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THE MARINE OBSERVER

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Editorial

A lot has appeared lately in the press and in magazines about the subject of smog. There does not yet seem to be any dictionary definition of this word, although it was first used by a president of the National Smoke Abatement Society 50 years ago; but what it means is a combination of smoke and fog.

Smog is only likely to affect the mariner when his ship is lying in some large industrial city such as London, where huge amounts of fuel are consumed for power and heat; in this case its chief disadvantage will be in impeding his journey between home and ship. In addition there will be the annoyance caused to the chief officer because of the mess it makes of his paintwork. In a river such as the Thames, during severe smog conditions all shipping must necessarily come to a standstill; conditions in this river do not permit the comprehensive use of a shore based radar which has been used so spectacularly and successfully in the River Mersey for guiding shipping in and out of the river in foggy conditions.

Smog in a less spectacular form can be seen to seaward of the Tyne and Sunderland area in "favourable" conditions with a light westerly breeze, and at times in the Liverpool or Glasgow area.

Presumably some of the fog encountered at the major European ports has also smog-like qualities but one does not hear of it attaining the "pea soup" consistency that is found in London. From descriptions such as those provided by Charles Dickens it seems that the unpleasantness of the London fogs has lessened somewhat during recent years—but nevertheless one cannot get away from the heavy mortality figures which were attributed to the great "smog" of December 1952. Some of the main reasons why there is so much atmospheric pollution in the London area are because it is the largest and one of the oldest cities in the world, having a great variety of industries drawing their power from the combustion of coal, and because of the British love of the open hearth fire. Another reason is because the relative humidity of London's air is higher than at many continental ports.

American visitors are always rather intrigued at the enormous number of chimneys on houses in the approaches to London. In the foggy areas outside of Europe the complication of smog is not so prevalent because in most cases the cities are newer and therefore smoke abatement plans have been more easily applied and open hearth fires are not so popular.

In England there is a permanent committee of experts studying problems associated with all aspects of atmospheric pollution, and steps are being taken gradually to improve matters. It seems it will be a very long time, however, before the smog menace disappears from areas such as Greater London.

All fog is not smog and as far as the mariner is concerned there seems little doubt that low visibility from whatever cause is the most annoying meteorological phenomenon he encounters. Very high winds may have more disastrous effects if a vessel happens to be unlucky, but fog inevitably brings many minor and major casualties as well as the inconvenience it causes in delayed arrivals and sailings. One only needs to look at *Lloyd's List* after a few hours of widespread fog to see the high incidence of casualties.

Meteorologists cannot do anything to stop fog, although attempts have been made from time to time to clear airports of fog when aircraft are about to land. All the meteorologist can hope to do is to forecast the extent, duration, and degree of low visibility and to provide statistics so as to show the normal visibility expectations in certain areas. The mariner can assist the meteorologist considerably in this respect by providing accurate observations of sea and air temperature and humidity. When he is under way and knows fog is inevitable, all the mariner can do is to take the normal seamanlike precautions of reducing speed, maintaining a good look-out, visually, aurally and by radar, and keeping his whistle going. In coastal waters this is the time when all his skill as a navigator and seaman is needed because of the obvious problems associated with swift tides and reduction in speed.

When one considers the capricious behaviour of sound in a fog and in heavy snow and when one remembers that in areas like the Grand Banks it is always possible in the spring to encounter fog associated with a southerly gale, one wonders that more attention is not paid to the position of a ship's whistle or siren and to the pitch thereof. It seems that the distance the sound of the whistle can carry depends considerably upon its pitch, and there is little doubt that the position of the whistle in many ships is by no means good. Article 15 says " it shall be so placed that the sound shall not be intercepted by any obstruction ", but in how many ships does this apply? Most of us at sea have known cases where, with no wind, when " feeling one's way " past a ship stopped in fog, the sound of the unknown ship's whistle was very faint because it was masked by her funnel. A similar argument could well apply in the case of an overtaking ship. In our last number there was an article entitled " Does sea fog reflect sound? " and in a later number we hope to include a more detailed feature on this subject.

A lot has been written lately about the use of radar to avoid collisions. A very informative article on this subject, by Captain F. J. Wylie, appeared in the July 1953 number of the *Journal of the Institute of Navigation.* (See page 107 of this number.) In this connection it is important to note that attempts were made at the 1948 International Conference on the Safety of Life at Sea to modify the Collision Regulations to take into account the use of radar. The Conference decided, however, that there was insufficient experience yet to justify making any specific alteration, and the wording of their Recommendations reads as follows: " The Conference, while recognising that the recent advances in radar and electronic navigational aids are of great service to shipping, is of the opinion that the possession of any such device in no way relieves the master of a ship from his obligation strictly to observe the requirements laid down in the International Regulations for Preventing Collisions at Sea, and, in particular, the obligations contained in Articles 15 and 16 of those Regulations."

In other words it seems that the Conference wisely recognised the fact that radar and other similar apparatus are only aids to navigation and the action which is taken aboard ship to avoid danger inevitably depends largely upon the skill and seamanship of her master.

MARINE SUPERINTENDENT.

THE MARINE OBSERVERS' LOG

April, May, June

The Marine Observers' Log is a quarterly record of the most unusual and significant observations made by mariners.

The observations are derived from the logbooks of marine observers and from individual manuscripts. Photographs or sketches are particularly desirable.

Responsibility for each observation rests with the contributor.

BIRD LIFE

North Atlantic Ocean

O.W.S. *Weather Recorder.* Captain A. W. Ford. On Station " India ". Observer, Mr. F. Metcalfe.

15th June, 1953. Three black-backed gulls were observed among 200 and more fulmars. The gulls made attempts to poach on a meal of ship's waste, but without much success. They were not seen again.

Position of ship at 0900 G.M.T.: 59° 00'N, 19° 06'W.

LOCAL CURRENT SET

Red Sea

M.V. *Arabistan*. Captain J. E. Cooke. Suez to Mena-al-Ahmadi. Observer Mr. P. H. Alexander, 2nd Officer.

2nd April, 1953. At 0130 G.M.T. a position was obtained 15 miles NNW from Jabal-at-Tair Light by visual bearing and radar range. Until this position the vessel had made a good course (148°T) from noon sights of the previous day; wind SE 7, rough sea, heavy swell, moderate visibility. Further fixes were obtained between 0130 and 0245, and by 0245 the vessel had set 1¾ mile to the eastward; the apparent course was 148°T but the course made was 134°T. The wind had freshened to force 8 and veered to SSE: ship's speed dropped from 7 kt to 5½ kt in this period. A course 165°T was set to clear the island, but to make this course good 15° had to be allowed for the easterly set. At 0315, the vessel being clear of the island, the 15° for set was removed, and the vessel found to be making good her true course (148°T) to a position (at 0715) 7 miles WNW of Zubair Is. At 0730 the vessel was found to be setting in an easterly direction again, and 15° had to be allowed to counteract this. The wind at this time had backed to SE and moderated to force 6. By 1000 the vessel was clear of the islands and only 3° for set was necessary to make good the required course of 148°T.

Position of ship at 0600: 15° 18'N, 42° 00'E.

LINE OF DEMARCATION

Caribbean Sea

M.V. *Port Pirie*. Captain P. H. Pedrick. Curaçao to Cristobal. Observer, Mr. T. A. Fairbairn, 2nd Officer.

7th June, 1953, 2055 G.M.T. The vessel passed from blue to green water with a very pronounced line of demarcation running from horizon to horizon in a 145° to 325° direction. The ship bore 021°, 29 miles from the mouth of the Rio Magdalena.

Sea temperature (green water) 85°F.

Position of ship: 11° 33'N, 74° 40'W.

Note. Three previous observations of a line of demarcation with similar colour changes to that described above have been published in the post-war volumes of the *Marine Observer*. The green water is the river outflow.

Yellow Sea

S.S. *Hunan*. Captain C. A. N. Baker. Tientsin to Hong Kong. Observer, Mr. D. S. Southey, 2nd Officer.

17th June, 1953, 0400 G.M.T. Vessel crossed sharply defined line extending 040°–220° between dark green and light green water. Sea temperature of dark green water (on western side of line) was 70°F, temperature of light green water was 66°F. Wind S'W, force 4.

Position of ship: 32° 21'N, 123° 49'E.

Note. The above observation was forwarded to us by The Director, Royal Observatory, Hong Kong with the comment that they have no previous reports of clearly defined lines between water of different colour and temperature in the Yangtze area.

DISCOLOURED WATER AND LINE OF DEMARCATION

Coastal waters of Peru

S.S. *Talca*. Captain T. H. G. McGill. Observer, Mr. P. A. A. James.

5th June, 1953, 1900 G.M.T. Vessel passed through area of brownish-red water. On determining the current for the period it was found that the vessel had set 24 miles to the N. Air temperature 65·5°F, sea 65°. Wind, sea and swell moderate.

Position of ship: 13° 58′S, 76° 32′W.

8th June, 1953, 1700 G.M.T. When 7 miles off Aguja Point a well-defined line of demarcation was noted half a mile to the westward. The vessel was steaming in greenish water, while the colour of the water to the W of the line could be described as "blue-black". The line, almost parallel to the ship's course (345°–165°) was visible for about 2 hours until it was too far away to be seen. Air temperature 70·2°F, sea 67·1°.

Position of ship: 06° 04′S, 81° 11′W.

Note. The state of current and sea temperature is very complex off the coast of Peru, and while the cool Peru Current flowing northward is the general current of the coastal region, this is interrupted at times by incursions of warmer water from seaward, which often has a southerly set. The cool water of the Peru Current is rich in plankton and marine organisms of all kinds, and its normal colour is greenish. The oceanic water from further seaward, much less rich in animal life, is of a deep blue colour. In the observation of 8th June S.S. *Talca* was evidently near a line of demarcation between the green and the deep-blue water. The incursions of the warmer oceanic water into the Peru Current kills the plankton locally, resulting in a brownish-red discoloration of the water, as observed on 5th June. This phenomenon is known by the Peruvian name of "Aguaje". When more marked, so that the sulphuretted hydrogen given off by the decomposing organisms is in sufficient quantities to discolour ship's paint, as happens from time to time in Callao harbour, it is known as the "Callao painter". These are the relatively minor manifestations of Aguaje. In the early months of the year a warm current known as the Holy Child Current flows southward across the Equator along the coast of Ecuador to about lat. 03°S. In occasional years, such as 1925, this current extends much further south, to lat. 12° to 15°S, replacing the Peru Current near the coast and resulting in a catastrophic destruction of plankton and fish along the whole of its course, together with the starvation or migration of the guano birds.

PHOSPHORESCENT WHEELS

Arabian Sea

M.V. *British Empress*. Captain A. Henney, O.B.E. Port Okha to Persian Gulf. Observer, Mr. P. M. Alderton, 3rd Officer.

5th April, 1953, 2125 Indian Standard Time. Commencing from about NNW, shafts of pale white diffused light appeared, apparently travelling on the surface of the water at a great speed. Each shaft was several feet wide and they stretched as far as the eye could see. At first they appeared in perfectly parallel lines, equally spaced, passing the ship at about one every second, but after five minutes they wheeled round in perfect formation and approached the ship from all points of the compass. They came from only one compass point at a time and each change of direction was swift and definite, though not abrupt. The most frequent directions were from NNW and SSE.

After about 15 minutes the shafts occasionally formed into a rotating radial movement in which they retained their equal geometrical precision and the frequency of about one per second. At this time the pattern was continually changing about every 20–30 seconds from the parallel lines to the wheel. The periods of transition were hardly noticeable, but they were not abrupt. Each time the wheel appeared it was in a different place. On one occasion there were two distinct wheels visible at the same time. Throughout the period the wheels appeared they varied in direction of rotation, some clockwise and some anti-clockwise. Five minutes later the pattern became still more complicated but remained perfectly regular and at 2150 the light faded out over a period of 30 seconds.

Although the light appeared to be on the surface of the water it was completely unaffected by the wind and no disturbance of the water was produced. The most notable feature of the phenomenon was the effortless speed and mathematical precision of movement. The only near analogy I think of is that of being placed in the middle of a large A scan when a large variable AC current is supplied. The whole effect was one of great weirdness and eerieness, so much so that the look-out man came on to the bridge quite scared, believing that he was suffering from hallucinations.

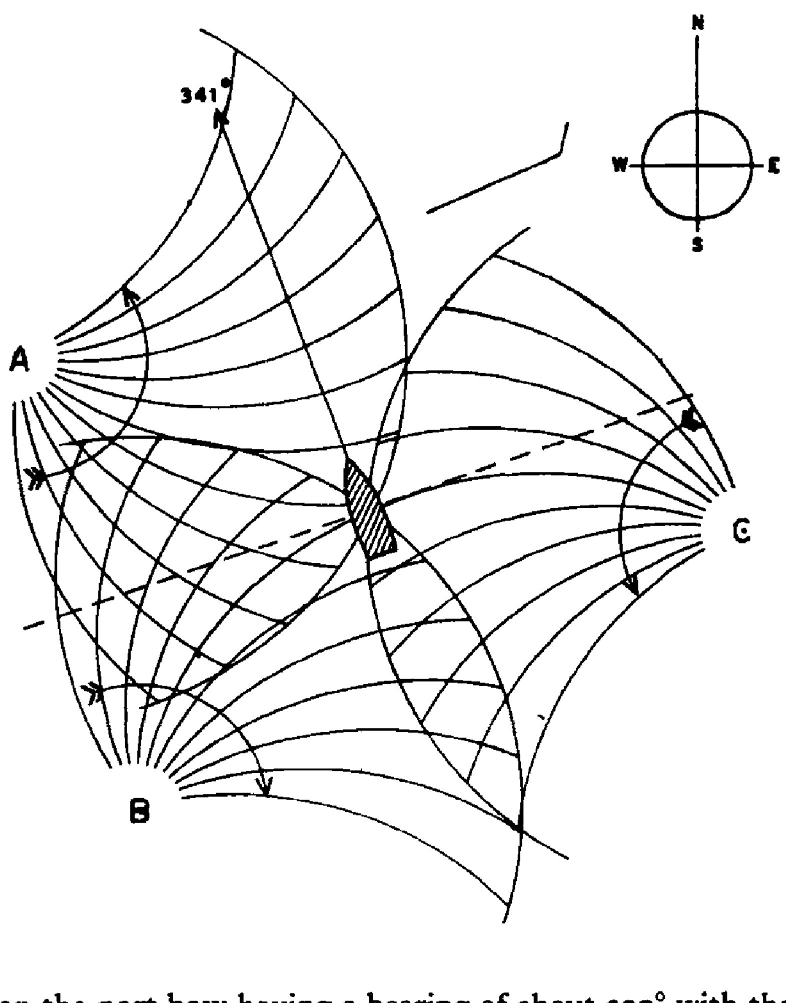
The ship's course was 290°(T), speed 10 kt and no alteration of either took place during the observation. The sea was that corresponding to Beaufort Scale wind force 2–3, swell negligible, sea temperature 78°F. The sky was cloudless, with perfect visibility, wind NW force 2–3, air temperature 80°F.

Position of ship: 22° 42′N, 68° 08′E.

Gulf of Thailand

M.V. *Rafaela*. Pladju to Bangkok. Observer, Mr. H. Barth, 2nd Officer.

24th April, 1953, 0215 S.A.T. (1915 G.M.T.). Faint flashes of light with oscillating movements were observed on the sea. The flashes gradually increased in strength until at 0230 they suddenly changed into rather intensive rays of light moving around centres lying near the horizon. Three groups of rays were present, as shown in the sketch.



(*a*) One on the port bow having a bearing of about 300° with the rays rotating anticlockwise.

(*b*) One on the port bow having a bearing of about 230°, rotating clockwise.
(*c*) One on the starboard bow having a bearing of about 95°, rotating anti-clockwise.

The beams were curved with the concave side in the direction of the movement, and were passing the ship continuously with a frequency of about three a second; they looked more like glowing shafts than beams of light. Reflections on the ship were clearly visible. The Chinese quartermaster became panic-stricken, left the wheel and did not return until he had been called three times.

The phenomenon lasted till 0250, and it had been clear by the increasing strength of the group ahead and the decreasing strength of the groups astern, that the ship was advancing through the area of phosphorescence. Soon only the oscillating flashes could be seen and they also disappeared shortly afterwards. At 0300 the situation was normal again. The third engineer also saw the phenomenon clearly, as described above.

The moon set at 0242 S.A.T., but it had disappeared some time before, behind squall clouds low on the horizon. The weather was clear, wind ENE force 2, visibility extremely good. Sea, rippled.

Position of ship at 0230: 06° 50'N, 103° 10'E. Course 341°.

Note. The above observation was forwarded to us by the Director, Section for Oceanography & Maritime Meteorology, Koninklijk Nederlands Metorologisch Instituut, de Bilt, Holland.

The phenomenon of the rotating phosphorescent wheel is well-authenticated. It seems to be confined to the Arabian Sea, Bay of Bengal and the China Seas. Its appearance is rare and quite unpredictable and many observers in these regions have never seen it at all. The phenomenon of the moving parallel bands of light has been observed on a number of occasions but is also rather rare. The observation of M.V. *British Empress* is of especial interest owing to the frequent change from the parallel bands to the rotating wheel. Such a change has only once been received before. This was an observation made by S.S. *Kurmark* in the Gulf of Oman (25°N, 57°E) on 18th April, 1923, but the changes were not so frequent or complex as those seen by M.V. *British Empress.*

The observation of M.V. *Rafaela* is also of especial interest since three wheels were seen in operation at the same time and the two on the port side were rotating simultaneously in opposite directions. The cause of the wheel and that of the moving bands are at present quite unknown and observations such as the two given above, and others which also give us some idea of how complex these phenomena can be, will all have to be taken into account when a solution of the mystery is attempted.

A good deal of work has been done by marine biologists on the chemical processes producing light in marine organisms, and the kinds of organisms in the region of the sea surface which produce light are well known; these are mainly dinoflagellates (microscopic creatures on the border line between plants and animals), and animal constituents of the plankton (small crustacea, fish larvae, etc.) It is inconceivable that such creatures could move in the sea with the speed of the observed rapid movements of the light. It seems probable, therefore, that the movement is due to some form of stimulating process which can move rapidly over or through the water, the light of the organisms flashing up and then dying down as it passes.

PHOSPHORESCENCE

Australian Waters

M.V. *Fremantle Star*. Captain C. R. Horton, D.S.C. Hobart to Cape Town. Observer, Mr. J. C. Farmer, 3rd Officer.

20th June, 1953, 1200 G.M.T. Off the east coast of Tasmania the vessel passed through a band of irregular phosphorescence about 50 ft in width, which stretched from horizon to horizon in an E-W direction. The phosphorescence was in the shape of rectangles of a bright green colour and measuring 12 in. by 6 in., and appeared to have no movement.

Position of ship: 42° 30'S, 148° 15'E.

New Zealand Waters

M.V. *Coptic*. Captain A. E. Smith. Auckland to Durban. Observer, Mr. B. Pratt, 3rd Officer.

6th June, 1953, from 0800 G.M.T. onwards. Considerable quantities of phosphorescence were seen around the ship at frequent intervals. The phosphorescent areas varied in size from one inch to about six inches and always oval in shape.

Position of ship: off North Island between Castle Point and Honeycomb Rock.

LINE SQUALL

Bay of Biscay

S.S. *Cedar Hill*. Captain J. P. Allen. Bordeaux to Mediterranean ports. Observer, Mr. G. S. Reynolds, 2nd Mate.

18th May, 1953, 1215 G.M.T. Observed line of cloud shown on the two photographs printed opposite. The height of the base was about 500 ft and the depth of the cloud was about 200 to 300 ft. The formation, which stretched NW–SE from horizon to horizon, moved in a NE'ly direction; no apparent rolling of the cloud was observed.

Approaching cloud; wind SSW, force 2, temp. 65°F. Underneath cloud; wind SSW, force 3, temp. 63°F. Having passed cloud; wind SW'W, force 4, temp. 62°F. The barometric pressure was almost constant throughout.

Position of ship: 45° 08'N, 03° 28'W.

Note. This squall was observed in the rear of a small depression centred at about 46°N, 03°W at 1200 G.M.T., which was moving a little west of north. The cold front of this depression lay eastward of the ship, just off the west coast of France.

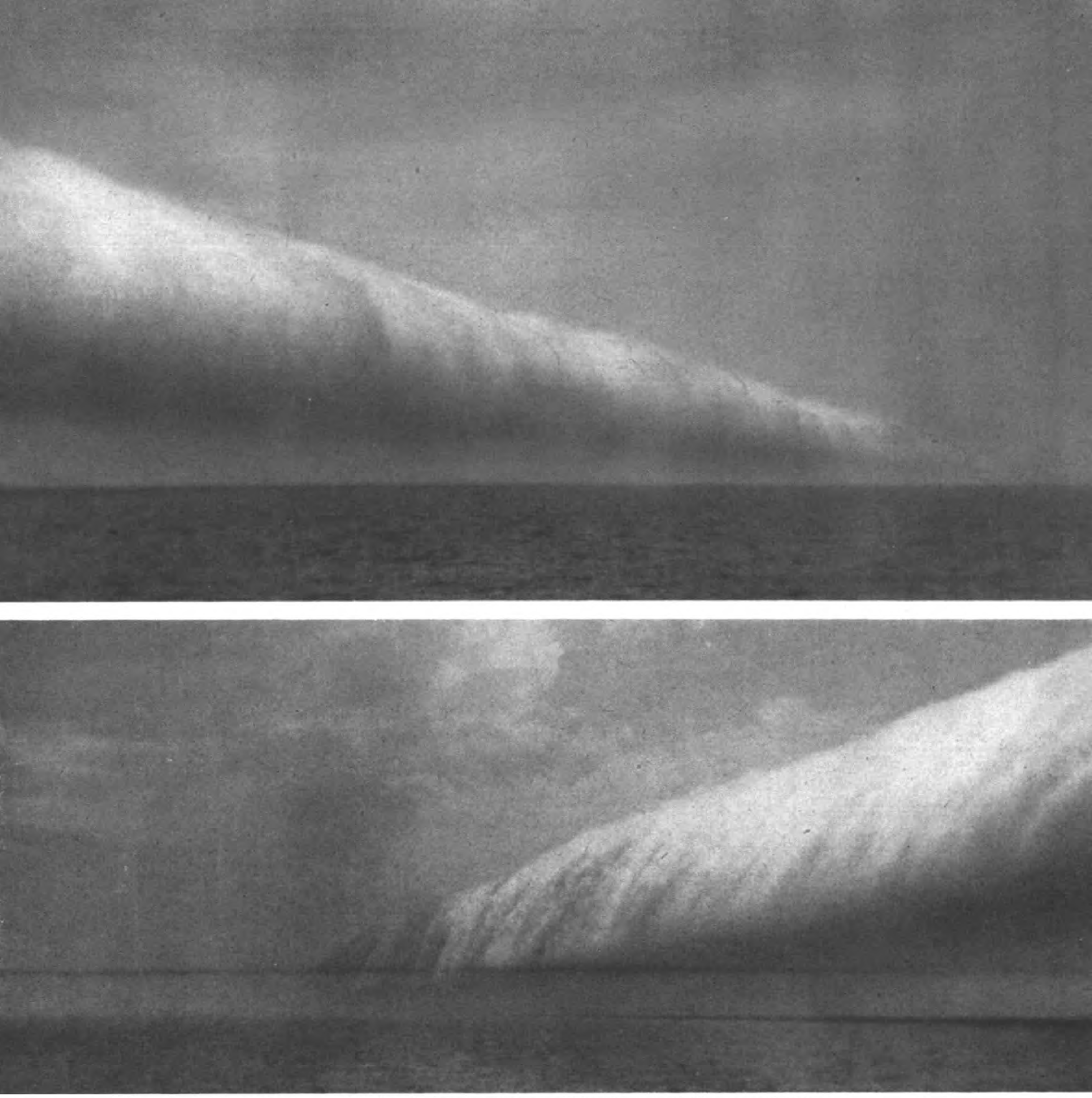
TORNADO

Off West Africa

M.V. *Dominion Monarch*. Captain B. Forbes-Moffatt. Las Palmas to Cape Town. Observer, Mr. G. H. Perry, 3rd Officer.

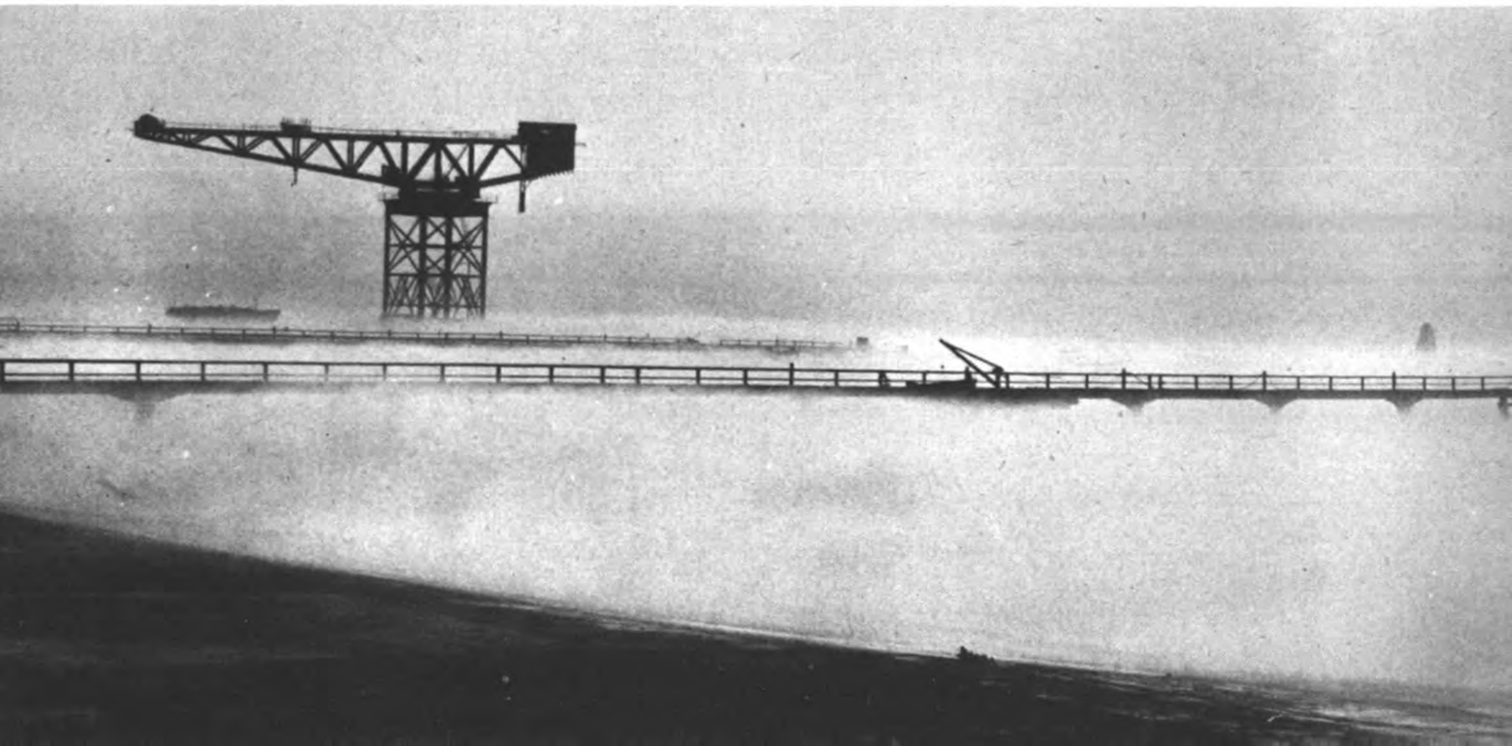
10th June, 1953, 2045 G.M.T. to 11th June, 0045. At 2045 wind backed from 360° to 350° force 5 with the barometer rising slowly. At 2050 sheet lightning commenced in SE and cloud began to bank up in SE. At 2325 the sky became completely and suddenly overcast with low flying scud. At this time wind veered to 090° and increased to force 7 in gusts with heavy rain; barometer, previously rising slowly, now began to rise almost vertically. At 2330 the wind veered to 110° and maintained its force: the radar screen showed that very heavy rain was surrounding the vessel. Very shortly afterwards the wind backed to 100° and decreased to force 4–5, and although rain at the ship ceased, heavy rain was clearly shown on the radar screen to be in close proximity. By 2350 lightning became vivid and moved quickly from SE to SSW; the barometer reached the peak of its rise, having risen 2.0 mb since 2332. At 2352 there was heavy rain and brilliant flashes of sheet lightning but no thunder, and for the next few minutes there were frequent variations of wind direction while the barometer fell steeply. At 2358 the rain ceased and the radar screen showed that the heavy rain belt had clearly passed the ship, having travelled from SE to NW. From 0000 to 0020 wind backed from 040° to 070° force 5–6, and decreased soon afterwards to force 2–3. At 0045 the barometer ceased falling steeply; it had fallen 2·5 mb since 2355.

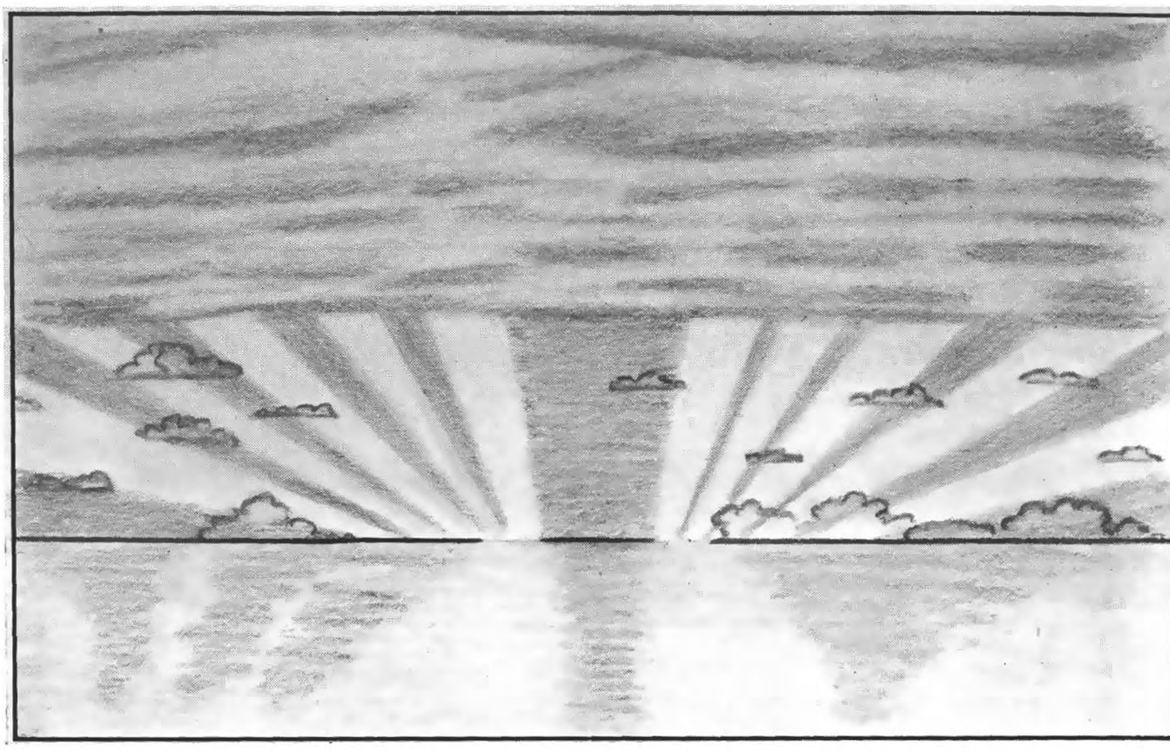
Position of ship at 2330 (10th): 17° 44'N, 17° 40'W. Course 180°, speed 20 knots.



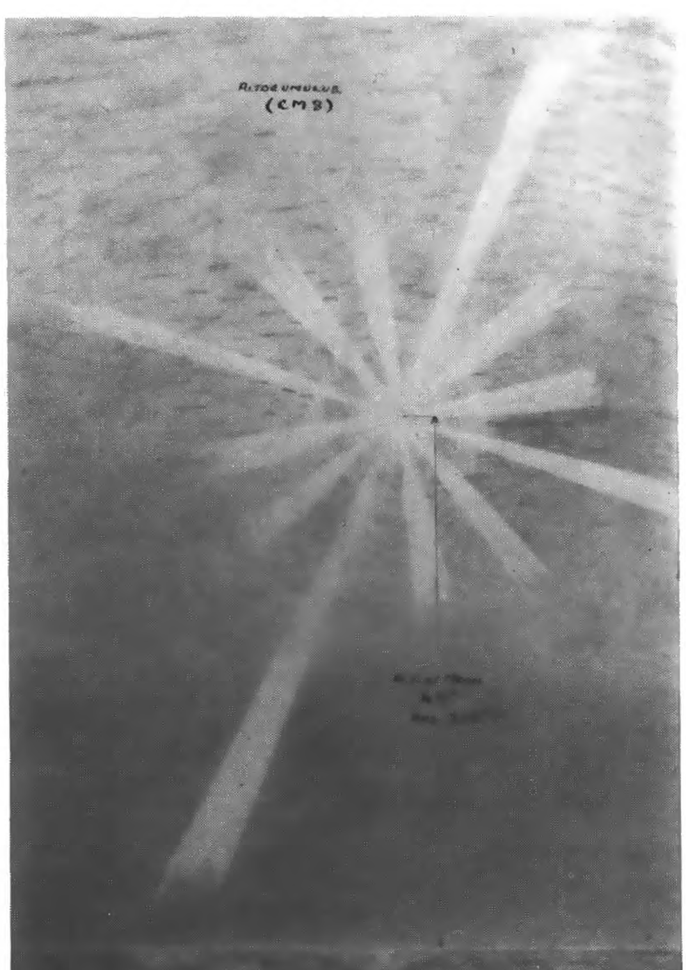
Photographs of line squall cloud observed from S.S. *Cedar Hill* on 18th May, 1953, in the Bay of Biscay (see opposite).

a fog at Marine Aircraft Establishment at Felixstowe on 15th November, 1949. This photograph illustrates the
ry shallow nature of sea fog under certain conditions; note the sharp contrast between land and sea visibilities.





Sketch of anti-solar crepuscular rays observed from M.V. *Paringa* just before sunset on 5th April, 1953 (see opposite).



Drawing of a phenomenon of bright rays radiating from the moon, observed from S.S. *Mandasor* on 23rd June, 1953, in the Gulf of Aden (see opposite).

CREPUSCULAR RAYS

Australian Waters

M.V. *Paringa.* Captain H. P. Mallet. Melbourne to Aden. Observer, Mr. P. W. G. Everett, 4th Officer.

5th April, 1953, 0945 G.M.T. Sharply defined crepuscular rays of a pale salmon colour were observed in the eastern sky 15 minutes before sunset. The rays ranged from the vertical almost to the horizontal and brightly illuminated two arcs of the horizon, each of 3°, with a band of dark shadow, approximately 5°, between the arcs. Maximum intensity remained for about five minutes, after which the horizon became obscured by rain. The sky was mainly covered by a layer of Sc but with an almost clear band of 7° of altitude above the eastern horizon, in which the rays and a few Cu clouds were seen.

Position of ship: 35° 21′S, 117° 33′E.

Note. It is unusual for antisolar crepuscular rays to be so bright as to give the illuminated arcs on the horizon. A copy of the sketch in the logbook is shown opposite.

LUNAR RAYS

Gulf of Aden

S.S. *Mandasor.* Captain G. A. Jackson, M.B.E. Colombo to Aden. Observers, the Captain, Mr. J. K. Cooper, 2nd Officer, and Mr. J. R. Knott, 3rd Officer.

23rd June, 1953, 2025 G.M.T. The moon had for the previous four hours been surrounded by a yellow and faint purple diffused light of about 3° radius. Ac cloud had been observed increasing and gaining altitude. The wind, from WSW, was hot and brought fine sand with it. After standing for an hour in the wind, exposed skin became coated with minute sand particles.

At 2025 a faint ray was seen developing from the moon's lower limb, extending downwards at an angle of about 20° to the vertical. The ray rapidly increased in brightness while other rays developed from all parts of the moon, which was at an altitude of 43°, bearing 213°(T).

At 2030 the phenomenon reached its peak of brilliance, with 12 rays consisting of bright white light, so bright as to illuminate the layer of Ac, over a radius of about 18° from the moon, and turning the immediate sky into blue as bright as daytime. The ray which first appeared reached from the moon to 5° above the horizon where the sky was a dull uniform grey; it became so bright as to throw light on the sea surface.

The four brightest rays gave the impression of a large cross suspended in the sky inclined at about 20° to the vertical. These rays appeared to be below the Ac, which was now high. The rays remained brilliant for about 10 minutes, after which the phenomenon began slowly to fade, the last trace of the rays vanishing at 2105. The diffused yellow light round the moon remained.

Corr. bar. 999·4 mb, wind WSW, force 4. Temperatures, air 91°F, sea 88°. Dew point 77°.

Position of ship: 12° 25′N, 47° 35′E.

Note. This is not a halo phenomenon, on account of the type of cloud. It is an extremely interesting observation for which at present we can offer no explanation. The original of the sketch reproduced opposite was made in colour by Mr. Knott.

ABNORMAL REFRACTION

Mediterranean Sea

M.V. *Esso Bedford.* Captain F. Hewlett. Fawley to Port Said. Observer, Mr. J. Ridley, 2nd Officer.

4th April, 1953, between noon and 1600 G.M.T. Abnormal refraction was experienced in the Galita Channel of a very severe nature. It increased the height of Galita Lighthouse threefold and showing the slopes of the island, which are not actually precipitous, as sheer cliffs for a height of 300 ft or so. Ships in the vicinity were out of all proportion; at first they appeared to have all their superstructure heightened and the remainder of the vessel flattened to such an extent that an American T2 Tanker appeared very much like a NE coast of England flat-top collier, with the funnel, bridge and topmasts shrinking into the main deck until they seemed to be non-existent.

Position of ship: 37° 20′N, 08° 30′E to 09° 30′E.

S.S. *Pacific Stronghold.* Captain A. Cooke. Birkenhead to Port Said. Observer, Mr. J. Cockburn.

26th April, 1953, 0700 G.M.T. At the western end of the Galita Channel a mirage was observed ahead. There were very definitely two horizons, distant land was distorted and distant ships distorted and doubled: these were visible far outside normal range of vision. The mirage lasted for about an hour and was lost only when showers commenced.

Wind E'ly force 2–3. Cloud Sc 6/8 with precipitation in sight. Air temperature 68°F. Sea temperature 61°. Visibility 5–10 miles.

Position of ship at 0600 G.M.T.: 37° 18′N, 07° 48′E.

T.E.S. *Tenagodus.* Captain H. G. Watkins, M.B.E. Cardiff to Mena-al-Ahmadi. Observer, Mr. W. Irvine, Chief Officer.

13th May, 1953, 1400 G.M.T. For about ten minutes an elevated as well as a true horizon was observed over an arc of about 90° of horizon from starboard beam forwards. The sextant angle of elevated horizon to true horizon was found to be 0° 4′ of arc. A distinct erect and an inverted image of a medium-sized tanker, one over the other, were observed, but after a period of 20 minutes no vessel could be seen.

Air temperature 74°F, wet bulb 66½°, sea temperature 69°.

Position of ship: 36° 16′N, 26° 00′E.

South Atlantic Ocean

T.E.S. *Tenagodus.* Captain H. G. Watkins, M.B.E. Cape Town to Algiers Observer, Mr. W. Irvine, Chief Officer.

12th June, 1953, 0840 G.M.T. A well-developed superior mirage was observed. A double image of Robben Island was observed, one erect and one inverted, at a distance of 12 miles from the island. At the same time an inverted image of Dassen Island was observed 19 miles off.

Air temperature 61°F, wet bulb 52°, sea temperature 58°. Sky 5/8 fine Ci and 1/8 thin As.

Position of ship: 33° 45′S, 18° 10′E.

M.V. *Timaru Star.* Captain H. W. McNeil. Takoradi to Cape Town. Observer, the Master and Mr. T. E. Harris, 3rd Officer.

4th April, 1953, 1830 G.M.T. Cape Columbine Light was first observed at a distance of 53 miles, bearing 135°(T). Later the moon rose on a similar bearing and until it reached an altitude of approximately 10° it appeared to be distorted and of a very pronounced orange-yellow colour.

At 2142 Dassen Island Light was observed at a distance of 41½ miles. Wind SSE force 3, sky cloudless with distant lightning to the NW.

Position of ship: 32° 12′S, 17° 06′E.

SOLAR HALO

Indian Ocean

S.S. *Perim*. Captain L. Porter. Aden to Colombo. Observers, Mr. F. Eagle, 3rd Officer, Mr. A. Petrie, 4th Officer.

28th June, 1953, 1100 Ship's Time. A halo was observed forming around the sun, altitude 74°. Within 15 minutes all the colours of the spectrum were visible and clearly marked. The phenomenon remained until 1330 when the colours quickly faded and the halo became a whitish ring; it completely disappeared at 1400. The inner radius of the halo was constant at 16°, its width 2° to 3°. Cloud, 4/8 Cu of little vertical development, trace of Ci.

Position of ship at 1200 ship's time: 10° 04'N, 65° 54'E.

Note. This is an interesting observation, as halos of radius 16° have only been reported on one or two occasions; halos with radii of 17°–18° have been observed more frequently.

LUNAR HALO

Pacific Ocean (Gulf of Champerico)

M.V. *Darro*. Captain T. Powell. Los Angeles to Plymouth. Observer, Mr. T. Challis, 3rd Officer.

25th June, 1953, 0425 G.M.T. A lunar halo was observed with vertical diameter of 35°, and horizontal diameter of 30°. This remained until 0525 G.M.T. when it disappeared. At the time there was much lightning on the eastern horizon.

Visible cloud, Cu and Ac, which moved across the halo from time to time.

Position of ship: 10° 10'N, 87° 39½'W.

Note. This is a very interesting observation and comes within the class of abnormal halos which are reported from time to time. Oval halos have been seen before, but the only one which is included in the list of halos definitely known, that is, which have been carefully measured on several occasions at least, is the halo circumscribing the halo of 22° radius. This is formed by the joining up of the arcs of upper and lower contact to the 22° halo, forming an ellipse. This occurs only with the sun at altitudes between 45° and 60° and the longer axis of this halo is horizontal. It is most striking when the halo of 22° is not seen at the same time, as sometimes occurs.

Indian Ocean

S. S. *Mandasor*. Captain G. A. Jackson, M.B.E. Aden to Madras. Observer, Mr. J. R. Knott, 3rd Officer.

1st May, 1953, 1905 G.M.T. A complete lunar halo appeared suddenly and disappeared just as suddenly at 1931. Cloud present in the region of the halo was thin As. The radius of the halo was 29½° measured to the outside edge and the width of the halo was 40'. Altitude of moon's centre 40½°. During the time of observation the halo was constant and of fair brightness, the colour being white.

Position of ship: 05° 52'N, 80° 15'E.

Note. The true radius of this halo, measured to the inside, was 28° 50'. The halo was first seen by Scheiner in 1629 and is sometimes called Scheiner's Halo. It is very rare and has only been observed on a few occasions since that date. The present observation, with its measured radius, is therefore of great interest. The radius has previously been given as "about 28°".

GREEN FLASH

Mouth of English Channel

S.S. *Southern Collins*. Captain J. W. Ross. St. Vincent to Bromborough. Observers, the Master and Mr. W. W. Ross, 3rd Officer.

6th April, 1953, Sunset. A prolonged green flash of about 2 seconds was observed as the sun set, bearing 279°(T).

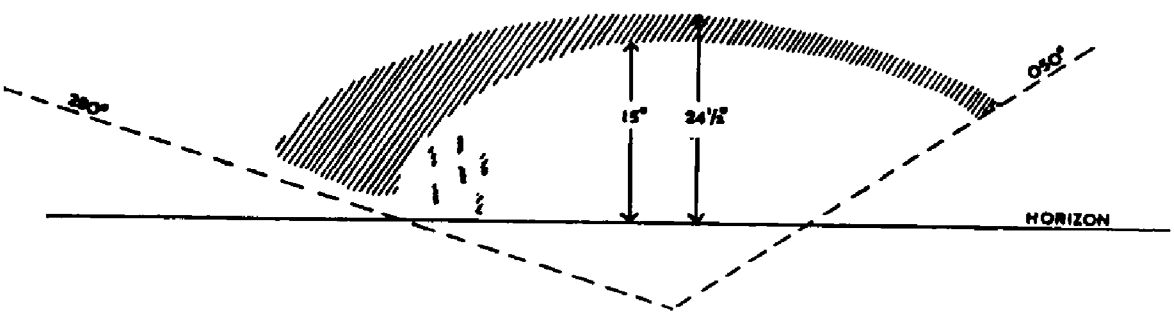
Position of ship: 48° 15′N, 08° 28′W.

Note. The duration of the green flash given in this observation is much longer than that generally seen and seems to indicate an unusual degree of abnormal refraction at the time.

AURORA BOREALIS

Gulf of St. Lawrence

S.S. *Beaverlodge*. Captain D. Parsons, R.D., R.N.R. London to Montreal. Observers, the Master and Mr. J. S. Brooks, 3rd Officer.



21st June, 1953, in the early hours. An aurora was observed to northward over the Quebec shore. The western end of the auroral arch was bearing 280° and the easterly end 050°. The lower rim of the arch was at altitude 15° and the upper rim 24½°. Streaks were observed below the arc at the w'ly end. The auroral arch remained fairly constant for 45 minutes, though the streaks changed shape frequently. Cloud Cu 1/8, visibility excellent.

Position of ship: 50° 00′N, 60° 42′W.

METEORS

Gulf of Guinea

M.V. *Apapa*. Captain W. S. Byles, R.D., R.N.R. Southampton to Cape Town. Observer, Mr. C. Markham, 4th Officer.

8th May, 1953, 0251 G.M.T. A meteor, 2 to 3 times the apparent size of Venus, and magnitude −6, was observed bearing 179°(T) at an altitude 50° in the constellation Scorpio. It travelled in a SE direction, and after about 3 sec disappeared behind cloud at bearing 137° and altitude 30°. After 2 sec flight a large piece appeared to break off from the main body.

Position of ship: 01° 56′N, 10° 12′W.

South Atlantic Ocean

M.V. *Parima*. Captain G. S. Grant, R.D., R.N.R. Montevideo to Las Palmas. Observer, Mr. J. Escolme, 3rd Officer.

2nd June, 1953, 2317 G.M.T. A meteor was observed to fall from the zenith in a direction 040°. It was seen to break up into three parts, and left a slightly luminous trail, and faded at about 50° alt.

Position of ship: 32° 54′S, 50° 47′W.

3rd June, 1953, 0136 G.M.T. A meteor was observed travelling in a N–S direction, and appeared to disintegrate into about six parts and left a luminous trail.

Position of ship: 32° 29′S, 50° 21′W.

8th June, 1953, 0015 G.M.T. A meteor was observed to be travelling parallel with the horizon, through an arc of 70°, at altitude 13°. It left a luminous trail 25° long and lasted for 4 sec. The meteor first appeared near the constellation Peacock, bearing 145° and faded in bearing 215°.

Position of ship: 07° 32′S, 32° 55′W.

Persian Gulf

S.S. *City of Lyons*. Captain C. G. Griffiths. Aden to Umm Said. Observer, Mr. J. B. Jones, 3rd Officer.

27th May, 1953, 1924 G.M.T. A meteor of phenomenal brilliance appeared at first in the vicinity of the star Denebola, at altitude 33°. It fell very rapidly to the horizon and was visible for 1½ sec. Its path made an angle of 30° to the vertical from left to right. It appeared to be 4 to 5 times the size of Sirius, and had a centre of brilliant white with a very distinct blue-green edge.

Sky clear, visibility excellent.

Position of ship: 26° 05′N, 54° 36′E.

UNIDENTIFIED RADAR ECHOES

North Atlantic Ocean

S.S. *Rialto*. Captain F. Goodman. Middlesbrough to New York.

11th May, 1953. Vessel steaming in dense fog. At approximately 2100 S.M.T. Radar gave echoes on apparent objects that we were unable to identify. Echoes were similar to those given by sea clutter but were in two distinct groups. Firstly, one group to port, distant 1½ miles, and about half an hour later another group, this time to starboard, distant ½ mile. Speed was reduced each time accordingly. Nothing was sighted. After the objects (apparent) had been astern for about half an hour, the sea temperature started to rise until reaching 65° at 2300.

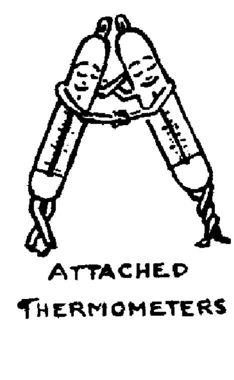
Air temperature 53°F throughout. Sea temperature 53° at 2000, 47° at 2130, 45° at 2140, 55° at 2230 and 65° at 2300.

Position of ship: 41° 20′N, 51° 03′W. Course 268°, 14 kt.

Note. The above observations were forwarded to the Director, Naval Weather Service who comments as follows:

The sea temperature observations show a temporary drop of 8°F followed by a sharp rise of 20°F in approximately 19 miles on steaming further westward. This suggests a southward penetration of a tongue of cold water with a local eddy forming in the broad Gulf Stream current. It would seem possible that a current rip might be formed and the echoes (reported as similar to sea clutter) may be due to reflections from areas of very disturbed water. Reports of echoes occurring with current rips would be welcomed, especially when visual observations can also be made.

This sketch is one of a number that were drawn on the cover of a meteorological logbook sent in from the M.V. *Port Wellington*. The sketches were made by the observing officers. We intend to publish a selection of these in future numbers of *The Marine Observer*.



Drift of the *San Ernesto* 1943–49

By Capt. J. P. Thomson, O.B.E.

(Until he retired in 1951, Capt. Thomson was Marine Superintendent of The Eagle Oil and Shipping Co., Ltd.)

In June, 1943, a tanker of 12,000 tons deadweight—dimensions 460 ft × 62 ft × 33·3 ft, draft about 17 ft F., 22 ft A., engines placed aft and bridge just forward of the middle line—was on a ballast passage Australia to the Persian Gulf. She was sailing without escort and was torpedoed and had to be abandoned by her crew in lat. 09° 18′S, long. 80° 20′E at 11.10 p.m. on the 15th June.

The first torpedo hit the vessel in the engine room and the captain found it necessary to give the order "Abandon Ship" as he felt that further attack was almost certain. It seemed that his decision was well founded, as the submarine torpedoed the ship a second time—this time under the bridge—then surfaced and commenced shelling up to 4 a.m. the next morning, and the crew observed from the boats their vessel burning fiercely fore and aft.

The captain, after laying off until 3 p.m. the next day, returned to the wreck and found that all means of boarding had been destroyed by fire and that the hull was seriously damaged.

There was now no alternative but to shape a course for Colombo; the crew had abandoned in four boats but one was damaged and those in that boat were taken into the captain's boat. The crew, all told, numbered 41 but one man had lost his life in the engine room when the torpedo hit. The captain's boat, containing 21 members of the crew, was picked up 8½ days later in lat. 01° 15′S, long. 77° 16′E, having made 510 miles towards Colombo. The other two boats sailed together for a few days and then lost sight of each other, but finally both boats made the Maldive Islands 30 days after the destruction of their vessel.

In these two boats there were 19 men in the charge of the second and third officers respectively. One seaman died whilst in the boat and another after landing. They were well cared for, after landing, by the Governor of the Islands and when they were able to travel he sent them to Colombo on board an Arab dhow, which made good time on the passage. Her sailing qualities were commented upon by the survivors as being superior to those of the 24 ft steel lifeboats.

The above is now the tragic history of the past, but the fate of the wreck is of interest. Five hours' ruthless attack had failed to sink her, and in June, 1949, some six years later, she was reported aground by an officer of the Royal Netherlands Navy on the west side of Pulau Nias Island, Afocles Bay, lat. 01° 15′N, long. 97° 15′E, heading south, abeach along the port side, and a depth of 19 to 23 ft along the starboard side.

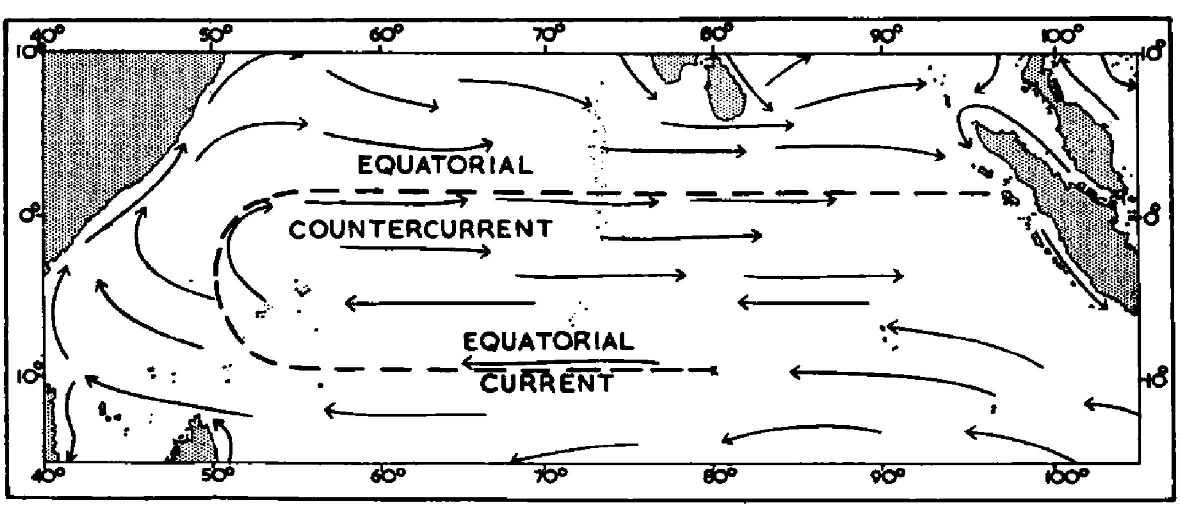
The wreck had been reported by aircraft a few weeks after being torpedoed, but from then onwards no report of her being sighted was ever received.

As the vessel lay aground at Pulau Nias Island, it appears that she would have been at a draft of about 19–20 ft and therefore about 50% of her hull would be above water and subject to the winds, and the other 50%, being under water, would be subject to the currents. The distance from the position in which she was torpedoed to where she grounded was 1,189 miles, and the course N 58°E. Pulau Nias Island is remote and it has not been ascertained when she grounded, but if we assume six years' drifting, the distance made good was under 200 miles per year and the motive power would appear to have been the preponderance of the SW monsoon. It would be interesting to see a small chart showing the probable track, also any possible explanation of why the vessel was not sighted, although she had drifted across the trade routes.

Note. It is quite impossible to say what route a drifting ship takes, especially over an unknown but long period of time. Even with the best current charts available, there is so much variation of current direction and strength at every point of the Indian Ocean that no one can say what the current was on any individual day or succession of days. The only thing that can be done is to lay down what may be called a basic track, derived from the vector mean rate and direction of current, that is, the actual resultant flow of the water in the long run. Even this can only be done approximately when the period of drift covers a year or more, since the vector mean direction varies to some extent in different seasons of the year, and there is no means of knowing at what time of the year the ship was at any given point of the track.

The *San Ernesto*, at the time under the command of Captain George Waite, O.B.E., was abandoned in about the middle longitude of the Indian Ocean, right on the Fremantle to Aden shipping track, a little over 900 miles due south of Ceylon. This position is within the main flow of the west-going South Equatorial Current. It is likely, therefore, that over a sufficient period of time she was carried westward and the probable basic route is that shown in the chartlet. Somewhere in the longitude of the Seychelles Islands or to westward of them, where the current has considerable variability throughout the year, she could drift north-westward, northward and north-eastward, finally entering the Equatorial Counter-current which flows eastward throughout the year between about latitudes 3° or 4°N and 5°S. If the ship arrived at a position northward of the equator in the eastern part of the ocean, the vector mean direction of the counter-current would carry her straight on to Pulau Nias.

The reason for calling the suggested track a basic one is that at any point the ship might diverge from it in almost any direction, for a longer or shorter period of time. Ultimately the resultant flow of water, as determined by the combination of current observations, would be likely to bring her back to some part of the region of the track. The length of the suggested track as shown is roughly 4,800 miles, which would give an average of 800 miles per year if the drift took the full six years. The distance actually travelled was probably much greater, since the average rate of current in the equatorial regions of the Indian Ocean is considerably higher than 2 miles per day. The shortest time in which this drift could be made, based on the vector mean current rate, is roughly fifteen months. No opinion can be expressed on why the ship was never sighted; this would depend on pure chance.



Possible " basic " drift of the *San Ernesto* from when she was abandoned in 1943 to when she was found on Pulau Nias Island. The current in the Arabian Sea and Bay of Bengal flows in the opposite direction during the north-east monsoon.

The direct track from the point of abandoning to Pulau Nias is unlikely to have been the basic one, as it cuts right across the vector mean current directions.

On the suggested track, the SE trade wind, which is the cause of the South Equatorial Current, would assist the westward drift of the ship. In the case of the Equatorial Counter-current, which is not essentially a wind-driven current, that part of the current which lies north of the equator is opposed by the wind during the north-east monsoon season.

E. W. B.

THE DEEP-SEA FLOOR AND THE HISTORY OF THE EARTH

Notes on the Joint Commission on Oceanography of the International Council of Scientific Unions Symposium, held at the University of Liverpool on the 1st and 2nd September, 1953.

The President, Dr. J. D. H. Wiseman of London, welcomed the visitors, amongst whom were representatives from the U.S.A., France, Germany, Holland, Algeria, Sweden, and the International Hydrographic Bureau; thirteen of these contributed papers, the reading being followed by a short general discussion.

Most of the principal authorities upon deep-sea research were present, many of whom had taken part in oceanic exploration, and the papers read embraced results of research on sedimentation from geological, geophysical, and biological standpoints. Papers were also read on the evidence of possible changes in ocean-volume and climate of the past, and on the interpretation of continuous echo-sounding records and the preparation of bathymetric charts. The focus of the whole was upon the contribution of the various lines of work to the elucidation of the earth's history. Some of the papers were illustrated by lantern slides, which although adding to the interest made the taking of notes in the poor light a difficult matter. Others were, unfortunately, read in foreign languages. The titles of all the papers are included in this article but summaries are only given of those where notes were obtained.

The first chairman, Professor J. Proudman of Liverpool opened the proceedings and was followed by Professor Hans Pettersson of Sweden who read his paper on "Deep-sea sediments and their origin". Professor Pettersson stated that the sediment "carpet" varies considerably in thickness but on average amounts to about 3,000 metres. Its thickest point in the Atlantic is west of Madeira where it is about 3,400 metres. Surprisingly lesser thicknesses have been recorded in the equatorial Pacific and Indian Oceans. In some parts of the Atlantic the sediment was estimated to be about 2,000,000 years old. In the central Pacific, "cores" of sediment up to 15 metres in length had been obtained; these must have taken at least 15,000,000 years to accumulate. Professor Pettersson described methods of investigation, which included the systematic studies of very long sediment cores and the seismic method of finding the thickness of the sediment carpet. Experiments had revealed that deep-sea bottoms were extremely rugged whereas it might have been thought that they would have been smoothed out by the incessant fall of sediment. This persistent ruggedness appeared to indicate that volcanic forces had been active. There was the possibility that considerable quantities of uranium and radium were contained in ocean-bed sediment.

The next paper by Professor C. W. Correns of Germany was read in German and described the presence of amounts of "Titanium in deep-sea deposits".

The first session was concluded by Dr. J. D. H. Wiseman's paper on "Three methods of determining the age of minor temperature oscillations during the past 15,000 years". During these thousands of years, minute shellfish, a form of plankton which grows and multiplies in the surface waters, have died and sunk to the bottom, depositing their chalky shells. From evidence obtained by the use of the core-sampler at depths of over 4,000 metres in mid-Atlantic, a check of the iron and titanium found with the shells in the deposits made it possible to date the history of the shellfish. There were periods when the surface waters were warm and they multiplied exceedingly, and there were periods when they were not so numerous, indicating colder conditions. On this basis Dr. Wiseman said that his calendar coincided closely with land records, which showed similar phases of warming up and cooling off. The probability was that during the next few centuries we could expect a slight decrease in the temperature of the sea. At the present time it appeared that we were at the peak of one of the minor fluctuations and that the temperature would fall a few degrees over the coming century. This would not mean a return to the Ice Age or anything like that; it would just be history repeating what happened in 550 B.C. and again in A.D. 1200

Professor R. Revelle of the U.S.A. was the chairman of the afternoon session and he called upon Professor Louis Fage of France to describe " Recent results on oxygen-content in Mediterranean deep waters ". This paper was read in French as was also the one which followed " The role of unicellular plankton in deep seas ", read by Professor F. Bernard of Algeria.

" Some effects of high hydrostatic pressure on apparatus and organisms observed in the Danish *Galathea* Deep-Sea Expedition " was the title of the paper read by Professor C. E. ZoBell of the U.S.A. He displayed numerous samples of damaged deep-sea apparatus, thermometers, samplers, metal containers, etc. It had been found very difficult to obtain temperatures at great depths, because below 8,000 metres all the protected thermometers used were broken. Glass thermometer tubes were pulverised and metal containers had their walls bent in and their insides embedded with fine particles. Capillary glass tubes were used with the bacteriological water sampler and these withstood pressure of 1,000 atmospheres at depths exceeding 7,000 metres. Evidence of life at these great depths in the form of barophilic bacteria was found. Cultures of these were physiologically active in a nutrient medium maintained in the laboratory at pressures approximately similar to the environment from which they were recovered. Several species were kept under observation at pressures ranging from 700 to 1,000 atmospheres (as much as 15,000 lb/sq in.).

Professor Ph. H. Kuenen of Holland then discussed " The classification and origin of submarine canyons ". Several processes had contributed to the formation of these canyons or ravines on the ocean floor. Some were drowned river valleys, and others were the result of glacial turbidity currents. Changes could take place in these submarine ravines from the deposition of sediment or excavation by submarine erosion. He gave several examples of various types in the Mediterranean, California and New England coasts and around Japan.

For the morning session on the second day the chairman was Dr. J. D. H. Wiseman of London. Professor R. Revelle of the U.S.A. spoke of " The possible changes in ocean-volume since mid-Mesozoic times", and he was followed by Vice-Admiral J. D. Nares of the International Hydrographic Bureau, Monaco, who described " Future plans for preparation of sheets of the *General Bathymetric Chart of the Oceans* ". This paper was obviously the one of most interest to marine observers and a brief outline of the events leading up to the modern production of these fine charts is therefore given. Lieut. M. F. Maury of the United States Navy prepared the first bathymetric chart in 1854, of the North Atlantic Ocean, then in 1866 Sir John Murray of the *Challenger* Expedition contributed his *Physical Charts of the World*, including bathymetric charts of the oceans. Resulting from various voyages of oceanic exploration numerous other charts of deep-sea soundings were produced until in 1903 the standardised preparation of *General Bathymetric Charts of the Oceans* was entrusted to the Prince of Monaco, who since 1885, had carried on oceanographical work in a systematic manner in the North Atlantic and Mediterranean on board his various yachts, and had founded and endowed a magnificent oceanographical museum at Monaco; many important memoirs have been issued from the Monaco press. The International Hydrographic Bureau finally became established at Monaco and had continued to produce and publish sectional sheets of Bathymetric Charts of the Oceans, corrected to the latest available information.

Oceanic navigational charts merely serve as graphical instruments to plot positions, trace a ship's course and to solve navigational problems in general. They rarely show depth contours in the open sea and the interpretation of the soundings shown are for the practice of navigation. The oceanic bathymetric charts show depth contours in the open sea and are tinted so as to permit the user to obtain at a single glance a comprehensive view of the general aspect of oceanic depths. The endeavour is to fully satisfy all possible users and these are many and varied. In addition to hydrographers and navigators interested in depths of oceans and seas and with the currents and tidal streams therein, there are biologists who are chiefly concerned with the animal life in the seas and fishery developments, depending on depth and geographical position. Geologists are interested in the evolution of the earth's crust, the formation of the sea bottom and modification of coast-line, geographers in the study of the sea in connection with geographical science, and geophysicists in the chemical composition of sea water, the upwelling of deep water and, like navigators, the behaviour of ocean currents and tides.

Vice-Admiral Nares, who was accompanied by the Hydrographer of the Navy, Vice-Admiral A. Day, spoke of the future production of some of the charts included in the full range of 24 coloured sheets, each 43 in. by 29½ in., showing deep sea soundings and depth contours of the oceans, together with the principal mountain ranges of continents. Sixteen of the sheets are represented on Mercator and eight on gnomonic projection. Vice-Admiral Nares kindly gave the writer a copy of the latest bathymetric chart produced, which was for that part of the Southern Ocean which includes South Georgia and is of the greatest interest to the whale fishing industry.

Dr. F. F. Koczy of Sweden then gave his " Survey of the echo-soundings taken by the Swedish Deep-Sea Expedition ". A special high-power apparatus of British manufacture was used which recorded continuously the bottom figuration down to 5,000 fathoms. Depths on stations were checked and the microstructure of the ocean floor examined. A search was made for suitable trawling areas but a flat bottom was found only occasionally and on the whole the ruggedness of the bottom was greater than expected.

Professor R. M. Shackleton of Liverpool was chairman for the final all-British period and Dr. M. N. Hill read his paper on " Structural features of the floor of the eastern Atlantic ", followed by Dr. G. M. Lees with " The geological evidence of the structure of continents and ocean floors ". Sir Edward C. Bullard concluded with " Heat flow through the ocean floor and its implications ". He said that it had recently become possible to measure the amount of heat flowing through the floor of the ocean, the temperature-gradient being determined by forcing a probe carrying recording thermometers into the bottom. The measurements involved the determination of the rate of increase of temperature downward into the sediments, the conductivity being measured in the laboratory on the samples collected.

The titles of the papers read at this Symposium give some indication of the basic scientific research taking place on the deep-sea floor, which covers approximately two-thirds of the earth and is largely unexplored. With the invention of the core-sampler and with recent advances in echo-sounding devices and other techniques, great strides in investigating the deep-sea floor are being made and these are producing important and far-reaching results, which may well revolutionise many of the theories concerning the history and development of our planet.

The seaman's main concern with the sea bottom is to keep his vessel from coming into contact with it, but it is hoped that these notes will serve to illustrate the great interest that is being taken by international scientists in that section of oceanography which deals with the deep-sea floor.

M. C.

The Storm of 31st January—1st February, 1953

By R. F. M. Hay, M.A. and Miss J. Laing
(Marine Branch, Meteorological Office)

A widespread NW–N gale affected the north and east of the British Isles and most of the North Sea on 31st January, 1953. It was accompanied by serious loss due to floods on the east coast and in the Low Countries and a large number of shipping casualties among which the foundering of the M.V. *Princess Victoria* with heavy loss of life near the entrance to Belfast Lough was the most serious peacetime shipping casualty in home waters for many years. A representative of the Marine Branch of the Meteorological Office gave evidence at the formal investigations into the loss of the M.V. *Princess Victoria* and the loss of the motor trawler *Guava*. Other trawlers and coasters owned in the United Kingdom which were lost in the same night were the *Sheldon*, *Michael Griffiths* and *Yew Valley* and formal investigations into the losses of these vessels remain to be heard. About the same time many other ships were missing, believed lost, in the North Sea, including the Dutch vessels M.V. *Catherina Duyvis*, M.V. *Salland* and M.V. *Westland* and the Swedish vessel S.S. *Aspo*. It is likely that the full circumstances in which these tragic losses occurred will never be fully determined.

The depression responsible for this gale formed as a warm front wave which broke away from a quasi-stationary depression near the Azores and it was first

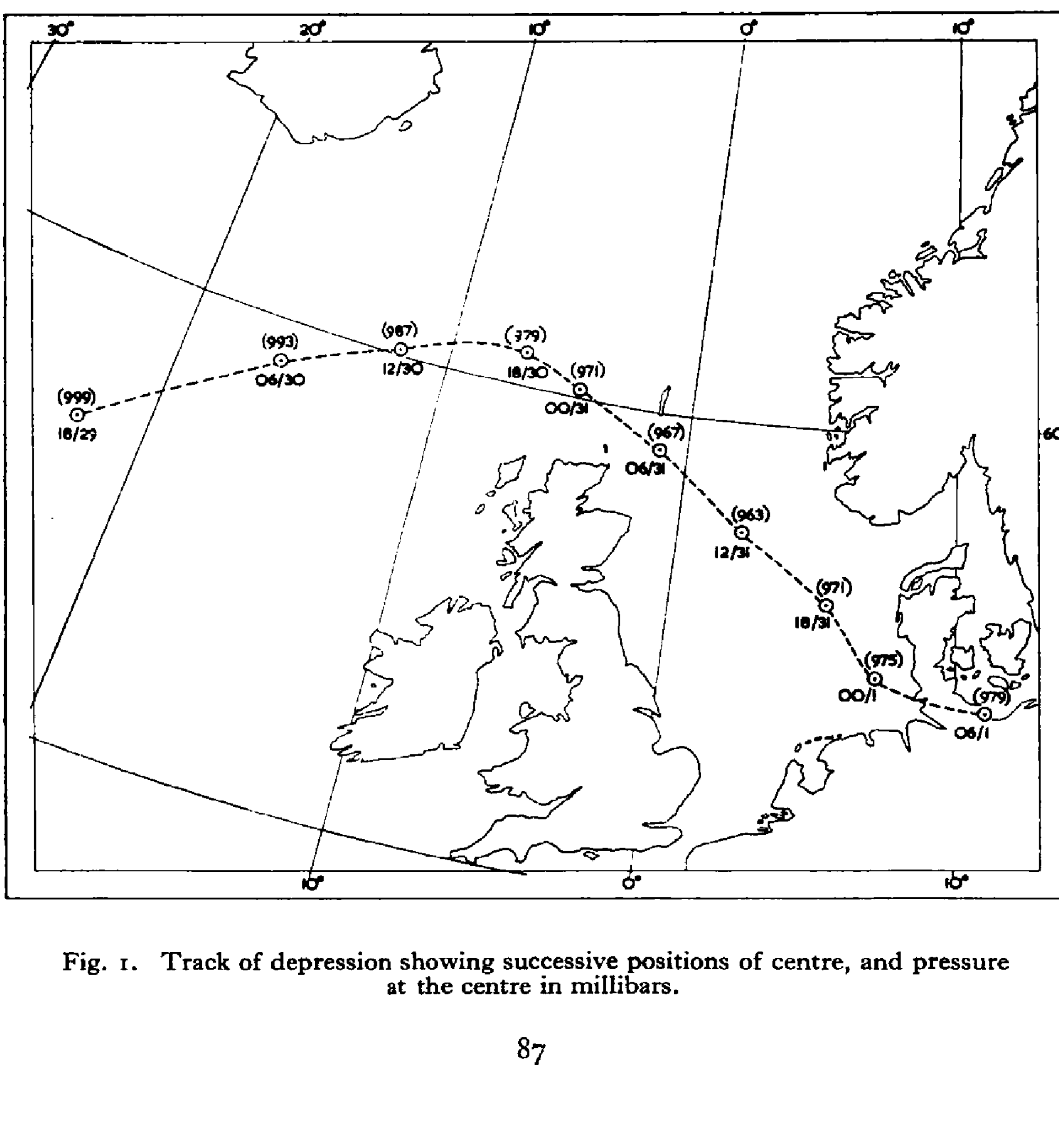


Fig. 1. Track of depression showing successive positions of centre, and pressure at the centre in millibars.

shown on the chart for 1200 G.M.T. 29th January at 54½°N 27°W with a central pressure of 1003 mb. Its subsequent track and the pressures at its centre are shown in Fig. 1. Shortly after 1800 G.M.T. 30th the centre began to move in a SE'ly direction from just south of The Faeroes towards the North Sea, while pressure was still falling there. The cold front had crossed Scotland by midnight and the centre had become occluded about this time. Meanwhile a rapid intensification of the anticyclone to westward occurred and this, together with the intensity of the depression, was responsible for the exceptionally steep northerly gradient which developed over the north and east of the British Isles and most of the North Sea. The synoptic situations at 1200 G.M.T. 30th, 0001 G.M.T. 31st and 1200 G.M.T. 31st January are shown in Figs. 2, 3 and 4.

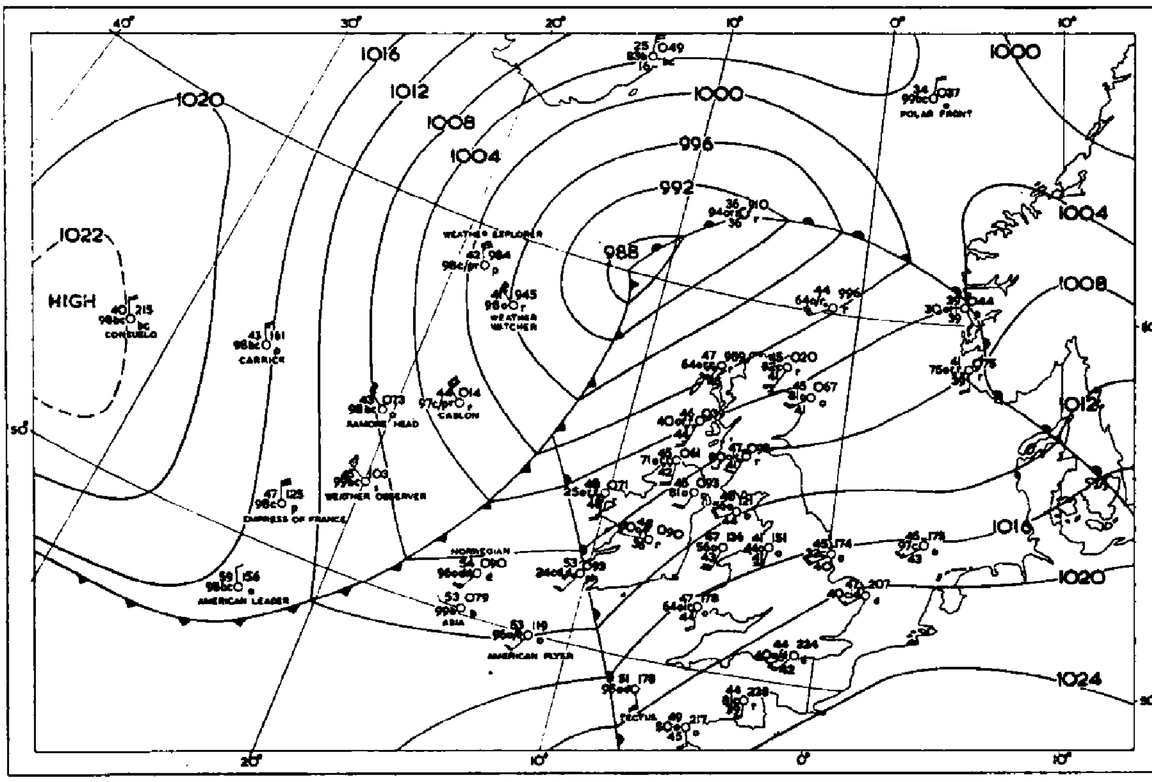


Fig. 2. Synoptic chart for 1200 G.M.T. 30th January, 1953.

Although the gale affected a wide area, and later attained exceptional severity in the extreme NE of the British Isles and parts of the North Sea, the severity reached off the north-west seaboard, which was one of the first areas to be affected, was by no means unusual. At several stations in S.W. Scotland and the Irish Sea a storm of greater severity had occurred only six weeks earlier, on 17th December, 1952, and a search through the records for the previous 15 years showed that severer gales had happened on several occasions.

Conditions in the Atlantic near ocean weather station " India " were described as follows by the Meteorological observer on *Weather Explorer*.

" 30th January, 1953. Position 58° 53′N, 18° 48′W.

At 1330 G.M.T. a squall was observed approaching from the NW. The wind then was 320° (T), at 28 kt and the sky was broken. As the squall came nearer the wind rose rapidly to 50 kt with gusts to 65 by 1345 G.M.T.; light sleet began to fall but the pressure remained steady at 998·2 mb. By 1400 hours the wind was averaging 60 kt and gusting to 70. It then increased to a steady 65–70 kt and occasionally it reached 70–75 kt with gusts to 80 kt until 1500 G.M.T. The sky was overcast throughout with 7/8 scud and 8/8 Cb and Ns above. At this point the barometer fell slightly then suddenly rose 2 mb in approximately 10 minutes. Thereafter a few breaks were seen and the wind eased to force eleven and there was a gradual improvement to broken skies by 1600 with showers of hail. The sea during this period averaged between 15 and 20 ft at first and later 20–25 ft with turbulent precipitous waves and driving spray which reduced the visibility at times to ½ mile. The direction of the swell was approximately 320°(T), but a cross swell from 020° could be observed but it was not possible to time it or estimate the height with any accuracy. From 1600 G.M.T., there was a gradual lessening in wind speed until by 1800 it was 40–50 kt gusting to over 60. The swell lengthened and became 25 to 30 ft in height, period 7 sec and more regular than previously. The pressure had by then risen 18 mb since 1500 G.M.T."

In the extreme N and NE of Scotland, according to C. K. M. Douglas, the storm was very exceptional. Not long before this time the Electrical Research Association had installed an electric cup generator anemometer on top of a 500 ft hill in Orkney. This instrument recorded mean winds of near 100 m.p.h. (87 kt) between 0800 and 0840 G.M.T. 31st with a gust up to 125 m.p.h. (107 kt) during the morning. A Dines anemometer at Grimsetter nearby with a standard exposure recorded a mean wind of over 60 kt through the morning with gusts up to the limit of the anemometer at 107 m.p.h. (93 kt). On and near our north-east coasts as a whole a WNW to NW gale got up quickly between 0300 and 0700 G.M.T., subsequently there was a veer to N and an increase to force 10 which occurred later at various east coast stations as far south as Yorkshire while force 9 was recorded as far south as Felixstowe.

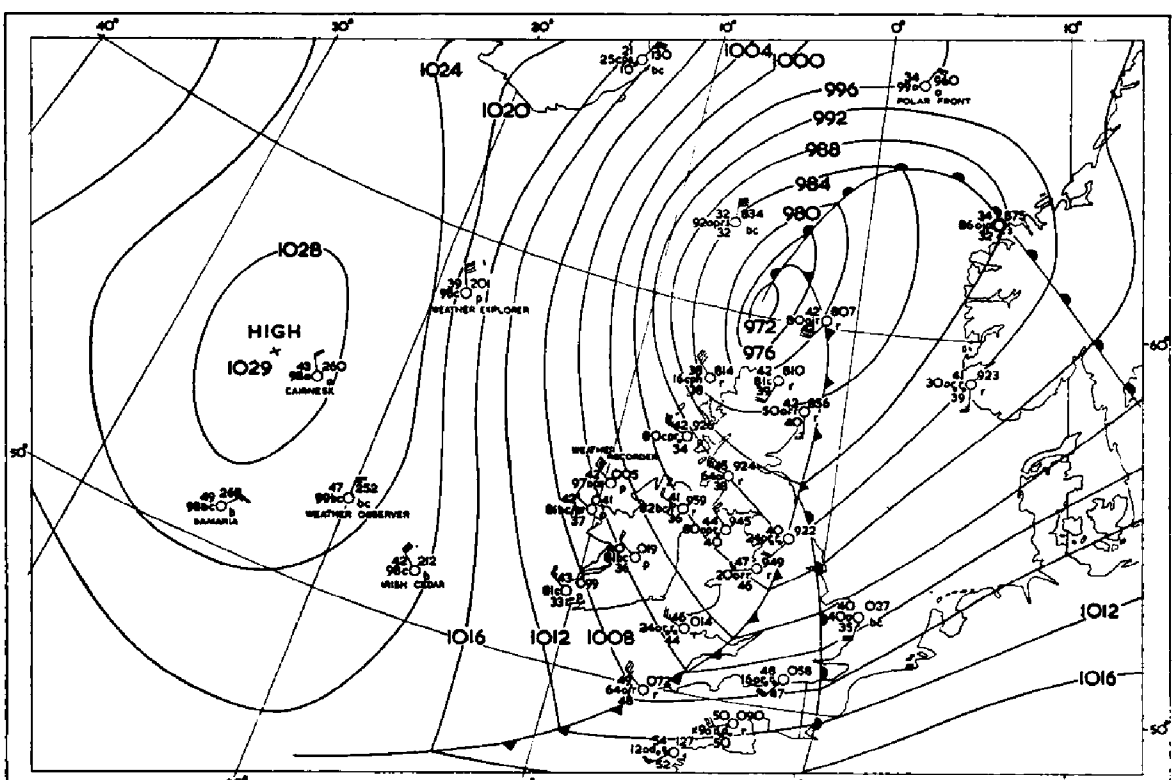


Fig. 3. Synoptic chart for 0001 G.M.T. 31st January, 1953.

Pressure gradients in these areas were also very remarkable, the geostrophic wind reaching 140–150 kt in a belt 100 miles wide off North Scotland at 0600 G.M.T. and off NE Scotland at 1200 G.M.T. The values of extreme winds published for stations on the northeast and extreme north coasts of Britain leave no doubt that this storm gave the worst gale on record in these areas from a NW to N direction. The destruction of timber in N.E. Scotland was widespread and there is abundant evidence that it has not occurred on such disastrous scale for at least half a century. All the available evidence also goes to show that the gale over the western and middle North Sea was of a record-breaking character.

The height of the waves produced during the storm were not outstanding in the Atlantic. *Weather Recorder* in position 54° 30′N, 11° 48′W encountered 29 ft waves at 1200 G.M.T. 31st and the destroyer H.M.S. *Contest* proceeding to the assistance of the *Princess Victoria* was forced to reduce speed by waves reported as 25–30 ft high which were encountered in the North Channel around 1200 G.M.T. on 31st. The estimated wave height in the North Channel at 1500 31st was 26 ft. It is likely that the period of these waves was less than that of waves of the same height in the open Atlantic, which would imply that the waves in the North Channel were steeper and more dangerous than the corresponding waves in the Atlantic.

In the North Sea the following wave heights were recorded by the steamships *Tasso* and *Tinto*.

		Position	Wave heights (ft)	Wind Dirn.	Wind Force
S.S. *Tasso*	1200 G.M.T. 1st Feb.	56° 04′N 02° 45′E	30	360°	11–12
	1800 G.M.T. 1st Feb.	56° 21′N 02′ 52′E	30	360°	11–12
S.S. *Tinto*	1200 G.M.T. 1st Feb.	56° 40′N 04° 20′E	30	360°	9–10
	1800 G.M.T. 1st Feb.	55° 30′N 03° 20′E	30	360°	8–9

These seas were quite exceptionally high for the North Sea and their shortness would have made them more dangerous than waves of comparable height but greater length met in the North Atlantic. It will be remembered that the trawler M.V. *Guava* was missing after this storm and when she was contacted for the last time at 2210 G.M.T. 31st her position was approximately 53° 30′N, 03° 00′E.

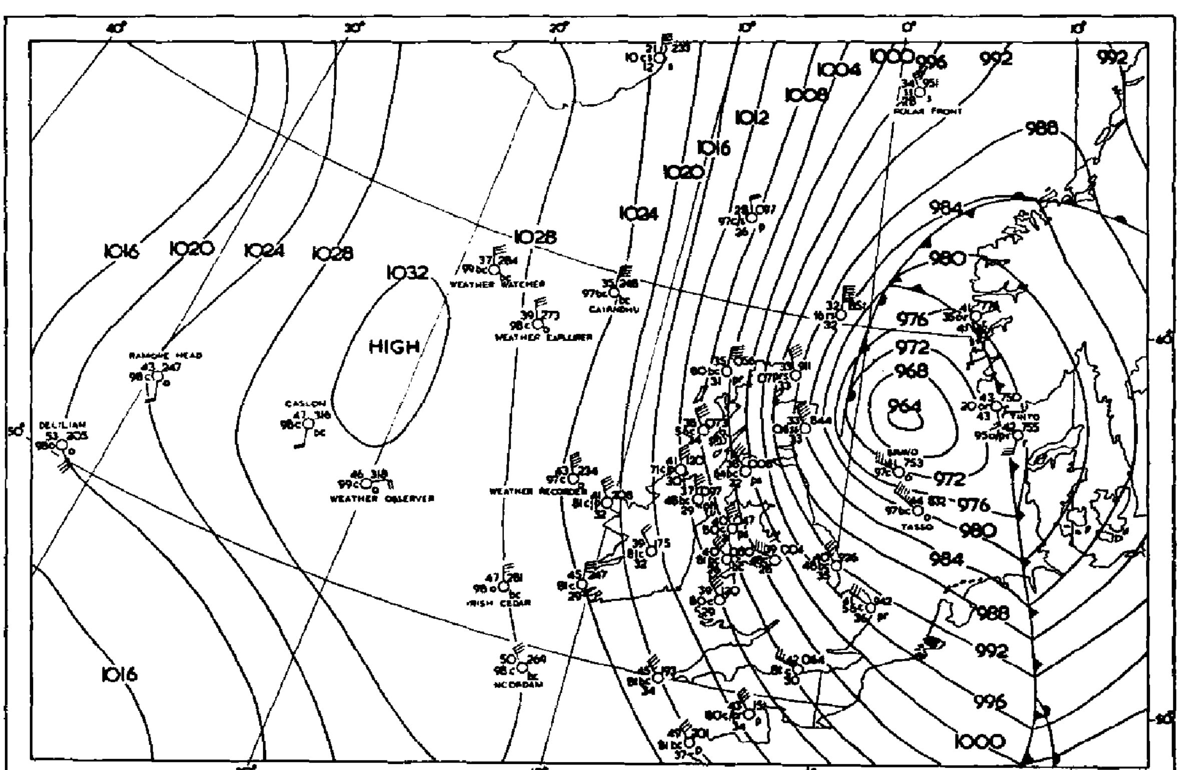


Fig. 4. Synoptic chart for 1200 G.M.T. 31st January, 1953.

No account of the storm of 31st January would be complete without a description of the last voyage of the ill-fated *Princess Victoria* which was a twin screw motor-driven ferry boat built for the carriage of passengers, motor-cars and general cargo by Messrs. William Denny in 1946. Her gross tonnage was 2,694. When the ship sailed at about 0745 31st January a severe gale warning for the area had been in force since 0255 G.M.T. and the wind was already blowing NNW force 8–9 with gusts to force 11; during the morning and early afternoon of that day they were NNW or N force 9–10 with gusts to force 12. A glance at the Admiralty Chart for the Irish Sea shows that winds from NW to NNW have a nearly unlimited fetch since these directions are open to the Atlantic. At some time around 0900 G.M.T. after the ship had gained the open water outside Loch Ryan she was struck by a heavy sea. As a result the ship took in water and sustained damage to her stern doors which could not be closed again, a shift of cargo occurred then or soon after, and the ship took a list to starboard.

An SOS message was broadcast at 1032 G.M.T. after which numerous radio messages were exchanged with shore radio stations and other rescue craft, but although the destroyer *Contest* was alerted at an early stage and proceeded from Greenock at full speed she was not in time to render assistance before the ship had sunk. The *Princess Victoria*, on her beam ends at the last, finally sank about 1415 G.M.T., a bare 5 miles NE of the Copeland Islands, her heroic wireless operator continuing to send out messages up to the last. The few survivors were picked up by various vessels and shore lifeboats.

This article has naturally emphasised the sea aspect of these disasters caused by this storm. The loss of life caused ashore by the breaking of the sea defences along hundreds of miles of coast in the east of Britain and Holland and Belgium, was on a far greater scale and was greater than in any other similar disaster for centuries. The great public concern shown over the disaster led to the holding of an enquiry, as a result of which the Government has set up a Flood Warning System whereby the Central Forecasting Office, Dunstable, and the Hydrographic Branch of the Admiralty, are made jointly responsible for the issue of flood warnings to local authorities. The idea behind the system is to divide the coast into districts, so as to make certain that any area in which there is considered to be a serious risk of flooding from an abnormal rise of sea level is given a few hours' warning, while at the same time the number of unnecessary warnings is reduced to a minimum. The great storm of 31st January has certainly shattered an illusion that has tended to become prevalent in recent years, that in these days of swift travel and scientific achievements man has had little to fear from the sea; on the contrary the forces of nature demand from him an unceasing vigilance.

SELECTED SHIPS IN THE CARIBBEAN

The following is an extract from a letter received from Dr. F. W. Reichelderfer, Chief of the U.S. Weather Bureau.

" A total of 365 radio weather messages from British vessels in Eastern Caribbean waters (03°N–30°N, eastward of 60°W) were addressed to " Observer Washington " in July, 1953. Of this number, 119 observations were taken at 0000 G.M.T., 44 at 0600 G.M.T. 120 at 1200 G.M.T., and 82 at 1800 G.M.T. You will be interested to learn that the total number of weather messages received during July from ships of all nations plying routes in the area was 887.

" We are grateful for your efforts in arranging for the co-operation of your vessels in furnishing messages to us."

Presentation of Barographs to Captains

As mentioned in the October 1953 number, barographs have been awarded to the masters of four " Selected " ships for consistently good meteorological work during a long period of years.

At a luncheon party at which the management of the Port Line were hosts, aboard their vessel *Port Auckland* in the King George V Dock, London, Dr. O. G. Sutton, our Director, made the presentation to two of the recipients. On boarding the ship Dr. Sutton inspected the bridge and the meteorological and navigational equipment. The recipients of the award on this occasion were Captain J. G. Lewis, O.B.E. (Port Line), at present in command of the *Port Auckland*, and Captain A. E. Williams (New Zealand Shipping Co.), in command of the *Dorset*. In presenting the awards Dr. Sutton thanked the Port Line for their hospitality and his pleasure at having this opportunity of meeting some of the voluntary observing officers and masters and the management aboard a ship. He recalled with pleasure that, including the awards made in 1953, four captains of the Port Line had thus received barographs, and five captains of the New Zealand Shipping Company. He felt that these awards were very justly earned and emphasised the great debt which everybody interested in meteorology owed to voluntary observers in merchant ships. The long record of " Excellent Awards " earned by these two masters was admirable. This presentation took place on 1st December, 1953.

Also present aboard the ship were the Marine Superintendents and brother captains of the recipients, as well as other representatives from the Meteorological Office.

The presentation to Captain Roswell was made by Dr. Sutton aboard the *Wellington*, headquarters ship of the Honourable Company of Master Mariners, at an informal gathering of the Company on 13th January.

Dr. Sutton expressed his appreciation to the Honourable Company for having invited him to make the presentation in such appropriate surroundings. He mentioned the long and pleasant association which the Meteorological Office had had with the masters, officers and owners of British merchant ships and how difficult it would be for the meteorologist if the radio weather reports so readily provided by merchant ships in all oceans were not forthcoming.

Tea was served beforehand and this gave Dr. Sutton an opportunity of meeting personally various members of the Honourable Company. After the presentation Mr. Frank Carr, Director of the National Maritime Museum, gave a talk on " Ships of other days ".

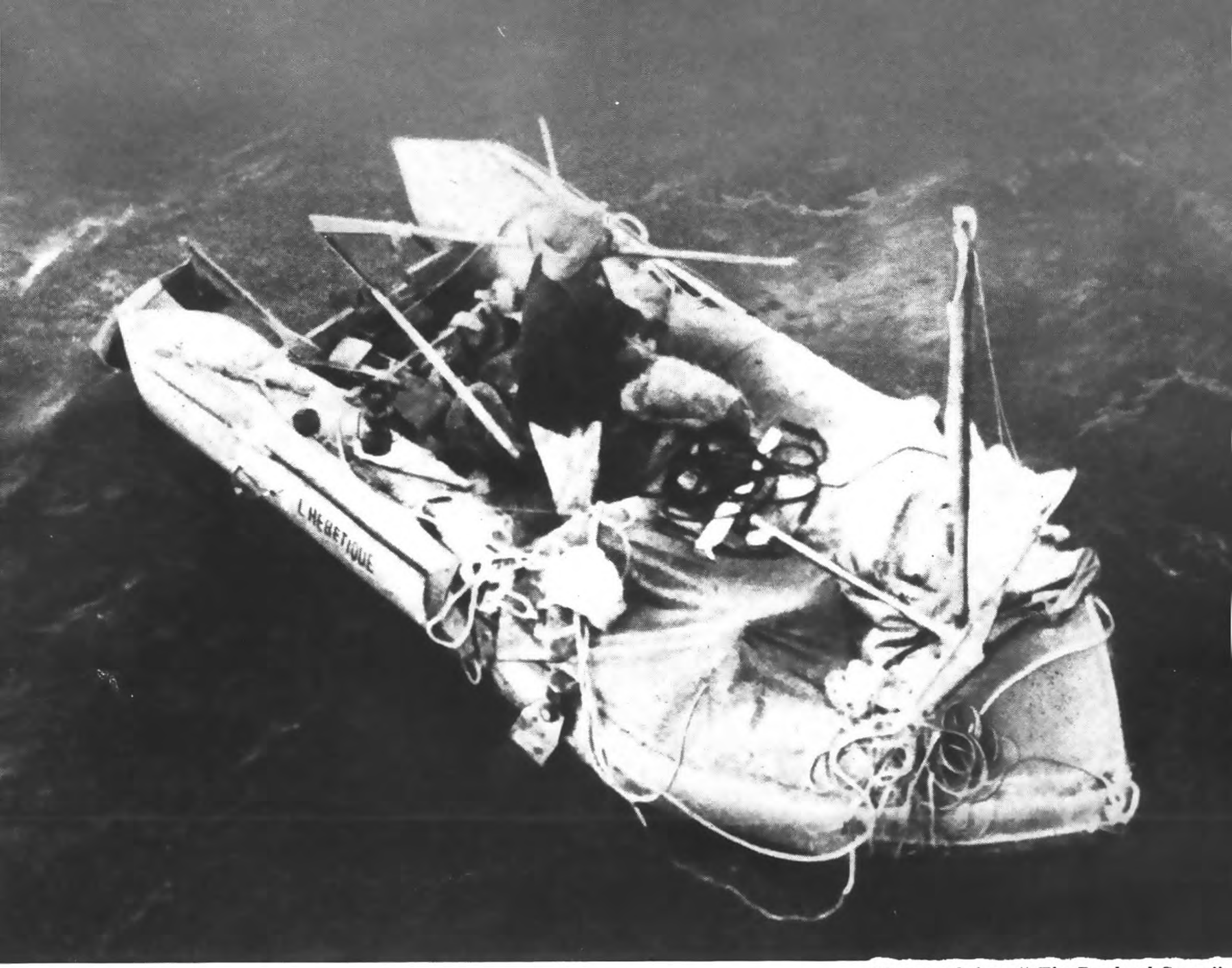
Dr. Sutton also presented the barograph to Captain Lawrey aboard the *Wellington* in the early afternoon of 27th January in the presence of a Technical Committee of the Honourable Company. Prior to the presentation Dr. Sutton entertained Captain Lawrey and Captain Gorman, Assistant Marine Superintendent of the Port Line at luncheon.

C. E. N. F.

THE NORTH SEA FLOODS

A breach in the sea-defences at Sutton-on-Sea, Lincs., about 300 yds. long, the widest to be made in this country during the storm of 31st January, 1953.

Opposite page 92



Photograph from " The Bombard Story "

Dr. Bombard's rubber dinghy *L'Hérétique.*

The Director of The Meteorological Office, Dr. Sutton, presenting an inscribed barograph to Captain Lewis aboard the *Port Auckland*.

Across the Atlantic by Raft

By Dr. Alain Bombard

(In 1952 Dr. Bombard, a French doctor, crossed the Atlantic alone in a rubber dinghy taking with him no supplies except a sealed box of emergency rations. This box was still sealed when he landed at Barbados. The object of his voyage was to prove that shipwrecked mariners can live and keep themselves in reasonably good health solely on fish and plankton obtained from the sea. A review of his book *The Bombard Story* appears on page 111. This article was translated from the French by the Air Ministry.)

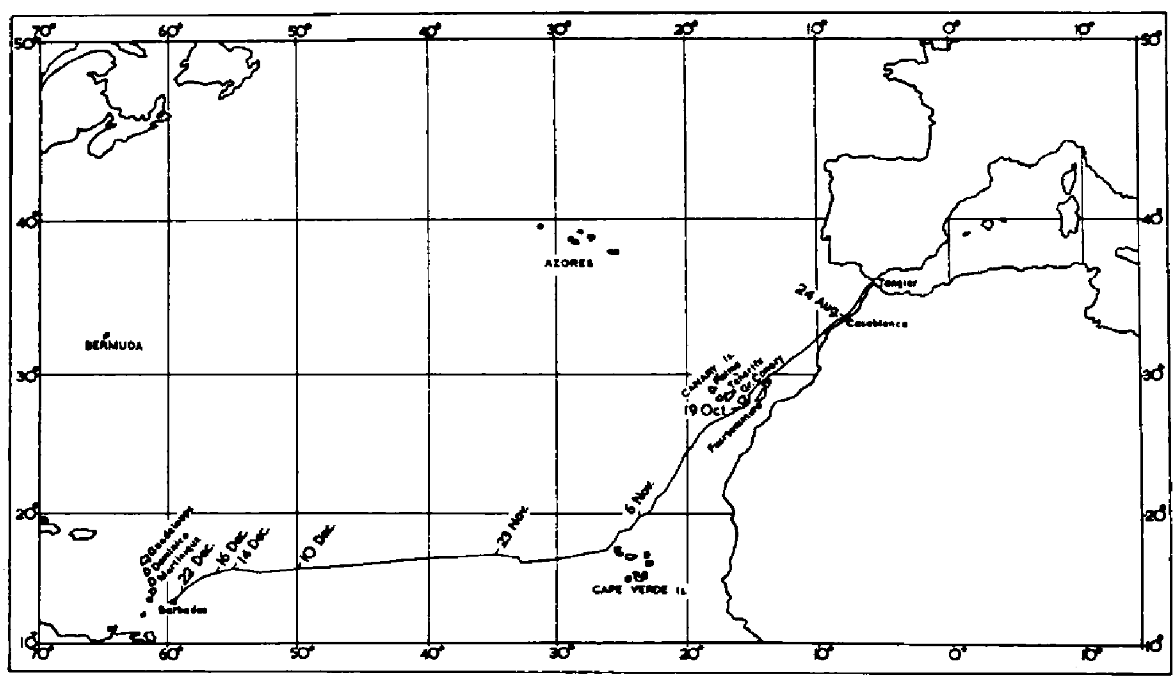
The meteorology of the Atlantic in the trade-wind region under normal conditions is very well known; but although it has been generally accepted that the NE trade is constant and strong from November to April, with some regular features from May to August, little study has been made and little is known of its variations.

Without attempting to draw any decisive conclusions, I should like to describe the weather I encountered from the time I entered the Atlantic by the Strait of Gibraltar until I reached Barbados, that is to say, from 13th August to 23rd December, 1952.

I shall therefore divide my account into three parts:

(*a*) Gibraltar–Casablanca (13th–20th August)
(*b*) Casablanca–Las Palmas (24th August–3rd September)
(*c*) Las Palmas–Barbados (19th October–23rd December).

Only in the third part will a special mention be required about rainfall, which I never encountered during the first two parts of my journey.



Track followed by Dr. Bombard's rubber dinghy *l'Hérétique* across the Atlantic, 13th August, to 22nd December, 1952.

Gibraltar to Casablanca

I left Tangier on 13th August with a strong easterly wind, blowing in gusts which had already persisted for 48 hours, with peak velocities of Beaufort force 5–6. I had been told that the great danger at that time of year was the establishment of a SW wind after 24 hours of E wind, which would have made it impossible for me to continue south to Casablanca; and indeed, this E wind carried me to a point roughly 20 n. miles west of Cape Spartel, when it failed at about 9 o'clock in the morning. There was virtually no wind until about midday, when it rose in the NE, reaching a force of about 5 Beaufort towards 4 o'clock, thus allowing me to continue southwards in the Atlantic Ocean a good way below Cape Spartel. I was often enveloped in patches of fog from 10 o'clock in the evening onwards.

The following are details of the first day's weather, which was to be the pattern for the whole of my voyage as far as Casablanca. Dead calm with fog from 10 p.m. until 8 a.m. The fog lifted between 8 a.m. and midday, but with no wind; then at last a NE wind, reaching its maximum at about 4 o'clock in the afternoon, rose at midday and dropped at 8 o'clock in the evening. The fog then took about two hours to gather. I never encountered any contrary winds, and had merely to be content with these 8 hours of wind for 16 hours of inaction. I never observed the presence of the phenomenon of Land and Sea Breezes.

Temperatures varied from 104°F during the day to 66°–68°F during the night. Let me say at once however that the colour of my craft, which was treated with aluminium paint, was bound to distort the whole question of temperatures. As the colour was extremely radiant, it increased the local temperature considerably during the day, only to absorb many more calories at night by evaporation, and thus create a quite low local temperature. The temperature figures which I give should always therefore be treated with the greatest possible reserve.

It was this phenomenon of the drop in wind towards 8 o'clock in the evening which forced me to spend the night of 19th–20th August outside Casablanca harbour, which I did not enter until the morning of the 20th.

Casablanca to Las Palmas

Readers in Morocco generally will know the state of the weather before my departure from Casablanca on 24th August—absence of wind and thick fog which were to keep me opposite the El Hanck Light for 24 hours.

The same conditions as before accompanied me until I was just opposite the north side of Cape Blanc. Once round this Cape the trade wind at last set in. It was then regular for the next nine days, with a force of about 6–8. This was probably the most favourable and constant wind that I had in all my voyage, except perhaps the one I encountered from 10th December onwards, after my meeting with the British cargo-boat *Arakaka*. This explains the splendid average of 55 n. miles a day which I achieved during this first part of the voyage.

Within sight of the Canary Islands, the wind tended to revert to the " rhythm " which prevailed between Tangier and Casablanca, and it was to the accompaniment of a veritable " paroxysm " of 8 Beaufort strength, which for the first time whipped up the sea to an uncomfortable pitch, that I reached the Grand Canary coast on 3rd September, at the point known as Castillo del Romeral.

Las Palmas to Barbados

We have now reached the third part of the voyage in which there should have been the least variation in the meteorological elements. Theoretically, I should have encountered a constant NNE wind, reaching Beaufort force 8 at times, and practically never leaving me in the course of my 65 day crossing. In actual fact, there were three distinct meteorological periods. The first, which lasted from 21st October until 23rd November, which I have called the BAD WEATHER PERIOD. The second, from 23rd November to 10th December, DEAD CALM PERIOD. The third, from 10th to 23rd December, NORMAL TRADE WIND PERIOD.

I have purposely omitted to mention the three days immediately following my departure, as during that time I was still under the influence of the land nearby.

Then a violent wind arose, reaching 10 Beaufort, and making the sea extremely uncomfortable, with high rollers breaking on the heavy ocean swell. Everything went well as long as the wind remained high, matching the rough sea. The waves did not catch up on me quickly enough, and I was relatively safe. Everything went wrong when at irregular intervals the wind suddenly dropped for two to five hours, while the sea remained very rough. The waves then buffeted me violently and threatened to overturn me, swamping the raft six times in the process.

The NNE direction was maintained fairly regularly. The wind force ranged from Beaufort force 6 to 10 (already a strong gale). There was no rain before 11th November, after which it proved to be a real tropical downpour.

It is important, I think, to describe the clouds. These did not share the speed of the winds they brought; that is to say, a cloud sighted on the horizon would take up to 12 hours to reach me, without being preceded by a more violent wind. At the moment when the cloud passed overhead, the wind would break loose, exactly as if there had been a movement of rotation of the air under the cloud, but not extending beyond its boundaries. The wind would drop just as suddenly when the cloud had passed beyond me.

The most uncomfortable episode of my voyage occurred on 13th November, when rain and wind reached a violence that I could not measure, I only know that I collected, on that day alone, some 50 litres of water.

This phenomenon of a cloud independent of the wind it brought was to follow me for the rest of my voyage. Temperatures varied (with the coefficient of error to which I referred above), the day maxima reaching 133°–135°F, and the night temperature dropping to 55°–57°F. The rain was very cold— 57° or 59°F— compared with the sea temperature at the surface of 86°–90°F.

During the day of 23rd November the weather suffered a violent disturbance, due to a phenomenon of much greater extent than the preceding ones; it was, in fact, observed by two yachts, *Nymphe Errante* and *Maeva*, which on that same day according to their logbooks, passed more than 230 km to the north of my position. A gigantic rectilinear disturbance, straight as a bow string, reached me in 5 or 6 hours, and a wind arose as described before, reaching Beaufort force 11. I experienced this phenomenon for 6 hours, after which the trade wind failed for 27 days and the peak wind force did not reach 2 on the Beaufort scale. The sea was very calm with rare instances of purely local rainfall. The phenomenon of the absence of the trade wind is noted in the logbook of the S.S. *Arakaka*, which I met on the morning of 10th December. The wind arose at noon on the same day; to blow for 24 hours, remaining strong in the upper regions, up to about 800 metres, where I could see the clouds moving extremely rapidly, and finally the trade wind appeared, with its normal regularity and volume. The rainfall became daily, and generally occurred at about 3 o'clock in the afternoon.

Conclusions

The trade wind was maintained throughout my voyage, since I never encountered any contrary winds. Its characteristics, however, were greatly modified, so that at times I almost thought I was in the doldrums. The phenomenon of local winds under the clouds had never so far, to my knowledge, been reported in those regions. It is clear that we were here confronted with a phenomenon of frequent occurrence, namely the modification of the trade wind, already reported by Gerbault, Le Toumelin and Marin Marie, to name only French writers.

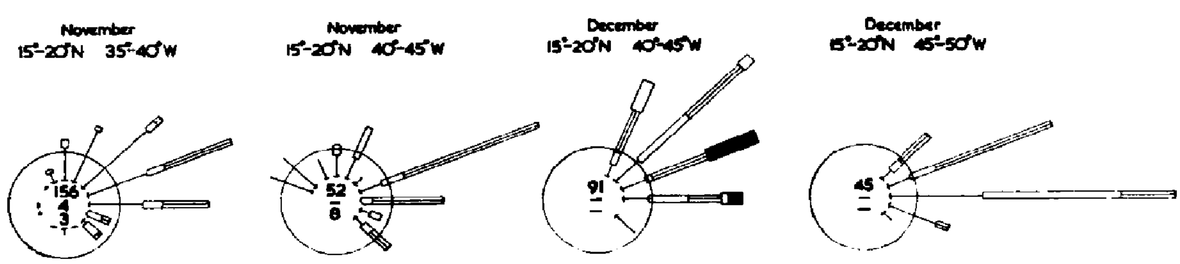
I consider that it would be desirable for the meteorological conditions of these regions to be restudied, for their description has stood unchanged for more than 60 years. The phenomena of the variations of the seasons, temperatures and winds, which we observe in our regions, must be accompanied by similar phenomena in the regions of the so-called regular winds. It would be dangerous, in my opinion, at the present time to rely on the wind I have been describing as a " trade " wind proper before restudying it and redefining its position.

Note. On the route Gibraltar to Casablanca the large diurnal variation of wind and fog observed by Dr. Bombard was presumably the effect of the North African land mass, since over the open sea which is unaffected by a land mass the diurnal variation of these elements is small.

Dr. Bombard does not say in his article whether his thermometer was exposed to the sun, but he points out it was not shaded from his dinghy. In the open sea there is little diurnal variation of air temperature as measured by a thermometer correctly exposed in a ship's screen, compared with that found by Dr. Bombard. The upper 5-percentile temperature in the open ocean on the Gibraltar to Casablanca route is just under 80°F for August, as calculated from records from British selected ships.

On the route Casablanca to Las Palmas a wind of force 6 is quite frequently to be expected in August and September, but force 7 and 8 are of infrequent occurrence. The " rhythm " of the wind which Dr. Bombard mentions as occurring between Tangier and Casablanca and also within sight of the Canary Isles was presumably the diurnal variation due to the land effect.

When on the first part of the route Las Palmas to Barbados, Dr. Bombard mentions the wind as reaching force 10, and it is suggested that he may mean that *gusts* reached this value. In October in this area no British selected ship reported the mean wind as being above force 6 in this area during the 31 years of observations used in preparing wind data used in *Monthly Meteorological Charts of the Atlantic Ocean.* In November such ships have reported stronger winds only on rare occasions in this area. Gusts are likely to exceed force 6 however quite frequently in this region.



EXPLANATION.—The arrows in the roses fly with the wind. Their length indicates percentage frequency on the scale 0 10 20 30 40 50% Their thickness indicates force thus 1-3 4 5-6 7 8-12 From the head of the arrow to the circle is 5%. The number of observations is shown by the upper figure, the percentage frequency of variable winds by the middle figure and calms by the lower figure in each rose.

The trade winds, while they vary much less than winds in temperate latitudes, should not be regarded as blowing absolutely constantly, and several countries have prepared wind roses for this area. In Britain the Marine Branch of the Meteorological Office have published wind roses for each month for each 5° square of latitude and longitude including those on Dr. Bombard's route. These roses are based on many meteorological observations from British selected ships and give the frequency of wind forces for each sixteen points of the compass (or for eight points in areas north of 30°N and south of 30°S). The wind roses for 15–20°N, 35–40°W for November for 15–20°N, 40–45°W November and December and for 15–20°N, 45–50°W for December are shown above.

AMSTERDAM ISLAND

In *The Marine Observer* for July, 1952, we drew the attention of observing ships on the Cape Town to Australia route to the fact that wireless weather reports would be very gladly received by Amsterdam Island (37° 49′S, 77° 34′E). We have recently been informed by the South African Weather Bureau that this station now operates on 500 kc/s in addition to 8,300 kc/s and watch is kept on both frequencies simultaneously at 0600–0615 and 1200–1215 G.M.T. daily. The call sign has been changed to FQF2.

The meteorological station on Amsterdam Island relays any ship reports it receives to both Australia and South Africa, and also supplies a plain language report of its own weather to any ships operating there.

Cargo Ventilation

By P. R. Brown, M.Sc., A.R.C.S., D.I.C.
(Marine Branch, Meteorological Office)

With the slow decline of the seller's market the subject of the care of cargo will undoubtedly receive more attention from shipowners. While it is to be expected that some of the larger ships to be built in the future will be fitted with one of the modern mechanical ventilating and drying systems, it must be presumed that many ships, especially the smaller ones, will continue to rely on natural ventilation supplemented by less ambitious systems of mechanical ventilation. Whether a ship has a comprehensive controlled system of ventilation or relies on natural ventilation of its cargoes a very important factor in the care of cargo is the knowledge of the deck officers on the subject. No system of ventilation can prevent damage if the ship's officers do not know when to and when not to use it, and the simplest form of ventilation can keep cargo in good condition in the great majority of circumstances if employed to the maximum advantage. No rules on cargo ventilation can be formulated to meet all requirements and thus it is highly desirable that officers in charge of cargoes should have a sound knowledge of the basic principles of humidity, evaporation, condensation and the transfer of heat.

The control of temperature and humidity in a cargo space is complicated because there are several sources of heat and sometimes more than one source of moisture. Let us consider the uninsulated cargo space containing initially dry non-hygroscopic cargo which does not generate heat itself. The cargo and the bulkheads, ship's side, deck and deckheads of the cargo space will at any time have a certain heat content depending on their dimensions, density, specific heat and temperature. The heat transferred to or from them will mainly arise from one or more of four sources. It should be emphasised that the remarks in this paper refer to uninsulated compartments.

(1) From solar radiation heating the ship's structure and hence the boundaries of the cargo space or conversely outgoing radiation cooling the ship's structure during night-time
(2) From the transfer of heat from the engine room
(3) From heat being transferred to or from the boundaries of the cargo space by contact with the surrounding sea water and/or air (depending on the position of the cargo space)
(4) From contact with the air brought in by the ventilation.

It can be assumed that (1) will be the most important for upper 'tween deck spaces and of small importance in lower holds below the water line. The effect of (2) may be important for spaces adjoining the boiler or engine rooms but will not normally be great in spaces well away from these. The greatest effect of (3) will be in cargo spaces below the water line. The importance of (4) will depend partly on the type of cargo filling the space and the rate at which air is ventilating this space. If the cargo space is filled with goods having high density and high specific heat (that is having high heat capacity per unit volume), such as metal goods, limited ventilation with air at a temperature different from that of the cargo will not alter the temperature of the cargo a great deal. But if the space contains a cargo having small heat capacity per unit volume, such as wool, ventilation by air at a different temperature may alter the temperature of the cargo considerably.

In view of the several sources of heating and cooling that can exist it is not possible to lay down many rigid rules for ventilation. When dryness is desirable in the cargo space some generalisations, however, can be made which will apply in most cases. Some examples of this are as follows:

(*a*) do not ventilate if the dew point of the atmosphere outside is higher than the temperature of the air in the cargo space. This is probably the best practical rule.

(*b*) unless fresh air is desirable in the space for such reasons as reducing odour, fumes or gases, theoretically one should not ventilate unless the dew point of the atmosphere outside is less than the dew point of the cargo space. However, if the air in the compartment at the beginning of the voyage is dry, the occasions on which ventilation could be carried out would be severely restricted by this rule. In practice ventilation with air of a somewhat higher dewpoint (i.e. of a somewhat higher moisture content) is often preferable to having stagnant air in a compartment, as an air current would help to eliminate any possible pockets of saturated air trapped in damp corners. To apply this rule in practice, presupposes, of course, a knowledge of the dew point inside the cargo space. The converse of (*b*) i.e. ventilate if the dew point of the atmosphere is less than that of the space, holds true in most circumstances. Even in these circumstances care must be exercised, for if the air temperature outside is considerably lower than the dew point inside the space, mixing of the two lots of air may cause a small amount of condensation, although this will normally be a temporary effect which will disappear when the ventilation has been turned on for some time.

With hygroscopic cargoes the problem of ventilation is more complex and usually the ship's officer must judge the circumstances and ventilate accordingly, remembering the basic principle that ventilation when the dew point of the incoming air is less than that of the air already in the compartment removes moisture from the space, and vice versa. It is also well to bear in mind that if the cargo in a compartment includes any liable to damage by moisture, any other cargo containing moisture should not be placed near any bulkhead which would be affected by heat from the engine room or elsewhere. If cargo containing moisture gives up some by evaporation due to heat transfer from a hot bulkhead, for example, this extra moisture which the air in the compartment receives might be absorbed by cargo liable to damage by moisture.

Actual readings of air, dew point and sea surface temperatures would normally be used for deciding the daily ventilation. When considering an overall future ventilation plan for the voyage at any time it is advisable for a ship's officer to consider carefully the sea and outside air temperature his ship is likely to encounter on the remainder of the voyage. It can be assumed that the lower portion of the outside of the ship's structure and possibly the lower holds will take up, with a time lag, the temperature of the sea water: from a consideration of the outside air temperature he can anticipate at what stages of the voyage successful ventilation is likely to be possible. As long period temperature forecasts are not normally available, it is best for this purpose to use the mean sea surface and mean air temperatures shown in marine climatological atlases, such as the monthly meteorological charts of the Atlantic, Indian, Western Pacific and Eastern Pacific Oceans (M.O.483, M.O.519, M.O.484, M.O.518) prepared in the Marine Branch of the Meteorological Office and published by Her Majesty's Stationery Office. These are available free to selected ships on request.

It can be seen that the subject of cargo ventilation offers plenty of scope for ships' officers interested to draw their own conclusions and make their own rules in respect of their own ships and the cargoes they are liable to carry.

M.V. Cedric

The newly built liner M.V. *Cedric* is fitted with a modern forced draught ventilating system covering all the main cargo compartments and distant reading thermometers for each space, arranged so that the temperature for each space can be read in a deck house. In addition, for the maiden voyage from London to New Zealand via the Panama Canal and back in December, 1952, to April, 1953, under the command of Captain F. Charnley, a distant recording dry and wet bulb thermograph and two hair hygrographs were loaned by the Meteorological Office for the reading of humidity in some spaces. The Chief Officer, Mr. Stanger, made a complete series of all possible daily readings of temperature and humidity. Mr. Stanger also studied the results with admirable knowledge and drew the following conclusions:

Outward Journey

" The distant reading thermometers have brought out several points which seem to be of significance, viz.:

(*a*) The temperatures of the uninsulated lower holds follow very closely the temperature of the sea water with a time lag when sea water temperatures change quickly. No. 6 lower hold is slightly warmer in general than No. 1 lower hold; this is presumably due to tunnel heat penetrating the uninsulated hold ceiling.

(*b*) The main 'tween decks, whilst assuming a mean temperature very similar to that of the lower holds, have a side to side variation in bright sunny weather of up to 7°F, the side exposed to the sun being warmer than the shady side.

(*c*) The upper 'tween decks immediately below the weather deck are generally warmer than the lower compartments and the side to side variations of temperature in bright sunny weather have been as high as 12°F. In dull weather the side to side variations disappear and the temperature drops sharply.

(*d*) When there is a large side to side variation of temperature the mean cannot be used as a criterion for introducing fresh air or not. On such occasions the lower side temperature must be the deciding factor.

(*e*) Introducing cooler air into a compartment has very little cooling effect on the compartment. This is presumably due to the new air being rapidly warmed to the temperature of the cargo in the compartment.

" The instruments on loan from the Meteorological Office have also provided some interesting data. One of the hygrographs was placed in No. 2 upper 'tween deck and the other in No. 4 bridge space. (The hygrograms for the week commencing 29th December, 1952, are shown in Figs 1 and 2.)

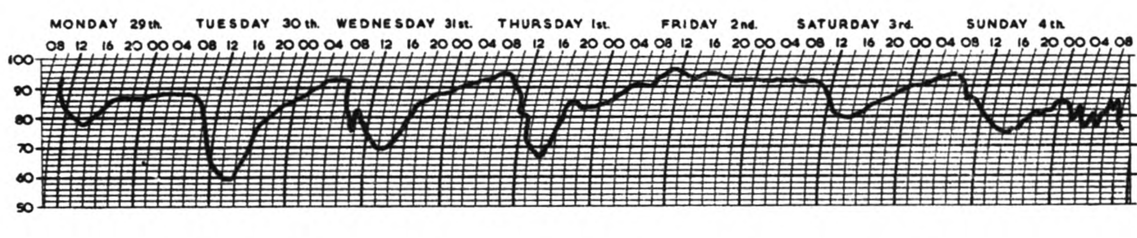


Fig. 1. Hygrogram from No. 2 upper 'tween deck of M.V. *Cedric*.

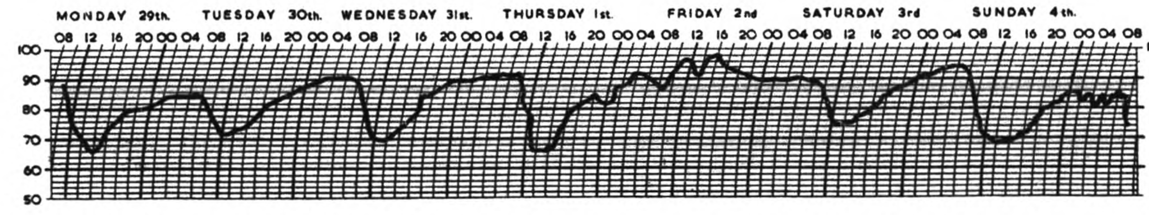


Fig. 2. Hygrogram from No. 4 bridge space of M.V. *Cedric*.

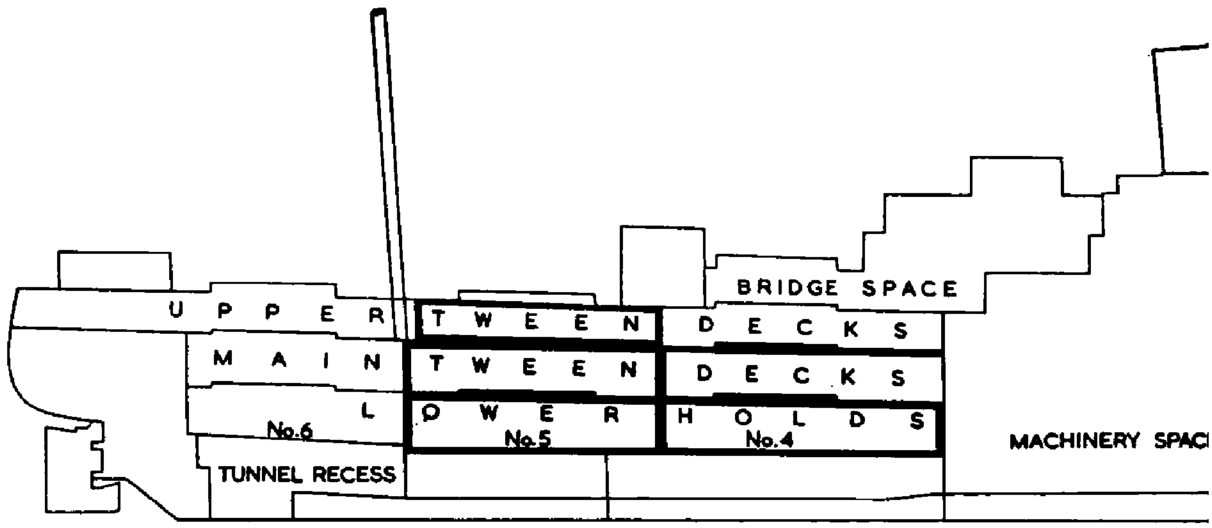


Fig. 3. Plan of holds of M.V. *Cedric*. Th

" In bright sunny weather humidity reaches its peak value each day about 0700 A.T.S., drops steeply to a minimum value at about 1400 and climbs steadily to peak value again the following morning.

" No. 2 upper 'tween deck was fairly closely stowed with cases and cartons, thus affording only moderate facility for through ventilation, whilst the bridge space was stowed with unpacked cars and jeeps giving ideal conditions for easy ventilation. Every care was taken to keep this space as thoroughly ventilated as possible and when conditions permitted the weather boards at the after end were removed to ensure " near perfect " ventilation. The very great similarity between the two graphs indicate that the controlled ventilation under moderate conditions of stowage for ventilation can achieve almost as good a circulation of air as natural ventilation can under ideal conditions.

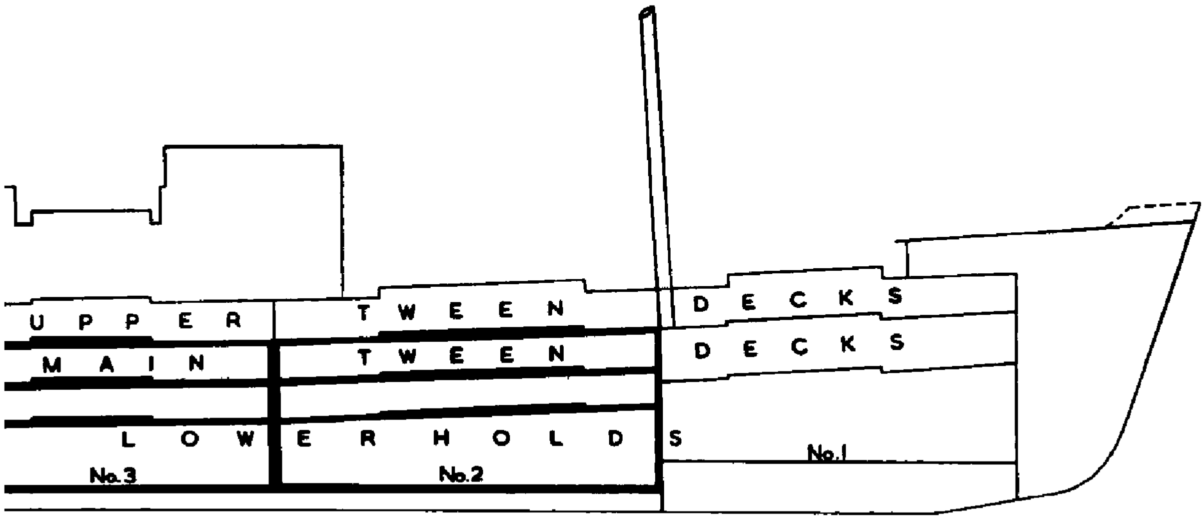
" In No. 2 upper 'tween deck, where the dry and wet bulbs of the distant recording thermograph were positioned, the dew point was, during part of the voyage, consistently higher than the deck dew point and on some occasions higher than the deck temperature. To avoid as much as possible turbulence between the air in the compartment and the new air the fan was used as an exhaust unit, the fresh air being drawn in through the ordinary ventilators. A careful watch failed to reveal the precipitation of any moisture.

Homeward Journey

" The various points mentioned in the previous report have emerged on this passage also, except that No. 6 lower hold has not maintained the slightly higher temperature than No. 1 lower hold, and the intermediate decks in cooling conditions have been somewhat cooler than the lower holds.

" The conclusion has been reached that in dull weather the temperature of the decks immediately below the weather deck is governed by the temperature of the atmosphere, and that the intermediate decks are influenced by both air and sea-water temperatures. It has been noticeable that, except for No. 6 lower hold, internal temperatures have been less sensitive to the influence of external conditions than on the outward passage. Side to side variations have been smaller and the lag behind changes of sea and air temperatures greater.

" While the homeward general cargo was principally wool, No. 6 lower hold was full of scrap iron and, as a large proportion of our outward cargo was metal, it seems that the calorific properties of the cargo, particularly as regards absorption and retention of heat, have a considerable effect on hold temperatures.



thick black lines indicate insulated holds.

" In Halifax I was informed by the Port Warden, who acts as Cargo Surveyor, that many ships arriving in cold weather have experienced particularly heavy condensation underneath steel hatch covers. I am glad to be able to report that there was no signs of condensation in any of our hatches that were opened at that port.

" Provided that hold temperatures can be known with reasonable accuracy, I am convinced that our present system of ventilation, i.e. introducing fresh air into a compartment only when the temperature of the compartment is higher than the deck dew point, is essentially sound. The only occasions when such ventilation could cause condensation are when the air temperature is considerably below the dew point of the compartment. Under this circumstance the air in the compartment could be cooled by the incoming air sufficiently to cause it to precipitate some of its moisture content. In such cases it would probably be wiser not to ventilate an insulated compartment.

" A matter to which I have given considerable thought is the best care of such cargo as steel or iron that has not been given any anti-corrosion treatment. I have noticed that a pocket-knife or key which has been left lying on a desk shows sign of rusting more rapidly than a similar article shut away in a drawer; the corrosive agent is presumably salt air, since the one article receives excellent ventilation and the other little or none. I am inclined to the view that such cargo would probably be better without ventilation, particularly if the compartment containing it could be filled with reasonably dry air prior to sailing, but I feel that this might well be the subject of a technical investigation."

Conclusions

Mr. Stanger's conclusion on the diurnal variation of relative humidity in the compartments mentioned in his report on the outward journey are of interest. Fan ventilation was mostly operated from 0900–1700 Apparent Time of Ship (approximately local time), and consequently from 1700 to 0900 next day the air in the compartments was substantially unaltered. Thus as the temperature of the holds decreased during the night due to long-wave radiation being given off by the ship's structure, the relative humidity increased, as is to be expected, reaching its maximum about the time the ship's structure could be expected to attain its minimum temperature. Ventilation, commencing at 0900 hours, would first tend to decrease the high relative humidity obtaining in the hold in the early morning. It appears from Mr. Stanger's results that heating and cooling of the ship by outside radiation is a major factor in determining relative humidity in the compartments, since the relative humidity in bright sunny weather rises from 1400–1900 hours when the ship's structure would usually cool, although fan ventilation was normally operated. It must be remembered that the diurnal variation of relative humidity is very small for air over the oceans, which is not influenced by any ship. The above conclusions on the diurnal variation of relative humidity are based on Mr. Stanger's results for No. 2 upper 'tween deck and No. 4 bridge space, but it is likely that they would apply generally to all bridge spaces and upper and main 'tween decks.

Mr. Stanger's remarks, in his report on the homeward journey, about the occasions when ventilation could cause condensation when the air temperature is considerably below the dew point of the compartment, refer presumably to occasions when the mixing of the two lots of air may cause temporary condensation.

From the temperatures Mr. Stanger reported it appears that No. 3 upper 'tween deck, No. 1 main 'tween decks and No. 1 lower hold spaces (see Fig. 3) were colder on the outward journey than on the homeward journey and considerably colder than the outside temperature on the outward journey, but No. 6 upper 'tween deck space was much warmer on the outward journey. The variation of the temperature in the cargo spaces follows that of the outside air and also that of the sea temperature (since the variations of air and sea temperature bear a close resemblance) most closely if the temperature of the spaces is compared with the outside air temperature between 24 and 48 hours previously. This lag can normally be considered as nearer 24 than 48 hours.

Acknowledgment

I am indebted to Captain F. Charnley and Mr. W. J. Stanger for use of the readings made aboard the M.V. *Cedric* and to Captain A. E. Lockhart, Marine Superintendent, Shaw Savill and Albion Co. Ltd. for permission to write up the results. I am also indebted to Mr. Stanger for some of his comments which are included in this article.

Longest St. Lawrence Season

The following information has been taken from *Lloyd's List and Shipping Gazette* issue of 23rd December, 1953.

The longest season of St. Lawrence navigation on record ended on 20th December with the departure from Montreal of the Israeli steamer *Yaffo* (7,190 tons). The vessel had arrived there from Hamburg on 15th December, the latest date on which an ocean-going vessel had ever arrived. The season opened on 2nd April when the Canadian steamer *Seaboard Star* arrived from the United Kingdom. This was five days earlier than the previous earliest first arrival, the *Mont Alta* on 7th April in 1949.

The following table shows the dates of the first arrival and the last departure from Montreal in recent years:

	FIRST	LAST
1947	19th April	5th December
1948	19th ,,	10th ,,
1949	7th ,,	15th ,,
1950	18th ,,	7th ,,
1951	13th ,,	13th ,,
1952	13th ,,	10th ,,
1953	2nd ,,	20th ,,

In an interview, the master of the *Yaffo*, Captain Eivind Myhre, said on arrival at Montreal that heavy snow, not cold weather, was the greatest danger to a ship moving up to Montreal so late in the season. Twice during the run from Quebec, which took two days compared with the normal nine hours, he had had to anchor when snow reduced his visibility to almost zero.

Hints on Observing

4. JUDGING VISIBILITY

By CDR. C. H. WILLIAMS, R.D., R.N.R. and CAPT. J. R. RADLEY.

(Cdr. Williams and Capt. Radley are the Port Meteorological Officers at London and Southampton respectively).

The importance of this observation to the navigator is obvious, for surely to no one else does poor visibility cause so much worry and hindrance.

In judging the visibility at sea the observer is in most cases entirely dependent on his own skill and experience. It is seldom that there are any means available to actually measure the distances. Variation in visibility is due to a number of causes; it may be due to fog, mist, snow, heavy rain, smoke, dust or sand. It has long been customary to define variations in visibility when due to fog in descriptive terms such as poor visibility, moderate fog, dense fog, etc., but these words, although useful in a general sense, do not convey an exact mental picture to the recipient of a radio message. It is necessary, therefore, in addition to mentioning the reason for the decreased visibility, to give some figures as to the actual distance that the observer can see.

When the present international code was drawn up in 1947 the visibility code (VV) related to precise measured distances and allowed slight variations in visibility to be reported. When preparing the code it was realised that actual measurements of visibility, as are made ashore, would very rarely be practicable at sea. A special section for use at sea was therefore provided at the end of the visibility code table (code figures 90 to 99); the complete code covers a much wider range and allows visibility to be indicated to a much greater degree of accuracy than this.

Visibility is defined meteorologically as the furthest horizontal distance at which a person of normal sight can, under normal conditions of daylight illumination, distinguish and identify an object for what it is known to be. Ashore, visibility can in most cases be accurately estimated by means of objects or lights at known distances, so that two observers, provided they have normal eyesight, should both arrive at the same code figure.

Obviously this is seldom possible at sea, but nevertheless the visibility is better described as being of a certain judged distance, such as for instance " visibility half a mile ", rather than merely as " moderate fog ". The visibility scale for use at sea is reproduced below and, in addition, some equivalent descriptive terms are given so as to indicate the intensity of the phenomenon causing decreased visibility. These equivalents are merely descriptive and it is felt that their inclusion here is perhaps useful as they are used at times in weather bulletins for shipping.

Visibility scale (Specification for use at sea)		Equivalent description of weather		
CODE FIG.	SCALE OF DISTANCES	FOG	SNOW	RAIN
90	less than 50 yd	Dense fog	Very heavy	—
91	50–200 yd	Thick fog	Heavy	Heavy tropical
92	200–500 yd	Fog	Heavy	Heavy tropical
93	500–1,000 yd	Moderate fog	Moderate	Very heavy
94	1,000 yd—1 n. mile	Thin fog, mist or haze	Slight	Heavy
95	1–2 n. miles	Visibility poor	Very slight	Heavy
96	2–5 n. miles	Visibility moderate		Moderate
97	5–10 n. miles	Visibility good		Slight
98	10–25 n. miles	Visibility very good		Very slight
99	Over 25 n. miles			

As visibility can be reduced by causes other than fog it is necessary, in addition to noting the extent of the visibility, to record the cause, and provision is made for this in the " present weather " (ww) code, for inclusion both in the radio weather message and in the meteorological logbook. In passing, it may be worth remembering that it is important that entries in the logbook under these two headings (VV and ww) should agree with each other in describing the visibility and type of weather, and that the entries of Beaufort notation (column 46) should also fit the picture.

Atmospheric obscurity may be caused by either (*a*) visible moisture particles in the air, such as cloud, fog, rain, hail, snow, or spray, or (*b*) solid particles such as dust, soot or smoke, and salt. Visibility, that is to say the transparency of the atmosphere, depends on the amount of these liquid or solid particles held in suspension by the air. The visibility may vary considerably in different directions and on sunny days it is often better when looking away from the sun than when looking towards it.

A visibility of, say, code figure 94 may be caused by heavy rain, or by moderate drizzle, or by slight snow. Falling snow is most effectual in reducing visibility; in a heavy snowfall visibility may be only a few feet. Rain, unless torrential, rarely causes a visibility less than 1,100 yards except when accompanied by mist, driving spray or a very low cloud base. Dust or smoke can at times be so thick as to reduce visibility to fog limits, and they are then termed " dust fog " or " smoke fog "*. Visibility of less than 1,100 yards is called fog; between that distance and 2,200 yards it is called mist or haze, depending on whether it is caused by water droplets or dust particles.

For judging visibility, most ocean-going ships are long enough for some objects on deck at a range of 500 yards or less to be visible from the navigating bridge (" Visible " in meteorological practice means that an object can be seen and recognised) so there should be no difficulty at sea in judging the visibility corresponding to the lowest numbers of the scale, 90 and 91. It is possible that visibility may be slightly improved by the local heating aboard the ship, and this should be kept in mind when judging the range of objects visible on deck, particularly when looking aft from the bridge. The effect is, however, likely to be negligible owing to the motion of the ship, and to the wind.

The ranges at the other end of the scale, 97, 98 and 99 (5, 10 and 25 miles or more) can also be fairly easily judged by experienced officers, by the clarity of the horizon, or by seeing ships hull-down, etc. The remaining five code numbers, 92 to 96, require considerable care. Generally speaking, if all objects on board are clearly discernible but if the horizon is not visible from the ship's bridge, one of the code figures of 92 to 96 must be recorded. One way of estimating which of these it should be is to look along the surface of the sea to a point where it disappears and then judge how far from the ship's side that point is. In doing this the height of the observer must be kept in mind, as this may affect his estimation of distance. As is well known, when trying to get a sight with a sextant in misty weather it is frequently possible to get a better horizon by going down to a lower deck than the navigating bridge. The visibility, although unchanged, may then appear to be improved. Experience with fog buoys in the wartime convoys will still be fresh in many officers' memories, and will be useful in helping their judgment in the matter. If at about the time of observation land or a ship are sighted, the distance at which these become visible or disappear from sight again can be a useful indication to the observer.

When estimating the distance of an object which is only just visible, observers should always take into account the colour of the object and the contrast between it and its surroundings or background. Impurities in the air, as well as having an effect on the visibility, also affect the apparent colouring of distant objects; for instance, distant hills covered with green trees may appear to be quite blue.

*Sometimes smoke fog is referred to as " smog ", see Editorial, p. 70.

Sometimes in hazy weather all details of the landscape and its colours disappear and the land stands out like a silhouette against the sky. In mist or haze, a ship with a black hull, white upper works, a red funnel with a black top, would probably be much more easily seen than a grey-painted warship at the same distance. The direction of the illumination, sun or moon, is also important, and may in some cases cause the grey ship to be the more conspicuous.

At night the distance at which shore lights or the lights of other ships become visible is of course some guide, but in using them careful consideration must be given to other effects, such as the night being dark or being moonlit, the probable power of the lights seen, and their colour. White and green lights are often more easily seen than red ones of the same candle power. Obviously, for estimates of visibility at night to be reliable, considerable care and judgment are required on the part of the observer. It should not be done hurriedly. A decrease in illumination is not necessarily a decrease in visibility. Usually the visibility (transparency of the air) just after dark will be the same as before sunset, although one cannot apparently see as far; usually because at sea there are no lights by which to judge. Often the appearance of a " loom " around the ship's navigation lights is the first indication of decreasing visibility at night.

In ships that are equipped with radar the actual distance at which objects become visible can be measured. In cases where this is done a note could with advantage be included in the " remarks " column of the meteorological logbook, i.e. " visibility checked by radar bearings and distances of passing ship ", or words to that effect, to show that in that case the visibility was an actual measurement instead of the usual estimation.

From the foregoing it will be seen that estimating the visibility at sea is largely a matter of care and judgment on the part of the observer. The experienced and observant officer will notice indications of changes in visibility and must rely on his judgment in arriving at the correct code figure. Non-instrumental observations such as visibility, wind direction and force, height and type of clouds, and in general " keeping a weather eye open ", are part of a seaman's trade and should be fostered. Even with observations in which instruments can be used, care is needed in reading them, and skill and judgment are as necessary as ever. " Gadgets " are not always available, and when they are it is not unknown for them to break down; then the observer, ashore or afloat, must call on his own experience and by carefully considering all the factors of the case, deduce his considered opinion.

Ashore, visibility can usually be measured by a number of means, none of which is available in a ship at sea. A short description of the methods in use at shore meteorological stations may nevertheless be of interest.

For observations in daylight a number of suitable objects at known distances from the station are chosen. The ranges conform as nearly as possible to a list of standard distances laid down, the objects being chosen with great care, and including as many as possible that are suitably placed, of dark colour and if possible viewed against the horizon sky. Naturally the objects close at hand need not be large, but a distant one must be something conspicuous, such as a church or a hill. With a good selection of objects at various ranges and directions the observers are able to record the visibility with considerable accuracy.

At night the problem is naturally more difficult; it depends on the distance at which a light can be seen. This, of course, depends on the brightness of the light, and on other factors. Fixed lights of known candle power are used and they are fitted and screened in a standard manner. These fixed lights are sometimes used in association with an instrument known as the Gold Visibility Meter which measures the apparent brightness of a distant light and thus the transparency of the air. This instrument is a visual photometer with which the light is observed through a graduated neutral filter which can be varied until the light is only just visible. If a Gold Visibility Meter is not available then estimates have to be made by eye from observations of the fixed lights. Another method is by use of a photo-electric visibility meter. In this case a horizontal beam of light is projected from a small searchlight, and the illumination is measured at a distance of 300 yards or so by a photo-electric cell and galvanometer.

At several major seaports in Great Britain observations of fog of two intensities, 1,100 yards and 440 yards are made, using buildings or other objects on or near these two ranges by which to judge. The times at which the chosen objects become invisible and again become visible are recorded. Monthly averages of the duration of fog are made from these observations.

It is hoped that these few remarks will encourage ships' officers to give the subject some thought, and to develop their powers of observation in judging visibility at sea.

What do you mean, visibility half a mile!

Institute of Navigation

At the Seventh Annual General Meeting of the Institute of Navigation on 14th October, 1953, the retiring President, Vice-Admiral A. Day, Hydrographer to the Navy, in his Presidential address chose as his subject " Man and Machine in Navigation ". His talk ranged from the adventurous voyages of the early navigators with almost no instruments to the present-day era of electronic and other aids which science has placed at the disposal of the fortunate modern navigator. As is unavoidable in talking of navigation, meteorology and ocean currents came often into the picture. Emphasis was rightly placed upon the fact that whatever instruments he was provided with the navigator still needs to be a seaman—" eye and ear will still give the quickest and finest intelligence to the brain and in certain circumstances nothing else will do ". Admiral Day also pointed out that the provision of more instruments means more scientific background to an officer's training, and stressed the value of " fair weather " practice with various modern aids to navigation as well as with the primary aids. " A lack of practice with primary tools or an indifferent use of radar may lead to close-quarter situations . . . of danger ".

The Report of the Council of the Institute for the year 1952–53 draws attention to the wide scope of subjects discussed at Institute meetings during the year. These include " navigation and hydrography ", " navigation on land ", " radar and ice ", " navigation in the operation of jet aircraft ", " the use of radar for preventing collisions at sea ", " navigation and oceanography " and " the accuracy of wind forecasts for aviation ".

Perhaps the most interesting of these discussions which has not previously been referred to in this Magazine was the one on " Navigation and Oceanography " which was delivered jointly by Dr. Deacon of the National Institute of Oceanography and Cdr. Ritchie of the Hydrographic Office at the Admiralty. This paper brought out several instances of the inescapable relationship between oceanography and meteorology, and the value of both these sciences to navigation. For example, mention was made of the bearing which a study of ocean waves may have upon forecasting of hurricanes and upon the design of harbours; of the possible use of deep echo soundings (in the oceans) for navigational purposes; and of a German method of obtaining information of the nature of the bottom during an echo sounding. The valuable part that electronic aids can play in obtaining accurate ocean current observations was mentioned and in the discussion afterwards credit was given to the extremely useful current observations made by voluntary observers in British selected ships, which have provided the material for the present-day current atlases issued by the Meteorological Office.

The paper on " the use of Radar for preventing Collisions at Sea " which was read by Captain Wylie of the Radio Advisory Service provided some useful expert opinion and advice on this difficult and controversial subject. The lengthy discussion which followed was evidence of the interest which the paper aroused. In view of its importance to all mariners, we quote Captain Wylie's conclusion in full:

" The most important factors which contribute towards collisions when one or both ships have radar seem to be:

(*a*) Confusion over the applicability of the Steering Rules in thick weather.

(*b*) The possibility of confusion over freedom of action in thick weather before the fog signal is heard.

(*c*) Unwise action between the times of radar contact and sound contact.

" The infinite variety of circumstance attending the subject of collision at sea leaves no room for doubt that only courts of law can decide on the interpretation of particular rules in specific cases. On the other hand an international ruling that the conditions under which the Steering Rules may operate are limited to those envisaged when they were written would be a great contribution to safety at sea, and might be found as welcome in the courts as on the bridge. Indecision about the extent to which radar affects Article 16 seems no reason for further delay.

"On the question of freedom of action before hearing a fog signal, the judgements appear to differ. However, there seems no reason why a ship with radar should not have the freedom in this respect accorded to one without.

"The avoidance of close-quarter situations, and the offering of co-operation between radar-fitted vessels by giving early and bold indications of manœuvring action, seem to be the most important contributions to safety that can be made. A proper use of radar, which it is believed should include plotting, is implicit in these actions. Speed considerations should not be allowed to obscure the fact that wise course action in the early stages of an approach can be the greatest contribution to safety."

Among those who were elected Fellows of the Institute were: Captain Brett Hilder, Extra Master and First Class Air Navigator; Mr. W. M. C. Hewitt, Fleet Navigation Officer of B.O.A.C.'s Atlantic and Caribbean Service, Master Mariner and First Class Air Navigator; Captain J. Klinkert, Extra Master, Lecturer in Sir John Cass College; and Mr. L. S. Le Page of the Royal Naval Scientific Service who was previously Head of the operational research group of the Ministry of Transport Marine Safety Division. The new President of the Institute in succession to Admiral Day is Mr. D. H. Sadler, Head of the Nautical Almanac Department of the Royal Observatory.

C. E. N. F.

SEA-WATER SAMPLES

In the past we have endeavoured to stress to our voluntary observers the desirability of "backing up" a report of discoloured water or phosphorescence with a sample of the water taken at the time of the observation and it is encouraging to note the number of ships who are now doing so.

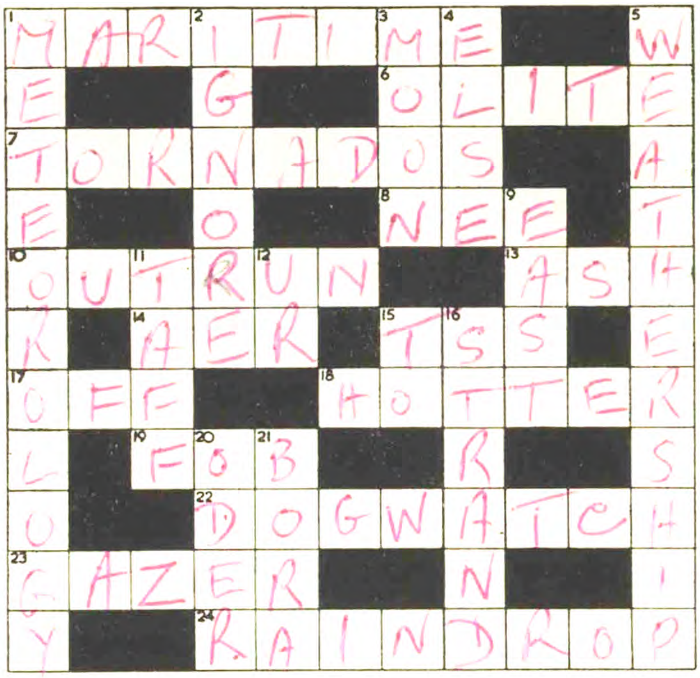
Unhappily, the value of most of these samples has been considerably lessened because of the decay consequent on the lapse of time between the observation and the analysis.

Dr. T. J. Hart of the National Institute of Oceanography, to whom all these samples are sent told us that in a recent sample amongst much unrecognisable organic debris he could only pick out those organisms which are capable of survival consequent on the decay and death of others.

He has asked us to impress upon observing officers the fact that the addition of one-tenth the volume of formalin preserves most organisms in recognisable condition for years. If a sea-water sample is stored unfixed—even in a refrigerator—most of the organisms die and begin to decay within about two days. The ones that survive after weeks can only be those capable of living under almost airless, heavily contaminated conditions. It is very unlikely that they would form any large proportion of the population present when the samples were taken.

Will officers therefore please endeavour to enhance the value of their samples by adding the preservative before sealing the bottle? It would also be appreciated if it could be stated on the bottle whether the sample is preserved or not.

CROSSWORD



ACROSS

1 (and 1 down). If you weren't interested in this you wouldn't be doing this crossword (8, 11).
6. *See* 14.
7. Land waterspouts (8).
8. Directions at birth (3).
10. A liner should do this to a tramp (3–3).
13. Oar material (3).
14 (and 6). Of meteoric origin though not meteorological (8).
15. Many prefer this prefix to show their superior power (3).
17. We might expect the wind to be from this shore at night (3).
18. Thermal comparative (6).
19. Consignor pays carriage to the ship (3).
22. A good marine observer needs more sea time than this (3–5).
23. Would he make a good marine observer? (5).
24. Of interest to a hydrologist (8).

DOWN

1. *See* 1 across.
2. Don't look now, its tail is in the Thames (6).
3. Its quarters look like halves (4).
4. Found in Selsey Bill (4).
5. Is this the craft of 1 down? (11).
9. Oriental seat (4).
11. A welsh rail? (4).
12. Looks like rain at this ancient city (2).
15. Comes after the port of departure (2).
16. Shore overlooked by Nelson's Column (6).
20. An eastern European river (4).
21. A piercing northerly wind (4).

(*Solution on page* 116)

Southern Ice Reports

During the year 1953

April, May and June, no ice reports received. Reports of ice for April, May and June 1952, will be found in *The Marine Observer*, Vol. XXIII, No. 160, page 114.

Book Reviews

The Bombard Story. By Alain Bombard. 8½ in × 5½ in. pp. 214. André Deutsche. London, 1953. *12s. 6d.*

This is the story of the almost unbelievable courage, tenacity and endurance of a French doctor who wished to prove for himself and for seamen a theory that survivors of a shipwreck could live for a considerable time on what the sea itself provided. He also wished to show to the world and to seamen in particular the enormous importance that morale played in survival.

To test his theory, Dr. Bombard sailed with one companion in a rubber dinghy provided with no food or water (apart from an emergency supply in sealed containers) across the Mediterranean from Monaco to Tangier and then on his own through the Straits of Gibraltar to Casablanca thence to Gran Canaria (Canary Islands) and thence 2,630 miles to Barbados.

Water was the primary problem. Dr. Bombard had discovered from experiments at the Museum of Oceanography at Monaco that the liquid content of many seawater fish was pure fresh water and he devised a simple method of extracting the liquid from the fish. When no fish was available he found that thirst could be quenched by drinking about 1½ pints of sea-water a day. If he was fortunate enough to get rain then he would be able to drink fresh water. For food his laboratory tests showed that raw fish could be supplemented with a certain amount of plankton.

Having completed his laboratory experiments Dr. Bombard set sail in his rubber dinghy. It was somewhat similar to the conventional R.A.F. " general purpose " rubber dinghy but it had a wooden stern-board aft so as to prevent chafe harming the fabric when fishing and it was fitted with a sail and with a rubber cover forward to act as shelter when sleeping and to catch rain.* He also carried a small radio receiver.

Dr. Bombard had studied the winds and currents carefully before starting on his voyage. The most frustrating part of the voyage was in the Mediterranean when the winds and currents were so uncertain and fish supplies were also disappointingly poor. Here for three days he and his companion lived on nothing but a little salt water and thereafter for 11 days they lived on fish and fish juice.

At Tangier, Casablanca and Las Palmas attempts were made to dissuade Dr. Bombard from continuing his voyage because they said he had already proved his theory by getting as far as he had. Dr. Bombard had always in mind what the seaman—the potential shipwrecked mariner—might say, " until he has tried the open ocean he has proved nothing ". And so in due course Dr. Bombard left Tangier on the long track of 3,300 miles to Barbados which he accomplished in 131 days calling at Casablanca and Las Palmas. After 53 days at sea out from Las Palmas he encountered the British selected ship *Arakaka*, the first ship he had seen since Las Palmas. Received aboard by the Master he was tempted to stay, especially as his health and morale had sunk to a rather low state due to his disappointingly slow passage. But he had not yet completed what he had set out to prove so he got back to his rubber dinghy and to his diet of raw fish and fish water and rainwater and after a further 12 days landed at Barbados.

The book is written in an entertaining and unassuming manner and is enthralling from start to finish, and one marvels at the courage and fine philosophy of the author.

On another page in this magazine there is an article by Dr. Bombard in which he stresses the meteorological aspects of his voyage. The medical aspect is well covered in *The Bombard Story* and it seems there is little doubt that, from this wonderful voyage of his, Dr. Bombard has opened an avenue of hope to many a

* A drawing of the dinghy appears under *Arakaka* in the " Marine Observers' Log " on page 195 of the October, 1953, number of this magazine and a photograph is shown opposite p. 93 of this number.

shipwrecked mariner who might otherwise die from despair and panic. This is undoubtedly a book which all seamen should read not only for the practical value of the information it gives but also because it is a great story.

Dr. Bombard makes some rather strong criticism of certain published information about the presence of birds, etc., as a means of giving definite indications of the approach of land and the bad effect this may have upon the morale of a shipwrecked mariner if it turns out to be erroneous.

In the foreword Dr. Bombard makes one surprising statement. He infers that throughout the world in time of peace more than 200,000 human beings lose their lives at sea each year and that more than a quarter of them survive the initial disaster to their ship and die in open boats. It would be interesting to know the authority for these statistics. The author seems to be somewhat " out of date " in his scepticism about the value of radio in cases of shipwreck.

Included in the book are some admirable photographs and a track chart of the voyage.

C. E. N. F.

Deep-sea Research. Vol. 1, Number 1, October, 1953. pp. 64. Quarterly. Pergamon Press, London. Price 90*s.* per volume.

This is an international scientific magazine, the Editors of which are Professor L. Fage of the Institut d'Oceanographie, France, Mr. C. D. Ovey, Cambridge University and Dr. Mary Sears, Woods Hole Oceanographic Institution, U.S.A. In the Foreword and in an article entitled " International collaboration in deep-sea research " stress is laid on the fact that little can be done in this subject without international co-operation because of the huge expense and, indeed, the international character of the oceans themselves and of the enormous expense of fitting up expeditions to make the necessary observations. The magazine owes its origin to the activities of the Joint Commission on Oceanography of the International Council of Scientific Unions which is under the auspices of UNESCO. At its first meeting at the Institut Oceanographique in Monaco in 1952 the terms of reference of this Commission were restricted to investigations of the deep-sea floor and are defined as follows:

(*a*) The morphology and stratigraphy of the deep-sea floor.
(*b*) The general properties of the sediment carpet and its substratum.
(*c*) The properties of the water layer next the deep-sea floor.
(*d*) The abyssal fauna inhabiting the deep-sea floor.
(*e*) The organisms and processes important to deep-sea sediments.

The editors of *Deep-sea Research* emphasise, however, that in this magazine " not only will basic scientific research on deep-sea problems be acceptable, but also theories and hypotheses deduced from basic work which aim at piecing together the many problems which arise in this domain, concerning the geological and climatological history of the Earth ".

A glance through the pages of this magazine does indeed emphasise the fascinating nature of deep sea research and the enormous strides which have been made towards international collaboration in this work since Maury—famous for his pioneer work in meteorology as well as oceanography—published the first bathymetric charts in 1855. The bathymetric work of the *Challenger* Expedition and of Prince Albert of Monaco comes to mind when considering the history of organised Oceanography. The relationship between general oceanography and meteorology is obvious but this is not so easy to realise in the case of the deeper layers of the ocean except from a climatological viewpoint. The report of the Swedish Deep-sea Expedition aboard the *Albatross* (1947–48) is reported in the first volume of this magazine; in addition to the many interesting biological and geological investigations that the expedition made, mention is made of the important part that a study of long cores taken from the bottom of the ocean can play in studying world climatology. In an article about the record sounding of 5,940 fathoms made in the Marianas Trench (Pacific Ocean) by H.M.S. *Challenger* in 1951, a description is given of the methods used to check the accuracy of this sounding, both by sounding wire and by the explosion and hydrophone methods—and of verifying the position by star sights and by Loran. Bottom samples taken close to this sounding provided the geologists and biologists with plenty of material for study.

C. E. N. F.

Letters to the Editor

TIDAL WAVE

SIR,—This letter is in reference to the note " Tidal Wave, North Pacific Ocean ", which was published on page 197 of *The Marine Observer* for October, 1953. (The Canadian ship *Mossel Bay* observed on 4th November, 1952, what was thought to be a tidal wave of height 70 ft; at the time there was a force 10, WNW wind with waves periodically working up to 50 ft.)

The time of the earthquake off Kamchatka which generated the seismic sea wave has been established at 1658 G.M.T. on 4th November, 1952. This is about 13 hours later than the time of the large wave noted by Captain Cabot. Since winds of force 10 were listed for the period described, the large waves were undoubtedly related to storm conditions.

It is the opinion of this Office that a ship in an area of deep water (about 3,000 fathoms in the location noted) will be unaware of the passage of a seismic sea wave since the wave will be only a few feet high and its length may exceed 100 miles. Its speed will be about 450 knots.

U.S. Coast and Geodetic Survey,
Washington.

R. W. KNOX.

TIDAL WAVE

SIR,—The report of a giant wave submitted by Captain Cabot of the S.S. *Mossel Bay* and printed on page 197 of the October 1953 *Marine Observer* was read with great interest in the Hydrographic Office. One of the most disputed points concerning tidal waves (or tsunamis, as they are now more often called in this country) is whether they can actually be detected in deep water. Up to now, no authentic deep-water observation of a tsunami has been made known to the Hydrographic Office.

At first glance, the *Mossel Bay* report appears to provide such an observation. However, the earthquake that generated the November 1952 tsunami occurred at about 1700 G.M.T., 4th November, 1952, and hence could not have been connected with a wave observed at 0400 G.M.T. the same date. The latter must have been a true wind wave, probably resulting from the juxtaposition of two or more wave trains generated by the gale.

Incidentally the speeds of advance given in your note are considerably less than those actually associated with tsunamis. U.S. Coast and Geodetic Survey Special Publication No. 300 *The tsunami of November 4, 1952, as recorded by tide stations* gives the speed of this tsunami between the epicentre off the coast of Kamchatka and Honolulu, Hawaii, as 434 knots.

U.S. Navy Hydrographic Office.

Capt. J. B. COCHRAN,
Hydrographer.

MARINE OBSERVER A LONG WAY FROM THE SEA

SIR,—After ordering several publications from Her Majesty's Stationery Office, I discovered *The Marine Observer*. I think things would be left undone without some words of praise for your magazine. It is excellent reading, and practical. (I have been to sea—Merchant Marine (blackgang) engine room.)

Washington Street, H. T. BURNS.
Kansas City, Mo., U.S.A.

Editor's Note. The great railroad centre Kansas City, on the Missouri River, is one of the leading cattle and grain towns of the mid-west. It is over 600 miles from the nearest sea.

FROST SMOKE

SIR,—In the gulf of St. Lawrence, in winter, "frost smoke" is much more extensive, both in space and time, than in the example given by Hay in *The Marine Observer*, for October, 1953. My account of the meteorology of this region[1] gives a summary of frost smoke observed in 1941–43, based on personal experience, on the debriefing of pilots from the R.A.F. School at Charlottetown, Prince Edward Island, and on data and synoptic charts available in the Meteorological Office, Charlottetown, which data included observations from islands in the Gulf but no ships' observations.

Frost smoke formed on five days in the winter of 1941–42 and on 15 days in 1942–43, the longest spell being of five days in December, 1942. All cases occurred in the months of December, January and February, i.e. when the sea surface temperature was at or near freezing point (no day-to-day sea temperatures were then available—monthly means for periods ending in 1940 were used) and fresh to gale gusty winds (highest gradient wind 70–80 knots) from between west and north were always present. Forecasting the distribution and extent of the frost smoke depended largely on studying pilots' reports of the open sea areas—the ice is by no means solid all the time (the Gulf freezes over about mid-December to early January and the thaw occurs in early April in the south and late April in the extreme north) but is broken up by tides, strong winds and especially by the temporary thaws that occur during a normal winter.

The frost smoke nearly always extended to great heights reaching up to about 5,000 feet in December, when there was much open sea and up to about 2,500 feet later in the winter when there was more sea ice. There are no records to indicate how low the surface visibility fell at sea but pilots often reported visibility well below 1,000 yards and visibility fell at one time to 1,000 yards (with sky obscured by ice crystals) at Charlottetown airfield, 10 miles inland on the wind track. Without the original records, which I do not have at present, I cannot say how low the visibility fell on the Gulf Islands but it was down to 1,000 yards on several occasions.

Assuming, with the strong winds present, that the air temperature at Grindstone Island (Magdalens) (196 feet above M.S.L.) or at St. Paul Island (104 feet above M.S.L.) was representative of the open Gulf near the sea-ice, a minimum temperature difference of about 16°F between (mean sea) temperature and air temperature was necessary before frost smoke would form.

Small temperature changes were quite critical. For instance, on 2nd and 3rd January, 1943, widespread frost smoke was reported in a W to NW stream of polar continental air with Grindstone temperature varying between 4° and 11°F. On the evening of 3rd January, 1943, temperature rose a little (due to a slight intrusion of polar maritime air) from 11°F at 1430 A.S.T. (Atlantic Standard Time) to 15° at 2030 A.S.T. (air saturated at both times); with the rise of temperature the frost smoke dispersed, the visibility at Grindstone rising from 1,000 yards at 1430 A.S.T. to 6 miles at 2030 A.S.T. With the temperature varying between 14° and 16°F on 4th January, 1943, only traces of frost smoke were observed by pilots, whereas the previous day the frost smoke had been continuous over the large areas of open water with the top about 2,500 feet. On the evening and night of 4th January, 1943, a depression gave snowfall and rising temperatures. By 1430 A.S.T. on 5th January, 1943, the temperature at Grindstone had again fallen to 15°F with no frost smoke; no pilots' reports were available that day due to unserviceability of the airfield. On 6th January, 1943, however, with Grindstone observation showing saturation at 11°F in a strong Northwesterly gradient extensive frost smoke was again reported over the Gulf. From the above saturation temperature figures and taking an (average) Gulf temperature for early January as 30°F, the critical minimum vapour pressure difference for frost smoke formation lies between 2·9 and 3·3 mb, figures of similar magnitude but lower, being minimum values, to those quoted by Hay.

This phenomenon of frost smoke is referred to as " Arctic sea smoke " in the *Meteorological Glossary* and sometimes as "sea smoke", " water smoke ", " Arctic ice smoke " or " smoke frost ". It is usually stated to be very shallow. The kind of extensive deep frost smoke observed in the Gulf was given the local name of ice crystal fog, especially by pilots. It occurs in other parts of Eastern Canada—I had some evidence for its presence in the Bay of Fundy and Hurd[2] mentions its presence in the Newfoundland region—and probably in similar latitudes in Eastern Asia.

Meteorological Office,
Gloucester.

L. JACOBS, M.A., M.SC.

[1]JACOBS, L. *The Meteorology of the Gulf of St. Lawrence and Prince Edward Island.* Originally circulated in Sept., 1943, reproduced as Meteorological Office Publication M.O.M.515 in Jan., 1948.

[2]HURD, W. E. *Some aspects of Northern Atlantic and Arctic Weather and Climate.* Reverse of Pilot chart of North Atlantic Ocean, Sept., 1948.

Note. I am grateful to Mr. Jacobs for drawing my attention to his paper " The Meteorology of the Gulf of St. Lawrence and Prince Edward Island " which I had not previously seen. His assertion that the formation of the frost smoke, " or ice crystal fog " as it is called on Prince Edward Island depends upon the air temperature being at least 16°F cooler than the sea surface is based on all evidence available through two winter seasons in that locality and agrees with the results for the isolated cases discussed by Starbuck and Hay. In all these cases and those recorded in the Antarctic in 1911 there were strong winds. The great depth of ice crystal fog at Prince Edward contrasts with the shallow fog reported in the other cases, particularly as the depth was apparently largely independent of the lapse rate. In the Antarctic the shallowness of the frost smoke was probably due to the presence of an inversion at a low level in the air originating in the continental anticyclone. R. F. M. HAY.

Personalities

RETIREMENT.—COMMODORE A. I. ROBERTSON, C.B., R.D., R.N.R., has recently retired from the sea owing to ill health. He was captain of the New Zealand Shipping Company's motorship *Ruahine* having taken her over as a new ship in May, 1951.

After being educated at the City School, Lincoln, of which his father, J. W. Robertson, M.A., was schoolmaster, Arthur Ian Robertson went to sea in 1913 as an apprentice in the Prince Line, and in 1916 joined the Royal Naval Reserve as a midshipman and served in the Navy during the remainder of the first world war. In 1919 he joined the N.Z.S. Co., as a fourth officer and was promoted through the various grades to chief officer until the outbreak of the 1939–45 war when he was mobilised as a Commander R.N.R. During the war he was promoted to Captain R.N.R. serving in various parts of the world in command of H.M. ships, among which was the escort aircraft-carrier *Patroller*.

He rejoined the N.Z.S. Co. in 1945, and commanded in turn the *Empire Flag*, *Kent*, *Cornwall*, *Norfolk*, *Rimutaka*, and the Company's cadet training ship *Rakaia*. Commodore Robertson was associated with the Meteorological Office from 1924 to his retirement, and he received several Excellent Awards. In April, 1952, he was promoted to Commodore R.N.R. He had the distinction of serving as R.N.R. Aide-de-Camp to both H.M. King George VI and later to H.M. Queen Elizabeth II.

At the coronation service in Westminster Abbey he had the honour of representing the Royal Naval Reserve.

In the Coronation Honours List he was made a Companion of the Order of the Bath (Military). He is a Younger Brother of the Trinity House, and a member of the Royal Naval Reserve Advisory Committee.

We wish him a speedy return to health and a long and happy retirement.

C. H. W.

Notices to Marine Observers

Postal Arrangements

The quarterly numbers of *The Marine Observer* are published on the last Wednesdays of December, March, June and September.

The Marine Observer is addressed to the Captain, S.S./M.V. ...., c/o the owners, and captains are requested to make their own arrangements for forwarding.

Shipowners, Marine Superintendents and all concerned in the despatch of mails to ships are asked to kindly facilitate the despatch and delivery of mail received at their offices from the Meteorological Office and "Air Publications and Forms Stores" to their ships abroad. Addressed to the captains of ships, this contains information required for the conduct of meteorological work at sea, and is most effective if received by the captains at the earliest possible date.

Ice Observation

Drifting ice, derelicts and other floating dangers to navigation are reported by all means of communication at the disposal of the master.

See Chapter 12, pages 96–98 of the *Marine Observer's Handbook*, Seventh Edition.

It is also desirable that more detailed information than can be given in a TTT wireless message should be available to the Meteorological Office for the purpose of research, and for Admiralty Charts and Sailing Directions.

Marine observers will greatly assist by noting the conditions of ice, either drifting or fast, in the pages provided at the end of the logbook (Form 911), or on Form 912, which may be supplied to the captain of any British ship on application to a Port Meteorological Officer or Merchant Navy Agent.

Observing ships using the Trans-North Atlantic tracks are requested to record not only when ice is encountered, but also when they have passed through the ice region during the ice season without encountering ice. In this case a "nil" report should be returned, since it is desirable as far as possible to determine when tracks have been clear of ice.

Difficulties in Clearing Radio Weather Messages

The Master of any ship which experiences frequent difficulties in clearing radio weather messages to coast radio stations in any part of the world is requested to make a note in the ship's meteorological logbook mentioning the time and date of the occurrence and to give any other information which it is thought might be helpful. The complaint will then be forwarded by the Meteorological Office to the director of the Meteorological Service to which the message was addressed with a view to the circumstances being investigated and of improving if possible the reception conditions at the radio station concerned.

It is only by receiving reports of this nature that we are able to know of the difficulties the radio officers aboard the selected ships experience in this respect. On receipt of all such reports we will do our best to rectify matters. Generalised reports merely stating that difficulty was experienced from time to time in clearing a message to such-and-such a station are not sufficiently explicit to enable us to take remedial action.

Inspection of Instruments Aboard Voluntary Observing Ships

Principal Observing Officers are requested to see that when the ship arrives in a home port all Meteorological Office instruments, books, atlases, stationery, etc., are readily available for muster by a Port Meteorological Officer or Agent. If the Observing Officer himself is unlikely to be aboard or free to attend the muster it would greatly help if he would leave a note as to the whereabouts of the various items (including the spare thermometer and remains of any broken instruments).

NAUTICAL OFFICERS AND AGENTS OF THE MARINE DIVISION OF THE METEOROLOGICAL OFFICE, GREAT BRITAIN

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Bristol Channel.—Mr. J. C. Matheson, Port Meteorological Officer, 2 Bute Crescent, Cardiff. (Telephone : Cardiff 21423.)

Southampton.—Captain J. R. Radley, Port Meteorological Officer, 50 Berth, Old Docks, Southampton. (Telephone : Southampton 4295.)

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Tyne.—Captain F. B. West, Custom House Chambers, Quayside, Newcastle upon Tyne. (Telephone : Newcastle 23203.)

Crossword Puzzle Solution

(*See page* 109)

ACROSS: 1, Maritime. 7, Tornados. 8, NEE. 10, Out-run. 13, Ash. 14–6, Aerolite. 15, T.S.S. 17, Off. 18, Hotter. 19, F.O.B. 22, Dog-watch. 23, Gazer. 24, Raindrop.

DOWN: 1, Meteorology. 2, Ignore. 3, Moon. 4, Else. 5, Weathership. 9, East. 11, Taff. 12, Ur. 15, To. 16, Strand. 20, Oder. 21, Bora.

Marine Observer's Handbook

7th Edition, 1950

(reprinted 1952)

A standard reference work for the ship's officer since it was first published; this new and improved edition was written primarily to assist officers in British Commonwealth vessels, who carry out voluntary observations at sea for Meteorological Services, to do the work in the most efficient and uniform way. It provides a comprehensive and valuable source of information for those who are interested in meteorology, but who have little or no specialized knowledge.

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