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CONTENTS

	<i>Page</i>
Editorial	166
The Marine Observers' Log — October, November, December	169
On the origins and growth of tropical meteorology: from ancient times to the early nineteenth century. By J.M. WALKER	187
Recent progress in weather routeing for merchant vessels. By J.S. HOPKINS	195
Aurora Notes October to December 1989. By R.J. LIVESEY	198
Personalities	201
Book Reviews	
<i>Comecon Merchant Ships</i>	203
<i>Soviet Merchant Ships</i>	203
<i>The Human Impact of climate uncertainty</i>	203
<i>Climate and Man</i>	205
Notices to Marine Observers	206
Index	210

COVER PHOTOGRAPH: Bogong Moths on board at Sydney, N.S.W. on 5 October 1989, taken by Mr A.D. MacPherson, 2nd Officer on m.v. *ACT 8*. (See page 180).

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

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Editorial

'Man is by nature a meteorologist, ' but no man likes to labor in vain; and when men are invited to enter this field as recording observers, to whom, or to what office shall each one be directed to send his observations, that they may be prepared and discussed for use; so that none shall have labored in vain?

From *Sailing Directions*
By Lieut. M.F. Maury, USN

In this edition we have attempted to cover a long time span, from the origins of tropical meteorology to the latest developments in ship routing and a review of a book which looks at the impact of climate uncertainty on man's activities. One common factor emerging from this format is the obvious conclusion that the work of voluntary observers is no more in vain in the 1990s than it was in the 1850s when Matthew Fontaine Maury was eminent as mariner and meteorologist. Weather information collected for centuries is the staple sustenance for researchers and practising meteorologists, as evidenced by the outlook for forecasting and climate research.

Much concerted action is in progress around the world with research into global climate change and other burning issues in climatology, vying for attention and resources. At a June 1990 conference in London, it was announced that the Montreal Protocol of two years previously had now been signed by more than 70 countries, who agree to phase out chemicals that damage the ozone layer by the year 2000. Industrialised countries would fund the transfer of technology to the Third World, itself brought into a binding agreement to develop chemicals to replace the CFCs that damage the ozone layer. All this will be good news for the proposed autumn session of the Intergovernmental Panel on Climate Change, sponsored jointly by UNEP and WMO, which will complete the largest and most ambitious assessment of the issue of climate change ever undertaken. Further to these moves, the United Nations is setting up an early warning system to detect the accumulation of atmospheric pollution and plot its effects on oceans and climate. A comprehensive network of marine observation stations, named the Global Atmosphere Watch, is being established around the world. This scientific exercise, sponsored by WMO, is of enormous practical significance to business and industry, particularly shipping, offshore energy and insurance. The GAW network will act as an early warning system to detect additional concentrations in greenhouse gases, changes in the ozone layer and in the long-term transit of pollutants, including acidity and toxicity of rain, dirt and dust particles.

Another body currently being set up under the auspices of the Natural Environment Research Council is the Centre for Deep Sea Oceanology at Southampton, England. Here the new unit will undertake work similar to the U.S. Woods Hole Oceanographic Institution at Cape Cod. The new Centre will consolidate the operations of the renowned laboratory at Wormley, Surrey and the research vessel fleet presently based at Barry, South Wales; most of Southampton University's oceanology and geology departments will also occupy the Centre. Although still in its formative stages, the Centre is planned to open in 1994 on land adjoining the Ocean Village Marina and will be the largest oceanology unit in Europe. Selected observing Research Vessels *Discovery*, *Challenger*, *Charles Darwin* and the newbuilding *James Clark Ross* will, in the

future, be using Southampton as their home port. The Centre will play a leading role in modelling the climate of the oceans, the understanding of which is fundamental to the modelling of the combined ocean/atmosphere system.

The contribution of satellites to WMO programmes in the next decade will provide vast amounts of many new kinds of data for meteorology and operational hydrology. In the 30 years since the first meteorological satellite launch in 1960, the weather satellite has grown into a highly sophisticated platform which can provide global coverage of cloud observations, sea-surface temperatures, estimates of land-surface temperatures and moisture values, cloud motion, winds, wind-waves and estimates of local air-mass stability. A £297m European climate monitoring satellite, designed to improve the accuracy of prediction of weather changes due to the greenhouse effect, is due to be launched in March 1994. High altitude geostationary and the relatively low altitude polar-orbiting meteorological satellites will continue to be deployed throughout the 1990s. In the second half of this decade it is planned to have experimental Polar Platforms in space, with large groups of observing sensors on board, as part of the international space station programme, providing long-term near-continuous observations of the Earth.

In the field of sea surface technology, one of the most exciting developments has been the introduction of the prototype large passenger catamaran. The *Hoverspeed Great Britain* has broken the speed record for crossing the North Atlantic in a bid for the Hales Blue Riband Trophy (see photograph opposite page 188). This revolutionary new type of craft has also been introduced into cross-Channel service. The Met. Office ship routeing section, METROUTE, monitored and advised upon the catamaran's progress, on passage from Hobart, where she was built, to her celebratory arrival at Falmouth on 23 June, after her crossing of the North Atlantic from New York in the record time for a passenger craft of 3 days 7 hours 54 minutes. The 2928-n.mile Blue Riband passage from Ambrose to Bishop Rock was completed at an average speed of 36.6 knots, topping the 1952 record of the *United States* by just one knot. The start of the attempt on the record on 19 June was delayed by a few hours on the advice of METROUTE's Sea Ice Officer, on account of an extreme southerly ice floe sighting in 38°N 49°W, south of the Newfoundland Grand Banks. The revised departure time enabled the catamaran to transit the danger area during daylight hours, a wise decision when travelling over the sea at 35 knots. Captain John Lloyd, *Hoverspeed's* Master, reported meeting force 7 winds on the last day of the passage but, as predicted by METROUTE, these were soon replaced by favourable following breezes, and Bishop Rock was passed at 0825. The 74-m long catamaran was soon to be joined on the new Portsmouth to Cherbourg service by *Hoverspeed's* second super-cat; capable of carrying a minimum of 400 passengers and 80 cars, the catamarans reduce the channel crossing time from 4½ to 2½ hours, in comfort and style. Propulsion by the four 5000 bhp Riva Calzoni water jets enables the routine crossing to be made at 35 knots. Three further fast catamarans will follow in later months, superseding five hovercraft on *Hoverspeed's* Dover to Boulogne and Calais services.

The 1990s will see rapid acquisition of data sets which will allow greatly improved analysis and prediction of the ocean climate. Consistently good observations from the surface will continue to be of inestimable value for at least this decade in order to allow for normal seasonal and inter-annual variability. Knowledge about the climate of the ocean is invaluable in its own right because it

influences many activities, including naval, commercial and leisure operations, fisheries, insurance and waste disposal. It is also important to understand the climate of the ocean because it is strongly coupled with the climate of the atmosphere. The ocean controls the magnitude, timing and regional variation of global warming due to the greenhouse effect.

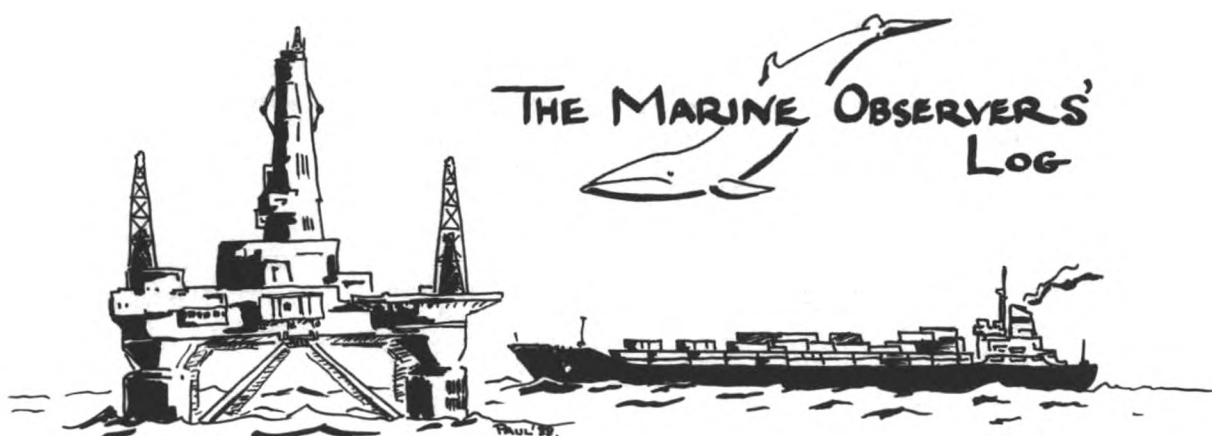
Despite the renaming of branches, associated with some reorganization as the Met. Office became an Executive Agency last April, the Observations (Marine) Branch is no less desirous of having the co-operation of as many met. observing ships as was Met 0 1a. To help with the necessary back-up to these operations, we are now using personal computers and word processors extensively and all data received continue to be added to the 135 years' weather records, consisting of over 69 million ship reports, stored in the Marine Data Bank.

One factor out of our control is the time it takes for ships' logs to reach this office, followed by quality control and assessment. Usually many months must elapse between commencement of a log and the mailing of an acknowledgement letter to the ship. On account of this unavoidable delay, we are often asked to consider sending copies of Masters' letters to officers at home, or care of their company for forwarding to their current ship, as they have often left their original post by that time. With the numbers involved, we would find this an almost impossible task to maintain with any satisfaction, and the only helpful suggestion that can be made is for keen officers to leave advice on their last ship for copies of these letters to be forwarded to them.

Two requests we would like to make to marine observers by means of this journal. First, there being such an international spread of officers throughout the Voluntary Observing Fleet nowadays, we ask for code figures to be entered as clearly as possible in the logs. Secondly, please turn to a new page in the meteorological logbook to start the new year. Your assistance in these matters will help our programmers to transfer your log entries to the database accurately and economically.

Whilst the log entries are important as permanent records, transmitted observations received in real time are invaluable to the forecaster, and attention to both these aspects of voluntary observing will ensure that 'none will have labored in vain'.

J.F.T.H.



October, November, December

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

CYCLONE 'ALIBERA'

Indian Ocean

m.v. *Tamathai*. Captain I. Woodier. At Tamatave. Observers: the Master and ship's company.

21–31 December 1989. The ship berthed at Tamatave on the 21st and at that time Alibera was situated some 600–700 n.mile to the north-east. During the first day alongside, the ship began to surge gently along the quay and so extra moorings were put out amounting to nine parts at each end. During the next eight days this movement gradually increased as Alibera tracked around in circles between 300 n.mile and 600 n.mile to the north-east. Moorings were frequently being parted and so were increased to 11 and 12 parts fore and aft respectively, but it was not possible to increase beyond this number owing to the lack of bollards aboard and ashore. Fenders on the quayside were constantly having to be replaced owing to the motion of the ship and by the 28th/29th its movement had become extremely violent as it rolled, surged and moved bodily several metres away from and towards the quay, especially in the period from two hours before high water until just afterwards. The deck crew was kept at station during this time, rejoining and replacing moorings. On the morning of the 29th as many as 10 moorings were parted in a single surge and the conditions were then considered too dangerous for the ship to remain alongside; as no cargo work was planned for the period between 30 December and 2 January, it was decided to leave the berth. As the ship departed, the vessel astern which had suffered no problems, broke all its moorings and required a tug to put it back alongside. The presence of the *Tamathai* had given the vessel considerable shelter from the swell which was hardly apparent on the surface of the water.

As the inner anchorage was crowded with other vessels, the ship attempted to anchor just outside the harbour, hoping for some shelter from the Grand Recif, but this did not help as the swell was short and steep and the ship rolled violently. It was decided to seek shelter in the lee of Ile aux Prunes, a small islet about 7 n.mile to the north. Anchorage was effected 0.5 n.mile to the west of the island, the effects of the swell being eliminated.

At this time, Alibera was forecast to pass about 300 n.mile to the north, but during the night of 29 December and the morning of the 30th its track became more south-westerly until it was headed directly towards Tamatave. At 1630 GMT on the 30th the port was declared closed and all vessels were directed to leave. The following observations are a selection from those made during the 30th and 31st.

Date and time (GMT)		Wind Dir'n	Force	Pressure (mb)	Position of storm
30th	2100	SSE	6	1003.6	
31st	0000	S	7	1002.0	17° 00'S, 51° 30'E
	0300	S×E	9/10	1000.1	
	0600	SSW	11	998.3	
	0900	SSW	11	995.8	
	1200	SW	8	994.1	18° 48'S, 50° 12'E
	1500	SW×S	8	995.5	
	1800	WSW	6	998.8	
	2100	WNW	6	999.0	

Shortly after 0700 on the 31st the vessel began to drag anchor. At that time eight shackles were in the water and nearly two hours were spent in picking up the anchor before anchoring again with two anchors, the wind having increased to force 12. The vessel then seemed quite secure with both anchors holding. Though the effects of the wind were considerable, no effects were felt from the swell as Alibera passed roughly 50 n.mile to the east, eventually to come ashore some way to the south. Position of ship on the 30th: approximately 18° 03'S, 49° 27'E.

HEAVY WEATHER

Eastern North Atlantic

m.v. *Silver Tower*. Captain D. Robinson. Bremerhaven to Almirante. Observer: Mr P.E. Roche, 3rd Officer.

20 October 1989. During the evening the vessel was in very heavy weather, and at one point another light was visible which transpired to be a 6000-tonne vessel on a southerly course at a range of about 6 n.mile. This could only be determined through an exchange of positions as the other vessel was not visible on either the 3-cm or 10-cm radar, and was expected because the light was frequently being obscured by waves. The vessel was the *Kosmos II*, headed for Bilbao. It was notable that the sound of the wind blowing through the rigging of the mainmast aerals and halyards was deafening in the wheel-house at times of very heavy gusts.

At approximately 2130 GMT there was a sudden lull in the wind, very noticeable by the lack of sound from the rigging and the fact that it was possible

to hear the deep throbbing from the main engine along with the escape of exhaust gases from the funnel. The ship's speed was 4 knots (the normal service speed being 22 knots, actual). This lull was also marked by the barograph which showed the pressure rising very sharply through 3 mb by 2145, and by the wind which had been WSW'ly, but suddenly veered to NW×W'ly while decreasing to force 4. There was moderate rain and the air temperature increased from 17 °C to 18.5°. The waves continued breaking after the wind had died away, coming from the original direction of the wind, but they were at least 1–2 m lower, this being reflected by the motion of the vessel.

These conditions lasted for around 15 minutes after which the wind quickly backed to WSW'ly again and increased to force 9 (not as strong as before); the pressure then began to fall although not as sharply as it had risen and the temperature returned to 17°.

Position of ship at 2130 GMT: 46° 59'N, 12° 28'W.

PASSAGE OF A 'NORTHER'

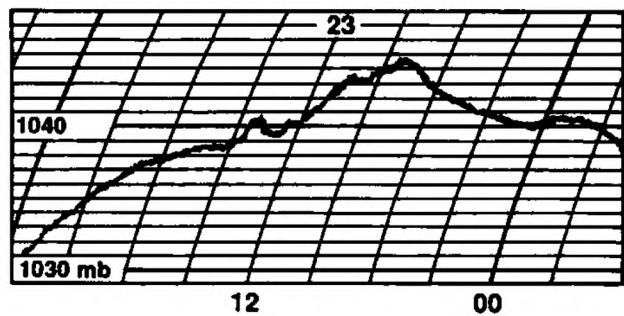
Gulf of Mexico

m.v. *Maersk Captain*. Captain N. Vause. Algeciras to Tampico. Observers: the Master, Mr A. Roberts, Chief Officer, Mr R. Orange, 2nd Officer, Mr C. Fleming, 3rd Officer, Mr D.J. Minihane, Radio Officer and ship's company.

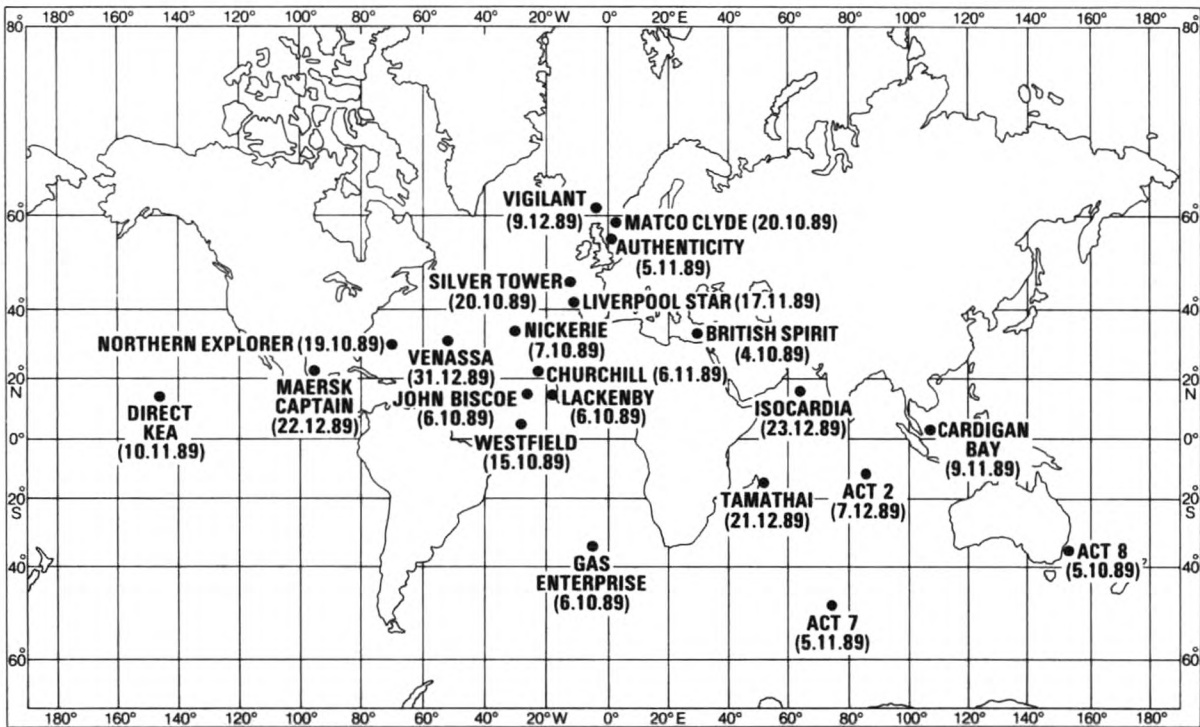
22–24 December 1989. During this period the vessel experienced the effects of an intense anticyclone. At 1200 GMT on the 21st it was noted from a weather map that there was an anticyclone over the eastern side of the Rocky Mountains and this was to extend southwards across the Gulf. The following account has been compiled from both Deck and meteorological logbooks, while the barograph trace shows the pressure changes.

Date and time (GMT)	Wind Dir'n	Force	Dry bulb (°C)	Pressure (mb)	Cloud (oktas)	Remarks
22nd 0200	SW	3	24.0	1016.2	3	
0600	NW	8	20.2	1017.1	8	Wind veers NW'ly at 0530, quickly increasing.
0900	NW	8	15.5	1019.4	8	Rain showers.
1200	N	9	14.0	1024.9	8	Rain showers.
1500	N	10	10.0	1026.8	8	Moderate drizzle.
1800	N	10	8.6	1029.7	8	Moderate drizzle.
2100	N	10	7.0	1030.7	8	
23rd 0000	N	10	6.5	1034.0	8	
0300	N	10	6.3	1039.0	8	
0600	N	10	5.9	1040.1	8	
0900	N	9	3.5	1041.5	8	
1200	N	10	4.0	1042.5	8	
1500	N	8	3.0	1044.3	8	
1800	N×W	6	3.9	1045.8	5	
2100	N	5	5.8	1043.1	3	
24th 0000	N	4	6.0	1041.8	3	

From 1130 on the 22nd to 2300 on the 23rd the vessel was hove to as the port of Tampico was closed. Sea smoke of varying depth and density was observed between 0000 and 2300 on the 23rd. At the height of the anticyclone from 2100 on the 22nd to 1200 on the 23rd, seas reached 10 m.



On consulting the pilot for the Gulf of Mexico it was discovered that this type of anticyclone was a classic example of a Norther, and upon berthing the Master was informed that the weather in the area was the worst for four years.
 Position of ship: approximately 22° 18'N, 97° 42'W.



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

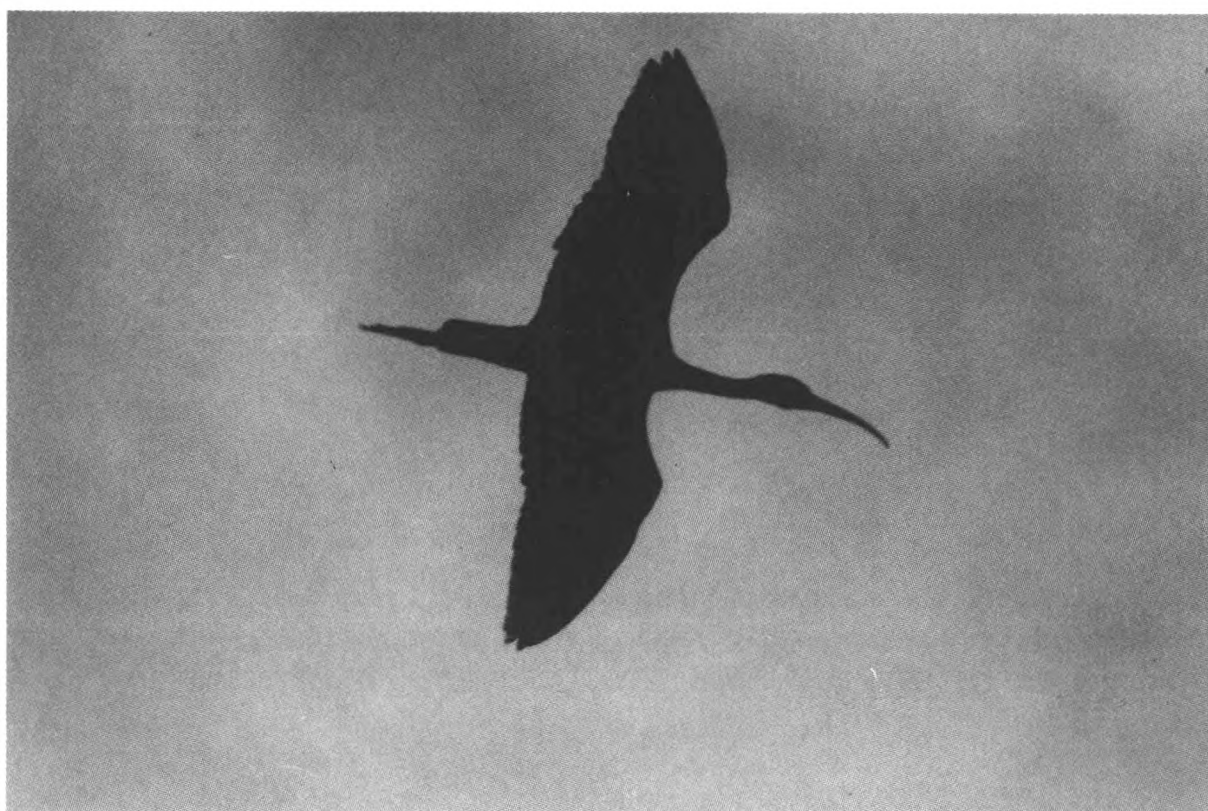
LIGHTNING **Mediterranean Sea**

m.v. *British Spirit*. Captain A.R. Wilkinson. Arzew to Ulsan. Observers: D.K. Corlett, 2nd Officer and Mr M.C. Rattue, 3rd Officer.
 4 October 1989. At 1800 GMT sporadic lightning was seen right astern of the vessel, in a localized area, and at 2000 a low line of cumulus cloud together with a cumulonimbus with anvil was noted on the port quarter. The frequency of lightning was increasing. Observations of the lightning were made until midnight, and the following record was compiled.



Photo. by R.A.S. MacMeikan

Precipitation in an unstable, north-westerly airstream as seen from m.v. *Sumburgh Head* on 8 November 1989 at approximately 1040 GMT in position 46° 08'N, 09° 54'W.



Photographer unknown

Glossy Ibis photographed from m.v. *Nickerie*. (See page 178.)

Opposite page 173

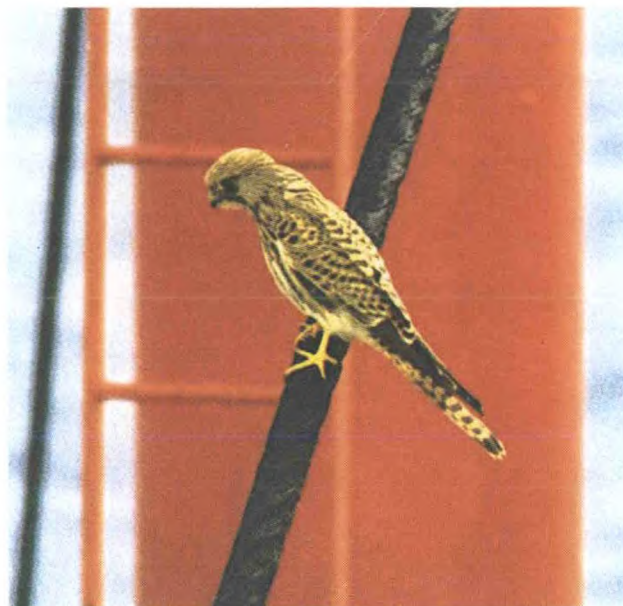


Photo. by R.C. Plumley

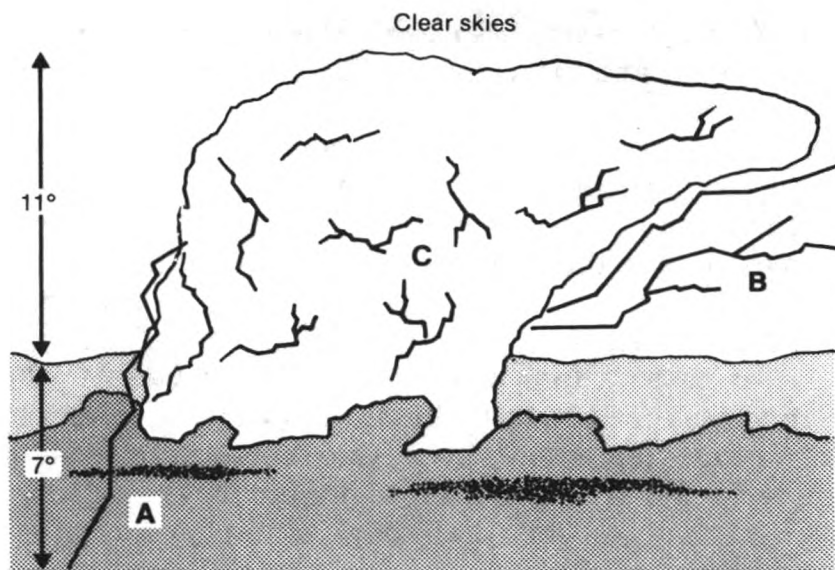
Unidentified kestrel on board R.R.S. *John Biscoe*. (See page 179.)



Photo. by Captain A.D.G. Bell

Night Heron (*Nycticorax nycticorax*) pictured on board m.v. *Havkong* on 14 December 1989, in position 06° 00'N, 108° 00'E.

Time (GMT)	Bearing	Distance (n.mile)	Remarks
2220	025°	26.2	Continuous, internal forked lightning illuminating whole cloud. Very strong bolts to sea surface (point A on sketch), visible at least five times longer than other flashes. Long, forked lightning (B); continuous, internal forks (C) illuminating whole cloud milky-white.



2220 GMT
Brg 025°

2240	028°	28.6	Number of external lightning bolts decreasing; whole cloud illuminated.
	308°	31.0	Second cloud (without anvil) developing. Forked lightning horizontally from left to right seen within cloud.
2300	030°	32.5	First cloud still internally lit; occasional bolts outside cloud, in line with anvil shape.
	315°	30.5	No distinctive shape to second cloud; frequency of left-to-right forks increasing. See sketches.



2320	040°	36.5	Anvil shape becoming less pronounced in first cloud; no external lightning, but occasionally lit internally from second cloud to first. Clouds now forming a continuous line of cumulonimbus occasionally lit by internal flashes. Long, forked horizontal lightning continues, but at reduced frequency.
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By 0000 on the 5th there were only occasional flashes illuminating large areas of low cloud internally and the rest of the sky was clear throughout. No thunder was heard at any time.

Position of ship at 2200 GMT: 32° 24'N, 29° 50'E.

CETACEA

North Atlantic Ocean

f.p.v. *Vigilant*. Captain D.L. Rattray. Fishery duties off west coast of Shetland. Observers: Mr A.R. Davidson, Chief Officer and Mr P.C. Waiton, 2nd Officer.

9 December 1989. Between 0900 GMT and 1130 the vessel was lying stopped in the vicinity of a fleet of purse seiners, all of which had large catches of mackerel averaging between 70 tonnes and 120 tonnes in their nets before being pumped into their tanks. The observers, who were aboard a 6.7 m Sea-Rider while moving amongst the fleet and inspecting the fishing vessels, made the following observations

Initially, two groups consisting of four and five Killer Whales were seen cruising in the area on the surface, and swimming close to the nets containing live mackerel but without actually touching them; they appeared to be attracted by fish being thrown to them by the fishermen. The larger group comprised one very large whale, two medium size and two small individuals. Several times the large whale swam on the surface to within 10 m of the Sea-Rider before diving underneath; it was at least 8 m long with a large, crooked dorsal fin 2 m high, and was close enough to see the eyes, teeth and the blowhole opening and closing as the whale dived. The medium-sized whales were estimated to be about 5 m long, and the small ones 2.5–3.0 m long, but at no time did they come very close to the Sea-Rider. After 30 minutes only the group containing the large whale was observed.

At 1130 as the observers returned to the *Vigilant*, a group of five Pilot Whales was seen swimming towards the Killer Whales, but owing to navigational duties both groups were lost to sight when about 0.5 n.mile apart; five minutes later there was no sign of either group.

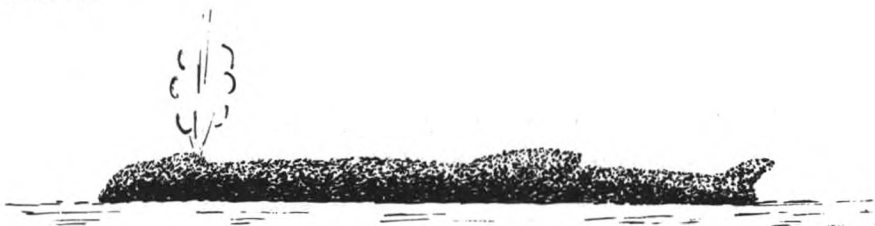
The method of pumping fish aboard purse seiners can put a quantity of blood into the water, and although this type of fishing on such a scale is very common in the area from September to January, the observers had never seen Killer Whales paying so much attention to the fishing boats and their nets before.

Position of ship: 60° 08'N, 02° 34'W.

North Atlantic Ocean

m.v. *Venassa*. Captain G.B. Porter. Antwerp to Houston. Observer: Mr B. Blythe, 3rd Officer.

31 December 1989. At 1245 GMT a whale was sighted abeam of the port bow, about 100 m off, on the surface. No blow was seen and it disappeared below the surface, reappearing about 80 m off the port quarter at which point most of its upper body was visible. The upper body was uniformly black with a small dorsal fin set well down the back and with the head having a 'bulbous' appearance, see first sketch. The whale was about 14 m long, and at no time was the underside of the whale visible.



On its second appearance, it blew and then made a shallow dive showing a very curved tail fin. It continued to circle around just below the surface, blowing at regular intervals of about 20 seconds, surfacing through the low swell and showing most of its upper body, see second sketch.



Weather conditions at the time were: temperature 19.5 °C, wet bulb 16.0°, pressure 1028.7 mb, wind light airs. There was a calm sea with a long, low northerly swell.

Position of ship: 31° 58'N, 51° 05'W.

Indian Ocean

m.v. *ACT 7*. Captain N.D.T. Johnson. Rotterdam to Sydney. Observers: the Master, Mr M.J. Power, Chief Officer, Mr B. Wilson, Chief Engineer Officer, Mr S. McKeown, SM1A and Mrs Wilson.

5 November 1989. Three pods of whales were sighted about the vessel at 1330 GMT. One group consisted of about four whales whilst the other groups consisted of three individuals each. With the whales in each pod being close to one another their blows appeared confused but averaged 15–20 seconds with longer intervals at times. Each blow was powerful, going high and vertical; after the blow, a long back was shown before a small, stubby fin came into view. Because the whales were over 1500 m from the ship and the light was relatively poor, no detail as to colour or approximate length could be observed. However, the impression was of very large whales indeed. Some smaller whales were included in the group. One observer saw a tail partially raised as the whales disappeared astern.

At 1350 another pod was seen fine to starboard and closer to the vessel. The fins on these whales appeared to be larger and more curved than those of the ones sighted earlier. As before, the blows were powerful, high and vertical, but the timing was random as the whales swam clear of the ship. There appeared to be four whales in this pod with at least one of them being considerably smaller than the others. Although not as long as those seen at 1330 they were large nevertheless, being 12–18 m long and dark, battleship-grey in colour. They had pronounced blowholes, but the fin was the most distinctive feature along with the fact that the backs were not as long as the first whales seen.

Much debate followed as to the species observed in these two sightings. Twenty whales had been seen in as many minutes and the observers reached the conclusion that those seen at 1330 were Blue Whales whereas the others were either Fin or more likely Sei Whales taking into account their more pronounced and curved dorsal fins and smaller size.

Position of ship: 48° 26'S, 76° 00'E.

MARINE LIFE

South Atlantic Ocean

m.v. *Gas Enterprise*. Captain I.H. Alexander. Santos to Fujairah. Observers: the Master, Mr D.R. Lewis, Chief Officer, Mr N.G. Young, 3rd Officer and Mrs Alexander.

6 October 1989. At 1800 GMT in the white foam coming from the bow wave, small, black, oblong pods were seen floating past, all roughly of a uniform size. On deck a small drogue was put out and the observers were able to catch two of the objects. Close scrutiny revealed that the black colour was a sheath surrounding the marine creature inside. Unfortunately, the two specimens had been mashed up by the vessel's speed through the water, but on piecing them together they looked like a cross between a small squid and a cuttlefish. The ship passed through these pods from the time of sighting until darkness.

Position of ship: 36° 13'S, 04° 03'W.

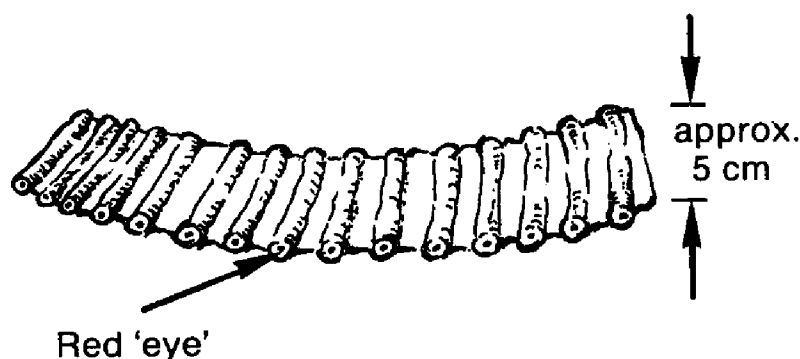
Note. Dr F. Evans, of the Dove Marine Laboratory, University of Newcastle on Tyne, comments:

'I think they were most likely squid, not cuttlefish. It is possible that the assemblage was a post-spawning shoal, approaching death. This is the fate of squid generally. The animals are then in poor condition (and break up more easily) and may be found at the surface. The eggs are laid away from the surface in masses following a complicated courtship; why squid should mostly breed and then die is a puzzle.'

Arabian Sea

m.v. *Isocardia*. Captain J. Sharp. Dubai to Tabango. Observer: Mr M. Gooderham, 3rd Officer.

23 December 1989. During the day the vessel passed a dense concentration of small, ribbon-like organisms as shown in the sketch. Each ribbon was about 5 cm wide and was composed of 'fingers' connected along their sides by transparent



material; each finger appeared to have a red 'eye' at the centre. Initially, just the occasional one was seen, but then the density of them increased and it took the vessel 6 n.mile to pass through the most dense area.

They were of various lengths ranging from 2 cm to 200 cm and were coiled in a variety of shapes; there appeared to be no movement apart from that caused by the passage of the ship. The creatures were present on the surface and could also be seen down to a considerable depth owing to the calm sea conditions; some lay flat on the surface while others extended vertically downwards. At the time the sea temperature was 26.4°C.

Position of ship: 17° 02'N, 65° 34'E.

Note. Dr F. Evans comments:

'The creatures were salps in their chain form, a similar report from this part of the world is given in *The Marine Observer*, October 1984, when some of the creatures were collected in a bucket, and chains were noted to be up to 3 m long.

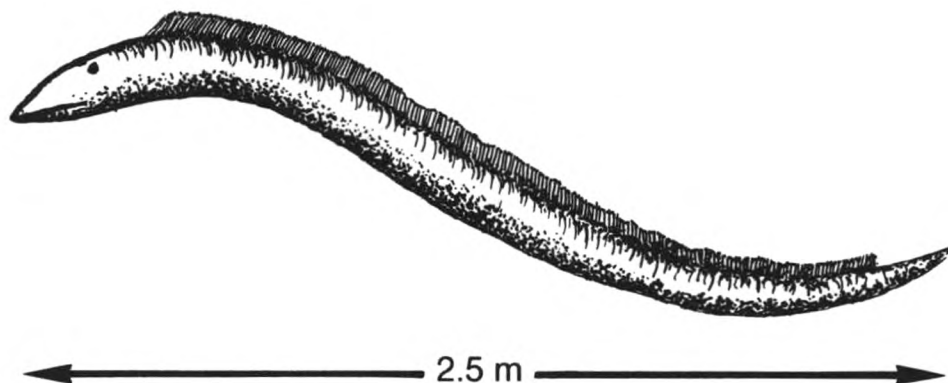
'Salps have alternating generations, an asexual, solitary generation which reproduces by budding, followed by a sexual generation of individuals joined, as here, in chains. Each chain has arisen from a single, solitary parent. The red 'eye' is known as the nucleus, and is basically the stomach, and the colouring comes from the gut content, most likely microscopic plants.'

FISH

South China Sea

m.v. *Cardigan Bay*. Captain A.J. Leslie. Tokyo to Singapore. Observers: Mr P.M. Reid, 2nd Officer and Mr T. Nicholas, SM2.

9 November 1989. Between 0100 GMT and 0200 whilst the vessel was in virtually undisturbed water, stopped and drifting to accommodate ETA at Singapore, a sea creature similar to an eel was observed, see sketch. It was much larger than an eel, about 2.5 m long and was seen on the starboard side of the vessel at a distance of about 15 m. The eel/sea snake was just under the surface and was twisting and turning continually; after approximately one minute it dived away not to be seen again.



The circumference of the animal was judged to be consistent with the average man's arm, it had a continuous fin along its length and its body appeared to be tapered towards its tail end. It was a light, salmon-orange colour on its upper side, while its underside was white.

At the time the vessel was in an area close to fish traps of some sort and it was later reported that the ABs working on the fo'c'sle also saw similar eels/snakes.

Position of ship at 0000 GMT: 02° 06'N, 104° 36'E.

Note. Mr N.R. Merrett, Head of the Fish Section, British Museum (Natural History), comments:

'The continuous fin along the length of the body confirms that this was a fish rather than a snake. As the observer points out, an estimated length of 2.5 m is rather long for an eel. Perhaps this fish was a Dealfish (family Trachipteridae: size to 2.5 m) or a small Oarfish (family Regalacidae: size to 8 m +). Both these fishes have an elongated body form tapering to the tail, with a continuous dorsal fin along the back. The underwater colour could well be as described. These species tend to occur over deep water, over the slope or oceanically, so a record of the soundings in which the ship was at the time would have been helpful (as always, incidentally).'

BIRDS

North Atlantic Ocean

m.v. *Nickerie*. Captain C.J.B. Trinick. Paramaribo to Portsmouth. Observers: Mr D.R. Attrill, Chief Officer and Mr M.A. Afghani, 3rd Officer.

7 October 1989. At 1900 GMT a large land bird (shown in the photograph opposite page 172) was sighted and seemed to be looking for a place to land, possibly for the night as the sun was setting. The general appearance of the mainly jet-black bird was very thin, but not unhealthily so; it had a slightly mottled underside, an elongated neck and a black, curved beak approximately 15 cm long. Its legs were perhaps white or grey and the feet were not webbed. The bird was about 1 m long over all and had a wing-span of 1.5–1.8 m.

Attempting to land, the bird tried once on No. 1. hatch and several times on the crane wires which indicated that it may have been used to landing on trees or branches. In all, it stayed with the ship for 15 minutes during which time the weather was fine and clear with the wind SE'ly, force 3–4.

Position of ship: 35° 15'N, 30° 25'W.

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

'This was a Glossy Ibis (*Plegadis falcinellus*), an interesting record of a bird not often reported at sea.'

North Atlantic Ocean

m.v. *Churchill*. Captain P. Mathews. Antwerp to Recife. Observers: the Master, Mr P. Newton, Chief Officer and ship's company.

6 November 1989. At 1000 GMT a bird was observed on the main deck, in the 'sea clean' that had recently been used to wash the decks. The Chief Officer rescued the frightened bird and took it to the bridge where the decision was made to try and clean his plumage even though he appeared not to have much life left in him. He was identified as a petrel, but any distinct markings were hard to see owing to his sodden state. The bird was put in a bucket of fresh water and then lightly rinsed with it while trying not to stress it too much. As the sun was warm, it was decided to shelter him on the windward side, inside the upturned bucket thus allowing his feathers to dry naturally. The watchman checked his legs and wings, ensuring nothing was broken that could impede his flight.

Within two hours a new bird emerged from the bucket, testing his wings and balance. The petrel, now named 'Charlie', was completely dry and showing a 100 per cent improvement on his state earlier in the morning. The observers were able to handle him without causing undue fright and there was much interest in the little hero. At this time he was identified as a Madeiran Storm Petrel, commonly found in the region; he measured 17 cm long and appeared to be a young fellow as his head plumage was quite fluffy. He quite happily strolled around the bridge wing, bemused by the Master's carpentry skills, and the same afternoon, about four hours later, he was released. He appeared to fall for some distance, but then swooped upwards, skimming over the waves, obviously realizing that he was a very lucky petrel and glad to be free again.

Position of ship: 21° 22'N, 20° 27'W.

Note. Captain P.W. Chilman, of the Royal Naval Birdwatching Society, comments:

'An alternative identification to the Madeiran Storm Petrel (*Oceanodroma castro*) would be Leach's Storm Petrel (*Oceanodroma leucorhoa*). Both breed in the Atlantic and other oceans, quite frequently coming on board after which they have trouble taking off again. Launching them over the side once they have rested is the best course.'

North Atlantic Ocean

R.R.S. *John Biscoe*. Captain C.R. Elliott. Grimsby to Montevideo. Observers: the Master and ship's company.

6-7 October 1989. At 1745 GMT on the 6th a bird joined the ship while approximately 18 n.mile south-east of Fogo in the Cape Verde Islands and was thought to have been either a kestrel or a sparrowhawk (see photograph opposite page 173).

While onboard, water was left for it at various places along with fresh meat, but the bird touched nothing. Most of its time was spent either perched on the forward or aft mast, or flying close to the ship. It was not even tempted by flying-fish found on the deck or by a swallow which stayed briefly with the vessel.

The bird was about 30 cm long from head to tail and had a small, semi-hooked beak. It had bright yellow legs and a striking pattern on its wings and upper sides being of a sandy-brown colour with nearly black squares and diamond shapes. The undersides and front were a light grey-brown with a darker band running from the neck to the back of the head.

When the ship was about 300 n.mile south-south-west of Fogo, the bird flew off to a passing northbound tanker.

Position of ship on the 6th: 14° 37'N, 24° 06'W.

North Pacific Ocean

m.v. *Direct Kea*. Captain A.J. Fee. San Pedro to Melbourne. Observers: the Master and ship's company.

10-24 November 1989. Approximately one day after leaving San Pedro, a small bird was observed around the accommodation area of the vessel. Its features were as follows: the main body was black in colour but with small, golden-coloured specks on the top half and on its wings, whilst its underside had white specks. The beak was thin, black and pointed, about 2.5 cm long, and the eyes were also black; it stood approximately 12 cm tall and had only a small tail. The observers thought it may have belonged to the starling family.

When first seen, the bird was very thin and wet, and also had difficulty walking about. After that, it was fed every morning on a mixture of bread and bacon chopped up in a bowl, and a bowl of fresh water was put out for it on the aft end of the bridge deck.

It remained with the vessel, staying mainly at the aft end of the bridge deck, but towards the end of the passage, the bird began to fly more and more around the vessel. By the time the Australian coast was reached, the bird had roughly doubled its weight from the first observation and disappeared as soon as the ship neared the coast.

Position of ship on the 13th at 1800 GMT: 15° 18'N, 144° 24'W.

Note. Commander M.B. Casement comments:

'This is probably a Golden Plover (*Pluvialis apricaria*). These birds regularly travel long distances on migration from the Arctic tundra to the tropics in autumn, and are frequently reported taking rides aboard ships, but this was an exceptionally long "hitch".'

INSECTS

Eastern North Atlantic

m.v. *Lackenby*. Captain C.R. Bamford. Saldanha Bay to Port Talbot. Observers: the Master, Mr I.C. Gravatt, Chief Officer, Mr W.D. Russell, 2nd Officer, Mr P.W. Holliday, 3rd Officer and ship's company.

6-8 October 1989. Whilst on passage the vessel received the company of several uninvited guests when about 80 n.mile off the coast of Senegal. The first of these 'guests' was originally thought to be a locust, but after the seeds of doubt had been sown, it was decided that they were probably some sort of grasshopper.

On average, they were about 5 cm long with a wing-span of about 8 cm; there were four wings, two fairly solid, narrow ones and two slightly smaller ones which were attached farther back on the body, opening up into a fan shape. The insects had six legs in total comprising four small ones used to support the main frame and when climbing, and two large ones at the rear which were used for launch into flight with a fairly powerful jump. In colour, the insects were sandy-brown over all, but on the rear legs wide, black stripes were visible, and on some, there were distinctive red marks. Two feelers were located on the head.

Initially, about 10 insects were seen around the area of the bridge, but once off the coast of Mauritania, most of the vessel's decks could boast around six of them. The guests arrived sometime during the early hours of the morning when the wind was generally N'ly, force 2-3, but there were none to be found on the 8th when the wind was NE'ly, force 6-7.

Also found on board was a quite large praying mantis which was generally green in colour although sandy-brown in places; it was about 10 cm long. This and several of the grasshoppers were kept in an attempt to 'bring them back alive'; however, they seemed to be showing even less interest in the bridge sandwiches than the observers.

Position of ship on the 6th: 14° 00'N, 18° 00'W.

Tasman Sea

m.v. *ACT 8*. Captain R.H. Nightingale. At anchor, Sydney. Observers: the Master, Mr J. Murray, Chief Officer, Mr A.D. MacPherson, 2nd Officer, Mr R.C.B. Booth, 3rd Officer and Mrs E. MacPherson.

5-6 October 1989. At around 1500 GMT the bridge wing door was opened and allowed a sudden ingress of moths. Further investigation of the bridge wing revealed that there were numerous moths 'sleeping' in every available crack and corner, and in fact, wherever they could get a grip on the paintwork. The moths were not overly disturbed by the Second Officer's presence as he photographed them (see front cover). There were very few moths observed on the port (lee) side, and by daybreak most of them had either left the ship or had found somewhere dark and sheltered to hide.

One suggestion as to the reason for the moths' arrival was a combination of an offshore wind and a bush-fire to the north of Sydney earlier in the day. As the ship was at anchor, both deck and accommodation lighting was on.

Weather conditions at the time were: dry bulb 16.5°C, pressure 1009.0 mb, wind WNW'ly, force 5-6. Cloud cover was 3 oktas, there was also a new moon.

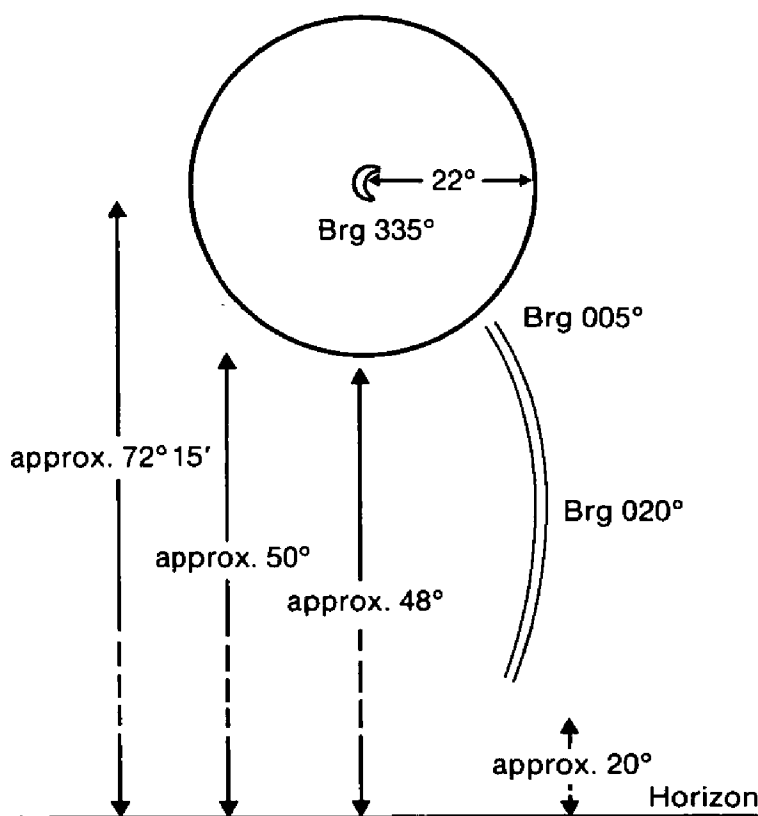
Position of ship: approximately 33° 55'S, 151° 12'E.

Note. Mr M. Honey, of the Department of Entomology, British Museum (Natural History), identified the insects as Bogong Moths (*Agrotis infusa*) (Boisduval). It is a pest of south-east Australia where the caterpillars feed nocturnally on winter crops and grasses. Adult moths migrate to the Australian alps during the summer months and remain dormant in rock crevices and caves before dispersing to lower elevations in the autumn. The aestivating moths are harvested and eaten by the Aborigines.

HALO Indian Ocean

m.v. *ACT 2*. Captain M. Thwaite. Suez to Fremantle. Observers: Mr D.W. Lax, Chief Officer and Mr A. Shireh, SM1A.

7 December 1989. At 1330 GMT a lunar halo of 22° radius was observed, the sky being covered by 2 oktas of towering cumulus around the horizon and 4 oktas of thin cirrostratus overhead. At 1335 an arc of contact appeared from the right-hand side of the halo, faint at first but becoming quite pronounced at 1338 (see sketch).



This arc remained visible until 1350 when it faded, and the halo remained until 1356. The moon's altitude was about 72°.

Position of ship: 11° 21'S, 86° 46'E.

CORONAE

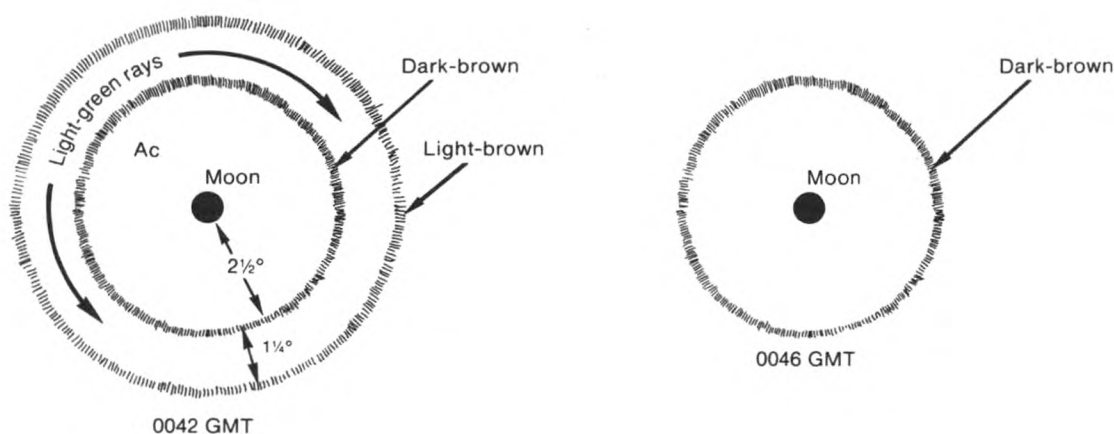
Eastern South Atlantic

m.v. *Westfield*. Captain G.C. Clifford. Portocel to Sheerness. Observer: Mr W.L.K.F. Lansakara, 3rd Officer.

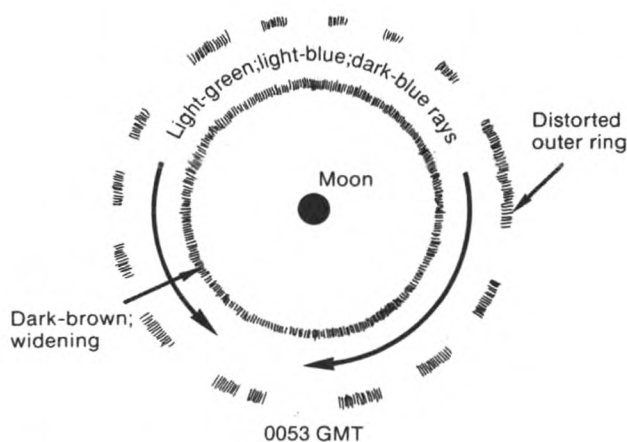
15 October 1989. At 0042 GMT when the moon was at an altitude of 60°, bearing 080°, a corona was observed in the cloud around it (6 oktas of semi-transparent altocumulus); it was seen in three clearly distinguishable stages.

The first observation was of two clear rings, see first sketch; the inner circle was dark-brown and of 2½° radius with a thickness of 6 minutes, but the outer ring area was very attractive with a light-brown ring and some light-green rays. Inside the inner ring the colour was that of the cloud.

At 0046 the outer circle with the light-green 'atmosphere' had disappeared leaving only the inner one, see second sketch. Afterwards, however, varying conditions were noted, and as the moon rose through some dense cirrus, the inner ring became larger followed by more green rays flashing out.



At 0053 the corona was very similar to the first observation, but the inner ring was much thicker and the outer one was distorted; very light-green rays were



visible between the two, see third sketch. Later, a change in colour was noticed as the light-green became light-blue and then dark-blue. At about 0121 the display faded as the cloud broke up.

Position of ship: 18° 24'S, 38° 24'W.

Note. Dr R. White comments:

'Generally, this observation is fairly standard. Even though the form and colouration of the corona is formally fixed for a given drop size and source, variation is possible as a result of polydispersion (more than one size of droplet in the cloud) and multiple scattering (which will be more important when the cloud looks "thick"). In the third phase, the irregularity in the outer circle suggests that the cloud is breaking up into cells which have the property that the drop size varies with position (whether near the centre or near the boundary) in the cell.'

METEORS

North Atlantic Ocean

m.v. *Northern Explorer*. Captain H.R. Forrester. Esquivel to Port Alfred. Observer: Mr L.H. Musselwhite, 2nd Officer.

19 October 1989. At 0626 GMT a meteor or perhaps a man-made object was seen, bearing approximately 070° , and of estimated magnitude -1.0 . It appeared just below and to the west of Pollux at an altitude of about 30° and travelled roughly 35° to the vertical from west to east, disappearing at about 10° altitude. The object seemed relatively near and as though it was approaching, but whether this was because it was quite bright was not certain. Perhaps it was bright because it was relatively near!

Minutes later at 0630 another meteor was seen, of estimated magnitude 2.4 (similar to Merak). This one appeared at about 12° above and to the east of Castor, travelling at about 15° to the vertical from east to west, disappearing at Castor.

A third meteor was seen at 0653, of estimated magnitude 2.0 (similar to Dubhe), appearing east of and about 3° above Bellatrix, travelling in a line with Bellatrix and Betelgeuse, east to west towards Jupiter and Gemini, disappearing between Jupiter and Betelgeuse. All three lasted no more than 2 seconds each and it was thought that they may have been the start of the October Orionids.

Position of ship: $30^\circ 19'N$, $69^\circ 15'W$.

Note. Mr H. Miles, Director of the Artificial Section, British Astronomical Association, comments:

'The sightings were of natural meteors and not produced by man-made space debris. It is likely that the first and third objects reported were Orionids, but the track of the second one points to it being a sporadic, as the track, when produced backwards does not pass near to the radiant of the Orionids.'

AURORA BOREALIS

North Sea

m.v. *Authenticity*. Captain J. McKay. Immingham to Dundee. Observers: Mr C. Raymond, 2nd Officer and Messrs D.C. Fairweather and M. Brownjohn, Lookouts.

4/5 November 1989. At about 0000 GMT the aurora was sighted on the starboard bow and took the form of a rose glow due north of the ship, extending over roughly 2° of the horizon; its height above the horizon was about 5° .

Occasionally, perhaps four times, a ray of the same colour was seen extending

west or east at a small angle to about twice the height of the glow. The rays or beams were transitory, no more than two being seen at one time; their intersections with the horizon were separated and their width was about a quarter of the moon's diameter, they did not appear to taper.

The duration of the sighting was only about 15 minutes although the display may have been longer; the build-up and decline of the glow were not seen. At the time of the midnight observation, the cloud cover was 2 oktas which were distributed around the horizon and so the auroral display was slightly obscured. The glow was not much higher than any of these clouds.

Position of ship: 55° 18'N, 01° 12'W.

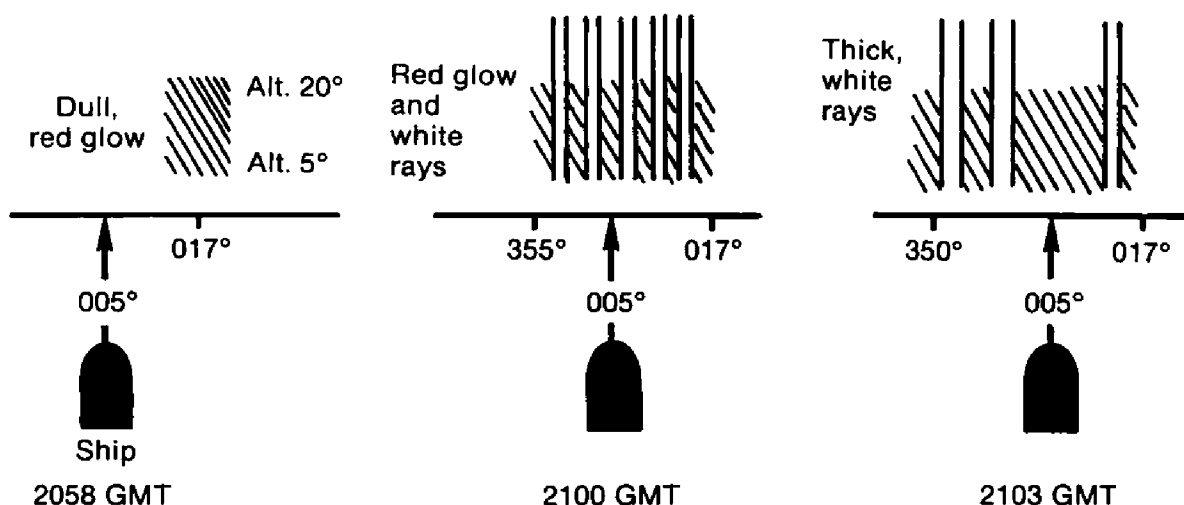
Note. Owing to navigational and observational duties, this report was not compiled as the display progressed, but was compiled from memory later.

Eastern North Atlantic

m.v. *Liverpool Star*. Captain S.H. Duckworth. Haifa to Ellesmereport. Observers: Mr P.W. Jackson, Chief Officer and Messrs A. McCredie and A. Thomson, Lookouts.

17/18 November 1989. Between 1955 GMT and 2000 as the sky was rapidly clearing from the west after the passage of a cold front, leaving a dark night with a clear atmosphere, a dull-red glow was noted on a bearing of 315° and at an altitude above the horizon of 5°. At 1959 a nearly vertical (with left-hand inclination), white ray was noted on the left-hand side of the glow. At 2000 both the glow and ray disappeared. The ray was elevated from near the horizon to the cloud edge at approximately 15°, and stars could be seen through the red glow.

Between 2058 and 2112 the aurora was sighted again, see sketches, commencing as a dull-red glow on a bearing of 017° and elevation of between 5°



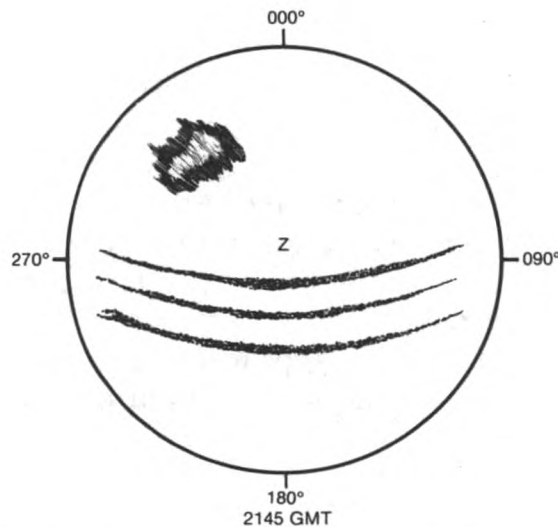
and 20°, then widening to port, bearing 350° and also brightening to a distinct, red glow. Interspersed throughout were numerous white rays extending vertically to an elevation of 25° and forming a curtain. Occasionally, two or three individual rays broadened to thick ones of roughly 1° in width.

Position of ship: 41° 23'N, 09° 36'W.

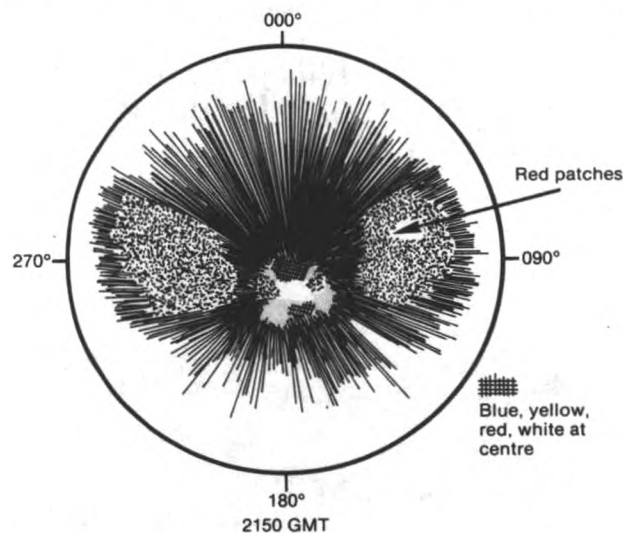
North Sea

m.v. *Matco Clyde*. Captain P.D. Kelly. Awaiting cargo east of Beryl Oilfield. Observers: the Master, Mr D. O'Keefe, Chief Officer, Mr R. Skene, 2nd Officer and Mr S.R. Ainscow, 3rd Officer.

20/21 October 1989. At 2145 GMT the aurora was first observed to the north-west of the vessel, taking the form of a quiet, rayed band of moderate/bright intensity at an elevation of between 5° and 30° while covering a horizontal arc of $25\text{--}30^{\circ}$. The colouration at this time was mainly white/grey with weak, blue patches. Also observed were three, occasionally four homogeneous arcs which ran from about 20° above the western horizon to about 20° above the eastern one, through a point south of the vessel's true zenith. These arcs were only light-grey in colour, see first sketch.



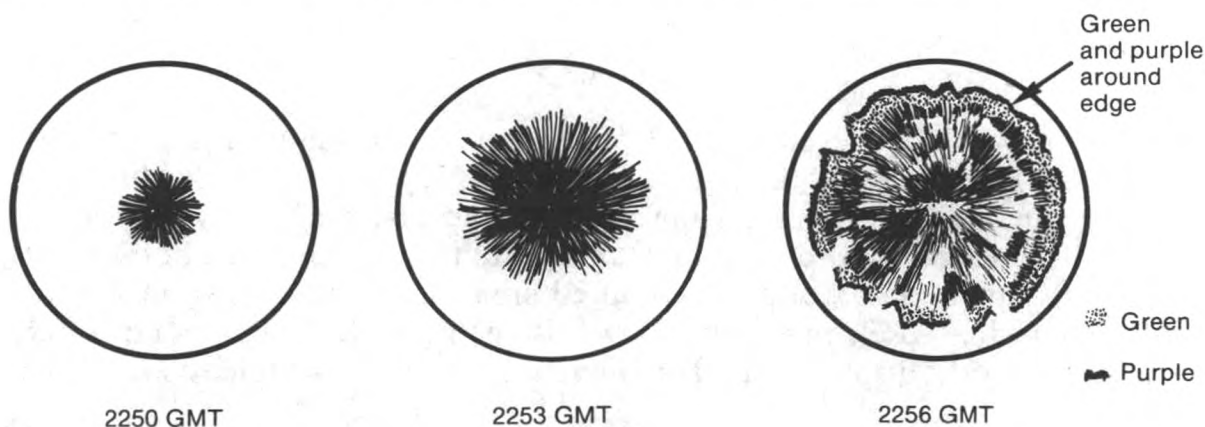
The display quickly developed at 2150 into a full corona of bright intensity, centred on a point south of the vessel's true zenith. It was initially all white/grey in colour, but patches of red soon appeared and these became a very deep colour by 2200. The red colouration was most intense to the east and west of the vessel and was also present in a brightly-coloured area surrounding the centre of the display above the vessel, blues and yellows also being evident, see second sketch. For a short time the display centred on the zenith actually resembled a face, and it



was easy to understand how such an event would have been alarming to people of earlier times. The spectacular coronal display began to fade and break up at 2220 although further displays of lesser brilliance were seen until about 0230.

21/22 October. On this night the aurora was noted at 1810 as patches of moderate intensity and was pulsating, but by 2030 it was developing into a coronal display covering about 50 per cent of the sky and was brighter to the north of the vessel than to the south. The display was bright/brilliant, and although mainly grey/pale-blue in colour, also had some patches of red. The whole phenomenon was beginning to pulsate more rapidly.

At 2050 a full coronal display developed, brilliant in intensity and flaming, with large patches flashing and 'dancing' about the sky. The elevation was between about 10° and the zenith and contained no breaks. Twenty minutes later it faded to moderate/bright, covering only about 40 per cent of the sky in large patches but still pulsating rapidly. The display became brighter again at 2120 covering 50 per cent of the sky at elevations of between 10° and 70° ; it was flaming again and mainly blue/grey in colour with occasional patches of red. By 2130 it was fading and was visible only to the north of the vessel in the form of weak/moderate pulsating patches. After an hour the aurora quickly became brilliant in the form of a flaming coronal display; the moon had risen in a clear sky but this did not affect the observation of the aurora in any way. Just before 2250 the display faded once more but was soon replaced by a brilliant corona which appeared first at the zenith and rapidly spread downwards. As it reached lower down into the sky it had the appearance of folded, heavy curtains; the bottom edge was brightly coloured green then purple, see sketches.



The display continued as less brilliant, flaming patches of weak/moderate intensity throughout the night until 0200 and the aurora eventually faded at 0245.

Position of ship: $59^\circ 30'N$, $01^\circ 50'E$.

On the origins and growth of tropical meteorology: from ancient times to the early nineteenth century. *

By J.M. WALKER

(Department of Maritime Studies, University of Wales College of Cardiff)

"In our age of weather satellites and computer-produced weather forecasts, with so much new to learn, the temptation is to ignore the work of past decades, not to mention past centuries. He who yields to that temptation will be the proverbial stranger in his own land. No thoughtful meteorologist can feel comfortable in his day-to-day professional life without knowledge of whence the science came, of the intellectual struggles of a relative handful of men who built the base for the tremendously accelerated progress during the last two generations."

Baum (1971)

Like their modern counterparts, the mariners, country folk and travellers of ancient times were keen observers of nature, passing on their meteorological knowledge in the form of proverbs and weather lore. They accepted their inability to change the weather and recognized the need to cope with the vagaries of their environment if they were to survive. Few attempted to understand the physical principles which govern atmospheric behaviour. In general, people were content to attribute the mysteries of the weather to the gods. The origins of tropical meteorology therefore lie in the mythology, folklore, magic, religion and philosophy of ancient times.

Ancient India

The earliest known references to weather in the tropics are those found in the collection of 1028 hymns called *Rig-Veda*, which is the oldest literary record of the Aryan-speaking people who migrated into north-west India 3500 years ago. No-one knows the precise antiquity of the hymns, but most experts believe they were composed between 1200 and 500 B.C. However, some of the material in the hymns may be much older. There is evidence that the hymns incorporate Indian traditions formed long before 1200 B.C., perhaps as early as 5000 B.C., and some scholars have suggested that the *Rig-Veda* can be regarded as an embodiment of all that was known to the Aryans.

The *Rig-Veda* is 'renowned for the beauty of its invocations to the creative spirit of the natural world' (Watson 1974), and it contains numerous prayers for sunlight, fair weather and warmth, which Alvi (1976) considered an indication that the climate of north-west India was colder when the hymns were composed than it is nowadays. The hymns are dedicated to the Aryan deities, the most prominent being Indra, the storm-god, the bestower of rains, to whom 250 hymns are addressed.

Figurative language was used in the *Rig-Veda*, so interpretations of the hymns are open to question. Nonetheless, as Unakar (1933, 1934) has shown, it is

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beyond dispute that the hymns contain weather lore and much valuable information about contemporary weather and climate in north-west India. Furthermore, there are references in the *Rig-Veda* to ships and voyages in them, indicating that the Aryans also possessed some knowledge of maritime meteorology. We do not know how successful the Aryans were in their attempts to induce rain by means of religious rites. It would be surprising if they were aware of the scientific principles involved. As Alvi (1976) has pointed out, however, their practice of burning offerings in sacrificial fires 'seems somewhat similar to the present-day technique of cloud-seeding from ground based generators'!

Allusions to weather and climate also appear in two great Hindu epics, the *Ramayana* and the *Mahabharata*, which are concerned with events taking place in India between 1000 and 700 B.C. To give a vivid example, the *Mahabharata* contains what seems to be a description of the onset of the summer monsoon in the region of India north of Delhi, where the poem is set. In the words of the translation quoted by Khrgian (1970):

'Indra ... covered the entire firmament with masses of blue clouds ... And those clouds, luminous with lightning, and incessantly roaring against each other in the welkin, poured abundant water ... And in consequence of the myriads of waves caused in the falling torrents, the deep roar of the clouds, the flashes of lightning, the violence of the wind, and the general agitation, the sky looked as if dancing in madness. The sky became overcast, and the rays of the Sun and Moon totally disappeared in consequence of that incessant downpour ... And the Earth was filled with water all around.'

References to weather and climate can be found in various other literary works of ancient India (see Damiens 1984). In the book entitled *Arthasastra*, for example, written by Kautilya in the fourth century B.C., there are statements which indicate not only a systematic approach to the study of India's rainfall patterns but also reveal that some sort of raingauge must have been used in those days (Sammadar 1912). Another work of ancient India, *Manu-Smriti*, which was probably written in the second century A.D., also contains various meteorological references, but is notable chiefly as the source of the motto used today by the India Meteorological Department, *Adittyat Jayate Vrishthi*, meaning 'from the sun, rain is born'. This fundamental truth could not have been better expressed.

References to weather and climate can also be found in ancient Hebrew texts and in the classical literature of China and Greece. In Homer's *Odyssey*, for example, and in *The Psalms of David* (Psalm 107), changes in wind and weather and associated changes in sea state are attributed to divine control. The Chinese kept weather records and were particularly interested in phenology and weather lore, as Wang (1979) and Wang and Zhang (1988) have pointed out. The Greeks were interested in weather lore too, the writings of Hesiod (c. eighth century B.C.), Theophrastus (c. 315–240 B.C.) being particularly important in this respect (Neumann 1989).

The achievement of the Greeks

Aristotle (384–322 B.C.) discussed monsoons and other tropical weather phenomena in his celebrated treatise, *Meteorologica* (Shaw 1926; Frisinger 1977), and a number of other Greeks of the period advanced knowledge of the tropical atmosphere significantly. Some of them, like Nearchus (Warren 1987), were travellers who had visited tropical lands. The Romans also travelled widely.



Photo. courtesy of Hoverspeed Ltd

Hoverspeed Great Britain leaving New York prior to the successful attempt to beat the transatlantic record held by s.s. *United States*. (See page 167.)



Figure 1. This shows the lines of sundials and two of the figures, the one in full sunlight (on the south-west face) being Lips, the other, partly in shadow (on the west face), being Zephyros.

Figure 2. This shows the lines of sundials and two of the figures, the one on the left (on the south-west face), being Lips, the one on the right (on the south face), being Notos.



According to Sir Napier Shaw (1926, *Manual of Meteorology*, Vol 1, p. 83): NOTOS represents a young man emptying a jar of water and signifies rainy weather; LIPS represents a man of middle age bearing an *aplustre* (the ornamental finial of the stern of a Greek ship under which the helmsman stood) and signifies good sailing weather for a homeward voyage; ZEPHYROS represents a fair, almost effeminate, youth, nude except for a loose mantle, the folds of which are filled with flowers. It signifies pleasant warm weather.

Indeed, *The Periplus of the Erythraean Sea* (a guide to the Arabian Sea, Red Sea and Persian Gulf), written in the first century A.D., provides documentary evidence that Graeco-Roman seafarers not only maintained trade links between the Middle East and India but also understood monsoon winds sufficiently well to sail by direct routes between the Red Sea and India (Schoff 1912).

Although the Greeks and Romans undoubtedly acquired some of their knowledge of foreign parts from first-hand experience, they also obtained information from merchants and other travellers. There was an extensive trading network linking southern Europe, the Middle East and various tropical lands long before the Christian era began (Warren 1987). As Couper (1972) has pointed out, there is proof of organised sea transport between the Persian Gulf and India during the third millennium B.C., and there is evidence that the ancient Egyptians, Minoans and Phoenicians travelled widely in the tropics, particularly in and around Africa. Indeed, it is conceivable that Phoenician mariners circumnavigated Africa as early as 600 B.C.

Knowledge of atmospheric and oceanic behaviour in the tropics must have been considerable in ancient times. Certainly there was no lack of information about physical conditions on the seas near India, Arabia and the Horn of Africa (Panikkar and Srinivasan 1972). In all probability there were individuals who tried to guard such knowledge as a trade secret, but, in general, the knowledge formed part of an oral tradition which was disseminated through interactions between groups of people, especially by contacts among the merchants of different countries. For many hundreds of years very little of the knowledge was written down. The achievement which marks out the Greeks, and to a lesser extent the Romans and the Indians, was that they recorded the knowledge and also studied it systematically.

The Tower of the Winds, Athens

The Tower of the Winds (emblem of the Royal Meteorological Society), or, to give it its proper title, the Horologium of Andronikos Kyrrhestes, was built about 40 B.C. by the astronomer Andronikos of Kyrrhos. This octagonal marble building originally served the triple purpose of sundial, water-clock (clepsydra) and weather-vane. According to Vitruvius (Marcus Vitruvius Pollio, Roman architect of the first century A.D.), the tower was originally surmounted by a revolving bronze Triton holding a wand which pointed out the face of the building corresponding to the wind. (See Figure 1 and Figure 2 on opposite page.)

The mediaeval period

Between the second century A.D. and the Renaissance of Science in the late Middle Ages understanding of the ocean-atmosphere system and its elements progressed little. Greek science declined completely and the disciplines which advanced most in the east were astronomy and pure mathematics. Nevertheless, knowledge of atmospheric and oceanic behaviour in the tropics continued to increase down the centuries. The increase was slow during the mediaeval period (fifth to fifteenth centuries) but accelerated from the late fifteenth century onwards, when sponsored voyages of exploration by Europeans penetrated far beyond what were previously thought to be the limits of the known world.

During the mediaeval period, Arabs ranged widely over the Mediterranean Sea, north Indian Ocean and adjacent lands. They expanded into Africa, southern Europe, south-west Asia and the Indian subcontinent, and their ships

penetrated beyond the Malay Peninsula to the Far East. By the eighth century, Arabs were trading regularly between the Persian Gulf and China (Wheatley 1961), and on every coast they visited they came into contact with Chinese merchants who were maintaining trade routes pioneered long before the eighth century. Commercial voyages were certainly made from China to India in the fifth century and were possibly made to East Africa too (Hourani 1951).

Unlike the Arabs and the Chinese, the Pacific islanders left no documentary evidence of their activities during the mediaeval period, so the extent of their travels has to be inferred from archaeological and other evidence; the extent of their atmospheric and oceanic knowledge is unknown. However, the impressive feats of navigation achieved by the islanders would have been impossible without an ability to interpret the winds, state of the sea, ocean currents and stellar patterns. Moreover, there can be little doubt that the islanders were also able to read the clouds intelligently. They probably knew how to recognize the warning signs of approaching squalls and tropical storms and were surely aware that islands below the horizon reveal their whereabouts by the clouds which apparently hang motionless above them.

Mediaeval knowledge of tropical weather systems was probably much greater than is generally supposed. As Couper (1972) has shown, the network of maritime trade routes across the Indian Ocean and seas farther east was certainly complex. There was intermingling of Pacific islanders with Chinese seafarers in Indonesia, and there were business contacts between Arab, Chinese, Indian, Persian and Burmese merchants on all the coasts from China to Mozambique. It is likely that an equally complex network of trade routes existed simultaneously in and around South America, Central America and the Caribbean. Whether or not there was direct contact between the two networks remains conjectural.

The works of Majid and Sidi Ali

Insight into the atmospheric and oceanic knowledge of the mediaeval period has been gained from a number of Chinese and Arabic texts written between the fifth and fifteenth centuries (Hourani 1951; Aleem 1967; Warren 1987). Among the texts are reports of journeys, essays on various aspects of travel and books on geography, but a comprehensive work on meteorology and oceanography has not yet come to light. However, two celebrated works on navigation contain exceptionally detailed and accurate information about the winds and weather over the Indian Ocean and adjacent lands at different times of year.

The works are *Kitab al-Fawa'id fi usul al-bahr wa'l-qawa'id* (the Book of Useful Instructions and Principles of the Science of the Sea), written by an educated Omani mu'allim (pilot), Ahmad Ibn Majid, in the second half of the fifteenth century, and *al-Muhit* (The Ocean), written by a Turkish admiral, Sidi Ali Celebi, between 1554 and 1557. Both authors discussed winds, weather, ocean currents and state of sea, and both provide specific advice on sailing seasons, defining them in terms of the dates when monsoonal wind reversals and associated changes in the weather normally take place. Indeed, Sidi Ali recommended seasons for as many as 52 different routes across the Indian Ocean and adjoining waters (Hammer 1834; Tibbetts 1971).

The works of Majid and Sidi Ali demonstrate that the Arabs accumulated a wealth of atmospheric and oceanic knowledge by the late Middle Ages. They also reveal that the Arabs gave some thought to the causes of the phenomena they observed, as the following passage shows. The words are those of Tibbetts (1971),

taken from his translation of Majid's work:

'In all the coasts of the world the wind comes from the land only at night, and (it) generally comes from the sea only during the day, because of the heating up of the (desert) sand by day and the coldness of the sea at night. It comes from the land, because the sea is colder than the land by day and the land is colder than the sea by night.'

The logic is a little awkward, as Tibbetts noted. Nevertheless, the writer was clearly familiar with the fundamental principles of land and sea breezes. In Tibbetts' opinion, 'it is possible that the copyist has omitted something due to his confusion with the constant repetition of the words for hotness and coldness.'

Ahmad Ibn Majid has become famous in Europe as the pilot who led Vasco da Gama from Malindi (East Africa) to Calicut (India) in 1498, though some say the guide was not Majid but a Gujarati Moor (see Aleem 1968; Tibbetts 1971). The identity of the pilot is unimportant here; the significant fact is that the Portuguese explorers of the Indian Ocean drew upon the nautical expertise of the Arabs, including their knowledge of meteorology, climatology and oceanography. No such expertise was available to Christopher Columbus when he set out to cross the Atlantic Ocean in 1492, nor was it to the Portuguese seafarers who explored the west coast of Africa in the fifteenth century.

Halley's contribution

From the late fifteenth century onwards European *knowledge* of the tropics grew steadily. Despite the growth, however, and despite the scientific awakening which took place in Europe in the sixteenth century, *insight* into the physical nature of tropical weather systems increased hardly at all until, in 1686, the mathematician and astronomer Edmund Halley (1656–1742) produced the first substantial contribution to tropical meteorology since the days of Aristotle. This took the form of a paper, *An Historical Account of the Trade Winds and Monsoons, observable in the Seas between and near the Tropicks; with an Attempt to assign the Phisical Cause of the Said Winds*, published in *The Philosophical Transactions* of The Royal Society of London. The annals of science contain few contributions to knowledge of the ocean-atmosphere more notable than this paper.

Halley began his paper with a detailed and methodical description of surface winds over the Atlantic Ocean, Indian Ocean, western North Pacific Ocean and eastern South Pacific Ocean and, in doing so, identified 'several problems that merit well the consideration of the acutest naturalists'. He then dismissed the explanation of trade winds 'some have been inclined to propose', rejecting the view held by such eminent philosophers as Galileo Galilei (1564–1642) and Johann Kepler (1571–1630) that 'as the globe turns eastwards, the loose and fluid particles of the air, being exceedingly light, are left behind; so that, in respect of the Earth's surface, they move westwards, and become a constant easterly wind'. He believed it necessary 'to substitute some other cause, capable of producing a like constant effect, not liable to the same objections, but agreeable to the known properties of air and water, and the laws of the motion of fluid bodies'. In his opinion, trade and monsoon winds result from 'the action of the sun beams on the air and water, as he passes every day over the ocean, considered together with the nature of the soil, and situation of the adjoining continents.'

Developing Mariotte's vague ideas on the effects of 'The Motion of the Earth from West to East' and 'The Vicissitude of the Rarefactions of the Air by the Heat of the Sun', contained in *Traité du mouvement des eaux et des autres corps fluides*, published posthumously in 1686 (Burstyn 1966), Halley reasoned as follows:

'First then, according to the laws of statistics, the air, which is less rarified or expanded by heat, and consequently more ponderous, must have a motion towards those parts where it is more rarified and less ponderous, to bring it in to an equilibrium; and secondly, the presence of the sun continually shifting to the westward, that part towards which the air tends, by reason of the rarefaction made by his greatest meridian heat, is with him carried westward, and consequently the tendency of the whole body of the lower air is that way. Thus a general easterly wind is formed, which being impressed on all the air of a vast ocean, the parts impel one another, and so keep moving till the next return of the sun, by which as much of the motion as was lost is again restored, and thus the easterly wind is made perpetual.'

Three paragraphs later he argued:

'But as the cool and dense air, by reason of its greater gravity, presses on the hot and rarified, it is demonstrable that this latter must ascend in a continued stream, as fast as it rarifies, and that being ascended, it must disperse itself to preserve the equilibrium; that is, by a contrary current, the upper air must move from those parts where the heat is greatest: so by a kind of circulation, the north-east trade wind below will be attended with a south-westerly above, and the south-easterly with a north-west wind above.'

Although as Majid's treatise shows, the basic nature of land and sea breezes had long been appreciated, Halley deserves credit for so lucidly expounding in physical terms the concept Majid outlined and for being the first to recognize that thermal contrasts between land and sea are fundamental in the shaping of atmospheric circulation patterns *on the scale of trade winds and monsoons*. In attributing the westward component of trade winds to the effect of the sun shifting westward over the ocean, however, his intuition failed him. It remained for George Hadley (1735) to explain that the westward component is due to the influence of Earth's rotation on air currents flowing towards the equator (the Coriolis effect). Nevertheless, as Deacon (1971) has commented, 'his general explanation and the importance he attached to the relative situation of land and sea has not been challenged.'

Certainly Halley's convective mechanism was an improvement upon the notion of Martin Lister, who, in a paper read before The Royal Society of London in 1684, described the trade winds as the 'constant breath' of the sargasso weed 'because the matter of that Wind, coming (as we suppose) from the breath of only one *Plant* it must needs make it constant and uniform: Whereas the great variety of *Plants* and *Trees* at land must needs furnish a confused matter of Winds'. Shaw (1926) has pointed out that this 'explanation' is evidently based upon Aristotle's theory of exhalation or emanation as the cause of winds. He remarked: 'If Dr Lister had described the trade winds as the surface-exhalation or emanation from an anticyclone instead of from the plants that grow therein he would have made an effective contribution to the subject.'

Early observations

The papers of Halley and Hadley are all the more remarkable as they were the only significant contributions to tropical meteorology published during the

seventeenth and eighteenth centuries. Nevertheless, the foundations for the scientific progress of the nineteenth and twentieth centuries continued to be laid: there were advances in mathematics and physics; meteorological instruments were invented and improved; and knowledge of weather systems expanded at an ever-increasing rate (see, for example, Capper 1801). As always, seafarers showed a keen interest in atmospheric and oceanic behaviour, with the master mariners of the East India Company displaying the most diligence, carefully and systematically recording in their log-books observations of wind, weather and sea state at regular intervals during their voyages (Markham 1871; Parkinson 1937).

Individuals ashore began to make regular meteorological observations too. Among the first were Mr Henry Traill, who kept a diary of the weather at Calcutta between 1 February 1784 and 31 December 1785, and Colonel Pearse, who kept a similar journal, also at Calcutta, recording in it twice a day (7 a.m. and 2.15. p.m.) between 1 March 1785 and 28 February 1788 observations of wind force and direction, as well as measurements of pressure, temperature, humidity and rainfall. By the middle of the nineteenth century there were hundreds of weather stations in India, the most notable being those maintained at the Madras, Bombay and Trivandrum Observatories. As Markham (1871) commented: 'The practical importance of meteorological observations is so great as to have ensured their registration in India at a very great number of stations and over a long period of time. They affect the operations of the seaman and the husbandman, and are a vital element in the calculations of health officers, administrators and engineers'. Markham mentioned many of the officials and enthusiasts who established stations and noted that abstracts of meteorological registers were often published in the *Journal of the Asiatic Society of Bengal*.

Although the early observations are historically important and interesting, most are worthless for scientific purposes. There were too many shortcomings. Too many observers were untrained or imperfectly trained and too many failed to appreciate the importance of punctuality or the need for accuracy. Moreover, the specifications, calibrations and exposures of instruments frequently left much to be desired (Alvi 1976). Little attention was paid to standardisation or other scientific requirements of meteorological observations. Such matters were largely neglected before 1865, when the Meteorological Committee appointed by the British authorities in India resolved to act upon a critical report prepared by James Glaisher (1863).

Whatever the quality of the early observations, however, the enthusiasm for observing the weather and maintaining meteorological registers was a welcome development, for it was a manifestation of an upsurge of interest in meteorology during the late eighteenth century and early part of the nineteenth. Henceforth, there was to be no neglect of tropical meteorology, or any other branch of meteorology, for that matter.

REFERENCES

- Aleem, A.A. (1967) Concepts of currents, tides and winds among medieval Arab geographers in the Indian Ocean. *Deep-Sea Res.*, 14, pp. 459–463.
 — (1968) Ahmad Ibn Majid: Arab navigator of the XVth century and his contributions to marine sciences. *Bull. Inst. Oceanog. Monaco*, Numéro Spécial 2 (*Cong. Int. Hist. Oceanog.*, 1), pp. 565–580.

- Alvi, S.M.A. (1976) *Hundred Years of Weather Service (1875–1975)*. India Meteorological Department, 207 pp.
- Baum, W.A. (1977) Foreword printed on the dust-jacket of *The History of Meteorology: to 1800*. (Frisinger 1977).
- Burstyn, H.L. (1966) Early explanations of the role of the Earth's rotation in the circulation of the atmosphere and the ocean. *Isis*, **57** (188), pp. 167–187.
- Capper, J. (1801) *Observations on the Winds and Monsoons; illustrated with a chart, and accompanied by notes, geographical and meteorological*. Printed by Whittingham, London. 234 pp.
- Couper, A.D. (1972) *The Geography of Sea Transport*. Hutchinson University Library, London. 208 pp.
- Damiens, J. (1984) Météorologie dans l'Inde ancienne. *La Météorologie*, **VII** (3), pp. 35–39
- Deacon, M. (1971) *Scientists and the Sea 1650–1900: a study of marine science*. Academic Press. 445 pp.
- Frisinger, H.H. (1977) *The History of Meteorology: to 1800*. American Meteorological Society. Historical Monogram Series, Science History Publications, New York. 147 pp.
- Glaisher, J. (1863) Report on the Meteorology of India in relation to the health of the troops. In *Report of the Royal Commission on the Sanitary State of the Army in India* (Volume 1). London. pp. 781–943.
- Hadley, G. (1735) Concerning the cause of the general trade winds. *Phil. Trans. R. Soc.*, **39**, pp. 58–62.
- Halley, E. (1686) An Historical Account of the Trade Winds and Monsoons, observable in the Seas between and near the Tropicks; with an Attempt to assign the Phisical Cause of the Said Winds. *Phil. Trans. R. Soc.*, **16**, pp. 153–168.
- Hammer, J. von (1834) Extracts from the Mohi't, that is the Ocean, a Turkish work on Navigation in the Indian Seas. *J. Asiatic Soc. Bengal*, No. 35. pp. 545–553.
- Hourani, G.F. (1951) *Arab Seafaring in the Indian Ocean in ancient and early medieval times*. Published in 1975 by Octagon Books (Princeton Oriental Studies, Volume 13), 131 pp.
- Khrgian, A.K. (1970) *Meteorology: an historical survey, Volume 1* (Second Edition). Israel program for Scientific Translations (Translation by R. Hardin), 387 pp.
- Markham, C.R. (1871) *A Memoir on the Indian Surveys*. Printed by Order of Her Majesty's Secretary of State for India in Council, London. 303 pp.
- Neumann, J. (1989) Forecasts of fine weather in the literature of Classical Antiquity. *Bull. Amer. Meteorol. Soc.*, **70**, pp. 46–48.
- Panikkar, N.K. and Srinivasan, T.M. (1972) Early concepts of oceanographic phenomena of the Indian Ocean. *Proc. R. Soc. Edin.*, **72** (24), pp. 263–273.
- Parkinson, C.N. (1937) *Trade in the Eastern Seas, 1793–1813*. Cambridge University Press. 435 pp.
- Sammadar, J.N. (1912) Indian meteorology of the 4th century B.C. *Q. J. R. Meteorol. Soc.*, **381**, pp. 65–66.
- Schoff, W.H. (1912) Translation from the Greek and Annotation of *The Periplus of the Erythraean Sea* (Travel and Trade in the Indian Ocean by a merchant of the First Century). Longmans, Green, and Co. 323 pp.
- Shaw, Sir Napier (1926) *Manual of Meteorology: Volume 1 (Meteorology in History)*. Cambridge University Press. 339 pp.
- Tibbetts, G.R. (1971) *Arab Navigation in the Indian Ocean before the Coming of the Portuguese*. The Royal Asiatic Society of Great Britain and Ireland, Oriental Translation Fund, New Series, Vol. XLII. 614 pp.
- Unakar, M.V. (1933, 1934) Meteorology in the *Rig-Veda*. *J. Asiatic Soc. (Bombay Branch)*, **9**, pp. 53–78, and **10**, pp. 38–57.
- Wang, P-K. (1979) Meteorological records from ancient chronicles of China. *Bull. Amer. Meteorol. Soc.*, **60**, pp. 313–318.
- Wang, P-K. and Zhang, D. (1988) An introduction to some historical governmental weather records of China. *Bull. Amer. Meteorol. Soc.*, **69**, pp. 753–758.
- Warren, B.A. (1987) Ancient and medieval records of the monsoon winds and currents of the Indian Ocean. In *Monsoons*, eds. J.S. Fein and P.L. Stephens. Wiley Interscience, New York. pp. 137–158.
- Watson, F. (1974) *A Concise History of India*. Thames and Hudson, London. 192 pp.
- Wheatley, P. (1961) *The Golden Khersonese (Studies in the Historical Geography of the Malay Peninsula before AD 1500)*. University of Malaya (Reprinted by Greenwood Press, 1973. 388 pp.)

Recent progress in Weather Routeing for Merchant Vessels *

By J.S. HOPKINS

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In the days of sail, the choice of a route by a vessel could be critical in determining whether the voyage would be speedy, slow or end in disaster, and so early mariners quickly learned some rudimentary climatology for route-planning purposes. In the 1840s and 1850s, Maury's compilations of observations into advisory wind and current charts were a great step forward. However, reliance on climatology meant that individual voyages could still be adversely affected when conditions departed from the norm, and so further significant advance had to wait until weather forecasting became sufficiently accurate for reasonable guidance to be available several days ahead. The costs of operating a modern merchant vessel are such that efficiency of operation is vital, and a saving of even a few hours on a voyage of many days can help the financial viability of the enterprise. The Met. Office began a ship routeing service (now named METROUTE) in 1968, and as forecasting models improved in accuracy and in length of forecast period, so the benefits of ship-routeing became clearer.⁽¹⁾ Significant further developments have occurred over the last few years as a consequence of wind and wave forecast guidance from numerical models now being available on a global scale out to five days from data time.

Collaborative effort between the Systems Development Branch and the Marine Division of the Met. Office has resulted in the design of a special database which brings together the details of the vessels being routed with forecast products from the Met. Office global models. (Figure 1). This database is accessed both by the routeing officers via on-screen dialogues, and also by standard programs which are run to a time schedule linked to the availability of updated forecast products. The dialogues provide rapid interaction between the database and the routeing officers, allowing them to handle many more routeings than was the case with a paper-based system. Information on new voyages and also updated reports from ships already on passage can be inserted into the database at any time, and routeing officers can display information either in tabular or chart form for easy assessment and cross-checking. (Figure 2).

Most passages require an advised route which will minimise time on passage and so minimise fuel and other operating costs. However, certain special requirements can be stipulated; for example, sensitive cargoes may demand that wind/wave conditions remain below a specified threshold over the whole voyage, and this consideration is more important than achieving a minimum passage time.

The calculations to define a chosen route, using vessel performance characteristics and forecast weather, are rather time-consuming to be run on an *ad hoc* basis, and so are usually batched to be run overnight. Thus, new predicted positions for vessels on passage are available to routeing officers at the start of each working day, based upon the output from the midnight (00 UTC) run of the forecast models. Charts showing these predicted positions out to five days ahead are plotted automatically. (Figure 3). The routeing officers are all experienced

* Revised extract from a paper presented to the Institute of Marine Engineers in March 1990.

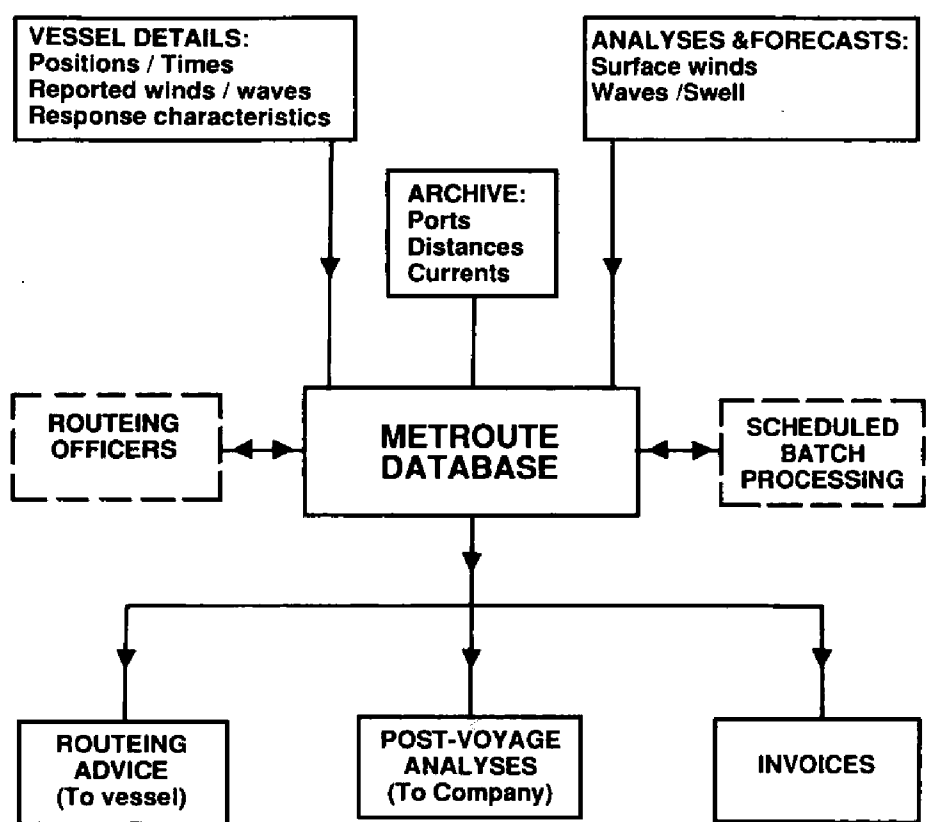


Figure 1. Schematic representation of the METROUTE database.

SHIP ROUTEING : VRS SUMMARY LIST FOR : ANNONSHIP

VOF

uvr4

To see full VRS details, type 'S' beside the report and press ENTER.

To add a new VRS, type in the details at the bottom and press PF6.

To add a WAY-POINT type 'B'-BEFORE or 'A'-AFTER in the SEL field, type in just a position at the bottom, and then press PF6.

PSG from : CHERBOURG				to : CRISTOBAL		
SEL	TIME	DATE	WIND dd/ff	LAT. WAVES ht/pd	LONG. SWELL dd/ht/pd	COURSE
-	0000	Z 09 / 05 / 90	060 012 kt	13 12 N 01.0 m 01 s	075 12 W 070 02.0 m 06	240 s
-	0600	Z 09 / 05 / 90	060 012 kt	12 24 N 01.0 m 02 s	076 13 W 070 02.0 m 06	233 s
-	1200	Z 09 / 05 / 90	060 016 kt	11 42 N 01.5 m 02 s	077 24 W 070 02.0 m 08	237 s
-	1800	Z 09 / 05 / 90	060 018 kt	11 00 N 02.0 m 02 s	078 24 W 060 02.5 m 08	235 s
New >	0000	Z 00 / 00 / 00		00 00 N	000 00 E	999
VRS >		999 999 kt		99.9 m 99 s	999 99.9 m 99	s
ENTER- SEE FULL VRS DETAILS PF1 - HELP PF3 - ReSELECT PASSAGE PF6 - ADD NEW VRS PF7 - PAGE UP PF3 - PAGE DOWN PF19 - TOP OF LIST PF20 - BOTTOM OF LIST PF24 - SCREEN CHART						

Figure 2. Example of on-screen voyage record available to routing officers. Positions, wind and wave reports are entered automatically into the database if the vessel is a member of the Voluntary Observing Fleet. ('99' here denotes missing data.)

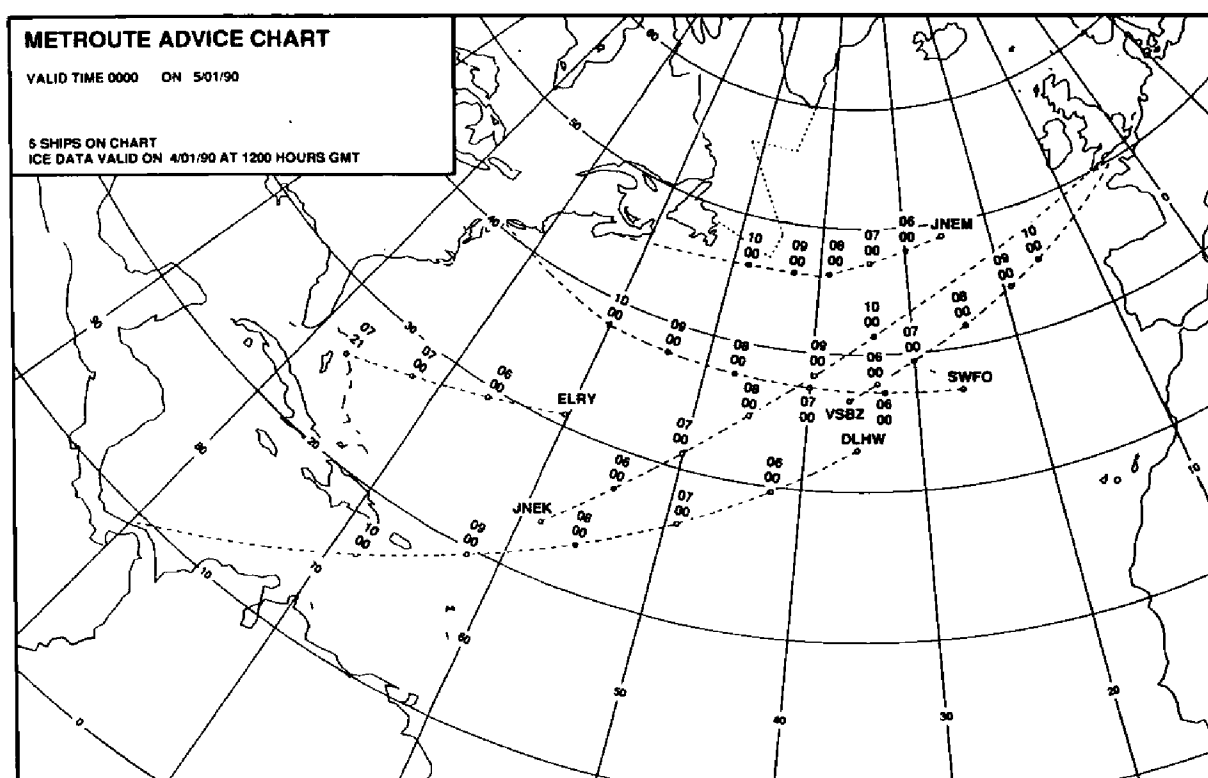


Figure 3. Five-day predicted positions for a sub-set of vessels being routed in the North Atlantic. In this example, Great Circle tracks are shown, with vessel speeds computed from predicted winds/ waves applied to vessel performance characteristics. After the fifth day, the track is continued to the destination.

ships' masters and so they can apply their professional know-how to the predictions so produced, making modifications if necessary, before passing appropriate guidance to the vessel. Since the METROUTE service is located within the Central Forecasting Office at Bracknell, the team also has access to senior meteorologists for further forecasting support. The philosophy of the 'man-machine mix' (i.e. nautical skills and meteorological experience allied to numerical predictions from proven atmospheric and sea-state models) is one which we are keen to preserve, since both components are vital to the credibility and consistency of the advice provided.

Post-voyage analyses are important components of the service offered; the owner or charterer may wish to have an independent assessment of the vessel's performance over the voyage, taking into account the weather experienced; and of course, comparison of time taken along the advised route provides an immediate indicator of the time benefit provided by the routing service. Such comparisons for a whole fleet over a few months have shown that the cost of the routing service is quickly recouped in operational savings.

The final role of the database is to ease the handling of the mundane (but important) administrative details such as the raising of invoices. Since all relevant details have been added to the database at an earlier stage, the generation of these final products in a clear and accurate fashion requires only a little further effort.

REFERENCE

1. Marine Division Staff. (1977) Development of Ship Routing and its modern application at the Met. Office, Bracknell. *The Marine Observer*, 47, pp. 23-31.

AURORA NOTES OCTOBER TO DECEMBER 1989

By R.J. LIVESEY

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Table 1 lists the observations received from ships of the U.K. Voluntary Observing Fleet and from Ocean Weather Ship *Cumulus*. Table 2 lists the principal auroral activity reported by professional meteorologists and amateur astronomers when four or more reports were received for any given night. The times quoted are the first and last GMT figures when any observer saw the aurora, which will be related to the location and longitude of the observer. The magnetic index A_p has been given for the day before the aurora began, the evening on which it began and the day afterwards. A_p is a measure of magnetic disturbance in the Earth's field taken over the 24-hour day. The bigger disturbances correlate with fine auroral displays.

Table 1 — Marine Aurora Observations October to December 1989

DATE	SHIP	GEOGRAPHIC POSITION	TIME (GMT)	FORMS IN SEQUENCE
3/4 Oct.	.. <i>Canmar Europe</i>	53° 24'N, 35° 00'W	0100–0130	QG.QRA. Max. alt. 20°
20/21	.. <i>Matco Clyde</i>	59° 30'N, 01° 50'E	2145–0230	RB. m ₃ HA.CRR. pRR. (Red, blue, yellow, half-sky.)
21/22	.. <i>Matco Clyde</i>	59° 30'N, 01° 50'E	1810–0200	pP.Crr.p ₃ CRR.RP. p ₂ CRR.p ₂ P. All-sky
21/22	.. <i>Norrisia</i>	56° 02'N, 02° 07'E	1822–2230	G.RR.p ₃ mRV.pP. CRR.G.
21/22	.. <i>Charles Darwin</i>	58° 47'N, 08° 10'W	1820–1835	G.CRR.P (red). Max. alt. 90°
21/22	.. <i>OOCL Challenge</i>	51° 00'N, 21° 00'W	2230–0130	QG
21/22	.. <i>Shetland Service</i>	56° 30'N, 02° 06'E	2230–2330	N
22/23	.. <i>Cumulus</i>	57° 00'N, 20° 00'W	0530	QN
23/24	.. <i>Lackenby</i>	51° 58'N, 53° 45'W	2225	QRA.RA.aRA.RA. Max. alt. 11°
24/25	.. <i>Cumulus</i>	56° 49'N, 20° 05'W	0100–0200	QN
24/25	.. <i>OOCL Challenge</i>	51° 42'N, 51° 42'W	0045	QP
25/26	.. <i>OOCL Challenge</i>	49° 06'N, 67° 30'W	0009	QRA
26/27	.. <i>Cumulus</i>	56° 54'N, 19° 54'W	2235–2337	QR.R.QN
3/4 Nov.	.. <i>Mairangi Bay</i>	45° 00'S, 92° 15'E	1500–2000	RA.G.RA.m ₅ RA.G. Max. alt. 28°.
3/4	.. <i>Authenticity</i>	55° 18'N, 01° 12'W	0000–0015	G.RR.m ₂ RR. (red).
6/7	.. <i>Cumulus</i>	51° 11'N, 19° 41'W	0030	QN
16/17	.. <i>Flinders Bay</i>	39° 00'S, 143° 30'E	1100–1135	Q (red).RR.CRR. Max. alt. 30°.
17/18	.. <i>Shetland Service</i>	56° 30'N, 02° 06'E	1755–1900	RV.aRV
17/18	.. <i>Liverpool Star</i>	41° 30'N, 09° 35'E	1955–2112	G.HA.RR.G.mRR. RV.HA.G. Max. alt. 25°.
17/18	.. <i>Sulisker</i>	68° 24'N, 01° 01'W	1730	CRR.HA.G.CRR. All-sky.

Table 1 (contd)

DATE		SHIP	GEOGRAPHIC POSITION		TIME (GMT)	FORMS IN SEQUENCE
17/18	..	<i>Discovery</i>	.. ..	42° 00'N, 11° 09'W	1957	G (red).
25/26	..	<i>Cumulus</i>	.. ..	57° 07'N, 20° 30'W	0555	QN
2/3 Dec.	..	<i>Cumulus</i>	.. ..	56° 33'N, 20° 30'W	0000–0200	QN
7/8	..	<i>Cumulus</i>	.. ..	55° 40'N, 08° 14'W	0542	N
29/30	..	<i>Cumulus</i>	.. ..	57° 00'N, 20° 00'W	2055–2310	QRR. Max. alt. 80°.

KEY: a = active, m₂,m₃,m₅ = multiple (2,3,5 forms), p = pulsating, p₂ = flickering, p₃ = horizontal streaming, A = arc, C = corona, G = glow, HA = homogeneous arc, N = unspecified form, P = patch, Q = quiet, R = ray, RA = rayed arc, RB = rayed band, RR = ray structure, V = veil.

**Table 2 — Auroral reports received October to December 1989
(from four or more observers in the Northern Hemisphere)**

DATE	TIME (GMT)	NUMBER OF OBSERVERS	MAGNETIC INDEX A _p			LOCATION AND ACTIVITY OF AURORAE*
4/5 Oct.	—	4	12	6	5	Finland (7)
6/7	1830–0010	6	5	10	12	North Dakota (4), Ireland (1), Scotland (1), Finland (5)
20/21	1800–0235	21	24	112	146	North Dakota (5), Wales (7), Denmark (7), Hungary (4)
21/22	1800–0350	36	112	146	51	North Dakota (5), Scotland (7), England (5)
22/23	1830–0250	21	146	51	22	North Dakota (5), Scotland (4), England (1), Finland (4), 'Lima' (1)
23/24	2225–1100	4	51	23	17	North Dakota (5), North Scotland (5), North America (5)
24/25	2306–1100	5	22	17	23	North Dakota (5), North America (1), 'Lima' (1), North Scotland (1), Finland (5)
25/26	2100–0247	5	17	23	24	Halifax N.S. (2), North America (3), North Scotland (5)
26/27	1820–0245	15	23	24	17	'Lima' (4), North Scotland (6), Scotland (4), Finland (5)
1/2 Nov.	1858–0148	4	14	8	21	North Scotland (3), Scotland (1)
2/3	1830–0110	•6	8	21	6	North Scotland (5), Scotland (4), England (4)
4/5	1840–0015	7	26	28	19	Scotland (4)
5/6	1945–0249	6	28	19	11	North Dakota (1), North Scotland (4), Scotland (3)
17/18	1630–0520	25	5	109	45	North Dakota (4), Wales (3), Halifax N.S. (6), Ireland (4), Scotland (6), England (6), Denmark (7), Hungary (6), Finland (3)
24/25	1800–2255	4	6	8	2	North Scotland (1), Hungary (3)
26/27	1700–0330	13	2	11	6	Scotland (4), Hungary (1)

Table 2 (contd)

DATE	TIME (GMT)	NUMBER OF OBSERVERS	MAGNETIC INDEX A_p			LOCATION AND ACTIVITY OF AURORAE*
29/30	1820-0248	5	28	19	20	North Dakota (3), North Scotland (5)
1/2 Dec.	1754-0510	10	20	38	22	North Dakota (5), Scotland (5), England (5)
22/23	1835-0049	5	8	26	15	North Dakota (4), Scotland (2)
26/27	1909-0345	9	16	22	25	North Dakota (5), Scotland (5)
27/28	1950-0345	6	22	25	10	North Dakota (1), Scotland (5)
29/30	2055-2335	5	10	50	30	'Lima' (4), North Scotland (7), Hungary (4)

*Storm activity code: 1 = glow or patch, 2 = homogeneous arc or band, 3 = rayed arc or band, 4 = ray bundles, 5 = active moving or flaming storm, 6 = coronal or half-sky, 7 = all-sky storm.

Note. The magnetic index A_p is given for the day before the aurora, the evening of commencement and the day following it.

The year 1989 saw the most active storm auroral events for a number of years. This activity permitted many delighted people in lower latitudes to see the aurora, perhaps for the first time. Consequently there was a large number of incoming reports to study. It is pleasing to record that with the raising of the Iron Curtain, reports started to come in from Hungary and Romania although the aurora in those latitudes tends to be the red mid-latitude aurora found to the south of the main storm structure when activity is strong. Such red apparitions are a feature of mid-European mediaeval records.

One marine auroral report was misidentified by the observers themselves as an apparition of NLC in November, but so far as the records since 1884 show, NLC do not manifest themselves at this time. Like fishing and shooting, they have their own 'close season'. However, the marine report tied in nicely with respect to activity, forms and timing with an auroral storm confirmed by other observers and the magnetic record. This emphasises the co-operative nature of our land and marine observing team.

As reported in this journal in April, the Ocean Weather Ship *Cumulus*, although nominally based at station 'Lima,' may now be deployed to adjacent areas in the North Atlantic Ocean. For a number of years, various weather ships on 'sentry duty' at Lima have sent in auroral reports that have been interesting and valuable. In Table 3 is given the score card for O.W.S. *Cumulus* in the years 1986-1989. Because of cloud and weather conditions many an aurora has had to be logged as 'unspecified' in form. However, the large number of sightings in 1989 bears out the high level of activity experienced in that year. Although the voyage programme of *Cumulus* can be modified, the meteorological staff continue to observe and report upon the aurora and we are very grateful for their continued support.

In all, at the present count, some 55 ships of which 10 were in the Southern Hemisphere, have contributed to auroral observing in 1989. On March 13/14 during the course of the Great Aurora, 25 ships contributed observations. Apart from the *Cumulus* with a score of 37 reports, the *Alliance* contributed four and several ships three nightly reports. Some of the ships' names have been turning up

Table 3 — Auroral sightings from O.W.S. *Cumulus*, near 57° 00'N, 20° 00'W

YEAR	AURORAL FORMS	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JLY.	AUG.	SEP.	OCT.	NOV.	DEC.
1986	N, G	1		2	1	3		3		2	1	1	1
	HA, HB								1				
	RA, RB	1								2			
	RR		1	1						1			
	CRR	1											
													Total 23
1987	N, G	2	1	3						1	3	1	
	HA, HB			2									
	RA, RB			1						1			
	RR								1	1	1		
	CRR												
													Total 18
1988	N, G	2	1	2	1	1				1	3	1	2
	HA, HB					1							
	RA, RB									2			
	RR	1											
	CRR												
													Total 18
1989	N, G	2	3	10	4	2			5		1	1	
	HA, HB	1		1									
	RA, RB	2											
	RR				2				2				
	CRR			1									
													Total 37

for a number of years as regular observers, but it is good to see new names appearing in the lists. What happens to the reports? They are all analysed for location, time, activity and any peculiarities, and copies are lodged with the national auroral archives in Aberdeen University. Dr Gavine has recently inspected records and enjoyed going back in time looking at old observations. They are all there for future researchers to consult.

Personalities

(Readers are invited to notify the Editor of observing officers retiring from the Navigating and Radio Departments.)

RETIREMENT — CAPTAIN C.A.S. BORTHWICK retired from the Met. Office on 5 March 1990 on his sixtieth birthday.

Arthur Borthwick was born in March 1930 and educated in Edinburgh. He underwent pre-sea training at Leith Nautical College prior to joining Currie Line Ltd of Leith in July 1947. He later joined Shaw Savill & Albion Co. Ltd in mid 1952 and served 27 years with that company before joining the Met. Office. The

first of 31 meteorological logbooks he provided was received from the *Waipawa* in September 1953. Of these, 13 logs were assessed as Excellent, and he received four Excellent Awards for his efforts.

He obtained his Master's Certificate in 1957 and was given his first command in July 1965, the *Delphic*. He spent four years in command of the *Canopic* and a similar period on the ship he considered the finest of the Shaw Savill buildings, *Iberic*.

In the spring of 1979 Captain Borthwick joined the Ship Routeing Service at Bracknell and was the senior member of the team of six Master Mariners serving in METROUTE when he retired. We hope he continues to enjoy good health and a happy retirement, as he and his wife remain at their Wokingham home.

RETIREMENT — CAPTAIN A.A. RAILTON of P.& O. Containers Ltd was born on 14 April 1930 and studied for the sea at South Shields Marine School after attending a course at the Outward Bound Sea School at Aberdovey. He signed indentures with Alfred Holt and Co. in September 1946 and sailed first on s.s. *Samcree* under management for the Ministry of War Transport.

Alan Arthur Railton obtained his Master's Certificate in 1955 and was first appointed Master in 1970 when he took command of m.v. *Egori*. He transferred to Overseas Containers Ltd in November 1982 and retired on 30 April 1990. His weather observing began with a met. log from the *Ajax* in October 1951, followed by 23 further logs in 15 observing years. Thirteen of these logs were 'Excellent' and he received six Excellent Awards in the 1980s.

Captain Railton writes that he hopes that his co-operation in weather observing has been of value and feels that there is still a role for the Voluntary Observing Ships in spite of modern high-technology developments. He is also pleased to see that the younger officers on board show interest in keeping up the work and says that *The Marine Observer* is a popular publication with all on board. Our thanks for his kind remarks and good wishes for peaceful retirement go to Captain Railton.

RETIREMENT — CAPTAIN D.N. BOON has retired from Geest Line after 43 years at sea. David Boon was born in July 1930, received higher education at Christ's College, Finchley and took the concentrated course for Second Mate's at King Edward VII Nautical College in London. He first went to sea as an Apprentice in March 1947 in m.v. *Lingula*, a 9,000 dwt tanker of the Anglo Saxon Petroleum Company, and later spent 12 years with Elders & Fyffes Ltd. He obtained his Master's Certificate in February 1957.

He joined Geest Line in 1965 and was promoted to command of m.v. *Geestport* in August 1966. His spectacular observing career, during which there were only four years out of 39 when logs were not received from him, produced a grand total of 96 meteorological logbooks of which 11 were marked Excellent. He received Awards in 1969, 1973, 1988 and 1989. In his final two years at sea, he helped provide special data for the VSOP-NA project

Captain Boon writes to us that, during an interesting sea career, in 1979 he rescued three West Indian fishermen adrift in the Caribbean; in August 1985 he rescued Richard Branson and eight crew of *Virgin Atlantic Challenger*, 200 miles west of the Scilly Isles. Twelve months later in the same approximate position he

rescued lone transatlantic sailor Michael Richey and his yacht *Jester*. His son Nicholas is a Second Officer with Mobil Shipping Co.

We thank Captain Boon for his encouraging words about observing and routeing and send him best wishes for a happy and fruitful retirement.

Book Reviews

Comecon Merchant Ships by Ambrose Greenway. 154 mm × 248 mm, 190 pp., *illus.* Price: £14.95 (p&p extra 95p).

Soviet Merchant Ships by Ambrose Greenway. 154 mm × 248 mm, 298 pp., *illus.* Price: £16.95 (p&p extra £1.85).

Published by Kenneth Mason, Dudley annex, 12a North Street, Emsworth, Hampshire PO10 7DQ. Orders to Ruskin Book Services Ltd, Adam House, 56–58 Birmingham Road, Kidderminster, Worcs. DY10 2SA.

The latest editions of Lord Greenway's authoritative reference works are most comprehensive recognition manuals. They are the definitive works for those concerned with international shipping. The author highlights the fact that the whole Communist Bloc, excepting perhaps East Germany, is suffering in varying degree from potentially crippling economic problems and a long, hard struggle lies ahead. Shortages of equipment in domestic shipyards have been and will continue to be commonplace and these in turn lead to late deliveries and even cancellations of orders.

On the Russian front there is a certain acceleration in the scrapping of many uneconomical vessels that were built in long series during the expansion period of the 1960s, and it has been stated that such a building programme will not be repeated. The introduction of large cellular container ships is some 25 years behind Western counterparts. These facts and much more become clear from studies of these unique volumes with their first class photographs and ample details of the ships and others in their series. The fact that the front cover illustrations for both book jackets have been inverted does not detract from the usefulness of their contents, especially if one does not understand cyrillic script.

As general guides to the Soviet and Comecon shipping scenes these books must be the best available and it will be interesting to observe future developments resulting from the policies of *glasnost* and *perestroika*.

J.F.T.H.

The Human Impact of Climate Uncertainty by W.J. Maunder. 154 mm × 233 mm, xxv + 170 pp., *illus.* Routledge, London. Price: £10.95 paperback, £25.00 hardback.

In this volume Maunder presents a well illustrated overview of the role of weather and climate information in economic, social and political decision making. The book is aimed at the non specialist and is eminently readable as an interesting and challenging introductory text to this fascinating field.

There are two major themes throughout the book. Firstly the need to acknowledge the variable nature of the atmosphere as an integral component of

resource management. Secondly, the necessary research that must be undertaken to monitor and understand the atmospheric resource, its interaction with other components of the Earth's resources and how the value of weather/climate information may be assessed. Topics are well illustrated with examples, mostly from the U.S.A. or New Zealand. Extensive, up-to-date bibliographies are provided. The examples are primarily from land based activities such as building and construction or agriculture; however, principles discussed are equally applicable to marine transportation and offshore development.

In the first two chapters there is a brief review of the development of climatology from the description of regional conditions to an evolving and interactive component of the complex decision-making process. The dichotomy of opinion is highlighted, between those to whom this evolving field of economic climatology is unscientific and therefore assumed undesirable and those to whom it is an essential development in a world of possible climate change and increasing population, pressure on resources and sensitivity to weather variations.

In the next three chapters the basic principles of the components of the atmospheric resource, climate impact and sensitivities and methods of use of weather data are set out. These form an important foundation for subsequent chapters. The concept of limitation or adaptive responses to specific changes in the atmospheric resource are explored. Current issues such as ozone depletion and greenhouse warming are explained clearly yet concisely and are used as an illustration of the political implications of climate change. The decision making framework within which the atmospheric resource must be managed is described. The importance of the dissemination of weather/climate information from the scientist to the decision maker is emphasized. Although techniques for monitoring and forecasting weather have been improved considerably, the author criticizes severely the lack of corresponding investment into improving application of weather knowledge and analysis of the sensitivity of activities to weather and climate. The following chapter on climate impacts and sensibilities is very general; however it provides a useful link to later chapters through forward references to specific examples.

The interesting topic of commodity weighting weather data with respect to its economic influence for decision making is explained very well. It provides a central concept in economic climatology. The impact of weather anomalies is assessed by considering the spatial distribution of the anomaly relative to that of the commodity production and importantly, also the contribution of the commodity to the national economy. This principle is illustrated using examples of agricultural production in New Zealand and commodity weighted temperature departures in the U.S.A.

In chapters 8 and 9 the role of weather/climate information in management and planning in agriculture, electricity production and consumption, manufacturing, retail, trade, construction and transport are considered fairly cursorily. For many products transportation costs represent a considerable proportion of the total cost of production and delivery. Accurate forecast of weather related demand and transportation conditions can improve efficiency considerably. This is emphasized further in chapter 10, in which it is suggested that the current and future role of weather information is via commodity weighted weather/climate information in explanatory or empirical models.

The final chapter is opened with an imaginative futuristic agenda for the day in the life of a weather administrator in 1994. This is used to portray the envisaged

future role of economic meteorology/climatology. The author concludes that within a decade meteorologists must be making significant contribution to economic and political decisions.

This book is very interesting and easy to read without expert knowledge. A thorough, although sometimes repetitive, case is presented for an urgent increase in the effort to treat the atmosphere as a valuable resource to be utilized and included in economic and political planning and decision making. It represents broad principles rather than ideas restricted to a particular type of weather information or commodity. As such, specialists may be disappointed by the depth of discussion of their particular aspect of this topic but they should be challenged by the possibilities of applying the principles discussed.

Dr M.F. Mylne
Met. Office, Advisory Services
(Climate Assessment and Publications)

Climate and Man by Fred Pearce. 210 mm × 260 mm, 176 pp., illus. Vision Books, The Forum, 74–80 Camden Street, London NW1 0EG. Price: £14.95.

The prospect of global warming and its consequences are of concern to us all. *Climate and Man* subtitled *From Ice Ages to the Global Greenhouse* is, therefore, a topical book and one which is easy to read, lively and never dull. The chapters are short and each one covers several topics or various aspects of the same topic. The book, published to coincide with the London Weekend Television series shown in Britain in summer 1989, *Climate and Man*, is aimed at the general reader and assumes little or no specialist knowledge. The topics covered in the book are many and varied, and each topic is explained in simple, non-technical language. Throughout the book there are selections of striking black-and-white photographs which visually emphasize some of the points made in the text.

The author, who is news editor of *New Scientist*, has divided the book into four parts which he calls 'The Goldilocks Planet', 'A Change in the Weather', 'Models for the Future' and 'Prognosis for the Planet'. These titles do not give any real indication of the subject matter and in the course of the book the author manages to work in the Black Death, Lord Byron, dinosaurs, Neanderthal Man, Vikings, volcanoes, World War II and Mrs Thatcher. Throughout the book a number of specialists in climatology and related matters are quoted verbatim, sometimes presenting differing viewpoints. As the author says, 'In the final pages, the optimists and pessimists battle it out.'

Having given the book such a good build-up I have to spoil it by saying that overall it is disappointing. The scope of the book is so wide that coverage of most of the subjects is very shallow. It gave me the impression of giving the type of explanations an adult would give to a young, inquisitive child, that is, enough to satisfy the curiosity but with much omitted so as to keep it simple. To illustrate, chapter 2 is called 'Ice and the wobbly planet'. The 'wobbles' referred to, though not mentioned by name, are obliquity, eccentricity and precession and, of these, obliquity is the only 'wobble' discussed. There are a few bloomers in the book. You would be surprised to learn for example: tornadoes '... are most frequent in tropical areas, ...'; Mexico '... depends on hurricanes for up to half its rainfall.'; 'In summer many of the rain bearing depressions that pass over Britain, preventing droughts, began life as hurricanes in the Caribbean'; 'If the (ice) caps

start to move ... they would push thousands of icebergs into the oceans. As the icebergs melt they could raise sea levels by several metres.'

The one major omission is that the main greenhouse gas, water vapour, does not even rate a mention. Water vapour will increase in response to global warming and is expected to further enhance it. There is little in this book which would appeal directly to a mariner unless he wanted a simple introduction to the problems of climate change.

R.D. Whyman
Met. Office

(Marine Advisory and Consultancy Services)

Notices to Marine Observers

STATE OF SEA PHOTOGRAPHS REQUESTED

For the forthcoming revision of *The Marine Observer's Handbook*, good quality photographs of the state of the sea, in colour or black-and-white, for estimating wind speed, are required immediately. Readers are invited to send their state of sea photos to the Editor of *The Marine Observer*, including an indication of the estimated wind force for each illustration. A reward in the form of a useful publication is offered to any contributor whose work is published in the handbook.

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Norfolk: Mr Earle Ray Brown, Jr., PMO, NWS, NOAA, Norfolk International Airport, Norfolk, VA 23518. (Tel: 804-441-6326)

Texas: Mr James Nelson, NWS, NOAA, Route 6, Box 1048, Alvin, TX 77511. (Tel: 713-331-0450)

* A limited selection of PMOs holding small stocks of instruments and/or stationery for issue to the U.K. Voluntary Observing Fleet. For complete details, see the *Marine Observer's Guide*.

INDEX TO VOLUME 60, 1990

Subjects of *Notices to Marine Observers*, photographs and persons named in *Retirement* and *Obituary* notices are indexed under these general headings.

- Abbey*, 9, 14
ACT 2, 181
ACT 3, 18
ACT 7, 69, 70, 175
ACT 8, 180
Alliance, 68
 Antarctic and John Biscoe, 128
Appleby, 64
 Atlantic storm, Unusually severe, hits the Iberian Peninsula during February 1989, 122
Atlantic Universal, 72
Auckland Star, 19
 Aurora Australis:
 Indian Ocean, 20
 Tasman Sea, 21
 Aurora Borealis:
 Caribbean Sea, 20
 Eastern North Atlantic, 184
 North Atlantic, 19
 North Sea, 183, 185
 Aurora, Notes on, 40, 88, 133, 198
Australian Venture, 108
Authenticity, 183
 Awards, Special long-service:
 CLARK, CAPT. P.J., 87
 LAWRENCE, CAPT. S.J., 87
 MANSON, CAPT. P.J.R., 87
 THOMAS, CAPT. C.O., 87
- Baltic Link*, 110
 Barograph, Presentation of, 38
Benalder, 66
Benavon, 71
 Bioluminescence:
 Arabian Sea, 118
 Eastern South Atlantic, 119
 Indian Ocean, 17
 Birds:
 Caribbean Sea, 87
 Eastern North Atlantic, 117
 Eastern North Pacific, 118
 Eastern South Pacific, 72
 Indian Ocean, 73
 Mediterranean, 72
 North Atlantic, 117, 178, 179
 North Pacific, 179
 North Sea, 15
 Southern Ocean, 16
 Book Reviews:
 Age of the Arctic-hot conflicts and cold realities, Gail Osherenko and Oran R. Young, 138
 Climate and Man, Fred Pearce, 205
 Comecon Merchant Ships, Ambrose Greenway, 203
 Fairplay World Ports Directory 1990, P. Malpas, 138
 How to Write and Publish a Scientific Paper, Robert A. Day, 97
 Human Impact of Climate Uncertainty, W.J. Maunder, 203
 Oceans of Birds, Tony Soper, 96
 Penguins, John Sparks and Tony Soper, 48
 Shiphandling for the Mariner, Daniel H. MacElrevey, 97
 Ships Atlas, The, 139
 Soviet Merchant Ships, Ambrose Greenway, 203
British Esk, 17
British Ranger, 17
British Renown, 116
British Spirit, 113, 172
British Trent, 13
- Cardigan Bay*, 22, 69, 177
Cetacea:
 Coral Sea, 115
 English Channel, 11
 Indian Ocean, 69, 175
 North Atlantic, 114, 174
 Norwegian Sea, 68
 St George's Channel, 67
 South Atlantic, 12
 Western South Atlantic, 115
 Tasman Sea, 69
Charles Darwin, 12
Churchill, 117, 178
 Clouds, When is a Cb not a Cb?, 132
 Convergence, Cold air, land-breezes, snowfalls near coastlines in southern Britain 11-13 January 1987, 26
 Coronae, Eastern South Atlantic, 182
 Cuckoo, Grey-capped, 87
 Cyclone 'Alibera', Indian Ocean, 169
- Depressions:
 North Atlantic, 7, 9, 64
 North Pacific, 63
 North Sea, 6
 South Pacific, 108
Direct Kea, 179
 Dolphins see *Cetacea*
 Dust, Red Sea, 67
- Editorial, 4, 54, 166
Eland, 20
 Electrical storm, Severe, South China Sea, 66
Encounter Bay, 76
Endeavour, 65
English Star, 72, 87, 115
Esplanade, 121
 Excellent Awards, 100
 EYRE, J.R. and F.W. TAYLOR, Future satellite missions, 32
- Farnella*, 118
 Fish:
 Gulf of Guinea, 13
 South China Sea, 177
 Fleet Lists:
 Australia, 52, 155
 Canada, 156
 Great Britain, 50, 142
 Hong Kong, 158
 India, 160
 New Zealand, 52, 163
 Fog, Shallow, Western South Atlantic, 113
Forthbank, 67
 Front, Passage of, The Little Minch, 10
- GADSDEN, M., Noctilucent clouds, 77
Gardline Locator, 13
Gas Enterprise, 176
 Global Telecommunications System of the World Weather Watch, 83

Halo, Indian Ocean, 181
 Halo complex, Tasman Sea, 18
Havkong, 110
 Heavy weather, Eastern North Atlantic, 170
 HENDRY, I., Three new recruits from the U.K. oil and gas industry, 37
 HOPKINS, J.S., Recent progress in Weather Routeing for Merchant Vessels, 195

 Iberian Peninsula, Unusually severe Atlantic storm hits the, during February 1989, 122
Indiana I, 113
 Insects:
 Caribbean Sea, 75
 Eastern North Atlantic, 180
 Tasman Sea, 180
Ironbridge, 7
Isocardia, 112, 118, 176

John Biscoe, 179
 John Biscoe and the Antarctic, 128

Lackenby, 119, 180
 Land-breezes, snowfalls, and cold air convergence near coastlines in southern Britain, 11–13 January 1987, 26
 Letters to the Editor, 45, 93
 Lightning:
 Mediterranean, 172
 Western North Pacific, 112
Lincolnshire, 75
Liverpool Star, 184
Lord Nelson, 11

Maersk Captain, 171
 Marine life:
 Arabian Sea, 176
 South Atlantic, 176
Mark-C, 71
Matco Avon, 67
Matco Clyde, 185
 Meteors:
 Pacific, 120
 North Atlantic, 183
 South China Sea, 119
 Southern Indian Ocean, 76

Naticina, 73
Nickerie, 117, 178
 Noctilucent clouds, 77
 'Norther', Passage of a, Gulf of Mexico, 171
Northern Explorer, 183
Nosira Lin, 23
 Notices to Marine Observers:
 Code book Met. O 509, Corrections to, 49
 GMT to be entered in the Met. logs, 140
 MARID ships, Reports from, 49
 Port Met. Officers overseas, 208
 Retirement of Canadian Port Met. Officer, 98
 Royal Institute of Navigation annual competition 1990, 140
 Staff of the Observations (Marine) branch of the Meteorological Office, 206
 State of sea photographs requested, 206
 Tropical storms, Avoidance of, — Revision of advice to shipmasters, 49

Obituary, CARTER, Capt. M.J., 47
 Oil and gas industry, Three new recruits from the U.K., 37
Oriental Bay, 119
Osaka Bay, 107

Pacheco, 74
 Photographs:
 Basking Shark, opposite 66
 Bogong moths, front cover October
 Clouds, opposite 130
 Cuckoo, opposite 67
 Cumulonimbus cloud, front cover, January
 Cumulus, Ocean Weather Ship, opposite 79
 Electrical storm, front cover, April
 Fogbank, opposite 115
 Forthbank, opposite 114
 Galileo spacecraft, opposite 13
 Glossy Ibis, opposite 172
 Heron, opposite 115
 Hoverspeed Great Britain, opposite 188
 Humpback Whale, opposite 66
 John Biscoe off Adelaide Island, front cover, July
 Kestrel, opposite 173
 Lincolnshire, opposite 114
 METEOSAT infra-red satellite pictures, opposite 28
 Moraybank, opposite 114
 Night Heron, opposite 173
 Noctilucent cloud, opposite 78
 North Sea Pioneer, oil rig, opposite 12
 Ocean Alliance, North Sea oil rig, opposite 12
 Osprey, opposite 115
 Petrel, opposite 66
 Port Met. Officers Conference, opposite 29
 Presentation of barograph to Capt. M.J. Godbehear, opposite 12
 Radar screen showing red dust, opposite 67
 Research Satellite in Earth orbit, opposite 13
 Seal, opposite 67
 Showery precipitation in north westerly air-flow, opposite 172
 Tower of the winds, Athens, opposite 189
 White-tipped Shark, opposite 67
 PIKE, W.S., Land-breezes, snowfall, and cold air convergence near coastlines in southern Britain, 11–13 January 1987, 26
 PLUMLEY, R.C., John Biscoe and the Antarctic, 128
 Port Meteorological Officers' Conference, 38

Radar Interference, Arabian Sea, 17
 Refraction, Abnormal, Mediterranean, 74, 140
Remuera Bay, 16
 Report of work, 56
 Retirements:
 BOON, CAPT. D.N., 202
 BORTHWICK, CAPT. C.A.S., 201
 COSKER, CAPT. J., 137
 JOHNSTON, CAPT. J.M., 95
 RAILTON, CAPT. A.A., 202
 SANDY, CAPT. C.M., 47

St Helena, 114
 Satellite:
 Indian Ocean, 121
 missions, Future, 32
 Re-entry, Red Sea, 22
Satucker, 115
Scandutch Hondo, 61
 Seals, South Atlantic, 70
 Search and Rescue, Bay of Biscay, 24
Sentis, 20

Sharks:

- Indian Ocean, 71
- Red Sea, 116
- South African Waters, 14
- Western Approaches, 71

Shetland Service, 6

Silver Tower, 170

SMITH, K.C., Unusually severe Atlantic storm hits the Iberian Peninsula during February 1989, 122

Snowfalls, land-breezes, and cold air convergence near coastlines in southern Britain, 11–13 January 1987, 26

Squall, Baltic Sea, 110

Tamathai, 169

TAYLOR, F.W. and J.R. EYRE, Future satellite missions, 32

Telnes, 15

Tide rips:

- Eastern North Atlantic, 113
- Indian Ocean, 114

Tolaga Bay, 24

Tropical meteorology, On the origins and growth: from ancient times to the early nineteenth century, 187

Turtles, Mediterranean, 13

Typhoons:

- 'Brenda', South China Sea, 61
- 'Wayne', Western North Pacific, 107

Unidentified lights, North Pacific, 23

Union Endeavour, 21

Valdivia, 63

Venassa, 174

Vigilant, 10, 174

WALKER, J.M., On the origins and growth of tropical meteorology: from ancient times to the early nineteenth century, 187

Waterspouts:

- Strait of Malacca, 110
- Western Pacific, 65

Weather Routeing, Recent progress in, for Merchant Vessels, 195

Westfield, 120, 182

Whales see Cetacea

Zenatia, 114



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