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# The Marine Observer

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Met. O. 1007

# THE MARINE OBSERVER

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

**VOL. 63** **No. 320** **APRIL 1993**

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COVER PHOTOGRAPH: United Kingdom Ocean Weather Ship *Cumulus* photographed at Reykjavik on 28 January, 1992 by N.A. Matheson. (See page 53.)



LONDON: HMSO

# Annual Report of the Observations (Marine) Branch for 1992

**1. Voluntary Observing Fleet (VOF)**

At the end of December 1992 the following were members of the United Kingdom VOF:

(a) 460 Selected Ships undertaking voluntary observation of the weather conditions at sea at specified hours, equipped with complete sets of meteorological instruments and stationery loaned for this purpose.

(b) 1 Supplementary Ship, which carried out a limited observing programme, using an abridged complement of instruments.

(c) 39 'Marid' vessels, mainly coasting and North Sea operators, which supply unique information on sea temperature and the current weather conditions, which is of importance in the forecasting of fog in the areas in which they trade. In certain cases the data may also provide forewarning of the formation of sea-ice.

(d) 2 automatic light vessels and 1 light tower, *Royal Sovereign* off the coast of East Sussex.

(e) 7 Auxiliary Ships, i.e. those requested to make and transmit limited observations on a special form provided by Port Met. Officers, enabling them to send in vital weather information from oceanic areas where data are in particularly short supply.

(f) 34 Oil Rigs and Platforms reporting in Ship Code from the oil fields around the continental shelf, guided by the Offshore Advisers based at Aberdeen Weather Centre and Bracknell HQ.

On recruitment, Selected Ships are provided with precision aneroid barometer, marine barograph, air and sea thermometers, screens, sea temperature bucket, logs and code books. Many ships are also fitted with Met. Office supply distant reading or automatic weather message transmission terminals. All these ships are part of the World Meteorological Organization (WMO) scheme involving about 7,450 merchant ships world-wide.

Port Meteorological Officers remain in the forefront in promoting the need for more recruits to co-operate in voluntary observing, particularly in these times when our knowledge of weather and climate is so important to the improvement of the environment. The valuable expertise of some observing ships is unfortunately lost to the scheme from time to time, such as Ben Line's last ships which ended service in mid-year. The 1885 *Benalder* was that line's first observer for the Met. Office on a London to Japan round voyage with Captain W.M. Waring. As in all cases when operators advise that ships must cease to be observers, the Met. Office's valuable equipment on loan must be returned, usually with the intervention of Port Met. Officers. Increasing help from these officials overseas ensures that new recruits continue to replace losses.

New observers of interest in the year included *Scillonian III*, whose Master, ex-Blue Star Line, was persuaded by one of our Nautical Officers on leave on the islands to make the useful observations on passage between Penzance and the Scillies during the April to October season. The General Superintendent, Fleet Operations, of the Kuwait Oil Tanker Company gave permission for the use of that company's ships, if and when they called at suitable ports for recruitment. We were pleased to receive pre-departure briefing visits from crew members of one of the yachts sailing in the British Steel Challenge: this resulted in receipt of a good number of accurate weather observations from *Heath Insured* during various legs of the Round-the-World yacht race, and all credit is due to those on board who found the right moment to see to the weather message on such occasions.

Special thanks are due to those on the many observing ships which took the time to return the WMO questionnaire, *Marine Meteorological Services Monitoring Programme*, with the objective of improving broadcasts and weather bulletins that fall under the heading of 'Weather Services for Shipping'. Collation and summary on the returns from all voluntary fleets involved by the co-ordinator, our colleague George Kassimidis of the Hellenic Met. Service, is awaited with interest and we will report on this in due course.

The 900 meteorological logbooks received from observing ships during the year shows a small increase over the numbers for the past two years, and despite more of the newest, longer, version of the log being brought into circulation. Log number 50,000 since the end of World War II was treated as a special case, with much help coming from the Master and Managers of *Baltic Universal* to feature particular aspects of the ship's operations. Ships' reports of marine and meteorological phenomena continue to be sent to scientists or experts for analysis and comment; unfortunately many of these correspondents have less spare time to devote to these identifications, as readers of *The Marine Observer* may have noticed. In particular some departments of the Natural History Museum whose personnel have provided excellent comment in the past, and we believe benefitted from samples and descriptions sent in from ships, now wish to charge for these services. Unfortunately the Marine Division has no remit to pay for such information, but alternative sources are still under investigation where necessary.

The Port Met. Officer from Dar es Salaam requested assistance in detailed training in marine meteorological matters. He was subsequently invited to attend the Met. Office College near Reading and work beside the PMO at Cardiff and ship routeing officers for several weeks in total. He made good use of time spent in the U.K. and returned to his country a happier and wiser man.

During a visit to the Marine Division at Bracknell in April, the Master of P&O European Ferries' *Pride of Hampshire* invited senior meteorologists from the Central Forecasting Office to experience for themselves the conditions under which navigating officers work and record the weather on board. Accordingly a total of twelve forecasters made the crossing on three separate return trips between April and August on the company's Portsmouth to Le Havre service. To the Nautical Staff of the Met. Office who accompanied them, appearances were that these voyages resulted in a very useful exchange of views on both sides. The weathermen doubtless claimed some credit for the absence of any rough weather experienced on all three trips.

The four P&O Containers' newbuildings, starting with *Jervis Bay*, are the latest VOF ships to be fitted with the Met. Office Observing System for Ships (MOSS), permitting coded messages formatted on screen to be automatically transmitted and thus to reach their destination in 'real time' for timely assimilation into forecasters' charts. Five bulk carriers operated by Furness Withy and Ropner bring the total units installed to 33, including our Ocean Weather Ship *Cumulus*.

Met. Office Distant Reading Equipment was fitted to the new P&O container ships as well as newbuildings for Caledonian MacBrayne at Lowestoft, also to *Geest St Lucia* and *Geest Dominica* building in Denmark. The hull-mounted sea temperature sensor and Electronic Resistance Thermometers in screens for taking dry- and wet-bulb temperatures, connected to the bridge-mounted multi-channel indicator, were also installed on R.R.S. *Discovery* during her major refit.

*OOCL Challenge* has been crossing the North Atlantic for five years as host to the container housing the Automated Shipboard Aerological Programme (ASAP) on free loan from the Canadian Atmospheric Environment Service. Manned by a contract operator from J. Marr and Son of Hull, two radiosonde launches were made daily at sea without having to change ship's course, and using the MOSS transmission method. The ASAP unit operated and manned by the Finnish Met. Institute aboard *Canmar Ambassador* on the North Atlantic for the last six years was removed from the ship at the end of 1992. After refurbishment it was planned to redeploy the container on the Phillips North Sea Platform *Ekofisk* as part of a European Met. Services joint project. The Office also continued to provide financial support for ASAP operations on board R.R.S. *Bransfield*, mainly for use when on her Antarctic station.

Several co-operative projects were undertaken to assist in the monitoring of the role of the oceans in climate change. OWS *Cumulus* made useful intercomparisons and inspections of one of the fixed meteorological data buoys passed *en route* to and from the ship's North Atlantic station. For the World Ocean Circulation Experiment (WOCE), a WMO project designed to improve the description and modelling of the global ocean circulation, four new drifting buoys were uplifted in April for the United States National Oceanographic Service from Portsmouth, Virginia by *Atlantic Conveyor*, for shipment to Liverpool. The buoys were then transferred by RAF transport to *Cumulus* at Greenock for eventual deployment in the North Atlantic in latitude 59°N between longitudes 20°W and 30°W. The data transmitted by these buoys are monitored by the Scripps Institution of Oceanography at La Jolla, California. Two buoys were embarked on board *Geestport* in June for deployment in the Caribbean, for satellite tracking and weather monitoring. Other U.K. VOF ships were requested by the New Zealand Met. Service to launch drifting buoys in the Pacific *en route* from Wellington to Balboa.

The above gives an indication of the many additional co-operative measures made by ships of the Voluntary Observing Fleet for which scientists must be grateful.

**2. Ocean Weather Ship**

OWS *Cumulus* had an eventful year, not least whilst experiencing more than her usual share of bad weather in the autumn, from the many deep depressions hurrying by station 'Lima', the weather ship's permanent North Atlantic duty station in position 57°N, 20°W. On the first voyage in January a lightning strike damaged the ship's satellite communications, GPS, one radio receiver and oceanographic data logger: receipt of messages connected with Global Maritime Distress and Safety System (GMDSS) trials were therefore interrupted. The ship's magnetic compass was also badly affected, incurring deviations of up to 45°, but reversal of the horizontal magnets reduced these extreme readings to some extent, until all these faults were righted on the ship's next return to home base at Greenock.

At the end of January the ship made a special call at Reykjavik to deliver four drifting buoys, three for the U.K., one for France, for deployment by the Icelandic Met. Service. Opportunity was taken to invite staff of the Icelandic Met. Office ('Verdurstofa Islands'), and almost the whole complement accepted the hospitality of the weather ship's managers, J. Marr & Son of Hull, to pay their first visit to such a ship. The photograph on the front cover records the visit, as can be seen by the Icelandic courtesy ensign flown. *Cumulus* also deployed four drifting buoys for the United States (see above) and that country reported that, shortly after deployment, the buoys were accurately transmitting meteorological and oceanographical data from the North Atlantic.

During annual drydocking at Milford Haven in June, a new VAISALA DigiCORA upper air sounding system was installed, modernising the equipment with which data from the instrument package lifted on high by a helium-filled balloon was launched four times a day, on passage and on station. Being the only weather ship stationed to the west of northern Europe, the information provided by the radiosondes, and by the hourly detailed weather reports, are of great value to the recipient National Met. Centres. Useful information also comes from Norway's own Ocean Weather Ship, *Polar Front*, stationed mainly off that country's north-west coast in 66°N, 02°E, but roving as required by their Met. Institute.

Other regular commitments on board *Cumulus* included taking bathythermograph soundings, four per day on passage and two when on station; making regular solar turbidity measurements by sunphotometer for the Royal Dutch Met. Service and for the WMO recording centre at Asheville; and individuals on board were responsible for forwarding reports of observed aurora to the British Astronomical Association (Aurora Section), birds to the Royal Naval Birdwatching Society and cetacea sightings to the Oxford and Cambridge census groups. Meteorological messages were transmitted by MOSS or Telex-over-Radio and administration traffic by the ship's SATCOM Standard-C equipment.

Interest was shown in the ship's sea training facilities, whereby up to 20 individuals may take regular courses in background science and technology, in observational methods and in basic seagoing operations, or a course tailored to the needs of groups on the normal 33-day round voyages from Greenock. These courses are offered by Oceanscan Master Service Ltd of Godalming, Surrey, U.K.

As part of an extensive programme of familiarisation of all sectors undertaken by the Chief Executive during his first year in control of the Met. Office, Professor Julian Hunt paid a visit to *Cumulus* at her Greenock base and sailed on the ship to the bunkering terminal, witnessing a radiosonde launch *en route*.

### 3. Ship Routeing

The five Master Mariners with extensive command experience who make up the METROUTE ship routeing team were kept well occupied throughout the year, receiving several new contracts, including a new routeing order from Acomarit Service Maritimes, Geneva-based shipowners and managers, for part of their large global fleet. In addition, there were renewals for routeing to many parts of the world from such companies as A.P. Moller, BTC, Cunard, Esso International (Bahamas), Geest Line, James Fisher, Shell International Marine, Trader Navigation, Wallem Ship Management and Zodiac Maritime. The liner *Queen Elizabeth 2* was again given routeing advice on her world cruise undertaken during the northern winter season, in addition to her regular trans-Atlantic crossings.

The first of several planned METROUTE agencies was set up in Singapore, with IMPRO Scientific Instruments. They will cover all Far East areas as agents, including the key centres of Hong Kong, Japan, Korea, China and Taiwan. Orders already secured by IMPRO for METROUTE include the routeing of cargo ships across the Pacific.

Tropical Storm advisories and the Sea Ice desk continued to constitute a large part of the ancillary work, with a large number of requests from owners and charterers for voyage analyses and assessments of ship performance.

The Marine Advisory Service continued to operate for the benefit of marine surveyors, underwriters, solicitors and loss adjusters, mainly concerned with legal matters in connection with ship casualties and cargo damage or loss occasioned by heavy weather.

**4. Services to Shipping**

Following due consultation with the Department of Transport Marine Directorate, nautical colleges and officers' unions, agreement was reached to cease, from 1 December 1992, inclusion of Part 4 of the twice-daily broadcasts of the North Atlantic Weather Bulletin from Portishead and Goonhilly radio stations. The groups in the coded analysis, originally intended for ships' officers to plot their own weather charts on board, are no longer required by the great majority of seafarers who can obtain up-to-date professionally produced charts by facsimile.

Following general public concern over the future of broadcasts of shipping bulletins on Radio 4 Longwave, in the light of BBC proposals to turn the wave length into a news and current affairs station in 1994, and for Radio 4 to migrate to FM, the Marine Superintendent voiced these worries in a letter to the Controller of the service in October. In reply, he received assurances from the BBC News and Current Affairs department that there was an awareness of the BBC's responsibility to those at sea and that the shipping forecast on Longwave would continue.

For the U.K. coastal waters shipping forecasts, facilities for making coastal station reports were withdrawn at two stations, Land's End and St. Abb's Head, but alternatives were arranged at Scilly Airport and Fife Ness Coastguard Station. Such changes continue to become necessary from time to time, as automation pervades and it is sometimes necessary to locate other manned stations that are able to make the observations at times suitable for inclusion in the broadcasts.

The Marine Superintendent was again highly involved with the meteorological implementation arrangements for the Global Maritime Distress and Safety System (GMDSS) SafetyNET service. He co-ordinated the introduction of interim meteorological services following difficulties and delays caused by the slow response internationally to the International Maritime Organisation (IMO) agreed start date of 1 February 1992. By the year's end, a full or interim service was in operation by or for most participating countries, Russia and China being the two notable exceptions.

**5. International activities**

The Marine Superintendent had a full programme of national and international meetings in connection with marine meteorological services. In February he was at INMARSAT HQ in London for a meeting on meteorological and oceanographical reports through INMARSAT. The objectives were to review the present status on the transmission of these elements and agree on future development, aiming for simplicity and economical use of resources, both from the shipboard and shore processing standpoint. Later in the year there was a further review and update on the distribution of Maritime Safety Information through SafetyNET. At the IMO in April he attended the Maritime Safety Committee meeting on the results of the pre-GMDSS trials and follow-up sessions to these in Geneva on two occasions during the year.

At WMO in Geneva in March, he acted as one of two experts (the other being a Russian ocean modelling expert) to produce a draft plan for a co-ordinated high seas system providing meteorological support for marine pollution emergencies on the high seas: this will eventually form a new section of the WMO Manual on Marine Meteorological Services. Marine Superintendent attended the Co-ordinating Group on COSNA (Composite Observing System for the North Atlantic), also in Geneva; the group is undertaking a complete review of the various observing systems on the North Atlantic in order to obtain the best results from all these resources.

### 6. General

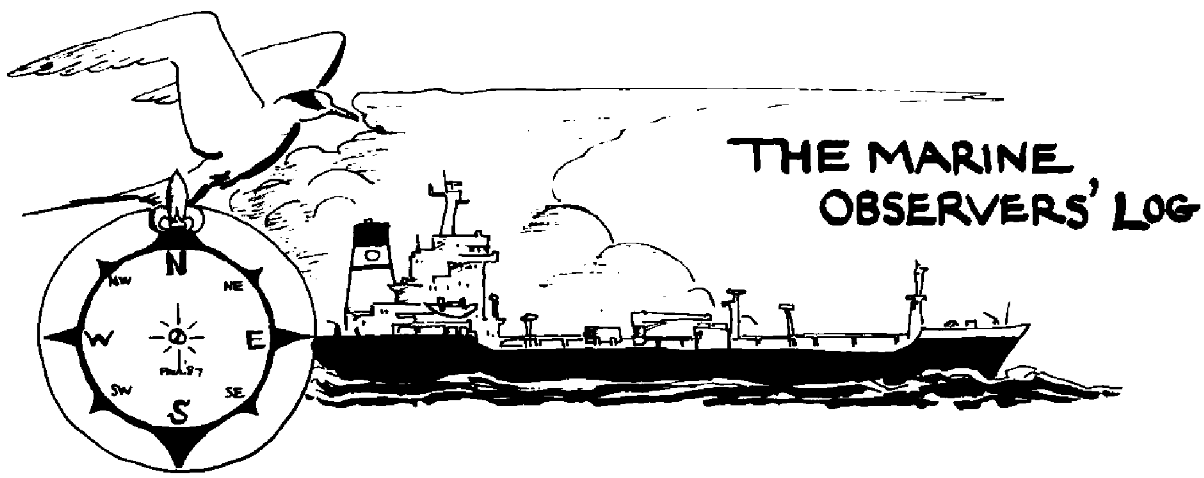
In his capacity as Branch Director of the Observations (Marine) branch of the Met. Office, the Marine Superintendent provided material for an article entitled *Metroute — the U.K. Met. Office ships' routeing system*, published in *Safety at Sea International*, January 1992.

When the Royal Met. Society's 'History of Meteorology Group' met at the Archive in Scott Building in June, Captain Houghton of the Marine Division joined other speakers in giving a short talk on *The collection of ships' weather logs*, including an inspection of some of the oldest such logs of the nineteenth century held in the extensive vaults at Eastern Road.

At the opening of the new 'Sir John Houghton' Lecture Theatre at the Bracknell Met. Office Headquarters in July, the recently retired Chief Executive, whose conception the theatre was, presented his first special award for contributions to weather forecasting to deserving staff. Shortly afterwards the Sea Ice Officer attached to the METROUTE ship routeing team gave a talk to a well-filled lecture theatre of interested members of staff, who had requested an in-depth exposition about the formation and extent of ice in the polar regions. They heard a well composed treatise which included many little-known facts about the evolution of ice: it is hoped to reproduce part of this talk as a journal article at a later date.

For the tenth meeting of the WMO Commission for Basic Systems, held in Geneva in November, the International Chamber of Shipping was asked to provide a speaker representing the shipping industry. In response, P&O Containers nominated Captain John Peterson, currently Master of their new container ship *Jervis Bay*, to speak on the subject of *Provision of weather services: understanding user requirements*, for which we were able to provide him with information and graphical material during his briefing visit to the Marine Division earlier in the year. In a friendly and enthusiastically-received exposition on meteorological services and implications for the future, Captain Peterson highlighted the role played by the U.K. Port Met. Officers in encouraging ships to co-operate in the international weather observing scheme.

Four shipmasters with long and auspicious observing records were rewarded with inscribed barographs at ceremonies held in Bracknell. Excellent Award books were available for 300 Masters, Principal Observers and Radio Officers who provided the best meteorological logbooks for the year. The chosen books were *Cassells's Concise English Dictionary* (1992 edition), *Philip's International World Atlas* and *Darwin* by Adrian Desmond and James Moore. Several awards for previous years remain unclaimed and all concerned would be advised to consult the lists in July editions of *The Marine Observer.*




# April, May, June

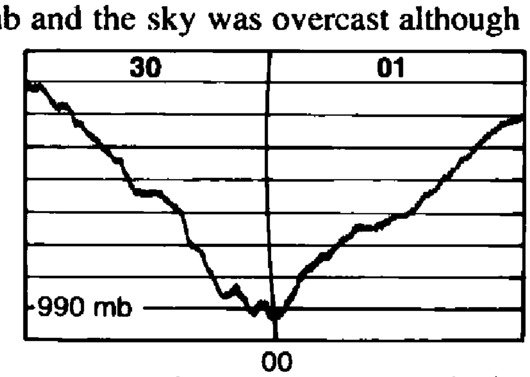
*The Marine Observer's Log* is a quarterly selection of observations of interest and value. The observations are derived from the logbooks of marine observers and from individual manuscripts. Responsibility for each observation rests with the contributor. The standard international unit for barometric pressure is the hectopascal (hPa) which is numerically equivalent to the millibar (mb).

### TYPHOON 'BOBBIE'

**Western North Pacific**

m.v. *Pacific Teal.* Captain M.J. Stares. Sendai, Kyushu to Fukushima Tonden, Honshu. Observers: the Master and ship's company.

29 June–2 July 1992. At 0700 UTC on the 29th the vessel was secured at Fukushima Daiichi power station, but the approach of typhoon Bobbie (in position 25.7° N, 127.2° E at 0030) caused concern ashore and the vessel was directed to sail the following day. By the evening of the 30th the vessel was 'loitering' north of Kinkasan, when the wind was S'ly, force 2–3, the pressure was 1004.2 mb and the sky was overcast with rain. During the middle watch the wind veered to N×E'ly, force 3–4; thereafter, the pressure decreased rapidly and the wind increased but remained N×E'ly to N'ly. At 0000 on the 1st the wind had reached force 9 with the pressure reading 992.9 mb, and then rapidly moderated as the pressure rose, see barograph trace. At noon the wind was N'ly, force 4–5, the pressure was 997.5 mb and the sky was overcast although the rain had ceased. By




1800, Bobbie had been downgraded to an extra-tropical storm in position 36° N, 141° E and the vessel berthed on the 2nd as the swell had subsided.

Position of ship on the 30th: approximately 38° 24'N, 141° 30'E.

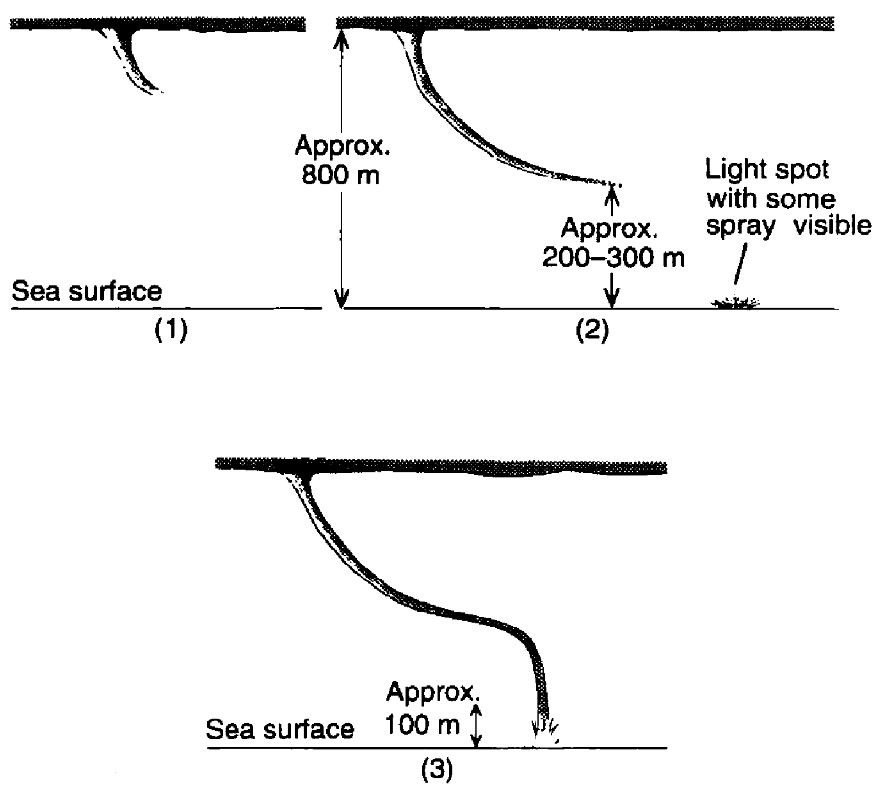
## WATERSPOUT

### Indian Ocean

m.v. *Benavon*. Captain W.A. Mason. Singapore to Suez. Observers: the Master, Mr M.N. Sherwood, Chief Officer and Mr J. Allen, Radio Officer.

17 April 1992. At 0220 UTC a waterspout was observed to be developing from the base of a cumulonimbus cloud on the starboard quarter approximately 6 n.mile distant, see sketch (1).

It gradually became longer and curved more and more, its lower section becoming almost horizontal, still some 200–300 m above the sea surface at which point a light spot with some spray became visible on the sea surface, see sketch (2). The spout was then quickly completed, the lowest section being almost vertical. Spray was observed at the base and then rose higher and higher up the spout to an estimated height of 100 m, as in sketch (3). It had taken some four minutes from the initial sighting to reach this stage, and lasted for about 30 seconds before quickly dispersing from its base upwards again, finally disappearing, the whole process having taken roughly six or seven minutes.




Unfortunately, owing to the distance away from the vessel, it was not possible to determine the direction or rate of rotation of the spout, and there did not appear to be any rain falling from the cumulonimbus at the time of the waterspout.

Reference to the *Marine Observer's Handbook* revealed that the waterspout was much larger than average and justified the Radio Officer's comment as being the best example of a waterspout he had ever seen.

Weather conditions were: air temperature 29.3°C, wet bulb 26.0°, sea 31.0°, pressure 1011.3 mb, wind S'ly force 2.

Position of ship: 05° 53′N, 83° 08′E.

## ICEBERGS

### South Atlantic Ocean

m.v. *Maersk Cadet.* Captain J. C. Harley. Ascension Island to the Falkland Islands. Observers: the Master, Mr T. Sinclair, 2nd Officer and ship's company.

8 May 1992. At 1730 UTC the officer of the watch noticed several echoes, the closest of which was about 14 n.mile away, on the ship's radars. As there were small patches of fog present, the Master was informed. Initially, it was thought that the echoes were fishing boats, but due to their size and also recent reports of icebergs, the observers were sceptical.

At about 12 n.mile an indistinct white object was seen on the horizon, but owing to low cloud on the horizon and also the fog patches, its identity was uncertain. As the distance from it was reduced, it became obvious that there were two icebergs visible on the port bow, with the possibility of several more. The ship continued to approach cautiously, and eventually passed within 2 n.mile of two weather-worn icebergs (see photograph). There were also four more, three of which were tabular whereas one was more peaked and weathered; these four were 8–14 n.mile distant.

*Photo. by T. Sinclair*

Weathered icebergs passed at approximately 2 n.mile.

As the icebergs were passed, vertical sextant angles were taken to determine their height; one was found to be 46 m high whilst the other was 30 m high. Numerous bergy bits were seen close to these icebergs.

When the vessel returned northwards from the Falkland Islands four days later, similar echoes were encountered during darkness and it was thought that they were of the same icebergs already seen. This radar observation implied that the icebergs had drifted to the north-west, which was not as would have been expected since prevailing currents at this time of year would be to the north-east.

Position of ship: 49° 04′S, 54° 08′W.

*Editor's note.* The main point of interest about these observations is whether the icebergs could be the same ones as sighted by the *Falklands Desire* on 28 October, 1991 (*The Marine Observer*, October, 1992, pp.170–171).

## CETACEA

### Eastern North Atlantic

t.s. *Astrid.* Captain D.R. Norman. Training cruise from the Azores towards France. Observers: the Master and ship's company.

18–21 May 1992. At 1015 UTC a whale was sighted about 27 m off the starboard bow and appeared to swim with the ship for about a minute, before disappearing below the waves. Almost immediately afterwards two more whales were spotted abeam of the port bow, and blows were seen from both of them as they maintained the ship's speed for over a minute before seeming to drop back. Despite being only 22 m from the ship, the whales' actual blowholes were not seen although the small sickle-shaped dorsal fins of both whales and a large section of gently curving back were clearly visible. On one occasion the white underbelly of one whale was seen when it rolled onto one side. With nearly all of the ship's 35 crew members as observers, the whales were unanimously identified as Fin Whales, having a length of about 18 m and being of a pale-grey hue with no obvious markings.

On the 20th at 1525 a pod of about seven or eight pilot whales was sighted astern of the ship. They were an average length of 3–4 m and seemed to be playing in the wake; often, their heads were visible as the whales jumped over the waves. They did not seem deterred by the noise of the engines, and were not overly curious about the ship, seeming content to stay in the same place as the ship moved away. The pilot whales were easily identified by their uniformly black colouring and blunted heads; no blows were sighted, but the rather rough sea conditions could account for this.

Another Fin Whale was seen the next day, but it was likely that there was more than one individual. It was sighted off the starboard quarter and then passed astern and disappeared. After three or four minutes a Fin Whale appeared on the starboard side, staying with the ship for about a minute before submerging and reappearing on the port side. Its size was similar to the one seen on the 18th and the blowhole of 45 cm was visible despite relatively poor weather conditions.

Position of ship on the 18th: 43° 45′N, 20° 35′W.

Position of ship on the 21st: 46° 58′N, 16° 08′W.

m.v. *Ravenscraig.* Captain P.F. Middleton. Saldanha Bay to Immingham. Observers: Mr I. C. Gravatt, Chief Officer and Mr M. Fidler, Chief Engineer Officer.

4 June 1992. At 1615 UTC a large school of dolphins numbering 300–400 was observed approximately 0.5 n.mile to the east of the vessel. The large number alone was of great interest and at first it was thought that the agitation created on the sea surface was probably due to them possibly feeding on the abundant schools of fish which were in the area, but this was not the case. In their midst a large Killer Whale was observed on two occasions to leap clear of the sea surface and obviously chase after the dolphins; it was easily recognisable by the white flash on its side.

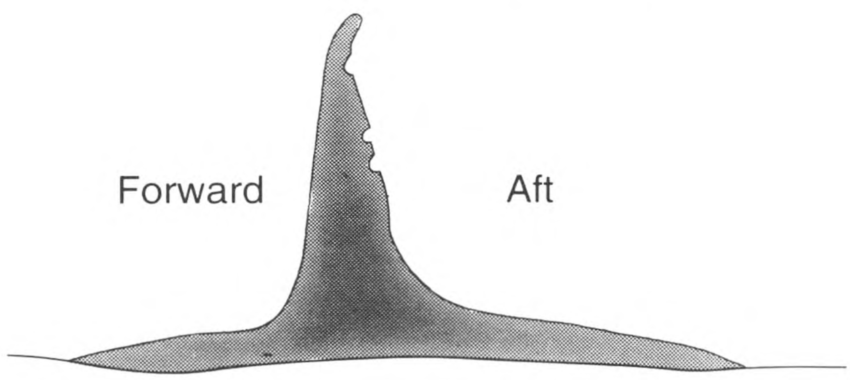
The visibility at the time was about 8 n.mile, and although the dolphins appeared to be escaping to the north, they quickly disappeared from view astern of the vessel.

Position of ship: 19° 05′N, 18° 00′W.

### Eastern North Pacific

m.v. *London Spirit*. Captain D.S. Wyllie. San Francisco to Manzanillo. Observers: Mr I.G. Swales, 3rd Officer, Mr M.A. Wright, 3rd Officer, Mr I.F. Alexander, Radio Officer, and ship's company.

1 May 1992. At 2000 UTC a group of six Killer Whales appeared on the starboard bow and commenced a series of short, shallow dives of approximately 10 seconds each in duration, followed by a longer shallow dive of several minutes which brought them abeam to starboard less than one cable from the ship. The group consisted of one large male approximately 10 m in length with a large near-vertical fin standing approximately 3 m high, see sketch. A smaller adult, 6 m long with a smaller fin (presumably a female whale) and four smaller individuals ranging from about 3–4 m (two calves, two juveniles possibly) completed the




group. The outstanding feature was the tall fin of the male, being nearly vertical and marked by one large notch at the tip on the aft edge, and two smaller notches lower down. The group showed no interest in the vessel, and the whales continued their reciprocal course until no longer observable.

Relevant conditions were: sea temperature 23.0°C, wind variable force 2, air temperature 26.0°, few clouds.

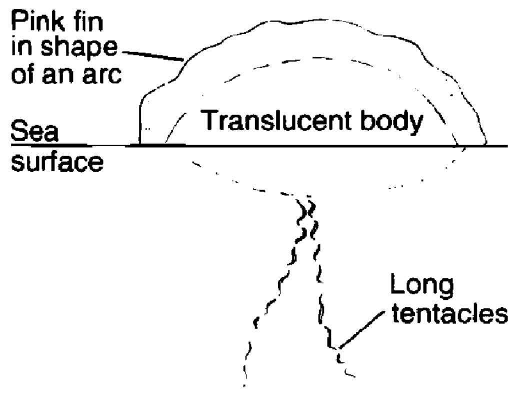
Position of ship: 25° 03′N, 113° 33′W.

## JELLYFISH

### Eastern North Atlantic

m.v. *City of Durban*. Captain P.E.T. Robinson. Cape Town to Zeebrugge. Observers: the Master, Mr D.A.K. Bamford, Chief Officer and Mr B. Donovan, Chief Engineer Officer.

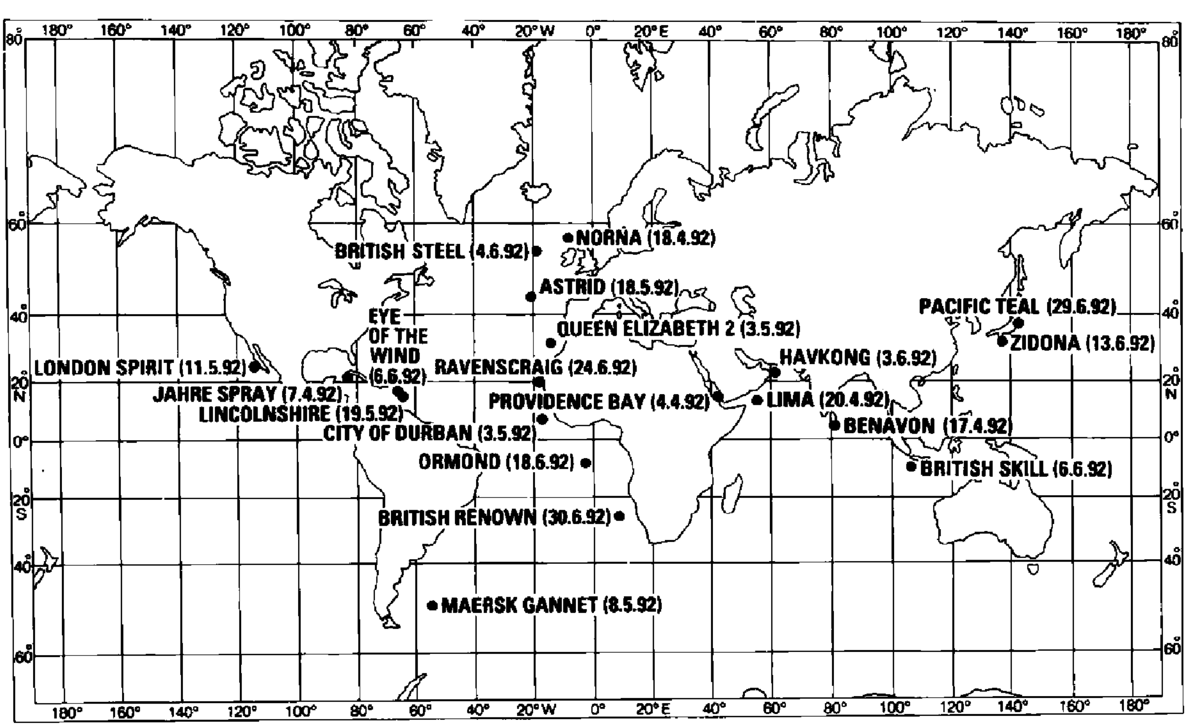
3 May 1992. At 1615 UTC while off the coast of Gambia, the vessel passed through a shoal of what looked like jellyfish. They were floating on the surface of the water and had a very distinctive pink fin, in the shape of an arc, which was clearly visible above the water. Two long tentacles streamed from the lower body, see sketch. The largest of the jellyfish were approximately 30 cm long and the smallest approximately 5 cm long. It appeared as though their bodies were inflated in order to keep the fin above the water, possibly using it like a sail.




The vessel passed through the jellyfish, which numbered 150–200, for more than an hour and over a distance of about 20 n.mile.

Relevant conditions were: sea temperature 24.6°C, wind NNW'ly, force 2, slight sea with a swell of about 1 m.

Position of ship: 12° 39'N, 17° 49'W.




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

## BIRDS

### Eastern North Atlantic

R.M.S. *Queen Elizabeth 2*. Southampton to Tenerife. Captain R.W. Warwick. Observers: Staff Captain R. Bolton, Mr P. Moxom, First Officer, Mr G. Ellis, 2nd Officer and members of ship's company.

3 May 1992. During the day a bird, shown in the photograph, was observed on the bridge wing. It seemed very tame, walking in and out of the bridge at will and amongst the legs of those watching him (or her). The bird was offered food and water but took neither in the hour that it was on board.

*Photo. By G. Ellis*

Whimbrel

Standing about 22 cm tall, the bird was believed to be a Snipe although the observers wondered if this species normally strays so far from the coast. The ship was travelling south at 30 knots on a fine day with S'ly, winds, force 5.

Position of ship: 32° 45'N, 14° 20'W.

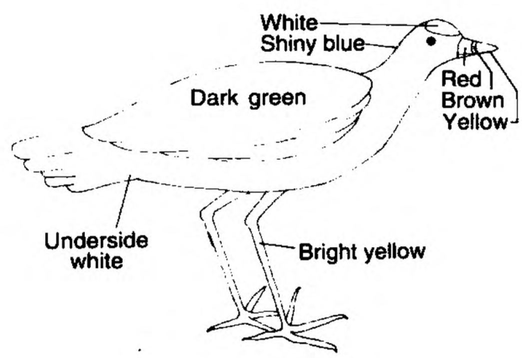
*Note.* Commander M.B. Casement, of the Royal Naval Birdwatching Society, comments:

'The photograph clearly identifies this as a Whimbrel (*Numenius phaeopus*). Note the dark stripe above the eye, with a light central stripe above. This species migrates from wintering quarters in western Europe/west Africa to breed in northern Europe and the Arctic; this one was possibly heading for Iceland. It is recorded fairly frequently aboard ships in the north-east Atlantic, usually in autumn.'

## Caribbean Sea

m.v. *Jahre Spray*. Captain A.D. Moos. Gabon to Texas City. Observers: the Master, Mr L.N. Sampath, Chief Officer, Mr Z. Pehnec, 2nd Officer, Mr S.Z. Peter, 3rd Officer and ship's company.

7 April 1992. At 1700 UTC, when the ship was 38 n.mile south by west of Isla de Pinos, the bird shown in the sketch was sighted perched atop the deck water




seal on the main deck. It was about 20 cm tall and had a rather colourful beak with its tip being a bright yellow, followed by a band of a distinctive brown shade and ending with a band of a bright-red colour. Its head had a crown of white.

Its moderately long neck was a metallic blue in colour and the back feathers were dark green. The undersides of the wings were white and the long, spindly legs were bright yellow and terminated in feet with four claws each.

The bird was with the vessel until 0100 the next day, but owing to the absence of any ornithologist (of repute) on board, the observers were at a loss to positively identify it.

The wind was S'ly force 3, the air temperature was 25.5°C and the course of ship was 296°.

Position of ship: 20° 52′N, 83° 07′W.

*Note.* Commander M.B. Casement comments:

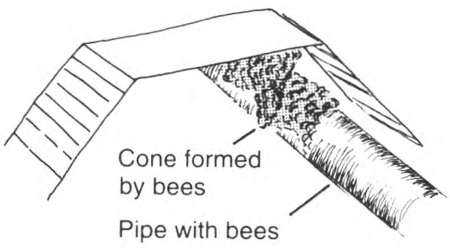
'The bird is identified as a Purple Gallinule (*Porphyrula martinica*). The white patch on the head distinguishes it from the Common Gallinule (*P. chloropus*). This species is less common, but fairly widespread in mainland U.S.A. (Florida, the coast of the Gulf of Mexico) and throughout the Caribbean islands.'

## INSECTS

### Caribbean Sea

m.v. *Lincolnshire*. Captain C.O. Thomas. At Point Lisas. Observers: the Master, ship's complement and shoreside workers.

19–20 May 1992. The vessel had finished loading ammonia, and pipelines were being disconnected when a swarm of bees was spotted between No.2 and No.3 cargo tanks. When looking more closely, the observers could see that under the walkway the bees were forming a 'cone' by hanging on to one another around the queen-bee; the pipework in that section was also covered in bees, (see sketch).




Nobody was available from ashore so the Chief Officer turned the fire-hose on the bees to try and dislodge them from the ship before it sailed. This dispersed the bees which then swarmed around the ship for a few hours before settling down again. By the next day, however, only a few bees were left on board and they were dying. It is believed that the queen-bee was killed by the fire-hose the previous day and so the swarm, upon not finding her, flew off the ship some time during the night.

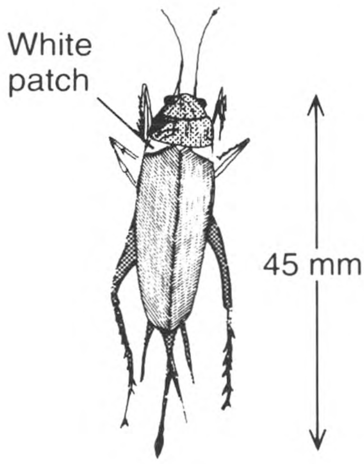
Position at 0000 UTC on the 20th: 12° 42′N, 63° 42′W.

### Red Sea

m.v. *Providence* Bay. Captain D. Tracey. Jeddah to Dubai. Observers: Mr K.S. Hardy, Chief Officer, Miss C.L. Guy, Cadet and Mr G. MacLeod, SMS.

4 April 1992. During the early hours of the 4–8 watch, as the vessel was passing south-west of Haycock Island at the southern end of the Red Sea, the bridge was

invaded by the sound of crickets. On investigation of the starboard bridge wing, several pairs were to be seen scurrying about, but their antics and 'chirping' ceased when a bright light was shone on them. As dawn approached, about 15 insects were found on the bridge wing. They were all black, with a white patch on each shoulder, see sketch. In some cases, these patches merged to form a white




band. A few insects had brown legs and undersides, but others were completely black apart from their backs which were exposed when their wings were lifted and which were paler. The visitors stayed for several days subjecting the nocturnal bridge watches to a form of audible 'torture'!

The weather at the time was overcast with low stratus cloud and continuous light to moderate drizzle. Winds were light and variable.

Position of ship at 0600 UTC: 12° 42′N, 43° 18′E.

## DISCOLOURED WATER

### North Atlantic Ocean

m.v. *British Steel.* Captain I.B. Middleton. Sept Isles to Redcar. Observers: the Master, Mr D. Bowman, Chief Officer, Mr R. Moore, 3rd Officer and Mr D. Grennan, Cadet.

4 June 1992. At 2043 UTC an area of discoloured water was observed. The surrounding sea appeared to be grey/blue in colour whereas the discoloured water was a vivid marine-green hue and covered an area approximately 100 m long by 50 m wide in the shape of an elongated oval.

This area passed about 350 m off the starboard side and, at the time, no apparent pollution was observed. The sky was completely overcast, thus ruling out the effect of sunlight on the water. No surface disturbance was noted and no unusual currents or waves were apparent. The echo-sounder was switched on, but no soundings were obtained, and the sea temperature was taken close to the discolouration.

Weather conditions were: air temperature 13.8°C, wet bulb 13.5°, sea 13.5°, wind S×E'ly, force 3. The sky was overcast with thick stratus and there was a slight sea with a low swell.

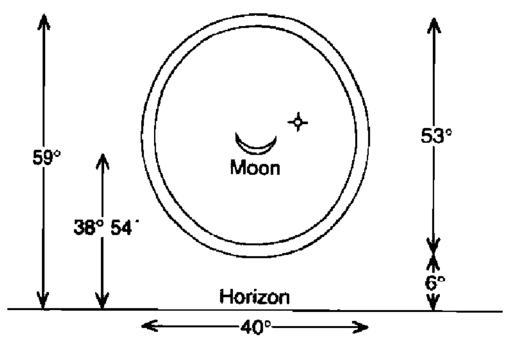
Position of ship: 55° 28′N, 19° 14′W.

## ELLIPTICAL HALO

### Indian Ocean

m.v. *British Skill*. Captain P.R. Anderson. Singapore to Kwinana. Observers: Miss E.M. Salmon, 3rd Officer and Miss R.V. Nelson, Senior Cadet.

6 June 1992. Between 1300 and 1345 UTC a complete halo phenomenon was observed round the moon, as shown in the sketch. The ring was complete although its appearance was elliptical, its horizontal diameter was 40° with its vertical diameter being 53°.




The illuminated part of the moon was not at the centre of the halo, its altitude at the lower limb (phase, new waxing) being 38° 54'. The altitude of the upper part of the halo was 59° whereas the lower edge was at 6°. These altitudes were obtainable, despite it being well into the hours of darkness, owing to the moon being 'bright' and a very clear horizon being visible.

The halo itself was 5° wide with some colouration present, and at the beginning of the observation the inner edge of the ring appeared auburn in colour. This colour seemed to move into the outer edge leaving the inner ring white. The star nearest the moon was Regulus, bearing 294° and was quite bright but the rest of the 'sickle' in Leo was not visible.

Lightning was visible throughout the observation period. The cloud was developing with the visible cloud covering 3 oktas of the sky at 1300. Earlier in the evening cirrocumulus was observed, although at the time of the observation it was difficult to identify the cloud types. Some cirrostratus and altostratus were visible but no low cloud was present. The development of the altostratus was such that by 1345 it almost covered the whole sky and masked the halo from view.

It was observed however, that as the moon set about an hour later, it was accompanied by a corona which was clearly visible and was white with a brownish tint round its edges.

Position of ship at 1300 UTC: 09° 37'S, 106° 05'E.

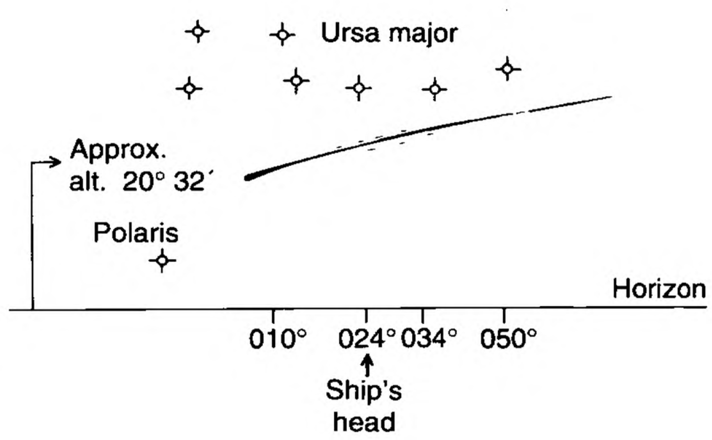
*Editor's note*. An article entitled 'Rare vertically elliptical haloes' was published in *The Marine Observer*, January 1991, pp. 22–27.

## METEORITES

### Arabian Sea

m.v. *Lima*. Captain A.F. Devanney. Las Palmas to Fujairah. Observer: Mr C.M. Berkley, 2nd Officer.

20 April 1992. At 1643 UTC a very bright light crossed the bow, leaving a trail of sparks as shown in the sketch. The 'head' was far brighter than Sirius and even




brighter than Jupiter which at that time was approaching its zenith. The trail of sparks looked very like a 'firework rocket' and commenced on a bearing of about 034°, the complete trail being seen from about 050° until it disintegrated bearing approximately 010° at an altitude of about 28° 30′. It was assumed that this was a decaying satellite or other space debris and the observer was glad he was not standing underneath!

Position of ship: 12° 14′N, 55° 01′E.

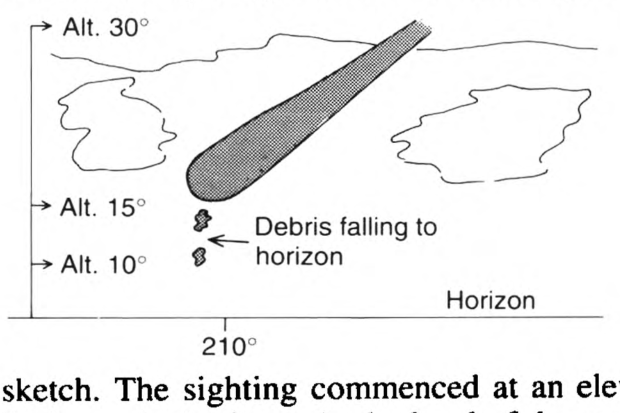
*Note.* Mr H. Miles, Director of the Artificial Satellite Section, British Astronomical Association, comments:

'This was a normal fireball. Because no indication is given for the time taken to cross the sky, it is not possible to say whether it was a natural object entering the atmosphere, or a piece of space debris.'

## South Atlantic Ocean

m.v. *Ormond*. Captain S.B. Tudor. Tanjung Bara to Rotterdam. Observers: Mr L.J. Vaz, Extra 2nd Officer and Mr J. Navarro, AB.

18 June 1992. At 2005 UTC, while the vessel was on a course of 323° and speed 13.5 knots, an extremely bright meteorite was sighted in the night sky,




bearing 210°, see sketch. The sighting commenced at an elevation of about 30° and extended to 15° above the horizon. At the head of the meteorite were chunks of illuminated debris falling down to 10° above the horizon. The meteorite was a very bright green colour and its brilliance illuminated the whole horizon as if it was early evening/dusk.

The total duration of the sighting was approximately 2–4 seconds, and the angle of descent with the horizon was about 45°.

Position of ship: 08° 37′S, 02° 52′W.

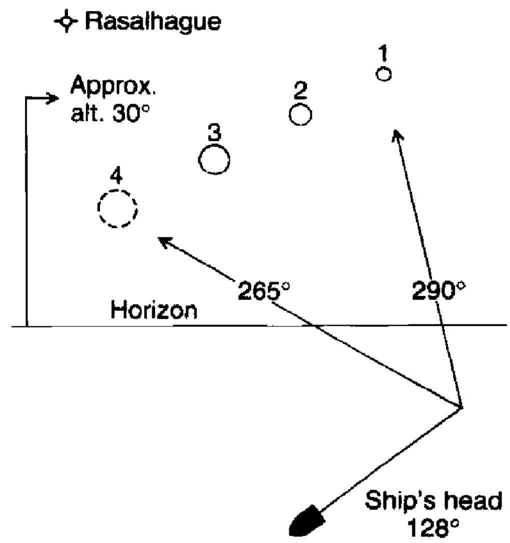
*Note.* Mr H. Miles comments:

'This is a good record of a piece of interplanetary material burning up in the atmosphere, whether or not any material reached the surface cannot be stated with certainty. The material was obviously quite friable, because of the visible fragments trailing behind the main mass. The green colour was due to the ionisation of the gases in the upper atmosphere as the object plunged through the atmosphere.'

## Arabian Sea

m.v. *Havkong*. Captain K.W. Newman. Bandar Khomenei to Shen–Ao. Observer: Mr B. Pritchard, Chief Officer.

3 June 1992. At 0017 UTC the phenomenon shown in the sketch was observed shortly before commencement of nautical twilight.




At (1) a small, intense white light with a red tail appeared. The white light then grew in intensity and the tail increased to a long orange-red glow, at (2). At (3) the ball of light continued to grow in size and intensity, the like of which the observer had never seen before in countless meteorite sightings. The tail then died as quickly as it had grown. Finally, at point (4) the ball of light spluttered then died out too. The approximate duration of the whole sighting was 5–10 seconds.

Position of ship: 22° 21′N, 61° 53′E.

*Note.* Mr H. Miles comments:

'It is thought that the phenomenon seen was a natural fragment of interplanetary material entering the atmosphere. The gradual increase in size was due to the object heating up the atmospheric molecules and dragging them with it. The red tail was due to ablation of the meteoroid and this material formed a visibile dust trail as it cooled. It is most probable that nothing reached the Earth's surface.'

## AURORA BOREALIS

### North-west Scottish waters

f.p.v. *Norna*. Captain B.A. Hall. Fishery protection duties off Barra, Outer Hebrides. Observer: Mr M.P. Donnelly, Junior Chief Officer.

18/19 April 1992. At 2330 UTC on the 18th the aurora was first noticed in the form of a glow of moderate brightness bearing about 340° and extending from 0°

to about 10° in elevation. This was shortly followed by weak to moderate rays which pulsated over periods of about 20 seconds and were at their most intense at 2340. The rays extended from an elevation of 5° up to 30° and were on a bearing of 330° to 350°.

The aurora was grey/yellow in colour but not very spectacular, and the whole display had faded by midnight.

On the 18th at 1330 the vessel had experienced abnormal VHF radio reception, being in contact with the *Sulisker* which was then roughly 135 n.mile away.

Position of ship: 57° 08'N, 07° 04'W.

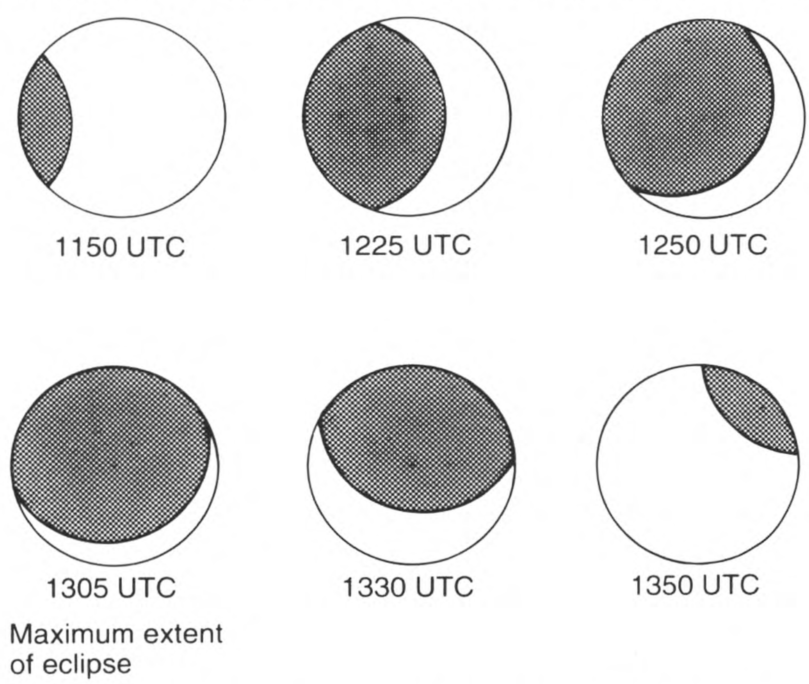
## PARTIAL SOLAR ECLIPSE

### Eastern South Atlantic

s.s. *British Renown.* Captain P.F. St Lawrence. Dunkirk to Dubai. Observers: the Master, Mr G.M. Hallett, Chief Officer, Mr D.M. Sharp, 2nd Officer, Mr T.J. Radford, 3rd Officer and other members of the ship's company.

30 June 1992. By reference to the Nautical Almanac some days previously, it had been noted that there was to be a total eclipse of the sun on this day. More interest was generated however (even among the engineers), when it was realised that the eclipse was only to be visible, generally, in the South Atlantic Ocean and the vessel was going to be in that area on the day. It was going to make a refreshing change for a BP tanker to be in the right place at the right time, and those on board just hoped and prayed it would not be cloudy. As it turned out, they were not disappointed.

The eclipse began at 1131 UTC and progressed as shown in the sketches. The temperature at that time was 17.6°C and there were 3 oktas of small cumulus




present. During the eclipse, every man and his dog was trying differing methods of obtaining photographs of the event. It was a common sight to see cameras adorned with sunglasses, but the most effective method of observing the phenomenon was by placing an arc welding mask shade over the eye or the camera lens.

At 1305, the time of maximum eclipse, a small crescent of the sun's lower limb was visible and long shadows were cast, as from a late evening sun. It was noticeably colder at this time, although the temperature had only dropped to 17.0°; the cloud cover had increased to 5 oktas cumulus and stratocumulus. Indeed, the cloud cover continued to increase, noticeably thicker to the north of the vessel, as the clouds were blown downwind by a 20-knot SE'ly trade wind, such that the eclipse was curtailed prematurely at 1350.

As it turned out, the vessel had missed the path of the total eclipse by about 450 n.mile, but the observers had still witnessed an extremely clear partial eclipse, the first time for many of those present.

Position of ship at 1131 UTC: 24° 47′S, 09° 38′E.

Position of ship at 1350 UTC: 25° 10′S, 09° 58′E.

## UNIDENTIFIED LIGHT

### Caribbean Sea

s.v. *Eye of the Wind.* Master A.R. Timbs. Training cruise in Puerto Rican waters. Observers: all officers and trainees on watch.

6 June 1992. At 0845 UTC (about one hour before sunrise), when the ship was about 10 n.mile off north-eastern Puerto Rico, a luminous white 'cloud' was noticed in the sky directly overhead.

It was brilliantly white, having the appearance of cirrostratus lit by the moon, irregular in shape and approximately 10° across.

While it was gradually fading and dispersing, a second phenomenon appeared slightly to the south-west of the first. This 'exploded' from a dot as might a firework; it grew very quickly in 1–2 seconds to become a perfectly circular disc of intensly bright colours with red in the centre, yellow around it and green/blue on the outside. The disc remained stationary and, after three minutes, it began to fade, becoming firstly pale green and then pale blue. After about 10 minutes it began to lose the circular shape. No further phenomena were seen.

Weather conditions were: air temperature 27.0°C, wet bulb 25.1°, pressure 1015.2 mb, wind E'ly, force 4. The sky was moonless, with 3 oktas of cumulonimbus along the northern horizon and over land to the south, and it was clear overhead.

Position of ship: 18° 25′N, 65° 36′W.

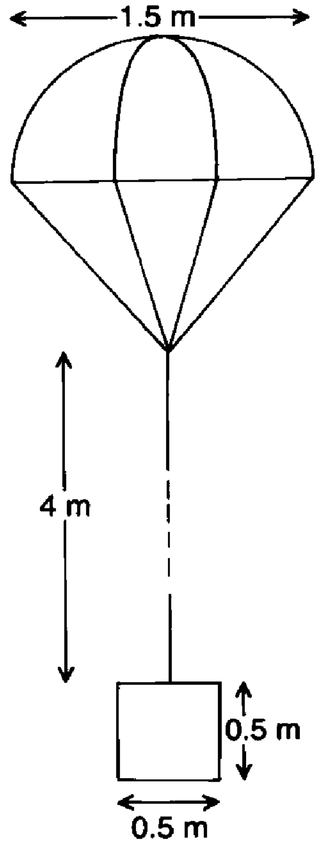
## PARACHUTE

### Western North Pacific

m.v. *Zidona.* Captain J. Brown. Singapore to Chiba. Observers: the Master, Mr J. Brown and Mr I.C. Bacon, 3rd Officer.

3 June 1992. At 0204 UTC whilst on the morning 8–12 watch a small parachute was suddenly observed fine on the port bow. It was white in colour and had a diameter of approximately 1.5 m and was attached to 4 m of fine white rope which carried a white box of size approximately 0.5 m × 0.5 m × 0.5 m.

The parachute and box landed in the water about 20 m off the bow and the parachute appeared to be floating in the water as the vessel passed, no markings were observed. The box missed the ship by 20 m. At the velocity with which it was falling, serious damage would have been done to the vessel and, more importantly to personnel working on deck, had it landed on the ship. Both VHF Channel 16 and NAVTEX were monitored, but no apparent warnings were identified.




Cloud coverage was 6 oktas with dense cirrus clouds; no aeroplanes were observed or heard and the nearest surface traffic was more than 20 n.mile away. The wind was variable, force 2 and the visibility was about 15 n.mile.

Position of ship: 33° 25′N, 137° 12′E.

*Editors's note.* The object was almost certainly a land-launched radiosonde instrument package attached to its parachute. It may have been launched in Japan or even the Chinese mainland, as these units will drift considerable distances during descent from heights as great as 30 km. It is thought unlikely that any damage would have been caused to ship or personnel.

# The tides, their origins and behaviour*

By J.V. Jelley

Accurate prediction of tides is of great practical importance in such diverse fields as dock management, off-shore oil exploitation, estuarine barrages and flood control. This paper reviews the basic phenomena which determine the rise and fall of coastal and ocean tides, and some of the factors that may lead to abnormal local variations.

Tides — the periodic changes in height of seas, coastal waters, and estuaries — have in recent years assumed an increasing significance with the expansion of modern technology in diverse ways. Just as present-day technologies provide the means for global data collection and detailed computation of the complex features of tidal phenomena, so they also impose many demands for increasing accuracy and scope in tidal predictions. Harbour management, the control of shipping movements, flood warning systems, dock operations, sewer outfall constructions, schemes like the Thames Barrage, and various aspects of the off-shore oil projects, for instance, all depend on detailed tidal predictions.

Similar information is required for studies of the marine environment: investigations of pollution; the possible dumping of radioactive waste off the Continental Shelf; silting of estuaries; and a better understanding of ocean currents and their relation to large-scale winds, which may assist in weather forecasting.

Moreover, as the world's energy demands grow, there is considerable interest in tidal power, exemplified, for instance, by the particularly favoured site of Fundy[1]. If the economic and environmental problems[2] can be solved, there is no doubt that this source, effectively of lunar power, is attractive, clean, regular, quiet and independent of weather.

Although the underlying physics and astronomy of tidal phenomena are very simple, we shall see that in a broader context the subject is one of extreme complexity. First, there are subtleties in the astronomy, but more important by far are numerous effects which significantly modify the elementary treatment originally presented by Newton; these derive mainly from geography, geophysics, hydrodynamics, oceanography and meteorology.

Let us first look at a few orders of magnitude. The Earth has a mean radius of 6271 km. The oceans, with an average depth of 4000 m, form but a thin film, only 0.06 per cent of the Earth's radius. Again, averaging over all the oceans, the mean tidal range — that is, difference in height between a High Water and Low Water tide, is only about 0.6 m, that is about 0.15 per cent of the average depth, or $\sim 10^{-7}$ of the Earth's radius. Thus, on a geophysical scale, the tides are a trivial phenomenon, only of importance to man insofar as he seeks to live and work very close to mean sea-level.

*Reprinted from *Endeavour*, Volume 10, No. 4 New Series, Dr J.V. Jelley, *Tides, their Origins and Behaviour*, pp. 184–190, Copyright 1986, with permission from Pergamon Press Ltd, Headington Hill Hall, Oxford OX3 0BW, UK.

## The basic astronomy and the lunar tide

The simplest treatment of tidal phenomena requires a number of very sweeping assumptions. We take the Earth to be covered entirely by oceans, of uniform and considerable depth; we assume that the Earth's axis is perpendicular to the ecliptic plane (the plane of the Earth's orbit about the Sun); we also assume the Moon's orbit to be circular and to lie precisely in the ecliptic plane; and at this stage we take the Moon to be the only source of the tides.

Proceeding on these assumptions, and referring to Figure 1, we deduce from the inverse square law of gravitational attraction that the attraction by the Moon of, say, a kilogram of sea-water on the equator, at A, immediately below the Moon, is slightly greater than that for a similar mass at the centre of the Earth E (or at P near the poles), both points being further from the Moon than A. This leads to a 'bulge' of water on the side of the Earth facing the Moon. There is likewise a very

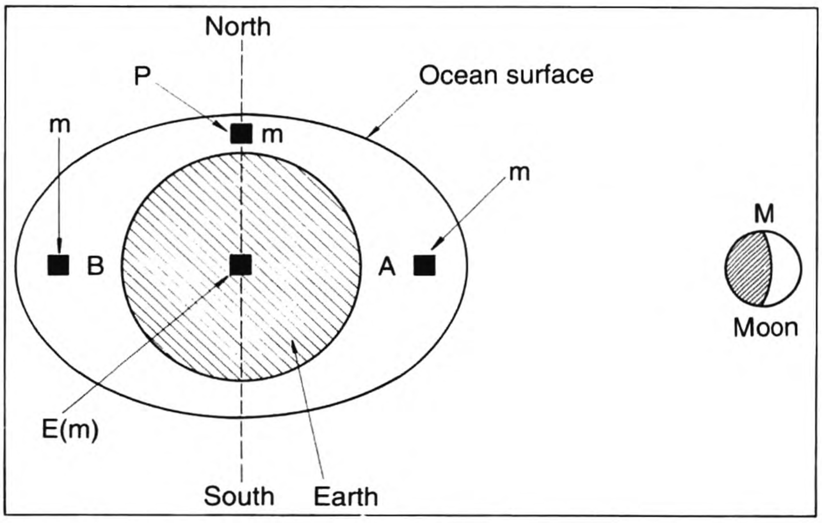



Figure 1. The two tidal bulges caused by the differential gravitational attraction of the Moon across the diameter of the Earth.

similar, though not identical, bulge on the opposite side of the Earth, a fact which is frequently misunderstood. It arises for precisely the same reasons, namely that a kilogram mass on the opposite side of the Earth, at B, is a little further from the Moon than E or P and is therefore attracted less: there are therefore two bulges, not one. Figure 1 has been drawn with the Earth's axis lying in the plane of the page. An identical situation arises in the orthogonal plane. The tidal bulges therefore resemble an almost spherical rugby football, the tides being due to the *gradient* of the Moon's gravitational field across the diameter of the Earth. On this basis it is simple to make a rough estimate of the strength of the maximum tidal force.

If M is the mass of the Moon, its attraction F on our 1 kg mass m of sea water is

$$F = GMm/s^2 \qquad \text{(i)}$$

where G is the universal constant of gravitation and s the distance between the mass m and the centre of the Moon.

The gradient of F is thus $(dF/ds) = -2\ GMm/s^3$ and the maximum tidal force $dF = T_o$ is given by:

$$T_o = -2\ GMm.s.^{-3}.ds \qquad \text{(ii)}$$

with ds equal to r, the radius of the Earth. We see at once that the tidal force caused by a large body remote from the Earth is proportional to the mass of the body and inversely to the cube of its distance.

Inserting in (ii) the numerical values $G = 6.67 \times 10^{-11}\ N\ m^2\ kg^{-2}$, M, for the Moon, $= 7.35 \times 10^{22}$ kg; $s = 3.84 \times 10^5$ km; and $r = 6371$ km, we obtain a value for $T_o$ of $1.10 \times 10^{-6}\ m.s.^{-2}$. With $g = 9.81\ m.s.^{-2}$ at the Earth's surface, we see that $T_o = 1.12 \times 10^{-7}g$. A 70 kg man standing at the equator will thus weigh 8 mg less when the Moon is overhead than when it is low over the horizon.

Since $T_o << g$ it cannot of itself lift water at A or B. However, ds (equation (ii)) decreases with geographical latitude θ, so the tidal force will in general be $T = T_o \cos\theta$. If now we resolve T into vertical and horizontal components, V and H respectively (Figure 2(a)), we find that $H = T_o \sin\theta \cos\theta$. Since V is again <<g it has no effect on the water, while H, known as the *tractive force* is the component that drives the tides. Plotting H over the Earth's surface (Figure 2(b)) we see that it is zero at points below the Moon and along the meridian orthogonal to the plane of the Moon's orbit.

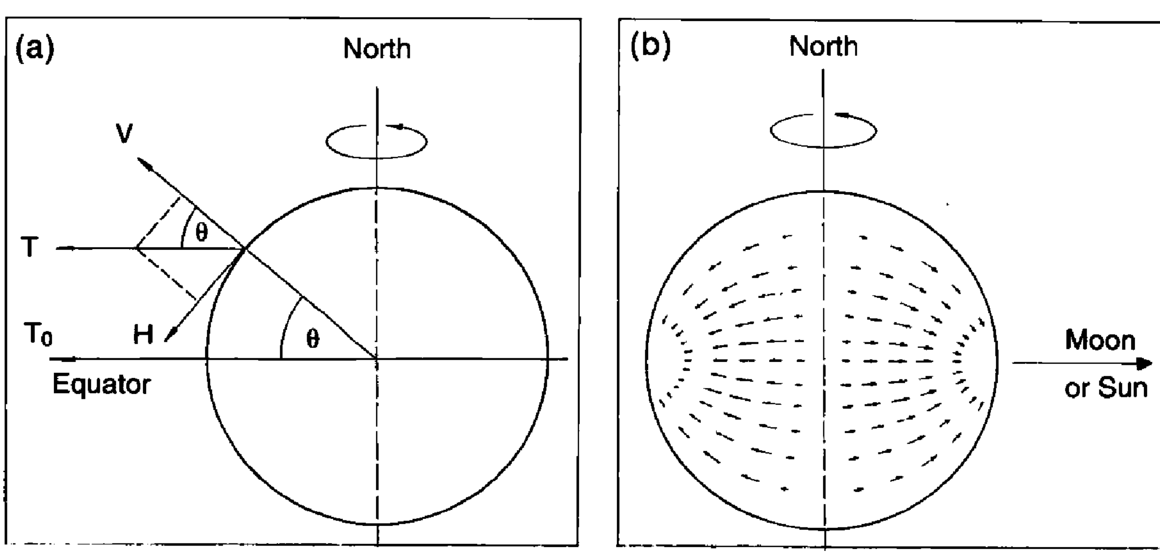



Figure 2(a). Resolution of the tidal force T into vertical, V, and horizontal H, components. The H-component, called the Tractive Force, is the one responsible for driving the tides. Figure 2(b). The pattern of the Tractive Force over the surface of the oceans.

So far we have assumed the Earth to be stationary. The situation is, of course, not static, as the Earth is rotating beneath the bulges, which are locked to the Moon. On the Earth's surface we therefore expect a tidal wave to sweep round, its wavelength being half the circumference of the Earth, and its velocity at the equator around 1670 km/hr. A given point on the Earth's surface will pass under both ocean bulges each day, leading to what are known as semidiurnal tides. Taking into account the duration of the synodical month (new moon to new moon, 29.53 days) and the slower motion of the Earth in its orbit around the Sun, it is easy to show that the mean transit interval for the Moon across a local meridian is 24 hr. 50 min. Consequently, as there are two oceanic bulges, the local component of the high tides will occur on average 12 hr. 25 min. apart.

The above and simplified treatment of the lunar tide is based on what is known as the Equilibrium Theory of tides worked out by Newton[3], in which it was assumed that the Earth rotates so slowly that there is time for the envelope of water to take up a permanent configuration relative to the position of the Moon. In other words, the treatment was based on the gravitational effects alone while ignoring the effects of the inertia of the water. It was later that dynamical models were developed, which took into account the inertia and the effects of the Earth's rotation. Of those involved in these developments both Bernoulli and Laplace[4] made important contributions, especially the latter, to whom perhaps one can fairly attribute the basis of the later developments.

The tidal bulges produced by these tractive forces must inevitably generate 'tide streams', or currents, which oscillate in direction with the tidal periodicities. As with the tide range, the tide streams in the oceans are likewise very gentle. Directly from (ii) above, it is easy to show that the maximum excursion of a cork from its mean position, say in the mid-Pacific, is only about 43 m, though this, the periodic component of the stream, is of course superimposed on any general ocean current present at that location.

**The solar tide**

The Sun similarly produces tides, also semidiurnal though with a periodicity of 12 hours (on average), rather than that of the 12 hr. 25 min. for the Moon. The Sun is 27 million times heavier than the Moon, and 389 times further away, so we deduce from (ii) above, that its tidal effect will be $[2.7 \times 10^7/(389)^3]$, or 0.46 that of the Moon. It is an extraordinary coincidence that the vast disparity between the masses of these two utterly different bodies is compensated so nearly by the relative cubes of their distances.

The real tides are, therefore, the combination of two separate components called 'partial tides', the Lunar and the Solar, and it is their interaction which leads to the familiar sequence of Spring and Neap tides. In Figure 3(a) the unbroken lines

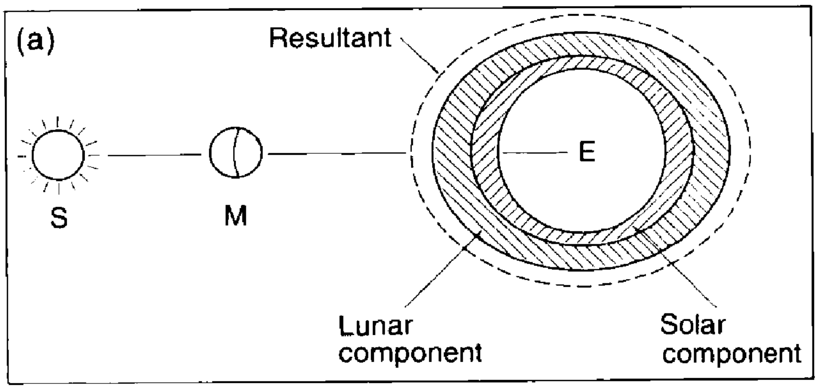



Figure 3(a). The superposition of the lunar and solar components at a Spring tide; i.e. new or full Moon.

represent the lunar and solar components. When the Sun and Moon are aligned at New and Full Moon, the solar component enhances the total tide, and we have a Spring tide. At First or Last Quarter (Figure 3(b)) the Solar component is displaced by 90° in longitude from the Lunar component and we then have a Neap tide.

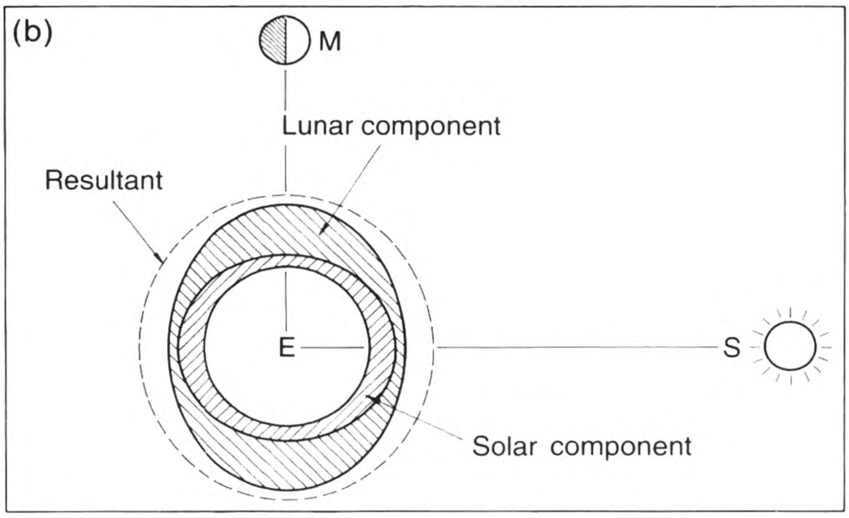



Figure 3(b). The same, for the situation at Neap tides; i.e. first and last quarter phases of the Moon.

Since these two tidal components oscillate in their relative phase every fortnight, the low and high water depths are modulated with this period. From the above simple estimate of the contribution of the Sun to the total tide, we deduce that the expected ratio of the tidal ranges between Springs and Neaps will be around $(1+0.46)/(1-0.46)$, or about 2.7, which is clearly important in the navigation of vessels in the shallow approaches to harbours and ports.

**Subtleties in the astronomy**

We now mention briefly a few of the finer points in the astronomy which introduce periodicities and variations in the amplitudes of the tides. First is the 23.5° tilt of the Earth's axis relative to the perpendicular to the ecliptic. This leads to alternate high and low water levels varying in a sequential manner, as shown in Figure 4; for example, AB is larger than CD, the variation depending on latitude and season. This causes a diurnal component to the tides. This is only one factor contributing to diurnal tides. In some places the semidiurnal constituent is imperceptible, frequently due to enhancement of the diurnal component due to resonances; examples are to be found in the South China Sea and the Gulf of Mexico.

Secondly, the Moon's orbit is elliptical, its perigee and apogee distances differing by 3.42 per cent which, through the cube-law ((ii) above) causes a Lunar tide variation of 40 per cent as a modulation of the semidiurnal tide, on a fortnightly basis. Since the axis of the ellipse is almost fixed in space, its orientation will drift during the year with respect to the Earth-Moon-Sun line when Springs occur, thus producing a modulation on a semi-annual time-scale (Figure 5). The Earth's orbit round the Sun is also elliptical, leading to smaller, though perceptible, annual variations in the Solar tide.

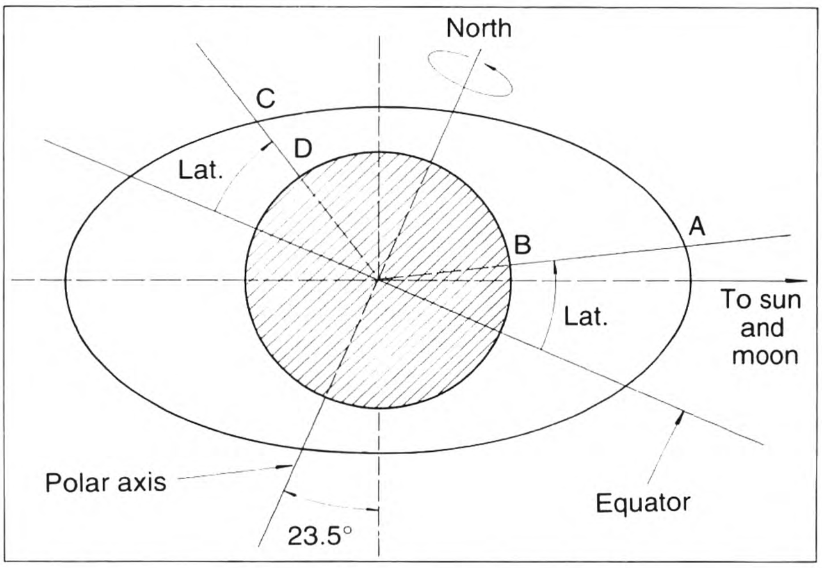



Figure 4. Diagram to illustrate the difference in level between alternate High Water Tides, depending on latitude.

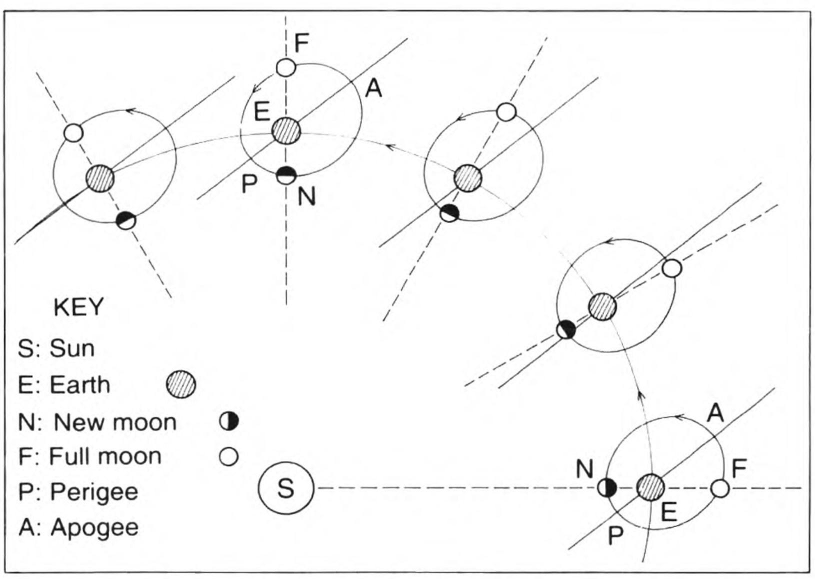



Figure 5. Diagram to illustrate the variation in the tidal force due to the Moon's elliptical orbit. The new and full Moon situations are shown for five successive lunations.

Another significant effect occurs because the lunar orbital plane is tilted by 5° to the ecliptic plane, the former rotating slowly, as a swash plate, with a period of 18.6 years. This, known as the Regression of the Nodes, causes a modulation, at this period, of the higher frequency components. Therefore the Moon's monthly excursion in declination can vary with this 19-year period over a range (23.5±5)° or 18.5° to 28.5°. A further low frequency modulation of the partial tides is caused by the slow precession of the major axis of the Moon's orbit, the line PEA in Figure 5, drifting clockwise with a period of 8.8 years.

**What about centrifugal forces?**

A brief discussion on this subject appears to be essential if only to dispel misunderstandings which frequently arise. Two phenomena are involved here. First, the Earth's rotation about its own axis indeed produces strong centrifugal forces, which vary from zero at the poles, to about $3.4 \times 10^{-3}$ g on the equator. However, they are constant in time at any fixed point on the Earth's surface, and since they have no periodic component, produce no tides. But what of the Earth-Moon system as a whole? The Moon strictly does not rotate about the Earth, but rather it rotates about the common centre of mass CM, which is 4680 km from the centre of the Earth. The Moon is held in its orbit just because the gravitational attraction between it and the Earth exactly balances the centrifugal force due to the rotation of the Earth and Moon about the CM, with a period of a month.

The Earth thus moves around the centre of mass, with a motion akin to that of the sleeve of an eccentric in the valve-gear of a steam engine. However, there are again no tide-producing or periodic variations, because every point on the Earth is describing a circle of precisely the same radius (Earth-centre to CM) and hence experiences the same centrifugal forces.

**Geography, geophysics and meteorology**

So much for the astronomy, and the tides on our hypothetical ocean-covered Earth. But what are the real tides like? Geography here plays a dominant role. Since most of the continents have a predominantly north-south orientation, they obviously interrupt the diurnal east-west march of the main tidal wave. There is one exception, the Great Southern Ocean, between latitudes 50° and 70° south, where this wave can flow in a more or less unfettered way. The tides we have around our shores are really twice removed from the basic forced wave set up by the Sun and Moon. As this flows from east to west across the South Atlantic, it sets up a free-wave which travels up through the North Atlantic, and this in turn finds itself meeting the Continental Shelf which surrounds the United Kingdom, Ireland, and the European countries. All the tidal periodicities determined by the astronomy are still there, but their relative phases and amplitudes are strongly influenced by the local geographical effects.

Thus, speaking generally, one must emphasize that the shapes, sizes and depths of all the seas have to be taken into account, in determining the actual tides at any specific place. The small tidal ranges and the gentle associated tide-streams which, as we have seen, occur in the deep oceans, are greatly amplified when the water enters shallow areas and becomes constrained by narrowing channels, typical of continental shelves. For example, the Atlantic tides surging in up the English Channel produce greatly amplified tidal streams, so that in extreme cases — such as at the Needles channel off the western tip of the Isle of Wight — the streams can reach as much as 4.4 knots at Springs. Moreover, in channels which taper in depth and/or width, and which are totally or partially closed at one end, resonances can occur, and if the periodicities of these are close to the 12 or 24 hour tidal frequencies, huge enhancements of the tidal ranges may be expected. The Bay of Fundy, between New Brunswick and Nova Scotia, is the supreme example, having the largest tidal range in the world, sometimes attaining 18 m (see Figure 6).

Geophysics is also involved. Laplace, in his development of the Dynamic Theory of tides in 1776, emphasized that since the seas and oceans are massive fluids, they will possess inertia and hence respond to gyroscopic or Coriolis forces, due to the rotation of the Earth on its axis. Movement of water in a south-north direction is influenced by these forces, the water being deflected to the East, somewhat analogous to the rotation of air masses around a depression. In the English Channel this leads to the dramatic differences in the tide-ranges in the Channel Isles and Brittany compared to those, say, in Devon (Figure 7).

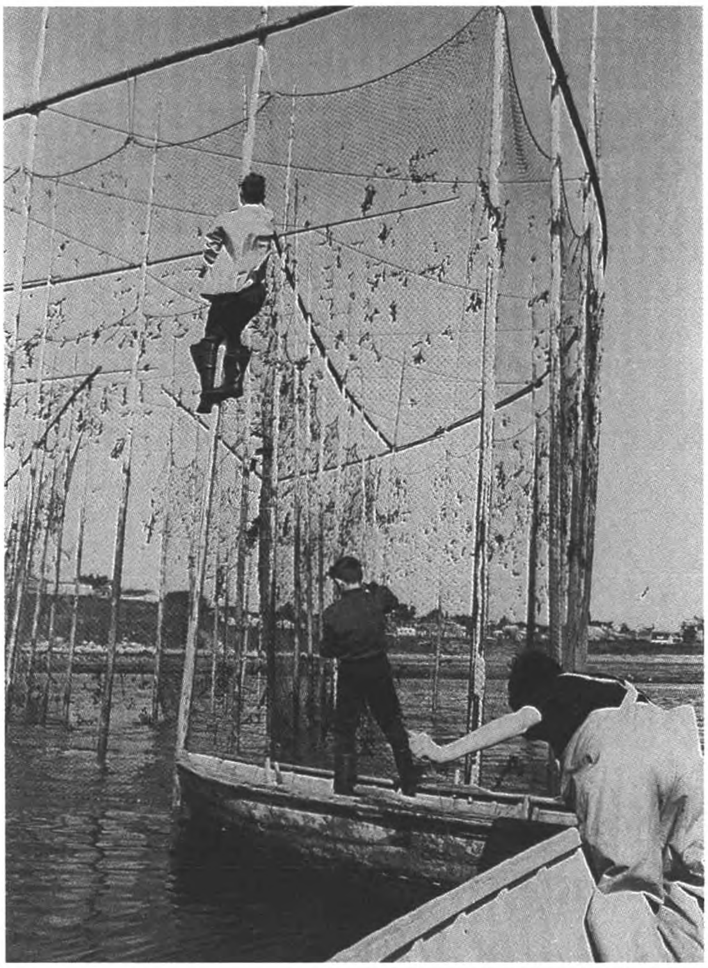


Figure 6. Salmon fishing near Saint John, New Brunswick, on the coast of the Bay of Fundy. The weir traps the salmon during the strong flow on the ebb-tide, and they are then fished out at low water. (Reproduced by permission of the Canadian Hydrographic Service from the *Canadian Tide Manual* (Ref. 18, p.9). Photo. by R. Brooks NFB Phototeque, 1964.)

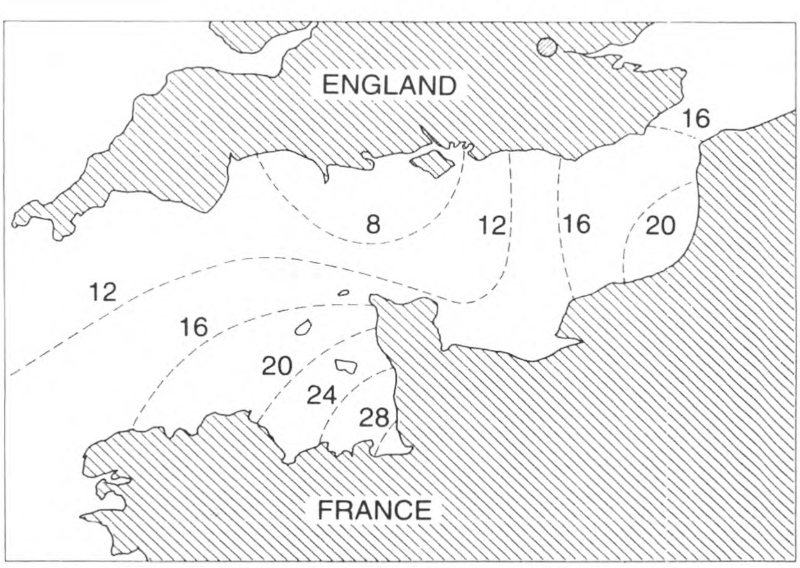



Figure 7. A plot of the average Spring tide ranges (in feet) in the English Channel, the marked difference between the U.K. and French coasts being due to Coriolis forces.

Tidal friction also plays a part. As the Earth rotates beneath the tidal bulge (Figure 8) it drags the wave forward, so that there is a delay of a few hours between the time of High Water and the Moon's passage across the local meridian NM. This is called the 'High Water Interval' or 'Establishment of the Port'. Although it is more or less constant at a given place, and is, therefore, a characteristic of that port, it varies or drifts periodically during the lunation owing to the

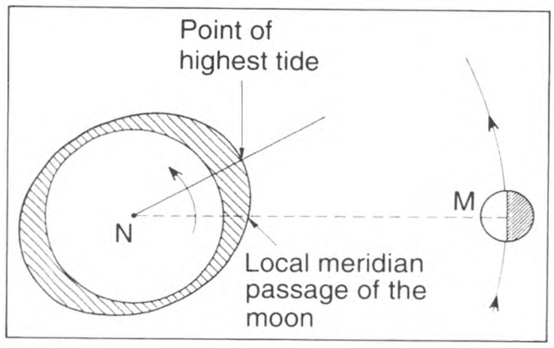



Figure 8. Diagram to illustrate the displacement of the High Water level of the sea from the Earth–Moon line, due to drag caused by friction as the Earth rotates on its axis.

relative phases of the lunar and solar partial tides, as will be evident from Figure 3. This tidal friction, believed to be the main component in the deceleration of the Earth's rotation (~ 3 ms per century), dissipates about $5.10^{12}$W, and arises mainly in the shallow seas, notably the Siberian Shelf, the Bering Sea, and the Patagonian Shelf. Then there is also another delay, of between one and three days, between a New or Full Moon, and the highest or lowest, High or Low Water. This is known as the 'Age' of the tide. Although this effect has not been fully explained, it is believed to arise from the overall response-time of the ocean system as a whole, to the tidal forces.

We should also mention Amphidromes. Tides, sweeping up, for example, into the North Sea, encounter both Coriolis Forces and reflections from coast lines. These two effects lead to Rotational Tides, with nodes (Amphidromic Points) where there are no tides, the sea surface lying on a slope, the whole of which rotates, rather as a swash plate. There are at least three such points in the North Sea, as depicted in Figure 9.

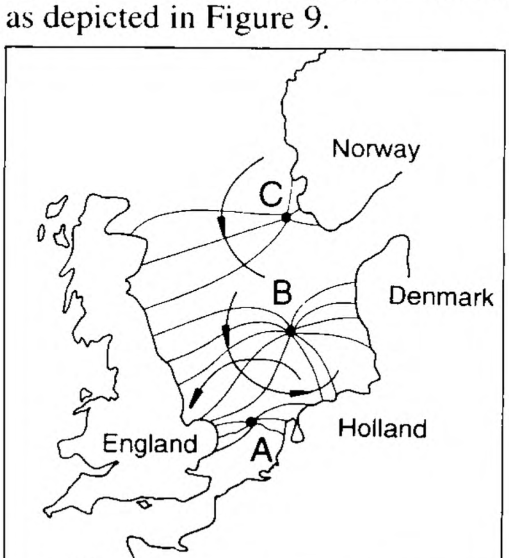



Figure 9. The approximate positions of the three Amphidromic Points in the North Sea, about which the tides rotate anticlockwise. The radial (cotidal) lines represent directions of maximum slope of the sea's surface, drawn for successive intervals of time.

It is appropriate to mention, if only briefly, the effects of Earth[5] and atmospheric tides. A.A. Michelson and H.G. Gale[6] carried out a famous experiment in which they could observe the tides set up in two enclosed pipes half-filled with water; they found that their amplitudes were only 70 per cent of those expected, thereby deducing that the Earth was elastic rather than viscous, and that the remaining 30 per cent was absorbed in the Earth itself. Thus the tides we observe are rather smaller than they would be for a rigid Earth. Atmospheric tides are likewise produced by the Sun and Moon, though the effects on the sea-surface are small. Nevertheless, there does occur a radiation tide[7] due to the heating of the Earth's hemisphere by solar radiation. This component is quite measurable, has a strictly diurnal period, and varies with the seasons.

Lastly, we note three meteorological effects. First, the level of the sea surface is directly affected by barometric pressure, which is not surprising. A mercury change of 2.5 cm can depress the surface by about 30 cm. A second meteorological effect, known as wind-stress, arises when a wind blows in one direction over a prolonged time, setting up a slope on the sea. This can be serious to those living in low-lying countries: for example, disastrous floods caused by fierce winds at Hamburg in February 1962, and two serious floodings, on December 22nd and 23rd in 1954, off the Hook of Holland.

The most severe meteorological effect is the Storm Surge. This is an extreme example of a wind-blown sea over a considerable fetch, coinciding with a Spring Tide. It is greatly enhanced if, in addition, the velocity of the storm centre is approximately that of the wave velocity. Storm surges can have devastating consequences. Examples are the St Elizabeth flood in Holland in 1421 which killed 10,000 people and, more recently, another flood in 1916 which prompted the decision to close off the Zuyder Zee.

**Tidal measurements and predictions**

The task of tidal prediction depends essentially on input data from tidal observatories set up around coasts. There are 34 permanent sea-level monitoring sites in the U.K., each equipped with a tide gauge. The development and operation of this network, and the co-ordination of the observations is carried out at the Institute of Oceanographic Sciences (IOS) at Bidston near Birkenhead[8]. The data from the gauges are analysed by the Tidal Computation and Statistics Group at the IOS[9] and used in the computer programmes, to produce tide-tables for a number of 'standard ports', with tidal differences for a much longer list of 'secondary ports'. These, the *Admiralty Tide Tables*, are then published by the Hydrographer of the Navy and are reproduced in *Reed's Nautical Almanac* and elsewhere, and are available to all who need them.

While there are many forms of tide-gauge[10,11], the majority are based on the simple analogue drum-recording of the level of a float in a stilling well (to damp out wave motion), an example of which is shown in Figure 10. This particular gauge, off the stone pier at Newlyn in Cornwall, is the primary observatory on the U.K.'s South Coast, the incoming Atlantic tide reaching Newlyn before it reaches anywhere else in the country. The mean sea-level there also acts as the benchmark for the Ordnance Survey datum.

The U.K. network of stations is currently being converted so that the data can be sent on-line, in digital form, directly to the IOS. There will then be no delay, as previously, when analogue charts were sent by post, so enabling warnings of unusual storm surges to be sent to points further along the coasts.

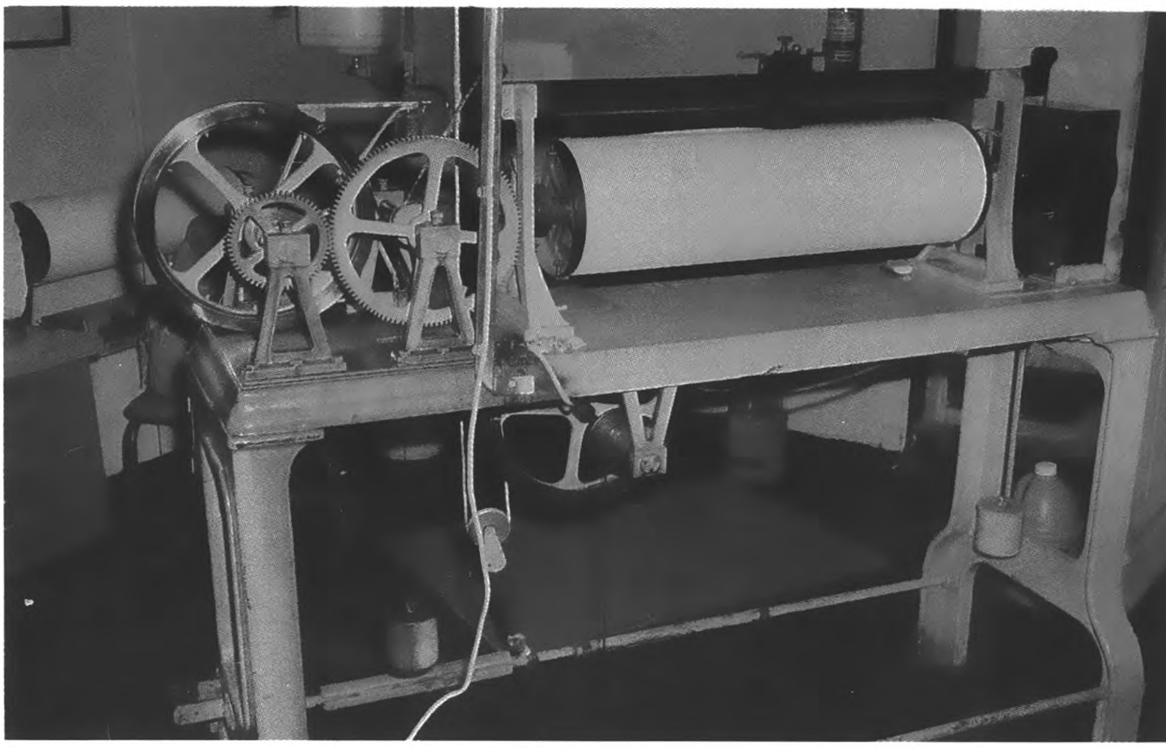


Figure 10. The recording instrument of the tide-gauge at Newlyn, Cornwall. This gauge serves as the reference for the Ordnance Survey datum for the U.K. (Photo. by the author, 1984.)

The procedure for the tidal predictions is complicated. We have seen that the basic tidal phenomena have a very wide range of periodicities, determined by the various and complex movements of the Sun and Moon. It is quite impossible to calculate the tides directly, from the basic astronomical data and hydrodynamics, simply because there is insufficient knowledge of the contours and details of ocean and coastal topography. We know precisely the frequencies of the various components, but not the phases and amplitudes of these at any given place. The procedure is, therefore, to take records over long periods of time, and to apply the well-established techniques of harmonic analysis to predict the tides to the required accuracy[7]. The digital computer has immeasurably improved the methods of analysis over recent years. Lord Kelvin developed an analogue mechanical computer in the last century to carry out just this task; examples of this may be seen in the University of Glasgow and at the IOS.

There are only about eight primary periodicities to take into account, tidal predictions are now so refined that the IOS can now identify up to a few hundred separate constituents of the tidal oscillations! The reader interested in an overall treatment of the subject is referred to the *Admiralty Manual of Tides*[12] while a comprehensive review of the theory may be found in the work of D.E. Cartwright[13].

## A forward look

While tidal phenomena have been well-studied in the coastal and continental shelf regions, far less is known about the deep oceans[14]: their tides and associated currents, and the locations of the amphidromes etc. However, the impact of the new technologies is considerable, especially the application of satellites and telemetry, and ocean studies constitute a rich field for future research.

First, there is passive radiometry, particularly in the infra-red[15] and microwave[16] spectral regions. It is now possible to measure sea-surface temperature, salinity and pigmentation, which have a bearing on the heat-exchange between the oceans and the atmosphere. Large automatic off-shore and deep-ocean instrumented buoys, tethered or free, can now provide data from remote ocean sites, through interrogation by satellites or on-board recorders.

Perhaps the most spectacular advances have followed from microwave altimetry[16]. Absolute values of sea-level can now be obtained with a precision of around 10cm, this necessitating accurate measurements of the geoid and the satellite's orbit. This in turn is derived by laser ranging, such as that currently undertaken at the Royal Greenwich Observatory[17]. Through radar altimetry it is now possible to study directly the ocean tides, wave height, surface wind-stress and hence ocean circulation, long ocean gravity waves such as those generated as Tsunamis[18,19], and even ocean floor topography. The implications of these developments are truly immense.

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Dr Jelley was educated at the Universities of Birmingham and Cambridge. He has been on the staff of the Atomic Energy Research Establishment, Harwell, for many years and was also a Research Fellow at Harvard College Observatory, and a Consultant at the Royal Greenwich Observatory. His research interests embrace a variety of fields related to astronomy and cosmic rays, including Cherenkov radiation, gamma-ray astronomy, instrumentation and tidal phenomena.

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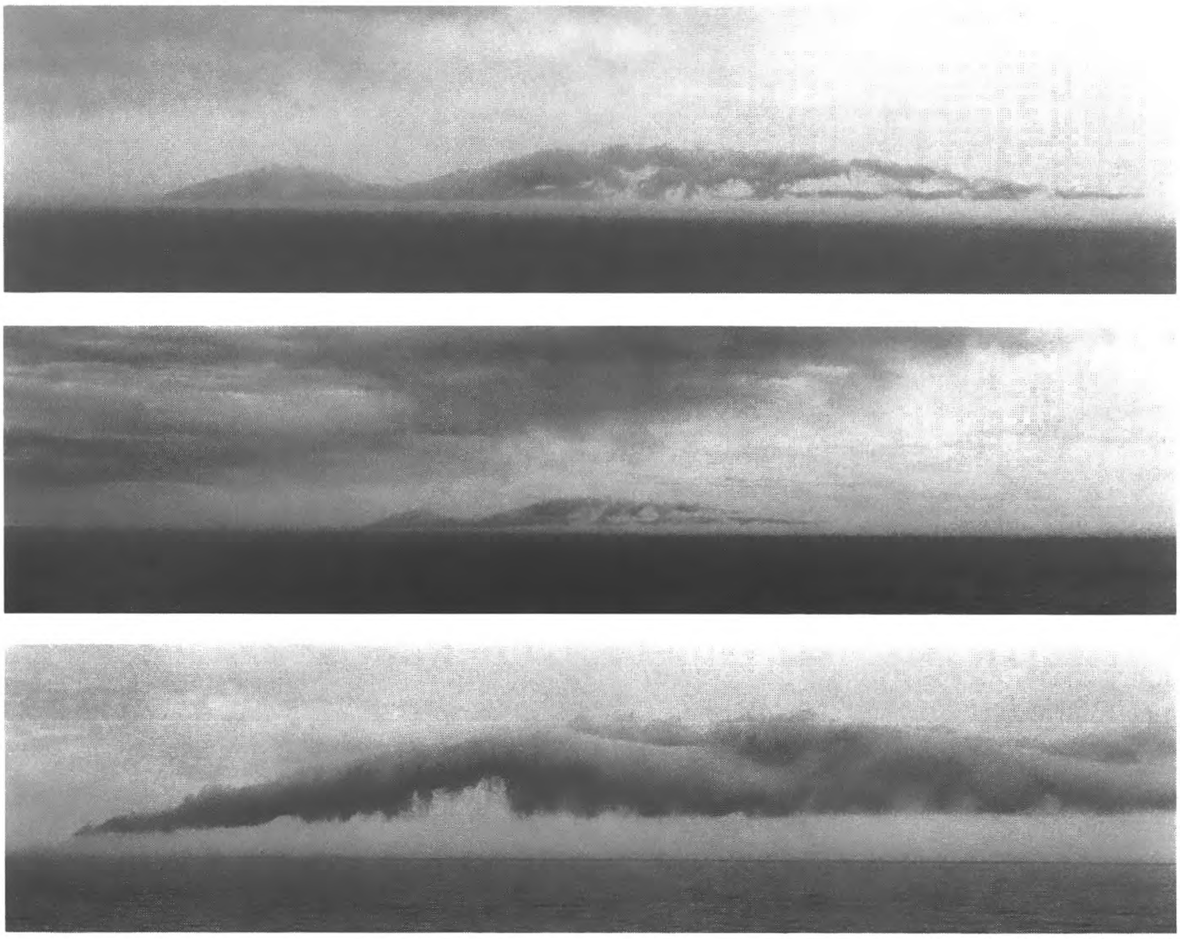
# Cloud formation off Oamaru, New Zealand

On 2nd March, 1992 the *Tarahiko*, a ship reporting for the Meteorological Service of New Zealand, was off Oamaru whilst *en route* from New Plymouth to Dunedin, when the cloud formation shown in the photographs was seen. The Master, Captain R.B. Smith wrote, 'The subject cloud was considerably lower than the rest and I have taken photos at three different focal lengths to get the overall picture and also detail. The cloud appeared to decay or dissolve quite rapidly from the underside although no precipitation could be seen from the ship.' The photographs were taken at about 1100 UTC, approximately the time of, or shortly before the passage of a cold front.



*Photos by Captain R.B. Smith*

Roll cloud showing rotating and twisting characteristics.

The cloud formation was thought sufficiently unusual to be of interest to the experts at the Meteorological Service of New Zealand, and so the report was sent to Miss Julie Fletcher, the Marine Meteorological Officer in Wellington.

After studying the information, Julie Fletcher and her colleagues offered the following explanation of the cloud:

'Your photos were passed around the office and generated a lot of comment and interest. Several people thought that the first photo showed a bank of fog in front of a distant island, until they saw the telephoto shots and realised the "island" was in fact a cloud formation.

'Combined opinion agreed that the cloud formation was a roll cloud associated with the leading edge of a gust front which would have preceded the main frontal band. Attached is a copy of the 0000 UTC chart of 2 March [unfortunately, not suitable for reproduction in this article] which shows a cold front moving northwards over the South Island. Your observation at 1100 hours about the time of the passage of the cold front ties in very well with this map. Roll clouds occur commonly with frontal squalls but are usually no more than very small scale features just at the leading edge of a cloud mass. The telephoto shot clearly shows the rotating, twisting motion which is characteristic of roll cloud.'

We are grateful to Julie Fletcher for passing to us this account from Captain Smith, and look forward to continued co-operation with her in the cause of voluntary weather observing.

## SPECIAL LONG-SERVICE AWARDS

The Chief Executive is pleased to announce that he has nominated the following four shipmasters for receipt of inscribed long-service barographs for observing service up to the end of 1991:

CAPTAIN A.D.G. BELL, Havtor Management, Oslo.
CAPTAIN C.R. ELLIOTT, British Antarctic Survey.
CAPTAIN D. PATRICKSON, Stephenson Clarke Shipping Ltd.
CAPTAIN E.D. SOMES, Acomarit Services.

The awards recognise the long service (minimum 18 observing years) and high quality of the nominees' work, and the submission of at least one meteorological logbook during the year in question.

Captain Bell's first log was sent from New Zealand Shipping Company's *Hinakura* in December 1966 and in 23 years of observing he has provided 38 logs, of which 24 were marked Excellent. He received two Excellent Awards.

Captain Elliott submitted his first log from Shaw Savill's *Romanic* in January 1966 and in 21 observing years provided 34 logs in all, 24 of them earning Excellent markings. He received Excellent Awards on 11 occasions.

Captain Patrickson sent his first log in January 1960 from *Crystal Bell* of Sugar Line, following it with 46 more over 24 observing years; 18 of these logs were marked Excellent and he has received eight Excellent Awards.

Captain Somes started observing when in the Moor Line, sending in the first of 45 logs from the *Dartmoor* in January 1958. Thirty-four of his logs have been given the Excellent marking and he has received nine Excellent Awards.

Presentation of the barographs is expected to take place in the spring or summer, given the usual struggle to bring all four Captains to Bracknell at the same time if possible. These annual ceremonies have been held continuously since being introduced by the Director of the Met. Office in 1948.

## PRESENTATION OF BAROGRAPH

Having returned home on leave to Chester from his recent voyage in command of P&O Containers' ship *Resolution Bay*, Captain Clive Short, accompanied by Mrs Short, was invited to the Marine Division offices on 21 October last, to receive his long-service barograph in person: he had been unable to attend the main ceremony with the three other recipients earlier in the year, when Captain Bligh provisionally accepted it from the Chief Executive on his behalf.

*Crown Copyright*

Presentation of barograph to Captain C.R. Short at Bracknell Headquarters on 21 October, 1992. Standing, left to right: Captain Short; Mr N.A. McConochie (General Manager, P&O Containers Ltd); Mr F. Singleton (Director of Observations). Seated: Mrs Short.

Mr Frank Singleton, Met. Office Director of Observations, presented his inscribed barograph to Captain Short in the presence of the P&O Containers General Manager, Mr N.A. McConochie, Marine Superintendent and staff. Mr Singleton paid tribute to the fine co-operative work by all shipmasters and observers in the Voluntary Observing Fleet. He reminded those present that such awards have represented a general mode of thanks to all contributors to weather observing records since the first barographs were presented in 1948.

Following the small ceremony, the Director and Marine Superintendent escorted the official party to lunch and a tour of the Central Forecasting Office.

# SCENE AT SEA

*Photo. by Captain R. Skucek*

*Photo. by P. Taylor*

Top: Cloud formation associated with down-draughts from thundery showers. Pictured from the brigantine *Ji-Fung* at Balinao anchorage, Luzon, Philippine Islands on 25 May, 1992. Left: Female Red-spotted Bluethroat (*Luscinia svecica svecica*) in breeding plumage on board the *Corystes* on 18 May, 1992 in position 56° 07′N, 00° 12′W. Commander M.B. Casement comments that this species breeds in Scandinavia, wintering in southern Spain and north Africa. It is more frequently recorded on migration.

*Photo. by J.R. Murray*

Right: Plankton bloom observed in the Irish Sea between Great Ormes Head and Point Lynas, Anglesey, photographed from the *Buffalo* on 24 June, 1992 whilst *en route* from Liverpool to Dublin.

# AURORA NOTES APRIL TO JUNE 1992

By R.J. Livesey

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

In Table 1 are listed the observations received to date from mariners during the period under review. There has been a decline in sunspot activity since the turn of the year and there has been a comparable fall in auroral sightings around the British Isles. The darker skies in summer experienced by North American

**Table 1 — Marine Aurora Observations April to June 1992**

| Date | Ship | Geographic Position | Time (UTC) | Forms in Sequence |
|---|---|---|---|---|
| 18/19 Apr. | *Norna* | 57° 08'N, 07° 04'W | 2330 | $p_2$RR.RR+G.G.RR.G |
| 26/27 | *Bora Universal* | 51° 18'S, 64° 15'W | 2345–2355 | $m_3$RR.HA |
| 11/12 May | *Cumulus* | 58° 18'N, 27° 39'W | 0212 | $R_3$R |
| 29/30 Jun. | *OOCL Challenge* | 47° 32'N, 60° 04'W | 0300–0315 | HA |

KEY: m = multiple (3 groups), $p_2$ = flaming, A = arc, G = glow, H = homogeneous, RR = bundles of rays, $R_3$R = long rays.

observers in the lower magnetic latitudes and the nights of the New Zealand winter have enabled observers in these countries to see auroral activity. There was a period of magnetic activity from 6–14 May with a big magnetic storm from the 9th to the 11th. The storm led to widespread aurora in Canada and the northern United States on the night of 10/11 May while New Zealand observers on South Island saw coronal and overhead activity on the nights of 9/10 and 10/11. On the other hand, only eight aurora reports were received from land observers in the British Isles for the whole three-month period.

There are a number of points relating to the observation of the aurora world wide that will interest mariners, who are used to coping with local time, time zones and Greenwich Mean Time. It is the convention to record auroral observations in Universal Time as used by astronomers and this is identical to Greenwich Mean Time which runs from noon to noon, hence the double date which is used to identify the night on which the aurora is seen. This is fine in Atlantic waters where there can be little confusion. As we travel west from the Baltic Sea to the American Great Lakes, times in GMT will show progressively later values in auroral reports but we are looking at the development of the same auroral event.

However, when looking at observations made in New Zealand waters near to the International Date Line there can be confusion. If the convention of date and GMT is correctly followed then an all-night storm can find itself split into two auroral event dates because noon GMT comes to pass in the middle of the New Zealand night. During a long-lived auroral event it is interesting to follow the records through. Sometimes the storm is first reported as an aurora australis in New Zealand, then as an aurora borealis in Europe and then America, then back to aurora australis as the Earth spins under the active auroral ovals over the two magnetic poles and whose orientations are determined by the sun. Short-lived aurorae may be seen by only one of the regions mentioned or only vaguely by the others according to the start and finish times of the aurora.

The most equatorward extension of the mid-latitude aurora will depend upon when the aurora developed and for how long it kept going. In the case of the event of 10/11 May, only one British observer, on the Moray Firth coast reported active aurora up to a maximum of 60 degrees in altitude for a short period, yet on the American continent it was covering two-thirds of the sky over North Dakota some six hours later. An elementary calculation shows that the aurora had moved quite a few degrees further south in geomagnetic latitude by the time the U.S.A. had rotated under the expanding auroral oval.

For the purpose of researching auroral and magnetic phenomena relative to one or more particular locations, scientists make use of the corrected geomagnetic latitude, longitude and local magnetic time. As an approximation, the Earth's magnetic field can initially be assumed to be equivalent to that of a bar magnet placed at the centre of the Earth, with the magnetic axis at an angle to that of the rotation axis of the planet. A geometric system of latitudes and longitudes can be drawn about the magnetic axis just as the geographic equivalents are drawn about the rotation axis passing through the north and south poles. The magnetic field at the Earth's surface is not truly geometrical and a system of corrected geomagnetic latitudes and longitudes is calculated based upon a method proposed by Yukio Hakura, of Japan.

As every mariner knows, the Earth's magnetic field does not remain constant, therefore it is necessary to recalculate the system at intervals. Local magnetic midnight, the start of the geomagnetic day at any point on the Earth, is defined as the time when the sun, the centre of the Earth and the corrected geomagnetic meridian all lie on the same plane passing through the observer's position. To all intents and purposes this is when the observer lies closest to the night-side tail of the auroral oval, expanded or otherwise, thus being in a position most likely to see aurora if it is active at his observing point. This has been well proven with observations over a period of years made from the British Isles.

In Figure 1 is shown a typical plot of corrected geomagnetic latitudes and longitudes with respect to the geographic parameters in the Northern Hemisphere. In Figure 2 the position of the overhead auroral oval in (a) quiet and (b) in storm conditions has been indicated with reference to the corrected geomagnetic co-ordinates.

In the geomagnetic latitude system a line of latitude currently runs from the Orkney Islands towards the top of the Gulf of Bothnia, at Oulu. In the corrected geomagnetic system the latitude line runs from Orkney to Helsinki. A look at land and marine observations of the aurora made in recent years would suggest that the latter system is valid as aurora is often seen successively at Helsinki and then from the region of the Pentland Firth on the same night as the Earth rotates under the active aurora. A similar check has shown why active aurorae are seen and reported from Hungary and the English Channel on the same night when it might have been thought that Hungary was too far south for aurorae to be visible. This again demonstrates the value of observing and reporting any aurora that may be encountered.

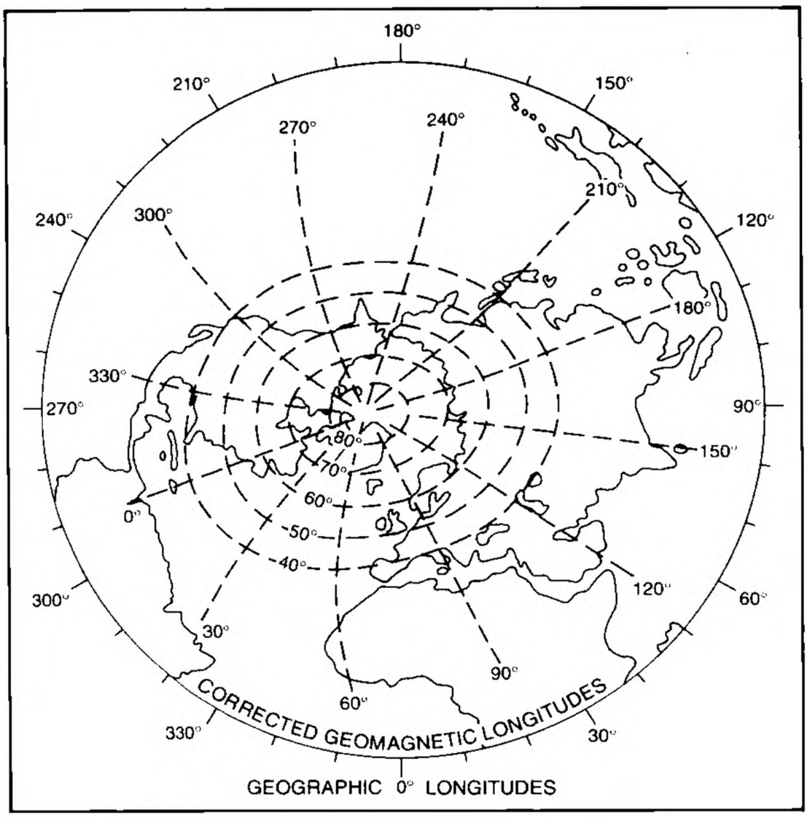



Figure 1. Corrected geomagnetic latitudes and longitudes with respect to geographic co-ordinates.

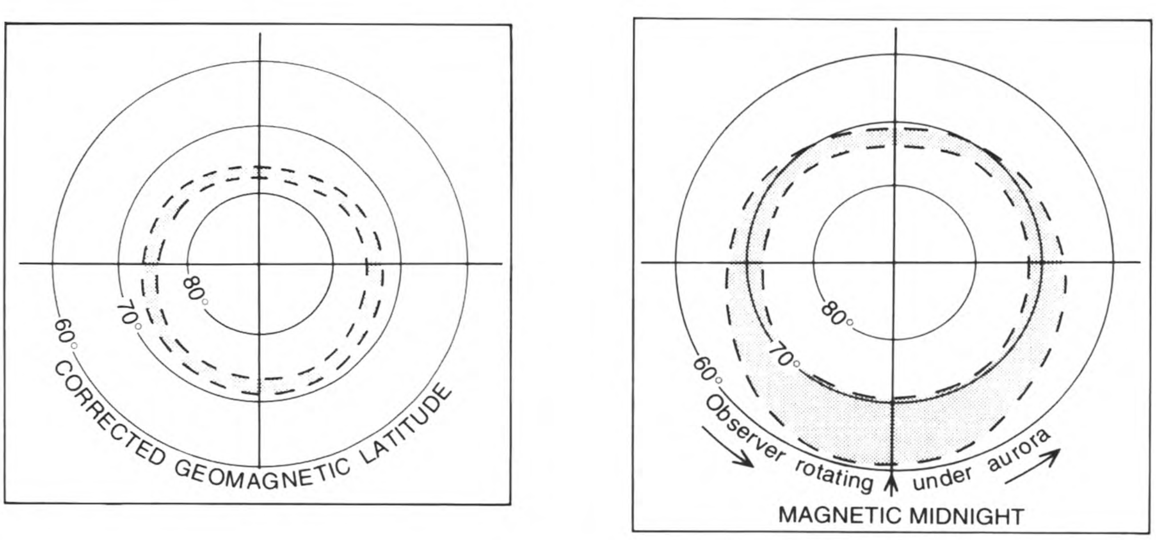



Figure 2(a). Position of the overhead auroral oval in quiet conditions.
Figure 2(b). Position of the overhead auroral oval in storm conditions. (With reference to corrected geomagnetic co-ordinates.)

## LETTERS TO THE EDITOR

(Letters to the Editor, and books for review, should be sent to the Editor, *The Marine Observer*, Meteorological Office, Eastern Road, Bracknell, Berkshire RG12 2PW.)

### Anglesey Seiche

At about 0700 on the morning of 17 September 1992, I was on the beach at Trearddur Bay on western Anglesey, when an acquaintance drove down the beach towing a fishing boat. He launched the boat in about six inches of water and we then engaged in conversation for a couple of minutes. Turning to the boat, we were amazed to find that it was high and dry about 20 metres from the water's edge. Small flatfish, mainly immature brill, could be seen stranded and flapping in the wet sand. About a minute later the sea started to return and quickly rose up the beach beyond where the boat had originally been launched. An hour later the oscillation in sea level was still taking place. I determined that the period was just over three minutes and the amplitude just under one metre, the latter measured with reference to a half-submerged rock. At the time of the event it was just after low water, there were no wind waves or ground swell and the sea had a glassy appearance. The weather was rather thundery with extensive unstable medium level cloud which was producing some bursts of heavy rain.

Many years ago I observed a similar water oscillation, known as a seiche, in Tobruk Harbour in Libya. This seiche had a period of 20 minutes and an amplitude of 1.5 metres, which was quite a sight to see in an almost tideless harbour. The period and amplitude of seiches are dependent on the shape, depth and size of the oscillating body of water. The Tobruk seiche was caused by a sudden pressure jump of about 4 mb disturbing the sea surface and related to thundery downdraughts affecting gravity waves, moving eastwards over the Mediterranean, in the boundary between a cool moist surface and a warm unstable air mass above.

The structure of the air mass over the sea on the two occasions described was remarkably similar. I returned to the Anglesey beach at about 1600 on the same afternoon on 17 September, but there was no sign of any seiche. I have no knowledge as to whether the seiche was confined to the local bay or occurred over other parts of Anglesey. Such an event taking place in, say, Holyhead Harbour at low water on a spring tide could have interesting consequences for a ship entering the port!

A.K. Kemp, Meteorological Office, RAF Leuchars, Fife.

### Texan co-operation

Thanks to Bracknell for letting me know about the parcel of observing instruments and stationery to add to my stock which I hold for issue to U.K. observing ships visiting ports of Texas. I shall be as judicious as possible in handing them out. The ship which brought the supplies out from Felixstowe, *Galveston Bay*, is a good reporting ship in the U.S. VOS Program, as are most of the Sea-Land vessels. Our only problem is they stop sending observations once they reach the coastal waters of either continent. Coastal reports is an area which we are always having a problem in getting.

I was able to enlist the two ships you advised me about, and one of them has already sent me an envelope of log sheets. We ask the ships to mail the log sheets to us every time they finish a round trip. Our archive people prefer it that way as it makes it easier for them to count up the observations sent, so the information can be published as soon as possible. That is part of the information in the back of the *Mariners Weather Log* listed as 'U.S. VOS Reports'. I will also attend the two ships of the U.K. Fleet you requested, now that they know I can supply them whenever they require stationery in my part of the world. On another of your ships I attended, I made entries in the additional remarks pages of the log book as requested, concerning the observed pressure, the ship's reading and the difference, dated and signed. I hope this will help and I will be doing this from now on.

James E. Nelson, Port Met. Officer, Houston.

*Editor's note.* Jim Nelson is one of the great band of Port Met. Officers in the U.S., and world-wide, who call on visiting VOF ships of other countries. This mutual co-operation is vital to the well-being of observers: lists of PMOs who hold U.K. stocks can be found in the October edition of *The Marine Observer*, in the *Marine Observer's Guide* and in current PMO lists sent from Bracknell.

Mr Nelson's point about observation and transmission when coasting is highly relevant. We can never have too many observations, and all ships should keep them coming in right up to the pilot station whenever it is prudent and convenient to do so. Coastal reports can often supply much-needed data to fill a gap on synoptic charts.

Our sister quarterly periodical in the United States, *Mariners Weather Log*, is always an excellent read and can be recommended as a complementary publication with a different emphasis to this one. *Mariners Weather Log* is for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington DC 20402.

## Memories of a typhoon

At 1200 LT on 8 August 1964, Typhoon Warning Signal No.3 was hoisted in Hong Kong harbour, indicating that all ships present should either proceed to sea or go to a typhoon mooring. We were working cargo alongside Kowloon Wharf at this time and, as the Far East trade was very competitive, the local agents persuaded the Captain to remain at the berth to complete cargo and sail onwards to Japan some three hours later.

During these three hours, as cargo was completing, I noticed that the Captain was impatiently striding back and forth on the Bridge, and other senior officers were being very attentive to their duties, and I wondered what was in store for us when we sailed. My meteorological experience and knowledge was limited mostly to books and so I watched events unfold as a novel occurrence. Certainly I can trace my subsequent lifelong interest in the subject to the events of the ensuing night, although I would not wish to see them repeated.

The vessel sailed from Kowloon Wharf as deck securing continued. As we cleared the Heads, the oncoming swell was sufficient to limit speed increase. Within two hours, the ship was at minimum speed to maintain headway with recorded winds at hurricane force 12. Radio reports received the next day suggested that gusts of up to 200 knots had been experienced in Hong Kong and that 18 vessels had sunk in the harbour overnight.

I went on watch for an indelible four hours. The requirement was still to make an 'offing' with a last fix putting the ship 15 miles off land. The wind had already stopped the radar scanner from turning. Visibility was near zero in driving rain and an enormous head swell limited movement to hanging on only. Next morning we were only 8 miles from the same point of land. As we rode the swells that night, I recall watching these mountains coming towards us, each breaking along the crest, with spume passing overhead as we plunged headlong into successive troughs. The bow and foredeck disappeared under water and one prayed that they would reappear. The Captain was conning the ship by gyro compass heading, keeping wind and swell about one point on the starboard bow. When the gyro became inoperative, steering was done by the magnetic compass.

After coming beam to swell for a time, the engine entrance was stove in and water was flooding into the Engine Room, and crew quarters, already vacated, were flooded, with one crew member sustaining a head injury. Deck cargo had mostly gone overside by this time, leaving a couple of large heavy lifts adrift on the foredeck. All hands turned out on deck to attempt to resecure whilst I held upright battens on the inside of the damaged Engine Room doorway, assisting the Carpenter to nail horizontal battens in place from the outside. Periodically I could see large seas rushing past and the Carpenter hanging on for dear life.

All personnel finally returned to the safety of the accommodation, and soon a clear sky was seen, with little wind and a confused swell. Hundreds of birds arrived in our vicinity, and the quiet around the Bridge could only be described as ominous. The proverbial eye of the storm did not last long, perhaps 20 minutes before the howling wind and driving rain returned. After going off watch at midnight, there was no sleep to be had, but returning with relief to the Bridge for the forenoon watch at eight o'clock the next morning, weather conditions had vastly improved to a mere storm. I found the Captain still sitting in the Pilot's chair in the wheel-house, with gaze transfixed, looking completely fatigued and his previously immaculate white uniform now stained a pale yellow colour.

After the typhoon had passed, No.1 hold was found to have been stove in with tween deck pillars set down nearly 24 inches. Some years later I joined another company vessel which had stayed in Hong Kong on the night of that typhoon, moored by her anchor cable to a typhoon mooring buoy in a normally sheltered bay. The connecting link to the mooring shackle had been stretched by some ten inches, even with the vessel steaming half ahead to keep some weight off the mooring.

P.W. Jackson, formerly Second Officer, *City of Ipswich.*

*Editor's note.* 'Ida' was the typhoon in question, and Peter Jackson's fourth log from the *City of Wellington* for August 1964, when in his third year with Ellerman's, shows that he has kept meticulous personal records of the happenings. The log contains a detailed two-page account and barogram of the storm. The ship was hove to for 12 hours and lowest pressure experienced in the eye was 28.85 inches (977.0 mb). We plan to publish more of Mr Jackson's evocative reminiscences in the future.

## South African reporting ship rewarded

We write concerning Weather Station c.s. *Cable Restorer* based in Simonstown, Cape Province. We act as a coastal weather station at our 'stand-by' moorings at buoys in False Bay.

*Cable Restorer* was built in October 1944 and is equipped with steam reciprocating engines, windlass, cargo winch and capstan. We have been a weather reporting station for the past 2½ years and I enclose a photograph of the ship as we have recently received an award for weather reporting.

I would mention that Southern Right Whales are frequently seen close to the ship where they breed at this time of the year [October], before going further

*Photo. by courtesy of South Atlantic Cable Company*

c.s. *Cable Restorer*

southwards. For interest, the deepest depression we have observed at our mooring was 985 mb with force 11/12 NW'ly winds and driving rain in May 1984.

Chief Officer N.D. Creaser, c.s. *Cable Restorer* (Captain N. Veistrup).

*Editor's note.* Mr Creaser and his colleagues are to be congratulated on achieving by a large margin the highest number of observations for a South African observing ship in 1991, as indicated in a copy of the letter of congratulation to the ship from our good friend, the Port Met. Officer at Cape Town. On behalf of the Chief Director of the South African Weather Bureau, the award was in the form of a one year's subscription to *National Geographic Magazine*.

# Book Reviews

*Dolphin Days — The Life and Times of the Spinner Dolphin* by Kenneth S. Norris. 150 mm × 227 mm, 335 pp. W.W. Norton & Company Ltd, 10 Coptic Street, London WC1A 1PU. Price: £14.95.

Focusing on the life and times of the spinner dolphins off Hawaii, the author describes his earliest contacts with these graceful animals, including work with a theoretical biologist, Gregory Bateson. With a team of enthusiastic students, he attempts to learn about these charming creatures' complex lives in the sea.

In this imaginative account, told with great feeling and obvious empathy, Kenneth Norris tells how the dolphins swim, find food, breathe in rough weather; he shows how his own scientific ideas evolve, taking readers on a hair-raising trip aboard a tuna vessel where he and his colleagues dive into the net to search for solutions to the tragic dolphin kill that occurs in the yellowfin tuna industry. He also shows how dolphins leap, spin, rest and communicate, all with familiarity and humour.

Linked with Hawaiian place names such as that of his base at Kealakekua, in sight of the massive Mauna Loa volcano, together with a good selection of unique photographs and drawings of dolphin behaviour, this is an absorbing account for anyone at all interested in these most appealing creatures.

J.F.T.H.

*War at Sea 1939–45* by Edward Smithies with Colin John Bruce. 165 mm × 240 mm, 206 pp. Constable & Co. Ltd., 3 The Lanchesters, 162 Fulham Palace Road, London W6 9ER. Price: £14.95.

Although the 1988 Copyright Act entitles the late Edward Smithies and Colin John Bruce to be identified as 'authors' of *War at Sea 1939–45*, they should more properly be regarded as anthologists, Mr Bruce providing linking comment and explanation between eye-witness accounts interviewed by Mr Smithies to produce oral history in book form.

Mr Bruce has divided the accounts under eleven headings, eight of which are devoted to the Royal Navy, its Reserves and the Royal Marines, one each to the Merchant Navy and the dockyards, another to the often forgotten Maritime Royal Artillery and the last to the experiences of survivors, Service and Merchant. Some of the passages are vivid, others fascinating for this reviewer because they explain some of the mundane detail that 'everybody knew' at the time but cannot be traced from documents today.

One of the disadvantages of oral history is that, to be really useful, the interviewer must have a very good understanding of the subject, to draw out the interviewee's illumination of the dark corners. If the late Mr Smithies and Mr Bruce did have such knowledge, unfortunately it does not show and one is left frustrated at the end of several anecdotes, knowing that the subject had more to say if only he had been asked the right questions. The general reader would also have benefitted from editorial notes, putting operations, convoys and losses (to name but a few topics) into context.

The dozen-or-so photographs are interesting and of good quality but deserve better captions. The stories take the reader all over the world but there are no maps (although Mr Bruce is the Map Curator at the Imperial War Museum). Finally, there is no index. My advice would be to welcome it as a present, but otherwise ask your local library to get it for you.

J.D. Brown
Assistant Director (Naval Historical Branch), MOD

*This is the Colour Book of Knots* by Floris Hin. 200 mm × 235 mm, 157 pp. + index, *illus*. Adlard Coles Nautical, 35 Bedford Row, London WC1R 4JH. Price: £13.99, hardback.

As someone who was in the Sea Scouts when young and a Deck Officer in the Merchant Navy for many years, I am no novice when it comes to doing knots and splices, but I have always found it very difficult to follow the more intricate knot or splice from a picture or diagram on a flat surface: in this book is shown an excellent method and one easy to understand. The clever method of illustrating the formation of each knot, splice and whipping on a flat surface by using different coloured strands and ends makes for easy execution.

The start of the book provides an excellent description of the use of various tools employed in the different types of rope work, and then goes straight into the types of rope and cordage, both natural and synthetic, that can be used, giving both their practical applications and properties plus the breaking strength of each.

Both functional and decorative knots are included, together with network and sennit, and thus all factions are covered. For anyone with an interest in learning 'knots and splices', either professionally or as an amateur, this book is a very useful addition to the bookshelf.

M.L.McN. Coombs

# Personalities

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

RETIREMENT— CAPTAIN G.J. ROBERTSON retired from the sea after a varied career spent mainly with Mobil Shipping Company.

George Johnstone Robertson was born in Edinburgh in February 1934 and educated in that city's George Heriot School. Before starting sea life in August 1951, as a Cadet in Christian Salvesen's *Southern Atlantic*, he underwent one year's pre-sea training at Leith Nautical College.

Six months after obtaining his Second Mate's Certificate, in March 1956, George Robertson joined Mobil: he succeeded to his Master's Certificate in December 1960 and was promoted to Master on *Mobil Flame* on 31 July 1964. The majority of his commands were offshore, including twelve years as Master of *Mobil Refiner* under the South African flag trading around the coasts of southern Africa, when he was sending his voluntary observing reports to Pretoria, but these do not appear on his U.K. record. He did however send three logbooks to Bracknell from *Mobil Petrel* during his last two years at sea, before retirement on 1 November 1992.

Captain Robertson writes that he managed to miss being involved in the Iraq/Kuwait war, as he happened to sail from the Gulf on 15 January 1991, the day before the conflict started in earnest. He now lives in South Africa, where we wish him good fortune and health in retirement with his wife, Peggy, and many of his eleven grandchildren.

# Notices to Marine Observers

## PART 4 OF THE ATLANTIC WEATHER BULLETIN DISCONTINUED

As from 1 December 1992, broadcasts of Part 4 (coded analysis) of the U.K. North Atlantic Bulletin ceased.

Following consultation with seafaring users, United Kingdom nautical colleges and union representatives, the Department of Transport (Navigation and Communication Branch) agreed to the cessation of this part of the bulletin. Reception of facsimile charts and current communication facilities have superseded the need for the coded analysis, which enabled ships to plot their own outline synoptic charts.

Parts 1, 2 and 3 of the North Atlantic Bulletin continue to be broadcast via Portishead and Goonhilly as before.

## CHANGE OF HQ TELEPHONE NUMBER

The telephone number at Bracknell HQ for Captain J.F.T. Houghton, concerning editorial enquiries or Marine Division observational matters generally, has been changed to 0344 855652.

## PORT METEOROLOGICAL OFFICER — CHANGE OF ADDRESS

The Port Met. Officer for East England, based at Hull, moved to a new address in the New Year as follows:

Captain Edward J. O'Sullivan
Port Met. Officer
Customs Building
Albert Dock
Hull HU1 2DP

Telephone (0482 20158) and facsimile numbers (0482 28957) are unchanged.

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