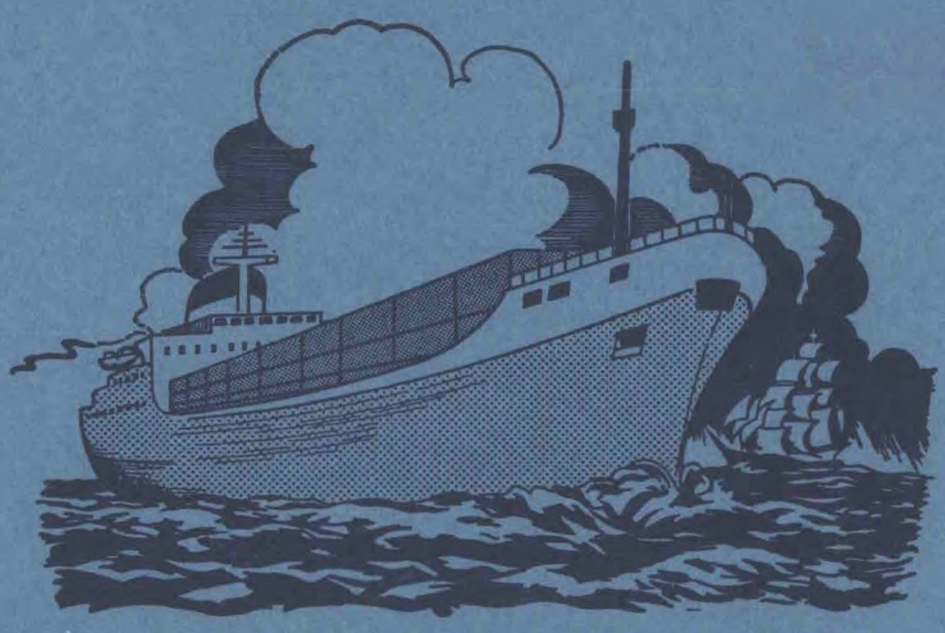
Met. O. 932

The Marine Observer

A quarterly journal of Maritime Meteorology



Volume L No. 267

January 1980

£1·75 net

THE
MARINE OBSERVER

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

Vol. L

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

VOL. L   No. 267   JANUARY 1980

CONTENTS

Letters to the Editor, and books for review, should be sent to the Editor, 'The Marine Observer', Meteorological Office, Eastern Road, Bracknell, Berkshire RG12 2UR

Published for the Meteorological Office by
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Editorial

Twenty years ago, on 1 April 1960, the first meteorological satellite was launched by the USA only 3 years after the USSR had put the first man-made object—Sputnik—into space.

The full name of the first weather satellite was Television and Infra-Red Observation Satellite, hence the acronym TIROS. TIROS 1, a drum-shaped satellite approximately 48 centimetres high and 108 centimetres in diameter, was launched into an orbit inclined about 48 degrees to the equator at a height which varied between 639 and 750 kilometres. Within a few hours after launch it was sending pictures back to earth and during its 79-day lifetime it completed 1091 orbits and sent back over 19 000 usable pictures of cloud patterns, tornado clouds, a hurricane, snow cover, pack-ice and land forms.

Prior to the launch of TIROS 1 the analysis of large-scale cloud structures and weather features depended entirely on the forecaster's interpretation of individual surface observations of the weather and cloud structure over the observing station and on the profiles of temperature and humidity in the upper air available from scattered Radio Sonde stations. Despite the fact that TIROS 1 was limited to 32 pictures per orbit these filled large gaps in the conventional observational network. Over the tropical eastern Pacific, the southern Indian Ocean and the southern oceans in general, the TIROS photographs furnished the first comprehensive information on the weather systems of these areas.

TIROS 1 was followed by 9 similar satellites numbered consecutively 1 to 10 launched during the period 1960–65. In the summer of 1961, TIROS III discovered and tracked 18 hurricanes, typhoons and tropical storms in the Atlantic and Pacific Oceans. During August 1962, TIROS V discovered 2 hurricanes and 4 typhoons, thus these satellites were dubbed the title of 'hurricane hunters'.

The early TIROS satellites carried a small television-type camera capable of producing and storing television pictures which had a resolution of about a mile. These television pictures could only be received at special ground stations in the USA where they were analysed and distributed internationally as nephanalyses, i.e. coded or facsimile analyses of the organization of clouds. The total delay in receiving a nephanalysis in the UK varied from about 5 to 8 hours.

However, TIROS VIII, launched in 1963 carried the first Automatic Picture Transmission system (APT) which gave broadcasts of television pictures every 3½ minutes. Relatively simple equipment on the ground could receive the pictures during the time that the satellite was above the horizon of the receiving station. Any suitably equipped ground station was thus able to receive the pictures.

The APT system still operates though it has been considerably modified since first introduced. Current satellites obtain the pictures with an instrument called a radiometer which measures the amount of incident radiation in either visible or infra-red wavelengths. Infra-red radiation is a form of heat and the satellite's sensors monitor temperature of the underlying features—high cloud will be coldest whilst tropical land or sea will be warmest. The sensors produce images irrespective of day or night in a range of shades from black for the hottest through grey to white for the coldest. Thus on the end-product charts, clouds appear as relatively pale shades and warm land or sea areas will appear black. If there is sufficient difference in temperature between land and sea, coastlines will be shown. A further development of infra-red radiometry on more recent satellites is the ability to monitor temperature profiles in the vertical and it is possible, in certain conditions, to produce temperature readings at various levels to over 30 000 metres above the surface. This system can also be used to monitor the water-vapour content of the air.

Since the launch of TIROS IX in 1966 most satellites have operated in a near-polar orbit circling the globe once every 1½ to 2 hours. Due to the earth's rotation, each orbit crosses the equator some 25 to 30 degrees of longitude further west than the previous one and complete global coverage is achieved about every 12 hours.

The end product is a series of pictures or images of the earth and its cloud cover, each picture successively further along the flight path, from which a mosaic of pictures can be produced covering about 3 or 4 orbits.

The early satellites were primarily experimental; the fully operational programme was commenced in 1966 with the launch of the Environmental Science Services Administration (ESSA) series. Nine satellites were launched in this series and these were followed, in 1970, by the National Oceanic and Atmospheric Administration (NOAA) series of meteorological satellites. These were all launched into near-polar orbits.

The current USA operational polar-orbiting satellites are TIROS-N launched in October 1978 and NOAA VI launched in June 1979. These are the first 2 in a new series which is planned to continue into the mid—or late 1980s; they carry very similar instrumentation and their orbits are arranged so that most parts of the globe are viewed by the 2 satellites every 6 hours or so.

While a polar-orbiting satellite can survey the whole of the earth's surface sequentially, there are advantages in having satellites which can survey a particular part of the earth's surface continually, i.e. a geostationary satellite which, as the name implies, remains stationary relative to the earth although orbiting in space. This can only be achieved if the satellite is above the equator at a height such that it takes exactly 24 hours to complete one orbit. From this height—about 36 000 kilometres which, incidentally, is substantially greater than the usual 800–1500 kilometres of the polar-orbiters—roughly one quarter of the earth's surface can be seen although the view towards the limits of the area is very oblique. Frequent pictures from geostationary satellites allow the movement and development of weather systems to be followed in greater detail than is possible using polar-orbiters. The first of these Synchronous Meteorological Satellites (SMS 1) was launched in May 1974 and there are now 5 geostationary satellites equally spaced above the equator which maintain continual meteorological surveillance over approximately three-quarters of the earth's surface. One of these, named METEOSAT and located at 0° longitude, although launched by the USA is operated by the European Space Agency.

In September last year the Marine Superintendent wrote to the Master of every ship in the British Voluntary Observing Fleet on the relationship between information gained from the satellites described above and the meteorological data obtained from observing vessels. This letter is reproduced below in order that it may reach as wide a field as possible.

'Over the past decade or so there has been considerable development in satellite technology and in the use of satellite-acquired data in meteorological practice. Recently this fact has been brought to the attention of a wider public by the inclusion in some television transmissions of satellite photographs showing cloud formations over parts of western Europe and adjacent waters. The increased publicity given to the use of satellite products has prompted some voluntary observers to question the continuing value of their observations and the main purpose of this letter is to assure you that your observations are as valuable now as they have been in the past.

'This arises from the simple fact that although satellites, in addition to "picture" products can, and do, provide for a restricted range of parameters in numerical data—the accuracy, time and area coverage achieved are severely limited. The images of cloud formations are of considerable help in producing good analyses without which reliable forecasting would be impossible. Ground/satellite systems have been introduced which enable approximate wind velocities in the upper air to be determined from the movement of cloud elements when and where they are present. Obviously, in the absence of cloud they cannot be applied. Wind velocity near sea level cannot be obtained. In the absence of cloud, satellite-borne infra-red sensors measure sea-surface temperatures to limited, and frequently uncertain, accuracies. In the presence of cloud the temperature at the cloud top can be similarly obtained. In the absence of cloud the broad distribution of temperature with height through the atmosphere can be deduced but even here it is necessary to rely on traditional observations for calibration purposes. In general the observational coverage is severely limited and does not meet the data requirements of numerical forecasting methods. However, it is interesting to note that our day-to-day knowledge of the distribution of sea ice world-wide has been greatly improved by satellite imagery.

'In order to maintain the ability to forecast it is necessary that a wide range of high-quality data continue to be provided in near real time. Apart from the serious limitations of satellite-derived data noted above, there are at present no means of obtaining from satellite observations surface atmospheric pressure and pressure tendency, temperature and humidity, surface wind speed and direction and visibility, all of which are essential. Further, there is no operational, as opposed to experimental, satellite system capable of providing sea-state data and the continuing issue of state of sea forecasts in the form of wave height charts must rely on ships' observations of these parameters.

'It is worth noting that differences in sea-surface temperature revealed by satellite infra-red sensors can delineate areas of upwelling and warm and cold currents. However, the actual set and drift of currents cannot be determined unless drifting buoys are deployed and tracked. This is an expensive exercise and the established method of determining current data cannot be replaced by direct satellite information. Consequently, the current data entries in ships' meteorological logbooks are still vital for the revision of existing current charts. I hope that this very brief survey will serve to show that the requirement for ships' observations is as strong as it ever was.

'I should like to take the opportunity afforded by this letter to tell you of some developments which are the subject of implementation or discussion. The World Meteorological Organization is deploying considerable resources to ensure that your observations are exchanged world-wide and that they are put to the maximum use. A revision of the ships' code to speed this exchange is likely to be introduced on 1 January 1982 but it is certain that no parameters at present reported will be dropped. Some developing countries are moving towards the establishment of port meteorological services similar to our own and hope to introduce meteorological services for shipping in their areas of responsibility. The UK's continuing need for ships' observations is demonstrated by our employment of marine staff at this Headquarters and in 7 major ports as well as by the continued provision of instruments to over 500 British ships at considerable cost.

'We shall continue to strive to enhance our services to shipping as we have done in the last decade during which the accuracy of forecasts and gale warnings has shown worth-while improvement. These services not only contribute to safety but, if used to good effect, can help to conserve fuel, reduce passage time and avoid or limit heavy weather damage, thus contributing to economic operations.'

1980 marks the 50th year of publication of this journal. *The Marine Observer* first appeared in January 1924 but, for obvious reasons, was not published in the years 1940 to 1946. To celebrate this occasion we have, somewhat belatedly some might say, updated the illustration which appears on the front cover. In the foreword to the first edition the then Director of the Meteorological Office, Dr G. C. Simpson (later Sir George) wrote:

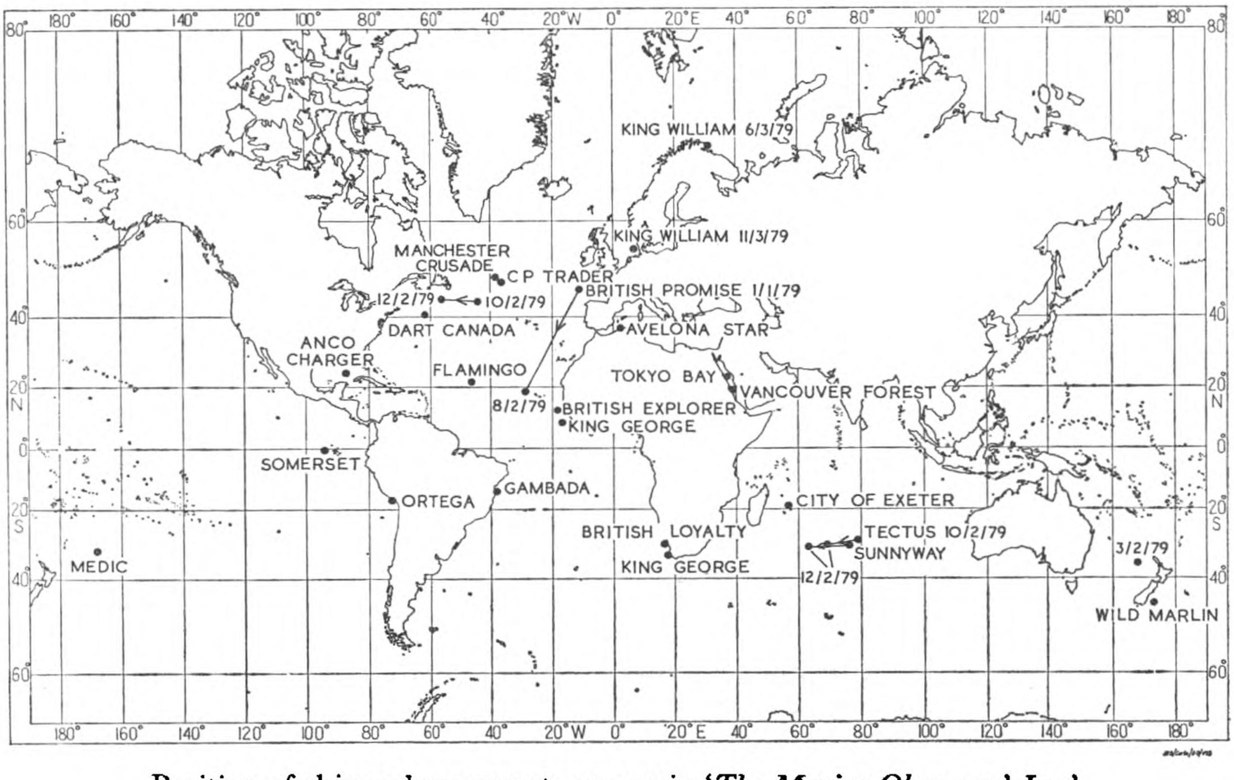
'In launching this new venture two thoughts are uppermost in my mind. First, I cannot help but think, with deepest feelings of gratitude, of all the unselfish work of a whole army of marine observers, many passed away and many still with us; work which has extended our knowledge of winds, weather and currents into the uttermost parts of the sea. The taking of the observations at the correct time in all types of weather and often in difficult and dangerous conditions . . . and the constant care of the instruments, have all been done in the faith that the observations would lead to a knowledge of the laws of the atmosphere which would prove of use and comfort to future generations of sailors. And this leads me to my second thought:

the desire of the Meteorological Office to extract this knowledge from the data provided and to hand it back to the seaman in the form which he can understand and suitable for use in daily life at sea. The gratitude I must ask the observer to accept on my assurance, but *The Marine Observer* will, I hope, be a tangible proof that the Meteorological Office is doing its share in this common undertaking.'

The gratitude remains as great as ever and we hope that we have not lost sight of the ideals and purposes for which this journal was conceived and launched.

May 1980 bring prosperity, health and happiness to all our readers.

C. R. D.



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

January, February, March

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

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

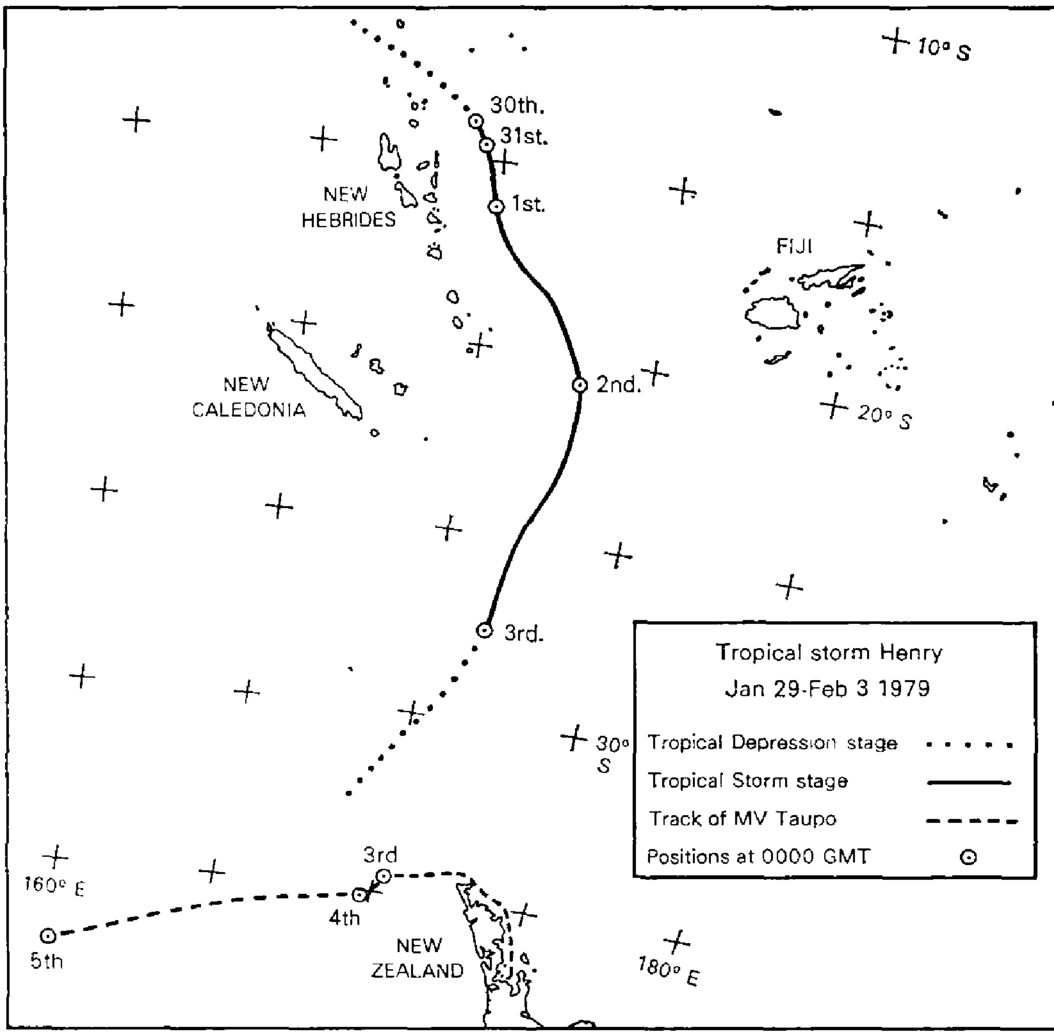
TROPICAL STORM 'HENRY'

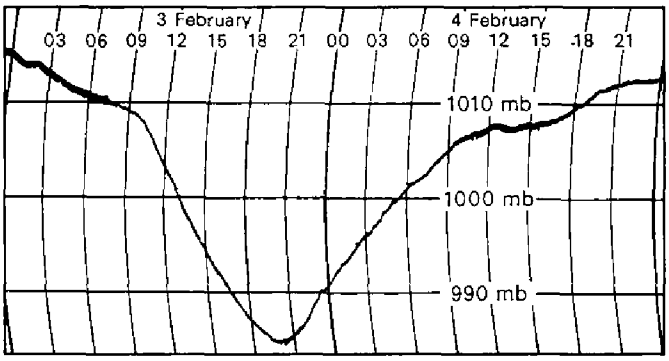
Tasman Sea

m.v. *Taupo*. Captain C. B. Cooke. Auckland to Suez. Observers, the Master and ship's company.

3–4 February 1979. The following observations were made when the vessel encountered tropical storm Henry, see also the accompanying chart which shows the relative position of the storm to the vessel. The vessel was stopped in the positions indicated on the chart between 0800 GMT on the 3rd and 0730 GMT on the 4th for engine repairs.

	GMT	
2nd	1930:	Auckland Radio issued the following storm warning: 'Tropical cyclone Henry centred at 1800 on the 2nd near 25°S, 172°E moving south-south-east at 25 knots but likely to become slow moving during the next 6–12 hours. Expect winds to 50 knots close to centre and winds over 35 knots within 250 n. mile of centre in southern semi-circle'.
3rd	0800:	Wind SE, force 6, barometric pressure 1009·7 mb, overcast, dry bulb 22·0°C, wet bulb 19·1.
	1200:	Wind SE, force 8, barometric pressure 1003·7 mb, heavy rain, dry bulb 19·5, wet bulb 18·0.
	1400:	Wind SE'S, force 8, barometric pressure 997·0 mb, moderate rain.
	1700:	Wind SSE, force 9, barometric pressure 989·0 mb.
	1900:	Wind S'E, force 9, barometric pressure 984·4 mb, moderate rain, dry bulb 20·5, wet bulb 19·8.





2000: Wind S'E, force 7, barometric pressure 985·3 mb, heavy rain, dry bulb 20·6, wet bulb 20·1.

2200: Wind NE, force 5, barometric pressure 986·0 mb, fair, dry bulb 21·2, wet bulb 20·2.

4th 0000: Wind N'W, force 7, barometric pressure 990·6 mb.

0200: Wind NW'N, force 8, fair.

0730: Wellington Radio issued the following storm warning: 'Tropical cyclone Henry centred at 0500 on the 3rd at 30°S, 171°E, position good based on satellite picture. Cyclone moving south at 25 knots with central pressure of 985 mb, but expected to decelerate after the next 6 hours. Expect winds 45 to 55 knots within 300 n. mile of centre in the sector east through south to south-west. Also winds to 35 knots within 150 n. mile of centre in remaining sector.'

0800: Wind NW, force 7, barometric pressure 1002·3 mb, fair.

1200: Wind W, force 5, barometric pressure 1006·5 mb, overcast, dry bulb 19·8, wet bulb 16·8.

Position of ship at 1200 on the 3rd: 35° 12'S, 167° 42'E.

Position of ship at 1200 on the 4th: 35° 42'S, 165° 48'E.

Note. Tropical storm Henry was downgraded by the National Oceanic and Atmospheric Administration on the 3rd and they do not give any further positions for the storm. It must have passed to the north-west of m.v. *Taupo*. This is supported by the wind observations and the barograph trace, see page 9.

Satellite photographs indicated that Henry had maximum surface winds of about 50 knots during the 2nd.

HURRICANE 'CELINE'

Indian Ocean

m.v. *Tectus*. Captain J. A. Forbes. Port Kembla to Richards Bay (S. Africa). Observers, the Master and Mr P. J. Hetherington, 2nd Officer.

10–12 February 1979. During this period the vessel encountered hurricane Celine and the following are extracts from the logbook:

GMT

10th 0700: Wind E, force 7, barometric pressure 1016 mb, cloudy, rough sea, moderate swell.

1000: Wind E, force 7, drizzle, rough sea, moderate to heavy swell.

1500: Wind ENE, force 7–8, barometric pressure 1012 mb, moderate rain, very rough sea, moderate to heavy swell.

1900: Wind E'N, force 9, barometric pressure 1008 mb, heavy rain, very rough sea, moderate to heavy swell.

2100: Wind E, force 9–10, moderate rain, lightning observed.

2200: Wind SE, force 10–11, barometric pressure 1002 mb, moderate rain, very rough sea, heavy swell.

11th 0100: Wind E, force 10, barometric pressure 998 mb, moderate rain, very rough sea, heavy swell.

0400: Wind SE'E, force 11, barometric pressure 993 mb, moderate rain.

0900: Wind E'N, force 11, barometric pressure 982 mb, heavy rain, very rough sea, heavy swell.

1300: Wind E, force 10–11, barometric pressure 980 mb, moderate rain.

1400: Wind ESE, force 10, barometric pressure 981 mb.

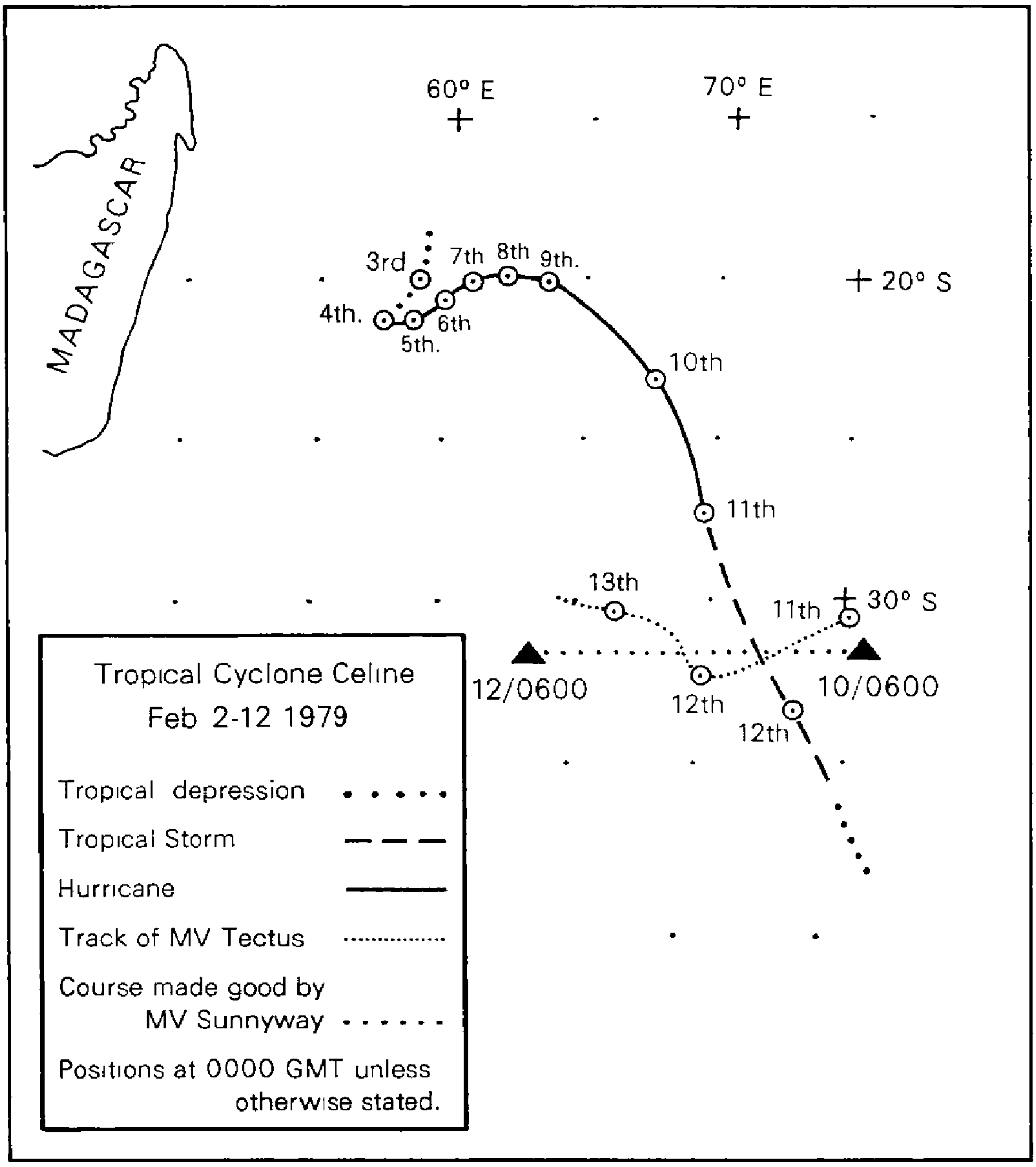
1800: Wind S'E, force 8–9, barometric pressure 982·5 mb, moderate rain, very rough sea, heavy swell.

2000: Wind S, force 8–9, barometric pressure 984·5 mb, moderate rain, rough sea, heavy swell.

2300: Wind SW'W, force 7–8, barometric pressure 990 mb, overcast.

12th 0500: Wind WSW, force 7–8, barometric pressure 1004 mb, lightning observed, moderate rain.

0700: Wind SW'W, force 7–8, rough sea, moderate to heavy swell.



By 0800 on the 12th the weather had moderated sufficiently to allow the vessel to resume her voyage to Richards Bay.

Position of ship at 0700 on the 10th: 29° 57′S, 78° 11′E.

Position of ship at 0700 on the 12th: 30° 51′S, 68° 58′E.

Note. Satellite photographs indicated that the strongest winds associated with Celine reached 100 knots during the period 8–10 February.

Indian Ocean

m.v. *Sunnyway*. Captain J. B. Caley. Dampier (W. Australia) to Hamburg. Observers, the Master, Mr M. A. T. McMillan, Chief Officer, Mr J. Pink, 2nd Officer and Mr R. G. Kirkby, 3rd Officer.

10–12 February 1979. During the period this vessel also encountered hurricane Celine and the following are extracts from the logbook. (See also the chart accompanying the observation from the *Tectus* above).

GMT

10th 0700: Wind ENE, force 6, barometric pressure 1017·9 mb, falling slowly, moderate sea.

1900: Wind ENE, force 8, barometric pressure 1008·4 mb, falling quickly, rough sea, moderate swell, overcast with rain showers.

11th 0300: Wind SE, force 10, barometric pressure 993·8 mb, falling steadily, visibility reduced by heavy rain and spray, vessel shipping water over decks and hatches, very rough sea, confused swell, mainly from an easterly direction.

0700: Wind SE, force 11, barometric pressure 988·7 mb, visibility further reduced by heavy rain and spray, damage to some deck fittings due to vessel shipping water.

1100: Wind S, force 10, barometric pressure 988·5 mb, steady.

1300: Wind S, force 12, barometric pressure 990·1 mb, rising steadily, air filled with spray, sea a mass of foam. Course altered to reduce amount of water shipped on deck, gangway lost overboard.

1500: Wind S, force 12, barometric pressure 993·7 mb, rising quickly.

1900: Wind SSW, force 11, barometric pressure 998·1 mb, rising quickly, rough sea, confused swell, vessel now able to resume course at reduced speed.

2300: Wind S, force 9, barometric pressure 1001·3 mb, sea moderating, vessel able to resume full speed.

12th 0700: Wind S, force 6, barometric pressure 1009·4 mb, moderate sea, confused swell.

Position of ship at 0600 on the 10th: 31° 24′S, 75° 54′E.
Position of ship at 0600 on the 12th: 31° 42′S, 63° 36′E.

HURRICANE 'BENJAMINE'

Indian Ocean

m.v. *City of Exeter*. Captain A. S. Matheson. Answering a distress call in Mauritian waters. Observers, Mr W. M. Murphy, Chief Officer, Mr D. E. C. Stevenson, 2nd Officer and Mr R. E. Niven, 3rd Officer.

6 January 1979. At 0836 GMT the vessel left Port Louis outer anchorage to proceed to the assistance of a vessel in position 15° 20′S, 55° 00′E. The weather at the time was overcast with rain showers, barometric pressure 1013·0 mb, wind N, force 2–3, swell height 1·5 metres from a north-north-westerly direction.

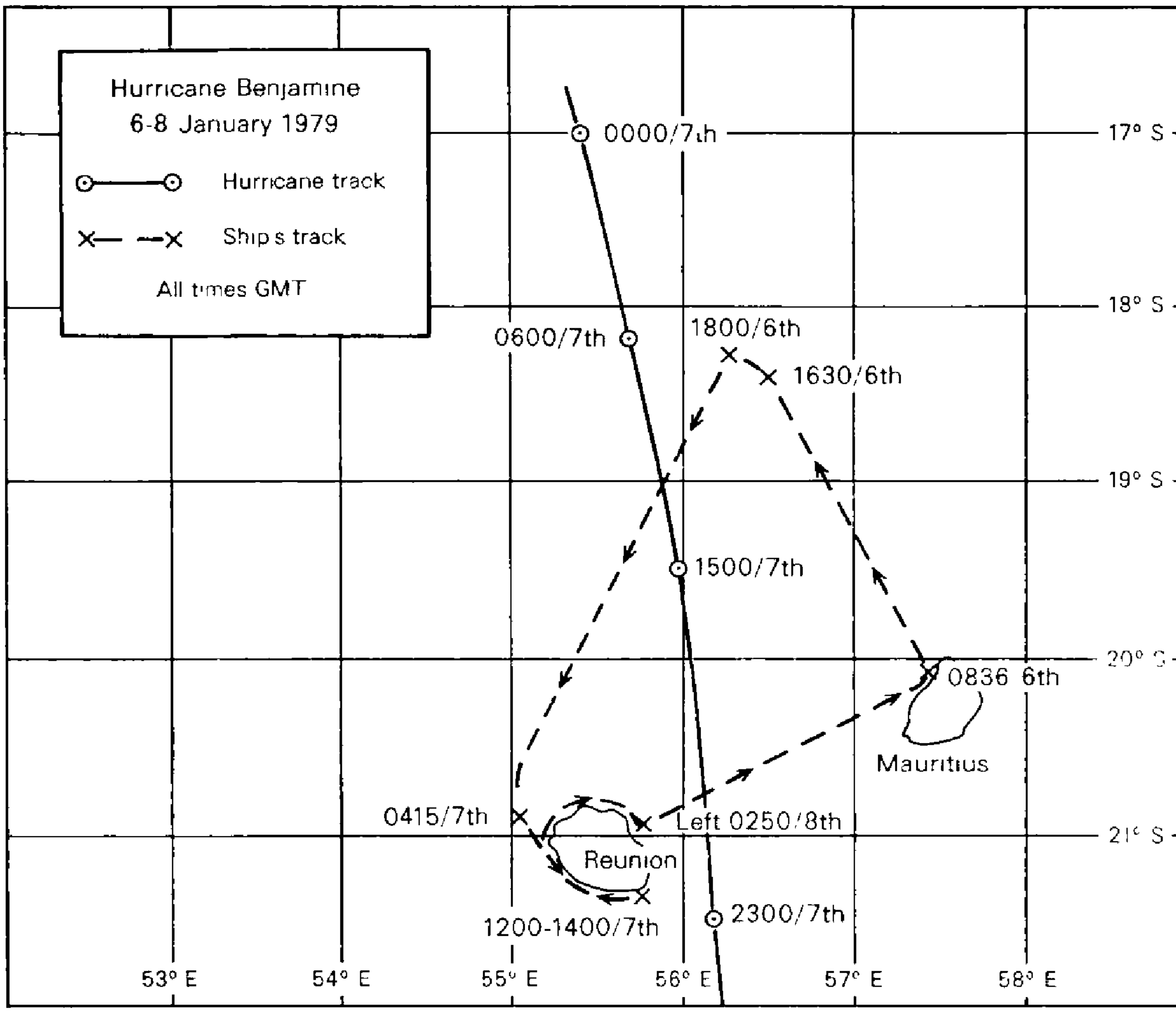
The vessel maintained a course of 333°(T) and a speed of 14 knots until 1630, during which time the wind veered to become ENE, force 3, the sky remained overcast with intermittent moderate rain. The swell had increased to 3 metres but no significant change in the barometric pressure was observed.

At 1630 course was altered to 298°(T) in order to avoid the storm centre. This course was maintained until 1800 when the distress call was cancelled.

At 1800, by which time the wind had increased to NE, force 6, course was again altered to 207°(T) in order to seek shelter off the southern and western coasts of Reunion; landfall was made at 0415 on the 7th. The vessel now proceeded down the western side of Reunion in the lee of the island where winds were light and variable. Off the southern coast the wind was now E'N, force 5.

At 1200 the vessel had reached the south-east point of Reunion. At 1236 visibility was reduced in continuous moderate rain, the vessel then stopped and drifted offshore until 1400 after which she proceeded westwards around Reunion as the wind freshened from the east.

At 1600 the rain became heavy and lightning was observed overland, the barometric pressure was now 1006·3 mb and falling and the wind SE, force 8–9.



From this time hourly observations were made and the following are extracts from the logbook:

GMT

1700: Wind SSE, force 10–11, barometric pressure 1003·3 mb, falling, heavy rain.

1800: Wind S, force 10, heavy rain.

1900: Wind SW, force 3–5 (in lee of land), barometric pressure 999·1 mb, falling slowly, intermittent slight to moderate rain.

2000: Wind W'S, mainly force 4 but increasing to force 8 at times, barometric pressure 999·1 mb, steady.

2100: Wind light WNW'ly, barometric pressure 1000·2 mb, rising.

8th 0000: Wind SSE, force 5, barometric pressure 1003·9 mb, swell height 3 metres from 180° as vessel approaches the north-east point of Reunion.

0100: Wind SW, force 3.

0200: Wind NE, force 5.

0250: Wind veered abruptly to SE, vessel now set course 062°(T) for Port Louis.

0300: Wind SSE, force 7, swell height 3 metres from 165°.

0500: Wind N'W, force 4, barometric pressure 1012·9 mb, intermittent drizzle.

During the morning the periods of drizzle became less frequent, the cloud became broken, although a stratiform cloud cover remained all day. The wind freshened to force 7 from a northerly direction, but backed to WSW and moderated to force 3 by 1100.

Position of ship at 1200 on the 6th: 19° 12′S, 57° 00′E.

Position of ship at 0600 on the 8th: 20° 36′S, 56° 24′E.

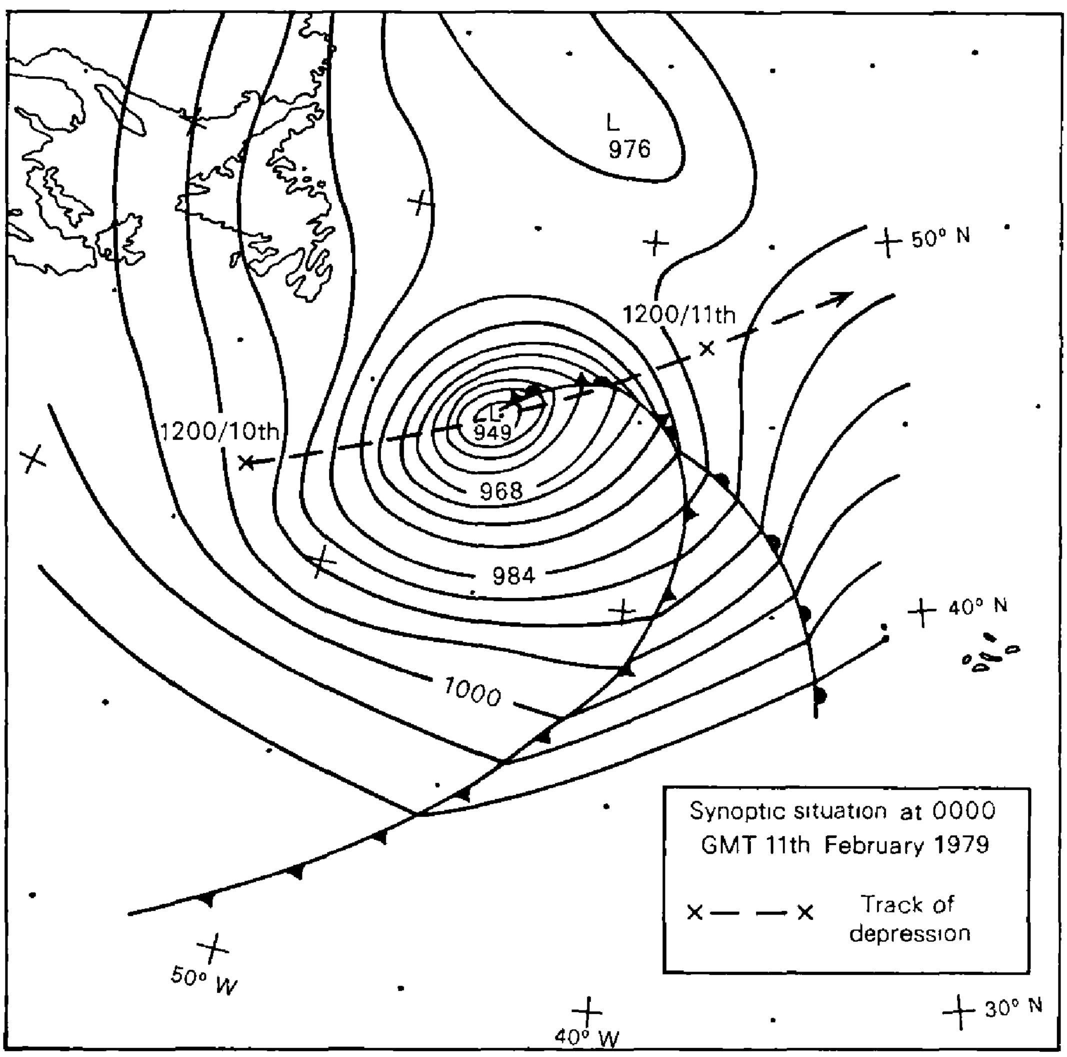
Note. Benjamine developed over the Indian Ocean early in January and attained minimum hurricane intensity on the 6th and maintained that level until the 8th.

ICE ACCRETION

North Atlantic Ocean

m.v. *Dart Canada.* Captain N. R. Pryke. Le Havre to Halifax. Observers, the Master and Officers of the watch.

10–11 February 1979. During this period the vessel encountered a very deep depression, see chart, which gave rise to hurricane force winds and severe ice accretion on board.



At 2000 GMT on the 10th the wind was w'ly, force 5–6, barometric pressure 980·3 mb, temp. 9°C and general weather conditions overcast with rain. Two hours later the pressure had fallen to 949·3 mb and the wind become variable, force 3. After a further 5 minutes the wind increased suddenly and sharply to become NW, force 12 and during this short period a violent rain shower was experienced. Hereafter the pressure rose quickly, the wind decreased very slowly to become WNW, force 8–9 by 0400 and force 7 by 1800.

Marked falls in temperature were also experienced as the vessel moved westwards from plus 10°C at 0000 on the 11th to minus 4 at 1800 and then to minus 8 at 0000 on the 12th. The rain which had been falling steadily since 2000 on the 10th became sleet or snow at 0230. At 1200 on the 11th the observing officer reported that freezing spray was causing severe icing over the forward section of the vessel. A further report indicates that freezing spray and heavy snow were experienced until the vessel arrived at Halifax at 1500 on the 12th.

There was also a marked fall in the sea temperature from 12°C at 0600 on the 11th to 2°C 6 hours later. This temperature was maintained until 0600 on the 12th by which time it had fallen to 0°C.

Position of ship at 1800 on the 10th: 43° 30′N, 43° 30′W.

Position of ship at 0000 on the 12th: 44° 24′N, 56° 00′W.

Note. The complex and persistent low pressure area over the North Atlantic during early February brought very cold air to the north-east of the United States. A new centre developed to the east of Cape Hatteras early on the 10th, it moved quickly east-north-east and deepened rapidly to become an intense and fully developed depression by 0000 on the 11th.

At this time the *Dart Canada* must have been close to, or at, the centre of the low. The barometric pressure recorded by the observing officer indicates that the depression on the synoptic chart should have been drawn a few millibars deeper. As the vessel continued westwards and the depression moved eastwards cold air and conditions suitable for superstructure icing were experienced by the vessel.

This type of icing may be due to freezing rain, freezing fog or freezing sea spray. Of these the latter is probably the most dangerous. Sea spray is likely with winds of force 5 or more and it is likely to freeze on impact with solid objects when the air temperature is less than that of the freezing point of sea water—about minus 2°C and when the sea-surface temperature is less than about 5°C. When the air temperature falls to less than about minus 18°C the spray may freeze itself before impact and not, therefore, adhere to any structure in its path. Generally speaking the stronger the wind and the lower the temperature, the more rapid is the accumulation of ice. There will be little accumulation near sea level because these parts will be frequently bathed in relatively warm sea water and decreasing amounts are likely above about 15 metres as the amount of sea spray will decrease with height.

ANOMALOUS PROPAGATION OF RADAR WAVES

Red Sea

m.v. *Vancouver Forest.* Captain J. F. Houghton. Jeddah to Dubai. Observers, the Master and Mr R. Gilchrist, 3rd Officer.

28 February 1979. At 2015 GMT a strong radar echo was observed 15 degrees on the port bow at a distance of 6·5 n. mile from the vessel; nothing was observed in this area by the naked eye. At 2124 the echo was found to be approaching the vessel at a relative speed of 7 knots, once again nothing was seen by the naked eye.

When the echo was at a distance of 2·5 n. mile from the vessel, course was altered from 143° to 090°(T). At this time the echo was weakening and appearing only once in every three or four sweeps; it was, however, approaching the vessel at the same relative speed and on a steady bearing.

At 2145 the echo was lost at an approximate distance of 1·8 n. mile from the vessel.

The vessel resumed her normal course at 2200.

Weather conditions at the time of the observation were: dry bulb and wet bulb 26·0°C, barometric pressure 1012·3 mb, wind E, force 2.

Position of ship: 18° 37′N, 39° 10′E.

Note. Mr P. Menmuir of the Royal Signals and Radar Establishment, comments:

'Electromagnetic waves, which, in free space travel at the speed of light, propagate more slowly through a denser medium such as the earth's atmosphere. On passing at an oblique angle from the (dense) sea level to the (less-dense) higher regions of the atmosphere, the path of a radio wave is bent, i.e., refracted, downwards towards the earth's surface and the radar horizon is normally somewhat further distant than the visible horizon. The degree of bending of the path depends to a great extent upon the vertical gradient of humidity (and to a lesser extent, the temperature gradient) which may be sharp enough to trap the radio wave in the lowest atmospheric layer so that the path of the wave follows the curved surface of the earth. Under such conditions, stronger than normal signals may be returned from a target beyond the maximum unambiguous range of the radar.

'The maximum unambiguous range of a particular radar depends upon the pulse-repetition frequency (PRF) and it is half the distance traversed by a discrete pulse of radio waves during the complete transmit/receive cycle. If the returning pulse from one cycle is detected during the next cycle, then a false echo will be painted on the screen at the correct azimuth but at the same distance from the radar as the target was beyond maximum unambiguous range, and, as the distant target approaches from a point beyond maximum range, the false echo will close in towards the centre of the screen. The echo may fade as the strength of the distant return signal falls below the accepted noise level close to the radar before re-appearing on the same bearing but at maximum range; these are known as "second-time-around" echoes. They may be eliminated by varying the PRF but the equipment would be more complex and hence probably more costly.'

DOLPHINS

South Pacific Ocean

m.v. *Wild Marlin.* Captain F. G. Bevis. Bluff (New Zealand) to Pitcairn Island. Observers, the Master and Mr K. N. Metcalfe, Chief Officer.

17 March 1979. At 0400 GMT what was thought to be a very large number of common porpoises was sighted travelling at about 15 knots in a north-easterly direction. The number was so large that when first sighted the watch-keepers were given the impression of a large reef.

As the vessel passed through the school those creatures in our immediate vicinity veered off to port and starboard then reversed direction and swam back behind us.

The creatures were about 2 metres in length, each had a small dorsal fin and a rounded nose. The backs were black and the bellies white.

Position of ship: 45° 21′S, 173° 07′E.

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

'These are not common porpoises as suggested, this animal does not occur around New Zealand. If all the animals were without a beak, then that rules out *Stenella* and *Delphinus.*

'Dolphins without a long beak in this area and which are patterned with varying amounts of black and white are the Southern white-sided Dolphins, *Lagenorhynchus cruciger*, the dusky Dolphin, *L. obscurus*, Fraser's Dolphin, *L. hosei* and the melon-headed Dolphin, *Peponocephala electra*. The first two animals do not usually appear in such numbers as those described by the observers, but the latter two have been recorded in large concentrations although there is little white on the *electra*, just a patch or streak on the underside. It is difficult to positively identify what species these could have been.'

Eastern South Pacific

m.v. *Somerset.* Captain A. B. Stalker, Balboa to Bluff (New Zealand). Observers, the Master and ship's company.

9 March 1979. At 1700 GMT a number, estimated to be 150, of Common dolphins were observed moving very quickly in a southerly direction. Some were seen to leap high out of the water.

A small number of them travelled on either side of the vessel for about two minutes before moving off in a northerly or southerly direction. The vessel's speed at the time was 17 knots.

Position of ship: 0° 12′S, 94° 18′W.

Note. Mr McBrearty comments:

'The swimming speed of dolphins is the subject of much argument. Obviously some species are faster than others and the Common dolphin, *Delphinus delphis*, is one of the "greyhounds" of the sea. If the energy supplied by mammalian muscle is computed and multiplied by the muscular mass of the whale (or dolphin), it will always be found that the animal goes faster than it should. Streamlining certainly helps but there is more to it than that—the answer is believed to lie in the skin. Dolphin (and whale) skin is highly specialized, it is most unlike the skin of land mammals in that the cells are "alive" right to the surface. Certain substances are released from the inter-cellular spaces when the outermost layer breaks away, thus smoothing the passage of water over the skin and creating laminar flow and, therefore, less drag. Hence more speed for less effort.

'The split school would probably reform after the vessel had passed. School structure during passage is most interesting—various patterns have been observed, namely the vee, line abreast, echelon and circle (often with juveniles in the centre). Many theories have been advanced as to the reasons for a particular pattern, all most interesting but inconclusive.'

WHALES AND DOLPHINS

North Atlantic Ocean

m.v. *C. P. Trader*. Captain J. R. Waling. Montreal to Rotterdam. Observers, Mr C. P. M. Lucas, 3rd Officer and Mr S. Simpson.

1 February 1979. At 1115 GMT approximately 100 snub-nosed creatures resembling sperm whales were observed. They appeared to be about 3 to 4 metres long and upon surfacing blew out air in the form of small plumes not greater than one metre in height.

Surrounding these creatures was a large school of dolphins, 300 and more in number. These were dark grey in colour with a large white stripe down the side. They had pronounced snouts and small dorsal fins. Some of the creatures came surprisingly close to the vessel—within 3 to 5 metres—and appeared to be carrying an eel-like object measuring about 25 centimetres in length. All the animals were heading in a westerly direction at an estimated speed of 3 knots.

A high-pitched noise was believed to have been heard coming from the dolphins; it was thought to be their means of communication.

Position of ship: 48° 03′N, 36° 35′W.

Note. Mr McBrearty comments:

'I believe these to be the North Atlantic or long-finned Pilot Whales, *Globicephala melaena*. Although the prominent rounded head would be quite noticeable, the long based curved dorsal fin should leave no doubt as to the species. They are frequently seen in large groups of 100 or more and drive fisheries were active in the western Atlantic until the mid-60s. There is still an active annual drive in the Faeroe Islands.

'These whales may often be associated with other dolphin species. I have had several reports of association particularly with the Common porpoise, *Phocoena phocoena*. The associated species described in this report certainly does not fit *Phocoena*, the large white stripe down the side and the prominent beak together with a length of 2 metres is more likely to fit the Common dolphin, *D. delphis* or Euphrasyne dolphin, *Stenella coeruleoalba*. In spite of the sleek streamline appearance of small cetaceans, they do carry a variety of internal and external parasites. Lampreys and other organisms such as stalked barnacles, *Conchoderma*, are often found on Cetacea.

'It is quite possible that the observer did hear a high-pitched squeaking noise coming from the dolphins. Dolphins make a variety of sounds both audible and ultra-sonic. In the archives of various research establishments, particularly those of the US Navy, there are mile upon mile of recording tapes containing dolphin sounds. There have been many attempts by various people to analyse and decode these sounds, but beyond being able to identify a few individual species by their sound characteristics, most of these sounds appear quite meaningless. Attempts have been made to play back recordings of dolphin noises to other captive animals—the results have been quite negative with the animals being disinterested. Therefore, although the animals do make a variety of sounds and calls, the so-called "communication" element may be no more than a simple "bird-like" flock call.'

North Atlantic Ocean

m.v. *Manchester Crusade*. Captain J. Illingworth. Montreal to Liverpool. Observers, the Master, Mr. M. Grover, Chief Officer, Mr C. Hiltunen, 2nd Officer and Mr B. Tyson, 3rd Officer.

21 March 1979. A school of white-sided dolphins, about 20 in number, and 2 large square-nosed whales were observed heading in a westerly direction.

Later, just before sunset, a disturbance was observed ahead of the vessel and as we approached the area a large whale, of the same species as those previously sighted, was seen to be swimming in fast tight circles and apparently being attacked or closely pursued by 2 killer whales. Although a whale calf was not actually seen it was thought that the large whale may have been a female protecting her calf from attack. As the vessel passed the scene of the incident the action was broken up if, perhaps, only temporarily.

Position of ship: 48° 58′N, 38° 56′W.

Note. Mr McBrearty comments:

'This is a very interesting observation. The attack pattern of the Killer whale is so typical of the species. It is quite probable that an unseen Sperm whale calf was involved.'

FISH

Eastern South Atlantic

m.v. *British Loyalty*. Captain H. J. Shields. Durban to Walvis Bay. Observer, Mr N. J. Hulse, 3rd Officer.

18 January 1979. A small fish, see sketch, was found on the main deck. It was 235 mm long, the beak being 35 mm. The upper and lower parts of the long beak fitted closely together, the upper was smaller than the lower; both parts had very sharp serrations. An orange-coloured line ran the length of the lower part.

The body of the fish was a dark silvery blue on the topside and silver coloured on the underside. A well-defined line separated the 2 colours.

It was thought that the fish was washed on board the previous day during heavy weather approaching the Cape of Good Hope.

Position of ship: 30° 03′S, 16° 18′E.

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

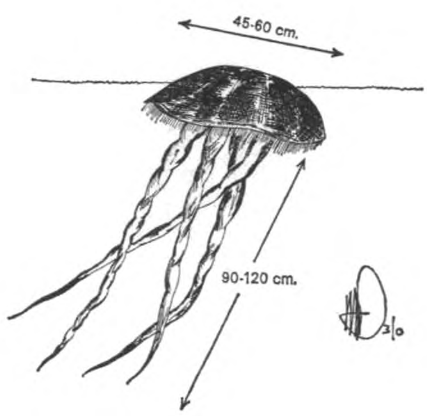
'A very good illustration of *Scombresok saurus*, the skipper. This is an oceanic Atlantic fish, usually found in shoals near the surface. Skippers are able to leap well clear of the water when pursued, which is perhaps why this one finished up on the deck of the *British Loyalty*. They use their long thin beaks for feeding on planktonic crustacea and probably on small fish.'

JELLY-FISH

Eastern South Pacific

m.v. *Ortega*. Captain C. W. Alison. At anchor Matarani (Peru). Observers, the Master and ship's company.

13 February 1979. On arrival at Matarani anchorage it was expected that the vessel would have a normal night at anchor for it was a quiet evening with only a slight sea and low southerly swell. However, after letting go the anchor and turning on the floodlight it was observed that the sea appeared to be alive; closer inspection revealed that a very large number of jelly-fish as illustrated in the sketch surrounded the vessel. Within minutes the engine room alarm was ringing due to a blocked



suction valve of the salt water intake. The jelly-fish seemed to have been attracted to the vessel and the duty engineer was constantly pulling out the creatures in order to keep the suction valve clear.

It was, however, soon decided that it was necessary to depart and once out of the bay no further jelly-fish were encountered.

Position of ship: 16° 50′s, 72° 10′w.

BATS

South Atlantic Ocean

m.v. *Gambada*. Captain R. J. Turney. At Todos Bay (Brazil). Observer, Mr C. Raymond, 2nd Officer.

1–3 January 1979. At dawn on each day whilst reading the draught from the jetty, Mr Raymond observed 4 bats flying between the vessel's bow and the jetty. Small fish were evident at the surface of the water and, from time to time, the bats skimmed the surface noisily.

Position of ship: 14° 42′s, 38° 30′w.

Note. Mr J. E. Hill of the Mammal Section of the British Museum (Natural History), comments:

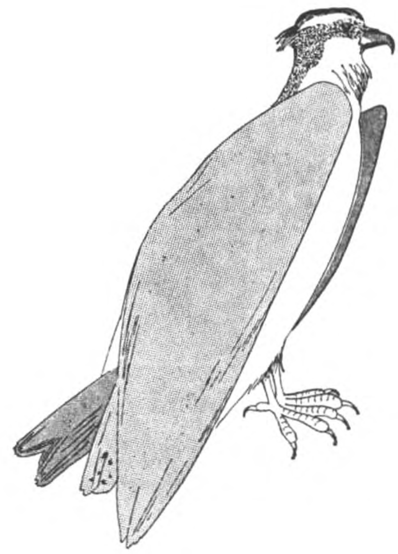
'The bats almost certainly represent the fisherman bat, *Noctilio leporinus*, which occurs widely in tropical Central and South America. The remarks made by the observer are consistent with the behaviour of this species when foraging.'

BIRDS

Gulf of Mexico

m.v. *Anco Charger*. Captain K. V. Lewis. Galveston (Texas) to Panama. Observers, the Master and ship's company.

24 March 1979. At 1400 GMT a large bird of prey as shown in the sketch settled on some tank ventilation pipes about 15 metres forward of the bridge. The bird remained on board the vessel for about 3 hours, all the time observing with interest the activities below on deck.



The bird stood about 60 centimetres in height, its wing-span measured approximately $1\frac{3}{4}$ metres. The plumage was black on the topside with a small patch of yellow or white just before the tail, the underside was white. Black specks were observed around the neck. There was a white patch on the crown of the head and the nape of the neck was tufted.

Position of ship: 24° 00′N, 86° 54′W.

Note. Captain G. S. Tuck, Chairman of the Royal Naval Birdwatching Society, comments: 'This is the Osprey, *Pandion haliaetus*.'

Western North Atlantic

m.v. *Dart Canada*. Captain N. R. Pryke. Norfolk (Va) to Southampton. Observers, the Master and Officers of the watch.

22 January 1979. At 1700 GMT the bird shown in the sketch drawn by Mr M. J.

Tansley, 2nd Officer, was observed standing on one of the containers forward of the bridge. Judging by its walk it was considered to be a wader.

The bird was about 40 centimetres tall and had a wing-span of 75 centimetres. The body and head were white, beak dark yellow and crest orange. The legs were dark brown and the feet black.

Position of ship: 40° 35′N, 62° 08′W.

Note 1. Captain Tuck comments:

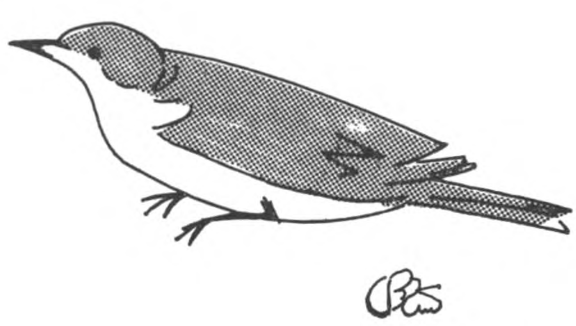
'I consider this to be an American Egret, also known as the Common Egret, *Casmerodius alba*.'

Note 2. At one time these birds were shot on their nests for the money their plumes would bring. Active protection was, however, introduced in Europe and America and it has now recovered its number in North America.

Red Sea

s.s. *Tokyo Bay*. Captain W. A. Fitzgerald. Suez to Port Kelang. Observers, the Master and ship's company.

8 March 1979. At 1000 GMT, whilst the vessel was on passage through the Red Sea, the bird illustrated in the sketch flew onto the bridge. It was believed to be a Black-headed Wagtail and thought to be some distance from its natural habitat.



The topside of the bird was olive green with a small white patch near the tail. The underside and chin were yellow and the head and beak black. The bird measured 15 centimetres in length.

Position of ship: 23° 12′N, 36° 54′E.

Note 1. Captain Tuck confirms that the bird is the Black-headed Wagtail, *Motacilla flava feldegg*.

Note 2. Races of this species occur all over Europe and part of north Africa, also in Asia north of the Himalayas and on the coast of Alaska.

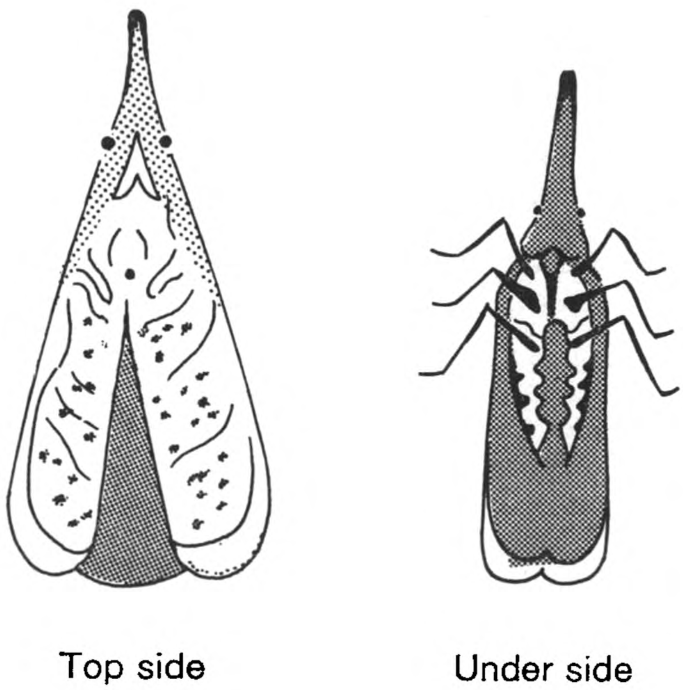
INSECT

Eastern North Atlantic

m.v. *King George*. Captain T. Young. Tilbury to Port Elizabeth. Observers, Mr P. Ward, Chief Officer and Mr S. Wainwright, 3rd Officer.

21 January 1979. The insect illustrated in the sketch was found on deck when the vessel was off the West African Coast.

It measured 5 centimetres in length and was mainly light brown in colour with dark flecks on the upper wings and a few distinctive fawn markings near the head; the tips of the wings were also fawn and translucent. The undersides of the wings were very dark brown, almost black; the underside of the body was fawn with the



same dark brown markings. The proboscis was long compared to the size of the body, the end was similar to that of an elephant's trunk.

Position of ship: 8° 31′N, 15° 51′W.

Note. Mr W. J. Knight of the Department of Entomology, the British Museum (Natural History), comments:

'This appears to be a species of the genus *Pyrops*. This species belongs to the family Fulgoridae, a group with sucking mouth parts which feed on plant sap. The species is common in Africa.'

BIOLUMINESCENCE

Eastern North Atlantic

s.s. *British Explorer*. Captain A. Skellern. Isle of Grain to Bonny (Nigeria). Observers, Mr L. J. Loftus, 2nd Officer and Mr P. Beare.

30 January 1979. At 0200 GMT what was at first considered to be a line of light was observed on the horizon fine on the port bow. Upon further and closer investigation it was discovered that the effect was caused by a form of bioluminescence not before encountered by the observers.

The bioluminescence took the form of strips each about 30 centimetres in length; interdispersed among the strips were areas of the more-usual flashing type. The phenomenon was about half a nautical mile long. As the vessel skirted the area, the bioluminescence increased in intensity.

Position of ship: 12° 53′N, 18° 13′W.

Note. Dr P. J. Herring of the Institute of Oceanographic Sciences, comments:

'This report probably describes a large area of *Pyrosomas* at the surface. These long cylindrical colonies of animals commonly range from 5 to 30 centimetres in length and from 3 to 10 centimetres in diameter. They glow very brightly and steadily, occasionally producing slow flashes of several seconds duration.'

North Atlantic Ocean

m.v. *Wild Flamingo*. Captain J. S. Laidlaw. Forte de France (Martinique) to Leghorn (Italy). Observers, Mr R. J. Pearson, 3rd Officer, Mr A. D. Macgillivray, Radio Officer and Mr J. Stewart.

24 March 1979. At 0000 GMT bioluminescence in the form of diffused white light and rapid flashing discs was observed on the surface of the sea. The sizes of the discs varied in diameter from 15 to 60 centimetres; the colours also varied from milky white to light green.

The display was observed for about 30 minutes and was further enhanced when the Aldis lamp was directed onto the water. The effect was observed along each side of the vessel and at a distance of about 10 metres all around. Some 'sparkling' was also observed in the areas where the sidelights were shining.

Weather conditions at the time of the observation were: dry bulb 22·0°C, wet bulb 19·6, sea temp. 23·5, barometric pressure 1019·7 mb, wind N, force 3, 7 oktas of cloud, no moon.

Position of ship: 22° 06′N, 45° 48′W.

South African waters

m.v. *King George*. Captain T. Young. Amsterdam to Port Elizabeth. Observers, the Master and ship's company.

23 March 1979. At 2000 GMT whilst the vessel was passing Cape Town exceptionally bright bioluminescence was observed in the bow wave and in the water along the side of the vessel; the phenomenon was observed only where the water was disturbed by the vessel and in the 'white horses'. The brightest effect was observed in the bow wave area where the effect could be likened to that of a strip-light shining on the water. No effect was observed when a bright light was directed onto the phenomenon. Similar forms of bioluminescence had been observed in the past in this area but not so brilliant as on this occasion.

Weather conditions at the time of the observation were: dry bulb 18·5°C, sea temp. 15·0, barometric pressure 1013·6 mb, wind SSW, force 3–4, no moon was visible.

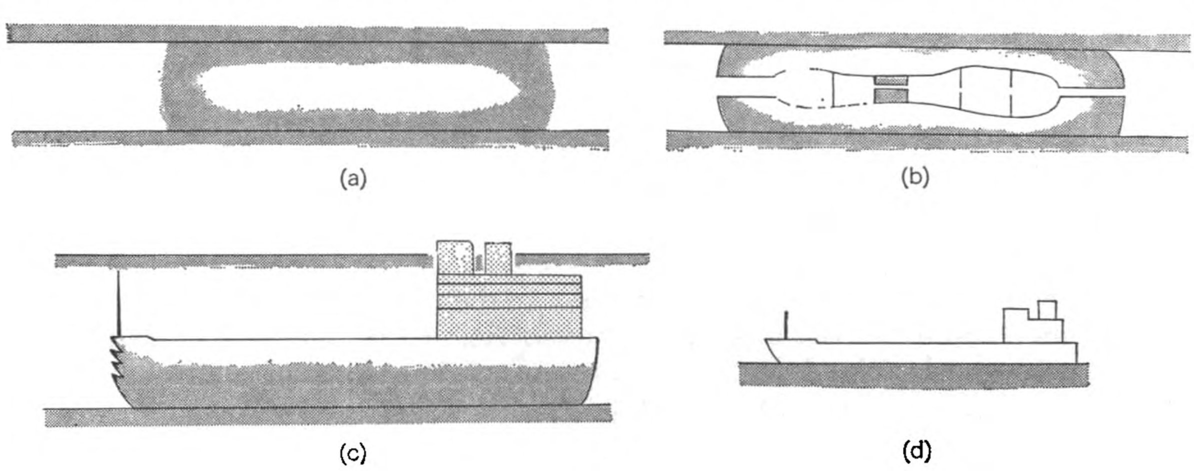
Position of ship at 1800: 33° 42′S, 17° 54′E.

ABNORMAL REFRACTION

Mediterranean Sea

m.v. *Avelona Star*. Captain R. Brownbill. Gibraltar to Port Said. Observers, the Master, Mr R. Owen, 3rd Officer and Mr M. Harris.

9 February 1979. At 0930 GMT radar contact was made with an object bearing



north at a distance of 15·3 n. mile. The image, seen on the horizon as a rectangular shape, lighter in the centre, is illustrated in the sketch at (a). When the distance between the vessel and the image had reached 20 n. mile, the latter was identified as a ship, see (b).

Throughout the day abnormal refraction was observed and for about an hour between 1300 and 1400 some distortion was seen to the land when the distance between the vessel and the land was 5 n. mile. The effect of refraction on ships at this time, however, was to make them appear taller and narrower, see (c) at a range of 25 n. mile and (d) when the range was less than 5 n. mile.

Weather conditions at the time were: dry bulb 19·0°C, wet bulb 15·5, barometric pressure 1010·3 mb.

Position of ship at 0930: 36° 48′N, 2° 30′E.

AURORA

Barents Sea

m.v. *King William.* Captain E. J. Owen. Kirkenes (Norway) to Weserport. Observers, the Master and ship's company.

6 March 1979. At 1715 GMT, shortly after sunet, an impressive aurora display was observed. The display took the form of rayed bands, generally bright in intensity, but more numerous and brilliant to the east. Flaming activity which was observed at 1730 at the eastern end spread gradually across the whole of the display. This activity ceased at 1745 and by 1750 only irregular patches remained. The bands were pale yellow or grey in colour.

Position of ship: 70° 14′N, 30° 55′E.

North Sea

m.v. *King William.* Captain E. J. Owen. Kirkenes to Weserport. Observers, the Master, Mr S. J. Milnes, 2nd Officer and Mr S. P. Harris, 3rd Officer.

11 March 1979. At 2140 GMT an aurora display in the form of coronal rays was observed, the elevation of the coronal point was 75° on a bearing of 160°(T). The sector of spread of the rays ranged from 100°(T), through north, to 290°(T). The rays in the sector 290 to 350°(T) were bright in intensity and a yellow/green in colour. The rays in the remaining sector were red in colour and flaming.

At 2201 the display began to disappear, first the red sector then the yellow/green sector until by 2205 only small irregular patches remained.

Position of ship: 54° 49′N, 6° 42′E.

SUNSPOTS

Western South Pacific

m.v. *Medic.* Captain W. W. Newport. Balboa to Tauranga (NZ). Observers, Mr A. T. Turner, Chief Officer, Mr K. B. Thorpe, 2nd Officer and Mr D. L. Haynes, 3rd Officer.

24 March 1979. During the morning a sunspot was observed when sights were being taken. The spot appeared as a small dot in the 6 o'clock position and a quarter of the diameter up from the lower limb. It was visible throughout the day until the sun was obscured by cloud during the early afternoon. The sun's altitude at 1929 GMT was 35° 53·9′ on a bearing of 064·5° (T).

Position of ship at 1930: 28° 45′S, 157° 45′W.

At 0150 on the 26th of March the sunspot had moved nearer to the centre of the sun and was larger in size.

Closer inspection of the phenomenon revealed three spots, the largest in a 5 o'clock position and one third of the diameter in from the circumference, the next in a 4 o'clock position and one third of the diameter in from the circumference and the third spot in a 10 o'clock position and one quarter of the diameter in from the circumference. There also appeared to be a slight speckling near the circumference on the upper arc, definite identification was not possible.

The phenomenon was observed using a sextant equipped with a telescope of 6-times magnification and an effective aperture of 30 mm. The sun's altitude at 0156 was 38° 00′ on a bearing of 304°(T).

Position of ship: 32° 28′S, 168° 03′W.

EMERGENCY TANKER LIGHTENING OPERATION

Eastern North Atlantic

s.s. *British Promise*. Captain J. Lambert. Milford Haven to Durban. Observer, Mr R. Raeburn, 2nd Officer.

1 January 1979. Orders were received to proceed to and stand by the *Andros Patria* after an explosion had occurred on board her the previous day.

At 0600 GMT on the 2nd when the *British Promise* reached the *Andros Patria* it was ascertained that a Dutch salvage tug, the *Typhoon*, had taken her in tow and transferred 3 members of her crew to the stricken vessel. Also in attendance were the Dutch tug *Poolzee*, the German tug *Titan*, a Japanese tug and the Spanish warship *Rowena*. After discussion with control centre previously set up in B.P. Head Office and the *Typhoon*, 5 members of the *British Promise's* crew were transferred to the *Andros Patria* and communication set up by means of VHF radio. The party reported that there was a large hole in the port side extending forward of the pipe manifold for about 13 metres and descending below the water line to an unknown depth. The deck in the vicinity of the hole was set down about 60 centimetres and the area around the hole was flexing considerably. Oil was leaking from the hole at an estimated 10 to 30 tonnes per hour and, in consequence, a large oil slick was visible. The vessel had a list to port of about 5° and all the port side and poop were covered in crude oil.

The port lifeboat was in fact on the davits, the starboard lifeboat davits appeared, however, to have been bent downwards and aft and the lifeboat ladder was trailing in the water.

Later 2 men from the *Poolzee* were taken on board the *Andros Patria*, a towline was connected and the vessel was towed by both tugs westwards—with difficulty at first since the rudder was locked at 20° to port, this was eventually returned to midships.

On 3 January as the *British Promise* accompanied the tow in a south-westerly direction away from the Spanish and Portuguese coasts, the weather deteriorated, the wind increased to gale force and the sea became rough with a heavy swell. The vessels were now rolling 10–20°. When the salvage team arrived on the scene they were unable to be taken aboard the *Andros Patria* because of the weather conditions.

Between the 4th and the 7th the bad weather persisted. Some of the salvage team managed to board the vessel on the 4th and stores, fuel and spares were transferred from the *British Promise* via the fishing vessel *Avelino Brion*. By the 7th engineers from the *British Promise* had effected repairs on board under extreme conditions in order to restore and maintain electrical power.

On the 7th the Portuguese warship *Roby* arrived together with 8 Dutch salvage men and 7 Greek officers. The tow was now being made in a westerly direction.

On the 8th the weather improved sufficiently to allow the full salvage team to transfer to the *Andros Patria* and the *British Promise* team to return to their vessel. The tug *Poolzee* was now able to make a heavier tow line fast and the *Typhoon* was released.

On the 10th it was decided to tow to position 33° 00′N, 25° 00′W and there to rendezvous with the *British Dragoon* in the hope that the weather might improve sufficiently to allow the *British Dragoon* to pump the remaining 167 000 tonnes of oil out of the *Andros Patria* and transfer it to the *British Promise;* 41 000 tonnes had by now been lost.

Between the 10th and the 20th all vessels proceeded southwards and on the 21st the *British Dragoon* went alongside the *Andros Patria* in order to commence the cargo transfer. The following day, however, the operation had to be abandoned due to a further deterioration in the weather. By this time 31 610 tonnes had been transferred and the *British Dragoon* and the *British Promise* proceeded at full speed to the lee of the Canary Islands to transfer the cargo. After so doing both vessels returned to rendezvous with the *Andros Patria* when the *British Dragoon* resumed the cargo transfer until, once again, the weather deteriorated.

On the 31st the *British Dragoon* returned alongside the *Andros Patria* when the third cargo transfer was commenced. By the following day the third transfer had been completed and all vessels headed in a north-easterly direction in order to clear Cape Verde territorial waters. On the following day a further 48 831 tonnes were transferred.

The weather deteriorated once again delaying further transfer of cargo and it was not until 8 February that a further 41 543 tonnes were taken off. It was not possible to pump the remainder of the cargo from the *Andros Patria.*

After the operation was completed the tugs towed the *Andros Patria* into Lisbon and the *British Promise* and the *British Dragoon* proceeded in accordance with Company instructions to discharge ports.

Position of ship at 1200 on 1 January: 46° 24′N, 10° 24′W.

Position of ship at 1200 on 8 February: 18° 42′N, 28° 54′W.

551.509.5: 551.40: 359

Naval Oceanography and Meteorology

By Commanders A. S. Watt and A. M. Morrice (Royal Navy)
(Directorate of Naval Oceanography and Meteorology)

Officers of the Royal Navy have always, from the very earliest days, played an important part in the development of the science of Meteorology—names such as FitzRoy and Beaufort need no introduction to seamen of the 20th Century. Their successors as naval meteorologists may not be so well known but, alone of the 3 armed services, the Royal Navy still trains selected officers in meteorology with particular emphasis on forecasting for the maritime environment, whose effects are still as important to naval operations in the late 20th Century, and perhaps even more so than in the zenith of sail in the 18th and early 19th Centuries.

When the Meteorological Department of the Board of Trade was established in 1854 there was no specialized service provided for the Navy. However, following the development of the Royal Naval Air Service, a separate organization was set up in 1916 by the Admiralty to meet the requirements of the Navy and named the Meteorological Section of the Naval Air Department. Shortly afterwards this transferred within the Admiralty to the Hydrographic Department and there it remained until 1920 when its responsibilities were taken over by a newly created Naval Division of the Meteorological Office. This was headed by a naval officer as 'Superintendent' and under him meteorological services to meet the increasing needs of the Fleet were developed; meteorological training to enable naval officers to forecast at sea was also arranged. During the 1930s it became apparent that a fully equipped and adequately staffed forecasting service was required to support Naval Fleet and aviation operations worldwide and, in 1937, the Naval Meteorological Branch of the Hydrographic Department was reconstituted. After the War the future organization of Naval meteorology was considered by the Admiralty Board and, in 1950, an independent department was established and named the Naval Weather Service Department under a director—abbreviated to DNWS.

During the 1950s and early 60s the increasing importance of submarines and anti-submarine warfare (ASW) had a far-reaching effect on the Naval Weather Service. Although SONAR, the underwater sound ranging detection equipment formerly known as ASDIC, was developed between the wars and was extensively employed in World War II, knowledge of the parameters affecting its performance was not extensive. However, it was discovered that important factors for these early sonars were those which related to heat exchange between the sea surface and the atmosphere—wind, cloud and airmass characteristics; in other words, it was meteorological considerations which were paramount. Therefore, it was the officers of the Naval Weather Service who naturally addressed the operational problems of oceanography as they related to sonar performance and ASW, although for the Navy as a whole the primary responsibility for oceanography remained with the Hydrographer. Thus in 1965, because of the changing pattern of demands and to make more effective use of resources, the Directorate was once again incorporated in the Hydrographic Department and, in 1966, DNWS became Director of Meteorology and Oceanographic Services (Naval), (DMOS(N)). In 1974, to reflect wider responsibilities in the oceanographic field, his title was changed to Director of Naval Oceanography and Meteorology (DNOM).

The Director is a Captain of the Instructor Specialization and under him is a cadre of officers trained in meteorology and oceanography. Of these about 80 are employed on meteorological and oceanographical duties at any one time with about half serving in HM Ships, which range from aircraft carriers to fishery protection vessels, and at the Fleet Weather Centre at Northwood which provides forecasts throughout the world for those warships and Royal Fleet auxiliaries not having their own meteorological organizations. The products of the Centre are transmitted by radio teletype and facsimile and will, no doubt, be familiar to a large number of readers. The remainder are in RN Air Stations in UK, abroad in NATO organizations or on exchange with Commonwealth and Foreign navies. In addition another 8 to 10 officers, specially trained for their particular meteorological and oceanographic requirements, serve in smaller warships and survey ships. In support of all these operations there is a rating structure of Wrens and Naval Airmen of the Meteorological Specialization of the Royal Navy.

As the importance of meteorology in maritime operations is well known and well understood by the readers of this magazine, the emphasis of this article will remain on the military oceanographic aspect of the DNOM task—an area perhaps not so familiar.

Military oceanographers have an interest in all aspects of general oceanography which have a bearing on maritime operations. However, it is the effect of oceanography on SONAR performance that is of particular Naval importance for nowadays SONAR is deployed by submarines, surface ships and helicopters and by Maritime Patrol aircraft of the Royal Air Force.

In a very much simplified analogy SONAR can be likened to underwater radar using sound rather than radio waves. Detection of a target can either be 'active' or 'passive'. Active detection involves the transmission of a sound pulse, the reflection of this pulse by the target and reception of the echo back at the transmitting ship (or submarine). A passive detection is obtained by receiving the sound made by a target, often at long ranges. Whereas a single passive detection will provide a target bearing only, an active detection will give both bearing and, by measuring the time interval between pulse and echo, range. However, the range at which a target can be detected actively will not be as great as that of a passive detection of a similar target. Moreover the target itself will, if it has the capability, make a passive detection of the active pulse at long range.

What then are the factors which affect SONAR performance and range? The following table sets out some of the important factors.

1. Power—the transmitter power (active only).
2. Frequency—the lower the frequency the better its sound is propagated. However, engineering considerations limit active sonars to use higher frequencies than passive sonars.
3. Attenuation—like radio waves, sound waves are attenuated as they propagate away from the source.
4. Scattering—scattering of the pulse by waterborne particles, animate or inanimate, by a rough sea surface and on reflection at the sea floor.
5. Noise—
   a. biological noise from whales, fish, shrimps etc.
   b. mechanical noise from ships' engines, ancillary equipment and propellers.
   c. sea noise from wind waves and/or rain at the surface.
6. Sea Temperature and Salinity—this will be discussed later.

The early sonar sets were active and, almost invariably, hull-mounted. As has already been mentioned, the performance of active hull-mounted sonar (HMS) depends on factors related to heat exchange between the sea surface and the atmosphere. To be more precise, it is the changes in the sound speed structure which result from meteorological effects that govern such sonar performance. The sound speed depends on temperature, salinity and depth. Of these factors, depth affects sound speed in a direct linear relationship, salinity varies little in the open ocean, and, therefore, it is temperature variations which are most important.

Figure 1 shows typical winter and summer sound speed/depth graphs for the north-east Atlantic with the associated changes in sound field coverage for a HMS as shown by the traces of sound rays from the transmitter. Figure 2 shows the changes in sound ray paths between morning and afternoon in summer if there were

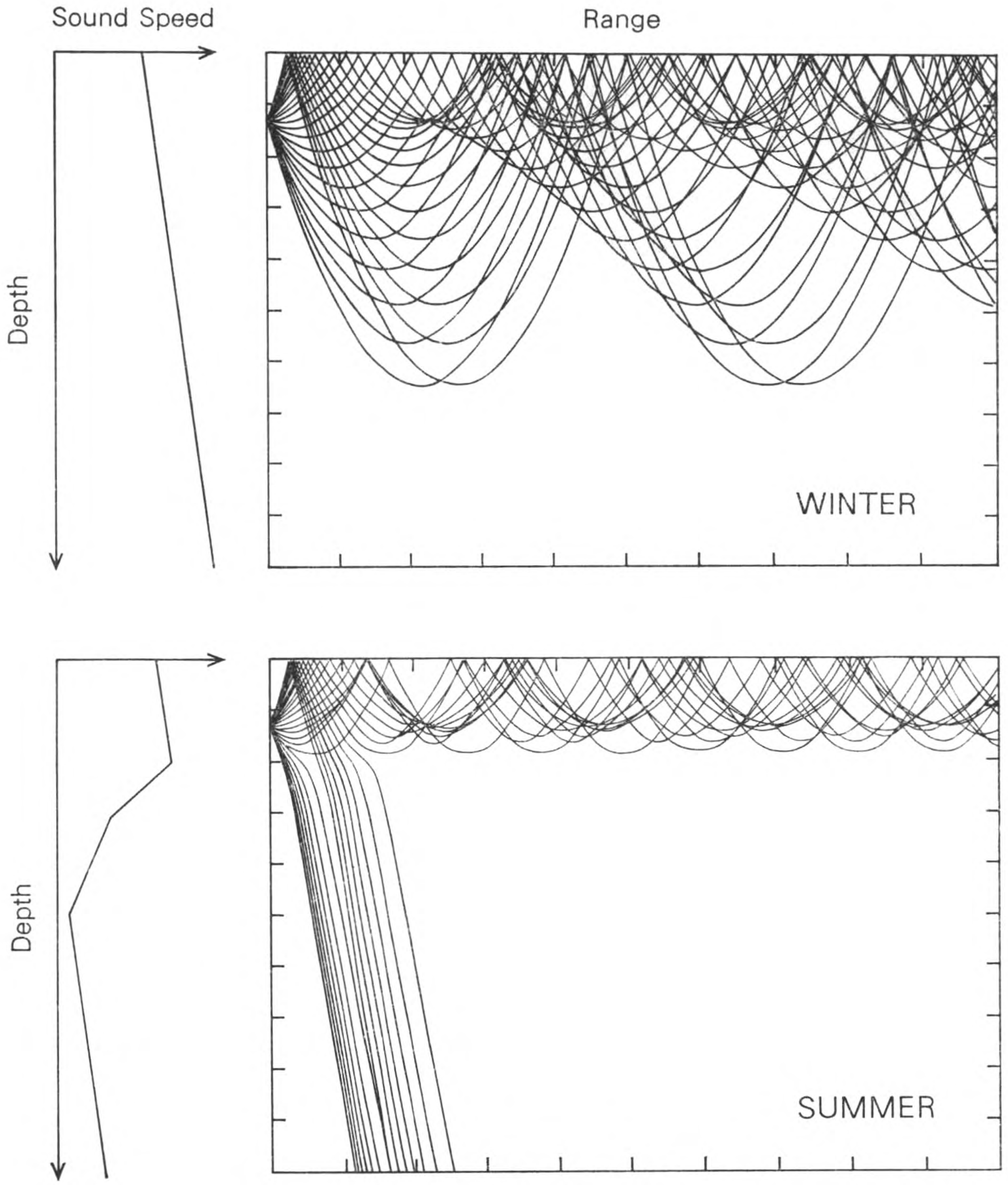


Figure 1. Typical winter and summer sound speed/depth graph for the north-east Atlantic

clear skies and light winds resulting in additional heating of the near-surface waters. As can be seen from the blank areas where no sound penetrates, the environment affords ample opportunity for a submarine to 'hide' from HMS.

However, developments in more recent years have moved the emphasis of oceanography, as applied to ASW, away from the near-surface structure to the whole ocean environment.

The concept of active variable depth sonar (VDS) allows the ASW expert to alter the depth of his sonar to take advantage of the environment, or, at least, to nullify the effect of near-surface factors which reduce the effectiveness of hull-mounted equipment. Figure 3 shows how adjusting the depth of the sonar transmitter alters the sound field coverage, thus allowing, within equipment limits, the operator to select the depth of optimum detection possibility. Also, improved

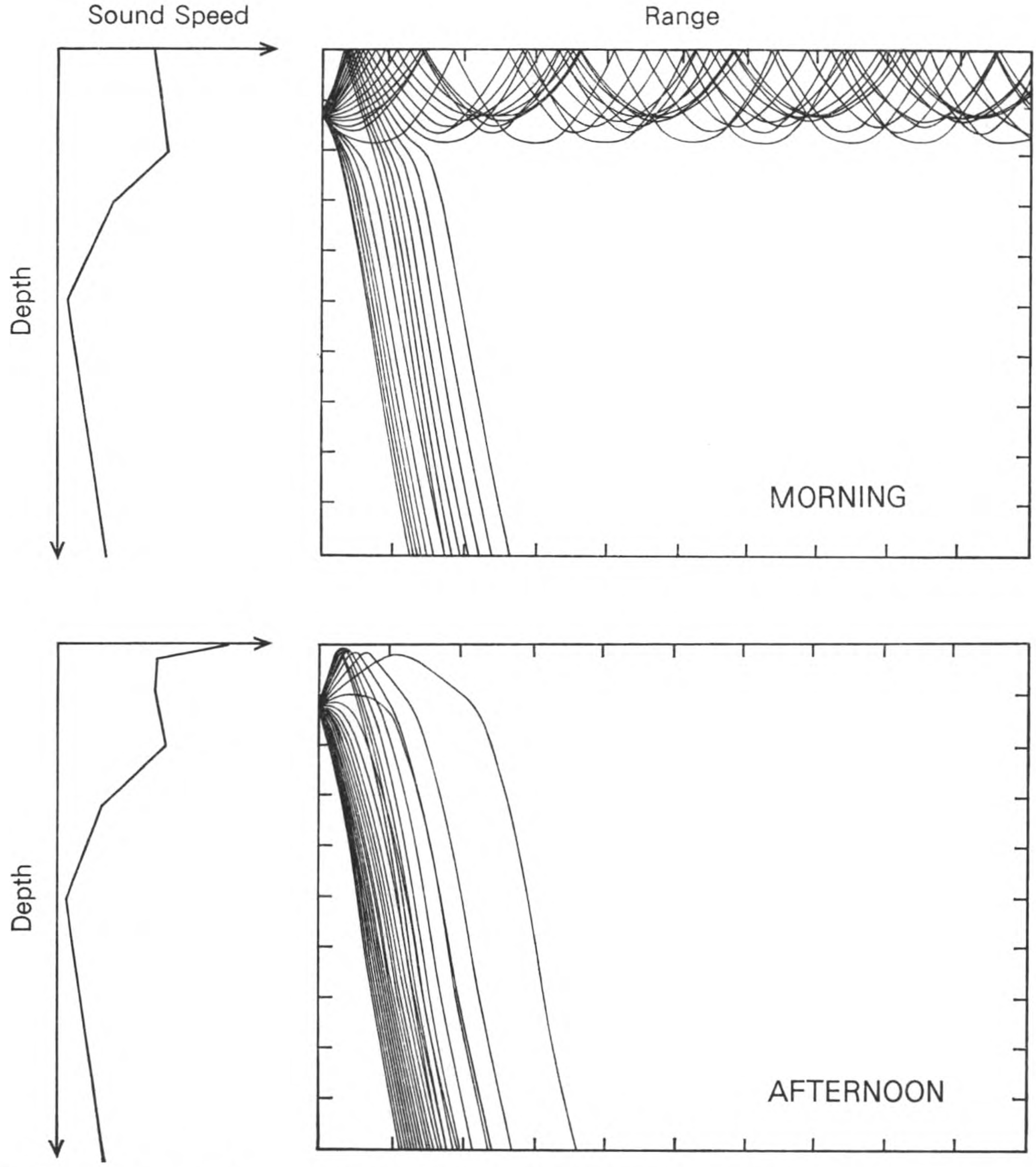


Figure 2. Changes in sound ray paths between morning and afternoon in summer with clear skies and light winds

technology has permitted the construction of more powerful transmitters which can bounce sound off the bottom.

The advent of passive sonar, which concentrates on lower frequency sound, extended the 'environmental understanding' required to the whole ocean. Figure 4 shows a target radiating noise in all directions and the sound paths which can be used to detect its presence. It can be seen that a knowledge of the surface conditions, the temperature and salinity structure of the whole water column and the nature of the sea bed are all required. In addition the performance of passive sonar will depend on the background noise generated by the effects listed under that heading in the table above. Indeed modern sonars, both active and passive, are heavily dependent on environmental conditions. A number of these conditions are slow to change and do not have a tactical importance, e.g. deep sound speed structure and

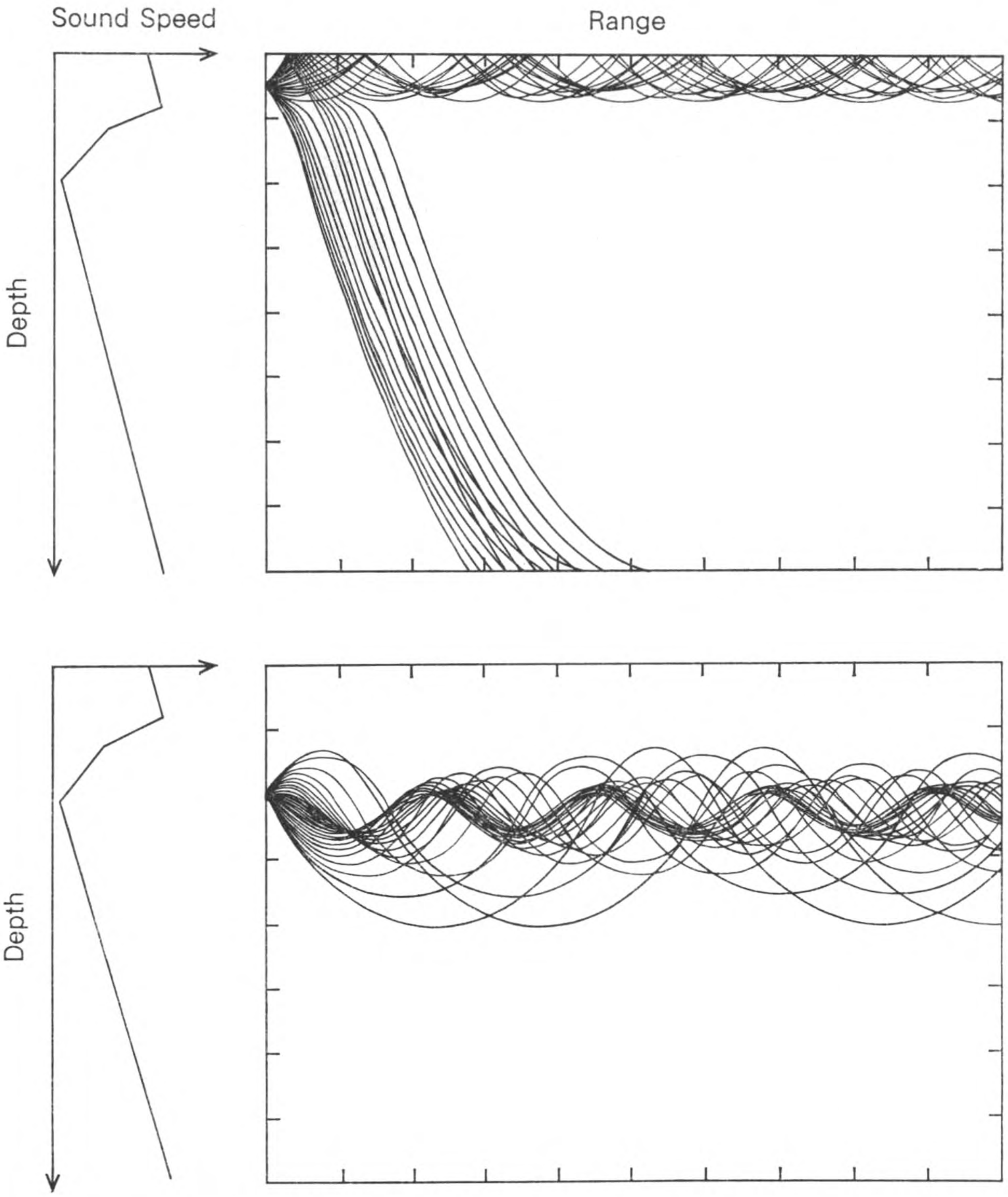


Figure 3. The change of sound field coverage with depth of the transmitter

sea floor characteristics. Others, such as sea state and near-surface temperature and salinity structure are of great tactical significance and are heavily dependent on atmospheric conditions. Weather and military oceanography are inexorably intertwined and are likely to remain so in the future.

(Before leaving this brief description of active, passive and variable depth sonar it is well worth mentioning that the most effective VDS, active and passive, is the submarine itself!)

The task of the Naval oceanographer is to give the Command advice on the optimum use and deployment of its sonar and ASW assets. To do this he has to forecast for a particular area the vertical temperature structure of the ocean and, from this, to derive a profile of sound speed with depth. He then calculates theoretical active

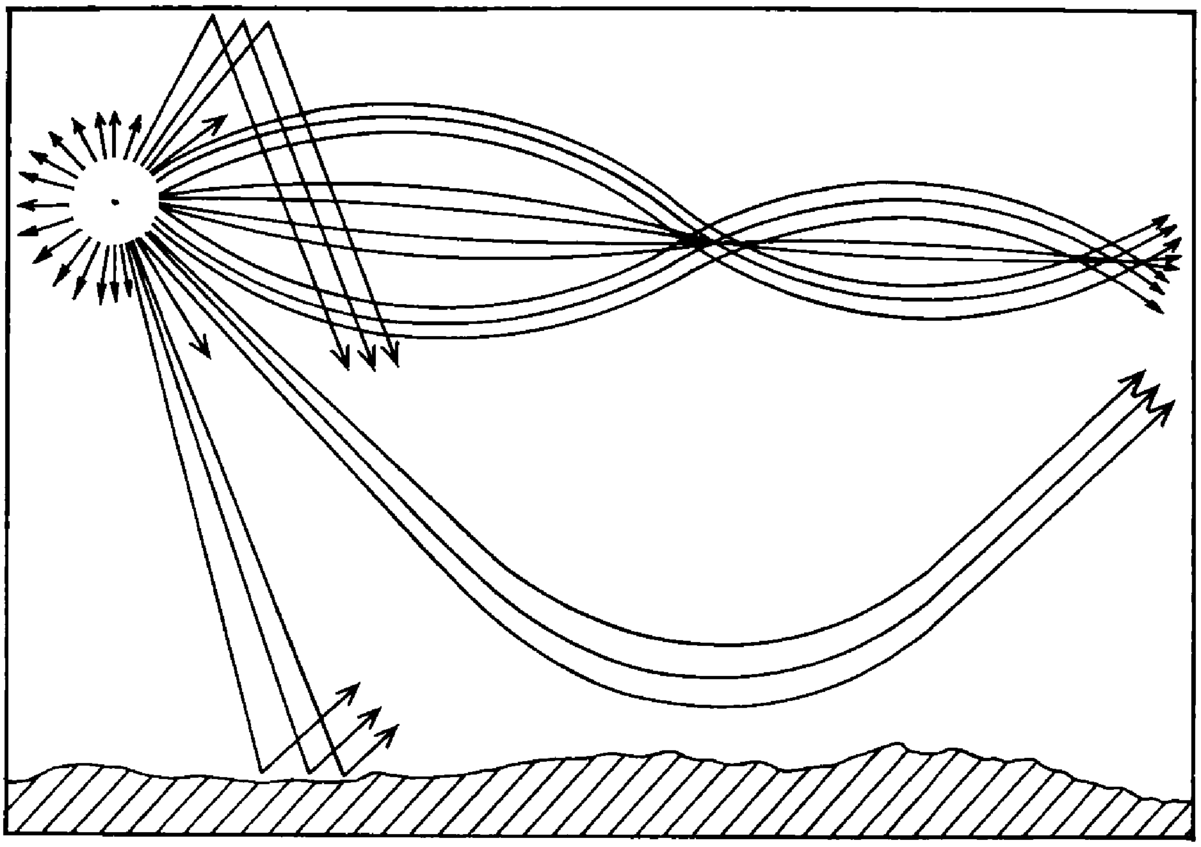


Figure 4. A target radiating noise and the sound paths which can be used to detect its presence

and passive ranges making allowances for such things as sea state, noise and scattering as well as possible changes in water mass over the path of the sound rays. All this involves his having a good set of data for the area in question and an appreciation of how the temperature/depth trace will be varied by the present and past weather conditions.

At sea the basis of the forecast will be temperature/depth observations obtained from an expendable bathythermograph (XBT) usually launched from his ship or another ship in company; at shore centres the forecaster will have the advantage of receiving all recent XBT reports signalled by the ships at sea. Both ashore and afloat much use is made of statistical data based on computer analyses of past measurements of the environment.

Coming closer to home, what reports made by the Voluntary Observing Fleet and readers of this journal are of interest to the Naval Oceanographer? Of particular importance are the sea-surface temperature readings, especially if they come from areas where data is sparse. The routine weather observation will always be used well, often providing the only quantitative information of surface conditions despite the data which now can be gathered from satellite observations. Reports of sightings of unusual rips, whorls, striations and changes of sea colour are of interest, as are the comments on unusual sightings of shoals of fish, mammals and bioluminescence. Sea-ice reports are valuable since the naval oceanographer is also responsible for providing the Fleet with information on the ice edge and berg movements.

The Naval Meteorological and Oceanographic Service, like any such service, relies on incoming data. The readers of *The Marine Observer* are well aware of the importance to meteorology of weather observations and reports. It is hoped that this article has shown how this same information can find a use far removed from the 'Weather Forecast for Shipping'.

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The Aurora

By R. J. Livesey

(This article is reproduced from the *Journal of the British Astronomical Association*, 89, (2) by kind permission of the Editor)

The Aurora, or 'Merry Dancers' of the Norsemen, must surely comprise one of the most beautiful and awe-inspiring of natural phenomena as the silent flickering and colourful shafts of light puncture the darkness of a northern or southern polar night. The cause of the auroral activity is a complicated interaction of solar activity, interplanetary plasma, the earth's magnetic field and atmosphere. The jigsaw is slowly being pieced together and the final conclusions have yet to be determined. Studies are based on information obtained from a wide variety of solar observatories[1], space vehicles, radio, radar and terrestrial geomagnetic observatories as well as from visual and photographic auroral observatories[2,3]; these all combine in their respective disciplines to fashion the pieces of the jigsaw. The following remarks by no means form a comprehensive picture of the aurora as it is understood today but are intended only as a general guide, which, like all good guide books, will have to be revised and rewritten as the years go by in order to take account of new information that comes to hand.

The coloured arcs, rays and other phenomena[4] that comprise the visible aurora are electrical gaseous discharges taking place in the rarified upper atmosphere at a height of about 90 kilometres and above. Interplanetary electrons and other charged atomic particles are guided down the lines of force in the earth's magnetic field to make impact with the atmospheric atoms. These are excited and emit light energy when returning to the ground state, thereby converting the kinetic energy of the impacting particle into the light of the visible aurora. When viewed with a spectroscope or photographed with a spectrograph, the light is found to exist as a number of discrete emission lines or bands, thus indicating the type and nature of the atmospheric atoms involved in the transmissions[5].

One of the strongest emission lines is green in colour and lies conveniently close to the peak colour sensitivity of the human eye. It is also usually detectable whenever auroral activity is present. Consequently the 'auroral line', as it is referred to, is the fingerprint of auroral activity. It can be searched for even in cloudy weather and in mist with the aid of an interference filter. In a hazy sky back-scattering light from a nearby town, auroral glow may be seen between clouds, which themselves will appear black and backlit in the filter.

In quiet conditions auroral activity is confined to 2 zones, one about each terrestrial pole. Each zone comprises an oval of about 5° of latitude in width, the mean radius of which is about 20° of latitude from the pole. As will be seen in Figure 1, the oval is offset relative to the geographic and magnetic poles but fixed relative to the earth–sun line. In disturbed conditions the ovals expand in radius carrying the auroral activity in each respective zone to lower latitudes. The frequency with which the ovals are disturbed is correlated with the sunspot cycle. Both northern and southern ovals are usually disturbed at similar times.

The location of the auroral arc in latitude and longitude above the surface of the earth is best obtained by photography of the auroral arc against the stellar background using 2 synchronized cameras placed about 30 km apart in an east to west direction[5]. A rough-and-ready estimate may be made by a solitary observer by measuring the angular height of the auroral arc above the true horizon and the angular distance in azimuth between the 2 points at which the base of the arc cuts the true horizon. A little geometry on the drawing board determines the solution with respect to the observer on the assumption that the auroral arc follows the curvature of the earth and its base lies at an altitude of approximately 100 km.

In addition to the visual detection of auroral activity, its presence, if obscured by cloud or by daylight, may be determined by the detection of the reflection of radio signals from the enhanced 'E' layer activity in the ionosphere[6] at the base of the aurora.

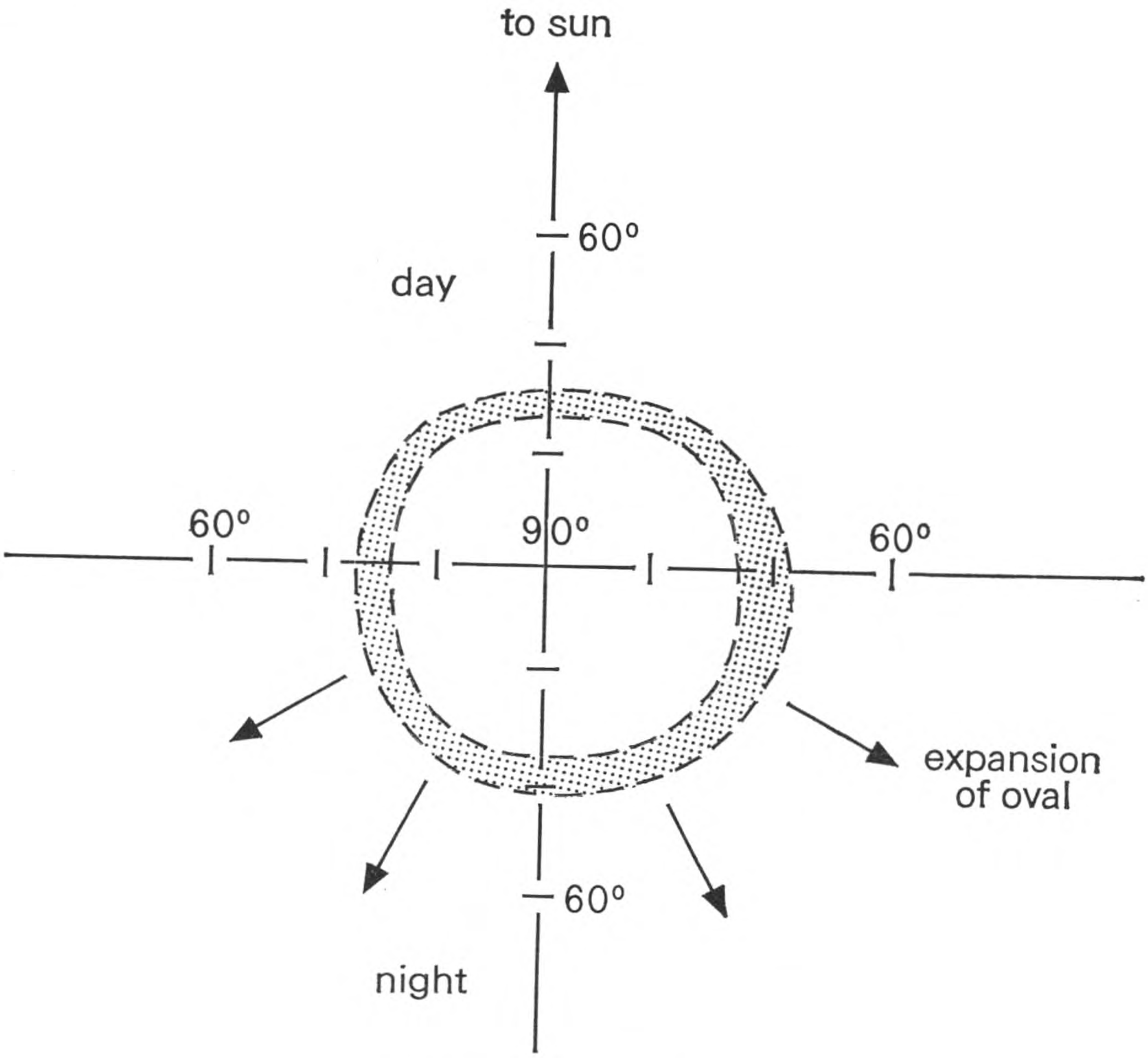

Figure 1. The auroral oval

Consideration may now be given to the quiet aurora. The earth possesses a dipole magnetic field[7], which, it it were in isolation, would lie symmetrically about the planet[8]. However, the sun emits a steady stream of electrically charged particles together with an associated magnetic field embedded in the stream. This phenomenon is referred to as the 'solar wind'[9]. This plasma blows on to the earth's magnetic field, compressing it on the sunward side and stretching it out in a long tail on the leeward side of the earth. The boundary between the solar wind and the earth's magnetic field forms a shock front behind which lies a layer called the 'magneto-sheath'. Above the poles the magnetosheath possesses downward extensions which reach into the atmosphere. The arrangement is shown in Figure 2. Within the magnetosheath lies the plasmasphere of toroidal structure containing the van Allen belts[10]. From the lee side of the 2 poles a sheet of plasma stretches out from the atmosphere, round the side of the van Allen belts and down the long tail away from the earth. These connections between the magnetosheath and the plasmasheath to the polar regions are the pathways along which ionized particles may be channelled down into the atmosphere, as indicated in Figure 3.

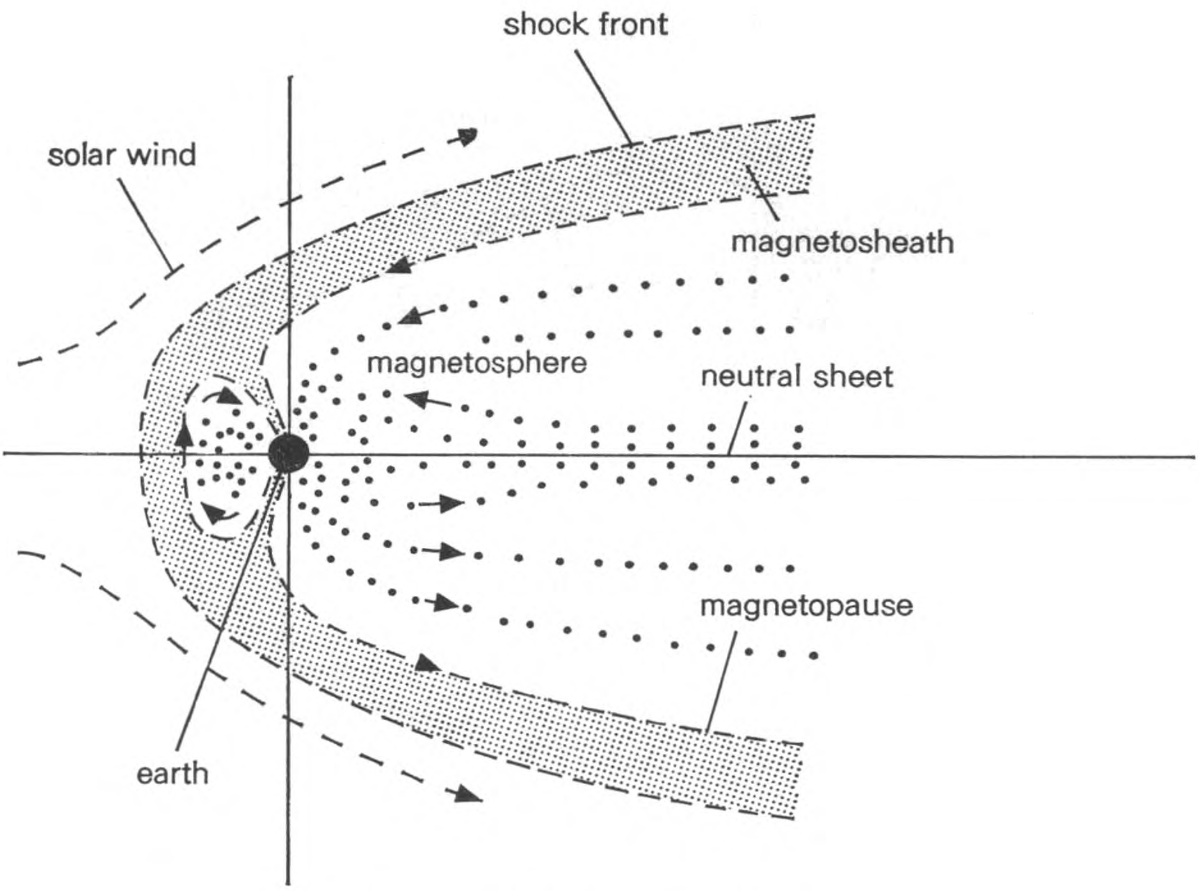

Figure 2. The magnetosphere

The van Allen belts surrounding the earth comprise trapped clouds of charged particles which travel spirally along the curved magnetic field lines connecting the north and south magnetic polar areas. As particles approach the poles these are magnetically reflected to travel in the opposite direction rather like a celestial tennis match. Interaction with the field causes protons to form the inner region of the belts and to precess eastwards with time. Conversely the electrons form the outer region and precess westwards. The resulting effect is a net westward drift and this electrical current tends to reduce the earth's magnetic field. Variations in the density of the van Allen belts cause ripples in the earth's magnetic field out in the magnetosphere and in places this may lead to a reduction or even local elimination of the field. Due to this effect particles can find their way down into the atmosphere to form multiple auroral arcs. In earlier days it was thought that the auroral activity was generated by particles leaking from the horns of the van Allen belts but, as will have been noted in Figure 3, the particles come from the magnetosheath or plasmasheath along defined channels[11].

The solar wind [12] in the quiescent state consists of a stream of protons and electrons travelling at a speed of between 200 and 800 kilometres per second at a density of 3 to 10 particles per millilitre. The magnetic field strength is about 5×10^{-9} Tesla (5×10^{-5} gauss) at a temperature of about 10^5K. The kinetic energy content exceeds the magnetic energy. In the mass, the wind is electrically neutral but the magnetosphere presents an impenetrable barrier to the individual particles, unless conditions modify the field to enable particles to find a route inwards towards the earth.

The sun may disturb the quiet magnetospheric pattern by ejecting clouds of high velocity plasma due to the collapse of a magnetic field above a sunspot in association with the development of a solar flare. Alternatively, the sun may eject a stream of particles continuously from a 'hole' in the corona, once referred to as

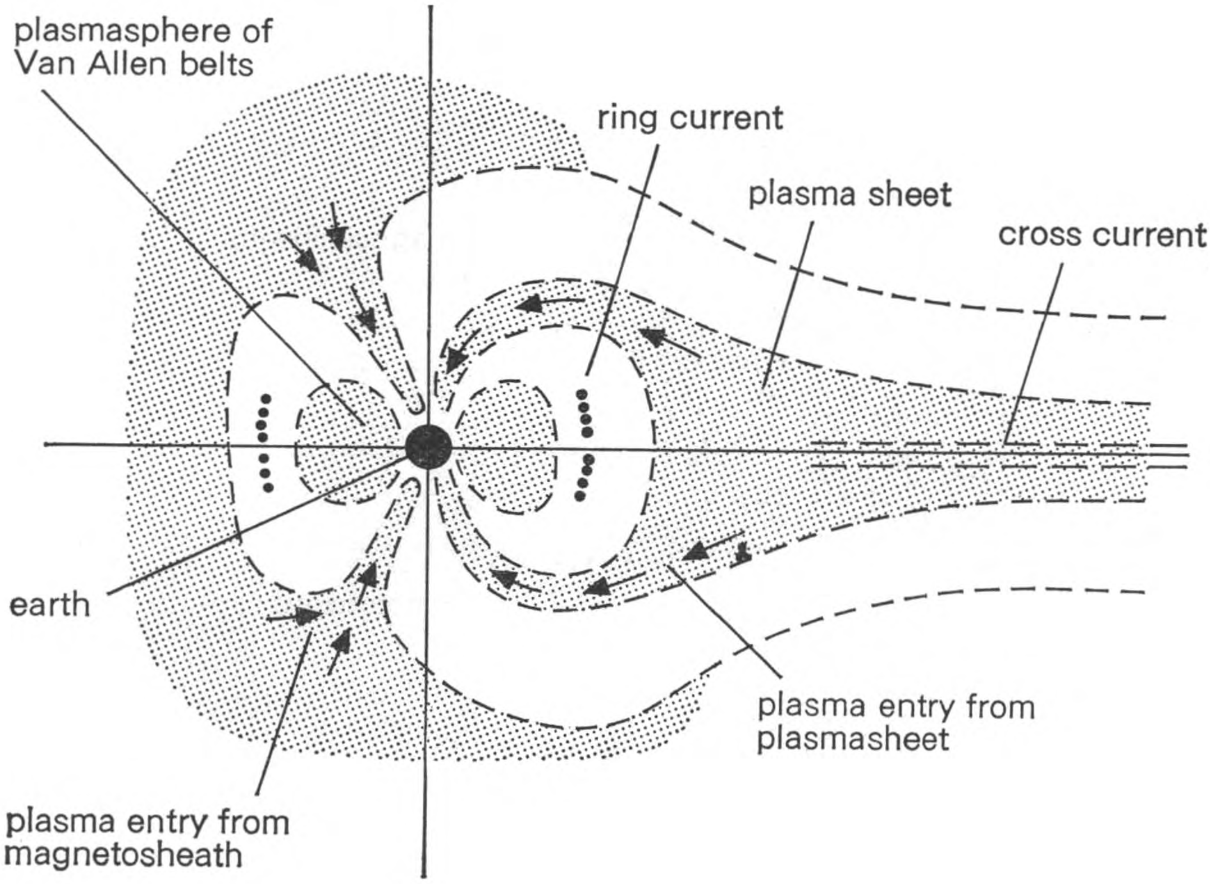

Figure 3. The plasma field

'M' regions. On encountering the earth the kinetic energy of these particles is converted to magnetic energy in the tail of the magnetosphere as the plasma clouds are directed around the outside of the magnetosphere from the solar to the lee side. When the particles arrive at the magnetosphere it is further compressed on the solar side. This is marked by an increase in the horizontal component of the earth's magnetic field observed at ground level. This compression increases the strength of the westerly ring-current flowing around the earth and leads to a reduction in the strength of the horizontal component. In due course, a minimum is reached and in the course of a day or so the field returns to normal.

If the north-south component of the interplanetary magnetic field remains northerly in direction the auroral ovals are not disturbed; if the component swings southerly the auroral ovals expand[13]. The magnetosphere, the atmosphere and the interplanetary plasma act as the components of a dynamo with the plasmas acting as the conductors of electricity. Unlike a man-made machine, the various electric and magnetic circuits can be changed by means of changes in the strength and magnetic field direction of the solar wind. The electrical currents set up by these changes in turn set up additional magnetic fields to modify the steady state pattern. The direction of the interplanetary magnetic field in the solar wind affects the efficiency of the dynamo which is increased when the field direction turns south. The excess energy generated when the field is southward is dissipated by conversion into a ring-current in the plasma surrounding the earth and in auroral activity. The effect on the earth's magnetic field is shown in Figure 4.

It is thought that particles travel inwards from the magnetotail via the plasma sheet to be precipitated in the region bounded by the auroral oval; daylight auroral particles come in from the magnetosheath[14]. In times of dynamo efficiency, particles entering the auroral oval cause the aurora to form and spread to lower latitudes. During the course of the general magnetic disturbance, minor periodic disturbances

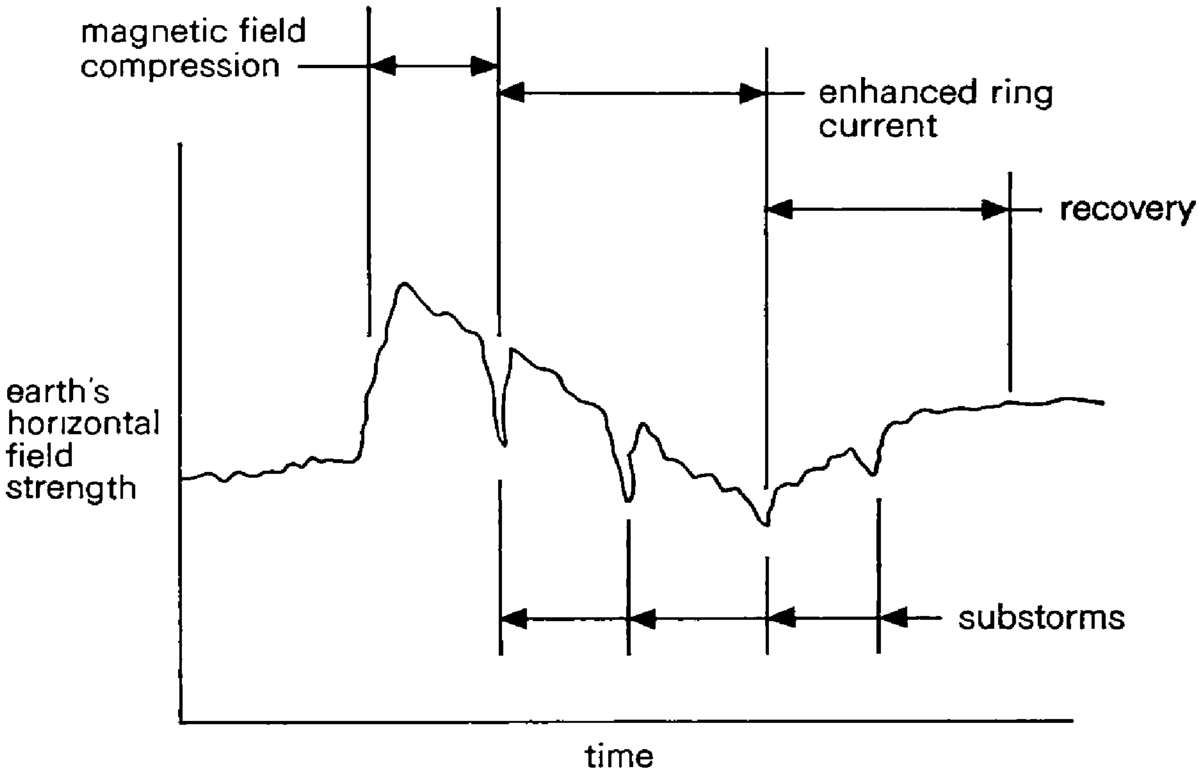

Figure 4. Record of a magnetic storm

of progressively lesser extent, known as magnetic substorms, take place. It is during these substorms that the auroral oval expands and auroral activity is observed in the lower latitudes.

The probability of flare-generated aurorae occurring increases with the rise in sunspot activity and falls with a reduction of such activity. Individual auroral storms may be allocated to individual flares and the resulting activity may be intense. Such storms only recur after one rotation of the sun in so far as the same sunspot group may produce a flare when the group is in the same relative position to the earth at the time of the second flare.

Coronal hole or 'M' region storms tend to recur at around 27-day intervals for several months on end, may appear for up to several consecutive nights on each recurrence and are quieter in activity. The probability of occurrence of 'M' region auroral storms does not follow the sunspot cycle precisely and peaks appear during the declining years of the sunspot curve.

The story of the aurora is by no means complete and questions remain to be answered. Some consider the magnetosphere to be a closed magnetic field while others postulate an open field with connections between the lines of force of the earth's magnetic field at the poles with those of the interplanetary field. Perhaps the position may be summarized by likening the auroral problem to short circuits in a car dynamo which, from time to time, is being contaminated by damp. The water leads to new electrical circuits and their associated magnetic fields which break down the existing insulation to cause sparks. In the terrestrial dynamo solar disturbances cause changes in the magnetic fields and electric currents such that short-circuit paths are formed with the result that charged particles are precipitated into the atmosphere to form gaseous discharge phenomena.

It is hoped that the foregoing picture of the aurora will be of interest to existing and future auroral observers and encourage them to maintain a good lookout during the years of the current solar cycle. At the present moment observational data received are being analyzed for comparison with magnetic disturbances and radio effects in the ionosphere. The locations of the auroral arc are being plotted so far as possible and storm visibilities being plotted against geomagnetic latitude. Thanks are due to David Gavine at Fort Augustus and John Branegan at Saline for their contribution to the analytical work.

The writer would like to express his appreciation and thanks for the encouragement and assistance obtained from Bennet McInnes, Ken Medway, Ron Ham and Charles Newton in setting up the co-ordination of auroral observing for the Solar Section of the Association. In particular he would like to thank Dr M. Gadsden of Aberdeen for material assistance and constructive criticism during the writing of this paper. The faults and errors, if any, are the writer's alone.

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SPECIAL LONG-SERVICE AWARDS

According to our usual practice, as is customary in the January edition of this journal, we announce the names of the 4 masters who, through length of service and superior quality of their meteorological records, have reached the required status for nomination of these awards.

The qualification required to reach the Special Award zone is a minimum of 15 years of voluntary observing; the number of years together with the number and quality of the meteorological observations received during these years determines the names of the officers to come within the Award zone.

The Special Long-Service Award scheme was brought into being in 1948 and since then the Director-General of the Meteorological Office has presented an inscribed barograph to each of the 4 masters to have been selected. The period considered for the following awards is taken up to the end of 1978 and from our records the Director-General is pleased to select the following shipmasters:

1. Captain F. C. Taylor, Commodore of P. & O. Strath Services, whose first meteorological logbook was received here in 1950 from m.v. *Gloucester* (Federal Steam Navigation Company Limited). Since then Captain Taylor has provided the Meteorological Office with 36 meteorological logbooks during his 22 years of voluntary observing.
2. Captain L. C. Taylor, Manchester Liners Limited sent us his first meteorological logbook in 1949 from s.s. *Manchester Progress*, since then Captain Taylor has provided 48 logbooks during his 27 years of voluntary observing.
3. Captain M. J. Winter, Associated Maritime Company Limited sent in his first

meteorological logbook in 1958 from s.s. *Gloucester City*, (Bristol City Line). Subsequently a total of 46 logbooks has been received from Captain Winter during his 20 years of voluntary observing.

4. Captain L. E. Howell, Container Fleets Limited, sent in his first meteorological logbook in 1955 from s.s. *Papanui* (New Zealand Shipping Company), since then, over his 19 years of voluntary observing, Captain Howell has provided a total of 33 logbooks.

The masters have been notified of their awards and the arrangements made for their presentation. We congratulate the 4 shipmasters on their exemplary achievements over these lengthy periods; their work has been of great value to the Meteorological Office.

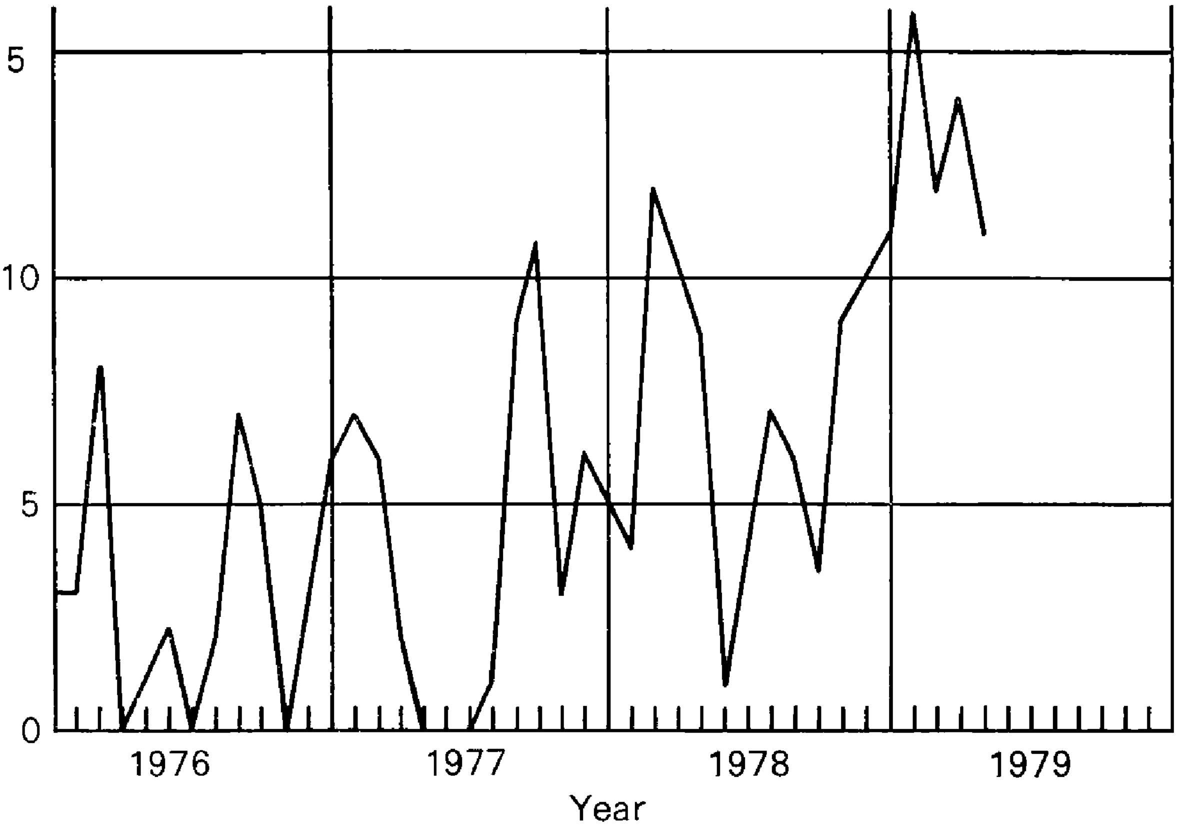
J. D. B.

AURORA NOTES JANUARY TO MARCH 1979

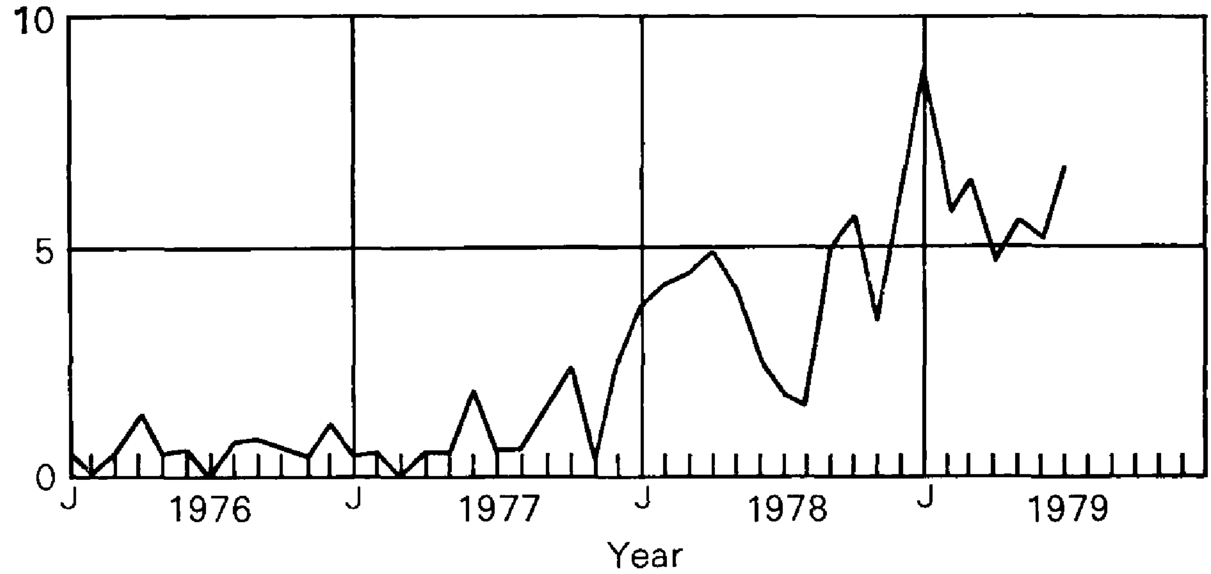
By R. J. Livesey
(Co-ordinator of Auroral Observing, the Solar Section of the British Astronomical Association)

Aurora observations for the period are shown in the accompanying table. The number of observations has increased by 14 over the same period in 1978, this is very gratifying as land observers in north-west Europe were considerably hampered by the severity of the winter weather. Taking into account all observations reported by land and sea from British Columbia to Finland, it would appear that auroral activity was maintained and increased with the sun's activity.

Visual and radio auroral activity was observed on the nights of the 1st to the 8th of January—that on the night of the 7th being widely observed. Some vague activity was observed between the 15th and 17th, this was followed by reports of radio



Number of nights per month in which observers confirmed auroral visual activity



Monthly averages of number of active sunspot areas measured by 60-mm refractor telescope

aurora between the 20th and the 23rd. Widely observed visual aurora on the 23rd persisted until the 27th.

There was some radio aurora at the beginning of February. Visual aurora was reported in high latitudes between the 2nd and the 6th and the 16th and the 19th. Widely observed visual aurora accompanied by radio aurora was reported between the 21st and the 28th.

Few reports of activity were received during the period 2nd to 10th of March. More widespread contact was reported on the 22nd, this was followed by a variety of reports associated with radio aurora between the 27th and the 31st.

As may be expected, as the *Miranda* sailed along the auroral zone in geomagnetic latitudes of 67 and 68, the probability of observing auroral activity was high and so it proved to be. The *Serenia* made useful observations in the region of the Shetland Islands during the January activity when the auroral oval expanded to more-southerly magnetic latitudes.

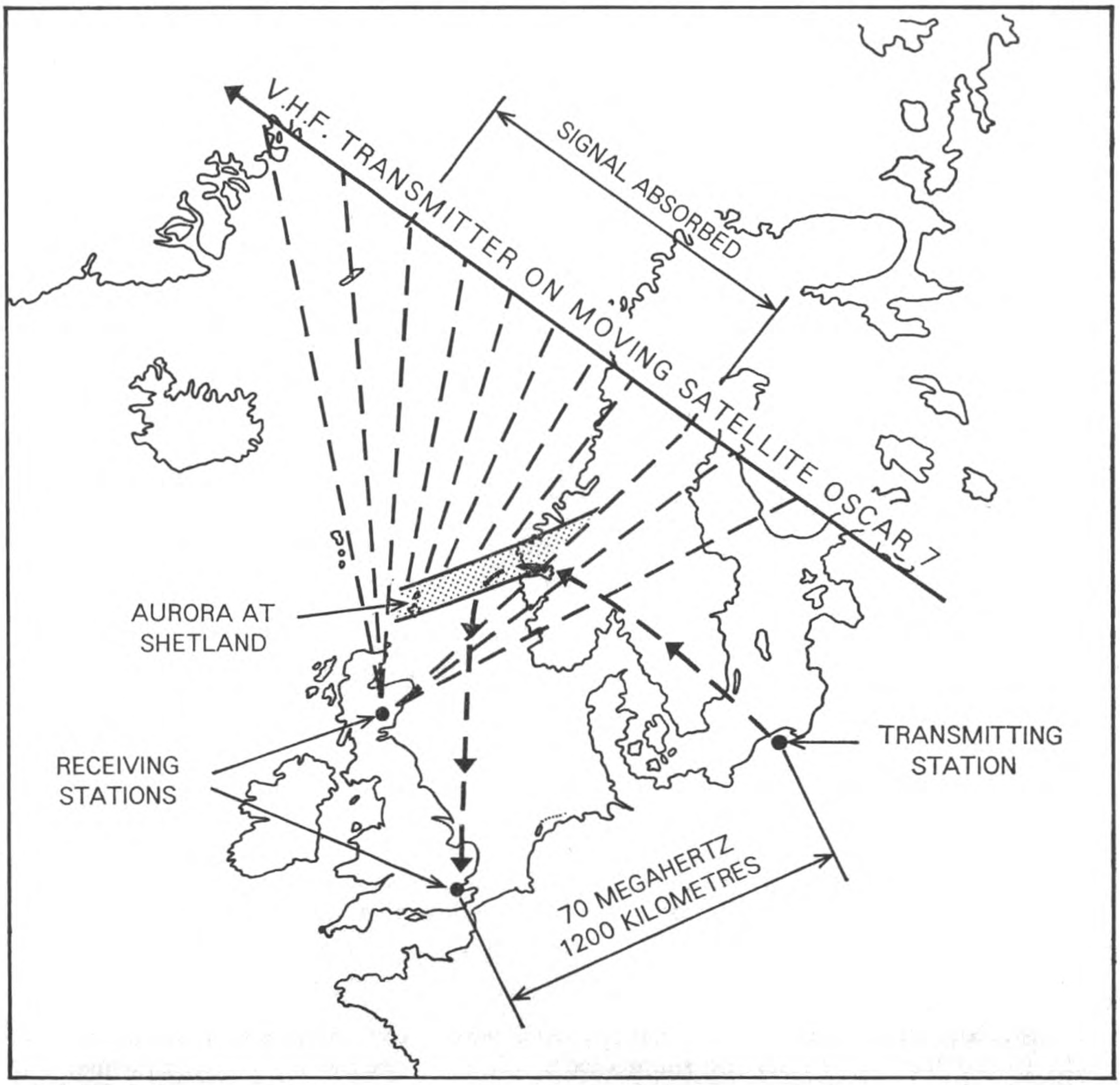
The radio aurora referred to in this report consists of the effect of certain radio waves caused by the strengthening of the electrified ionosphere due to the incoming particles from outer space released by the sun's activity. Radio aurora can exist without the presence of visual aurora and vice versa. Looking over the reports for 1977 and 1978 there were 205 visual and 194 radio event nights of which only 93 showed both visual and radio activity. Whereas the most probable local time to observe visual activity at its peak is at about 2200 hours, the peak for radio aurora is about 1900 with a secondary peak at 1500. Thus it is possible for radio observations to be used to alert visual observers to expect possible activity later in the evening.

As aurora ionisation develops it forms a radio reflector at a height of 100 kilometres or so above the earth's surface. If the aurora is intense the ionisation descends to 80 kilometres and forms an absorbing layer for radio waves. VHF transmissions which have a normal range of 80 kilometres can be extended to 1600 kilometres by bouncing signals off the aurora so that 2 stations at approximately the same latitude can contact each other. The method is frequently used by amateurs but, at the same time, the presence of aurora can be detected by hearing radio stations not normally available. The high-pitched morse tones, when reflected, are distorted to a low-pitched rasping tone. VHF transmissions from OSCAR (Amateur Radio) satellites behind the aurora may have their signals distorted or absorbed altogether. With suitable directional aerials it is possible for observers to work out the bearings of ionic clouds and compare these with visual observations.

High-frequency communications may be wiped out by ionospheric absorption. Weak and wavery signals found in the 3·5 and 7 mHz bands are indicative of auroral conditions. Because of the variable porosity and reflective power of the changing ionic clouds the radio signals may take a variety of path lengths which are mutually interfering; distortion rises with increase in frequency of the signal and may suddenly vary. Observers of visual aurora are well aware of the transient pattern of the visual forms in an active display.

Aurora activity nowadays is seen to be but one beautiful facet of a most complicated interaction between the out-pourings of electrified particles from the sun, the earth's magnetic field, ultra-violet radiation, the earth's atmosphere and the resulting ionosphere, involving scientists, both professional and amateur, in many disciplines.

The contribution of our active marine observers to the store of information on the aurora is most greatefully acknowledged. The writer looks forward to reading futher log entries from ships, plotting their locations and comparing the storm data with that from other sources right across the globe. Happy sailing!



Typical example of VHF radio effects showing signal absorption and signal refraction permitting transmitter to be heard at greater-than-normal range

Date 1979	Ship	Geographic Position		Time (GMT)	Forms
2 Jan.	*Admiral Beaufort*	57° 06′N	19° 48′W	2040–2050	QN
3	*Admiral Beaufort*	56° 48′N	20° 00′W	2340–0245	QHB
4	*Serenia*	60° 10′N	00° 50′W	1830–0600	RA, N, RA, N
7	*Serenia*	60° 10′N	00° 50′W	1830–2120	N, HA, P, RP, RA(2), C, PR, P R, RA, HB, N
7	*Esso Warwickshire*	59° 05′N	04° 03′W	1900–1915	RA
8	*Admiral Beaufort*	57° 06′N	20° 24′W	2345–2353	QN
8	*Serenia*	60° 06′N	00° 50′W	0430–0500	N
24	*Serenia*	60° 35′N	00° 25′W	0205–0500	N, P, mR, aN, R, RA(2), HA, RN, aP, R, N
25	*Serenia*	60° 06′N	00° 50′W	2030–2130	N, R, mR, N, P
27	*Swedish Wasa*	66° 15′N	9° 33′E	0530–0555	mR
2 Feb.	*Miranda*	70° 24′N	20° 39′W	1730–1800	HA
5	*Miranda*	70° 55′N	17° 42′E	0230	RA
6	*Miranda*	70° 31′N	17° 07′E	2100–2125	RA, RB, HA, RA
17	*Miranda*	67° 32′N	12° 54′E	0300–0330	aHA, amR
18	*Miranda*	68° 30′N	11° 55′E	1750–1805	HA, aR, R
21	*Admiral Beaufort*	57° 06′N	20° 18′W	0120–0140	QRB
25	*Miranda*	68° 37′N	12° 10′E	0015	RB
26	*Miranda*	68° 30′N	11° 44′E	2115	aRA
27	*Miranda*	69° 36′N	14° 25′E	2350–0110	R, RB, HB, amRB, amP, S, HB
2 Mar.	*King William*	68° 57′N	16° 43′E	2245–2255	A, pP
6	*King William*	70° 14′N	30° 55′E	1715–1750	mRB(3), pmRB(2)
11	*King William*	54° 49′N	06° 42′E	2240–2255	CR, P
27	*Admiral Beaufort*	56° 48′N	19° 48′W	2345–0250	QRB
29	*Admiral Beaufort*	56° 54′N	20° 12′W	0500	PRA

KEY: a = active, A = arc, B = band, C = corona, H = homogeneous, m = multiple, N = unidentified form, p = pulsating ,P = patch on surface, Q = quiet, R = ray, S = spirally curved ray, 2 = two of a kind, 3 = three of a kind.

Marine Aurora Observations January to March 1979

ICE CONDITIONS IN AREAS ADJACENT TO THE NORTH ATLANTIC OCEAN FROM JULY TO SEPTEMBER 1979

The charts on pages 43 to 45 display the actual and normal ice edges (4/10 cover), sea-surface and air temperatures and surface-pressure anomalies (departures from the mean) so that the abnormality of any month may be readily observed. (The wind anomaly bears the same relationship to lines of equal pressure anomaly as wind does to isobars. Buys Ballot's law can therefore be applied to determine the direction of the wind anomaly). Southern and eastern iceberg limits will be displayed during the iceberg season (roughly February to July). In any month when sightings have been abnormally frequent (or infrequent) this will be discussed briefly in the text.

The periods used for the normals are as follows. Ice: 1966–75 (Meteorological Office). Surface pressure: 1951–70 (Meteorological Office). Air temperature: 1951–60 (US Department of Commerce, 1965). Sea-surface temperature: area north of 68°N, 1854–1914 and 1920–50 (Meteorological Office, 1966), area south of 68°N, 1854–1958 (US Navy, 1967).

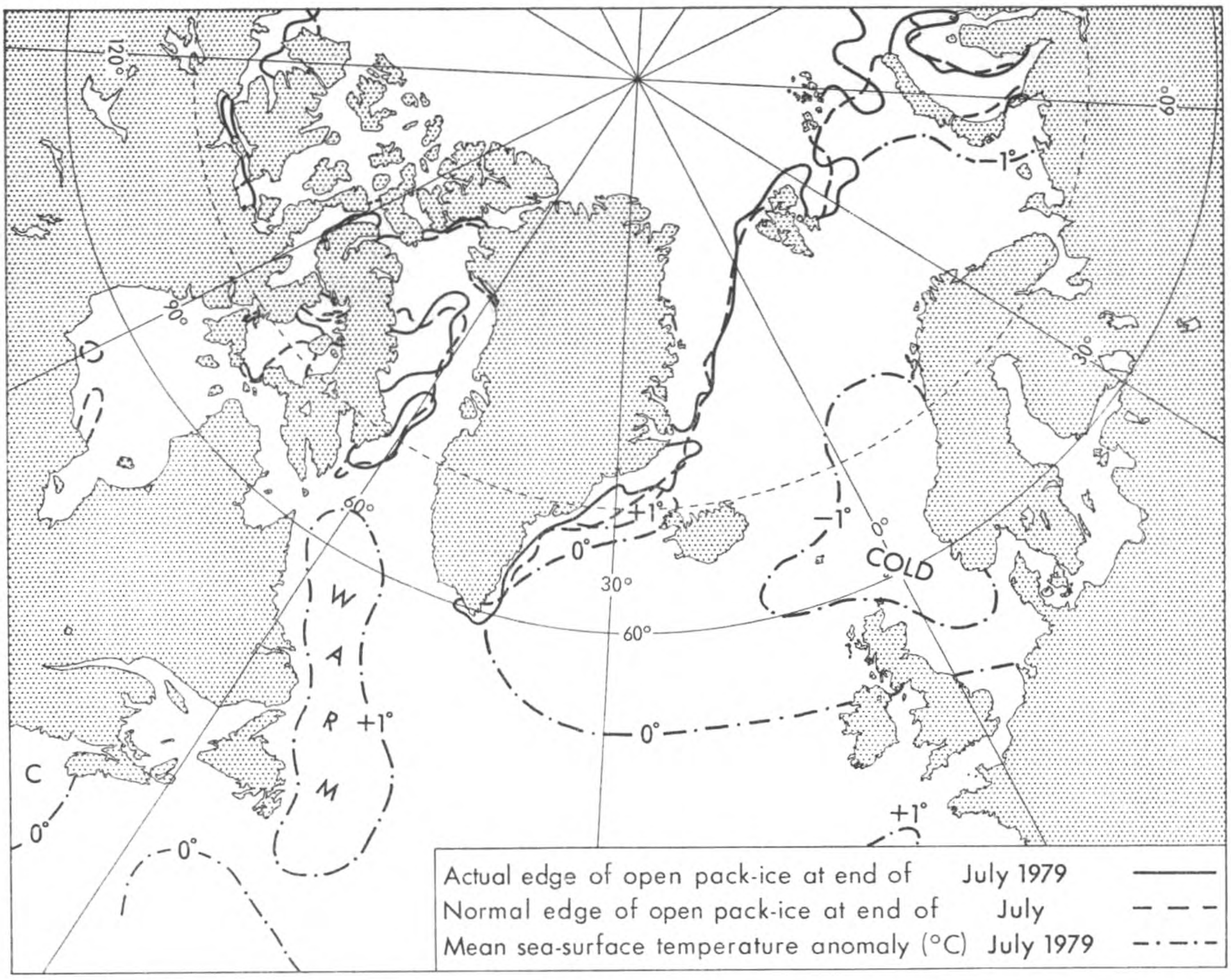
July

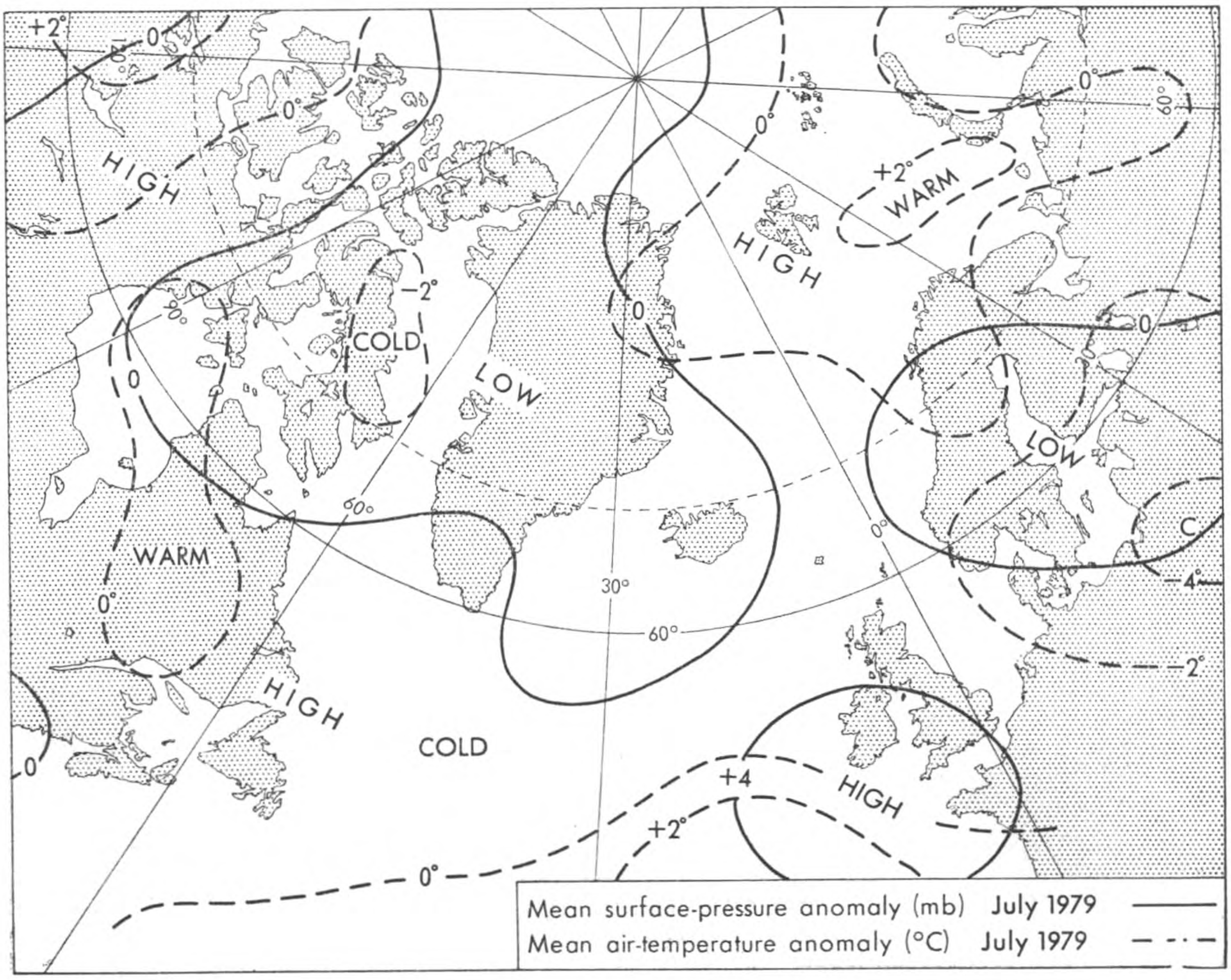
Over the Barents Sea temperatures were higher than normal and the ice edge receded northwards to a greater extent than usual during July so that in many sectors by the end of the month deficits replaced the excesses that had been a persistent feature of previous months. Elsewhere anomalies were rather weak and in most regions there was a rough balance between areas of excess and deficit.

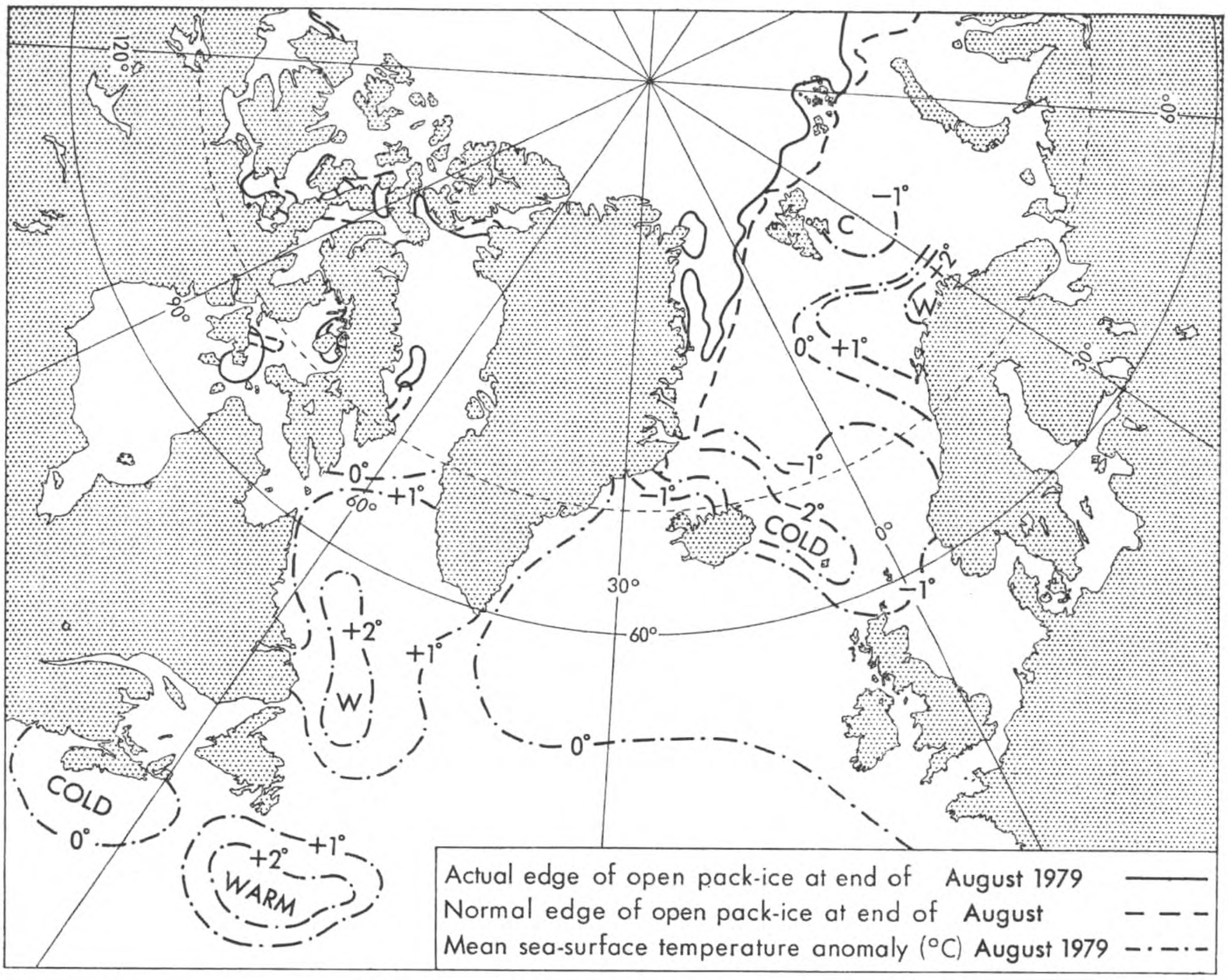
August

It was colder than normal over much of the Canadian Arctic with anomalies for northerly winds. In the northern straits and sounds ice conditions were more severe than usual.

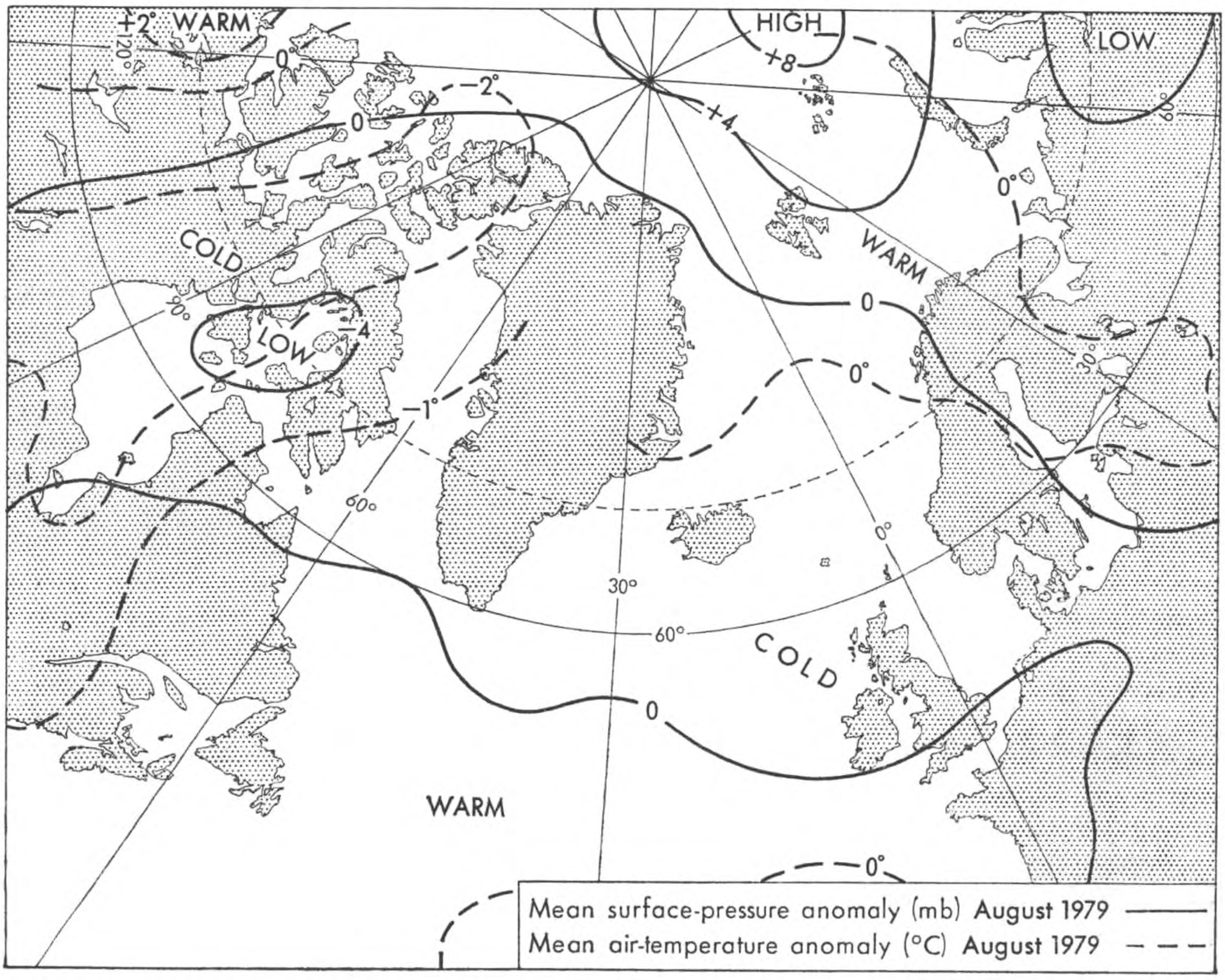
An anomaly for winds from east or south-east affected the Kara, Barents and Greenland Seas where the ice edge generally retreated north of its normal position to give substantial deficits by the end of August.


120°
90°
60°
30°
60°
30°
60°
-1°
+1°
0°
-1°
0°
COLD
W
A
R
M
+1°
C
0°
0°
0°
+1°
Actual edge of open pack-ice at end of July 1979
Normal edge of open pack-ice at end of July
Mean sea-surface temperature anomaly (°C) July 1979

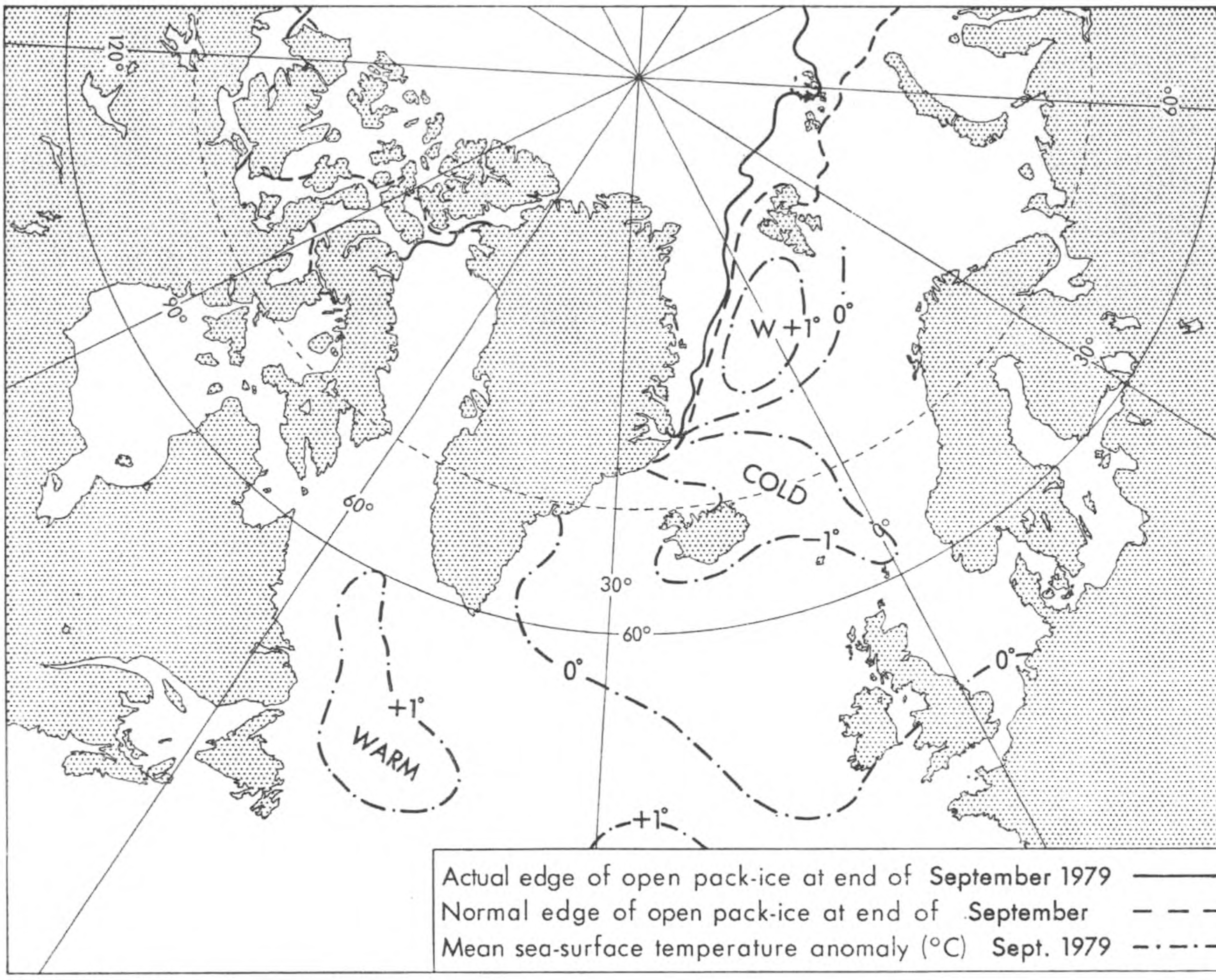

+2°
0
0°
HIGH
0°
+2°
WARM
HIGH
-2°
COLD
LOW
0
0
LOW
60°
0°
WARM
0°
30°
60°
C
-4°
-2°
HIGH
COLD
+4
HIGH
+2°
0°
Mean surface-pressure anomaly (mb) July 1979
Mean air-temperature anomaly (°C) July 1979



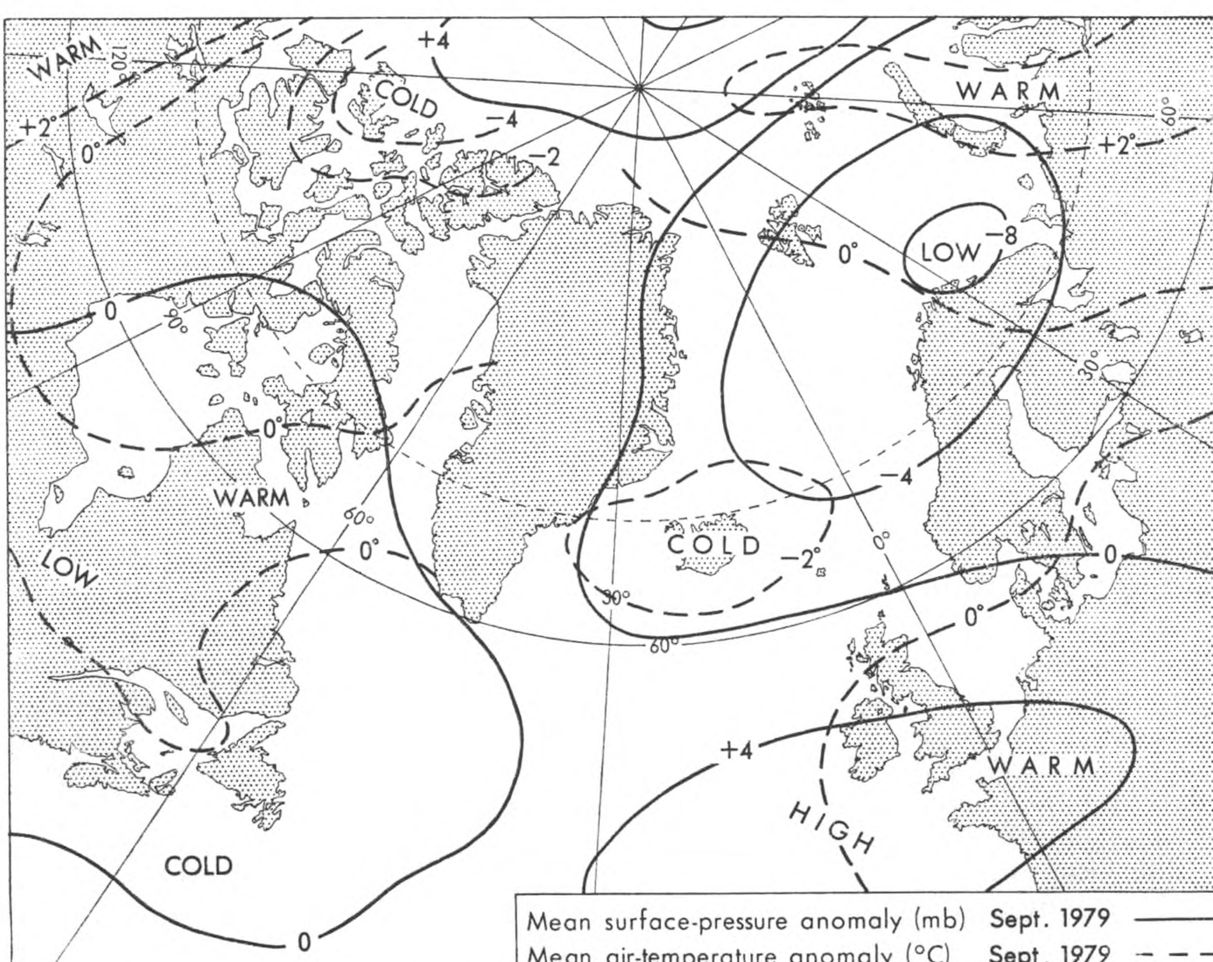
Actual edge of open pack-ice at end of August 1979
Normal edge of open pack-ice at end of August
Mean sea-surface temperature anomaly (°C) August 1979
COLD
WARM
W
C
+2°
+1°
0°
-1°
-2°
30°
60°
90°
120°



Mean surface-pressure anomaly (mb) August 1979
Mean air-temperature anomaly (°C) August 1979
HIGH
LOW
WARM
COLD
+8
+4
0
-4
+2°
0°
-1°
-2°
30°
60°
90°
120°



120°
90°
60°
30°
60°
30°
60°
W +1° 0°
COLD
-1°
0°
0°
0°
+1°
WARM
+1°
Actual edge of open pack-ice at end of September 1979
Normal edge of open pack-ice at end of September
Mean sea-surface temperature anomaly (°C) Sept. 1979



WARM
+2°
0°
+4
COLD
-4
-2
WARM
+2°
0°
LOW
-8
0
0°
WARM
LOW
0°
COLD
-2°
-4
0°
0
0°
+4
WARM
HIGH
COLD
0
Mean surface-pressure anomaly (mb) Sept. 1979
Mean air-temperature anomaly (°C) Sept. 1979

SEPTEMBER

The cold weather in the Canadian Arctic continued with re-freezing earlier than normal to give substantial excesses of ice in the area by the end of the month. In the Kara and Barents Seas the anomalies for south-easterly winds continued and, in fact, strengthened. With higher-than-normal temperatures the ice edge in these seas receded further north leaving very large deficits—in marked contrast to the excesses of ice earlier in the year.

Off the east coast of Greenland, though, temperatures were near normal and also the ice edge resumed a position close to the normal for the time of year, leaving little of the deficits of the previous month.

REFERENCES

Meteorological Office, London	1966	Monthly meteorological charts and sea surface current charts of the Greenland and Barents Seas.
	—	Sea ice normals (unpublished) and various publications.
US Department of Commerce Weather Bureau, Washington, DC	1965	World weather records, 1951–60. North America.
US Naval Oceanographic Office, Washington, DC	1967	Oceanographic atlas of the North Atlantic Ocean, Section II: Physical properties.

Book Review

Our Seamen—An Appeal by Samuel Plimsoll, MP, (First published in 1873 by Virtue and Company) 285 mm × 220 mm, pp. 216, *illustrated.* A facsimile edition published by Kenneth Mason, Homewell, Havant, Hampshire PO9 1EF. 1979. Price: £5·95.

All seafarers and most other people are familiar with the name Samuel Plimsoll and the marks—now commonly called Load Lines—inscribed on the hulls of ships to indicate the maximum depth to which they may be loaded.

Samuel Plimsoll was born in Bristol in 1824 and started life as a clerk. Later he set up in business as a coal merchant but this failed and he became destitute. For some time he lived in a common lodging house in London where he developed a deep sympathy for the poor. After he entered Parliament as Liberal member for Derby he became deeply interested in the suffering of seamen who often had to serve in overloaded ships belonging to unscrupulous owners. He soon realized the evil of such unseaworthy vessels and began a relentless campaign to prevent overloading and, despite severe opposition led by Benjamin Disraeli, procured the passing of the Merchant Shipping Act of 1876 which forced shipowners to have their vessels marked with a safe Load Line.

In the course of his campaign Plimsoll collated all the evidence he could find into a book and had it published. This is a facsimile edition of that book which, when launched in 1873, caused a public sensation that reverberated round the world. In it Plimsoll revealed scandal after scandal on the activities of unscrupulous shipowners and shady insurance companies which, he maintained, led to continuous disaster at sea with heavy loss of life. He quoted examples of undermanning, overloading, bad stowage, over insurance and produced written evidence, charts and photographs which were damning evidence. The book ended with the humanitarian call 'Help the poor sailors, for the love of God' which re-echoed around the shipping world with dramatic effect.

This facsimile edition of one of the most important maritime books ever published would occupy pride of place on any mariner's bookshelf.

C. R. D.

A BRIEF HISTORICAL NOTE ON BUYS BALLOT'S LAW

The name of Buys Ballot is to be found in almost every textbook of meteorology and his law of the relation of wind direction and pressure distribution is taught in the many schools which nowadays include elementary meteorology in their curriculum. It may, therefore, be of some interest to trace briefly the formulation of this law. Professor Buys Ballot, Director of the Dutch Meteorological Institute and Professor of Physics at Utrecht was amongst the pioneers in the use of synoptic meteorology for the issue of forecasts and storm warnings. In dealing with observations of pressure and temperature he made use of deviations from average values and in a paper presented to the Paris Academy of Sciences in 1857 he discussed the results obtained from observations at 3 stations in Holland. After showing that strong winds are indicated by large differences between the deviations, he proceeded to explain that if pressure was higher at Den Helder than at Maastricht (that is to say, higher in the north than in the south) then the wind was from the east while if pressure was higher at Maastricht the wind was from west or north-west. In the *Jaarboek* of the Meteorological Institute of the Netherlands for the same year (published in 1858), this conclusion is stated in more general terms. Translated into English it reads 'great barometric differences, within the limits of our country, are followed by stronger winds and the wind is in general perpendicular, or nearly so, to the direction of the greatest barometric slope in such a way that a decrease of pressure from north to south is followed by an east wind, and a decrease from south to north by a west wind'. In 1860 he published a paper entitled 'Eenige regelen voor aanstaande weersveranderingen in Nederland' (Some rules for approaching changes in the weather in the Netherlands), in which the law appears in its well-known form. 'Thus the rule for wind direction is this: if one places oneself in the direction of the wind with one's back to the place from which it is coming, then one has the lowest place, i.e. pressure on the left-hand just as in the case of hurricanes'. (These storms had long been known to have a whirling motion and the distinction between the anti-clockwise rotation in the northern hemisphere and the clockwise rotation in the southern hemisphere had been expounded in 1828.)

The above test, authorship unknown, is to be found in a pamphlet held in the National Meteorological Library and dated 1930.

Personalities

RETIREMENT.—CAPTAIN D. S. MILLARD retired recently, owing to ill health, after serving 43 years at sea.

Denis Stanley Millard was educated at St Joseph's College, Blackpool and, in October 1935, signed indentures as Apprentice with Manchester Liners Limited.

On obtaining his 2nd Mate's Certificate he remained with Manchester Liners, but after passing his 1st Mate's examination he was unable to obtain re-employment with them owing to the number of ships lost through enemy action. He was, therefore, appointed 2nd Officer of the *Ocean Rider* operated by the Sea Transport Officer and was present at the invasion of Italy, the relief of Malta and the invasion of North Africa east of Algiers.

On his second voyage to Algiers the ship was subjected to a severe aerial attack and was torpedoed in No. 1 Hold. The attacking aircraft came in very low from right ahead and was blown to pieces by the ship's guns immediately after launching the torpedo. Even though the *Ocean Rider's* No. 1 hold was full of cased aviation spirit and the blast from the exploding torpedo blew the hatch covers and deck cargo over the side, the cargo did not ignite and the ship managed to struggle into Algiers.

Shortly after Captain Millard was able to rejoin Manchester Liners and remained with them for the rest of his career. He obtained his Master's Certificate in 1945 and afterwards commanded many of their ships on the North Atlantic trade.

Captain Millard sent us his first meteorological logbook from the *Manchester City* in 1946. Since then we have received no less than 58 logbooks bearing his name of which 20 were classed as Excellent. He was awarded a barograph in 1974 and Excellent Awards in 1978 and 1979.

We wish him a speedy recovery in health and a long happy retirement on his small-holding in Eire.

Fleet Lists

Correction sto the list published in the July 1979 edition of *The Marine Observer*.

Information regarding these corrections is required by 30 September each year. Information for the July lists is required by 31 March each year.

GREAT BRITAIN (Information dated 20.9.79)

The following coasting vessels ('Marid' ships) have been recruited:

NAME OF VESSEL	MASTER	OWNER/MANAGER
Mairi Everard ..	M. Parker	F. T. Everard & Sons Ltd.
Modan..		Frome Shipping Co. Ltd.

The following vessels have been deleted:
Arco Scheldt, Castle Point, Duke of Lancaster, Sussexbrook.

GREAT BRITAIN (*Contd.*)

The following ships have been recruited as Selected or Supplementary Ships:

Name of Vessel	Date of Recruitment	Master	Observing Officers	Senior Radio Officer	Owner/Manager
Abbey	21.7.79	R. B. Leach	T. M. Graham, D. Gow, D. Bowman	D. Fenton	Houlder Bros. & Co. Ltd.
Asian Forest	14.9.79	R. A. French	P. J. Mooney, Wong Wan Kwok, Shun Yun Shing	Cheong Hon Hung	J. & J. Denholm Ltd.
Ataman	6.4.79	A. J. Palmer	D. Harding, I. H. Bothroyd, G. K. Thomson	R. Stevens	Ocean Transport & Trading Ltd.
Atlantic II	30.5.79	M. Allen	R. Sharp, A. Kemp, D. Blackburn	C. Berry	Atlantic Drilling Co. Ltd.
Baltic Enterprise	17.9.79	P. Moore	P. Green, M. Dunne, D. Warmington	D. Kennedy	United Baltic Corp. Ltd.
Baltic Valiant	18.6.79	M. de Lacey	P. E. Potter, J. H. Telfer, M. J. Kearney	A. Walker	United Baltic Corp. Ltd.
Bamenda Palm	5.9.79	G. Holeyman	A. Storre, D. Woods, G. Broom	L. Holt	Palm Line Ltd.
Benedict	14.6.79	J. C. Harris	P. F. Callaghan, C. Grayson, M. Locke	P. Davies	Blue Star Line Ltd.
Benjamin Bowring	23.8.79		C. F. Balaporia, D Peck, P. Polley		Bowring S.S. Co. Ltd.
Boniface	26.7.79	D. J. Eckworth	A. Tibbott, M. J. Walker, N. J. Barr	N. MacLean	Blue Star Line Ltd.
Border Pele	4.7.79	J. A. MacHardy	A. J. Lange, J. McIntyre, I Sloan, R. Banks	M. Wood	B.P. Tanker Co. Ltd.
Boswell	10.7.79	L. Hughes	R. Cornfield, D. Jones, P. Hobson	W. Donaldson	Blue Star Line Ltd.
Briarthorn	27.3.79	J. McEwan	B. Seaman, A. Devine		Coe Metcalf Shipping Ltd.
British Dart	9.5.79	R. J. Higgins	D. Exely, R. M. Kempson, –. Shannon	S. Taylor	B.P. Tanker Co. Ltd.
British Pride	*	W. F. Scott-Dickins	J. E. Worthington, T. M. Drennan, M. Percival, J. Crooks, J. Bright	P. Stewart	B.P. Tanker Co. Ltd.
British Ranger	11.9.79	J. L. W. Dwight	A. Wilkinson, –. Ardeny	–. Hartley	B.P. Tanker Co. Ltd.
British Test	6.4.79	P. D. Harrison	N. Henderson, M. Aldred, M. Mansbridge	D. Walker	B.P. Tanker Co. Ltd.
Bronte	13.2.79	M. J. MacNeil	D. Darlington, P. S. Cotgrove, D. J. Jones	R. Collins	Blue Star Line Ltd.
Browning	24.4.79	G. Round	L. Crawford, R. Tucker, N. Ainson		Blue Star Line Ltd.
Cast Dolphin	6.4.79	F. Best	G. Miller, J. Clarry, I. G. Jones	M. F. O'Grady	Denholm Maclay Co. Ltd.
Cast Orca					Denholm Maclay Co. Ltd.
Cast Seal	4.4.79	F. Surtees	–. Rosie, J. Needham, N. Leslie	–. Munnelly	Denholm Maclay Co. Ltd.
Celtic Endeavour	11.9.79	R. S. Stephens	H. Prigg, F. Duffin		C. M. Willie & Co. (Shipowners) Ltd.
Cicero	18.5.79	R. Reed	N. Taylor, K. Chapman, J. Coggin		Ellerman Wilson Line Ltd.
Dacebank	13.6.79	T. D. Faithful	W. Mather, L. Parker, M. Thompson	N. Marwood	Bank Line Ltd.
Derwent	8.8.79	C. J. Welch	R. Brooke, J. Exroy	D. Hobson	Houlder Bros. & Co. Ltd.
Devonbrook	26.3.79	G. Bowman	D. McElroy, I. J McKissack, C. Sutherland	G. Hull	Comben Longstaff & Co. Ltd.
Earl Godwin	31.5.79	G. Evans	P. A. Lloyd, M. L. Shakesby, S. Turner, N. Clerk		British Rail
Finnrose	11.9.79	J. W. Tricket	M. D. McMurtrie, D. McIver, M. C. E. Lambert	S. A. White	Denholm Maclay Co. Ltd.
Grey Hunter	23.4.79	G. D. Mutch	A. W. Marshall, A. Lynch, G. A. Noble		Ben Line Steamers Ltd.
Grey Warrior	30.3.79	I. F. Mackay	A. J. Smith, R. L. Sutherland, P. J. Trickey	W. J. Campbell	Ben Line Steamers Ltd.
Gulf Hawk	5.6.79				Gulf (Shipowners) Ltd.
Invincible	8.5.79	A. Atkinson			British United Trawlers Ltd.
Lycaon	3.8.79	H. K. Timbrell	M. J. MacDonald, K. M. Seery, A. B. Johnson	D. H. Storar	Ocean Transport & Trading Ltd.
Morant	29.3.79	B. Hodges	P. Charter, D. J. Browne, C. J. Barker	H. O. Gaskell	Fyffes Group Ltd.
Pacific Swan	22.2.79	J. T. Langstaff	D. Farmer, M. Mason, J. Dumazel	A. Catt	James Fisher & Sons Ltd.
Pikebank	5.3.79	–. McGregor	B. Stirling, D. J. Harrod, A. Jeffrey		Bank Line Ltd

GREAT BRITAIN (*Contd.*)

The following ships have been recruited as Selected or Supplementary Ships:

Name of Vessel	Date of Recruitment	Master	Observing Officers	Senior Radio Officer	Owner/Manager
Protesilaus	21.8.79	A. Simpson	J. Byard, P. V. Moore, S. A. Rajadyrai	J. Bridge	Ocean Transport & Trading Ltd.
Royal Prince	17.9.79	E. Buckle	M. Swann, S. Crawford		Furness Withy (General Shipping) Ltd.
Ruddbank	31.5.79	C. B. Davies	J. K. Ward, K. Gray, R. Penhalygon	J. Quine	Bank Line Ltd.
Sokoto	20.9.79	S. A. MacInnes	E. Lloyd, M. Bagley, B. Sommerhill	J. Nolan	Ocean Transport & Trading Ltd.
Spey Bridge	13.7.79	D. Allen	P. Collings, D. Gale, M. Robinson	T. White	Silver Line Ltd.
Strathettrick	26.4.79	R. Hodgson	J. Hannath, C. Heard	G. C. England	P. & O. S.N. Co.
Troutbank	5.9.79	G. Tully	E. F. S. Harrison, R. Ward, J. Nippers	N. Smirk	Bank Line Ltd.
Tuscan Star	18.5.79	J. L. Needham	J. S. Gayton, J. M. Jarratt	G. Shaw	Blue Star Line Ltd.
Vickers Vanguard	31.7.79	P. Ekbeck	D. Grant, B. Fraser	J. Rhind	Furness Salvesen (Agencies) Ltd.
Vickers Viking	31.7.79	A. A. Buschini	I. Macanna	P. Curtis	Furness Salvesen (Agencies) Ltd.
Vickers Voyager	25.5.79	M. Allieson	C. Nicolson, M. Henderson, –. Watson		Furness Salvesen (Agencies) Ltd.
Wild Marlin	*	F. G. Bevis	S. P. Webber, A. D. Bell, S. N. Monks	R. Harris	P. & O. S.N. Co.
Yorkshire	7.5.79	W. A. D. Davies	W. J. M. Hargreaves, A. G. Thelwell, D. Jenkinson, F. A. Bayliss	M. O. B. Bunce	Bibby Line Ltd.

*These ships were inadvertently omitted from the Fleet List published in July 1979.

The following Selected and Supplementary Ships have been deleted:
Amoria, Asiafreighter, Asialiner, Atholl Forest, Beechbank, City of Gloucester, City of Guildford, City of Lancaster, City of St Albans, Clan Macilwraith, Clan Macindoe, Clan Maciver, Coriolanus, Custodian, Dalesman, Dunkwa, Eurofreighter, Euroliner, Gela, Gowanbank, Hazelbank, Hector, Inishowen Head, Irisbank, Kurdistan, London Bombardier, London Cavalier, London Fusilier, London Grenadier, Manchester Challenge, Medic, Megantic, Merchant, Nairnbank, Nordic Breeze, Ocean Transport, Plainsman, Port Caroline, Port Chalmers, Port New Plymouth, Port Nicholson, St. Jerome, Scholar, Sig Ragne, Strathaird, Strathardle, Strathbrora, Strathconon, Sugar Refiner, Swedish Wasa, Tactician, Tekoa, Tor Belgia, Ulster Star, Vancouver City.

BRITISH COMMONWEALTH

HONG KONG (Information dated 13.9.79)

The following ships have been recruited since the list published in the July 1979 edition of *The Marine Observer*
Barber Perseus, Ibn Malik.

The following ships have been deleted:
Lycaon, Tai Ping, Tamano, Tema.

Printed in Scotland by Her Majesty's Stationery Office at HMSO Press, Edinburgh
Dd 586889 K17 1/80 (16889)

ISBN 0 11 722069 8
ISSN 0025-3251