Shipping heavy seas to starboard and spraying heavily over-all. Overcast throughout with line-squalls and showers. Moderate visibility.

1600: Wind NW'W, force 11, pressure 996·3 mb, temperature 22·0.

1700: Wind NW'W, force 11, pressure 998·2 mb, temperature 22·0.

1800: Wind NW'N, force 10, pressure 1000·3 mb, temperature 22·5.

1900: Wind NNW, force 9, pressure 1002·2 mb, temperature 22·0. Vessel rolling and pitching heavily to very rough NNW'ly sea and heavy, confused swell. Heavy seas to starboard maindeck. Spraying very heavily over-all. Frequent showers, heavily overcast and clear. Weather moderating slightly latterly.

2000: Wind NNW, force 9, pressure 1003·0 mb, temperature 22·5.

2100: Wind NNW, force 8–9, pressure 1006·1 mb, temperature 22·0.

2300: Wind NNW, force 8, pressure 1007·3 mb, temperature 21·0

21 December, 0100: Wind N'W, force 8, pressure 1010, temperature 21·0.

0300: Wind N'W, force 8, pressure 1011·3 mb, temperature 21·0. Rough beam sea and heavy swell, vessel rolling and pitching. Shipping light seas on starboard maindeck and spraying heavily for'ard. Mainly overcast and clear.

0700: Wind NNW, force 7–8, pressure 1013·3 mb, temperature 22·0. Vessel rolling and pitching to rough seas and heavy swell. Spraying to starboard. Cloudy, fine and clear. Occasional showers.

1100: Wind N'ly, force 7, pressure 1016·8 mb, temperature 21·0. Vessel pitching and rolling to rough beam sea and heavy swell. Spraying to starboard. Overcast with passing rain showers.

1500: Wind N'ly, force 6, pressure 1017·8 mb, temperature 21·0. Position, 29° 14'N, 57° 31'W. Moderate beam sea and swell. Vessel rolling easily. Spraying to starboard.

1900: Wind N'ly, force 5, pressure 1018·9 mb, temperature 19·0. Moderate beam sea and swell. Vessel moving easily. Spraying to starboard. Cloudy becoming overcast. Fine and clear.

This storm was later classified as a hurricane and named 'Lili'.

Position of ship at 0600 GMT on 19 December: 31° 24'N, 47° 24'W.

Position of ship at 1800 GMT on 21 December: 29° 12'N, 57° 54'W.

PASSAGE OF DEPRESSION

Gulf of St Lawrence

m.v. *Rubens*. Captain J. Parsloe. Hamburg to Escoumains. Observers: the Master, Mr C. Cooke, Chief Officer, Mr C. Ledsam, 2nd Officer, Mr A. W. Lewington, 3rd Officer and ship's company.

6–8 December 1984. After successfully dodging three low-pressure systems whilst on passage across the North Atlantic, we were finally caught by this one.

Originating in the Gulf of Mexico, the gale's centre was over the south-east of New York state at 1200 GMT on 6 December, with a pressure of 988 mb. It was forecast to move north-east at 35 knots and with falling pressure, was expected to develop into a storm in the Gulf of St Lawrence by 0000 GMT on 7 December.

The vessel entered the gulf at 0900 GMT on 7 December and encountered a very well-defined occluded front just south of the storm's centre at 1400 GMT. The pressure at the front was recorded as 969·6 mb.

On approaching Pointe Sèche, we were still encountering very high seas even though these had only 15–20 n. mile in which to build up.

The following information has been extracted from the ship's deck and meteorological log books. All times are in GMT.

Date and time	Wind Dir'n	Wind Force	Pressure (mb)	Temperature °C	Cloud	Remarks
6th 1700	Var.	2	1025·6	+0·3	2/8 Cu,Ac	Vessel rolling and pitching easily. Slight sea, low w'ly swell.
7th 0000	SE	6	1013·3	+2·3	8/8 St	Vessel rolling easily. Rough seas. Low SE'ly swell. Heavy showers of sleet.
0600	SE	8	992·7	+6·0	8/8 St	Vessel pitching easily to rough Seas. Low SE'ly swell. Continuous moderate rain.
0900	SE	6	983·1	+5·5	8/8 St	Vessel rolling moderately to rough seas and moderate SE'ly swell. Continuous light rain. Vessel enters Cabot Strait.
1300	SSE	6/7	972·8	+4·5	8/8 St	Vessel rolling easily in rough seas and low swell. Continuous moderate rain.
1400	—	—	—	—	—	Vessel passes through occluded front. Wind veers. Temperature falls rapidly.
1700	W'N	10	977·8	−3·1	8/8 St,Cu	Vessel pitching easily in very rough seas. Continuous light/moderate snow flurries.
2100	W'N	11	991·5	−4·5	Cb,Cu	Vessel pitching heavily to very rough seas. Moderate snow flurries.
8th 0100	NW	10	999·8	−7·8	8/8 Cb,Cu	Vessel pitching heavily to very rough seas and steep swell. Reduced to 100 revs.
0500	W'N	8	1002·5	−8·9	Cu	Vessel pitching easily to rough seas and low swell. Increased to 120 revs.
0900	SW	5/6	1006·4	−11·0	—	Sheltered waters. Fine and clear. Vessel enters St Lawrence River.

Position of ship at 1800 GMT on 6 December: 46° 36′N, 55° 18′W.
Position of ship at 0600 GMT on 7 December: 47° 30′N, 59° 30′W.

Bering Sea

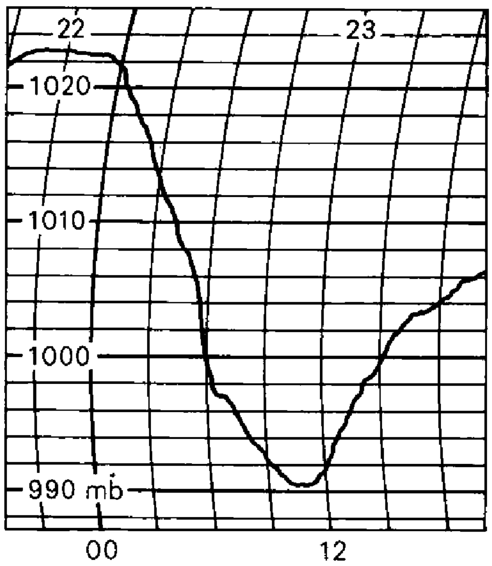
m.v. *Marilock*. Captain K. H. Thorne. Vancouver to Pusan. Observer: Mr P. M. Lovett, 2nd Officer.

22–23 December 1984. At 2300 GMT on the 22nd, the ship began to experience severe conditions whilst on passage off Attu Island. The barograph trace illustrates the depression which produced the following observations. All times are in GMT.

22 December, 2300: Barometric pressure 1022 mb, starting to fall. Wind backing towards the south-west and increasing to force 4.

23 December, 0200: Air temperature 2·0 °C. Pressure 1016·8 mb, falling steeply. Wind backing towards the south and increasing to force 7/8.

0530: Wind gusting to 80 knots. The port-side Stevenson screen was carried away, but despite being hurled to the deck it was not damaged, neither were the thermometers inside, therefore proving that the Meteorological Office's equipment is certainly robust. The vessel also sustained other minor structural damage; the outside loud-hailer was carried away and metal door screws were ripped off. Visibility was seriously affected and the combination of spray with heavy rain/sleet caused 'white-out' conditions. Mountainous seas resulted in certain deck fittings being either broken off or bent and the ship's speed was reduced to 6 knots.



0600: Pressure 996·7 mb, falling vertically. Wind force 12.
1030: Pressure levelled off at 991 mb and then started to rise quite sharply. The wind veered towards the south-west or west, more breaks appeared in the cloud cover and the rain became intermittent.
1800: Pressure 1005 mb, rising. The wind decreased, but very large seas and swell were still present and ice was forming on the bridge deck.

Position of ship at 0600 GMT on 23 December: 53° 06′N, 172° 12′E.

CLOUDS

Northern Spanish waters

m.v. *Mairangi Bay*. Captain R. Brinkworth. Dunedin to Flushing. Observers: the Master, Mr D. Robertson, 1st Officer, Mr I. M. Chadney, 2nd Officer, Mr A. D. Hutchinson, Radio Officer and Cadet S. J. Moon.

23 October 1984. At 1600 GMT an unusual cloud formation was noticed, and this on a day when we had experienced reduced visibility on a number of occasions due to fog. Although conditions had remained clear for the previous four hours, small light fog-banks were still evident towards the coast (of north-west Spain).

The cloud looked like the threads of a screw lying horizontally along the horizon. At least six 'threads' were visible, ranging in azimuth from 040°–070°, the ship's course being 030°. The height of the cloud top was estimated to be about 300 feet and there was a band of fog extending up to about 50 feet above sea-level. A photograph of the cloud is reproduced opposite page 196.

This formation lasted for approximately fifteen minutes before dissipating and becoming low cloud, type '1'.

Weather conditions at the time were: dry bulb 18·2 °C, wet bulb 17·6,

dew-point 17·2 (relative humidity 94 per cent); sea temperature 16·4, barometric pressure 1020 mb and visibility 8 n. mile.
Position of ship: 43° 10′N, 09° 46′W.

Note. Captain Brinkworth has also included some of his own thoughts on the clouds:

'I was fascinated by these clouds which formed off the north-west coast of Spain, but could find no reference to the type in any of the recognised mariners' text books, nor could any of my professional colleagues offer any explanation. It seems to be so rare that nobody had ever seen it before. I understand though, that this cloud is not so uncommon in the upper atmosphere and that airline pilots sometimes encounter these "billows". However, I am not entirely convinced that the causes of these two formations are necessarily the same.

'Please note in particular, the geographical position of the *Mairangi Bay* at the time of the sighting. The cloud formation occurred close to the continental shelf, that is, the 100-fathom line. As the predominant current in this region is 150° it is probable that there was upwelling; also, there is mixing in the area, of this current with the westerly flow along the northern coast of Spain. Then, a mixing of waters of differing densities and temperatures occurs, which is confirmed by the fact that there was a drop in the sea temperature of 2·5° in the preceding four hours. The presumption is, therefore, that there were isolated pockets of warmer water parallel to the slope of the continental shelf. The wind direction was also aligned with the general direction of the shelf.

'The general (medium cloud) formation of altostratus indicates that the atmosphere above the surface was stable. However, under this stable air would exist weak convective currents originating over the isolated patches of comparatively warm water. The wind speed at sea-level was north-westerly, about 5 knots, but the "bending" of the cloud top indicates a stronger wind velocity which increased with height until a temperature inversion was reached—probably at an altitude of 800–1200 metres. This inversion would be caused by the effects of the cold sea-surface and slight turbulence.

'In my opinion, the bank of fog on the sea-surface was incidental to the cloud phenomenon and merely gave a more dramatic effect to the scene.'

Drake Passage

m.v. *City of Durban*. Captain R. J. Smith. Wellington to Flushing. Observers: Mr P. Jackson, Chief Officer and Mr J. Murray, 3rd Officer.

5 December 1984. At 2300 GMT, a massive stratocumulus cloud was observed off the port bow. The base of the cloud was estimated to be at two thousand feet and there was extremely dense virga almost reaching the sea-surface. In total, the cloud covered an arc of the horizon measuring 40°. The Chief Officer photographed the cloud and the picture is reproduced opposite page 196. Course of ship 091°, speed 19 knots.

Weather conditions at the time were as follows: dry bulb 5·5 °C, wet bulb 3·0, barometric pressure 1009·9 mb, wind direction SW, force 3.
Position of ship: 56° 00′S, 75° 54′W.

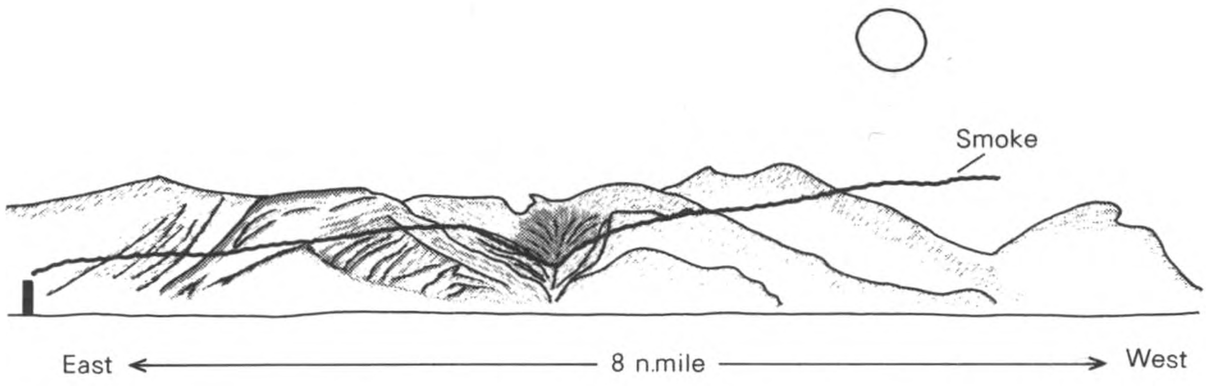
TEMPERATURE INVERSION

Western Mediterranean Sea

m.v. *Mentor*. Captain J. P. Wishart. Bremerhaven to Port Said. Observers: Mr M. J. Knight, Chief Officer, Mr. P. I. Anderson, 2nd Officer, Mr K. P. Widdowson, 3rd Officer and Cadet A. S. Cousins.

27 November 1984. At 1550 GMT when the sun was low in the sky and the contours of the coastline quite distinct, smoke was observed being emitted from a tall chimney near Toumojaje (distance from the ship, 7.2 n. mile). The smoke, which was heavy, was being carried westward by the light easterly wind and

could be seen to rise gradually as it was carried along. Suddenly, at the place shown on the drawing, it appeared to be 'sucked' down into the gorge-shaped contours of the mountains before rising again to continue its journey westward.



The only possible explanation that we on board could think of was that a temperature inversion or perhaps eddy currents in the gorge were responsible.

Weather conditions were as follows: dry bulb 20·4 °C, wet bulb 18·8, barometric pressure 1019·5 mb.

Position of ship: 37° 01′N, 04° 05′E.

Note. Mr David Ireland, of the Marine Climatology branch of the Meteorological Office, comments as follows.

'The officers' explanation seems correct. An inversion probably existed all along the coast, with an anticyclone centered over Spain, and the smoke would be trapped just below the inversion. The evening "cool" may have started downslope winds in the gorge and this possibly enhanced the dip in the inversion. It is unusual for it to be so marked and for the smoke to continue so undisturbed.'

EARTHQUAKE SHOCK

Arafura Sea

m.v. *Meadowbank*. Captain W. H. Martin. Lae to Darwin. Observer: Mr R. K. Ward, 2nd Officer.

24 November 1983. At 0530 GMT (1500 Ship's Time and Local Time in Darwin) distinct and intense vertical vibration was felt throughout the vessel. It was assumed that the vessel had crossed an uncharted shoal.

It was later discovered that the vibration had been caused by an earth tremor from the Timor–Flores line; this tremor was also registered at Darwin.

Position of ship: 10° 48′S, 131° 11′E.

Note. The following comment was received from Mr Graham Neilson, of the British Geological Survey, Edinburgh:

'Thank you for the report of an earthquake from Captain W. H. Martin of m.v. *Meadowbank*. Such reports are important to the seismological community as they serve as a check on the accuracy of instrumental locations of earthquakes.

'The earthquake mentioned in Captain Martin's report occurred at 05h 30m 34·9s UT on 24 November 1983 in latitude 7° 55′S, 128° 25′E. It had a focal depth of 187 kilometres and a Richter body-wave magnitude of 6·2. It was reported that the shock was felt on Alor, Flores, Sumba and Timor, as well as being felt in Australia from Darwin to Perth. The relatively large felt area is partly explained by the depth of the event—most shocks occur, within the earth's crust, at depths of about 30 kilometres or less, although earthquakes have been observed with focal depths down to about 750 kilometres.

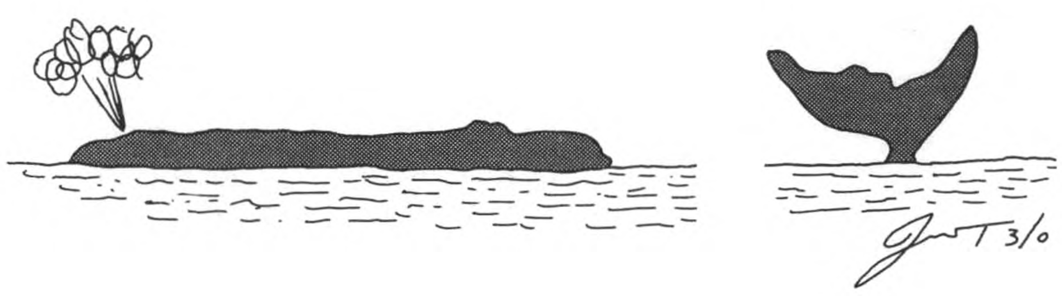
'I have forwarded a copy of Captain Martin's report to the International Seismological Centre for their information. Please extend my thanks to the officers concerned.'

CETACEA

Eastern North Atlantic

m.v. *Melampus*. Captain H. R. Lawton. Freetown to Abidjan. Observers: Mr M. G. Garside, 2nd Officer and Mr J. W. Tandy, 3rd Officer.

28 November 1984. At 1030 GMT two whales were spotted swimming together about 0·5 n. mile away from the ship. Their bodies were a dark grey in colour except for the undersides of their flukes which were a lighter grey. Both were about 11 m long with small 'lumpy' fins as shown in the sketch.



Approximately three or four minutes later, two more whales were observed swimming on the surface about 200 m ahead of the ship and on a collision course with it. I altered course to avoid them, losing sight of both in the process. I then noticed a solitary whale about 100 m to the side of the ship and this one dived so giving an excellent view of his flukes. The whales were believed to be humpbacked whales.

Position of ship: 06° 15'N, 11° 30'W.

Note. Mr D. A. McBrearty, of the Department of Anatomy, University of Cambridge, comments as follows:

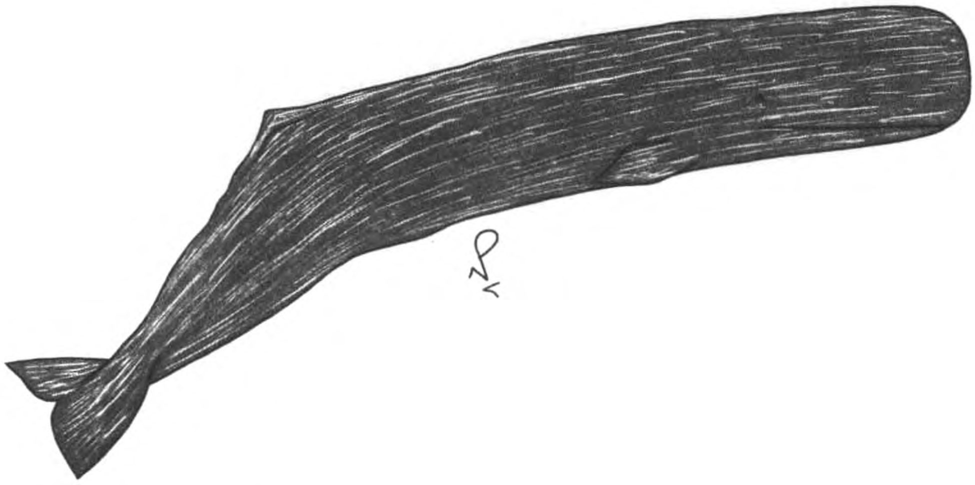
'These whales are identified by the observers as humpback whales (*Megaptera novaeangliae*) and there is nothing in either the description or the diagram which would contradict that. Sightings of humpback whales in the eastern North Atlantic are few, the western North Atlantic stock seems to be much greater in number. Incidentally, it has been shown that the markings on the undersides of the flukes are to humpbacks what fingerprints are to us and should be observed where possible, a photograph of those flukes helps conservationists and serves as an excellent marker for identifying individual animals over the years.'

South Pacific Ocean

m.v. *Tolaga Bay*. Captain G. C. Barrett. Auckland to Wellington. Observers: Mr M. B. Godbehear, Chief Officer, Mr D. R. Peel, 2nd Officer, Cadet N. Peters, and D. Dines, Seaman 1.

7 October 1984. Whilst the vessel was steering an east-south-easterly course, four whales were observed off the starboard bow some 2·75 n. mile from the ship and 5 n. mile due north of Matakaoa Point (North Island, New Zealand). One of the whales was slapping its tail on the surface of the water whilst two others were 'blowing' nearby. At first only three whales were visible to the

observers until a fourth suddenly leaped clear of the water, coming down with a large splash, see sketch. The whales were not swimming in any particular direction and seemed content to remain on the surface when the ship passed



close by to them. They were identified as being sperm whales.

Weather at the time was fine, with the wind NW'ly, force 5–6.

Position of ship: 38° 27′S, 178° 18′E.

m.v. *ACT 6*. Captain P. R. R. Ramsay. Auckland to Balboa. Observer: Mr A. R. Hembury, 3rd Officer.

16 November 1984. At 1730 GMT a single whale was sighted and 'blew' three times before being disturbed by the ship's passing. The whale had a square head and a distinctive triangular fin. From the description in the *Sea Guide to Whales of the World* by Lyall Watson, I would suggest it was a single 'Great Sperm Whale' during its series of blows between dives as no tail fins were seen. It was probably an adult since it was of considerable size, but it was too far away for a reasonable estimate of length to be made.

Position of ship: 36° 00′S, 177° 18′E.

Note. Mr D. A. McBrearty comments as follows:

'The observers have identified this whale as a sperm whale (*Physeter macrocephalus*) and there seems little doubt that this is what the animal was, although the tail flukes which are characteristically shown when the whale dives deep were not seen on this occasion. Male sperm whales dive to enormous depths for periods of up to one hour and therefore require some time at the surface at the end of such a dive in order to replace lost oxygen and rid the tissues of the CO_2 built up during the time under water. Consequently, they may be at the surface for several minutes before they again dive deeply and show the flukes. The blow, again characteristic but not mentioned in this report, is usually seen to be angled forward and to the left of the whale.'

FISH

Eastern North Atlantic

m.v. *City of Durban*. Captain R. J. Smith. Rotterdam to Melbourne. Observer: Mr P. Jackson, Chief Officer.

13 October 1984. At 1045 GMT, a solid radar target was observed at a range of 2·5 n. mile. No target was visible by eye, even in clear conditions and with the use of binoculars. When the target was at a range of 1·5 n. mile, a solid body

of fish was seen breaking the sea-surface in the target's position. A number of fish were jumping out of the water like tuna fish and they appeared to be the same size as tuna. Most of them were apparently basking on the surface and formed a dense layer, evidently sufficient to give a strong radar target.

Weather conditions at the time were: dry bulb 21·7 °C, wet bulb 20·0, sea 20·0, barometric pressure 1015 mb.

Position of ship: 20° 03′N, 17° 45′W.

Note. Mr J. D. Lankester of the Marine Division's Ocean Current section, is of the opinion that both the strong radar echo and the concentration of fish were the result of upwelled water, which is borne out by the relatively low sea-water temperature reported.

The photograph opposite page 204 appeared as the 'Satellite Image of the Month' in the NOAA *Oceanographic Monthly*, Volume IV, No. 10, October 1984. The infra-red NOAA-6 image from 10 October was taken of coastal waters further north (off the west coast of Morocco) and shows an area of upwelling. Cool upwelled water appears as light grey shades, warmer offshore water corresponds to darker grey shades. Offshore wind flow prior to 10 October has contributed to the vigour and extent of the upwelling incident. Near the westward extent of upwelling, contours of depth make a sharp transition from shallow to deeper waters (indicated by the arrow). Upwelling in this region has been observed on satellite imagery in almost every month of the year. Particularly intense upwelling incidents occur when high pressure systems in the central Atlantic dominate the synoptic scale flow.

Indian Ocean

m.v. *Moreton Bay*. Captain D. C. Blackman. Fremantle to Jeddah. Observers: Mr B. A. Mullan, Radio Officer and Cadet G. Dockerty.

7 December 1984. At about 0400 GMT a flying fish was found dead on the main deck. The following details were noted: the fish measured 26 cm in length over-all and its wing-span was 29 cm. On the upper sides of its body, the colour was a slate-blue, whilst the undersides were grey. The fish was photographed by the Radio Officer and the picture is shown opposite page 197.

Position of ship: 15° 00′S, 81° 50′E.

Note. Mr O. A. Crimmen, of the Fish Section of the Department of Zoology, British Museum (Natural History), comments as follows:

'The picture shows a flying fish of the family Exocetidae. This is a widespread group of fishes comprising about 40 species many of which are found in the Indian Ocean.

'The pectoral fins (on the flanks) are characteristically large and wing-like as the picture clearly shows. However, in some species the pelvic fins (on the belly) are also enlarged and the lower lobe of the tail is greatly elongated. These "four-winged" species are capable of a more sustained and controlled flight than their "two-winged" relatives. It is not clear from the photograph whether the *Moreton Bay*'s specimen has one or both pairs of fins enlarged; but the wing markings and the size of the lower caudal lobe in the picture suggest that it may be one of the "four-winged" varieties.

'These fishes propel themselves from the water by vigorous "sculling" with the tail fin, unfold their "wings" once they have left the water, and glide for distances of up to 400 m at a height of 1–2 m above the surface before falling back to the water. However, a gust of wind during a flight, especially if the fish took off from the top of a wave, can greatly increase these distances. Specimens are not infrequently found on deck or even in rigging.

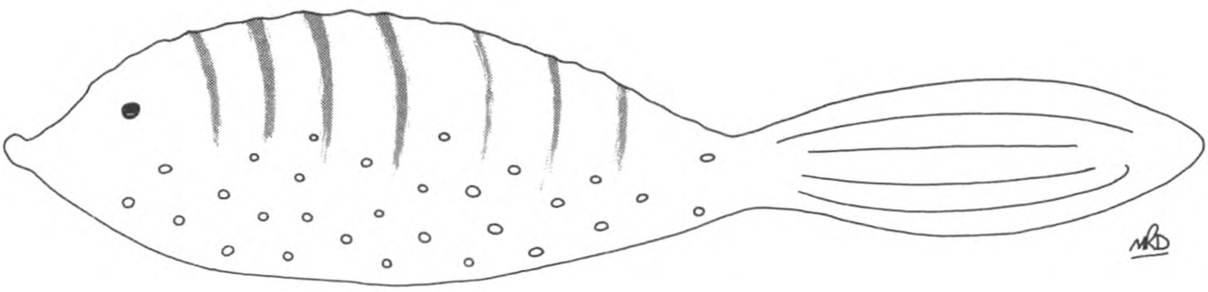
'Flying fishes have been seen to take to the air when being chased by underwater predators.'

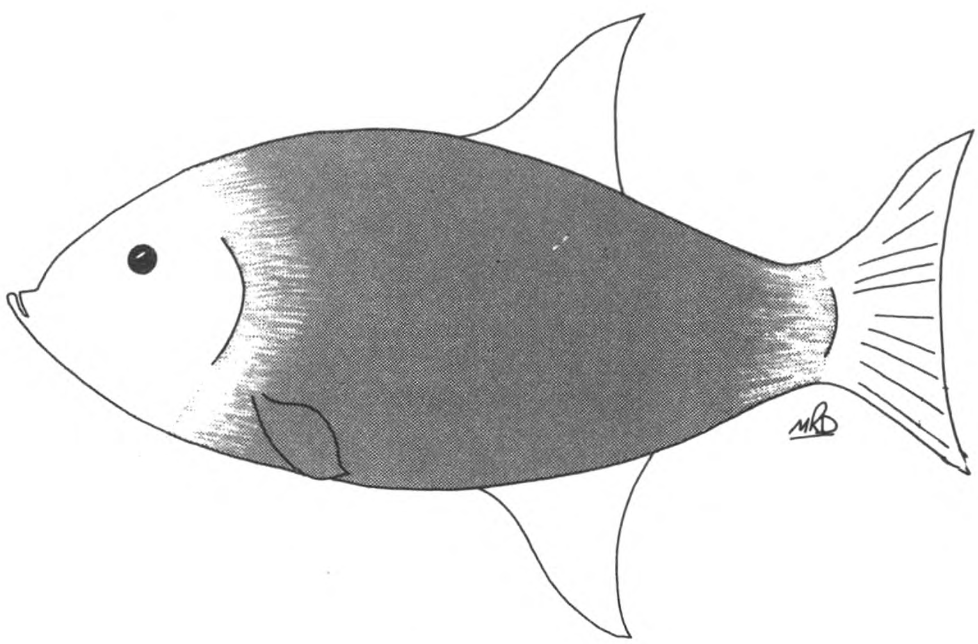
South China Sea

m.v. *British Ranger*. Captain P. N. Johnson. At Brunei anchorage. Observer: Mr M. R. Dickinson, 2nd Officer.

16 December 1984. At 1045 GMT the two species of fish shown in the sketches were observed feeding on a jelly-fish. The fish shown in the upper sketch was the only one of its kind visible. It had pinkish stripes over the top of its body

and these became faint as they tapered towards the belly which was a silvery colour with spotted markings. The tail comprised about one third of the total body length which was estimated to be 60 cm and the fish appeared to have no other fins.





There were large numbers of the fish shown in the lower sketch. When swimming they used their fins as shown. Generally, they were fawn/mauve in colour and were of various sizes up to a length of about 30 cm.

Position of ship: 05° 24′N, 114° 42′E.

Note. Dr F. Evans of the Dove Marine Laboratory, University of Newcastle upon Tyne, comments as follows:

'Although it is not possible to name the fish exactly, the fish in the upper drawing appears to be a File fish and that in the lower drawing a species of Trigger fish. Both are related, having nibbling teeth not unlike rabbit teeth and indeed they feed by nibbling; given a chance they will nibble the barnacles on a ship's side. The File fish has a long dorsal fin which does not appear in the drawing; it can be stowed flat. The Trigger fish has a first dorsal fin which again is housed and not shown in the drawing. This is spiny and can be locked by a click mechanism into an upright position to deter predators. The swimming action of the posterior dorsal fin and the ventral fin of the Trigger fish illustrated in the last drawing is quite striking. It looks like nothing so much as a bird flying on its side and indeed the more oceanic Trigger fish, which have the largest fins, can cover hundreds of miles propelled by nothing more than this bird-like flapping. None of the fish in this group should be eaten without local knowledge as the flesh of most is unwholesome.'

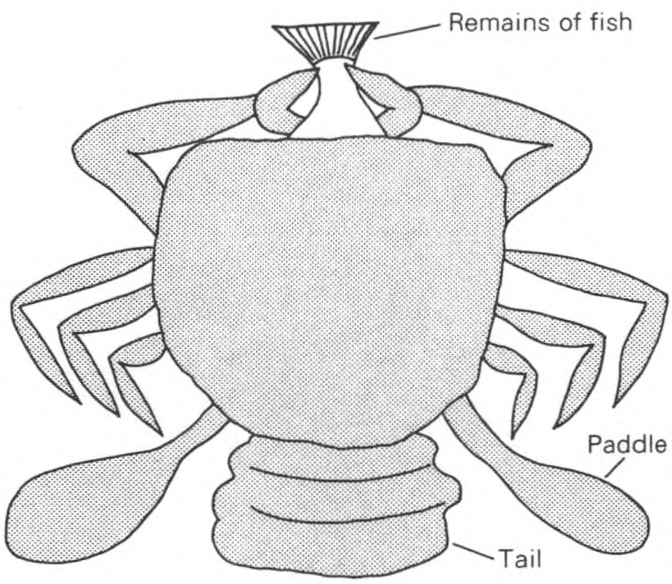
CRUSTACEA

South China Sea

s.s. *British Ranger*. Captain P. N. Johnson. At Brunei anchorage. Observers: Mr M. R. Dickinson, 2nd Officer and Mrs M. R. Dickinson.

11 November 1984. At 0800 GMT as we were walking around the main deck, my wife pointed out a crab which was swimming on the sea-surface. We observed it for approximately ten minutes before it disappeared, we assumed that it had dived.

It was about six inches across the main shell (observing distance was about 12 m) and was a sandy/brown colour. The crab's rearmost pair of legs were like paddles, which it used quite often in order to swim. It also held the remains of a fish in its claws, the silver tail and a small part of the body being visible, and the crab was obviously feeding on this. See sketch.



Poor crabs—they walk sideways and even swim backwards, it must be confusing!

The state of sea was slight at the time of observation.

Position of ship: 05° 25′N, 114° 42′E.

Note. Dr F. Evans comments as follows:

'This appears to be another example of red/brown crabs seen swimming (and swarming) far from land in tropical latitudes. There are well-documented cases from the west of the Indian Ocean, where the crab is known to be the portunid crab *Charybdis edwardsi*.

'The observers, by the way, are wasting their sympathy on crabs for being able to walk only sideways. They are also able to walk forwards but, it must be conceded, only when drunk.'

BIRDS

North Atlantic Ocean

m.v. *Harold La Borde*. Captain M. M. Reeves. Point Lisas to Rotterdam. Observers: the Master, Mr S. N. Harris, Chief Officer, Mr S. K. Jones, 2nd Officer, Mr I. D. Gordon, 3rd Officer and ship's company.

20–21 October 1984. At 1300 GMT a 'hawk' landed on one of the ship's rails. Looking very bedraggled, it could hardly perch in one spot for longer than a few minutes before having to look elsewhere for a place to rest, eventually settling down on the forecastle bulwark.

The length of the bird was estimated to be 40 cm from beak to tip of the tail, and when flying, its wing-span was estimated to be about 60 cm. The bird's head was very flat at the crown and was a black/brown colour, while a 'dirty' white band passing across the forehead and around to the neck was clearly visible above the very large black eyes. Its back and wings were coloured dark blue, whilst the undersides during flight were marked like the rest of the body, that is, 'dirty' white with brown freckles becoming larger from the head towards the tail.

Throughout the day, the hawk stayed with the ship and at dawn on the next day, a 'beheaded' petrel was found on the bridge deck! The bird returned and fed off the petrel for a short while before flying away in a north-easterly direction still clutching the petrel in its talons.

The moral of this story? Always fill up with 'petrel' before embarking on a long journey.

The vessel's course was 044° and the speed was 12 knots.

Position of ship: 29° 12′N, 44° 31′W.

Note. Commander M. B. Casement, of the Royal Naval Birdwatching Society, comments as follows:

'An accurate description. I suggest a Merlin (male) *Falco columbarius*. This species breeds in Greenland, Iceland (and in Scotland) and is known to migrate to West Africa—I believe they can do so 'non-stop' and their habit of taking rests aboard ships and feeding on small birds contributes to their survival.'

Black Sea

m.v. *Salmonpool*. Captain T. F. Jones. At anchor Ust' Dunaysk. Observers: the Master, Mr C. E. Devey, 2nd Officer and Mr D. R. Elt, 3rd Officer.

27 December 1984. At 0800 GMT a medium-sized owl was observed perching on a hatch motor on deck. It appeared to be asleep, well sheltered from the wind. The owl was approximately 25 cm in length and was coloured as follows: chest, oatmeal with black-and-white zig-zag vertical stripes, the upper body was a mottled medium-brown and around the neck was a small oatmeal/black ruff.

There was a grey/brown 'V' separating the eyes whilst the remainder of the owl's face was a medium-brown colour. The most striking features of the bird were the two large black ear-tufts which are shown in the sketch.

The owl awoke briefly at about 1115, excreted, preened itself and then went back to sleep having had a good look around, moving only its head. At one stage the head appeared to be rotated through 180 degrees. The observers remarked that when viewed from the front, the face reminded them of a squirrel. Detailed description of the feet was not possible.

The owl left the ship at approximately 1200, but returned the next day when it was accompanied by a second, smaller owl.

Weather conditions: dry bulb 7·0 °C, wind E'N, force 5, sky overcast with mist.

Position of ship: 45° 25'N, 30° 01'E.

Note. Commander M. B. Casement comments as follows:

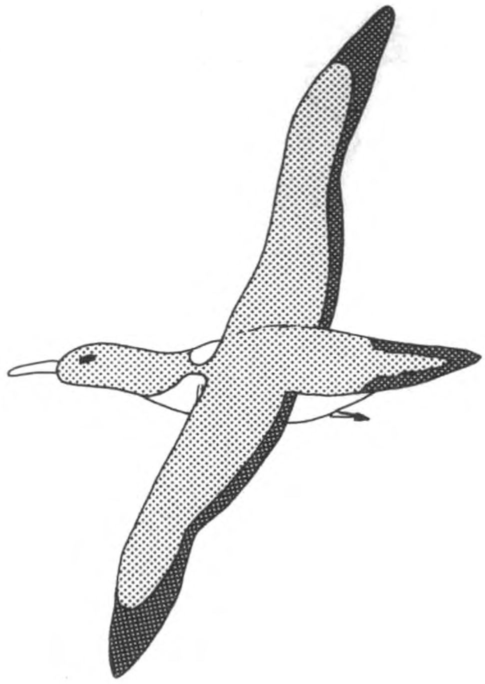
'This is a Long-eared owl (*Asio otus*) which breeds throughout northern Europe and is migratory south-westwards in the autumn. A striking-looking bird, it is frequently reported resting on board ships in the North Sea. Not many observations are received from the Black Sea.'

Indian Ocean

m.v. *Southland Star.* Captain P. W. Hutchinson. Los Angeles to Suva. Observer: Mr R. J. Shuttleworth, 3rd Officer.

16–18 October 1984. For three days, a group of three birds were periodically spotted near the ship. Their flight was often very low over the water and at times they appeared to almost skim the surface, they would then soar above the ship for shorter periods before again resuming their low-level flight. Their flight consisted of gliding interspersed with 'flutters' rather than steady beats of the wing.

The colour of the birds was a greyish-brown on their backs with a darker 'chocolate' brown trim on the wings and tails. Their undersides were white and this extended around the neck to give the appearance of a collar, as shown in the sketch. The estimated wing-span was 50–60 cm and length of body was



25–30 cm. It was also noticed that the birds approached the ship more closely at night, often giving a short, screeching call.

Position of ship: 10° 30′S, 105° 30′E.

Note. Captain A. S. Young of the Royal Naval Birdwatching Society, comments as follows:

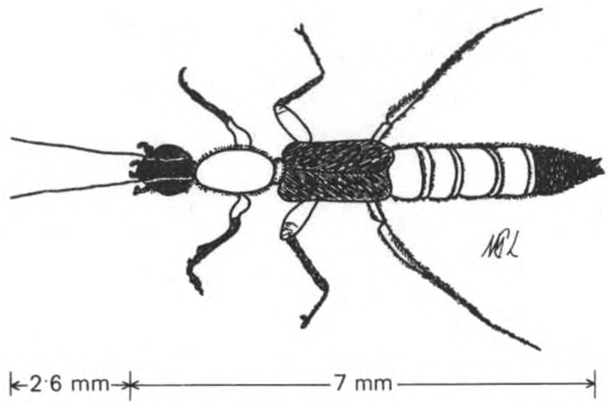
'I am fairly certain this is a juvenile Masked Booby (*Sula dactylatra*), the largest and most gannet-like of the boobies. Juveniles can be mistaken for the adult Brown Booby (*Sula leucogaster*) which share similar ranges. The white "collar" of the juvenile Masked Booby is diagnostic. I am not sure of their call, that is, if they use one other than in nesting colonies when the species generally makes quite a din; the screeching call is more reminiscent of the Tropic birds which can be quite frightening when unexpected.'

INSECTS

Gulf of Guinea

m.v. *Overseas Argonaut*. Captain T. S. Nurcombe. Kwa Ibo, Nigeria to Delaware. Observer: Mr M. C. Littlewood, 2nd Officer.

27 October 1984. After the vessel had left Kwa Ibo, two insects which resembled ants were caught on the bridge wings. They were about 7 mm long and were a translucent amber in colour except for the head and eyes together with the second and third sections of the two aft pairs of legs and the last two segments of the body which were black. The fore part of the abdomen was also black with what appeared to be pore-like holes on the surface. This part of the body also seemed to be split down the centre as if it were a wing case, but no wings were visible. Fine hairs covered the bodies of the ants, one of which is illustrated in the sketch.



It is a mystery how the ants came aboard as Kwa Ibo is a single-point mooring about 19 n. mile from the coast. The only possible means of access would have been via the representatives of the terminal and the officials who came on board or by the several terns that roosted on board overnight.

The wind was NW'ly, force 2–3 throughout the vessel's stay (about 30 hours), and just prior to departure, there was a heavy and prolonged shower of rain accompanied by lightning from a cumulonimbus cloud.

Position of ship: 02° 00′N, 05° 24′W.

LOCUST

Eastern South Atlantic

m.v. *ACT 7*. Captain W. A. Davidson. Rotterdam to Melbourne. Observers: Mr J. R. Webber, Chief Officer and members of the ship's company.

26 November 1984. At 1200 GMT a large insect was found on the foredeck by the Chief Officer. The insect was already dead and resembled a locust or grasshopper. It was approximately 4 cm in height when set upright on its legs and wings and measured almost 8 cm from the tip of the wings to the antennae as pictured in the photograph opposite page 197.

The insect had been dead for some time as it was quite stiff. It is not known where the locust/grasshopper came from, but the wind had been SE'ly force 4–5 for the previous two or three days so it was assumed that it had come from the mainland of Africa.

Position of ship: 27° 20′S, 11° 56′E.

Note. Mrs Judith Marshall, of the Department of Entomology, British Museum (Natural History), comments:

'This is a locust—*Locusta migratoria migratorioides* (Reiche and Fairmaire) adult female. This is the southern African sub-species of the African Migratory locust.'

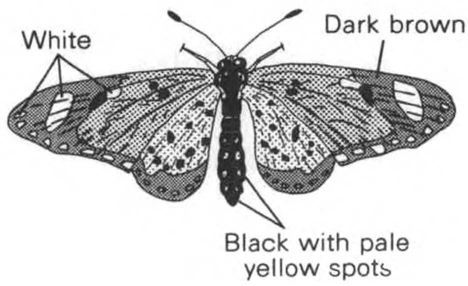
BUTTERFLIES

Eastern North Atlantic

m.v. *ACT 7*. Captain W. A. Davidson. Rotterdam to Melbourne. Observers: Mr S. M. Ross, 2nd Officer and Mr D. G. Robbie, 3rd Officer.

20 November 1984. At 1610 GMT the butterfly illustrated in the upper sketch was seen flying about on the bridge wing. An attempt was made to capture it

but without success and the insect then flew into the wheel-house and alighted on the bridge front window. It stayed there with wings folded, apparently resting, but we found that by tapping the window lightly, the butterfly would



open and close its wings, so an attempt was made to photograph it. This was not altogether successful as the butterfly would not co-operate with the camera shutter, so the 2nd Officer captured it in his hands, taking care not to damage it and the insect was brought to the chart table for closer examination and for drawing. The underside of the wing was a creamy colour with no variation and there were black markings corresponding with the dark brown ones on the upper surface.

The 2nd Officer then saw another butterfly which is shown in the lower sketch. This was also captured in the wheel-house and drawn. The underside of each wing was a very pale orange or pink and also had black markings matching those on the upper side.

We tried to interest both butterflies with a solution of sugar, but they appeared to be totally indifferent. It was thought that they may have been the male and female of the same species since the shapes of their wings were very similar and they were found shortly after one another. The wind had been blowing NNE'ly, force 3 for the previous two days and the vessel had passed 28 n. mile off Dakar at 0800 GMT.

Weather conditions at the time were: dry bulb 27·9 °C, barometric pressure 1011·9 mb, wind NNE'ly, force 2–3, fine and clear with few clouds.

Position of ship: 12° 11′N, 17° 58′W.

Note. Mr C. R. Smith, of the Department of Entomology, British Museum (Natural History), comments:

'The first butterfly is a male *Acraea eponina* (Cramer), apparently known as the "dancing Acraea". The species is very common in open habitats throughout the African region. The Acraeines form a sub-family of the very large family Nymphalidae.

'The second specimen is a female *Lachnocema bibulus* (F.), sometimes known as the "woolly legs". This member of the family Lycaenidae—the blues, coppers and hairstreak butterflies—is common throughout Africa south of the Sahara. The caterpillars of this family feed on scale insects and aphids.

'The unusual place of capture of these butterflies makes them a useful addition to our collection.'

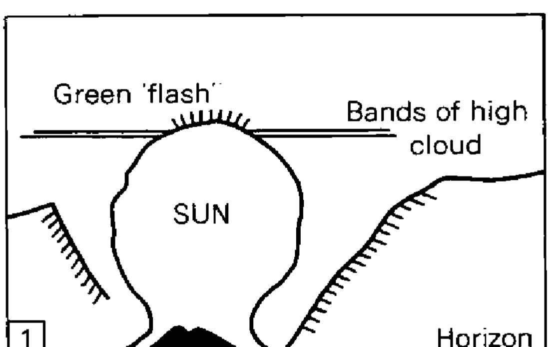
EXCEPTIONAL SUNSET

Red Sea

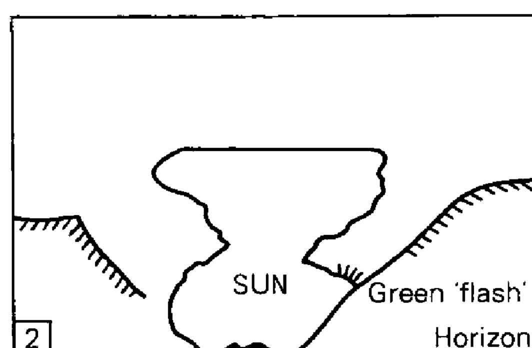
m.v. *Cable Venture*. Captain O. L. Harrison. Singapore to Suez. Observers: Mr P. M. Swan, 2nd Officer, Mr M. Holland, Chief Cable Engineer and members of the ship's company.

9 October 1984. At 1511 GMT a beautiful afternoon was splendidly rounded off by the sight of one of the most spectacular sunsets several of us agreed that we had ever seen. Not only were we treated to all the varying hues of red, orange, pink and lilac colours associated with a Red Sea sunset, but it all happened against the backdrop of mountain peaks which stood out sharp and clear on the horizon even though they were 72 n. mile away. In addition, we saw at least four separate and distinct 'green flashes'—what more could one ask for? The shape of the sun which at no time, from the instant its lower limb touched the mountains/horizon, presented a round shape, constantly changed in appearance from that of an 'upturned urn' to an 'hour-glass' and with all its edges ragged and shimmering.

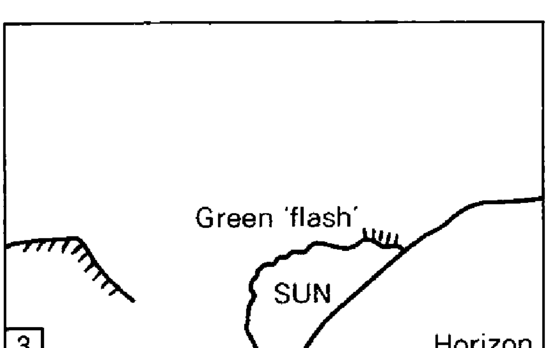
The sketches represent an attempt to reproduce some of the effects seen, but it must be remembered that the observer is no artist!



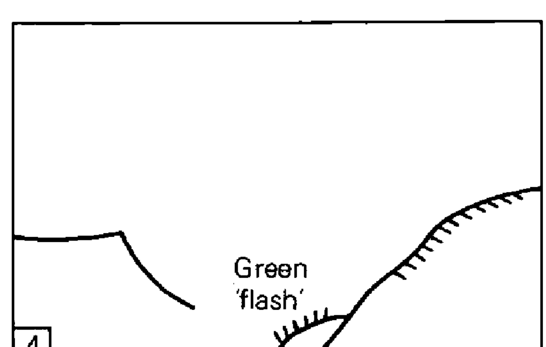
Sun's "liquid" lower limb "pours" around mountain peak.



Sun elongated and 'pinched' in the middle.



Sun disappearing behind Andidanob.



Remainder of sun turned vivid green as it disappeared.

Before, during and after these observations, we were experiencing extreme radar ranges with ships' echoes being received from over 40 n. mile and strong land echoes at the maximum range of 48 n. mile on our Marconi Radio Locator 16 radar.

Weather conditions at the time were: dry bulb 29·6 °C, wet bulb 24·6 and there was a trace of high cloud over the mountains.

Position of ship: 21° 54′N, 37° 48′E.

AURORA

North Atlantic Ocean

m.v. *Isocardia.* Captain D. M. C. Renton. Braefoot Bay, Fife to Houston. Observer: Mr J. Y. Simpson, 3rd Officer.

22 October 1984. At 2000 GMT the following display was observed by most of the ship's company. The sky in the direction between 280° and 350° was extremely well lit both above and below the cloud level. Above the cloud level, a very well-defined display of a searchlight-like pattern was seen, with the brighter beams being in the direction of 320° to 330°. The fainter beams of light were the ones which seemed to be changing direction, flicking across the sky from the horizon to a point almost overhead, although it was noticed that a few rays of light were almost parallel to each other and changed in intensity simultaneously.

The brighter rays could be described as having the same intensity of light as that received from the moon on a dark night when shining through cumulus cloud.

Below the low cloud, the sky was more of a homogeneous glow. The display lasted approximately eight minutes and faded out leaving only two or three of the more dim rays protruding above the cloud in the direction of 340°. These persisted for only another 20–30 seconds before fading away. The same display was again observed at 2030 GMT and lasted for eight minutes before stopping once more.

Weather conditions at the time were as follows: dry bulb 7·0 °C, wet bulb 4·5°, barometric pressure 1000·8 mb, wind SW'W, force 8 and partly clouded sky.

Position of ship: 58° 15′N, 21° 45′W.

537·37:574·5

Phosphorescent Wheels: Fact or Fiction?

By Dr Peter J. Herring
(Institute of Oceanographic Sciences, (NERC), Wormley, Godalming, Surrey)
and
Paul Horsman, MSC
(The Marine Society, London)

At 1803 GMT on May 15th 1879 H.M.S. *Vulture,* while in the Persian Gulf, encountered so remarkable a phenomenon that her master, Commander Pringle, sent back an account of it from Bahrain to the Hydrographer of the Navy. He had seen 'luminous waves or pulsations in the water, moving at great speed and passing under the ship from the SSW. On looking toward the East the appearance was that of a revolving wheel with centre on that bearing and whose spokes were illuminated and on looking towards the West a similar wheel appeared to be revolving, but in the opposite direction.' This was the first detailed account of the phenomenon which has subsequently become known as the 'phosphorescent wheel'. Since then many other reports of similar phenomena, involving bands of luminescence travelling rapidly in a circular, spiral or horizontal trajectory, have been entered in the log books of vessels round the world. Many of these vessels have been members of the Voluntary Observing Fleet and the reports have been logged by the Meteorological Office and usually published in the pages of *The Marine Observer.*

Descriptions of the phenomena vary considerably. At the simplest level a series of parallel luminous bands or waves are observed moving rapidly over the sea surface. The direction of the bands may change suddenly and several sets may be visible at once travelling in different directions. The *Deucalion* in the Sunda Strait reported that 'Rays of light appeared on the surface of the water coming from the south-east passing across the ship at regular intervals of half a second. . . . After a few minutes the direction of the beams of light changed. . . . From then until 1.40 a.m. the direction of these beams continually changed, passing across the vessel from all points of the compass.' In some cases the bands appear to be travelling several feet above the sea surface, e.g. the *City of Khios,* off Karachi: 'Shafts of pale white light were observed moving swiftly NE–SW. They appeared to be just above the surface of the sea and parallel with each other.' Parallel waves of light may be preceded by flashing patches, as reported by the *Tokyo Bay* in the South China Sea, 'Vessel passed through a patch of bioluminescence. . . . It took the form of a "rash" of lights . . . flashing at a rate of about 120 flashes per minute. This was followed . . . by fast-moving bands of light converging on the vessel from either beam, and then from astern.' The parallel bands may change into bands (or spokes) rotating round a central hub, in a typical wheel appearance, and the wheel may change back into parallel bands. The wheels may rotate in either direction and even reverse. The *British Patrol* in the Gulf of Oman reported luminous waves which 'appeared as if streaks of sand were being blown across the surface of the sea. . . . They came in an effortless pulsating rhythm. These parallel waves lasted about four minutes then changed to what appeared to be arcs turned back at their centre . . . after which four wheels appeared, one on each bow and quarter. On the starboard bow there were two concentric wheels rotating in the opposite direction to each other. The port bow wheel rotated anticlockwise. The port quarter wheel turned clockwise and the starboard quarter one anticlockwise. Once again the duration was about four minutes. The waves then commenced to move towards the ship, parallel to our course. At the same time other waves moved astern at right angles. This phenomenon only lasted about two minutes and reverted back to the four wheels, but the starboard bow wheel was now a single one rotating clockwise.' The hub or centre of rotation is described in some reports as bright, in others as dark and in many cases is at too great a distance to be visible (often described as 'on the horizon'). The spokes, like the bands, are sometimes described as travelling well above the sea surface, even over the deck.

No two reports are the same in the timing, dimensions or duration of the phenomenon, though the latter is usually between five and 35 minutes. Even when reports are received from more than one observer on the same vessel the accounts may differ substantially. In 1963 the *Kent* encountered luminous waves in the Persian Gulf. Three observers reported as follows:

1. 'A remarkable display of bioluminescence . . . began. It took the form of luminous bands of light moving at great speed in wave formation. At first the impression was one of extremely active phosphorescence glowing just below the sea surface and illuminating the whole area in a manner resembling the effect produced by strong reflected moonlight'.

2. 'As the vessel approached, the patches were seen to pulsate over the whole area, apparently in the form of waves. When the middle of the area was traversed by the ship at 2030, the phosphorescence consisted of rays of light striking the surface from below. Some of them took the form of two cartwheels, one abeam of the port bow and ahead; the other abeam of the starboard bow and ahead of it'.

3. 'The first impression was of patches of frothing luminosity on the sea surface approaching the port bow, one after the other, at intervals of one second. . . . The general effect was similar to the beam of light from a light-house flashing across a swell. . . . The approaching bands of light were very straight and regular'.

This difference in the interpretations of a single event is hardly surprising in such unusual and ephemeral circumstances in which changes occur with great rapidity and which are variously described as 'eerie', 'weird', 'almost frightening' and 'alarming'. The results in one case were that 'the lookoutman came on the bridge quite scared, believing he was suffering from hallucinations' and in another 'the Chinese quartermaster became panic stricken, left the wheel and did not return until he had been called three times'. The differences do, however, highlight the subjective nature of each account and emphasise how difficult it is to achieve accurate estimates of speed or size. This is a problem apparent to any watchkeeper who has had to report hazy events noted at night in the absence of fixed reference points. It is equally familiar to the police, who are frequently confronted with conflicting accounts of the same event by different witnesses!

We have so far collated almost 230 reports which describe either wheels, spirals or moving bands of luminescence. It is unlikely that all describe the same phenomenon; inevitably some will be of dissimilar events with superficially similar appearances but different causes. Nevertheless we believe that the great majority do describe the visible features of a single type of phenomenon, which we assume has a common cause.

The first question to be answered is the source of the light. There are several physical mechanisms by which light might be produced. One of these, electroluminescence, has been suggested by Staples (1966). He noted the possibility that a shock wave might induce light from bubbles of oxygen produced by the phytoplankton during daytime photosynthesis. Under certain conditions sound waves and cavitation can produce similar effects. It seems doubtful, however, whether such bubbles would survive during the dark hours when no photosynthesis occurs, yet when the phenomena are visible. It is far more likely that the light is bioluminescence produced by the small luminous organisms in the water, particularly the dinoflagellates and small planktonic animals. This surmise is supported by the fact that larger luminous objects are often observed in the bands as they pass. On one occasion a water sample was obtained at the same time and was found to contain numerous luminous dinoflagellates, as would be expected if the light was indeed bioluminescence.

The second fundamental question is what produces the observed patterns of bands or wheels of light. A few are undoubtedly produced by the stimulatory effect of shoals of fish or squid on luminous plankton. In April 1984, for example, the *ACT 7* in the eastern Atlantic encountered 'large whirling spirals containing thousands of fish (luminescent)', an appearance which would have led to its identification as an ill-defined phosphorescent wheel had the 'fish' (probably squid) not been visible. The *British Fulmar*'s observation (also in the Atlantic) of a 15 m diameter 'circular patch of extreme intensity . . . appearing to rotate rapidly clockwise about a centre point' is probably of similar origin. Most reports are clearly quite different and there have been several suggestions as to their cause but none satisfactorily explains all the observations. A Russian writer, Tarasov (1956) tried to explain them as 'eddies of whirling water' while Leslie and Adamski (1953) in their book *Flying Saucers Have Landed* regarded them as indications of extraterrestrial visitations by UFOs. Hilder (1962) interpreted them as magnetic phenomena induced by the combined effects of local variations in the earth's magnetic field and the magnetic effects of the introduction of iron and steel ships. This neatly explained the fact that there is a general lack of reports from the days of wooden sailing vessels (though that of H.M.S. *Vulture* is a notable exception), but gave no clear rationale for the formation of waves or wheels, though Hilder explained how the rotation direction could depend on the polarity of the ships' magnetic fields. He also argued that they were restricted to southern Asiatic waters because of the local magnetic variations. This is less convincing in regard to the Persian Gulf which is also a major area of 'wheel' activity.

Consideration of the positions of the various reports (Figure 1) shows that there is a restriction to tropical regions, between 35°N and 25°S and that it is a predominantly Indo Pacific phenomenon, 95 per cent of the observations occurring in this area. Even within this general region there are areas of particularly frequent reports. These are, the Persian Gulf and Straits of Hormuz

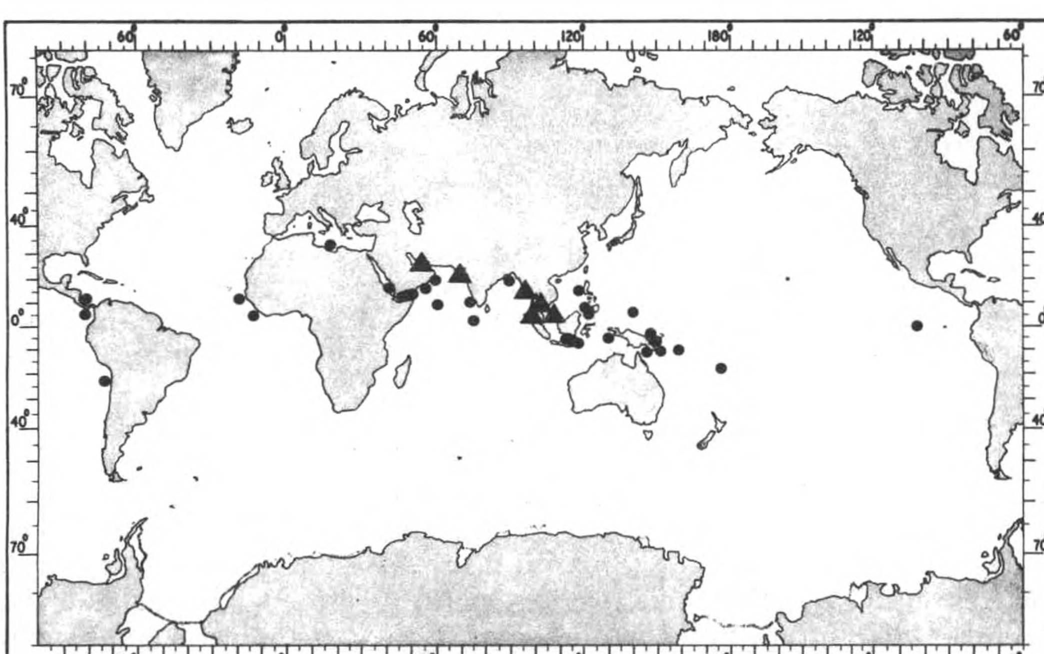


Figure 1. Geographic distribution of 'phosphorescent wheels' and moving 'parallel band' observations. Dots are single observations, triangles indicate areas of particularly numerous observations. Report clearly ascribable to fish, etc. (see text) are not included.

The unusual cloud formation observed from m.v. *Mairangi Bay* (*see* page 179)

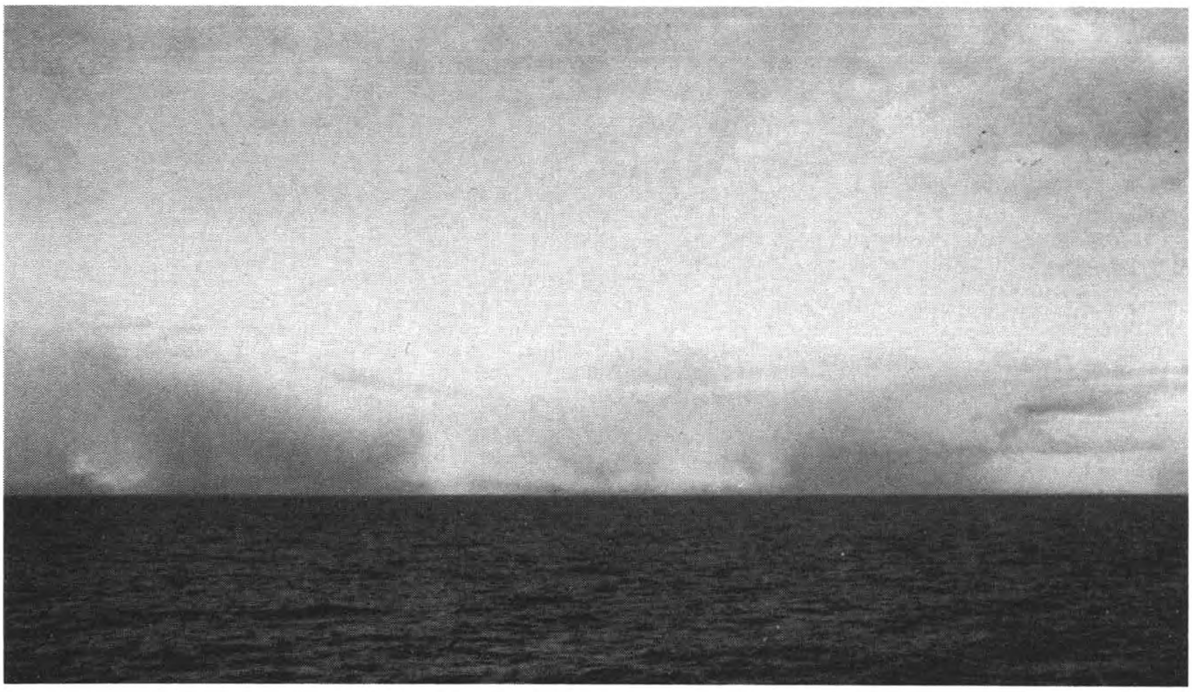


Photo by P. Jackson

Stratocumulus cloud observed from m.v. *City of Durban* (*see* page 180)

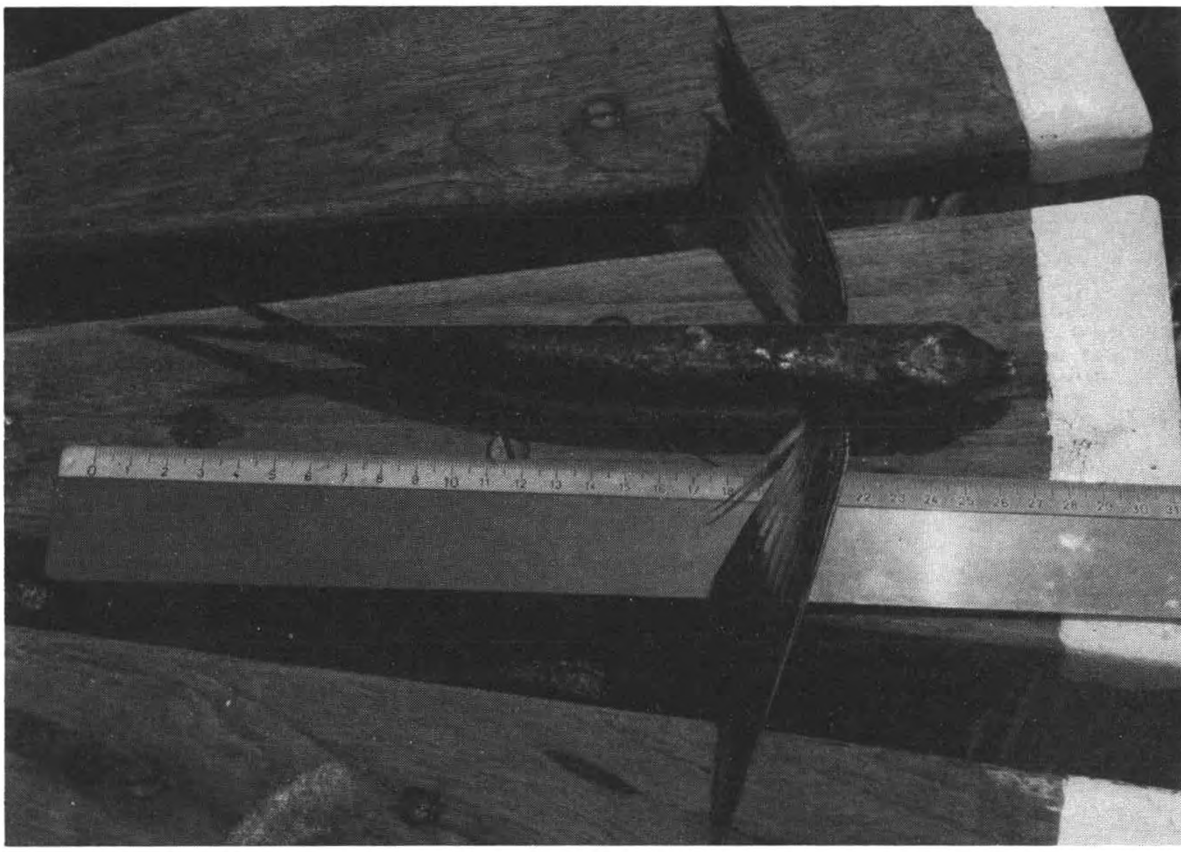
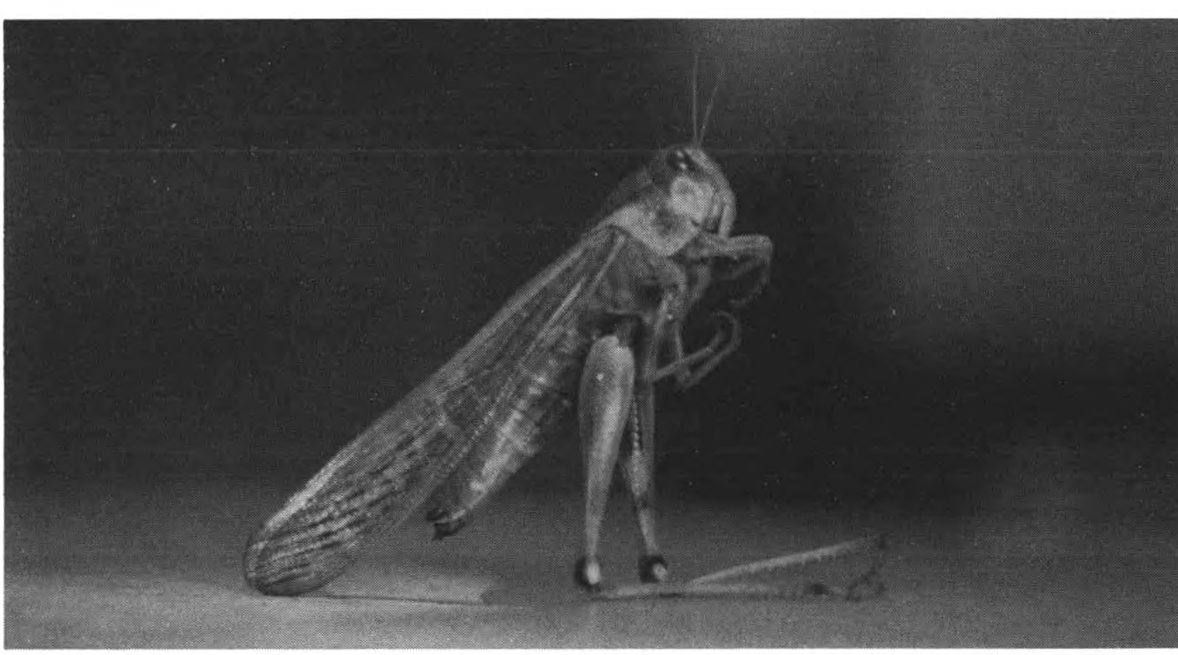


Photo. by B. A. Mullan

The flying fish found on board m.v. *Moreton Bay* (*see* page 184).



The locust which was discovered on board m.v. *ACT 7* (*see* page 190)

(48 reports) (Figure 2), the Gulf of Thailand (47), the South China Sea (42), the Strait of Malacca (26) (Figure 3) and the coastal seas adjacent to Karachi (11), Rangoon (7) and Bombay (6). The number is inevitably biassed by the frequency of shipping in different areas but a consistent pattern of distribution is clear. All these areas are relatively shallow, with water depths of less than 200 m, and the majority of other reports are from waters of similar depths, though a few are from deep water.

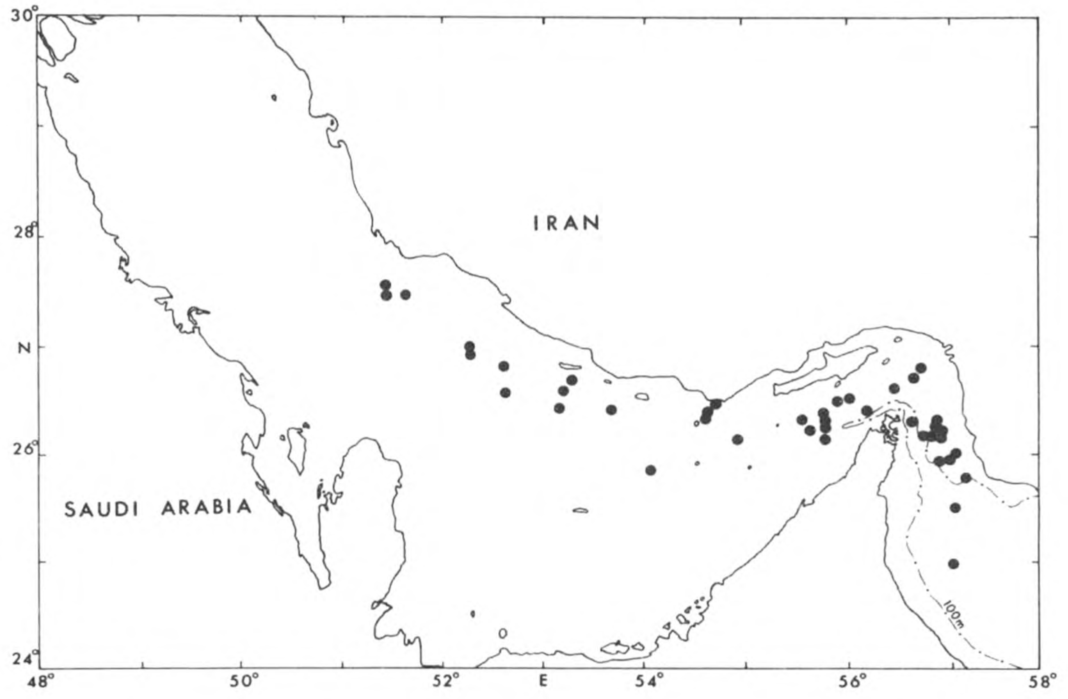


Figure 2. Known positions of 41 observations in the Persian Gulf and Straits of Hormuz. The 100 metres depth contour is indicated.

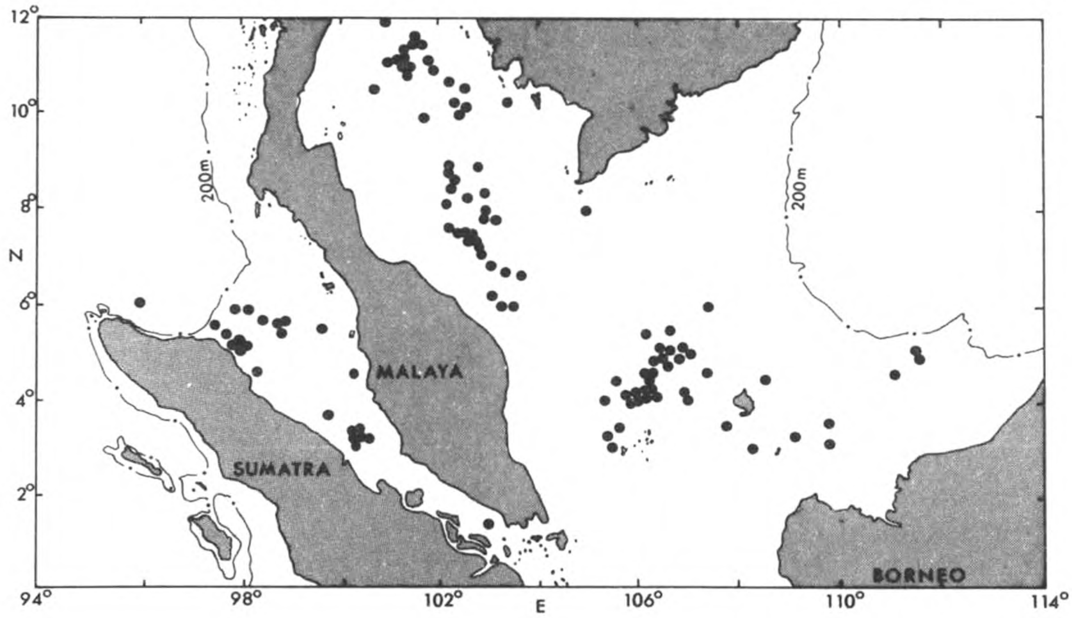


Figure 3. Known positions of 111 observations in the Strait of Malacca, Gulf of Thailand and South China Sea. The 200 metres depth contour is indicated.

This shallow distribution led the German hydrographer Kalle (1960) to a most ingenious explanation. He took the view that the observed patterns derived from the shock waves produced by submarine earthquakes and other seismic activity. He concluded that when these occurred in deep water the 'erupting ball' type of luminescence resulted but that when it occurred in shallow water 'phosphorescent wheels' were produced by the interference patterns set up by multiple reflections of shock waves at the surface and the bottom. He was able to show theoretically that under a variety of reflective conditions rotating wheels, parallel bands and concentric circles could be produced by these interference patterns. If these patterns stimulated the luminous organisms then the observed luminous phenomena would be produced. This explanation predicts that there should be a mirror symmetry in the wheels thus produced, with each half rotating in opposite directions, and that they should be observed only in regions (and at times) of high seismic activity. Both these predictions are difficult to test. The patterns of activity of the wheels are rarely described as symmetrical, though this might be the cause of the occasional impressions of their reversal. Although both south-east Asia and the Middle East are areas of known seismic activity a closer correlation with the observations is not obvious in the detailed distribution of submarine earthquakes and volcanic activity. The line of peak activity is to the south-western margin of the area of the south-east Asian reports, and the Gulf of Thailand, for example, is almost devoid of seismic events, despite its high frequency of wheel reports.

A more prosaic explanation of the parallel waves was provided in 1910 and 1921 by G. F. Tydeman, later Vice-Admiral of the Royal Dutch Navy, and based on the observations of the *Valentijn* in the China Sea in 1910. This was amplified by Dr Termijtelen of the Dutch Meteorological Institute in 1950 in *The Marine Observer.* The explanation assumed that the vessel encountered a long patch of luminous plankton. The interference between the existing waves and the bow wave produced breaking points at their intersections in the patch which in turn resulted in lines of light moving along the existing waves. The perspective effects of the parallel lines of light would make them seem to converge at the horizon and the relative movement of the ship would give the impression of rotating spokes. If the ship then passed through the middle of the patch the wheel on one side would disappear, only to reappear apparently rotating in the opposite direction on the other side. Tydeman accounted for those waves of light reported to be travelling above the surface by assuming that in these cases the luminous organisms were deeper in the water and that the surface waves acted as long cylindrical lenses focussing the deep, uniform, luminescence as lines of light on any superficial mist or haze. Perspective effects still produce the illusion of converging spokes, and the direction of their apparent rotation is determined by whether the observer is above or below the focussed lines of light.

The theoretical geometry of this explanation has been examined in some detail by Verploegh (1968) who finds it entirely consistent with many of the reports and emphasises the frequent allusions by the shipboard observers to rotating underwater searchlights or lighthouse effects. The speeds of the waves or spokes are usually reported to be 'very rapid' or 'tremendous' and estimates vary between 30 miles per hour and 30 miles per minute! However Verploegh calculated from the data in five reports that their true speed was 9 metres per second (20 miles per hour) and, making various assumptions about the wave forms, that waves of the observed periods (1·3–3 seconds) had theoretical focal lengths (2·5–14 metres) very close to the reported wavelengths of the bands in the eight 'most reliable' reports (5·5–9 metres).

If all these correlations are correct, and applicable in every case, the resulting conclusions are that (1) parallel waves are produced either by the refractive effects of surface waves on deeper luminescence, or by the interaction of intersecting surface waves, and (2) 'Wheels' and their rotation are illusions of perspective effects acting on parallel bands. One of the best examples of support for the latter supposition comes from Pringle's 1879 observations from H.M.S. *Vulture*. After describing the wheels he writes, 'I then went to the mizen top (50 feet above water) with the 1st lieutenant, and saw that the luminous waves or pulsations were really travelling parallel to each other and that their apparently rotatory motion as seen from the deck was caused by their highspeed and the greater angular motion of the nearer than the more remote part of the waves.' Another report tallying almost exactly with the predicted effects of perspective is that of the *Szechuen* in the South China Sea in 1952: 'bands of light on the port side began to revolve in a clockwise direction . . . As the centre of rotation came more on the beam the apparent direction of rotation was reversed. When the centre had passed the bridge, the revolving motion ceased . . .' Several other vessels also report wheels whose direction of rotation reverses as they come abaft the beam, and this evidence strongly supports the supposition that these wheels are illusions. Any illusory wheels can be expected to have very long spokes and indeed most estimates vary between several hundred metres and 'to the horizon'. If all wheels are illusory then no more than half a wheel should ever be visible. Nevertheless many reports include drawings of whole wheels. There are a few reports of much smaller wheels, ranging from 5–50 metres radius, and it is difficult to interpret these as similar illusions. The *Tokyo Bay* in the South China Sea in 1978 saw two rotating wheels 15–20 metres in diameter, one on each bow and rotating in opposite directions. These moved into the vessels side and then veered off astern. Another problem is the explanation of concentric spreading rings, which cannot be a similar product of perspective, nor do they match either of the two theories (in (1) above) by which waves of light may be produced.

One explanation of concentric rings of light, put forward in 1879 to explain the *Vulture* report, postulated a central flashing point source whose light stimulates adjacent organisms and the luminous response then propagates outwards as a series of rings, whose period reflects the flash frequency of the organism (or patch of organisms) at its centre.

The extensive series of observations in our collection suggests that another factor may often be involved, namely the vessel itself. This is not a novel conclusion and was voiced by M. Rodewald in 1954 as well as by many observers. One feature commonly noted is the frequency of waves (or spokes). 130 of our reports include an estimate of frequency and 121 of those were between $0{\cdot}5\ s^{-1}$, and $3\ s^{-1}$, with 96 between 1 and $2\ s^{-1}$. This is the frequency range of the engine revolutions of most vessels. In some cases there is a very close correlation indeed; the *Malaita* reported patches pulsating at 94 min^{-1}, the same frequency as the engines. The *Bulolo* reported flashing lines pulsating away from the vessel at 90 min^{-1}. Flashing patches reported by the *Yochow* were at 102 min^{-1} and were seen as another vessel passed by. Other evidence is the frequent appearance of the vessel as the centre of the phenomenon. The *Glengarry* reported 'Concentric circles converging on the vessel from the horizon at approximately the same frequency of 95 r.p.m. as the engine revolutions'; the *Dione* was similarly at the centre of a wheel; the *Stanrae Bangkok* 'had the impression that the vessel was causing it'; the *Hecate* had 'the subjective impression that it centred round the ship' and the *Glenfalloch* reported wheels whose intensity increased with their proximity to the ship. The *Brandon Priory* described 'pulsating sheets of light radiating from the vessel to the horizon'; the *Titan* noted how 'sound and vibration noises given off by the ship's engine was seen to agitate . . . luminescence' (of dinoflagellates); the *Kowloon Bay* suggested that the engine caused the 'circular waves emanating from the vessel on each side', and a similar description was given by the *Mahsuri*. Other vessels have reported wheels apparently maintaining station with the vessel's track and in many cases the wheels were either symmetrical about the vessel or alternated from one side to the other. The *Tabangao* reported that the wheels stopped when the vessel stopped.

The circumstantial evidence for an involvement of the vessel itself is therefore strong, though some observations could equally well be explained as illusions of perspective. It also accounts for the infrequency of reports from the era of sail or from twentieth century vessels under sail. The critical experiment of stopping the engines has never been done, though the *Tabangao* report is highly suggestive. If the wheels do continue after stopping engines then clearly the ships vibrations are not involved. We do not suggest that the vessel is always the cause of parallel bands. We do, however, believe that interference between vibrations emanating from the vessel and other wave patterns, such as wind-generated surface waves and swell or even internal waves, do produce some of the local wheels and other effects. Very large wheels are probably illusory, as Tydeman and Verploegh have convincingly argued. An analogous illusion can be experienced in a train passing a ploughed field whose furrows are 'end-on' to the observer. An apparent clockwise rotation is seen to the left and an anticlockwise one to the right. The immensely complex events of the phenomenon reported by Kuzmanov (1983) from the *Siam* in the South China Sea contain almost all the elements related in other accounts. Three to four wheels were observed at once, arranged around the vessel and travelling with it. In addition they appeared to rotate around a common centre and alternated with four sets of parallel bands coming towards the vessel at right-angles to each other. Patches flashing with a frequency very close to that of the *Siam*'s engines were also observed and the frequency was unaffected by changes in the vessel's course. A survey vessel some 17·5 n. mile north of the *Siam* saw nothing unusual. The tantalising nature of this and other accounts still lies in our uncertainty about the precise causes of the patterns and their restriction to certain areas of the world's oceans. It could be argued that it is the biological features of the particular areas that allow the stimulatory wave patterns to become visible by their luminescence, but there is no obvious biological factor that can be recognised as common to the main areas of the reports. Until and unless more observations are made, bearing in mind the various possible explanations, it will be impossible to distinguish between the suggested causes. Any observer fortunate enough to encounter any of these events should try to distinguish in particular whether a whole wheel is visible at once, whether it has a mirror symmetry of rotation and whether stopping engines stops the phenomenon.

Perhaps one of the more surprising factors is that no-one has located any descriptions of these phenomena made by local fishermen or other small boat traffic. Dramatic appearances of this sort might be expected to be enshrined in local folklore. The absence of any such stories from small boats is perhaps another fact supporting the involvement of the large vibratory source provided by the naval and commercial vessels from which most of the reports derive. Polynesian and Micronesian folklore does include descriptions of waves of light in the sea and their use as navigational aids. 'Te lapa' (as this phenomenon is known) is only encountered at least 8 or 9 n. mile offshore, though said to be best seen 80–100 n. mile out, and is described as like underwater lightning some way below the surface. Its direction indicates where land lies and its flickering rate gives an intimation of the range. According to Lewis (1972) it is probably produced by reflected swells but it appears to be unrelated to 'phosphorescent wheels' and parallel bands, which are extremely rare in the area concerned.

There is one aircraft observation on a moonless night over the South China Sea that describes patterns of bands that were probably luminous bands and clearly were not related to any vessels. Two aircraft of 210 Squadron at 6000 feet on 21 November 1949 saw disturbances that 'resembled that of shock waves. . . . The waves were moving quite rapidly with a speed and nature similar to those caused by dropping a stone in the water. . . . There was no breaking of the surface, the impression being of enormous ripples. There were several isolated instances of disturbance; some appeared curved, others square in shape.' Each patch had groups of parallel waves, and in each patch they had a different direction. No submarine earthquakes were recorded at the time. The speed and wavelength of the bands are not recorded in the aircraft report, but the description of the wave patterns is typical of internal wave trains. Internal waves usually travel relatively slowly (0·3–1·5 m s^{-1}) and have wavelengths of 50 metres or more. In these reports they do not correlate well with most of the ship reports of faster trains of shorter wavelengths. There are also a very few observations of parallel bands by sailing vessels (which could not have been the source of the waves), including the first recorded report, that of H.M.S. *Bulldog* in 1875 when becalmed north of Vera Cruz, and that of the wooden hulled H.M.S. *Vulture*.

Perhaps the shipboard observations will one day also be augmented by simultaneous space shuttle or satellite observations but until that circumstance arises we are largely dependent for our information about these extraordinary events upon the powers of observation of the Voluntary Observing Fleet (VOF), and the care and detail of the records in the logbooks.

Acknowledgements

Most of the cited reports are from VOF vessels whose logbooks are deposited at the Meteorological Office. An unpublished catalogue of 'phosphorescence' reports by the late Mr E. W. Barlow of that office has proved invaluable. We also thank Dr R. H. Kay for access to his correspondence, Dr T. Wyatt for locating some of the Dutch reports and Mrs H. Noordhuyn for translating them. Lt.-Cdr. G. A. Franklin of the Hydrographic Department, Taunton kindly provided copies of some of the early naval reports. We are most grateful to Dr S. A. Thorpe for his comments on the manuscript and information on internal waves.

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551.466:629.12

Treachery of Freak Waves*

By Captain T. Wilson Cameron, mni

Recently I was leafing through some copies of *Seaways* and came across an article I had not seen previously; probably I was away when the magazine was delivered. The copy was headed 'Abnormal Sea Waves' and appeared in the South Wales branch news of the January 1981 issue. It inspired me to set down that which follows.

In 1961, I was master of a small reefer on a voyage from Dover to Las Palmas. Our passage across the Bay in ballast was very stormy—the month was January. When off the north-west of Spain, the wind was on our starboard quarter, blowing a moderate gale with a very rough sea. Our Spanish third mate, an excellent and mature officer, fixed our position by bearings of shore lights and reported that we were on the 100-fathom line and stated, 'Very dangerous seas are often found around here'. I asked him where he had obtained this information from, and he replied that his father and grandfather had often warned him about this area.

Forthwith we altered course four points to starboard and in an hour or so the sea conditions improved considerably, so we were able to resume course for our destination and our voyage was completed without trouble. I have always remembered my Spanish shipmate's advice, and passed the information on to many officers I sailed with afterwards, especially if we were passing the Bay of Biscay.

Several years later I was sailing, on this particular voyage as chief officer, on a very well-constructed, well-maintained ore carrier from Monrovia to Birkenhead. The vessel was of 16 000 tons dwt, with bridge amidships and engines aft. I noticed one day that our homeward-bound track had been laid off right on the 100-fathom line off the coast of Portugal and Spain. I advised the master of the warning I had received from my Spanish officer and the source of his information but my captain said he did not believe yarns from third mates and we would keep the course as laid off.

A few days later off the north-west coast of Spain the wind was north-by-west, force 6–7 and the ship was spraying and occasionally shipping water. The weather was not troubling our ship to any extent. The sky was partly cloudy with a full moon in the west. At 0520 hours the moon was blotted out and all turned dark. I looked to port to see what type of cloud could obscure the moon so thoroughly, and was amazed—horrified, rather, to discover it was no cloud, but an immense wave approaching on our port beam. It stretched far north and south, had no crest, nor white streaks, and as it neared at quite a speed, I could see its front was nearly vertical. I yelled to the lookout man to come into the wheelhouse as he was on the starboard side of the bridge and could not see the wave.

As near as I could judge, about 80 to 100 yards away the wave started to break, and in another few seconds reached our ship and struck us fair abeam with three distinct separate shocks, sweeping our ship for her full length. Fortunately, the vessel rolled away just before the impact and this I am sure saved us from even more serious damage. Our MacGregor hatches escaped any injury and sounding around the ship revealed we were not making water. Some of the damaged items were quite extraordinary.

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* Part of a feature entitled 'Incident Desk' reproduced from *Seaways*, January 1985 by kind permission of Mr C. J. Parker, B.Sc, FNI, Secretary, The Nautical Institute.

Damage received

The forecastle head deck was set down about 3 in, and inside 14 in channel bars which formed the deckhead beams were cracked through, 5 in stanchions were buckled and the wooden shelving supported by 5 by 5 in timber vertical uprights was almost completely wrecked; many uprights were split top to bottom. Two floodlights bolted to our curved bridge front were swept away, along with their mountings—these were 50 ft above the sea. Heavy steel ladders from the bridge to maindeck were torn from their fastenings, spun around on their handrails and rammed up into a nearby alleyway where they stayed jammed against the deckheads.

Despite heavy brass helmets, the glasses were cracked on both gyro repeater and magnetic compasses on the monkey island 70 ft above our waterline. On the after house, heavy permanent awnings made of sturdy corrugated plastic and bolted in position were mostly swept away. There were many strange items of damage, but the ship remained watertight and seaworthy.

The wave was higher than our foremost track—85 ft above the water. As this wave approached from a direction 90 degrees different from the normal sea and wind, which had been northerly for a few days previously, I put its existence down to a submarine earthquake in the mid-Atlantic ridge. Certainly it appeared so much different from the normal wind-generated sea, of which I have seen thousands. There was no crest, nor white streaks, a nearly vertical front and quite a fast approach. Some time after this event, out of curiosity, I calculated the altitude of the moon at the time and found it to be 17° 42′. When daylight came, and I could examine the ship closely, I found that along with other strange damage our 7-in thick windlass bedplate had been cracked right through and right across in the way of the spurling pipes. The damage had to be reported to the owners.

In January this year (1984) I read in a popular Sunday newspaper that an Italian bulk carrier of some 20 000 tons was en route to Genoa from Rotterdam, when about half-way across the Bay of Biscay the master had reported to his owners that all was well. The ship, however, was never heard of again after this. The paper went on to say that the previous year a ship of the same company, of the same tonnage and on the same voyage had similarly vanished. This disappearance of two ships puzzled everyone concerned. I wrote the paper telling of my warning and experience on the 100-fathom line off NW Spain, and although acknowledged, no paragraph or word of warning was given.

On one Admiralty chart I can remember a little warning notice being printed, advising one to give the coast a wide berth, as the lights, being high, were often invisible in low cloud conditions. It would be quite natural for a cautious or nervous mariner to steer out for the 100-fathom contour line and use it as a clearing mark, only to encounter a dangerous sea often—I repeat, often—found hereabouts.

Gulf Stream Sea

In 1963 I was on a voyage from Corpus Christi, Texas to Rotterdam on a 16 000 ton bulk carrier, six months old, with everything aft. One evening we had just passed Miami and were endeavouring to stay in the axis of the Gulf Stream. It was a beautiful night, with a light NNE breeze, rippled sea, almost cloudless and with a full moon shining. I was yarning to the chief engineer in his room when I felt the ship commence to lift forward. I ran to the window and was startled to see an immense white foaming mass close ahead. I made the wheelhouse one flight up in record time and arrived there just as the foaming wave came over the bow. The entire deck was flooded to the gunwales; the sea water lashing about the decks was alive with phosphoresence.

Once that solitary wave passed, the surface of the sea returned to normal—just rippled—and there were no more alarms. The only damage we sustained was a slightly bent ladder, leading up to our after mast house, 400 ft abaft our stem. My chief officer who was of a mathematical turn of mind, calculated that when we were full of sea water on deck to the top of the bulwarks some 3000 tons of water was on board.

I did wonder later—did the U.S. m.v. *Sulphur Queen* encounter such a sea? She was a T2 tanker engaged in carrying liquid sulphur, and on our maiden voyage, whilst we were anchored awaiting a berth outside Port Arthur, Texas, she sailed from that port bound for a northern port in the U.S.A. She vanished without trace.

I reckon this sea was a seiche wave. An intense low had remained stationary for a few days north-east of Cape Hatteras and on the great circle track I intended to follow for the English Channel.

In 48 years at sea, naturally, I have encountered many gales in all the oceans of the world, but only twice have I encountered abnormal seas, and these are described here. A few years later I bought a paperback, *The Bermuda Triangle*. In that book I learned that an American passenger ship from Miami to Nassau had on the same night encountered a sudden wave on her port beam, which had caused considerable consternation on board.

I was surprised to read in *Seaways* that someone at the lecture about abnormal waves cast some doubts and disparaging remarks about the subject. That member has been lucky, but King Solomon, a landlubber, had the same trouble. However, he was honest enough to confess it in Proverbs 30: 18–19.*

* Three things are too wonderful for me; four I do not understand: the way of an eagle in the sky, the way of a serpent on a rock, the way of a ship on the high seas, and the way of a man with a maiden. (RSV).

551.466.3

Heavy Swell at Ascension

By A. K. Kemp

(Meteorological Office, Royal Air Force, Valley, Holyhead)

The following account may help to add to the good description given by the Officers of the m.v. *Keren* about a heavy swell which affected Ascension Island on 27 December 1983.*

The rollers of Ascension and St Helena have been known about since at least 1846. In that year thirteen vessels were wrecked on the shores of St Helena. Reports of the disaster indicate that waves broke seaward of the vessels at a depth of 70 feet and with a breaker height of 50 feet. It has long been suspected that the rollers originated from distant storms. On 1 March 1886 the ship *Buccaneer* at Ascension experienced a very heavy swell. Using ships' logs it was

* See *The Marine Observer*, October 1984, No. 286, pp. 189–190.

Opposite page 204

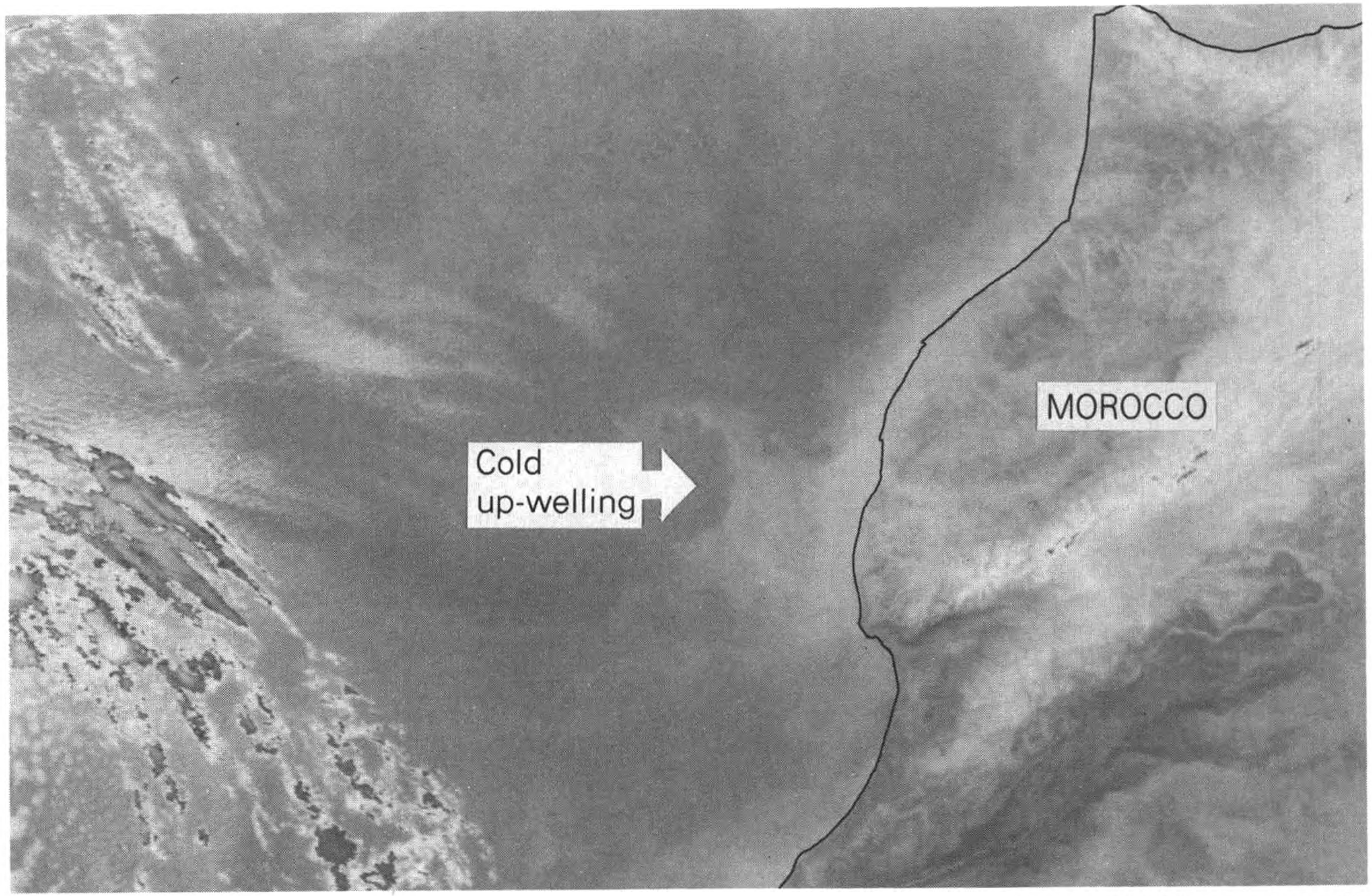

Photo from NOAA Oceanographic Monthly

NOAA-6 infra-red image from 10 October 1984 of coastal waters off the west coast of Morocco (*see* page 184)

Presentation of barographs on 20 May 1985 at Bracknell Headquarters. Left to right, standing: Captain K. Lehepuu; Captain R. A. G. Simmons; Captain C. R. Kelso; Captain A. Dorkins; Captain D. Laverick; Captain M. J. Charlesworth; Dr J. T. Houghton. Seated: Mrs Lehepuu; Miss J. Foster; Mrs Charlesworth; Captain E. Colley (*see* page 207) later estimated that the swell had originated from a storm at 40°N, 55°W on 25 February. The velocity of the waves was calculated to be 30 knots at the start, increasing to 48 knots at Ascension.

To find out the cause of the swell which affected Ascension on 27 December 1983, it was necessary to examine weather charts of the North Atlantic for the previous week. Just before Christmas 1983 an intense burst of very cold air spread south across eastern parts of North America. When this very cold air moved over warmer waters of the Atlantic a deep low pressure area developed which reached its maximum intensity at about 1800 GMT on 22 December (Figure 1). By this time, north-north-westerly winds were in excess of 70 knots over a large area to the west of the depression. Even by Atlantic standards this

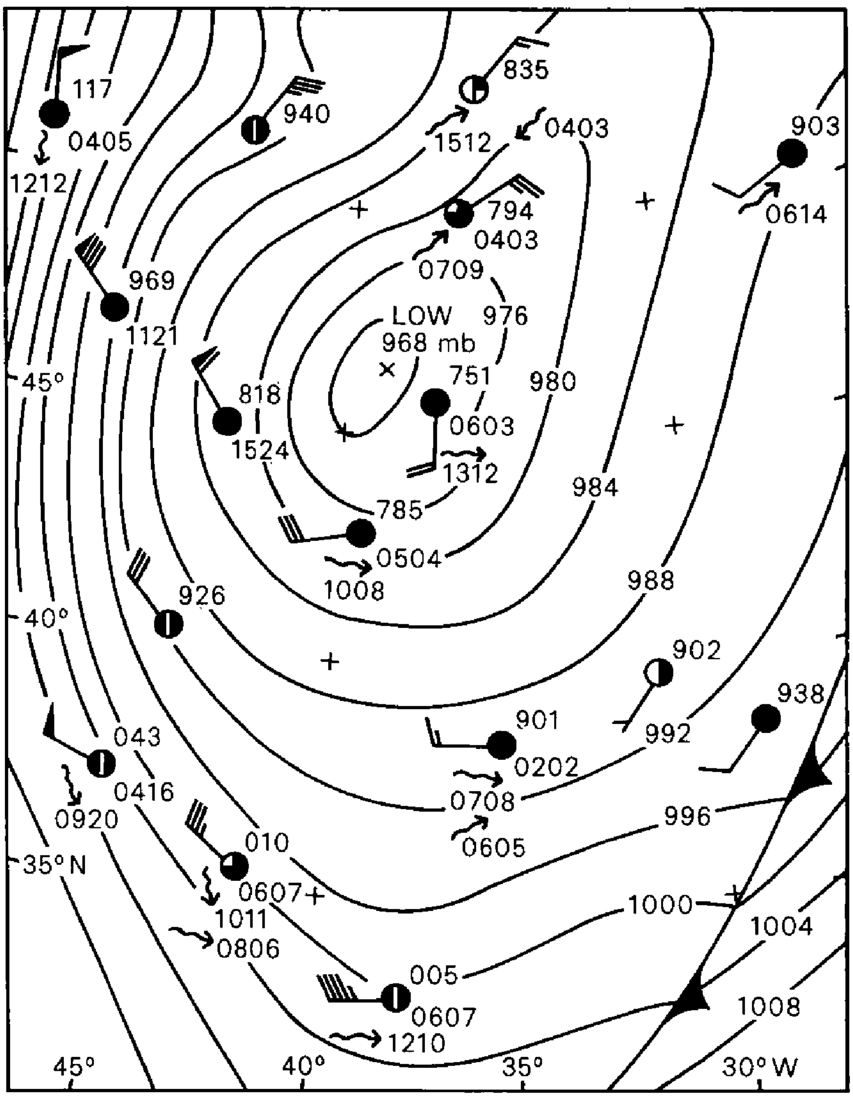

Figure 1. Part of the synoptic chart for 1800 GMT on 22 December 1983, showing the strong north-north-westerly air-flow to the west of the depression.

was an exceptional storm and many ships were in trouble with some loss of life.

The depression moved SSE in the direction of the largest waves it was generating; ideal circumstances for rapid augmentation of the already high waves. Calculations show that the waves with an initial wavelength of 150 metres would move at 30 knots and arrive at Ascension in just under 6 days. In practice the interval would be shorter, with time, swell waves increase in wave-length and therefore in velocity.

Contrary to the report from the *Keren*, the inhabitants on Ascension have no foreknowledge of approaching rollers although past experience has shown that they are more likely to occur during certain seasons of the year, especially during the winter in the northern hemisphere. However, given the motivation, it is usually possible to forecast the arrival of a heavy swell at a particular location. In the case just described, using the 1800 GMT actual weather chart for 22 December, five days warning could have been given of the heavy swell. In fact more than five days warning might have been possible since the Meteorological Office, Bracknell, now usually can predict the development of major storms in the North Atlantic several days ahead.

For the swell to maintain its energy over long distances it must move through uninterrupted water and not pass through regions where strong winds would oppose the movement of the swell waves. These fast-moving swell waves from very distant storms are virtually undetectable out at sea because of their low amplitude in deep water, but when they approach a shelving beach the steepening and breaking of the swell waves can be dramatic, as manifested in December 1983, at Ascension Island.

The U.S. *Mariners Weather Log*, Spring 1984, page 102, reported on the identical storm as follows:

'This incipient LOW formed in the trough of a LOW that was south of Kap Farvel and still part of another major cyclone. A Gulf of Mexico frontal wave was travelling northeastward towards this trough which was between two large HIGHS. Observations at 1200 from three ships aided the analyst in identifying the small circulation. There were already 40 knot winds and 20 foot seas in the area. By 1200 on 21 December the storm was 952 mb near 53°N, 35°W. The centre was almost directly

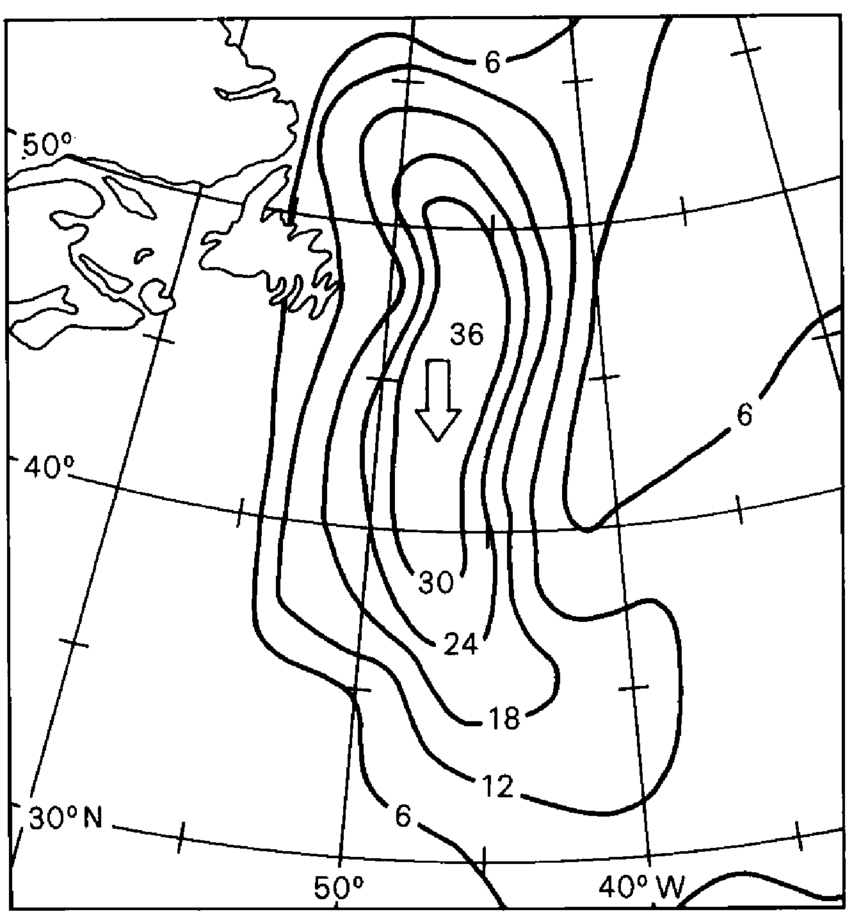

Figure 2. Sea wave chart for 0000 GMT on 23 December 1983.

over Ocean Station CHARLIE (USSR) which recorded a sea level pressure of 952.2 mb and 35 knot east winds. A ship in 48°N, 37°W had 50 knot easterly winds and 30 foot waves. Another ship in 49°N, 41°W had 33 foot seas and swells. By 1200 the storm's centre had risen to 973 mb but the gradient to the west had intensified as high pressure drifted eastward and the storm was circling westward and then southward. On 22 December there were numerous storm-force reports. Two vessels near 47°N, 48°W reported measured winds of 77 knots and 63 knots respectively, both reported 35 foot seas. Another near 47°N, 48°W measured 80 knot northwesterly winds and 38 foot seas. On 23 December the storm was headed northeastward again (Figure 2).'

PRESENTATION OF BAROGRAPHS

In culmination of the announcement in our bulletin on page 85 of the April 1985 issue, the following shipmasters were presented with inscribed barographs by the Director-General at Bracknell on 20 May 1985: Captain M. J. Charlesworth, MNI, Rowbotham Tankships Ltd, Captain A. Dorkins, P. & O. Bulk Shipping Ltd, Captain K. Lehepuu, MRN, MNI, ex Furness Withy (Shipping) Ltd, and Captain R. A. G. Simmons, Cayzer Irvine Shipping Ltd. (*See* photograph opposite page 205).

It was also our pleasure to welcome Mrs Charlesworth and Mrs Lehepuu, as well as Captain D. Laverick, Chief Marine Superintendent, Rowbotham Tankships Ltd, Captain E. Colley, Marine Department, P. & O. Bulk Shipping Ltd, Captain C. R. Kelso, Marine Superintendent, Cayzer Irvine Shipping Ltd and Miss J. Foster, the latter company's Public Relations Officer.

Before the ceremony in the Meteorological Office board room, the Director-General, Dr John T. Houghton, CBE, FRS, D PHIL, highlighted the problems entailed in bringing together four shipmasters at the same time and place, saying that this was a rare occurrence as it was not since 1977 that all four recipients had been able to attend at once. The day was one of the happiest in the Meteorological Office calendar, with the presentation of barographs to the four masters in recognition of their excellent efforts, perpetuated throughout many years of weather reporting for the Voluntary Observing Fleet (VOF). In saying thank you to them, he said, we must not forget their ladies who had so ably supported them over the years.

Dr Houghton said that although we have a system for receiving global weather information 24 hours per day, the coverage of this information would have enormous gaps over ocean areas if it were not for the excellent weather reports submitted by the personnel of vessels in the VOF. The personnel are to be congratulated on the continuing frequency of their observations, but more importantly, for the high quality of the data received. He emphasized that quantity was not so useful unless it was coupled with quality, and, happily, the Meteorological Office was the recipient of both from ships.

Following the formal presentations before the assembled guests and members of staff, the four masters were able to take a look back in time at earlier records they had helped to compile, as well as their record cards summarizing their outstanding services to the organisation.

Sir Nelson Johnson, KCB, Director of the Meteorological Office at the time, introduced the Barograph Award scheme in 1948 for which the current qualifications are a minimum of 17 years of observing and the receipt of at least one meteorological logbook in the 12 months of the relevant year, 1983.

J.F.T.H.

AURORA NOTES OCTOBER TO DECEMBER 1984

By R. J. Livesey

(Director of the Aurora Section of the British Astronomical Association)

In Table No. 1 are summarized the observations which have been received from ships during the period. There are odd occasions when a report is obtained after the preparation of the quarterly reports for publication, do not worry about this as late data is still logged in the records and is still available in the national aurora archives to any researcher who may wish to see them.

Table 1—Marine Aurora Observations October to December 1984

Date	Ship	Geographical Position		Time (GMT)	Forms in Sequence
2 Oct.	*Cumulus*	66° 00'N,	02° 02'E	1940–2300	qhA, $p_2p_3R_1V$, acR_2RA
2/3	*Starella*	57° 20'N,	20° 00'W	2240–0548	qN
3	*Cumulus*	66° 00'N,	02° 00'E	1954–2140	p_2mR_3RA, $amSGp_2mR_1R$, qfSG, $p_4$fsa, aR_2RA
5	*Irene Greenwood*	72° 10'N,	11° 36'E	2120–2130	qN
7	*Starella*	57° 20'N,	20° 00'W	0545	qN
12	*Irene Greenwood*	74° 00'N,	10° 00'E	1900–2250	aB+p
19	*Challenger*	57° 30'N,	07° 00'W	0055–0115	aG, RA, RB+RA
19	*Starella*	57° 20'N,	20° 00'W	0445	qN
21	*Starella*	57° 20'N,	20° 00'W	2030–2050	ahB, qN
22	*Starella*	57° 20'N,	20° 00'W	2245	qhB
24	*Starella*	57° 20'N,	20° 00'W	0001–0350	qN
14 Nov.	*Cumulus*	57° 20'N,	20° 00'W	2140–2200	qfhG
15/16	*Coltair*	61° 36'N,	01° 18'E	1930–0005	mpV, aV
15/16	*Cumulus*	57° 20'N,	20° 00'W	2115–0300	afhG, afhRA, amRRA, all sky, acR_3p, afRRA, qfhn, afhg, afhRA, amRRA
16	*Cumulus*	57° 00'N,	20° 00'W	2045–2100	afRR, afhG
18 Dec.	*Cumulus*	57° 20'N,	19° 30'W	0005–0045	$amhR_2RA$, $amhR_3GR$

KEY: a=active, c=coronal structures, f=fragmentary, h=homogeneous, m=multiple, q=quiet, p=undefined pulsations, p_2=flaming upwards, p_3=flickering, p_4=horizontal streaming, s=striated, R_1=small rays, R_2=medium length rays, R_3=long rays, S=striated, G=glow, A=arc, B=band, RA=rayed arc, RR=ray bundle, RB=rayed band, V=Veil.

In Table No. 2 are listed the observations received from land, marine and air sources during the period in terms of locations, dates and times. As one might well imagine, it is not unusual for observers in northern Norway or northern Canada to see active aurorae on a regular basis as they are living virtually under the auroral halo which exists constantly around both of the magnetic poles. On the nights when a number of observers report activity, we can be sure that the storm aurora has activated and moved 'equatorwards'.

With one or two exceptions, the bulk of the activity within the period has emanated from coronal holes, or areas of weak magnetic activity in the sun's outer atmosphere. These have produced the more quiet recurrent aurorae which are to be seen in the higher magnetic latitudes. One particular coronal hole

Table 2—Auroral Activity reported October to December 1984

Date (Night)	Location and Number of Observers	Geomagnetic Latitude Lowest	Highest	At Storm Peak	Maximum Storm Activity Code*	Time (GMT)
2/3 Oct.	'Lima', Scotland (4)	59	67	67	6	1940–0548
3/4	'Lima' (1)	67	—	—	5	1945–2140
4/5	North Norway (1)	66	—	—	2	2005
5/6	Canada, Europe (3)	59	70	59	5	2120–0730
6/7	Canada (2)	56	64	56	4	0247–0830
7/8	'Lima', Norway (3)	61	63	61	5	2219–0545
8/9	Canada (1)	64	—	—	2	2020–2125
9/10	Scotland (1)	61	—	—	3	2130–2230
12/13	Norway (2)	60	72	72	5	1830–2250
18/19	'Lima', Europe (10)	54	66	56	5	1730–0445
19/20	'Lima', Europe (7)	56	66	60	6	0833–0610
20/21	Scotland (2)	59	60	59	4	2044–2145
21/22	'Lima', Norway (2)	60	63	63	5	2020–2050
22/23	'Lima', Norway (3)	63	66	64	6	2205–2245
23/24	'Lima', Norway (2)	63	66	66	4	1755–0350
25/26	England (1)	58	—	—	1	2330–0030
26/27	Scotland, Norway (2)	58	66	58	5	1755–0515
28/29	Norway (1)	66	—	—	3	2215
29/30	Norway (1)	66	—	—	5	2223
30/31	Norway (1)	66	—	—	6	2205
2/3 Nov.	Norway (1)	66	—	—	3	1805
4/5	Canada, Europe (3)	59	66	66	5	1815–0325
9/10	Norway (1)	66	—	—	3	1720
10/11	Norway (1)	66	—	—	3	2013
13/14	Norway (1)	66	—	—	2	1825
14/15	'Lima', Norway (2)	61	—	—	1	2000–2200
15/16	Canada, Europe, 'Lima', Australia (12)	58	64	63	6	1200–0330
16/17	'Lima', Norway (3)	63	66	63	5	1620–0030
17/18	Norway (2)	63	66	66	3	1620–2200
24/25	Norway (1)	66	—	—	2	1930
25/26	Canada (1)	64	—	—	2	0445–0515
28/29	Scotland (1)	61	—	—	1	2130
29/30	Norway (1)	66	—	—	3	2025
2/3 Dec.	Canada (1)	64	—	—	2	0320
4/5	Canada (1)	64	—	—	2	0330–0435
5/6	Canada (1)	64	—	—	3	0120
9/10	Canada (1)	64	—	—	5	0450–0510
11/12	Canada, Norway (3)	59	66	63	5	2125–0317
12/13	Canada (1)	64	—	—	5	0405
13/14	Norway (1)	66	—	—	1	2018
15/16	Scotland (1)	61	—	—	1	2045
16/17	Canada (1)	64	—	—	5	0425–0500
17/18	Norway (1)	66	—	—	3	2145

Table 2—(continued)

Date (Night)	Location and Number of Observers	Geomagnetic Latitude Lowest	Highest	At Storm Peak	Maximum Storm Activity Code*	Time (GMT)
22/23	Canada (1)	66	—	—	2	0405–0500
24/25	Canada (1)	66	—	—	5	0600–0745
26/27	Scotland (5)	25	61	60	4	2031–2245
27/28	'Lima', Norway (2)	63	66	—	5	1620–0045
29/30	Scotland (1)	61	—	—	1	2045

* Storm Activity Code: 1=Glow, patch or surface, 2=Homogeneous arc, 3=Rayed arc, 4=Ray bundles, 5=Active, pulsating or flaming storm, 6=Coronal structures.

whose activity began on, or about, 1 August in the previous quarter, continued its activity throughout the present quarter and into January 1985 when it suddenly disintegrated. It is a noticeable fact in the records, that the weather ships at station 'Lima' to the west of Scotland but at geomagnetic latitude 63 degrees north, observe more 'aurora nights' of a usually quiet nature during the quiet periods of the sunspot cycle than they do of strong active storms at the height of the sunspot cycle. This situation is the reverse of experience in central Scotland at geomagnetic latitude 59 degrees north, where 'aurora nights' are more plentiful at the peak of the sunspot cycle but are of the violent, transient type of storm aurorae rather than the quiet coronal hole types.

During the period, on the night of 25/26 December, Dr Richardson who was stationed at the hospital in Tank, North-west Frontier Province, reported the presence of a glow that developed into a homogeneous arc which rose to an altitude of 20 degrees or so. This disappeared only to be followed by the development of a second arc, which also rose and disappeared. The display took place between 1500 GMT and 1520 GMT and was visible because a power-cut had blacked-out all distracting lights from the town. Now the geomagnetic latitude of Tank is only about 25 degrees north and it would be unusual to see auroral activity here unless there was a large storm in being. Such storms have occurred in the past and sent the aurora south to be observed in Bombay and Singapore. Aurora was present in Scotland on that evening and there was a magnetic storm in the northern hemisphere. Was it an isolated occurrence of aurora due to a localized distortion in the earth's magnetic field? Was it an emission from a space vehicle caused to glow in the upper atmosphere?

This example is given to encourage ships' officers to record anything unusual that they may see, even if they themselves think it may not be worthwhile, or that they are not in the location where phenomena are likely to appear. One never knows the value of an observation, now or at some time in the future. After all, the old Chinese records are regularly consulted at the present time and they go back well into the dawn of historical records.

LETTERS TO THE EDITOR

From Mr Simon H. Barker, Third Officer, m.v. *Fort Rouge*, C.P. Bulkships Ltd.

'Recently, whilst this ship was in Europe during winter months, we experienced some very cold weather, temperature-wise, along with quite strong winds. This caused a few people on board to come out with the phrase "wind chill factor."

'None of the books that we have on board give any information of values, curves, or how such things may be obtained for wind chill factor, yet I recall from my Scouting days that such things do exist. I was wondering, that if you have such a scale, could you send me a copy? Failing this, do you know where I might find such information when I return home? Looking forward to receiving your reply, yours upon the high Seas, Simon Barker.'

Mr Keith Grant of the Aviation and military Climatology section of the Meteorological Office Special Investigations branch has composed the following reply:

'"Windchill" is a word normally used to express the combined cooling effect of low air temperature and of wind on a standing or walking human. It can be measured either by the rate of heat loss per unit area, the "windchill factor" or "windchill index", or more commonly by the "Windchill Equivalent Temperature (WET)", sometimes known at the "equivalent temperature".

'It must not be thought that there is a definite physical formula by which this equivalent temperature can be computed from air temperature and wind speed. The simplest and most commonly used empirical formula is that proposed by Paul A. Siple and Charles F. Passel in 1945; more complex formulae produced by R. G. Steadman in 1971 and H. T. Beal in 1974 are acknowledged to be better, but have not been experimentally tested.

'Siple's formula is based on measurements made at Little America III in Antarctica during the winters of 1940 and 1941. He observed the rate at which water in small plastic cylinders froze, and derived the following formula (here in watts rather than kcal/hour):

$$\text{rate of heat loss (W m}^{-2}) = (12{\cdot}5 + 11{\cdot}63\sqrt{V} - 1{\cdot}163\,V)\,(33 - T)$$

where V is the wind speed in metres per second and T is the air temperature in degrees Celsius. The formula applies only to bare skin, whose temperature is assumed to be 33°c. For V in knots the coefficients of $\sqrt{V}$ and V should be 8·34 and 0·598. To obtain the windchill equivalent temperature, a low wind speed of about 3 knots has to be chosen, this corresponding to the apparent wind experienced by a human walking in still air. Table 1 shows the wind speed needed at various air temperatures to give certain cooling rates, labelled as "cold," etc. on a rather arbitrary scale, though 1625 W m^{-2} is roughly the windchill factor at which freezing of exposed flesh begins.

Table 1—Wind speed (knots) to give different degrees of windchill (Siple)

Description	Windchill Index	Approximate WET (°c)	Air Temperature (°c) −50	−40	−30	−20	−15	−10	−5	0
Cold . .	810	0	–	–	–	–	–	–	–	3
Very cold . .	1050	−10	–	–	–	–	–	3	5	9
Bitterly cold . .	1280	−20	–	–	–	3	5	7	12	25
Freezingly cold . .	1625	−30	–	–	3	8	12	21	–	–
Dangerously cold . .	2200	−50	3	7	14	50	–	–	–	–

'Steadman's formulae take into account all the different sources of heat loss and gain by a suitably clothed human (with face exposed) in different air temperatures, wind speeds, humidities and solar radiation regimes. Recently (1984) he combined his work on low and high ambient temperatures into a "universal scale of apparent temperature". Table 2 gives his results for windchill equivalent temperature at 80 per cent relative humidity using wind speeds at 10 metres above a land surface. For low relative humidities (say 30 per cent) it is necessary to subtract about 1 °c at air temperatures above 0 °c, but well below 0 °c the correction is negligible. In "full" sunshine a correction of about 7 °c at low wind speeds or 3 °c at gale force should be added.

'Some of the limitations of windchill should be pointed out. It becomes increasingly inaccurate as the exposed skin becomes colder. Wind speed measured at 10 metres over-estimates the actual

Table 2—Windchill Equivalent Temperature (WET) (°C) using reference speed 0 knots (Steadman)

Beaufort Force	Wind Speed at 10-metre height		Air Temperature (°C)											
	Knots	$m\,s^{-1}$	−40	−35	−30	−25	−20	−15	−10	−5	0	5	10	15
1 ..	2	0·8	−41	−36	−31	−26	−21	−15	−10	−5	0	+5	+10	+15
2 ..	5	2·4	−43	−38	−32	−27	−22	−17	−12	−7	−1	+4	+9	+14
3 ..	8½	4·3	−47	−42	−37	−31	−26	−20	−15	−9	−4	+2	+7	+13
4 ..	13½	6·7	−52	−47	−41	−35	−30	−24	−18	−12	−7	−1	+5	+11
5 ..	19	9·3	−57	−51	−45	−39	−33	−27	−21	−15	−9	−3	+3	+9
6 ..	24½	12·3	−61	−55	−49	−43	−37	−31	−24	−18	−11	−5	+2	+8
7 ..	30½	15·5	−65	−59	−52	−46	−40	−33	−27	−20	−13	−6	+0	+7
8 ..	37	18·9	−68	−62	−55	−49	−42	−36	−29	−22	−15	−8	−1	+6
9 ..	44	22·6	−72	−64	−59	−52	−45	−38	−31	−24	−17	−10	−2	+5

windchill at 1–2 metres, though Steadman's tables allow for this. No allowance is made for the effects of precipitation or sea spray. Siple's formula applies to shade conditions only. Windchill does not apply to inanimate objects, even to heat-producing engines. Despite these and other deficiencies, the concept of windchill is useful in countries which experience cold winters to distinguish the difference in human comfort and risk of exposure between light and strong winds.'

Book Reviews

Transatlantic Liners at War by William H. Miller and David F. Hutchings. 240 mm × 160 mm, 175 pp. including index, *illus.* David & Charles (Publishers) Ltd., Brunel House, Newton Abbot, Devon. Price £9·95.

Summer 1941, 'blistering heat of the Indian Ocean turned the non-air-conditioned *Queens* on the trooping run between Australia and Suez into floating infernos; temperatures below decks frequently reached well over 100 °F. Several soldiers died of heat exhaustion, strong arguments erupted as tempers flared and one cook was shoved into his own heated oven.'

Such accounts and many remarkable statistics abound in this fascinating history of the enormous effort made by the *Queen Mary* and the *Queen Elizabeth* to supply forces to zones of war where they were most needed. In late 1941, after Pearl Harbour, troop capacity of the *Queen Mary* was increased at New York from 5 500 to 8 500 in order to improve her powers of reinforcement on the Australian and Pacific fronts against the Japanese advance. In May 1942, she sailed with a total of 10 755 souls on board including only 875 crew; but the highest number of persons ever embarked on one ship was the 15 988 troops and crew on the *Queen Mary* from New York in August 1942.

The *Queen Elizabeth* began her secret maiden voyage to New York on 2 March 1940 from the Clyde unfinished from the builders, without trial runs and tests and with the launching gear still attached to her hull.

There are many first-hand accounts of troops and crew members who sailed in the great ships during their wartime passages. The book, well worth keeping in a personal or ship's library, is attractively bound and easy to read.

J.F.T.H.

Collisions and their Causes by Richard A. Cahill. 180 mm × 243 mm, 171 pp., *illus.* Fairplay Publications Ltd., 52–54 Southwark Street, London SE1 1UJ. Price £12·00.

Accounts of shipping casualties have always been of particular interest to mariners but have previously only become available in either official reports or in books written by inexperienced writers with little or no sea experience.

Richard Cahill is, however, uniquely qualified to write about collisions at sea after many years in command.

This may be the most comprehensive selection of collision histories published to date together with Captain Cahill's own comments which should lead to a clearer insight as to why collisions at sea continue to occur so often. This book is likely to increase the understanding of circumstances which can lead to collisions and will undoubtedly make a considerable contribution to more safety at sea.

J.F.T.H.

Whales of the World by Lyall Watson. 200 mm × 240 mm, 302 pp., *illus.* by Tom Ritchie. Hutchinson Publishing Ltd, 17–21 Conway Street, London W1P 6JD. Price in paperback £8·95.

This book is accurately described by the author as a handbook and field guide to all the living species of whales, dolphins and porpoises, and this 1985 revised paperback edition has been brought up to date from the original 1981 publication. It is a new kind of book about whales, a celebration of cetaceans themselves and a complete survey of these noble and intriguing creatures.

Cetology, the scientific study of whales, began in the fourth century BC, but in 2300 years has progressed remarkably little. We now know a considerable amount about the physiology and longevity of a comparatively few species of recent commercial interest. In the past decade the use of the aqualung and reliable underwater photographic and recording equipment has led to a greater knowledge of a whale herd for instance, aided by aerial photography.

It seems certain that Lyall Watson's book, with a host of coloured illustrations by Tom Ritchie, will have increased the novice's interest and knowledge of these fascinating animals considerably. With the text containing careful descriptions, classifications and maps, it is sure to continue in its appeal to seafarers, cruise passengers, coastguards and even armchair enthusiasts, even if some zoologists have found the book lacking in some technical detail. It does not have the pretension of being a scientific treatise, however, and is more than adequate as a reference book for the most ardent whale watcher.

J.F.T.H.

Personalities

OBITUARY.—CAPTAIN G. D. JOHNSON, aged 55, collapsed outside his cabin as his ship, m.v. *Sapele* of Ocean Fleets Ltd., was approaching Southend anchorage on 14 February 1985 at the end of a West African voyage. A doctor went to the ship by launch and Captain Johnson was airlifted by RAF helicopter to Southend General Hospital, but was found dead on arrival.

Geoffrey Johnson, a Yorkshireman, joined Elder Dempster Lines in 1955 as 3rd Officer from Hogarths, remaining with the Company beyond the time when it became part of Ocean Fleets. He was appointed Master in 1973 and his commands included m.v. *Lycaon* during that ship's long spell in the Falklands.

Captain Johnson first sent in a meteorological logbook bearing his name from the *Baron Renfrew* in April 1954, followed by two more soon afterwards; there was then a gap of 20 years when we again had the benefit of his observations in a further 13 logs up to the time of his passing away. Five of these logbooks were assessed as Excellent, and Captain Johnson received an Excellent Award in 1984. He also earned an award for presentation this year, and the book has been sent to his widow to whom we offer our sincere sympathy.

Notices to Marine Observers

OFFICERS' DISCHARGE BOOK NUMBERS

In order to fill the gaps in our records of the many Masters, Navigating and Radio Officers who have been involved in Voluntary Observing since 1945, we earnestly implore everyone concerned to ensure that Discharge Book numbers are accurately entered after the Officers' names inside the back cover of the meteorological logbook before it leaves the ship.

Completion of these records will ensure that Excellent Awards and Barograph presentations will not be denied to deserving observers; with so many names in our files, it has become a difficult task to keep proper track of Officers' movements without this information being supplied by those on board.

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Fleet List

BRITISH COMMONWEALTH

(This list was unavailable for inclusion in the July 1985 edition)

NEW ZEALAND (information dated 1.2.85)

Name of Vessel	Owner/Manager
Selected Ships:	
ACT 3	Blue Port ACT (N.Z.) Ltd
ACT 4	Blue Port ACT (N.Z.) Ltd
ACT 5	Blue Port ACT (N.Z.) Ltd
Amokura	Union S.S. Co. (N.Z.) Ltd
Aotea	Container Fleets (N.Z.) Ltd
Arrow	Sealord Fisheries Ltd
Bounty III	Pacific Lines
Coastal Trader	Shipping Corporation of N.Z.
Daniel Solander	Solander Fisheries Ltd
Dunedin	Bank and Savill Line
Eagle Arrow	Gearbulk Ltd
Fetu Moana	Shipping Corporation of N.Z.
Fijian	Reef Shipping Agencies
Forum New Zealand	Pacific Forum Line
Forum Samoa	Pacific Forum Line
Golden Bay	Tarakohe Shipping Co.
Holmdale	Union S.S. Co. (N.Z.) Ltd
James Cook	N.Z. Govt. (Fisheries Research)
Kolle D.	Nauru Pacific Line
Kotuku	Union S.S. Co. (N.Z.) Ltd
Kuaka	Union S.S. Co. (N.Z.) Ltd
N.Z. Caribbean	Shipping Corporation of N.Z.
N.Z. Pacific	Shipping Corporation of N.Z.
New Zealand Star	Blue Port ACT (N.Z.) Ltd
New Zealand Trader	Shipping Corporation of N.Z.
Ngahere	Union S.S. Co. (N.Z.) Ltd
Ngapara	Union S.S. Co. (N.Z.) Ltd
Otago Galliard	Fletcher Fishing Ltd
Spirit of Free Enterprise	Pacifica Shipping Co.
Taiko	Union S.S. Co. (N.Z.) Ltd
Tasman Enterprise	Development Finance Co.
Tasman Venture	Development Finance Co.
Tiare Moana	Shipping Corporation of N.Z.
Toki Arrow	Gearbulk Ltd
Tui Cakau II	Pacific Lines

New Zealand (*contd*)

Name of Vessel	Owner/Manager
Union Auckland	Union S.S. Co. (N.Z.) Ltd
Union Dunedin	Union S.S. Co. (N.Z.) Ltd
Union Nelson	Union S.S. Co. (N.Z.) Ltd
Union Rotoiti	Union S.S. Co. (N.Z.) Ltd
Union Rotorua	Union S.S. Co. (N.Z.) Ltd
Union Sydney	Union S.S. Co. (N.Z.) Ltd
Westport	N.Z. Cement Holdings Ltd
Supplementary Ships:	
Arahanga	New Zealand Railways
Arahura	New Zealand Railways
Aratika	New Zealand Railways
Ile de Lumiere	Sofrana—Unilines
Sealink	South Pacific Navigation Co. Ltd

Auxiliary Ships:
New Zealand also has a fleet of 12 Auxiliary Ships currently reporting.

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