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The Marine Observer

A quarterly journal of Maritime Meteorology

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THE MARINE OBSERVER

A QUARTERLY JOURNAL OF MARITIME METEOROLOGY PREPARED BY THE OBSERVATIONS VOLUNTARY (MARINE) BRANCH OF THE MET. OFFICE

VOL. 69 **No. 343** **JANUARY 1999**

CONTENTS

COVER PHOTOGRAPH: An immature Brown Pelican pictured on board the *Merchant Principal* while at anchor off Matarani, Peru, on 18 January 1998. It appeared very tame, Captain C.W. Harvey (the photographer) learned that this was because the local pelicans were used to humans, spending most of their day at the fish market hoping for scraps.

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LONDON: THE STATIONERY OFFICE

Editorial

Looking back, how could 1998 be best described? It is difficult to find a particular word that could be used to characterise a whole year. Would 'disastrous' fit? or 'momentous'? or even 'spectacular'? Certainly all of these could be suggested for, sadly, there have been disastrous conflicts in many parts of the world; politically momentous events upon which we will not dwell, and spectacular demonstrations of the raw power of nature over which man has no control, the tsunami which devasted part of the north coast of Papua New Guinea being a prime example.

Meteorologically-speaking though, the weather could easily have accommodated all of these suggestions; barely a week seemed to pass without news items from some region of the globe, featuring disastrous floods, droughts and fires, record-breaking temperatures and powerful tropical storms, not to mention ice fields appearing to be breaking up towards polar regions, or the hardship brought about to many by the Canadian ice storm early in the year. In the UK, we waited for a summer that eventually put in an appearance on a Saturday in August, the country generally getting away relatively lightly in the 'extreme weather' stakes, with only a plentiful supply of cloudy skies and with no worries about water shortages, but after heavy rain at Easter even parts of this country had then experienced flooding of a severity that few folk would want to see again.

The 'blame' for all this was readily placed at the feet of El Niño and its partner in crime, La Niña, by those perhaps looking for a scapegoat. Whether they were correct in doing so, or not, is beyond the scope of a short editorial feature, but in this issue of the journal, an article about these phenomena does make the point that significant meteorological events have always happened and will continue to do so, whether connected with El Niño or La Niña or not, and it is partly because human populations have increased so much that damage world wide resulting from these events is deemed ever more extensive, creating a change of attitudes such that the El Niño phenomenon is now greeted with apprehension and the expectation of dire consequences.

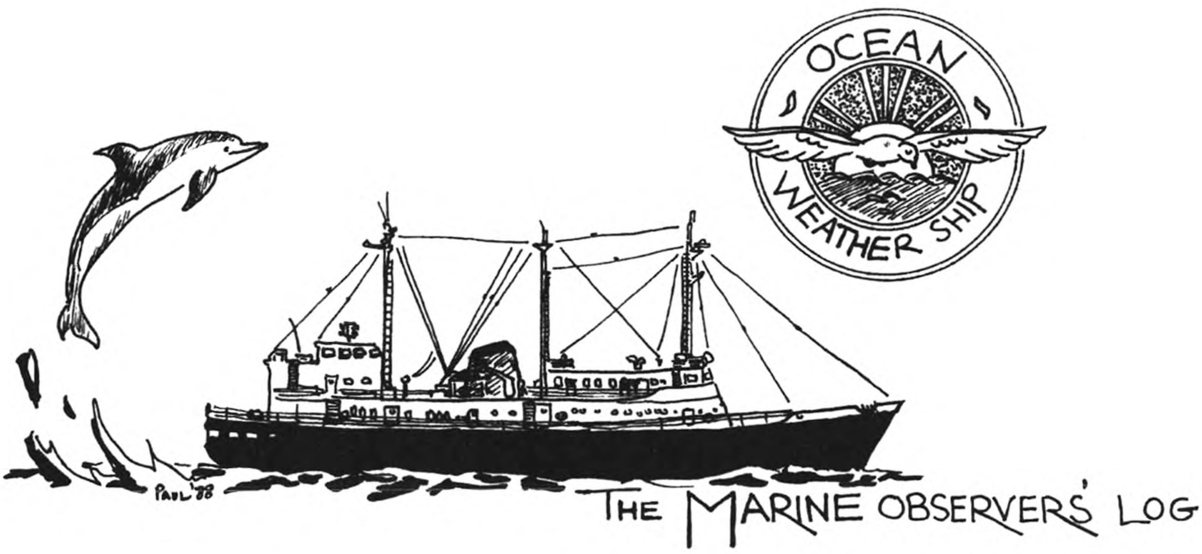
In retrospect, many folk would say quite definitely that the sun did not shine to meet requirements in 1998; if the sun had been on 'performance related pay' then it would have gone without, for the early effort it made in February hardly qualified it for an overall award for the year! But come this August there will be millions of heads turned skywards towards it on the 11th, despite all the warnings that it is dangerous to the eyes to do so, in order to watch the first total eclipse of the sun visible from anywhere in the UK since 1954 (and then it was necessary to be in Shetland). Much has been written already about what we can expect to see, and there are many details available of timings and suitable locations for land-based observers to get the best view. However, for mariners not in or near UK waters, there seems to be little useful information; therefore, at the risk of 'carrying coal to Newcastle', and to ensure that all UK VOF ships receive advice in good time, the April edition of this journal will include information about the ocean track of the eclipse, plus guidance (to those observers finding themselves within its path) on the safest ways to watch and record the event.

At the time of writing, during the autumn of 1998, we heard from the Hadley Centre in Bracknell and their colleagues at the University of East Anglia, that the UK can expect more extremes of weather in future years. Thanks to the effects of global warming, we can look forward to more frequent storms and flooding in the north and, during the summer months, more hot interludes especially in the south.

The announcement came with impeccable timing as the first deep depression (it was termed a 'bullseye' by one TV forecaster) of the autumn raced in from the Atlantic, accompanied by warnings of gales, heavy rain and localised flooding!

On the subject of timing, there is a drawback to writing editorials — on reflection, probably two — the first is is writing something that will not simply be skipped over by the reader as that 'boring bit at the front', the second is having to write one to a deadline. That is the problem when dealing with the world of printing; copy often has to be submitted almost to order, with the inevitable consequence being that events which are guaranteed yet to happen have to be approached, in some cases, as if they have already occurred. What a pleasure it would be to plan any sort activity if future weather behaviour could be a guaranteed certainty, like the turning of the year, even allowing for El Niño and La Niña adding their complications to the argument; there would then only ever be 100 per cent accurate forecasts, and mariners, aviators, farmers and the rest of us would know exactly where we stood. But such is science-fiction, so far.

So then, in late October 1998 with the rain and gales lashing the windows, and in the sure and certain knowledge that we have all enjoyed yet another festive season and wished each other a happy new year, the last of this century, Captain Norwell and his staff of the Observations Voluntary (Marine) branch, on behalf of the Chief Executive of The Met. Office, thank everyone for their continued interest in and contributions towards voluntary weather observing at sea and wish all marine observers calm waters ahead for 1999.



January, February, March

The Marine Observers' Log is a quarterly selection of observations of interest and value compiled from the meteorological logbooks of the UK Voluntary Observing Fleet and from individual observers' contributions. Responsibility for each observation rests with the contributor. All temperatures are Celsius unless otherwise stated. The standard international unit for barometric pressure is the hectopascal (hPa) which is numerically equivalent to the millibar (mb).

DEPRESSION

Mediterranean Sea

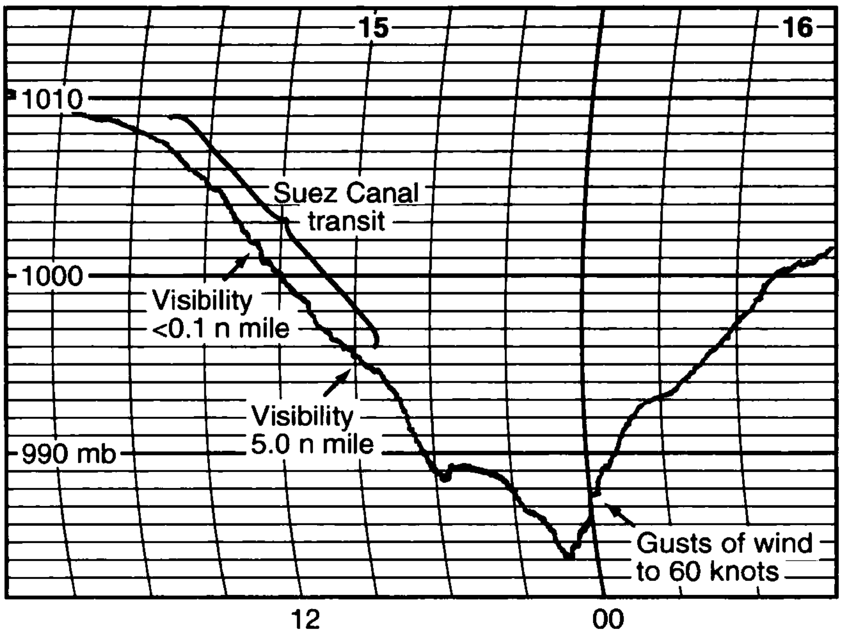
m.v. *Shenzhen Bay*. Captain D.W. Lax. Suez Canal to Rotterdam. Observers: the Master, M.K. Hill, 3rd Officer and ship's company.

15–16 March 1998. Between 1130 UTC and 1630 on the 15th whilst the vessel was between Ismailiya and Port Said during the northbound transit of the Suez Canal, strong S'ly winds estimated at force 7 were experienced, with gusts to 40 knots and an associated dust storm. The visibility throughout this time was reduced to 200–300 m and the pressure dropped from 1002.0 mb to 994.5 mb. Once the vessel was clear of the Egyptian coast, at about 1630, the visibility improved to about 5 n mile.

Over the next 24 hours the vessel, steering 288°, passed through a very large low pressure area and experienced the gale-force winds associated with it; the vessel was pitching and rolling quite heavily at times and shipping frequent spray over all. Gusts of wind to 60 knots, and more, were recorded by the vessel's anemometer.

The accompanying barograph trace for the period shows how rapidly the pressure fell, from approximately 1010.0 mb to a low of 984.0 mb in the space of about 20 hours. The trace also shows how quickly the pressure rose again (18 mb in 13 hours) as the vessel passed through the centre of the low. Also during this period frequent and very heavy rain was encountered which reduced the otherwise good visibility.

As the vessel passed through the depression the wind direction was constantly changing, veering from WSW'ly, force 7/8 as the pressure fell, to NNW'ly, force 8 shortly after the pressure had started to rise again.



The following observations were made during the period.

Date and time	Temperature			Pressure	Wind	
	Air	Wet bulb	Sea		Dir'n	Force
15th/1800	21.9°	16.4°	18.5°	—	SE	6
2200	19.6°	15.2°	17.5°	987.0	WSW	8
16th/0000	—	—	—	984.0	WNW	8
0200	15.1°	13.5°	17.7°	989.3	NNW	10
0600	14.4°	9.4°	17.8°	997.6	NNW	9
1000	13.9°	8.9°	17.9°	1001.8	NNW	7

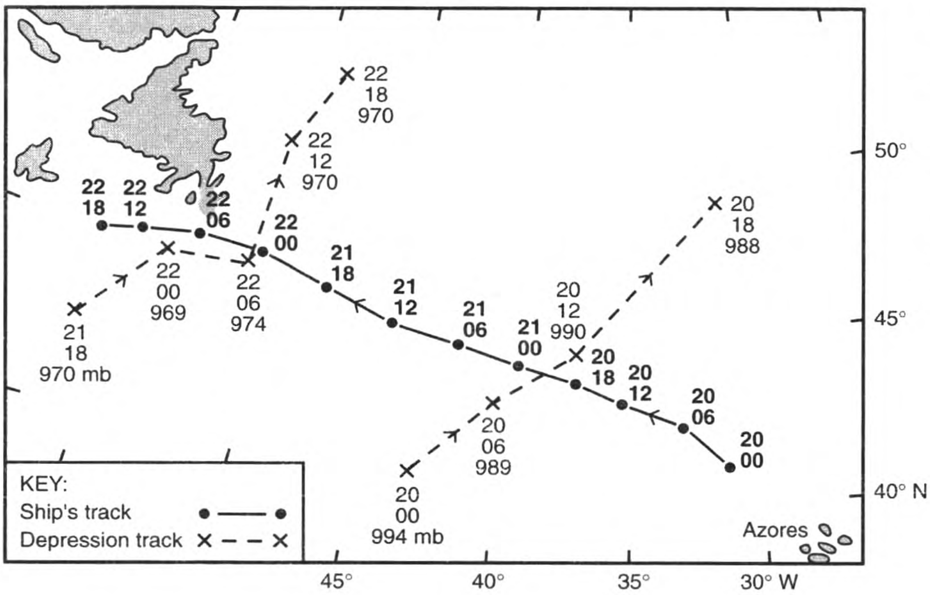
At 1400 on the 16th the air temperature was 12.0° and the pressure had risen to 1002.7 mb whilst the wind continued to decrease, being noted as N×E'ly, force 3/4.

Position of ship at 1200 UTC on the 15th: 33° 24.7′ N, 25° 40.5′ E.

North Atlantic Ocean

m.v. *N.O.L. Lageno*. Captain J. Harris. Port Said to Halifax, N.S. Observers: the Master, T. Oliver, 1st Officer, C.J. Hughes, 2nd Officer, L.A. Jenkins, 3rd Officer and ship's company.

20–23 January 1998. Between these dates two depressions crossed the path of the vessel. [*Editor's note*. The depressions' tracks are shown on the chart together with the vessel's positions.] At 0000 UTC on the 20th the pressure was falling gradually while the wind was S'ly, force 7 as the clear sky was quickly covered by 8 oktas of cumulus and stratocumulus. There were rough seas and a heavy swell at 0300, the sky was overcast but the visibility was good.



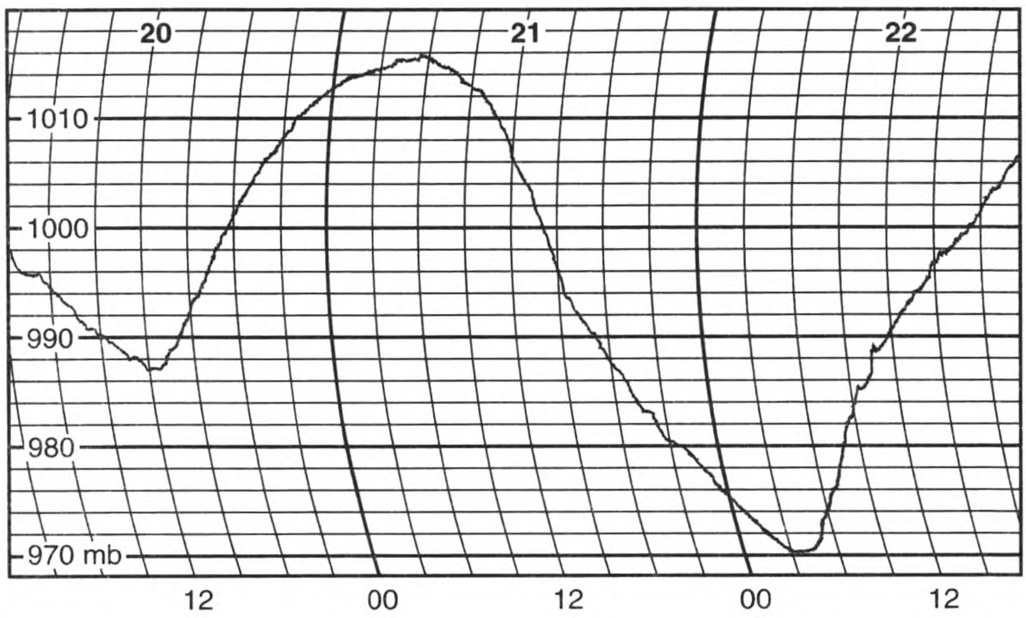
The plots for the ship's track show the date and time (UTC).

The plots for the depressions' tracks show date and time (UTC) plus the analysed central pressure value .

The following sequence of observations was then made as conditions deteriorated.

Date and time	Temperature Air	Wet bulb	Sea	Pressure	Wind Dir'n	Force	Remarks
20th/0600	16.0°	14.5°	13.0°	1002.1	SW×S	7	Lightning to the west at 0605.
0700	15.5°	14.4°	—	1002.1	SW×S	7/8	Moderate to heavy showers at 0730. Rough seas, heavy swell. Occasional heavy rain squalls.
0800	15.0°	14.1°	—	1000.0	S×W	7	
0900	14.6°	14.0°	—	998.1	S×W	6/7	Clouds dissolving.
1000	15.0°	13.5°	—	997.6	S×W	7	
1100	15.0°	13.0°	—	996.0	S×W	8/9	Rough seas, short moderate swell. Cloudy with frequent squally showers.
1200	15.0°	13.5°	13.0°	994.5	SSW	8/9	
1300	14.1°	12.5°	—	993.6	SSW	9	
1400	14.5°	13.5°	—	993.1	SW×S	10	Very rough seas, heavy swell.
1500	12.0°	11.3°	—	995.3	NW	10	Wind veered from SW'ly to NW'ly between 1440 and 1510.
1600	—	—	—	998.0	NW	9/10	Squally showers between 1430 and 1600. Low pressure area passed about 20 n mile ahead of vessel.
1700	11.5°	9.5°	—	1001.4	WNW	9/10	

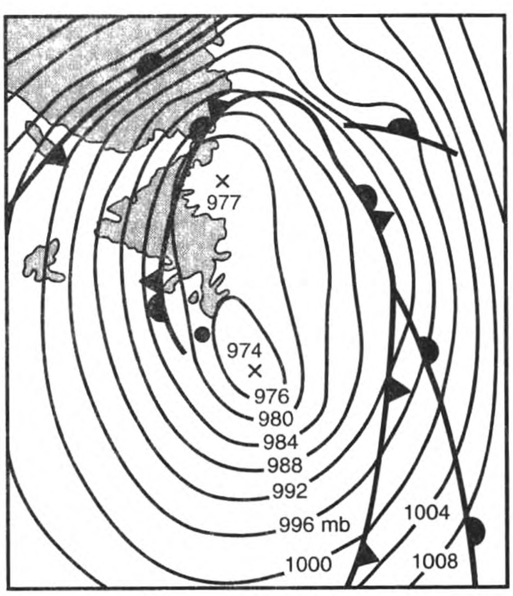
Between 1800 and 2200 the wind speed slowly decreased to N×W'ly, force 7/8 as the pressure continued to rise, being 1014.8 mb at the end of the period (the barograph trace shows the pressure tendencies of both depressions). The sea remained rough with a heavy swell while the sky was overcast with occasional rain showers. The wind was veering at 2300 and, by 0000 on the 21st, it was NNE'ly, force 7 by which time the air temperature was 9.5°. The cloud cover had completely dissolved twenty minutes earlier but there were now 2 oktas of cumulonimbus. At 0300, with the pressure having continued its rise to reach 1021.4 mb, the weather conditions had abated further; the wind was NE'ly, force 3/4 while the air temperature had fallen to 8.6° and the seas had also become



moderate with a confused and moderate swell. The wind direction could not be determined at 0600 having become calm but it was believed to be veering; this proved to be so, and by 1100 the pressure was again falling reading 1018.6 mb, the wind was ESE'ly, force 4 while the air temperature had fallen to 7.9°. By 1500 the wind was SE'ly, force 8, the pressure was 1007.7 mb and the sea was once again rough with a moderate swell. The sky was covered by stratus and the visibility was moderate.

The following observations were then made as conditions worsened.

Date and time	Temperature Air	Wet bulb	Sea	Pressure	Wind Dir'n	Force	Remarks
21st/1700	—	—	—	999.8	SE	10	
1800	—	—	—	997.2	SE	8	
2100	5.0°	5.0°	—	989.5	SE×S	8	Fog set in at 2045 after vessel crossed onto the Grand Banks.
22nd/0000	2.6°	2.6°	−2.0°	984.1	S×E	7	Continual fog throughout.
0300	2.4°	2.4°	—	978.4	ESE	7	Continual fog throughout.
0600	1.4°	1.4°	−2.0°	977.2	Var.	4	Fog. Wind direction indeterminable.



[*Editor's note*. The chart shows the synoptic analysis for 0600 UTC on 22 January 1998.

The position of the *N.O.L. Lageno* at this time is indicated by ●.]

Date and time	Temperature Air	Wet bulb	Sea	Pressure	Wind Dir'n	Force	Remarks
22nd/0700	—	—	—	980.6	NE	7/8	Fog cleared 0625, wind then NW'ly, force 7.
0900	−0.5°	−1.0°	—	986.5	NW×W	9/10	
1200	−1.0°	−1.8°	−2.0°	995.2	W×N	10/11	
1500	−3.8°	−4.4°	—	1001.3	WNW	12	Snow showers. Very rough seas, heavy swell, freezing spray.
1800	−6.0°	−6.0°	−2.0°	1006.5	WNW	12	Snow showers. Sea state as above.
2100	−6.5°	−6.5°	—	1013.4	WNW	11	Snow showers. Sea state as above.

Although the pressure was still rising, these conditions persisted as the vessel continued towards Halifax but the wind decreased slowly after 2300 as the storm departed. The pressure subsequently reached 1039.4 mb at 1600 on the 23rd by which time the vessel was alongside in Halifax.

Position of ship at 1200 UTC on the 20th: 43° 12′ N, 35° 30′ W.

Position of ship at 1800 UTC on the 22nd: 45° 30′ N, 57° 00′ W.

Western North Pacific

m.v. *Pacific Swan.* Captain B.D. Miller. Balboa to Mutsu Ogawara. Observers: the Master and ships' company.

5–7 March 1998. At 1130 UTC on the 5th, the vessel's course was altered to 255° in order to pass south of the projected track of a vigorous depression. This was in accordance with advice received from MetRoute although phenomenally high seas were forecast as unavoidable.

The following are extracts from the vessel's deck log book.

Date and time	Ship's head	Wind Dir'n	Force	Pressure
5th/1800	255°	ENE	4	1015.9
2200	150°	ESE	7/8	1007.1
6th/0000	Var.	S×E	7	1005.2
0100	Var.	S×W	8	1000.8
0200	220°	SSW	8	999.4
0400	230°	SSW	9	993.2
0500	230°	SW	9/10	991.9
0600	230°	SW	10/11	991.5
1000	270°	WSW	11/12	995.5
1100	270°	W×N	9/10	999.6
1200	270°	WNW	10	1001.2
1300	290°	WNW	10	1002.6
1400	290°	WNW	9/10	1003.8

For much of the above period the vessel was hove to with courses and engines adjusted as required. Winds were recorded in excess of 80 knots with seas estimated at around 9–10 m in height, and the visibility was severely restricted at times owing to heavy spray and driving rain.

At 1800 on the 6th, with the wind now WNW'ly, force 9, the vessel resumed her course of 325° for her destination.

Position of ship at 1130 UTC on the 5th: 33° 21′ N, 154° 40′ E.

Position of ship at 1000 UTC on the 6th: 32° 14′ N, 151° 43′ E.

WATERSPOUT

Mediterranean Sea

m.v. *Nordstrand*. Captain J.W. Jackson. Workington to Burgas. Observers: the Master and S. Zaliem, Engineer.

24 February 1998. At 0729 UTC the vessel was on a course of 084° at 8.8 knots and was within an area of prolonged thunderstorms and heavy rain squalls associated with cumulonimbus cloud based at no more than 500 feet. There was lightning below the cloud, and the wind speed reached 40 knots in the squalls. A waterspout was then observed to be forming at a distance estimated at about 4 n mile, developing to approximately 45 m below the cloud base. It retreated into the cloud about two minutes later, only to reform at 0733 and extend down to 61 m from the cloud base; at this time its end was tapered and rotation was not observable. The waterspout was lost from sight at 0737 in a heavy rain squall at a distance of 1.3 n mile (estimated by radar).

The vessel started to clear the rain at 0744 but the waterspout was no longer visible. The wind then veered slightly to NNW'ly and increased from force 6 to force 7 before backing to NW×W'ly at 0800 and decreasing rapidly. The swell height steadily increased, however, and was estimated at 4–5 m from the north-west.

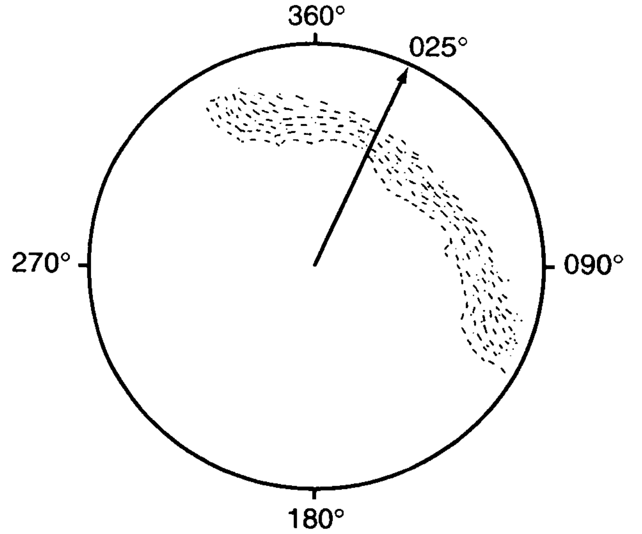
Position of ship: 37° 07.7′ N, 05° 26.47′ E.

RADAR ECHOES

North Atlantic Ocean

m.v. *Orion Reefer*. Captain A.J. Sharma. Abidjan to Marseille. Observers: M. Rashid Bashir, 2nd Officer and L. Srinivasan, 3rd Officer.

12 February 1998. At 1530 UTC a huge number of echoes were noted on the ship's radar while south of the Canary Islands on a course of 025° at 18.6 knots; they looked like dense concentrations of fishing vessels, remaining at a constant distance of 13 n mile. See sketch. Ships in the vicinity were seen passing through the echoes.



The echoes were observed at different ranges, and A/C rain was used to suppress them; a few were suppressed and the rest remained on the PPI.

Eventually these echoes vanished from the PPI by reduction of gain. The radar in use was a Furno Marine Radar, north-up display, on the 24-n mile range.

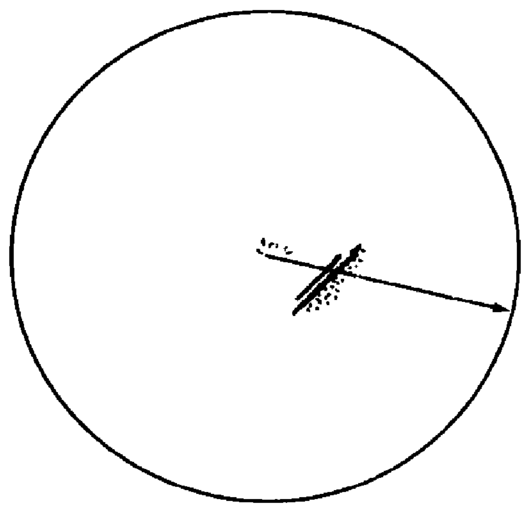
Weather conditions were: air temperature 23.0°, wet bulb 22.0°, pressure 1012 mb and the sky was hazy.

Position of ship: 24° 47.1′ N, 16° 36.7′ W.

North Atlantic Ocean

m.v. *Zetland*. Captain J.H. Lacey. Port Cartier to Rotterdam. Observers: B. Dais, 2nd Officer and E. Mendoza, GPD 1.

2 March 1998. At about 1830 UTC the vessel was off the Grand Banks of Newfoundland on a course of 124° at 12 knots in visibility of 0.5 n mile when numerous clear speckled echoes were detected by radar at a range of 1.5 n mile. They lay almost in a line across the bows, as indicated in the sketch and, as they approached, the line became more conspicuous so course was altered to head south in order to clear the sea line.



12 n-mile range

No ice or icebergs were detected as the vessel passed through the line (the vessel was in close proximity to all known ice limits) but a strange fishy smell was in the air as the fog thickened further to reduce the visibility to zero.

On passing the line of echoes, the observers suspected that the echoes were caused either by the end of tide rips or by a school of whales or by the fog itself. The vessel encountered another similar line and the lookout was intensified but nothing was detected. The vessel altered course again after clearing the lines.

At the time of the observation the wind was W×S'ly, force 2.

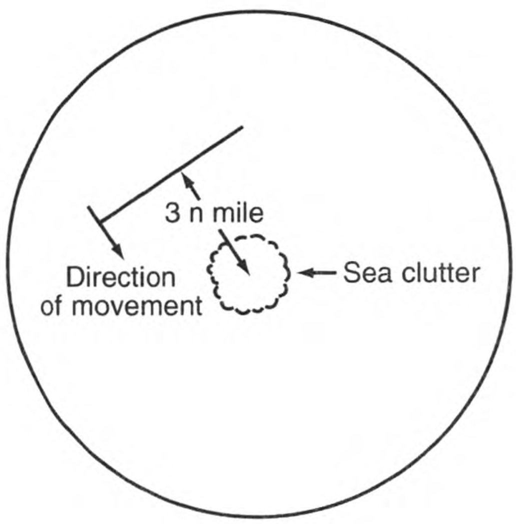
Position of ship: 43° 00′ N, 50° 06′ W.

UNUSUAL WAVE

Indian Ocean

m.v. *Oriental Bay*. Captain A.P. Talbot. Port Klang to Suez. Observers: A. Liddell, Cadet and M. Harrington, SM 1.

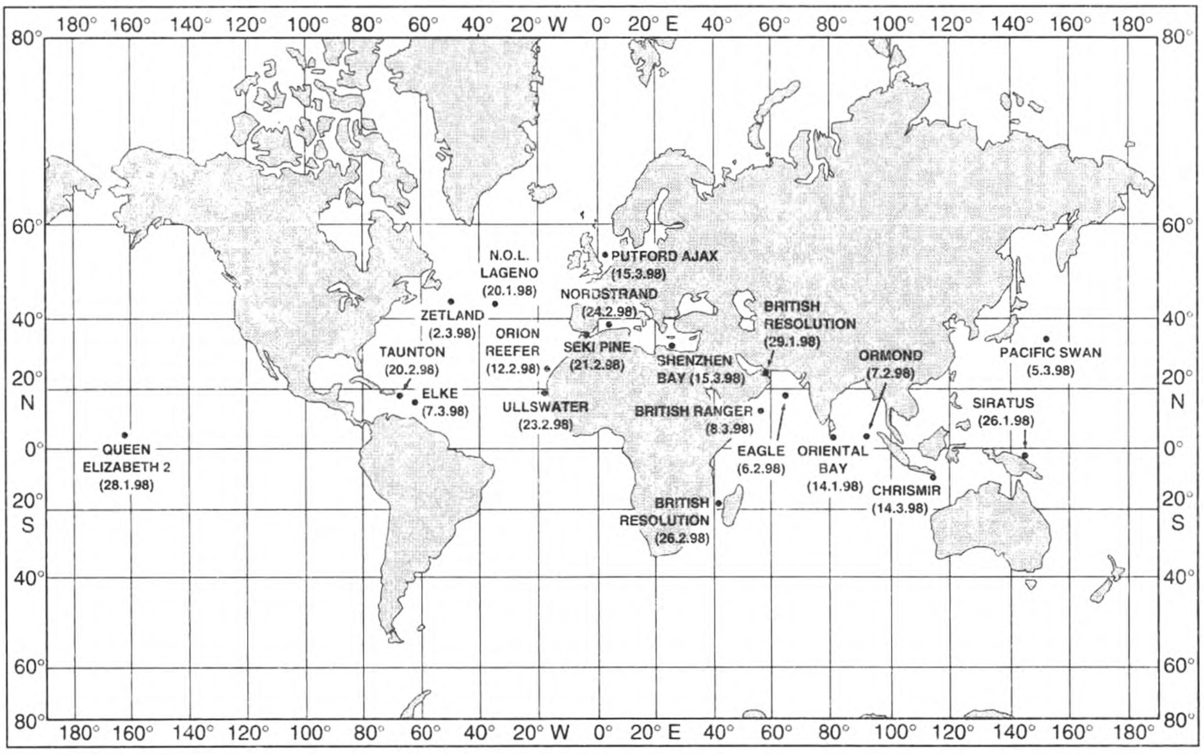
14 January 1998. At 2230 UTC the vessel was on a course of 269° at 23 knots when a line was observed on the radar at a range of 3 n mile, travelling from north-west to south-east at an estimated speed of 15 knots. As indicated in the sketch, the line was observed to be a wave.



It was about 10 minutes after the first sighting that the vessel passed over the wave, which was approximately 4 m high, and she heeled 5° to port while the autopilot deviated 3° off course. At the time of the event, there was a low swell of 1.0 m from 320° and the sea was 0.5 m from 360°. The current was estimated to be 2.5 knots running to the west.

Weather conditions were: air temperature 27.1°, wet bulb 24.2°, sea 28.5°, pressure 1011.0 mb steady, wind NNE'ly, force 3.

Position of ship: 05° 50′ N, 81° 18′ E.



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

TIDE RIP

Lombok Strait

m.v. *Chrismir*. Captain P. Bennett. Nagoya to Richards Bay. Observers: the Master, P. Mount, 3rd Officer and E. Uri, AB.

14 March 1998. At 0010 UTC the vessel was just approaching the narrowest part of the Lombok Strait when what first looked like a fleet of white-hulled fishing boats became apparent. In fact, the boats were the 'white horses' of breaking overfalls.

At 0030 the vessel entered the tide rip with P. Batuaba bearing 272° × 4.5 n mile. At this time the vessel was on a course of 185° to counteract a strong easterly set, the log speed was 13 knots while the speed through the water was 15 knots, and the speed over the ground was 19–19.5 knots.

From this time, short-sided overfalls of 1.8–2.4 m caused by the tide rip were experienced. At 0036 the vessel left the tide rip and the log speed increased to 15 knots while the speed over the ground reduced to 17–17.5 knots at which time the easterly set moderated.

Weather conditions at the time were: air temperature 29.5°, wet bulb 27.4°, pressure 1011.9 mb, no wind.

Position of ship at 0600 UTC: 09° 36′ S, 114° 30′ E.

CETACEA

Arabian Sea

m.v. *Eagle*. Captain R. Dixon-Carter. Singapore to Fujairah. Observer: C. Hubbard, 3rd Officer.

7 March 1998. At 0630 UTC whilst the vessel was on a course of 319° at 13.5 knots, a pod of approximately eight whales were seen swimming in a 'U'-shaped formation, with the individuals to the side and forward breaching frequently.

Most of the whales appeared to be Sperm Whales identified by their squared heads and forward-pointing blow; however, the individuals furthest forward seemed to be a species of baleen whale but disappeared before the vessel could approach. The Sperm Whales did not react to the ship's presence and continued to swim in an easterly direction, away from the vessel, as it passed within one mile of them. The depth of water was about 3,500 m and the surface water temperature was 24.0°.

Position of ship: 18° 47′ N, 63° 53′ E.

m.v. *British Ranger*. Captain D. Lewis. Durban to Fujairah. Observer: S. Woodward, 3rd Officer.

8 March 1998. At 0450 UTC a faint echo was noticed on the radar at a range of 4 n mile and 5 points on the port bow. Visual observation at this distance picked up disturbed water only; however, at a range of about 2 n mile, it became obvious that there was a very large group of dolphins moving in a close pack towards the east.

The dolphins passed within 50 m of the vessel and, on closer inspection, they were observed to have dark-grey bellies with black fins and black throats while their size was the same as the Striped Dolphin. There was no final count of their numbers but there were well over 200 of them.

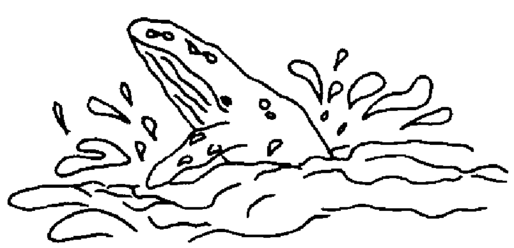
At the time of the observation the wind was ESE'ly, force 4 and there was a small to moderate north-easterly swell.

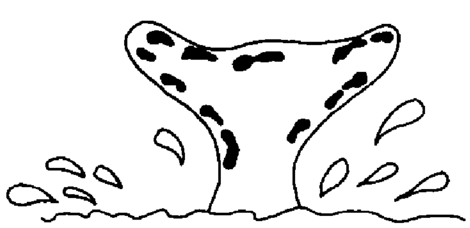
Position of ship: 12° 22′ N, 55° 54′ E.

North Atlantic Ocean

m.v. *Elke*. Captain W. Tebbutt. Martinique to Southampton. Observers: the Master, T. Cubelo, 2nd Officer and members of ship's company.

7 March 1998. At 1700 UTC two whales were sighted on the starboard side approximately 2 cables off. At the initial sighting, just on the starboard bow, the whales were observed to be surfacing and raising their tails high out of the water before slapping them down into the sea. Shortly afterwards the whales were on the starboard beam, still at the surface and raising their tails high, also flapping their 'wings' onto the water. The sketches indicate what was seen.





One whale was about 15 m long, and under the tail it was coloured white with grey patches, while the other one was 4 m long and black in colour. The vessel was on a course of 052° at 20.1 knots.

Position of ship: 15° 01′ N, 61° 02′ W.

Indian Ocean

m.v. *Ormond.* Captain P.A. Miley. Tubarao to Beilun. Observers: S. Singh, 3rd Officer and A. Banerjee, Cadet.

7 February 1998. At 0452 UTC an echo was observed on the radar at a range of about 5 n mile and about 3 points on the starboard bow. It was duly plotted on the ARPA and noted that a CPA of 0.0 n mile was given but although the day was clear and the visibility was good, nothing could be observed visually in the direction of the echo. As the subsequent bearing did not change and the range reduced, the OOW took action as per ROR.

When the range reduced to about one mile, there was still no vessel in the vicinity but there was a school of dolphins, all of them frolicking in the sun. As they passed close to the vessel they were carefully observed and compared with the 'dolphin chart'; there were about 45 individuals and were identified as Bottlenose Dolphins.

Such are the benefits of modern technology that the radars pick up even dolphins. The sea-water temperature at the time was 28.1° and the wind was NE'ly, force 2.

Position of ship: 05° 21′ N, 92° 18′ E.

Moçambique Channel

s.s. *British Resolution*. Captain J. MacAlpine. Dubai to Fujairah. Observer: L. Booth, 3rd Officer.

26 February 1998. At 0822 UTC whilst the vessel was following a course of 019° at 15 knots, a school of dolphins was sighted, consisting of about 12 individuals including at least three small ones. The dolphins were small, approximately 1–1.5 m long, very dark-grey in colour (almost black) with bellies only slightly lighter in colour, and had no distinguishing marks. Their dorsal fins were very pointed and tall while their flukes were flat and not very wide, and their beaks were very noticeably long and thin. Generally, they were slim and streamlined.

The dolphins were crossing the bow from starboard to port when, as they reached the port quarter, they were intercepted by three or four grey shapes in the water; these appeared to be light-grey in colour but were too far away for any distinguishing marks to be seen. These 'shapes' were approximately four or five times the size of the dolphins, they did not jump or dive like them but cruised just below the surface, nor was there a blow seen, as from a whale.

Immediately the two groups met, the progress of the dolphins was stopped and there was a great deal of turbulence in the water. One dolphin was 'flung' into the air five times in quick succession; this did not appear to be natural jumping but vertical backflips caused, presumably, by being thrown. No dolphins were observed swimming from the incident during the four minutes that they were in sight following the described interception.

At the time of the incident the dry-bulb temperature was 33.1°, the wind was SSW'ly, force 4 and there was a moderate sea.

Position of ship: 18° 36.2′ S, 41° 15.4′ E.

SEALS AND CETACEA

North Sea

m.v. *Putford Ajax*. Captain G.A. Cubbison. Support duties on Ravenspurn gas field. Observers: G. Collins, Chief Officer and S. Bowman.

15 March 1998. While taking the midday observation, the Mate was retrieving the sea-water bucket when he saw a seal's face looking up at him. After a few moments the seal dived away and was not seen again.

Later in the day, when the ship was on station, some splashes were heard which on investigation, were found to be caused by dolphins or porpoises (they were not identified) swimming along in the bow wave. Once the vessel had stopped, the dolphins or porpoises circled around it before swimming off.

Position of ship: 54° 02′ N, 01° 06′ E.

Editor's note. Evidently, seals find human antics with rubber buckets singularly uninteresting while the dolphins or porpoises found the stationary vessel very boring and no fun at all. We sincerely hope that voluntary weather observers are not in agreement with the seal, at least!

CETACEA AND BIRDS

Western Mediterranean

m.v. *Seki Pine*. Captain P.W. Jackson. Barcelona to Dublin. Observers: the Master and members of ship's company.

21 February 1998. At 1100 UTC a Ship Management Committee meeting was temporarily halted in order to view a large number of pilot whales swimming about the ship. Flat-calm conditions prevailed with a visibility of 3 n mile enshrouded with 'haze' which gave a light-toned sea and sky, distinctly contrasting with the appearance of dark whales. The whales remained at the surface, their backs and dorsal fins protruding; they were mostly in pairs but larger groups of about 10 individuals were also seen. In all about 100 whales were visible. At the time the vessel was 45 n mile east-north-east of the Straits of Gibraltar on a course of 243° at 14 knots.

Later, at 1600 when the ship was in the western approaches to the Straits of Gibraltar, Cory's Shearwaters were sighted passing the ship as they headed purposefully eastwards to the Mediterranean. The birds had grey heads and yellow bills and flew at sea level along both sides of the ship, never numbering less than 20 birds per minute, and being sighted until 1700. About 1,000 birds were seen, and it was thought that a migration was taking place although it seemed to be a little early in the year for this.

Position of ship at 1100 UTC: 36° 24′ N, 04° 28′ W.

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

"The main breeding grounds [of the Cory's Shearwater, *Calonectris diomedea*] are in the Mediterranean where the breeding season is May and June. They start moving to the breeding areas in February with the peak passage through the Straits of Gibraltar coming in March when peak passage of 3,600 birds per hour has been reported. They mainly winter off South Africa."

BIRDS

Eastern North Atlantic

m.v. *Ullswater*. Captain J.E. Sinnott. Richards Bay to Bristol. Observers: the Master and ship's company.

23 February 1998. During the afternoon watch it was noted that a bird, tentatively identified as a 'spoon-billed heron' had taken up residence on the helicopter landing area of No. 6 hatch; there was a thick dust-haze at the time, and it was thought that the bird had become disorientated. An attempt was made to photograph it but resulted in the bird taking flight, apparently leaving the vessel.

The next morning, however, it was spotted drinking from a puddle on deck and also looking for food, so the cadet was dispatched to take it raw fish which was devoured after initial caution. The vessel called at OPL Las Palmas and it was thought that the bird would fly off but this was not the case. Having been fed on a number of occasions, it took to following the cadet around the deck, looking for the next meal. Over the following days it began to allow people to approach quite closely and frequently followed the crew as they carried out their tasks.

By the time the vessel reached Bristol at the beginning of March the bird seemed to have taken quite a dislike to UK weather (wind and rain) and spent much of the time huddled under the hatch coaming in the lee. The Bristol havenmaster was welcomed aboard by the bird, and arrangements were made for a local bird rescue group to visit the vessel and take care of the visitor. The last report received was that the bird had been put on a drip and was recovering well.

Position of ship on 23rd February: 19° 47′ N, 17° 56′ W.

Editor's note. The *Ullswater's* passenger, the identity of which was confirmed as a Spoonbill, was featured in a local news report on BBC regional television, and we understand it made a good recovery. Curiously, a day or two later another 'shipwrecked' Spoonbill was taken into care, giving the local wildlife rescue group two unusual patients.

North Pacific Ocean

R.M.S. *Queen Elizabeth 2.* Captain R.W. Warwick. Honolulu to Pago Pago. Observer: E. Cahill, Cadet.

28 January 1998. At about 0900 UTC a bird, later identified as a Sooty Tern was found on the boat deck. On advice from the ship's doctor, it was placed on the starboard bridge wing to recuperate but whether the bird was injured or just exhausted was not known. The cadet became the designated care officer.

Later in the day another bird, this time identified as a Least Storm-Petrel, was found on the boat deck and was also placed on the starboard bridge wing. It was established that this bird was exhausted; the care officer was duly notified.

Position of ship at 0900 UTC: 04° 51.5′ N, 163° 45.8′ W.

Note. Captain Chilman comments:

"The Sooty Tern (*Sterna fuscata*) is widespread over the tropics where they usually breed on islands, often in vast colonies. They are usually seen in flocks but small groups and individuals are quite common and can be found anywhere at sea. I have frequently had them on board; I suspect they are attracted by ships' lights.

"There is no detailed description or size given for the Least Storm-Petrel (*Halocyptena microsoma*), and so I cannot say that the identification is wrong because not enough is known of its distribution but from the information available I think it is unlikely as this species breeds off Baja California and is believed to disperse down the coast as far as Colombia.

"Even in the hand, storm petrels are difficult. I would suggest the dark form of Leach's Storm-Petrel (*Oceanodroma leucorhoa*) or Tristram's Storm-Petrel (*Oceanodroma tristrami*) are more likely."

BIOLUMINESCENCE

Gulf of Oman

m.v. *British Resolution.* Captain J. MacAlpine. Map Ta Phut to Fujairah. Observer: D. Misiek, 2nd Officer.

29 January 1998. At about 1645 UTC bioluminescence was noticed, reaching what would be its full intensity some 15 minutes later. Bright-blue flashes were seen in the water around the ship and in the breaking bow wave and sea waves. The flashes were also seen at a distance from the ship, beyond its area of disturbance but it was noted that although flashes were seen around the ship and in its wake, the greater disturbance of the water caused by the propellers did not cause them to increase. The bright flashes seemed to occur only when a wavelet broke, to be followed by a dull milky glow which disappeared over two to three seconds.

The echo-sounder produced no appreciable effect on the bioluminescence, and light made no difference apart from outshining it; the conclusion was that turbulence must have caused it but in the wake of the ship where, logically, the bioluminescence should have increased, there was no increase. The bioluminescence ceased at 2025.

At the time, the sea-water temperature was 25° and the wind was SE'ly, force 3/4.

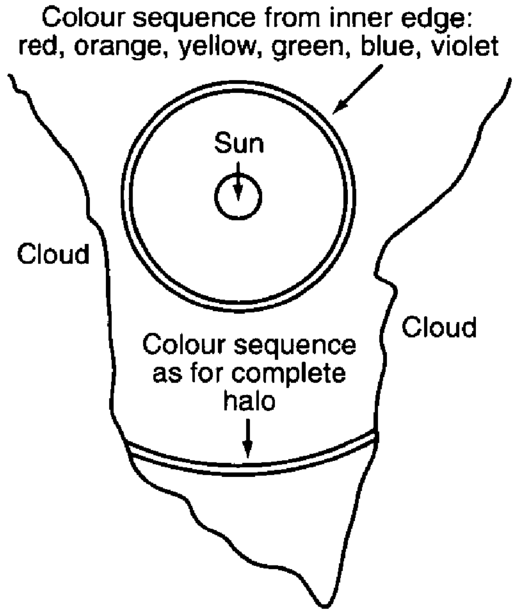
Position of ship at 1700 UTC: 24° 15.3′ N, 58° 03′ E.

HALO AND WILDLIFE

Bismarck Sea

m.v. *Siratus*. Captain C. Snape. Ardjuna to Brisbane. Observers: S. Quinlan, 2nd Officer, A. MacNeil, 3rd Officer and J. Simonis, Cadet.

26 January 1998. At 0300 UTC whilst the Third Officer was taking a meridian passage of the sun, it was noticed that there was a halo around it. Upon closer inspection it was noted that there were two parts to the phenomenon; there was a complete halo of 360° circumference showing most colours of the rainbow, with the innermost colour being red, while the second feature was an arc of about 30° appearing further outside the halo, see sketch. The altitude of the sun was 73° 52′, and the cloud type near the halo was cirrocumulus in small amounts but mostly cirrostratus. The halo and arc then faded away as altostratus drifted into the area.



Within the same hour as this observation a Killer Whale was sighted breaching on the port bow, and then six whales, which were identified as Sei Whales, swam past in three groups of two only a couple of hundred metres from the ship; these whales did not dive when the vessel passed but just continued to swim at the surface.

On the horizon at a distance of 6–7 n mile, it was noticed that there were tails sticking up vertically out of the water before coming down to the surface with a great splash. Owing to their distance the owners of the tails could not be identified positively but the observers believed they may have been Humpback Whales.

While the very excited 'first trip' cadet was observing all this from the bridge wing, he noted a school of tuna splashing along the side of the ship and, when they passed the bridge wing, a shark of about 2 m in length was seen among them.

The observers concluded that all the meteorological and nature phenomena were not connected in any way but reckoned that the marine life was just as interested in the halo as the ship's staff and had come to the surface for a look. After such an explosion of activity, it took several hours in the Officers' Bar to recover from the excitement!

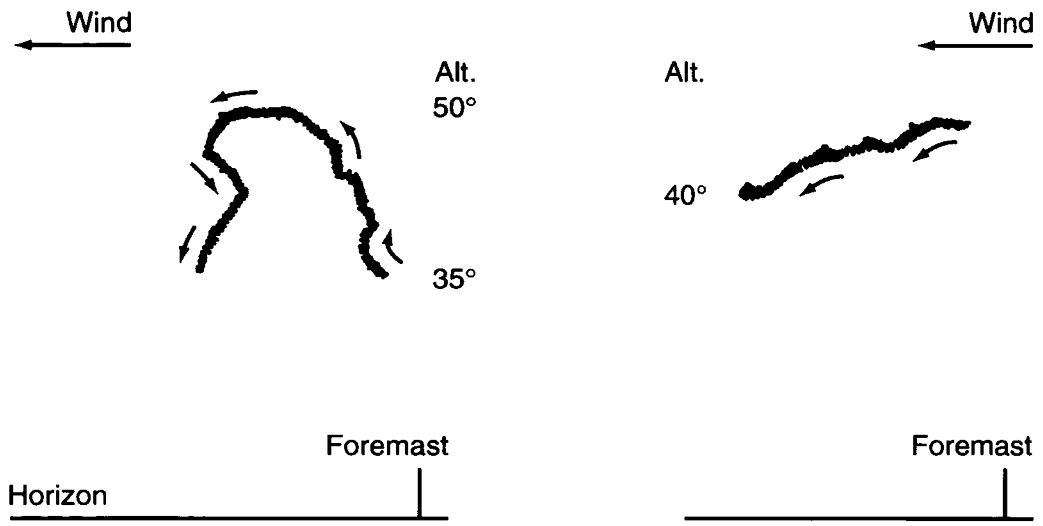
Position of ship at 0600 UTC: 03° 00′ S, 144° 24′ E.

UNIDENTIFIED TRAIL

North Atlantic Ocean

m.v. *Taunton*. Captain G. Nicholls. Puerto Bolivar to Rotterdam. Observers: R. Sarma, 3rd Officer and A. Bustamante, Quartermaster.

20 February 1998. At 0030 UTC, when the vessel was following a course of 037° at 12 knots, a streak of white smoky contrail was observed rising and then falling at a uniform rate, as indicated in the first sketch. The possibility of it being a flare was ruled out owing to the lack of bright light associated with flares and also because there were no aircraft observed in the vicinity.



The trail persisted for 15 minutes after which another similar one was sighted, as indicated in the second sketch, this too persisted for the same length of time.

At the time the skies were cloudless, the visibility was good and the wind was E'ly, force 3. Nothing unusual was detected on the PPI.

Position of ship: 17° 07.6′ N, 68° 18.3′ W.

MISCELLANY ...

An additional mélange of maritime sightings

Appleby. 30 March 1998. At 0520 UTC whilst in position 44° 11.5′ N, 156° 04′ E, a pod of Killer Whales was sighted by Captain A. Crofts and C. Sivarumarni, Second Officer.

Arunbank. 18 February 1998. Two large sunspots were observed at 0830 UTC by P. Aravanis, Cadet and A. Chritchard (Passenger). The sunspots were between 15° and 20° south of the solar equator, and positioned to the left.

Bransfield. 30 January 1998. Whilst the vessel was 8 n mile off the Brunt Ice Shelf in Antarctica, four separate pods of Orcas were seen in the flat-calm water. About 14 whales were seen by O. O'Keefe, Fourth Officer and C. Littleholes, SG 1, and there were about six young ones among them. The adult males and females were identifiable by their different sized dorsal fins. The whales seemed unconcerned at the approach of the ship.

British Adventure. 17 January 1998. Several Red-billed Tropicbirds circled the ship throughout the day from 0930 UTC. The ship's position was 23° 16.6′ S, 52° 16.9′ E.

(*Note.* Captain Chilman commented: "The Red-billed Tropicbird ((*Phaethon aethereus*)) breeds all round the tropics including the area of the report, and wander widely. They are very inquisitive and often fly close to ships; they also sometimes indulge in spectacular aerobatics. The Red-tailed Tropicbird ((*Phaethon rubricauda*)) also has a red bill and occurs in the area of the report, and the two could be confused unless the thin red streamers were seen.")

James Clark Ross. 27 January 1998. Whilst the vessel was engaged in scientific operations east of South Georgia on a course of 236° at 10 knots, numerous whales were seen between 1330 UTC and 1415. The whales were swimming together in mixed groups of three to seven individuals, all milling around within 20 m of the vessel in water of depth 1,700–3,700 m. Their numbers were as follows: Sei 10, Fin 20, Southern Right 10 and there was also a single Humpback.

Maersk Somerset. 24 March 1998. At 1600 UTC whilst at anchor off Galveston, a grey-coloured heron landed on the starboard bridge wing. Captain N.A. Vause, N. Fagen, Chief Officer, K. Short, Chief Engineer and W. Jenkins, Cadet noted that it looked to be in good condition.

Newport Bay. 21 March 1998. In position 05° 38′ N, 96° 34′ E a very distinct band was noted on the radar by C.W. Longmuir, Third Officer. It was parallel to the ship at a range of about 11 n mile and was 2.6 n mile deep. As the visibility in the direction of the echo was only 8 n mile owing to haze, it was not possible to determine whether the echo was caused by rain or low cloud.

Nexus. 19 January 1998. Between 1700 UTC and 2000 while the vessel was holding station during cable-jointing operations, a shoal of small shark-like fish about 45 cm long was seen alongside in the glow of the overside deck lights by Chief Officer D. King, I. Pinney, Second Officer and members of the ship's company. There were about 40 fish swimming together and breaking away as a group to chase flying-fish. Larger sharks could occasionally be seen on the edge of the illuminated area. The ship's position was 06° 35.4′ N, 97° 57.1′ E.

Petro Fife. 8 January 1998. Whilst the vessel was on station in the North Sea at the Kittiwake loading buoy, a single Guillemot was sighted on the poop deck at about mid-afternoon by M. Elson, COD and D. Codic, CPO. The bird had some discolouration on one leg, and may well have been injured but it flew off after about 10 minutes, seemingly untroubled. No other similar birds were seen throughout the day; it was thought Guillemots would usually be found in flocks.

(*Note.* Captain Chilman commented: "The Guillemot ((*Uria aalge*)) can be expected in this area at any time. As stated, they are usually found in flocks but strays can always occur. The discolouration on its leg could have been an injury but could also be due to natural causes.")

Vigilant. 14 February 1998. In position 60° 34′ N, 02° 09′ W two Killer Whales were sighted by A. MacCallum, First Officer and Seaman B. Bell. Very tall dorsal fins and white spots were highly visible in the calm sea, and the observers suspected that mackerel were attracting the whales as pelagic trawlers were also searching in the vicinity.

Waasland. 12 March 1998. Whilst on passage from Cabinda to Philadelphia, in position 36° 40′ N, 67° 05′ W, several waterspouts, each lasting for up to three minutes, were sighted within 2 n mile of the vessel. The wind was NNW'ly, force 6 and sea smoke was developing widely.

Western Bridge. 1 March 1998. At 1530 UTC several whales were sighted by Captain I.C Gravatt and H.T.J.J. Wijesuriya, Third Officer. Two of them came very near to the vessel but could not be identified. The ship's position was 37° 28′ N, 70° 07′ W.

... and finally

Wherever possible we endeavour to print observers' sightings together with full expert comment and analysis. Should our production schedule preclude this, then we will publish comments retrospectively, referring readers to the appropriate edition of *The Marine Observer.*

Issue	Page	Ship	Comments
October 1998	180	*Botany Bay*	Captain P.J. Chilman, of the Royal Naval Birdwatching Society, said, "The observer is probably correct in the identification of a Blue-faced Booby (*Sula dactylatra*), it is very difficult to separate immature boobies. As stated, they usually dive for fish but I have seen boobies catching flying-fish, it seems to be the usual thing in the Gulf of Panama. They usually land to eat the fish although I think they eat the smaller ones on the wing."
October 1998	Cover	*Kazimah*	Mr Mike Rowe, of the Tornado and Storm Research Organisation, said, "This is a useful report, made considerably more valuable by the photographic evidence. The outer pale sheath surrounding a dark narrow core has been reported many times but here appears with particular clarity."

Issue	Page	Ship	Comments
October 1998	186	*Kazimah*	Captain P.J. Chilman said, "These were certainly Cape Gannets (*Sula capensis*) which are very similar to the Northern Gannet familiar round Britain and in the North Atlantic. The main difference is that the Cape Gannet has black all along the trailing edge of the wing, while the Northen Gannet does not. They breed on offshore islands off Namibia and South Africa, and disperse as far as the Gulf of Guinea, occasionally as far as Tanzania. They can be found well out to sea but mainly stay near the coast. They are usually met with in small flocks but when fishing conditions are right they occur in great flocks."
October 1998	175	*Putford Aries*	Mike Rowe commented, "This observation was indeed of a funnel cloud, although the description of the sea surface underneath the cloud suggests that the vortex may have made contact with the sea surface, in which case it was a waterspout. On 23 October 1997 a northerly airstream covered the North Sea, between a high near Iceland and a low over Finland. A northerly outbreak is a frequent situation for waterspout formation around the UK."
October 1998	187	*Putford Achilles*	Mike Rowe commented, "This is an interesting report. The advent of oil and gas operations in the North Sea over the past two or three decades has made it clear that waterspouts occur more often in the North Sea than was once believed. Another surprise is that, at least in the northern North Sea, they seem to occur more often in the winter half-year. On 1 December 1997 the area was on the edge of a low near south-west Norway. A spout was seen in the same general area, in a similar weather situation, only a few weeks earlier."
October 1998	175	*Seki Cedar*	Mike Rowe commented, "A very useful observation. The total number of spouts observed, about 10, is unusually large. The direction of rotation was said to be clockwise but this was uncertain. Anticlockwise is normal, though not invariable, in the Northern Hemisphere."

Learning from El Niño *

BY GEORGE PHILANDER

(Princetown University USA)

If the stock market is erratic or the traffic jams in London are exceptionally bad, it must be El Niño. Droughts and fires in Indonesia, torrential rains in Peru and Ecuador, and a host of other disasters, all are attributed to El Niño. This phenomenon has gained so much publicity over the past year that the term is now part of everyone's vocabulary; it designates a mischievous gremlin. Few people are aware of its intriguing etymology so that few realise that, at one time, we welcomed El Niño as a blessing. If we now anticipate it with dread, the fault is not entirely El Niño's, but is partially ours.

Why is this disaster named after Child Jesus?

El Niño has become a synonym for disasters even though it refers to Child Jesus in Spanish. Originally El Niño was the apposite name given to the warm, southward, seasonal current that appears along the barren coasts of Peru and Ecuador around Christmas when it provides a respite from the very cold, northward current that otherwise prevails. Every few years the southward current is exceptionally warm and intense, penetrates far south, and bears gifts. A visitor to Peru described one such occasion, in the 1891, as follows:

> "... the sea is full of wonders, the land even more so. First of all the desert becomes a garden ... The soil is soaked by heavy downpour, and within a few weeks the whole country is covered by abundant pasture. The natural increase of flocks is practically doubled and cotton can be grown in places where in other years vegetation seems impossible."

The "wonders" in the sea can include long yellow-and-black water snakes, alligators, bananas, and coconuts (Philander 1998).

With time, we reserved the use of the term El Niño not for the annual, coastal current, but for the more spectacular, interannual occurrences that affect much of the globe. Not only our terminology, but also our perceptions, changed; we now have a pejorative view of El Niño, not because its character has changed, but because we have changed. Heavy rains still transform the desert into a garden, but they also wash away homes, bridges and roads, products of economic development and of a huge increase in population. As our economy and numbers continue to grow, the damage inflicted by natural phenomena such as El Niño, hurricanes and severe storms are likely to continue increasing, even in the absence of global climate changes.

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* Reproduced from *Weather*, September 1998 by permission of the Editor.

This article is reprinted from a special 72-page issue of *Weather* (September) on the subject of El Niño, available from the Royal Meteorological Society, 104 Oxford Road, Reading, Berkshire RG1 7LL, price £5.00.

How is El Niño related to the Southern Oscillation?

Bjerknes (1969) first realised that the warming along the shores of Peru associated with El Niño actually extends thousands of kilometres offshore and involves the entire tropical Pacific Ocean. Although that warming is sometimes described as a temporary departure from 'normal' conditions, it is evident in Figure 1 that normal conditions almost never prevail; sea surface temperature in the central equatorial Pacific (Figure 1(b)) is either above or below normal because it fluctuates continually (and irregularly). El Niño corresponds to the periods of high temperature in Figure 1(b), while Figure 1(a) shows the see-saw in surface pressure across the tropical Pacific that Walker and Bliss (1932) named the Southern Oscillation. In Figure 1 it is clear that El Niño corresponds to one phase of the Southern Oscillation, the phase during which the pressure difference across the Pacific is small. Philander (1990) proposed the term La Niña for the complementary cold phase.

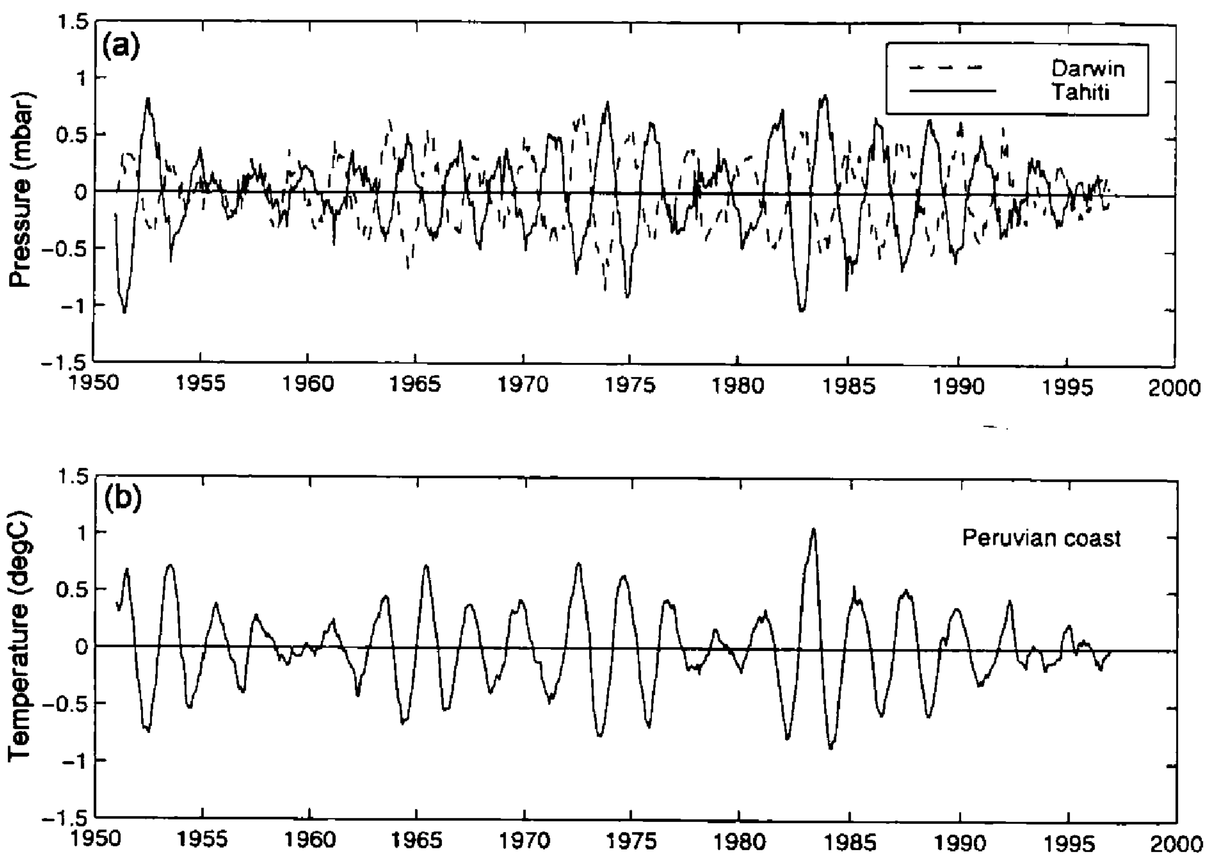


Figure 1. (a) The Southern Oscillation, the interannual fluctuations in pressure that are out of phase at Darwin (Australia) and Tahiti. These variations are highly coherent with those in sea surface temperatures in the central equatorial Pacific. (b) The departure of sea surface temperature from 22° C.

The circular argument that explains the Southern Oscillation

During El Niño of 1997/98, the maritime continent of south-eastern Asia and northern Australia suffered a drought that favoured devastating forest fires, while tropical storms spawned off Mexico, and heavy downpours drenched Chile and Peru. The reason for these changes in atmospheric conditions was a change in the sea surface temperature patterns of the tropical Pacific, especially the expansion of the area covered by surface waters warmer than 28° C. During La Niña such waters cover a relatively small area in the western tropical Pacific; during El Niño the area expands to cover much of the eastern tropical Pacific too, as shown in Figure 2. The regions with the highest surface temperatures favour deep convection so that moisture-bearing surface winds converge on to them; they are therefore covered with towering cumulus clouds that provide plentiful rainfall. During La Niña, those warm regions of heavy precipitation and low surface pressure are confined to the far western tropical Pacific. The westward trade winds are then intense, while the Galapagos Islands and the shores of Ecuador and Peru are arid. During El Niño, expansion of the pool of warm surface waters into the eastern tropical Pacific causes an eastward shift of the region of heavy rainfall, a rise in surface pressure in the western equatorial Pacific, evident in Figure 1, and a relaxation of the trades. The west has low rainfall at such times, as do India and south-eastern Africa. The jet streams tend to be displaced equatorward, causing unusual weather patterns in the extratropics.

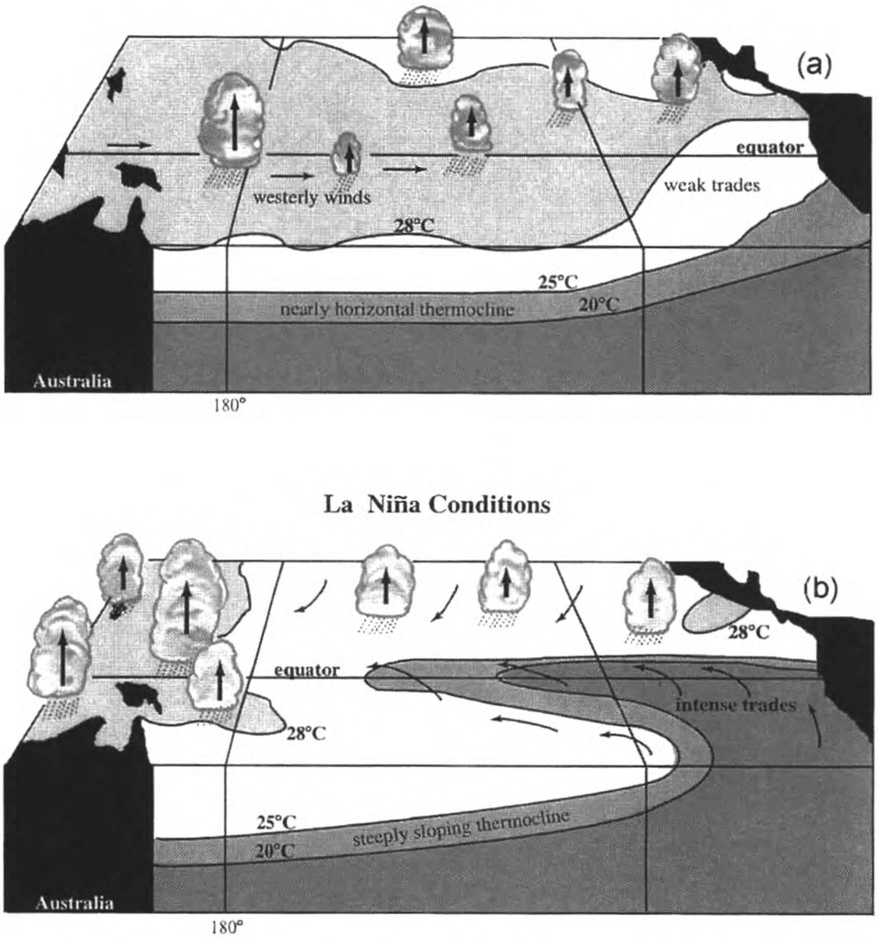
The changes in sea surface temperature shown in Figure 2 cause the interannual changes in atmospheric conditions associated with the Southern Oscillation. What causes sea surface temperature to change? Subsurface oceanic conditions are of great importance. The ocean is effectively composed of two layers of fluid: a shallow surface layer of warm water, some 100 m deep, above a deep, cold layer that extends to depths in excess of 4 km. The thermocline, a thin region of large vertical temperature gradients, separates the two layers. In the absence of any winds, the thermocline is horizontal and the warm surface waters are spread uniformly over the cold layer. There is a tendency towards this state during El Niño when the trades are weak (see Figure 2(a)). Their intensification, during La Niña, drives the warm waters westward, causing the thermocline to tilt downwards to the west so that the cold water becomes exposed to the surface in the east (see Figure 2(b)).

From this circular argument, in which changes in oceanic conditions are both the cause and the consequence of changes in atmospheric conditions, especially the surface winds, it follows that interactions between the ocean and atmosphere are at the heart of the matter. Consider a random disturbance which, at the height of La Niña, causes a slight relaxation of the trades. Those winds drive the warm surface waters westward so that their weakening causes an eastward expansion of the region of high surface temperatures, and hence of the region of rising air and heavy rainfall which remain over the warmest water. An initial, cautious retreat by the trades induces a tentative eastward step by the warm surface waters. This response quickens the retreat, it causes a further reduction in the intensity of the trades, which emboldens the pursuit. The warm surface waters and humid air therefore surge across the tropical Pacific and soon they are hugging the shores of Latin America. El Niño has arrived.

Once El Niño is established, the stage is set for La Niña to make its entrance. This new phase of the Southern Oscillation is an inversion, a mirror image, of the first part of this duet for ocean and atmosphere. To ask why El Niño or La Niña occurs is equivalent to asking why a bell rings or a taut violin string vibrates. The Southern Oscillation is a natural mode of oscillation of the coupled ocean-atmosphere system; it is the music of the atmosphere and hydrosphere.

The atmosphere and ocean are partners in a dance. But who leads? Which one initiates the eastward surge of warm water that ends La Niña and starts El Niño? Though intimately coupled, the ocean and atmosphere do not form a perfectly symmetrical pair. Whereas the atmosphere is quick and agile, and responds nimbly to hints from the ocean, the ocean is ponderous and cumbersome and takes a long

El Niño Conditions



La Niña Conditions

Figure 2. A schematic view of El Niño (a) and La Niña (b). During La Niña, intense trade winds cause the thermocline to have a pronounced slope from east to west so that the equatorial Pacific is cold in the east and warm in the west where moist air rises in cumulus towers. The air subsides in the east, a region with little rainfall except in the doldrums where the south-east and north-east trades converge. During El Niño the trades along the equator relax, as does the slope of the thermocline when the warm surface waters flow eastwards.

time to adjust to a change in the wind fields. The atmosphere responds to altered sea surface temperature patterns within a matter of days or weeks; the ocean has far more inertia and takes months to reach a new equilibrium. The state of the ocean at any time is not simply determined by the winds at that time because the ocean is still adjusting to and has a memory of earlier winds, a memory in the form of waves below the ocean surface. They propagate along the thermocline, the interface that separates warm surface waters from the cold water at depth, elevating it in some places, deepening it in others. These vertical displacements of the thermocline effect the transition from one phase of the Southern Oscillation to the next so that it is of critical importance to monitor oceanic conditions in order to anticipate future developments. That is why the development and maintenance of the measurement array shown in Figure 3 is a very significant scientific accomplishment. Those measurements are being assimilated by an operational oceanographic ocean model, which effectively serves as an interpolator for the data. The results, which are available on the World Wide Web a few days after the measurements have been made, enabled scientists to follow, and anticipate, the evolution of El Niño of 1997/98 in detail.

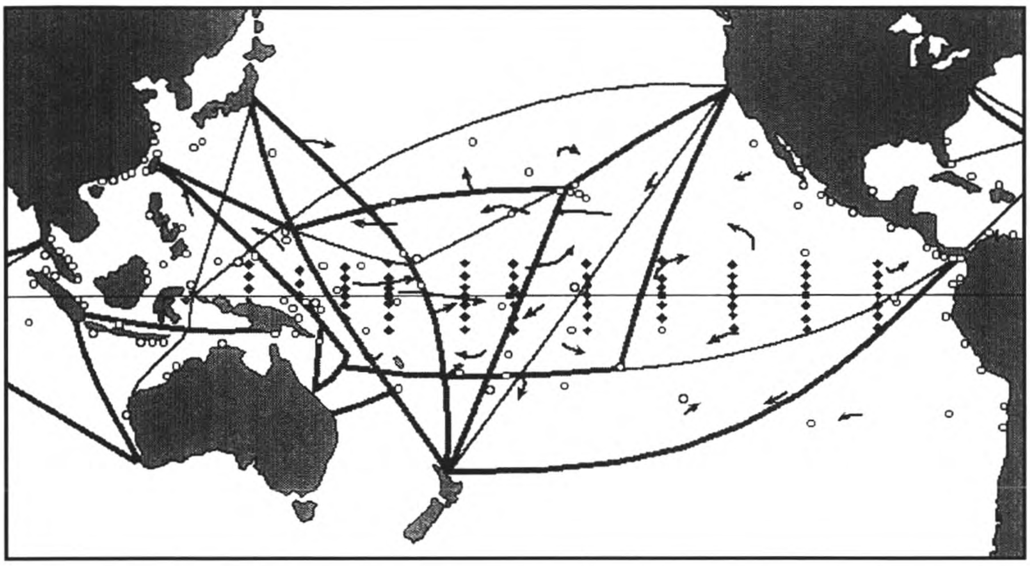


Figure 3. The array of instruments that monitor oceanic conditions. All these measurements are relayed to stations on land in real time. (The web site http://www.pmel.noaa.gov/toga-tao/ftp.html displays some of the measurements.) The lines across the oceans are the tracks of commercial ships that deploy instruments that measure temperature to a depth of a few hundred metres. the arrows are drifting buoys that measure temperature and the winds, and whose movements yield information about surface currents. The open circles are tide gauges that measure sea-level which depends on the average temperature of a water column. The solid diamonds, buoys moored to the ocean floor, are located where temperature is measured over the upper few hundred metres of the ocean. The solid squares indicate where oceanic currents are measured. (Courtesy of the Tropical Atmosphere Ocean Project Office.)

The predictability of El Niño

The Southern Oscillation, a natural mode of oscillation of the coupled ocean-atmosphere system, at times appears to be self-sustaining and hence relatively easy to predict. The 1980s seem to have been such a period; El Niño of 1982/83 was the start of two complete cycles of the Southern Oscillation. At other times the oscillation seems to be a damped mode that is present for a cycle at most, after being excited by random disturbances. Disturbances that very effectively can excite El Niño, because their surface winds have a spatial structure that coincides with those of the Southern Oscillation, are certain brief convective activities that are associated with two-week bursts of westerly winds over the western equatorial Pacific. (These convective activities do not involve ocean-atmosphere interactions that characterise the Southern Oscillation.) This type of disturbance was influential in initiating El Niño of 1997/98. That event followed El Niño of 1992 which persisted for a surprisingly long time, and which petered out, without being followed by a significant La Niña. It appears that the Southern Oscillation was damped during the 1990s, in contrast to the 1980s when it seems to have been more self-sustaining. Consistent with this view is the performance of the coupled ocean-atmosphere models that simulate and predict El Niño; those models had far more success with events of the 1980s than those of the 1990s.

Evidence that the Southern Oscillation is subject to long-term modulations, so that it is prominent and energetic during some decades, less so during others, is available from coral records that cover a century or more. One of the factors responsible for this modulation is the time-averaged depth of the equatorial thermocline, which depends on exchanges between the tropical and extratropical oceans. Current research on the Southern Oscillation is therefore concerned with ocean-atmosphere interactions, not only in the tropics, but also in higher latitudes.

REFERENCES

BJERKNES, J. (1969). Atmospheric teleconnections from the equatorial Pacific. *Monthly Weather Review*, **97**, pp. 163–172
PHILANDER, S.G.H. (1990). *El Niño, La Niña and the Southern Oscillation*. Academic Press, New York, 280 pp.
— (1998). *Is the temperature rising? The uncertain science of global warming*. Princeton University Press, 258 pp.
WALKER, G.T. and BLISS, E.W. (1932). World weather. *V. Mem. R. Meteorol. Soc.*, **4**, pp. 53–84

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Bottom pressure measurements across the Drake Passage choke point *

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Long term measurements of sea level or the equivalent pressure variations at the sea bed have proved their value to the scientific community for the study of climate change. Sea level and its possible trends are of direct interest and its variations can be related to internal processes such as changes in ocean circulation. Sea level is at present measured by instruments in-situ or on a global scale by altimetric satellites such as ERS-1, ERS-2 and TOPEX/Poseidon. The WOCE tide gauge network recently provided a basis from which long term drift in the TOPEX/Poseidon altimeter was detected which was finally ascribed to a software error. In-situ sea level measurements have shown themselves to be complementary to altimetry and between the two we now have global measurements of ocean dynamics at the sea surface. Measurements of bottom pressure to study dynamics associated with deep flows and the thermohaline circulation are less widespread. They have been concentrated in areas of particular interest. One such area is the Southern Ocean which plays an important role in the global climate balance through the interchange of water masses between the major ocean basins.

ACCLAIM

A programme of measurements was started in the late 1980s in the South Atlantic and the Southern Ocean which became known as ACCLAIM, (Antarctic Circumpolar Current Levels from Altimetry and Island Measurements), Spencer *et al* (1993), an acronym which omits the important contribution from Bottom Pressure Recorder (BPR) measurements to the programme. The programme was oriented towards a study of the circulation of the Antarctic Circumpolar Current (ACC) as one of the UK contributions to WOCE.

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The principal objective was to study variations in the ACC over a range of time scales and to resolve the spatial scales of the variability. BPRs were positioned across the main filaments of the ACC to measure transport fluctuations in the region of the Drake Passage 'choke point'. A parallel investigation using altimeter data was undertaken, Woodworth *et al* (1996b). The first BPR array was installed in 1988 in the Scotia Sea. In 1992 the work was relocated to concentrate on measuring across the Drake Passage between Burdwood Bank and Elephant Island where it has remained. The instruments were replaced annually to produce a long term data set.

POL sea level stations were installed on islands and at Antarctic mainland sites, the latter through collaborative work with the British Antarctic Survey, see Figure 1. With the development of improved instrumentation and modern microprocessor technology it became possible to construct autonomous sea level stations in remote areas and to have them run continuously, Woodworth *et al* (1996a). The desire to obtain data in quasi real time and to monitor the operation of the stations led to daily transmission of the data through a telemetry link. Operational stations have been installed at Ascension, St Helena, Tristan da Cunha, Port Stanley (Falkland Islands), Signy Island (South Orkney), Faraday (now Vernadsky) and Rothera. These stations record sub-surface pressure, sea temperature, air temperature and barometric pressure from which sea level variations can be derived. Goal 2 of WOCE, which is to measure the long term representativeness of any short term measurements, is satisfied to an extent by our BPR array and the sea level stations.

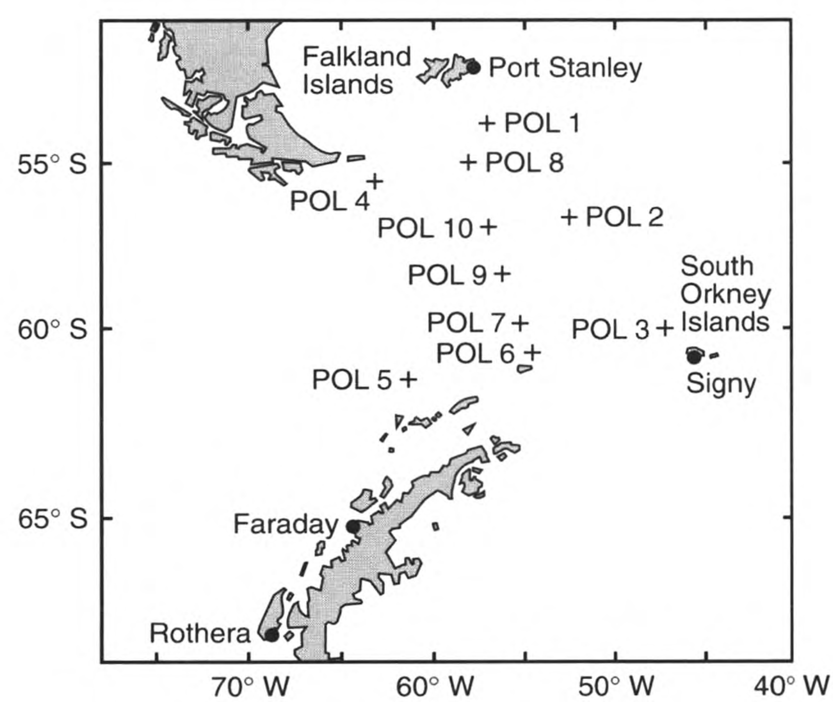


Figure 1. ACCLAIM deployment sites in the Scotia Sea and Drake Passage where bottom pressure measurements have been made between 1988 and 1996.

Qualitative comparisons have been made between the BPR data which were placed in the Drake Passage and earlier measurements made during the ISOS programme of the 1970s, Whitworth and Peterson (1985). In general the standard deviation of the ACC transport derived from cross passage slopes is lower in the

ACCLAIM data than was seen during the ISOS period (8 Sv compared to 10 Sv) [†] but not significantly different when compared to the inter annual variability. However there were two occasions when the transport changed by 40 per cent in the ISOS data which has not been seen during the ACCLAIM period. This suggests the ACC as well as undergoing interannual changes may alter on long time scales.

The bottom pressure measurements from these sites were inter-compared and shown to be related to wind stress, Meredith *et al* (1996). At the south side of the Drake Passage the ACC transport is most correlated with the zonally averaged eastward wind stress. The similarity with wind stress curl in latitude bands adjacent to the ACC is felt to be coincidental rather than causal. Large spatial scale coherence in the low frequency components of the signals was shown to exist between the BPRs on the south side of the passage and sea level stations along the Antarctic coast over a region of several hundred kilometres. The coherent signals over such large distances are also seen in FRAM [††]. The instruments on the north side were less coherent due to the effect of steric changes in the surface layers. A full set of comparisons will be made between the Drake Passage data and similar measurements made by Tom Whitworth of Texas A&M University at the African and Australian 'choke points' of the ACC. This will provide a measure of the extent of the large scale coherence in bottom pressures in the Southern Ocean.

At some of the Drake Passage BPR positions, Inverted Echo Sounders provide additional information on the variations in the internal structure of the water column. The instruments were positioned to make it possible to examine aspects of the meridional structure of the ACC in the area of the Scotia Sea and Drake Passage that is known to have the strongest flow in filaments constrained by the Sub-Antarctic and Polar Fronts.

MYRTLE

Most long term pelagic measurements, away from continents or islands, are made by replacing BPRs annually. To create a long data set the end points of each record have to be matched in some manner which can create difficulties in the interpretation of results. The use of instruments capable of continuous long term operation was considered at POL and MYRTLE (Multi Year Return Tide Level Equipment) was developed to meet this requirement, Spencer *et al* (1994). This BPR, Figure 2, is capable of continuous operation for five years on the sea bed. At predetermined times, which are normally one year apart, a capsule containing the measured data is released to the surface, Foden and Spencer (1995).

So far one such instrument has been constructed and was deployed in November 1992 from the R.R.S. *Bransfield* at position 59° 44′ S, 55° 30′ W on the WOCE Hydrographic Section SR1 in the Drake Passage. This is shown as POL7 in Figure 1. Because it was felt important to obtain data for WOCE from this area MYRTLE was deployed before the development of the satellite telemetry link for the capsules was completed. As a result the capsules were released by acoustic command from a surface ship and then recovered in the conventional manner. It is planned to make the capsules self release and transmit the data through an ARGOS satellite to the UK. A high degree of data security is ensured by storing all the data

[† 1 Sv = 1×10^6 m^3/s] [†† Fine Resolution Antarctic Model] in each capsule and in a data logger on the main frame. In November 1996 the one remaining capsule and the complete instrument were recovered using the R.R.S. *James Clark Ross* providing us with four years of sea bed pressure.

Figure 2. MYRTLE (Multi Year Return Tide Level Equipment). This instrument is capable of five years continuous operation at depths to 6,000 m. The measured pressure variations near the sea bed are returned by releasable data capsules annually.

The availability of this continuous data provided the opportunity to study the measured tides and low frequency sea level signal in detail. From an instrumental viewpoint the results have an important consequence. The tides are the main component of the signal and are coherent. When the data set was analysed the amplitudes of the harmonic constituents of the tide were found to remain substantially constant for the four year period. This suggests that the calibration of the pressure sensor is not changing with time which is important for long term monitoring as an ocean observing system inevitably prevents the sensors from being returned to the laboratory for calibration.

Tides are important as they are by far the most energetic signal in sea level and may be important in driving circulation in enclosed areas. There is a need for tidal information under ice shelves where little is known of their characteristics. In-situ measurements are difficult and satellite altimetry is not applicable. Numerical models of the tides under ice shelves only give acceptable values if bottom friction is increased to an unreasonably high value. Hence more tidal measurements are required to validate hydrodynamic models, Smithson *et al* (1996). A spectrum derived from the four years of pressure data recorded by MYRTLE shows evidence of non-linear tides which must emanate from the Weddell Sea. The tides in the Weddell Sea are being investigated at the present time with a series of BPRs deployed along the ice front.

The low frequency signal showed some coherence with the BPR to the south of MYRTLE, POL6 in Figure 1, but it contained a component of larger amplitude which was caused by the existence of a quasi-stationary eddy which existed locally. The bottom temperature showed evidence of cooling for a period of 10 months during 1995 after which it recovered to its original value. The decrease in temperature of 0.1° appeared to be widespread and is being investigated by a CASE student at UEA.

The large scale coherence which is seen to exist in the Southern Ocean is being investigated and measured on a basin scale by placing several BPRs around the South Atlantic. Most of these are already in place and are to be recovered in early 1999. The instruments used are a development from the MYRTLE technology but are smaller and less expensive containing only one pressure device. Many of the questions related to the large scale features of the ocean circulation could be addressed by arrays of BPRs deployed in the appropriate places. Satellite gravity missions, which have been approved for the year 2001, have the potential to improve our knowledge of ocean circulation but will require ground truth to improve the spatial resolution in particular areas, a role which can be filled with an array of BPRs.

Technical Note:– The data sets discussed in this paper can be obtained via Anonymous FTP from POL.FTP to 'bisag.nbi.ac.uk/pub/woce/acclaim/bprs' and consult the file 'INVENTORY'.

REFERENCES

Foden, P.R. and R. Spencer, 1995. A releasable data capsule for the deep ocean. *Oceans95, MTS / IEEE: Challenges of our changing global environment.* October 9–12, 1995, San Diego (Calif.) Proceedings, Volume 2, The Marine Technology Society, pp.1240–1246.

Hughes, C.W. and M. J. Smithson, 1996. Bottom pressure correlations in the South Atlantic. *Geophysical Research Letters*, **23**(17), pp. 2243–2246.

Meredith, M.P., K.J Heywood, R. Spencer and J.M. Vassie, 1996. On the temporal variability in the transport through Drake Passage. *Journal of Geophysical Research*, **101**(C10), pp. 22485–22494. (Correction published in Vol. 102, C2, p. 3501)

Smithson, M.J., A.V. Robinson and R.A. Flather, 1996. Ocean tides under the Filchner-Ronne Ice Shelf, Antarctica. *Annals of Glaciology*, **23**, pp. 217–225.

Spencer, R., P.R. Foden and J.M. Vassie, 1994. Development of a multi-year deep sea bottom pressure recorder. *Sixth International Conference on Electronic Engineering in Oceanography, 19–21 July 1994, Cambridge.* B.S. McCartney, *et al.*, editors, Institution of Electrical Engineers, pp. 175–180.

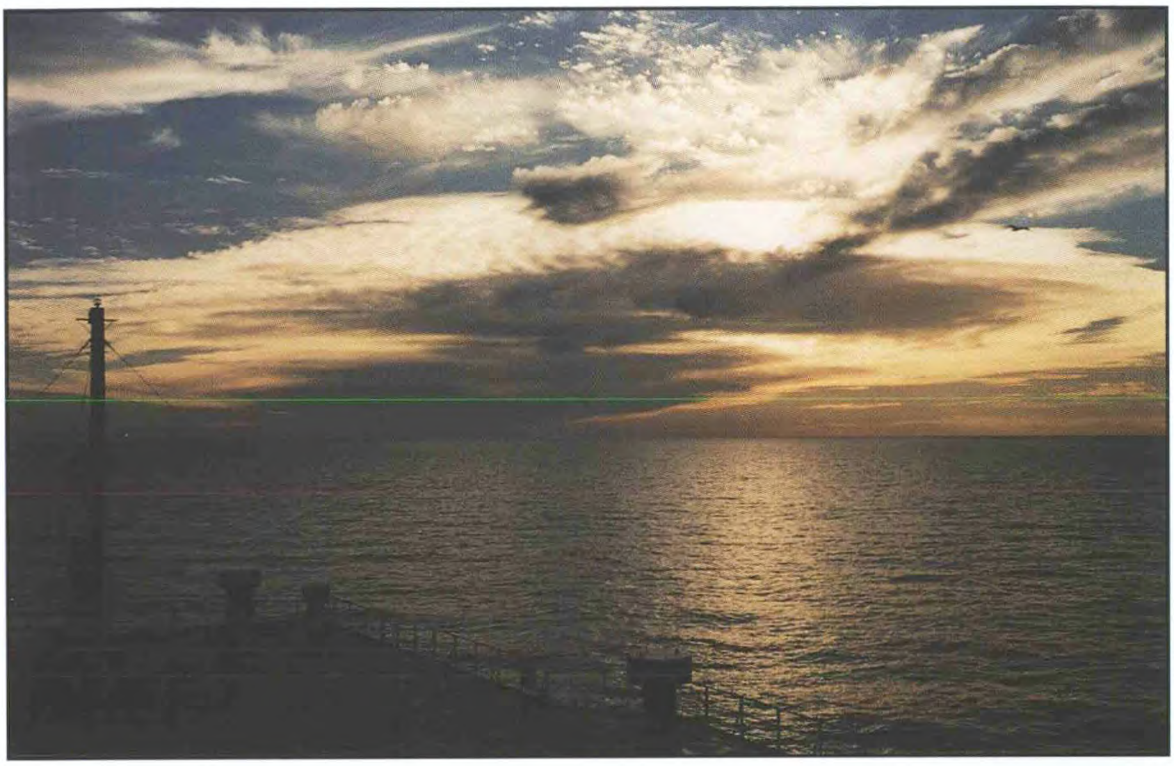
Spencer, R., P.R. Foden, C. McGarry, A.J. Harrison, J.M. Vassie, T.F. Baker, M.J. Smithson, S.A. Harangozo and P. L. Woodworth, 1993. The ACCLAIM Programme in the South Atlantic and Southern Oceans. *International Hydrographic Review*, **70**(1), pp. 7–21.

Whitworth, T. and R.G. Peterson, 1985. The volume transport of the Antarctic Circumpolar Current from bottom pressure measurements. *Journal of Physical Oceanography*, 15, pp. 810–816.

Woodworth, P.L., J.M. Vassie, R. Spencer and D. E. Smith, 1996a. Precise datum control for pressure tide gauges. *Marine Geodesy*, **19**(1), pp. 1–20.

Woodworth, P.L., J.M. Vassie, C.W. Hughes and M.P. Meredith, 1996b. A test of the ability of TOPEX/Poseidon to monitor flows through the Drake Passage. *Journal of Geophysical Research*, **101**(C5), pp. 11935–11947.

SCENE AT SEA



Captain P.W. Jackson

(a)

Captain P.W. Jackson

(b)

(a) Evening sky photographed from the starboard bow of m.v. *Seki Pine* on 27 July 1997 at 1830 UTC.

(b) The sky at the same time, pictured from the port quarter. Patches of cirrus are dense enough to cast shadows towards the anti-solar horizon.

A word about progress

Introduction

As the doors start to close on the twentieth century, technological advances in just about every sphere of human activity seem poised to influence our lives to ever greater extents, and we are swept forward powerless and possibly awestruck by the all-engulfing tide of progress. Given the daily bombardment of media coverage detailing the latest findings in whatever category of science or technology you may care to name, it is often all too easy to forget that there was ever a time when what is now accepted as normal was once beyond the imagination of most people (barring that of H.G. Wells perhaps) let alone known about and understood.

The work of Admiral W.H. Smyth

In a contribution to the 'end-of-century' nostalgia epidemic, we return to 1867, when Queen Victoria was yet to rule for a further 34 years and a book entitled *The Sailor's Word-book of 1867* was published. It was written by Admiral William Henry Smyth (born in 1788) who, as a naval surveyor, devoted most of his career to working in the Mediterranean where his observations and surveys, often carried out in collaboration with French, Austrian and Neapolitan contemporaries, were highly acclaimed. He was also a Fellow of the Royal Geographical Society, and was President of that institution between 1849 and 1851. Throughout his long and active life he had a habit of methodically storing information, whether practical or scientific, which he considered might be of use to the mariner, but it was not until 1858 that he began to concentrate on more literary pursuits and started working on his amassed material.

Admiral Smyth had this to say of his work:

> "Doubtless a well-digested marine dictionary would be equally beneficial to the country and to the service, for the utility of such a work in assisting those who are engaged in carrying on practical sea duties is so generally admitted, that it is allowable here to dilate upon its importance, especially when it is considered how much information a youth has to acquire, on his first going afloat, in order to qualify him for a position so totally different from what he had hitherto been familiar with. In this case such a volume might justly be deemed one of the most useful of his companions, as it would at all times answer his questions, and aid that ardour of enquiry which some of his shipmates might not find it easy to satisfy. It would quicken the slow progress of experience, and aid those who take a pleasure in the knowledge and discharge of their duties. But a work of this description must necessarily require constant additions, and revised explanations, to enable it to keep pace with the wondrous alterations and innovations which are now taking place in every department of the naval service. The future of this is utterly inscrutable!
>
> "It has been pronounced that such lexicography may be too diffuse; that to describe the track of every particular rope through its different channels, however requisite for seamen, would be useless and unintelligible to a landsman. But surely nothing can be considered useless which tends directly to information, nor can that be unintelligible which is clearly defined. Moreover, such a work may be so carried out as not only to be instructive in professional minutiae, but also to be a vehicle for making us acquainted with the rules which guided the seamen of former times, thereby affording an insight into those which are likely to direct them in their own.

"... at the age of seventy-seven, finding leisure at last on hand, I thought it feasible to work my materials into a sort of maritime glossary... . Now although many of the explanations may be superfluous to some seamen, still they may lead others to a right of understanding of various brackish expressions and phrases, without having to put crude queries, many of which those inquired of might be unable to solve. Nor is it only those afloat who are to be thus considered; all the empire is more or less connected with its navy and its commerce, and nautical phraseology is thereby daily becoming more habitual with all classes of the lieges than of erst. Even our parliamentary orators, with a proper national bias, talk of swamping a measure, danger ahead, taking the wind out of an antagonist's sails, drifting into war, steering a bill through the shoals of opposition or throwing it overboard, following in the wake of a leader, trimming to the breeze, tiding a question over the session, opinions above or below the gangway, and the like, so rife of late in St. Stephen's; even when a member 'rats' on seeing that the pumps cannot keep his party from falling to leeward, he is but imitating the vermin that quit a sinking ship.

"This predilection for sea idiom is assuredly proper in a maritime people, especially as many of the phrases are at once graphic, terse, and perspicuous. How could the whereabouts of an aching tooth be better pointed out to an operative dentist than Jack's " 'Tis the aftermost grinder aloft, on the starboard quarter". The ship expressions preserve many British and Anglo-Saxon words, with their quaint old preterites and telling colloquialisms; and such may require explanation, as well for the youthful aspirant as for the cocoa-nut prelector in nautic lore. It is indeed remarkable how largely that foundation of the English language has been preserved by means of our sailors."

Admiral Smyth died in 1865 leaving his work unfinished but his family and friends took over the mammoth task, to see the book published in 1867.

Here then is a snapshot of the meteorological and nautical working knowledge of 132 years ago offered by a selection of entries from Admiral Smyth's word-book:

AIR: The elastic, compressible, and dilatable fluid encompassing the terraqueous globe. It penetrates and pervades other bodies, and thus animates and excites all nature.

AIR JACKET: A leathern garment furnished with inflated bladders, to buoy up the wearer in the water.

ARCHED SQUALL: A violent gust of wind, usually distinguished by the arched form of the clouds near the horizon, whence they rise rapidly towards the zenith, leaving the sky visible through it.

ARENAL: In meteorology, a cloud of dust, often so thick as to prevent seeing a stone's throw off. It is common in South America, being raised by the wind from adjoining shores. Also off the coast of Africa at the termination of the desert of Zahara.

ASTEROID: The name by which the minor planets between the orbits of Jupiter and

Mars were proposed to be distinguished by Sir W. Herschel. They are very small bodies, which have all been discovered since the commencement of the present century; yet their present number is over 80.

ASTRONOMICAL OBSERVATIONS: There have been occasional slight records of celestial phenomena from the remotest times, but the most useful ones are those collected by Ptolemy. Since 1672, science has been enriched with a continued series of astronomical observations of accuracy and value never dreamed of by the ancients.

ATMOSPHERE: The ambient air, or thin elastic fluid which surrounds the globe, and gradually diminishing in gravity rises to an unknown height, yet by gravitation partakes of all its motions.

AURORA AUSTRALIS or BOREALIS: The extraordinary and luminous meteoric phenomenon which by its streaming effulgence cheers the dreary nights of polar regions. It is singular that these beautiful appearances are nowhere mentioned by the ancients. They seem to be governed by electricity, are most frequent in frosty weather, and are proved to be many miles above the surface of the earth, from some of them being visible over 30° of longitude and 20° of latitude at the same instant!

BALL-AND-SOCKET: A clever adaptation to give astronomical or surveying instruments full play and motion every way by a brass ball fitted into a spherical cell, and usually carried by an endless screw.

BANGE: Light fine rain.

BAROMETER: A glass tube of 36 inches in length, filled with the open end upwards with refined mercury — thus boiled and suddenly inverted into a cistern, which is furnished with a leathern bag, on which the atmosphere, acting by its varying weight, presses the fluid metal up to corresponding heights in the tube, easily read off by an external scale attached thereto. By attentive observations on this simple prophet, practised seamen are enabled to foretel many approaching changes of wind or weather, and thus by shortening sail in time, save hull, spars and lives. This instrument also affords the means of accurately determining the heights or depressions of mountains and valleys. This is the *mercurial* barometer; another, the *aneroid* barometer, invented by Monsr. Vidi, measures approximately, but not with the permanence of the mercurial. It is constructed to measure the weight of a column of air or pressure of the atmosphere, by pressure on a very delicate metallic box hermetically sealed. It is more sensible to passing changes, but not so reliable as the mercurial barometer. 29.60 is taken as the mean pressure in England; as it rises or falls below this mark, fine weather or strong winds may be looked for:— 30.60 is very high, and 29.00 very low. The barometer is affected by the direction of the wind, thus N.N.E. is the highest, and S.S.W. the lowest — therefore these matters govern the decision of men of science, who are not led astray by the change of reading alone. The seaman pilot notes the heavens; the direction of the wind — and the pressure due to that direction — not forgetting sudden changes of temperature. Attention is due to the surface, whether convex or concave.

CIRRO-CUMULUS: This, the *sonder-cloud*, or system of small roundish clouds in the upper regions of the atmosphere, commonly moves in a different current of air from that which is blowing at the earth's surface.

CLOUD: A collection of vapours suspended in the atmosphere.

CUMULO-CIRRUS-STRATUS: A horizontal sheet of cloud, with cirrus above and cumulus beneath; it is better known as the *nimbus* or *rain cloud*.

CUMULO-STRATUS: This is the twain-cloud, so called because the stratus blends with the cumulus; it is most frequent during a changeable state of the barometer.

CUMULUS: A cloud indicative of fair weather, when it is small: it is sometimes seen in dense heaps, whence it obtained the name of *stacken cloud*. It is then a forerunner of change.

FIRE-BALL: In meteorology, a beautiful phenomenon seen at times, the origin of which is as yet imperfectly accounted for.

FORECAST: A storm warning, or reasonable prediction of a gale from the inferences of observed meteorological instruments and phenomena.

HALO: An extensive luminous ring including the sun or moon, whose light, passing through the intervening vapour, gives rise to the phenomenon. Halos are called *lunar* or *solar*, according as they appear around the moon or sun. Prismatically coloured halos indicate the presence of watery vapour, whereas white ones show that the vapour is frozen.

MAGNETIC TELEGRAPH: An instrument for communicating messages by means of magnetism.

MARINE BAROMETER: A barometer, the tube of which is contracted in one part to prevent the sudden oscillations of the mercury by the ship's motion.

METEOROLOGIC TELEGRAPHY: The sending of telegrams to various stations at home and abroad, with the object of improving the science of meteorology, and issuing of storm warnings, etc.

SCREW-PROPELLER: A valuable substitute for the cumbersome paddle-wheels as a motive-power for steam vessels: the Archimedean screw plying under water, and hidden by the counter, communicates motion in the direction of its axis to a vessel, by working against the resisting medium of water.

STORM-DRUM: A canvas cylinder 3 feet in length, expanded at each end by a strong wooden hoop 3 feet in diameter. Fitzroy's is painted black, and presents, when suspended, the appearance of a black square of 3 feet, from all points of view.

SUBMARINE TELEGRAPH: Consists of a steel wire-rope, containing a heart of gutta-percha and other soft materials, in which are inclosed the copper wires through which the communication by electricity is conveyed. Rapid progress has been made in the art of making and handling this rope, as is proved by the existence of two cables between Ireland and America, one of which was recovered from the deep by creeping.

SUBMARINE THERMOMETER: An instrument for trying the temperature of the sea at different depths. It consists of a hollow weighted cylinder in which a Six's thermometer is placed; the cylinder being provided with a valve at each end, opening upwards, so that as it sinks the valves open, allowing a free course of water through the cylinder: when it reaches the required depth the line is checked and the valve closes; it is then hauled gently in, and the thermometer reaches the surface surrounded by water of the required depth, indicating its temperature.

TWIN-SCREW: A steamer fitted with two propellers and independent engines, to enable her to turn rapidly on her own axis. The twin-screw principle is not new, but latterly it has been so perfected that speed in turning is no longer a matter of doubt.

WATER-SPOUT: A large mass of water collected in a vertical column, and moving rapidly along the surface of the sea. As contact with one has been supposed dangerous, it has been suggested to fire cannon at them, to break the continuity by aerial concussion. In this phenomenon, heat and electricity seem to take an active part, but their cause is not fully explained, and any facts respecting them by observers favourably placed will help towards further researches into their nature.

WEATHER WARNING: The telegraphic cautionary warning given by hoisting the storm-drum on receiving the forecast.

WIND-GALL: A luminous halo on the edge of a distant cloud, where there is rain, usually seen in the wind's eye, and looked upon as a sure precursor of stormy weather. Also, an atmospheric effect of prismatic colours, said likewise to indicate bad weather if seen to leeward.

Afterword

If he were alive today Admiral Smyth might just recognise the descendants of some of the meteorological and scientific instruments in use during his lifetime, although even these are being superseded by the advent of remote sensing instruments and satellite telecommunications. Perhaps, in 2099 there will be a collector of scientific memorabilia lovingly polishing the wooden case of a rare antique marine barograph dating from the 1990's, and recently bought via virtual auction, who will wonder, while buffing up the brass inscription plate, if it is possible to acquire other instruments known from that period such as old TURBOWIN equipment, the precision aneroid barometer or the rare Stevenson screen (one with its complement of thermometers would be a real 'find'!)

REFERENCE

SMYTH, Admiral W.H., *The Sailor's Word-book of 1867. An Alphabetical Digest of Nautical Terms.* 1867 (Reprinted 1991). Conway Maritime Press Ltd.

All weather present and correct

The majority of weather observations recorded in ships' meteorological logbooks are coded correctly but where errors do occur they are often found within the coding for Group 12 (present weather 'ww' and past weather 'W_1W_2'). The following notes are a guide to the principles of the coding for this group.

Together, the code figures for these elements are intended to give as full a picture as possible of the weather experienced in the interval since the previous observation, normally either six or three hours ago. Whether conditions noted at the time of making an observation are the same as, or totally different from, what was recorded previously under ww, then W_1W_2 should indicate what has happened in the interval by means of two single-digit code figures.

The two code figures used in W_1W_2 are always placed such that the higher number is read first, therefore emphasising the past weather of the greater meteorological significance (although not necessarily of the greater hazard to shipping). They should *not* be placed to reflect the chronological order of meteorological events.

Example 1: A ship has passed through the cold front of a depression and is now in an airstream which is producing moderate showers; the observer is compiling the weather observation while rain is falling.

He codes the present weather 'ww' as '81' (from Table 12 of *Ships' Code and Decode Book*) to indicate moderate or heavy rain showers at the current time.

In the interval since the previous synoptic hour, the ship was first of all in the warm sector of the depression and conditions were quite different, the weather was overcast with drizzle; then there was a period of heavy rain before the cloud cover reduced from 8 oktas to 4 oktas.

For the past weather element 'W_1W_2', the observer selects the code figure for rain, '6' (from Table 13 of *Ships' Code and Decode Book*) and then '1' to indicate the change in the cloud cover, arranging them such that the higher figure appears under 'W_1' and the lower one appears under 'W_2'.

Thus, the complete entry for Group 12 in the logbook entry would read: 7 81 61

Group Indicator	Present weather	Past weather	Past weather
7	81	6	1

Example 2: A ship is experiencing cloudy conditions. The cloud cover has increased and the coverage is now 7 oktas, having reached this stage since the previous observation when there were only 2 oktas present. There was a thunderstorm four hours before the current observation time.

The observer selects '03' from Table 12 for the 'ww' element since the cloud is increasing or developing since the previous report (and the thunderstorm was greater than one hour ago, and so cannot be covered by the code figure '29'.)

For the 'W_1W_2' element he selects '1' from Table 13 to indicate that the cloud cover has been less than half the sky for part of the interval since the previous observation but also more than half the sky for part of it. He then selects '9' to indicate the presence of thunder in the intervening period for the other part of the element, and arranges them as in Example 1.

Thus, the complete entry for Group 12 in the logbook entry would read: 7 03 91

Group Indicator	Present weather	Past weather	Past weather
7	03	9	1

Example 3: A ship is experiencing clear conditions with nothing to report except clouds. There were 3 oktas of scattered clouds at the time of the previous observation, and the situation is basically unchanged although the ship passed through fog banks early in the intervening period.

For the 'ww' element the observer selects '02' from Table 12 since he can see no appreciable difference in the sky since the previous synoptic hour. With the cloud cover having remained at 3 oktas throughout the interval between observations, he selects '0' for one element of the past weather, but to report the previous prescence of fog, which could not be covered by the present-weather code of '28', he selects '4' from Table 13 for the other part, again placing the figures such that the highest appears first.

Thus, the complete entry for Group 12 in the logbook would read: 7 02 40

Group Indicator	Present weather	Past weather	Past weather
7	02	4	0

Summary

In all three examples above, the entire group, when looked at as a whole, gives a broad picture of the weather events from one synoptic observation to the next. In the second and third instances, the presence of significant phenomena such as a thunderstorm and fog could not be adequately covered by relevant codes for present weather but are recorded by the single-digit codes in the past weather element.

Presentation of barographs

The 'golden anniversary' of the first presentation of special awards to ships' masters with long service in voluntary weather observing was celebrated on 8 October 1998. Four recipients of awards marking careers up to and including 1996 were invited to Bracknell, each to receive a specially inscribed marine barograph from Mr Peter Ewins the Chief Executive of The Met. Office.

Captain A.C. McCulloch, Captain T.G. Whittaker and Captain J.L. Peterson, with their wives, and Captain B. Cushman (now retired) were first welcomed by Captain Stuart M. Norwell (Head of the Observations Voluntary branch) and Captain Eddie O'Sullivan (Manager of Marine Networks) before all assembled in the Reading Room of the National Meteorological Archive for the presentations; also welcomed was Captain S. Bligh, the Fleet Marine Manager of P&O Nedlloyd Ltd from which company, coincidentally, all four Masters came. On display, courtesy of Ian MacGregor (Library and Archives Services manager) and his staff, who kindly 'donated' the Reading Room for this event, were early meteorological logbooks from the four recipients. A curious coincidence was then revealed when it was found that, according to the records on display, both Captain Peterson and

Captain Cushman had sent their earliest observations from the same ship, the *Jason* (Blue Funnel Line) although a year apart.

When Mr Ewins, accompanied by Dr S.J. Caughey (Technical Director) and Ewen McCallum (Head of the National Meteorological Centre) arrived, they greeted the guests before Mr Ewins made a short introductory speech.

He briefly described the origins of the long-service award presentations, that they were begun in 1948 by Sir Nelson Johnson the Director of the day, and that they were intended to mark the appreciation of The Met. Office for long careers in weather observing at sea. The awards had been made annually ever since, although in 1980, adjustments to the formula used to identify qualifying Masters placed more emphasis on the quality of their service, bearing away from selection on grounds of the length of service only. To laughter all round, Mr Ewins said that it was not simply that the recipients "were old" that they had been invited to receive awards but because they represented an excellence of service from which all customers of The Met. Office could benefit, not just those in the marine sector. He then asked Captain Norwell to read the citations:

Captain Whittaker's name first appeared in a logbook from the *Clan McNair* (Clan Line Ltd) in 1971. Up until the end of 1996 a total of 46 qualifying logbooks were received, of which 23 were assessed as Excellent. His most recent command was the *Discovery Bay* which has now gone to the breakers but was a UK observing ship for 29 years. He received an Excellent Award in 1995.

Captain McCulloch is currently a serving Master on the *Newport Bay*. His first logbook was from the Strick Line vessel *Kohistan* in 1961 and, since then, a total of 56 qualifying logbooks have been submitted to the end of 1996. Of these, 13 have been assessed as Excellent, and Captain McCulloch also received four Excellent Awards between 1990 and 1994.

Captain Peterson is also a serving Master on the large container ships on the north-west Europe – Far East service. His first meteorological logbook was from the *Jason* (Alfred Holts, Blue Funnel Line) in 1964, and he has submitted 59 logbooks since then, 19 of which have been classed as Excellent. He received four Excellent Awards between 1990 and 1995.

Captain Cushman has recently retired from command of these same large container ships. His first meteorological logbook was also from the *Jason* but was sent to the Office in 1963. Up to the end of 1996 The Met. Office had received 46 logbooks of which 16 were classified as Excellent. He was the recipient of Excellent Awards in 1988, 1989 and 1990.

On behalf of The Met. Office, Mr Ewins offered his heartfelt thanks and congratulations to each of the four recipients as he made the presentations.

Captain Peterson then told how his father, also a Master and voluntary observer, had received a special long-service award from the then Director General, now Sir John Mason, in 1964. The collective memory of all Bracknell's Observation Voluntary staff could not recall a similar 'father and son' coincidence as ever having occurred before, and a search in the relevant bound volumes of *The Marine Observer* revealed a report of the presentation, photocopies of which were provided for Captain Peterson.

With the official aspect of the day's event completed by a 'photocall' (see following pages), the entire party then retired to the delights of lunch , hosted by the senior representatives of The Met. Office, before returning to Bracknell where the guests were shown around the National Meteorological Centre.

Above: Captain T.G. Whittaker receives his Special Long-service Award from the Chief Executive of The Met. Office, Mr Peter Ewins, on 8 October 1998, at Bracknell.

Below: Captain A.C. McCulloch receives his Special Long-service Award from the Chief Executive. *(Crown Copyright)*

Crown Copyright

Above: Captain J.L. Peterson receives his Special Long-service Award from the Chief Executive of The Met. Office.

Below: Captain B. Cushman receives his Special Long-service Award from the Chief Executive. (See page 39.)

Crown Copyright

Letters

The Marine Observer July 1998

I would like to make a comment about a small item in the July issue of *The Marine Observer*, page 102. Here it is:

From the temperate North Pacific a report was received from *C.S. Nexus* of a number of flower-like objects floating in the water. They were extensively distributed for the ship travelled through them for about two days. A sketch and description were attached to the report. The centre of each object was said to be about the size of a tennis ball and white in colour, while variable numbers of petal-like radiating fronds were attached to each centre so that the whole assembly measured about 15 cm across. Unfortunately, none of the objects could be caught.

In the report no identification was made, but having read it I am able to supply a name. The objects were colonies of the stalked barnacle *Balanus fascicularis*.

A similar report appeared in *TMO* in April 1980, page 65, supplied by s.s. *Pollenger* from the temperate north-east Atlantic. But the observers there were fortunate in being able to capture a colony. They described it as consisting "of a central spongy white body, the source of the buoyancy; the body was similar in texture to polyurethane foam. From the central body eight 'arms' protruded; at the end of each arm was a 'case', each 'case' containing a set of tentacles ..." The *Pollenger* observers believed that they were looking at a single animal.

My comment in *TMO* at the time read: "The organism was not in fact singular but consisted of a colony of stalked barnacles of the genus *Lepas*. The particular species captured, *Lepas fascicularis*, secretes its own float instead of depending on other floating objects such as wood or cuttle bones.

"Charles Darwin, in his vast monograph on the barnacles, cites seamens' descriptions of the secreted floats as resembling birds' eggs. Polyurethane foam is as good a fit, but in truth, as Darwin stated, the float is a vesicular membranous mass produced by the living colony."

I may add that apart from the float the individual barnacles look pretty much like other stalked barnacles of the *Lepas* genus. They are found worldwide in warm temperate waters and I have even picked up specimens in the English Channel. But I have never heard of them in such density as recorded from *C.S. Nexus* and am very glad to take up the report.

Dr Frank Evans, Dove Marine Laboratory, Cullercoats, North Shields.

Book Review

The work of the Harbourmaster, a practical guide (Second Edition). 220 × 300 mm, *illus.*, 401 pp., including index. Published by The Nautical Institute 202 Lambeth Road London SE1 7LQ. ISBN: 1 870077 02 4. Price: £50.00 (£75.00 for non-members) plus postage as follows: UK £7.00; Air Europe £9.50; Air mail world £15.00.

This latest and up-to-date guide replaces an earlier edition of some 10 years ago, and covers the changes and legislation introduced since then in addition to the basics that concern the varied duties and staggering responsibilities of the post. It also covers a variety of different port types, from the large commercial enterprises to fishery and recreational harbours.

The book is a handy reference to those already in post, bringing them professional advice and perhaps an instant aide-mémoire. It is also a good introduction to any aspiring candidates, who will be amazed at the broad scope of the task they are about to undertake.

With the demise of British shipping and the knock-on effect of a skills shortage, increasingly many harbourmasters are now recruited from non-nautical backgrounds. For them, this practical guide is essential studying material.

Whilst principally concentrating on the UK, it does not do so exclusively, containing well written articles from as far apart as the Falklands, Sri Lanka, Japan, the USA, Australia and Canada. This gives the guide the necessary international flavour which is required because so many regulations are applicable world wide.

The book follows what appears to be developing as the standard Nautical Institute format, being divided into sections and chapters each written by an expert in that particular field, and drawn from all over the globe. There are six sections subdivided into a total of 79 chapters covering areas such as harbour operations, safety, ancillary services (for example, bunkering), and thoughts on further development. At the end of each chapter there is a useful reference where further information may be obtained. Listing the chapters is impractical here but the reader may be assured that little is omitted; not only are the fundamentals covered, such as commerce, pilotage, dredging and buoyage, health and safety, traffic management, bunkering and waste reception, hazardous cargoes and firefighting, but also some of the wider aspects such as conservation, air pollution, security, customs and immigration. A very useful set of chapters covers contingency planning and emergency responses, including the handling of the media.

Amply illustrated in black-and-white, the book is priced sensibly.

Captain J. Roe
Port Met. Officer (South-west England)

Personalities

RETIREMENT — CAPTAIN P. MATHEWS retired at the end of July 1998 following a sea-going career which began in 1957. Paul Mathews was born in Liverpool on 7 May 1940 and started his sea training in September 1957 when, after leaving grammar school, he was indentured to Sir William Reardon Smith & Sons of Cardiff, where his first ship was the *Vancouver City*. In Captain Mathews' own words, his career began when he was told to, "Report to the bosun and do as he tells you!". Promoted to Third Officer in 1960, he recollects starting weather observations for the Meteorological Office (as it was then known) shortly afterwards; these were considered part of watchkeeping duties, observers being volunteered by the 'Old Man'.

He joined the Booth Line of Liverpool in 1967, and spent 10 very happy and interesting years voyaging from Liverpool and also New York, through the Windward Islands of the West Indies, and up and down the Amazon River as far as Iquitos in Peru, a distance of 2,200 miles from the mouth. During the low-river period on the upper river between Manaus and Iquitos, navigation could be very tricky and, as Second Officer, he spent quite some time out in a small boat sounding to find a channel deep enough to allow the ship through!

He was promoted to Master in May 1974, and in 1975 became an employee of Blue Star Ship Management Ltd upon the the formation of that company, remaining mostly on Blue Star Line ships until retirement.

It was in 1990, on m.v. *Auckland Star* (a 10,000 grt 'Banana Boat'), that he met his worst weather experience. He says, "While on passage from Ecuador to Japan, about 500 miles east of Tokyo, we ran into a small, vicious and unforecast low pressure area. Between about 1000 hours and 1700 the pressure dropped from 1015 mb to 900. During this time the wind increased from a westerly direction and there were gusts up to force 10; the sea developed from calm to very rough and confused. At 1830, while under reduced speed, the ship literally fell into a 'hole' in the sea, diving down and to port, landing with such force that the hull was buckled on the port side, at the Plimsoll line. On the ship's side the sheer strake and next plate down and the outer two deck plates were buckled over a 5-metre length, with corrugations up to 100 mm deep forming across the deck and down the ship's side in this area; number three hatch coaming was buckled and water began leaking into the hold through the hatch. Quite frightening. Fortunately the weather moderated as quickly as it blew up, and we made Tokyo safely without further incident. Extensive temporary repairs had to be made in South Korea before being allowed deepsea again.

"This sort of incident tends to focus the mind on the power of the weather and its effects on the sea, and to banish any complacency that a couple of weeks of quiet tropical weather may have built up.

"During my many years of involvement in voluntary weather and other environmental observations, I have met many people in various parts of the world with interests in these subjects, and I would like to thank them for many stimulating chats in the wheelhouse while on their visits to install and maintain even more complicated observing equipment. Keep up the good work!"

Not completely finishing with the sea, Captain Mathews hopes to continue his hobby of crewing on a Conway One Design yacht off north Wales, while other occupations in retirement will be golf and a recently developed interest in gardening; he says his wife also has many schemes lined up for his DIY skills!

We wish Captain Mathews a long and active retirement.

Notices to Marine Observers

Appointment of Port Met. Officer for North-west England

Mr Colin B. Attfield was appointed in August 1998 to replace Captain Jim Williamson in the position of Port Met. Officer for North-west England, based in Liverpool.

Colin Attfield was born in 1954 in Cowes on the Isle of Wight and, he says, owing to his father's Royal Naval background, "... lived a somewhat nomadic life, with barely more than two years in any place. A grammar school education in Singapore, Chelmsford, Dunfermline and finally Plymouth led to six O-levels and a somewhat inevitable career at sea."

He joined the Royal Fleet Auxiliary as a cadet in 1971, progressing through the normal certification process, achieving Masters (Foreign Going) and HND in Nautical Studies in 1989, at Plymouth. During his time with the RFA he visited most parts of the world with the exception of Australia and New Zealand, then took voluntary redundancy in 1993. Over the next three years he ran a small guest-house in south-east Asia while also undertaking short sea voyages during which he was given his first command. In 1997 he returned to the UK, working at the Hydrographic Office at Taunton, producing *Admiralty Sailing Directions*, from which post he joined The Met. Office. His main interest 'out of hours' is rugby union.

Excellent Awards for 1997

The October 1998 edition of this journal contained the listings naming those Masters and Officers who have been nominated to receive an Excellent Award for voluntary weather observing at sea during 1997; to date we have dispatched book awards to 169 nominees following the receipt of their completed claim forms which were attached to the letters of notification dated 3 August 1998.

Unfortunately, in what is becoming a common problem, we are unable to contact a number of observers via their last-known employer's address, for reasons unknown.

In this respect we would particularly like to hear from the following:

Masters: Captain R. Fullager Captain M.J. McGilvray Captain A.P. Talbot

Observing Officers: I. Beaton A.J. Boyd F.R. Gerstner E.F. Gumera H.P.G. Maynard P.I Preston G.J. Swadel

Other observers seeing their names in the October listings, and who have ***not*** already been notified of their award, are asked to contact us direct or through any UK Port Met. Office, so that their claim can be processed as soon as possible. Observers claiming in this way will be asked for their Discharge or Seaman's Book number.

We would like to remind observers that, as we are unable to hold unclaimed book awards indefinitely, we need to receive your claims by 30 April 1999 to ensure delivery of book titles. Claims dated or made later than this will be honoured by a certificate.

Fleet Lists

UNITED KINGDOM

Updated information regarding the list published in the July 1998 edition of *The Marine Observer*. Radio Officers, where carried, are indicated by **bold** type. Amendments for this list are required by 15 September.

Selected and Supplementary ships

NAME OF VESSEL	RECRUI-TED	MASTER	OBSERVING OFFICERS and **RADIO OFFICERS**	OWNER/ MANAGER
Audacity	30.5.98	C.P. Jones	R. Patten, A. Hatto	F.T. Everard & Sons Ltd
Berge Atlantic	9.9.98	O. Grimsild	D. Sarkar, P.F. D'Souza, S. Sankaranayanan	Bergesen d.y. ASA
British Vigilance	25.6.98	I.H. Alexander	C.P. Doolan, P.E. Simpson, W. Olaman	BP Shipping Ltd
Buccleuch	11.6.98	—	—	Associated Bulk Carriers (London) Ltd
CSO Marianos	14.7.98	J. Sutcliffe	P. Binks, R. Light, P. Williams	Coflexip Stena Offshore Ltd
CanMar Pride	10.8.98	J. Simcox	A. Verma, F.S. Bulara, H.K. Johari	Canada Maritime Services Ltd
Clansman	29.6.98	H. Sinclair	C.D. McCurdy, –. Gillon, –. Paterson	Caledonian MacBrayne Ltd
Edinburgh Castle	4.4.98	R. Meikle	P. Ginn, P. Boocock, P. Young	Lowline Ltd
Geo Prospector	16.9.98	P. Smith	D.David, M. Toppitt	Eidesvik Shipping (UK) Ltd
Global Mariner	3.7.98	D. Enever	T. Stewart, J. Moor, R. Eames, **A. Harwood**	Acomarit Services Maritimes S.A.
Grafton	11.5.98	P. Mookerjee	R. Sood, P.V. Fernandes, I. Kapadi, **B. D'Silva**	Associated Bulk Carriers (London) Ltd
Kent Voyageur	25.9.98	I. Biggs	M. Catanyag, M. Adamiak, N. Mesilang	Kent Line Ltd
Lapponian Reefer	16.7.98	I.J. Minnis	M.G. Sorra, R.M. Gabutin, R.B. Dajay	Holy House Shipping AB
Maersk Mariner	12.3.98	I. Black	R. Kendrick, S. Close	The Maersk Co. Ltd
Mansal 18	12.5.98	J. Davies	C. Bettison, E. Babic, Z. Outonovic	Marr Vessel Management Ltd
Nicky L	11.6.98	C. Profit	N. Finn	R. Lapthorn & Co. Ltd
NOL Agate	15.4.98	P.H. Bhatia	R. Chandran, N. Kyawmin, K. Kunarajah	Neptune Ship Mgmt. Services (Pte) Ltd
NOL Cyprine	29.4.98	L.Y. Min	N. Rathakrishnan, T.T. Huat, J. Lingham	Neptune Ship Mgmt. Services (Pte) Ltd
NOL Pearl	31.3.98	K.H. Tan	A.J. Gomez, G. Ashwani, P.T. Cheong	Neptune Ship Mgmt. Services (Pte) Ltd
P&O Nedlloyd Southampton	6.7.98	R. Kenchington	A. Jameson, M. Barraclough, D. Moody	P&O Nedlloyd Ltd
Pisces Voyager	11.6.98	K.S. Sandhu	R. Thakur, P. Chakraverte, A. Fobler	Bibby Harrison Mgmt. Services Ltd
Pride of Bristol	15.9.98	R. Baker	K. Willmot	The Pride of Bristol Trust
Scotia	18.3.98	J. Nichols	—	Marr Vessel Management Ltd
Solitaire	25.6.98	J. de Herzog	—	Allseas Engineering
Torben Maersk	26.6.98	M.I. Kahn	J. Parkin	The Maersk Co. Ltd

Selected and Supplementary ships (*cont*)

NAME OF VESSEL	RECRUITED	MASTER	OBSERVING OFFICERS and **RADIO OFFICERS**	OWNER/ MANAGER
Trade Cosmos	17.5.98	M. Cameron	Z.Y. Zhou, T.M. Janshed Ali, M.S. Uddin	Wah Tung Shipping Agency Co. Ltd
Tundra Princess	27.5.98	H.E.I. Hansson	E. Ebarle, J.J. Buhay, J. Garrovillas	Irgens Larsen AS

The following ships have been withdrawn:

Alpha Centauri Arctic Ranger Atlantic Liberty Celtic Ambassador Claymore Columbus Valparaiso Discovery Bay Eagle Arrow Ebalina Excelsior Exemplar Faki III Fremantle Star Hemera Hoo Kestrel Ivybank Kestrel Arrow Kukawa Lady Rebecca Larkfield Leonia Lima Lough Fisher Merchant Patriot Merchant Princess Moraybank Moreton Bay MOL Lageno Norquest Ocean Defender P&O Nedlloyd Tokyo Petro Tyne Pisces Pioneer Scotia Seillean Siliqua Siratus Staffordshire Stresa

British Commonwealth

The following Selected and Supplementary ships have been recruited to or withdrawn from the list published in the July 1998 edition of this journal.

AUSTRALIA

Recruited (Sel.): *Aotearoa Chief, Tasman Chief*
Withdrawn (Sel.): *Caribbean Challenger, Chekiang, Iron Dampier, Pacific Challenger*

INDIA

Recruited (Sel.): *Bharatendu, Tirumalai*
Recruited (Sup.): *Gem of Madras, Homi Bhabha, Jag Pradip, Lok Kirti, Major Shaitan Singh PVC, Raja Mahendra, Rabindranath Tagore, State of Tripura*
Withdrawn (Sup.): *Tirumalai*

NEW ZEALAND

Recruited (Sel.): *Spirit of Freedom*
Withdrawn (Sel.): *Ranginui, Rangiora, Rangitata, Takitimu, Turakina, Union Rotorua*

Hong Kong Special Administrative Region

Recruited (Sel.): *Delmas Tourville*
Withdrawn (Sel.): *Chengtu, Gulf Spirit*

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