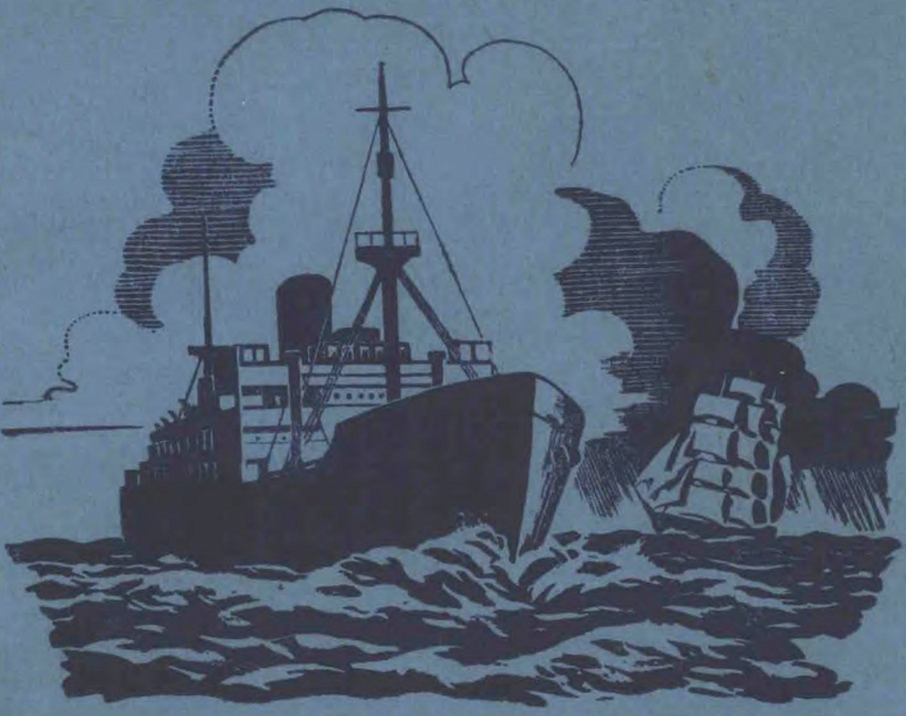
M.O. 512

The Marine Observer



Volume XIX No. 143

JANUARY, 1949

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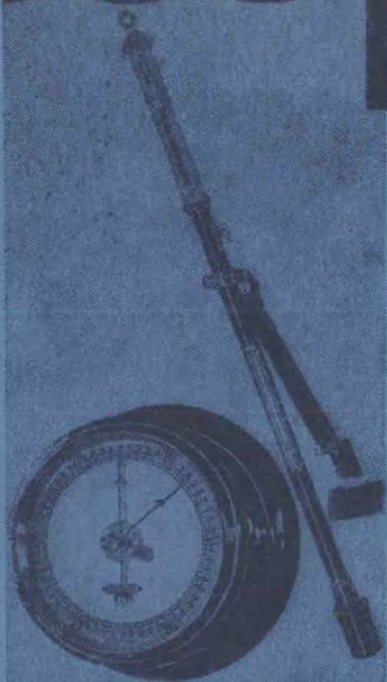

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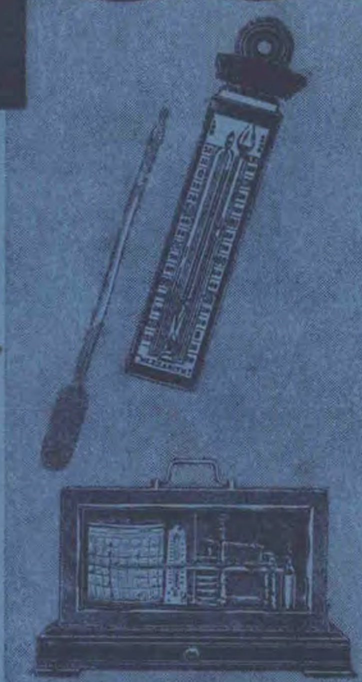

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M.O. 512 AIR MINISTRY

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A Quarterly Journal of Maritime Meteorology

prepared by the

Marine Branch of the Meteorological Office

VOL. XIX No. 143 JANUARY 1949

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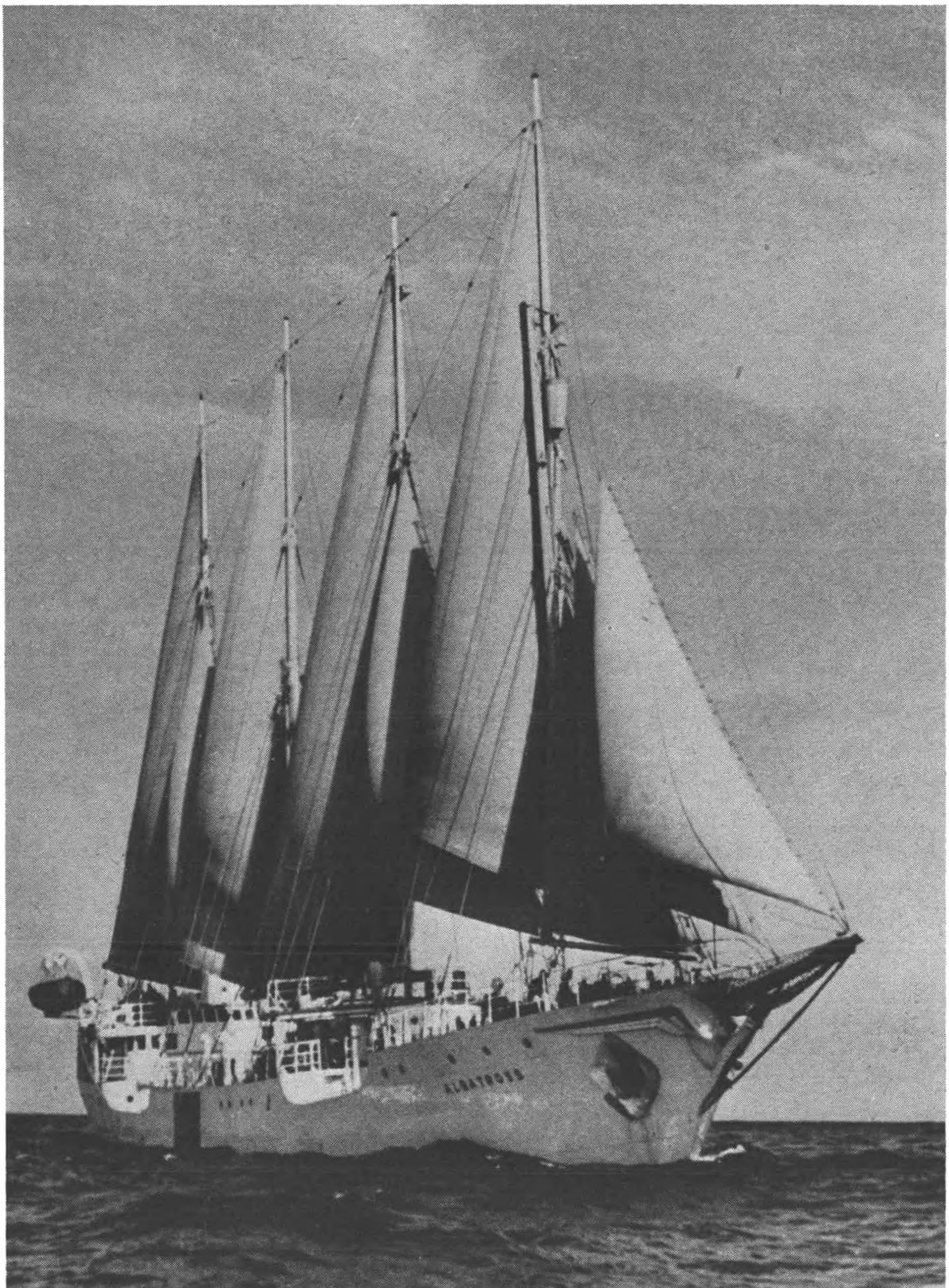

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The Swedish research ship *Albatross* (see page 55)

EDITORIAL

By the time this edition reaches our readers, we will have embarked upon our voyage across the unknown seas of 1949. Like any other voyage, it is an adventure which lies before us and there is little we can foretell as to the perils, joys and sorrows which we will encounter during its progress. Let us hope that the statesmen of the world, having in mind the stormy passage the ship of State endured during 1948, will manage to achieve some order out of chaos and set a steady course towards world peace, prosperity and happiness. It is only by real international co-operation that this can be achieved. One sometimes thinks it is a pity that there aren't more mariners in the Governments of the world, for when seamen get together they can usually understand each other no matter what their nationality; the language of the sea and the basic outlook of the seamen who sail upon it is international.

As for the readers of this magazine, wherever you are, afloat or ashore, may 1949 be a year of health and happiness.

Peering ahead into the New Year, there is one fact one can foretell with reasonable certainty, and that is the general workings of Nature. Men's deeds are unpredictable, but Nature, apart from the occasional phenomena, rarely departs from her pattern. Matings and births and deaths will take place, the seasons will come in succession with their beauty, and their rain and cloud and sunshine and storms, the fruits of the earth will grow and mature, the tides will ebb and flow. When one thinks of Nature in this way, one realises how much the weather influences our lives; apart from occasional droughts, violent storms or sudden waves of cold or heat, the general sequence one year is very like that of another. It is the particular sequence which is so difficult to predict, and it is this elusive aim which the meteorologists of the world are pursuing. If we could say for sure that next July will be wet and stormy in England, but that August will be unusually warm and dry, farmers and many other industries—including the "holiday industry"—could plan accordingly and our national economy would benefit thereby, but with the present state of our knowledge, we cannot do that; the best we can do is to forecast the weather twelve hours or twenty-four hours ahead, depending upon the intricacy of the meteorological situation, or occasionally, when conditions are favourable, as much as three or four days ahead.

As has been mentioned in these pages before, the voluntary observer at sea contributes in a very particular and important way towards our improved meteorological knowledge. Wherever he goes upon his voyages he sends radio weather messages to meteorological services, irrespective of nationality, thus contributing in no small measure to the welfare of mankind—a truly international gesture. (See map on page 36.) In their turn, the meteorological services which receive these messages issue forecasts and other information to shipping in the oceans bordering their shores.

1949 will be an important year meteorologically, for at 0001 on 1st January the new universal meteorological code comes into force. Let us hope that this code, which for the first time achieves world-wide uniformity for shipping, aircraft and the shore, will have a long life and that it will provide a ready means of disseminating meteorological information for the benefit of all concerned. To the seaman, although it provides for slightly more detailed information than was the case in the past, we feel that the new code will have many advantages, and that it will not be long before he can (except for a few elements) compose or read a coded weather message without the need of tables.

Mariners may ask why the wind force and visibility need to be reported in two figures. The reason for this is largely one of precision for the benefit of aircraft, to whom exact knowledge of these elements is vital when desiring to land or take off. Wind direction in degrees instead of points, and cloud amount in eighths instead of tenths, are introduced with the object of greater simplicity. The changes in the " ww " code and in the description of cloud are merely the results of a more detailed study into the requirements of the modern meteorologist. The reporting of pressure in three figures and the difference between sea and air temperature instead of sea and air separately in whole degrees are introduced for purposes of accuracy. The somewhat detailed information about waves is introduced with the object of obtaining more precise information than can be given by a mere general statement about " sea " and " swell ".

The importance of wave study, not only from the meteorological viewpoint but also for the naval architect and for many scientific and practical purposes, will be obvious to the mariner. The forecasting of waves for example, is of great importance to countries whose harbours are liable to be affected by swell.

The introduction of a group for reporting ice in a synoptic code is entirely new; it is felt by many countries that this information will be of value synoptically. It also provides a ready means of reporting the existence of ice to a shore authority in a concise manner and subsequently of disseminating that information by the shore authority for the information of shipping. The provisions of the International Convention for Safety of Life at Sea, as far as the reporting ship is concerned, still apply, however. (See pages 102 and 107 of the April 1948 number for some additional remarks upon this new code.)

Looking back on 1948 from the weather viewpoint, one is struck by the number of spectacular shipping casualties which have occurred. We remember the *Samkey*, lost with all hands off the Azores, the *Leicester*, abandoned with a 50-degree list in a hurricane on the Grand Banks, the *Willowdale*, capsising in heavy weather in the Bay, the *Lochmonar*, driven ashore in a West Indian hurricane, and several smaller vessels getting ashore in heavy weather. Without going into any detailed statistics, it seems that last winter was stormy, and this was borne out by the experience of the British Ocean Weather Ships during their first winter on that duty. During the summer, the West Indian hurricanes have been quite a menace and typhoons have not been lacking in the China Seas. One unusual casualty recently reported in Lloyds List was that of an oil tanker sunk by an explosion believed to have been due to the vessel being struck by lightning. The perils of the sea seem to be always with us.

MARINE SUPERINTENDENT.

JANUARY, FEBRUARY AND MARCH

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

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

Responsibility for each observation rests with the contributor.

WEATHER FORECASTING AND NAVIGATION

North Atlantic Ocean

The following are extracts from letters received from Captain W. H. Downing of S.S. *Manchester Progress*, to whom the Director of the British Meteorological Office recently made a special award for long and meritorious service as a marine observer:

"It is a great honour the Director of the Meteorological Office has conferred upon me. I can only say how very much I appreciate the distinction of being one of so few who have been chosen for this award.

"It is a long time since the advent of keeping the old 'Meteorological Log', and as a junior officer I well remember it was my chosen lot—I kept the records most religiously, sometimes to the exasperation of the Masters who, at that time, passed many sarcastic remarks about spending too much time, etc.

"I have always found meteorology most interesting and instructive. Many times I have been able to predict the line of progression of a depression and have deviated from my course to make better passages, especially in the winter time approaching the Tail of the Bank, when deviation twenty-four hours previously has made the vessel more comfortable and a better average has resulted, or eastbound when one had to decide whether north or south of Ireland.

"A story I would like to relate dates as far back as 1934, when I was Chief Officer of the S.S. *Manchester Producer*. A W/T message received in mid-Atlantic, addressed to the Master, read: 'In view of Test Match at Old Trafford, please give weather five days Saturday hence'. The Master passed the message over to me, saying, 'That is more in your line'.

"The reply was sent, 'Rain, Rain, Rain, Rain, Rain', and believe me, when the *Manchester Producer* arrived in Manchester on the Sunday, some blamed your humble servant, a member of the Lancashire County Club and M.C.C., for the weather. Not a ball was bowled and Australia did not win *that* Test, but might have won a boat race—the pitch was flooded!

" Last voyage, eastbound from Montreal on 23rd September, 1948, via Belle Isle, the hurricane coming up from the south of Newfoundland was ever in my mind, and I am happy to relate that after passing Belle Isle I ran SE until midnight, then Great Circle to Fastnet to 33°W., then Great Circle to Innistrahull. The weather had considerably moderated by then while vessels on the Great Circle were hove to in a northerly gale, force 9. I had a fair passage and made the tide I had originally expected to make; the weather information received from the west firstly, then east of 40°W., was correct and a great help. I have often heard from engineers it is not the length of the way, but the breadth of the way which counts—that time it was the breadth of the way."

SWELL

North Atlantic Ocean

The following is an extract from the Meteorological Record of M.V. *Accra*. Captain C. C. Cave. Las Palmas to Liverpool. Observer, Mr. G. Read, 2nd Officer.

27th to 31st January, 1948. Leaving Las Palmas on the 27th at 1500 G.M.T. a very high NW'ly swell was encountered, and by the time lat. 37°N. was reached, a further swell from SW became evident, superimposed on the first. By noon on the 29th in lat. 39° 02'N., long. 11° 30'W., the combined effect of this cross-swell was extremely severe, producing considerable height of water at the points of confluence. The vessel's bridge is 60 ft. above the waterline and with the vessel in the trough, and upright, the crests of the two adjacent swells were above the horizon when the confluence of both NW and SW swells happened to be in the vicinity of the beam. Maximum roll, 38°. Vessel drawing 24 ft. with a calculated metacentric height of 1·78 ft., was unable to maintain course of 017° (T) at 16 knots, and was found to roll less by steering 000° at 14 knots. Swell moderated on 31st at 0800 in lat. 48° 30'N., long. 8° 50'W.

Note.—The heavy NW'ly swell was due to gale force winds in the rear of a deep depression which moved from the Davis Strait on the 24th to a position 56°N., 32°W. on the 25th, deepening to 952 mb. By the 26th this centre had moved to 56°N., 28°W. and deepened further to 944 mb. Between this date and the 30th this depression drifted south and west with very slow filling, the NW'ly winds gradually backing to W. The waves from a SW'ly point were due to successive secondary depressions travelling ENE around the perimeter of the main centre, and later approaching the British Isles from the SW. These waves could more properly be described as " sea ", strong to gale force SW'ly winds being reported from the ship.

FALL IN AIR AND SEA TEMPERATURE

Gulf of Tehuantepec

The following is an extract from the Meteorological Record of S.S. *Sneaton*. Captain W. Armstrong. Vancouver to Panama. Observer, Mr. E. Wilson, Chief Officer.

20th January, 1948, 0530 G.M.T. On approaching the extreme edge of the Gulf, the sky was cloudy with Ac. at 14,000 ft., sea temperature 83°, air 81°F. When in position lat. 14° 50′N., long. 96° 42′W. the sea dropped to 65° and the air more slowly to 70°. Slight mist on edge of this cold water which cleared later. Sea remained at 65° to 66° for about two hours, then rose slowly until it was 70° at noon and 81° at 0600 on 21st in position lat. 12° 48′N., long. 92° 48′W. Slight N'ly airs prevailed during whole time. Sky cloudless in area of cold water but covered with Ac. when temperature rose to normal. Relative humidity increased from 74 per cent to 90 per cent between 0000 and 1200 on 20th. S.S. *Lillian Moller* was in the same area about 36 hours later and kindly sent us the following message : " At 1800 G.M.T. on 21st in position lat. 14° 36′N., long. 97° 39′W., clear cloudless sky, calm sea, air temperature dropped from 81° to 78° and sea from 81° to 71° ".

Note.—The region of the Gulf of Tehuantepec and the coast farther south-eastward is shown by M.O.M.446, Monthly Meteorological Charts of the Eastern Pacific Ocean, to be subject to large variations of sea temperature during the winter months. The strong N'ly winds of winter, known as " Northers ", are particularly severe in the region of the Gulf of Tehuantepec, where they are called " Tehuantepecers ". These drive the surface water away from the Gulf. The deficiency is made good partly by the flow of surface water from regions to northward and southward of the Gulf and partly by the upwelling of cooler sub-surface water. It is this upwelling which may at times give rise to sudden and considerable changes in the sea surface temperature.

SAND HAZE

Atlantic Ocean

The following is an extract from the Meteorological Record of M.V. *City of Chester*. Captain R. P. Longstaff, D.S.C. Baltimore to Cape Town. Observer, Mr. R. M. Faulds, 3rd Officer.

7th to 9th March, 1948. A sand haze was experienced obscuring the horizon and making observations very difficult. During this period the NE trade winds were gentle to fresh and the air temperature varied between 78° and 89° F. After two days the sand was clearly visible on the black top of the funnel. The vessel was from 800 to 1,300 miles from the African coast. Visibility during the haze was moderate.

Position of Ship at 1200 G.M.T. :

7th March, Latitude 11° 31′N., Longitude 38° 47′W.
8th March, Latitude 7° 30′N., Longitude 33° 43′W.
9th March, Latitude 3° 34′N., Longitude 28° 37′W.

Note.—S.S. *Ocean Valley* reported on 7th March at 1200 G.M.T. in lat. 11° 35′N., long. 27° 12′W., " sky obscured by dust haze ", and on 8th at 1800 in lat. 16° 04′N., long. 25° 40′W., " duststorm continuous ". Later, in lat. 16° 48′N., long. 25° 13′W., vessel hove to awaiting daylight.

Three days previously on 4th, S.S. *Marquita* reported at 0600 in lat. 23° 06′N., long. 22° 21′W., " air laden with fine sand ", and at 1200 in lat. 24° 03′N., long. 22° 00′W., " similar conditions ".

The region of the eastern part of the Atlantic over which sand from the Sahara has been observed is quite an extensive one. All the positions given by the above ships lie within this area, but that of M.V. *City of Chester* on 7th March is near the limit, and sand is only occasionally observed as far west and south as this. On the other hand it might, in exceptional circumstances, be carried still further.

LIGHTNING

Gulf of Oman

The following is an extract from the Meteorological Record of S.S. *British Commodore.* Captain N. Pinkney. Abadan to Djibouti. Observer, Mr. R. Maybourn, 2nd Officer.

9th March, 1948, 2100 to 2325 G.M.T. Barometer steady at 1009·4 mb. Wind N'ly, force 4. Sky overcast with continuous moderate rain. From about 2100 there had been intermittent flashes of lightning accompanied by thunder which occurred about every 20 minutes, sometimes quite close but more often in the distance. Suddenly at 2315, brilliant flashes of lightning occurred with such rapidity that they easily exceeded one a second, continuing at this rate for fully 2 minutes. From 2318 to 2325 they were occurring about 30 times a minute and after that they decreased, finally dying away about 2335. At no time were these flashes accompanied by thunder and their form was hidden by dense cloud. Weather prior to this phenomenon had been most unusual, as the vessel had encountered almost continuous heavy rain in the Persian Gulf for the previous 40 hours. During the lightning the wind did not exceed force 4 and the rain, if anything, was lighter than before, so that there was no suggestion of an electrical storm.

Position of Ship: Latitude 23° 14'N., Longitude 59° 30'E.

WATERSPOUTS

Australian Waters

The following is an extract from the Meteorological Record of M.V. *Port Jackson.* Captain F. W. Bailey, M.B.E. Auckland to Sydney. Observer, Mr. D. M. MacKeith, 3rd Officer.

26th March, 1948, 1510 G.M.T. About 100 miles due east of Sydney six very clearly defined waterspouts were observed. They presented rather an unusual picture as they were all connected with a solitary Cb. cloud—the rest of the sky was comparatively clear. Base of cloud estimated at 500 ft., and the six waterspouts anything from 10 ft. to 30 ft. in diameter.

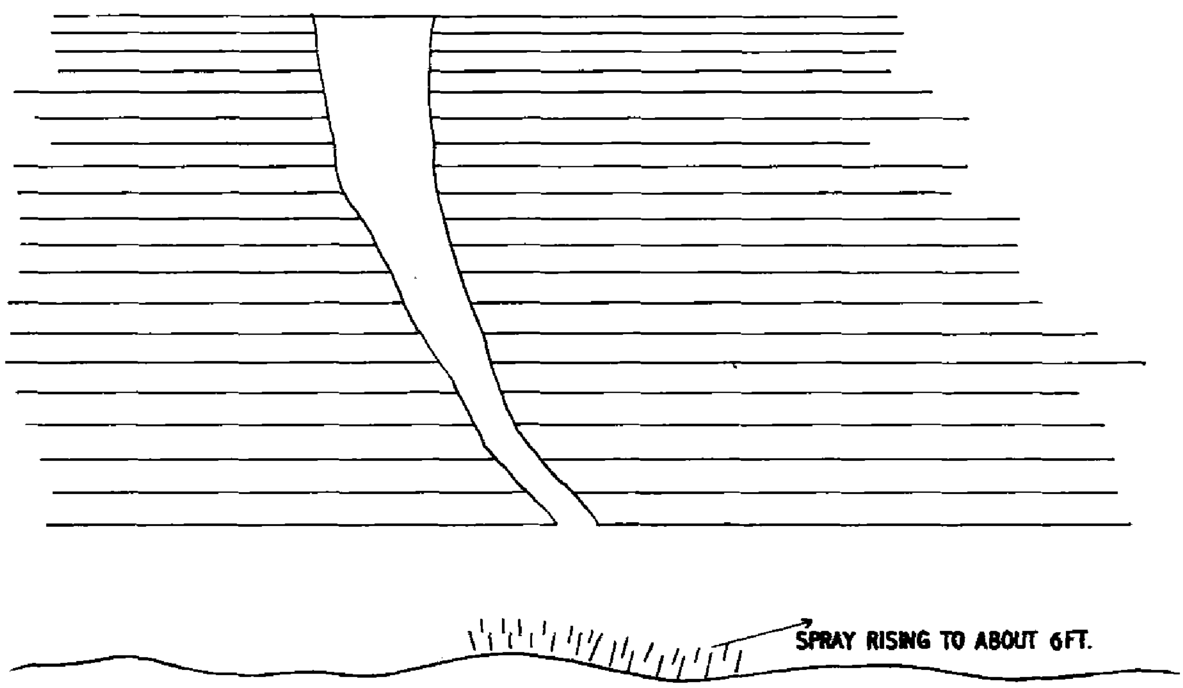
WATERSPOUT WITH SQUALL

North Atlantic Ocean

The following is an extract from the Meteorological Record of M.V. *Inishowen Head.* Captains W. A. Haddock and G. A. Moore. Newport News to Liverpool. Observer, Mr. N. C. Stark, Chief Officer.

21st February, 1948, 1800 to 2030 G.M.T. At 1800, wind E, force 6, barometer 1022·7 mb., rising slowly. Temperature: air 49°F., wet bulb 45°, sea 53°. Sky, large white Cu. 4/10, 1,500 ft. Swell ENE, long heavy. Sea ENE, very rough. Visibility good. At 1820 a dark cloud was observed low on the horizon from port bow to starboard. At 1840 this cloud extended to about 20° from zenith and broadened to within 25° of the horizon on either side with a long cone-shaped area of very light hue in the forefront. The surface of the sea became disturbed and a waterspout was distinctly seen. At 1855 waterspout passed about 300 ft. from starboard beam. Base 100 ft. above sea surface, height 150–200 ft., travelling W about 5 knots. It was visible astern about 4 minutes later when heavy squall commenced. Temperature dropped to 46°, wind changed to SE, force 7, barometer rose 1·0 mb. The squall lasted 15 minutes and was accompanied by torrential rain and heavy hail. At 1915 sky cleared, wind backed to E, force 5, sea and swell moderated. At 2030 sky was again large Cu. 4/10. Wind E, force 5. Temperature: air 48°, sea 52°. Barometer 1024·5 mb. Sea rough, swell heavy (short). Visibility very good. Course 069°. Speed 8 knots.

Position of Ship: Latitude 48° 10′N., Longitude 23° 51′W.



DISCOLOURED WATER

Brazilian Waters

The following is an extract from the Meteorological Record of S.S. *Princesa*. Captain R. Owen. Newport, Mon. to Montevideo. Observer, Mr. A. Cochrane, 1st Officer.

14th January, 1948, 1422 G.M.T. A narrow band of discoloured water was observed, stretching SE to NW, apparently from horizon to horizon. The approximate width of this stream was 80 ft. to 100 ft. Several less distinct patches were seen later in the afternoon.

Position of Ship: Latitude 12° 19′S., Longitude 35° 48′W.

Gulf of Panama

The following is an extract from the Meteorological Record of M.V. *Port Macquarie*. Captain E. E. Rowsell. New Zealand to London via Panama. Observer, Mr. H. J. Thompson, 3rd Officer.

6th March, 1948, 1900 G.M.T. Large patches of water observed to be

reddish-brown. Sounding revealed no differences from charted depths.
Position of Ship : Latitude 7° 38′N., Longitude 79° 52′W.

Off Gulf of Panama

The following is an extract from the Meteorological Record of M.V. *Kaipara*. Captain T. R. Windus. Balbao to Sydney. Observer, Mr. N. Fraser, Chief Officer.

21st January, 1948, 2230 to 2330 G.M.T. It was observed that for an hour the water was very much discoloured, dark muddy brown. The sea temperature throughout was 82°F. Wind NE, force 2. Barometer 1009·4 mb. Air temperature 81°. Clear sky. Swell and sea NE2. On a previous passage on 12th July, 1946, in the same vicinity, lat. 5° 55′N., long. 82° 31′W., a severe underwater tremor was experienced. This tremor caused the vessel to vibrate very heavily and lasted approximately 8 seconds.

Position of Ship at 2230 : Latitude 6° 02′N., Longitude 82° 22½′W.
at 2330 : Latitude 5° 56′N., Longitude 82° 35½′W.

PHOSPHORESCENCE

Pacific Ocean

The following is an extract from the Meteorological Record of M.V. *Port Wyndham*. Captain H. Steele. Panama to Wellington. Observer, Mr. C. P. Williams, 3rd Officer.

15th February, 1948, during the night. Numerous phosphorescent particles observed, about 2 to 3 miles in diameter and greenish-white in colour. Some were stirred up by the action of the ship, but a lot were floating by outside this action and appeared in patches about a half to the length of the ship (500 ft.) long. A rough sea was running at the time and the patches gave a queer mottled effect to a very dark coloured sea. Course 248° (T.). Speed 16½ knots.

Position of Ship : Latitude 38° 19′S., Longitude 173° 26′W.

ST. ELMO'S FIRE

North Atlantic Ocean

The following is an extract from the Meteorological Record of O.W.S. *Weather Watcher*. Captain F. A. Elston. On Station " I ". Observer, Mr. J. A. Franks.

16th March, 1948, 0100 to 0300 G.M.T. St. Elmo's fire was observed. The electric discharges occurred at fairly regular intervals varying from 2 to 6 seconds. Each flash was approximately 6 in. long and was seen along the W/T aerials and metal parts of the mast inclined at 30° to 45° to the wire or mast.

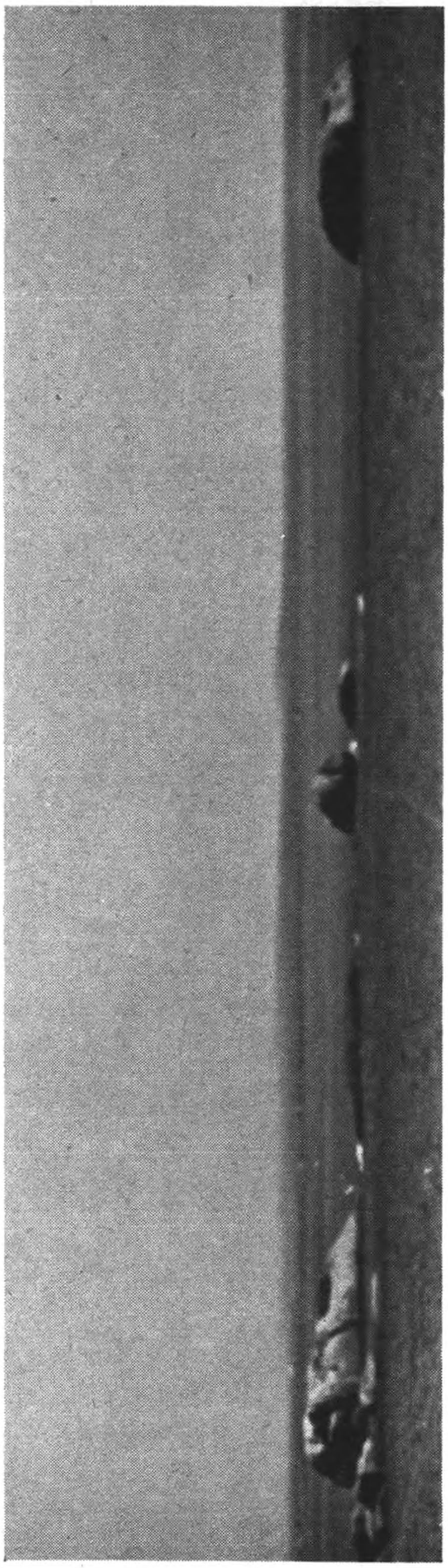
Position of Ship : Latitude 60° 00′N., Longitude 20° 00′W.

MIRAGE

Cape Town, South Africa

The following account was received from Mr. G. G. Pegler, M.V. *Silverwalnut*.

29th March, 1948. The photographs were taken from Camps Bay looking along the coastline towards the Cape of Good Hope. The phenomenon first appeared at 1400 G.M.T. and lasted for 7 minutes, during which period



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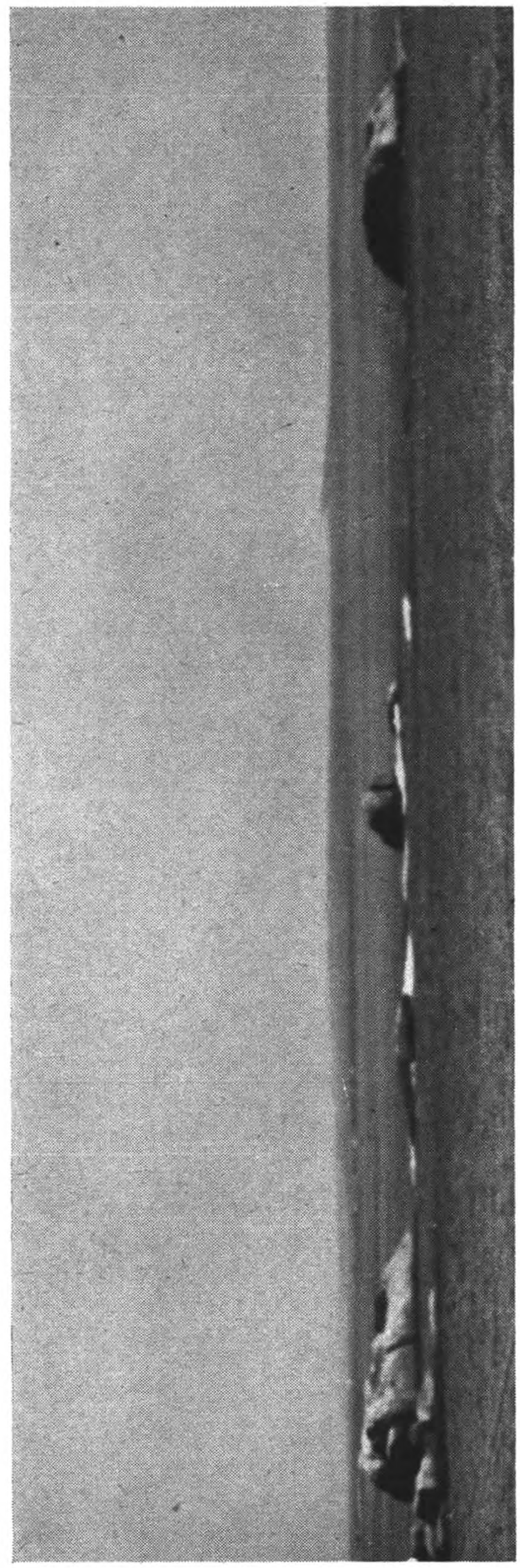

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the whole horizon in this direction appeared to be traversed by an enormous swell. The " crest ", with slight variations in shape, moved steadily along the horizon from south to west and finally merged into the usual horizon line. The remainder of the horizon was clear and completely undistorted throughout.

The sky was apparently cloudless, although a trace of cirrus may have been present. The temperature recorded at the Royal Observatory, Cape Town, at 1400 was 101·6°F.

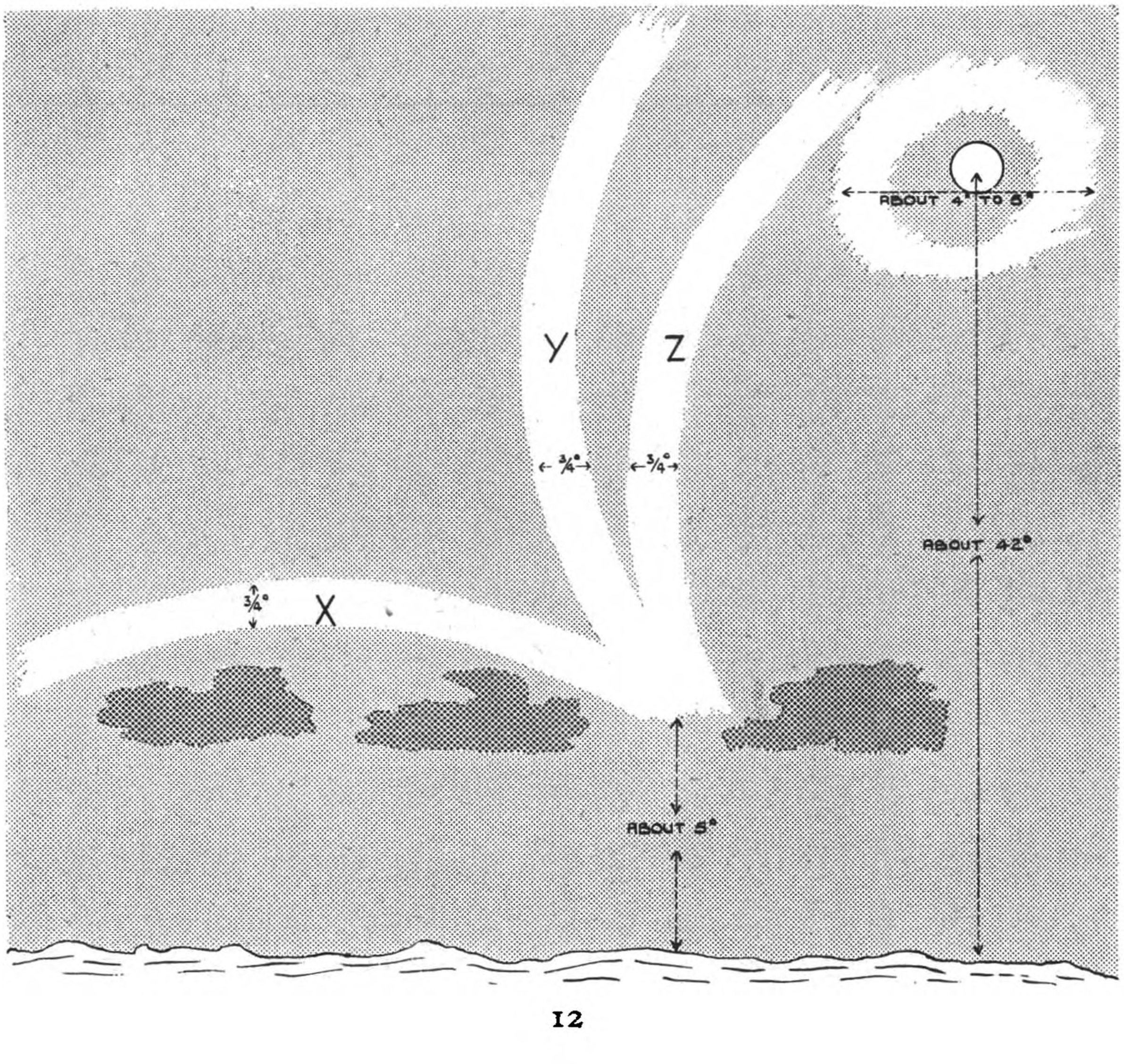
Note.—The phenomenon appears to have been a mirage of the horizon, formed at some height above the true horizon, the intervening space appearing like a belt of fog or haze. Such observations have not infrequently been made at sea, though rarely photographed. The peculiarity of the present interesting observation lies in the crests or the movement of these. Presumably the condition of abnormal refraction giving the mirage were more pronounced locally, in the direction of the crest, which was a portion of the mirage elevated above its general level. The movement can only be explained by assuming that this local direction of greater refraction gradually shifted with respect to the observer.

LUNAR PHENOMENON

North Atlantic Ocean

The following is an extract from the Meteorological Record of M.V. *Port Phillip*. Captain J. G. Lewis. Colon to London. Observer, Mr. M. B. Pettigrew, 4th Officer.

26th February, 1948, 0140 to 0220 G.M.T. A lunar phenomenon was observed showing three distinct arcs terminating at a central point about 5° above the horizon. Arc Z commenced in close contact with a whitish disc round the moon and all three arcs were uniform in thickness throughout their lengths, about ¾°.



Arc X equalled arc Z in length and ended about 5½° above the horizon. These arcs faded out at 0220. Gentle breeze, slight sea and heavy NNE'ly swell. Sky 4/10 clouded. Very good visibility. Barometer 1013 mb. Air temperature 50°F.

Position of Ship : Latitude 44° 05'N., Longitude 27° 06'W.

Note.—This is a remarkable observation, of which no explanation can be given. The arcs appear to be halo phenomena, but their positions do not agree with those of any of the known halo phenomena.

AURORAE

Icelandic Waters

The following is an extract from the Meteorological Record of S.S. *Goth*. Captain J. E. Bywater. Fleetwood to Iceland.

28th March, 1948, midnight. Northern Lights lasting 4½ hours were observed, dull red, green to pale yellow. They started as a thin arc of light from horizon to horizon and subtended an arc of 80° with apex approximately 30° above the horizon. They developed later to pillar or beam type, at times interchanging positions with each other rapidly and reaching to the zenith. The light at times was equal to that of full moon.

Position of Ship : Latitude 66° 36'N., Longitude 23° 36'W.

North Atlantic Ocean

The following is an extract from the Meteorological Record of O.W.S. *Weather Observer*. Captain N. F. Israel. On Station "Jig". Observer, Mr. E. J. E. King.

15th February, 1948, 2040 to 2230 G.M.T. Auroral display in the form of a bow, vertex bearing approximately 350° (T.), ends of bow 310° and 030° approximately. Faint white light at first, but bright yellowish-green rays extending upwards from the bow were observed for several minutes, fading at 2140 to more or less uniform whitish light. This faded slowly and was not distinguishable after 2230.

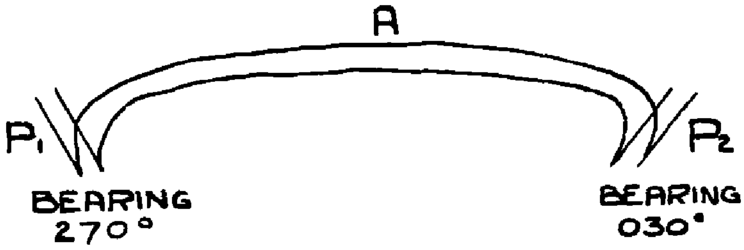
Position of Ship : Latitude 53° 50'N., Longitude 18° 40'W.

Note.—O.W.S. *Weather Explorer* on Station "Item" (lat. 60° 26'N., long. 20° 20'W.) reported at 1930 "aurora extending in a narrow arc overhead from NW to SE".

The following is an extract from the Meteorological Record of O.W.S. *Weather Watcher*. Captain F. A. Elston. On Station "Item". Observer, Mr. J. A. Franks.

27th February to 1st March and 3rd March, 1948. On 27th February, aurora observed at 2200 G.M.T. covering most of sky, extending from WSW through N to ESE, with streaks like searchlight beams from WSW towards zenith. On 28th at 2100, faint aurora to NW. Bright and in form of curtain at 2200. Almost disappeared at 2230. On 29th, vivid aurora was observed from 2200 to 2230. On 1st March aurora was observed in the form of an arc with side pillars (see P 1, P 2 in sketch). The arc was clear cut with well-defined edges. It extended from 270° through N to 030° and its elevation at " A " was 30°. It appeared shortly after 0001, its greatest brilliance was at 0015 and it began to disappear at 0020. On 3rd March, between 2200 and 2315, aurora was visible again in wide arc to NW ; similar in form to that observed in the early morning of the 1st, but not so well defined.

Position of Ship : Latitude 60° 00'N., Longitude 20° 00'W.



The following is an extract from the Meteorological Record of M.V. *Doris Clunies*. Captain J. G. Stevenson. Halifax, N.S., to Liverpool. Observer, Mr. P. Bracewell, 3rd Officer.

13th March, 1948, 2105 G.M.T. Northern Lights over an arc of the horizon NW to NNE, with streaks of light at an approximate altitude of 20°. This display lasted until 2130. Course 083°.

Position of Ship : Latitude 50° 37'N., Longitude 17° 50'W.

Note.—T.E.V. *Beaverlake* reported " 0200 G.M.T. aurora visible above clouds on 13th March in approximate lat. 48° 27'N., long. 29° 30'W.

South Australian Waters

The following is an extract from the Meteorological Record of M.V. *New Zealand Star*. Captain G. Owen. London to Australia. Observer, Mr. A. G. Smith, 3rd Officer.

16th February, 1948, 1500 to 1630 G.M.T. At 1500 approximately the sky between S45°E and S20°W brightened and then shafts of white, like searchlights, began to appear slowly. These shafts rose to an altitude of about 30° and during the period varied in intensity. The display lasted for about an hour and a half.

Position of Ship : Latitude 42° 33'S., Longitude 113° 55'E., to Latitude 42° 33'S., Longitude 114° 25'E.

Note.—S.S. *Southern Harvester* reported " slight Aurora Australis " on 16th February at 1800 G.M.T. in lat. 61° 38'S., long. 86° 30'E.

O.W.S. *Weather Explorer* on Station " Item " (lat. 60° 10'N., long. 20° 02'W.) at 0300 reported " faint aurora to N ".

METEORS

Adriatic Sea

The following is an extract from the Meteorological Record of M.V. *Telemachus*. Captain J. F. Webster. Port Said to Genoa. Observer, Mr. P. D. F. Cruickshank, 3rd Officer.

3rd February, 1948, 2130 G.M.T. Observed brilliant meteor. Duration 5 seconds, starting from the constellation of Aries in the zenith, vertically towards horizon (N'ly) through Cassiopeia. Disintegrated about 10° above horizon. Short luminous path, fading almost instantaneously. Meteor blue-white, path red, visible through cloud patches of cumulus humilis (sky 4/10 cloudy).

Position of Ship : Latitude 40° 05'N., Longitude 13° 27'E.

Arabian Sea

The following is an extract from the Meteorological Record of S.S. *Fort Assiniboine*. Captain A. H. Downs. London to Persian Gulf. Observer, Mr. G. L. Foster, Chief Officer.

3rd February, 1948, 1033 G.M.T. A meteor was observed bearing approximately 330°. It was about one-third to a quarter the size of the moon and was brilliant white with touches of green and red. It moved quickly across the sky from an altitude of about 15° to a bearing of approximately 305° altitude 8°. Course 320°.

Position of Ship : Latitude 22° 48'N., Longitude 59° 53'E.

The following is an extract from the Meteorological Record of S.S. *Fort Assiniboine*. Captain A. H. Downs. Bandar Shapur to Colombo. Observer, Mr. G. L. Foster, Chief Officer.

3rd March, 1948, 1825 G.M.T. A meteor was observed bearing 080°, altitude 35°. It moved southward with a slight decrease in altitude and disappeared bearing 145°. The body was brilliant white and about twice the magnitude of Venus. Duration of flight 3 seconds ; but the trail which extended across its entire path remained visible for 10 seconds and vapour remained for 60 seconds. The vapour trail was scattered later by upper currents in equal curves. Fine clear weather, good visibility and sky covered 3/10 with cirrus. Course 127°.

Position of Ship : Latitude 18° 35'N., Longitude 66° 10'E.

Australian Waters

The following is an extract from the Meteorological Record of S.S. *Tongariro*. Captain A. E. Williams. Melbourne to Aden. Observer, Mr. S. W. Lambrick, 3rd Officer.

25th March, 1948, 1218 G.M.T. Observed a brilliant green flash above the clouds which illuminated sky and sea for about 5 seconds, becoming a bright white. An orange streak was seen to pass vertically from the clouds into the sea beyond the horizon, bearing 255° approximately. The sky at the time was mainly covered with Cu. (large, without anvil), visibility very good.

Position of Ship : Latitude 36° 05'S., Longitude 120° 12'E.

North Atlantic Ocean

The following is an extract from the Meteorological Record of M.V. *Roxburgh Castle*. Captain J. M. Rayner. New York to Cape Town. Observer, Mr. J. K. Mumford, 3rd Officer.

7th January, 1948, 0429 G.M.T. Observed extremely bright meteor extending for about 64° across and parallel to eastern horizon from S to N. Its path commenced in the constellation of Argo and disappeared about 10° above Arcturus. Altitude by sextant about 37°. Colour bright green, and at its maximum the sea was illuminated to a greater extent than at full moon. No noise was heard, but the trail remained visible throughout most of its length for at least 90 seconds. Course 131°. Speed 15·5 knots.

Position of Ship : Latitude 14° 02′N., Longitude 39° 38′W.

Off Coast of Nova Scotia

The following note has been received from Captain E. W. Raper, Master of S.S. *Manchester Trader.*

On 27th February, 1948, at 0950 G.M.T., in position lat. 43° 54′N., long. 66° 34′W., observed very bright meteor at approximate bearing 350° and about 20° altitude. It travelled in an E'ly direction and disappeared at about 10° bearing approximately 010°. It was white, changing to green, and had a long orange trail. Wind N, force 3, clear sky with a trace of cumulus.

Pacific Ocean

The following is an extract from the Meteorological Record of M.V. *Port Wyndham.* Captain H. Steele. Panama to Wellington. Observer, Mr. C. P. Williams, 3rd Officer.

9th February, 1948, 1215 G.M.T. Observed a meteor bearing 135° (T.) with a brilliancy exceeding that of Venus and slightly larger in size. Duration of flight approximately 3 seconds, during which time its centre appeared to be yellow, with an orange border and trail, the whole being tinted with green. It appeared to about 55° altitude, bearing N15°E from *a* Centauri and S40°W from Antares. It then disappeared at an altitude of 30°, bearing S86°E from *a* Centauri and S3°W from Antares.

Approximate position of Ship : Latitude 23° 23′S., Longitude 131° 44′W.

The following is an extract from the Meteorological Record of M.V. *Inverbank.* Captain A. M. Williamson. Auckland to Makatea. Observer, Mr. J. Mitchell, 3rd Officer.

11th January, 1948, 0906 G.M.T. (2051 A.T.S.). Observed meteor which appeared near Aldebaran at an altitude of 33°, bearing 353°, and disappeared behind a layer of Ac. in the direction of Procyon. It was very brilliant, bluish-white, and seemed to proceed in a series of quick jerks, lighting up the sky for about 4 seconds. About a minute later, Venus set, brilliant red, and then disappeared with a distinct green flash.

Position of Ship : Latitude 34° 20′S., Longitude 179° 33′E.

SOUTHERN ICE REPORTS

During the Year 1948

January, February and March. No reports received.

Reports of ice previous to January, February and March, 1948, will be found in *The Marine Observer*, Volume XVIII, No. 139, page 44.

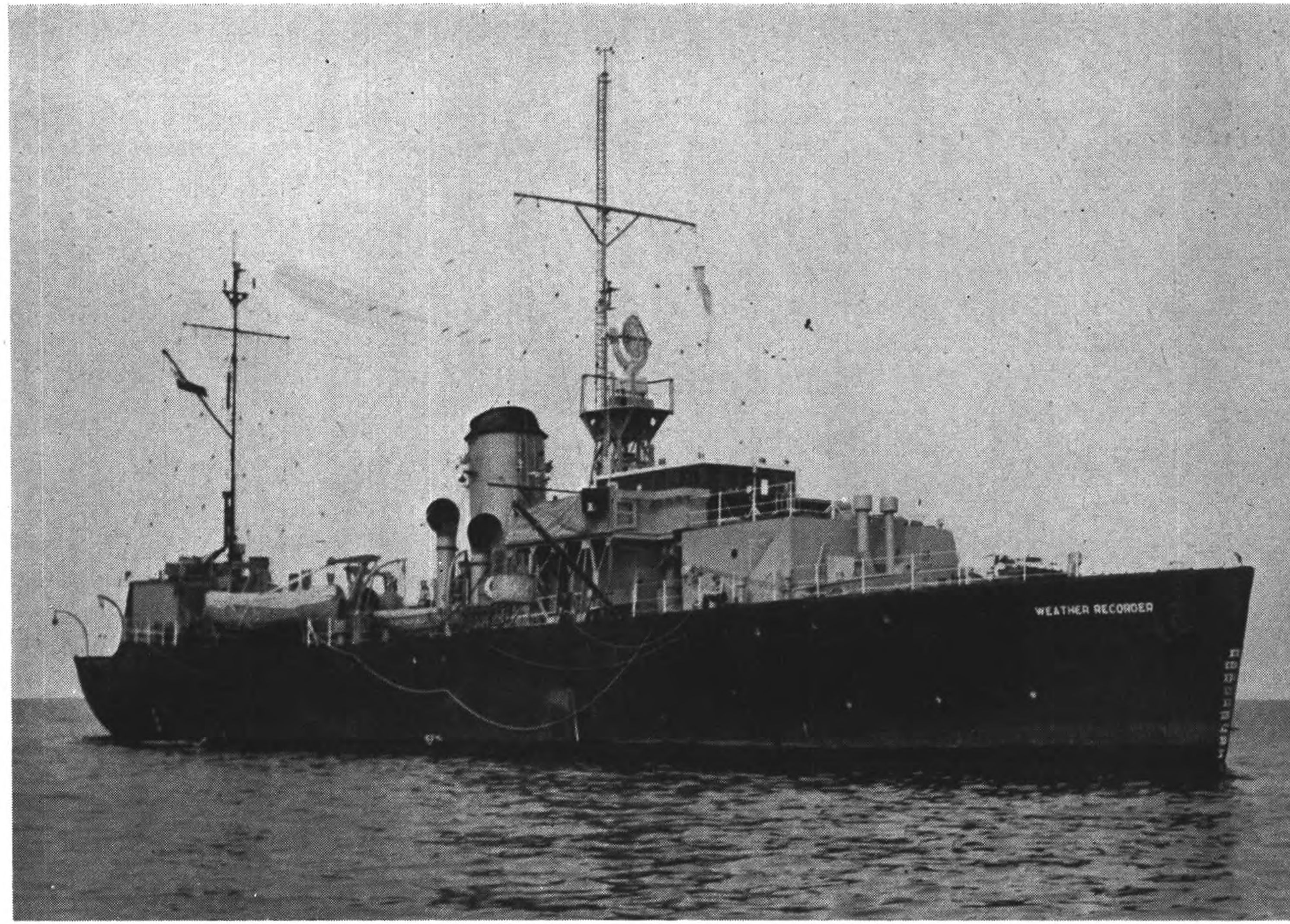


Photo by O. M. Ashford

This photograph of O.W.S. *Weather Recorder* was taken while on Station "Jig" (53° 50′N., 18° 40′W.) on the 8th July, 1948. Calm anticyclonic conditions prevailed so that it was possible to carry out research work aboard a rubber dinghy from which the photograph was taken. Details of research carried out during this voyage of the ship will be published in a later edition of *The Marine Observer*

STORM SURGES

Their Importance in Modern Tidal Science and Some Results of a Recent Investigation

BY R. H. CORKAN, M.SC.*

With acknowledgment to 'The Dock and Harbour Authority.'

1. The present position concerning accurate prediction of the tides—need for further study of storm effects

Ever since the Admiralty in 1836, using the results of Lubbocks' researches, published their first comprehensive tide tables for British ports, there has been an increasing demand for more accurate tidal predictions.

One obvious reason for this demand has been the increase in the size of ships using the ports, but probably a more important factor has been the steady rise in running costs and the loss which is involved when a ship misses a tide. So as to save time, not infrequently in these days, pilots are obliged to navigate vessels over bars and up tidal channels with a very small margin of water under their keels, and this is only possible with safety when the tides are accurately known.

The problem which meets the tidal expert if he is to provide accurate predictions may, for convenience, be divided into three parts.

First, he must be able to predict accurately the astronomical tide or that part of the change in level which arises directly from the tide generating forces of the sun and moon.

Secondly, he must be able to predict accurately the distortions in the astronomical tide which are produced when a wave travels in shallow water, and, also, as a result of friction. These distortions are of terrestrial origin.

Thirdly, he must be able to predict, or provide a simple method which the seaman may himself use to predict, the meteorological tide, or that part of the change in level which is produced by the casual effects of pressure and wind.

The work done in the last hundred years or so to find a satisfactory solution of the first and second parts of the problem will be familiar to all who have made a study of the Reports of the British Association and of papers by Lubbock, Whewell, Bunt, Darwin and others in the Philosophical Transactions of the Royal Society. Yet as late as 1920 the position was shown to be far from satisfactory where predictions of high accuracy were required.

Today, largely as a result of the researches in the past twenty-five years of Dr. A. T. Doodson, F.R.S., Director of the Tidal Institute, this unsatisfactory state no longer exists.

Dr. Doodson's work started in 1921 with a very thorough and detailed development of the tide generating forces, an essential preliminary if all important constituents of astronomical origin are to be sought. This was followed in 1928 by a greatly improved and simplified method of analysis which, besides providing many more constituents than any previous method, gave special attention to the elimination of the effects of unwanted constituents and reduced the labour and cost of an analysis to only a fraction of what it had been before.

The present position as regards the astronomical tide is that at a place such as

* Deputy Director, Liverpool Observatory and Tidal Institute

Liverpool, where the range at springs is of the order of 30 ft., the predicted error should not exceed 1 or 2 in.

The preparation of satisfactory predictions of the distortions in the astronomical tide, due to the very slow convergence of the higher harmonics, has presented a difficult problem. One solution is to build much larger predicting machines or, if only hourly heights are required, to use tabulating machines of the Hollerith or Powers type. Just before the war the Germans constructed a sixty-two component machine, having twenty-two components more than the previous largest machine, the Légé, at the Tidal Institute, but even this number of components would be insufficient at certain places.

When accurate predictions of only high and low waters are required then indirect methods of prediction may be used, and an important recent development produced by Dr. Doodson has been the Method of Harmonic Shallow Water Corrections, which is really the harmonic analogue of the older non-harmonic method of differences. This method has given completely satisfactory results at all important British ports and at certain foreign ports where it has been employed. As an extreme example the method has been very successful at Basra, on the Shatt-al-Arab, where previously, due to the large diurnal as well as semi-diurnal distortions, prediction had to be given up as practically hopeless.

It may now be safely said that as far as both the astronomical tide and its distortions are concerned, these are, or can be, predicted with all the accuracy required, and they no longer present a major problem to the tidal expert.

Unfortunately no similar statement can be made concerning the meteorological tide.

The effect of pressure alone, assuming that the sea acts like an inverted barometer, has been considered on a number of occasions, but the effect of the wind, the really important factor in the majority of large disturbances, has not received the attention its importance deserves. This has been due partly to the inherent difficulties of the problem and also to the anomalous results to which any simple method of treatment normally leads. Numerous tables have been prepared showing the effect on the tides of the local winds when from different directions and of varying strength, but since these only depend on averages deduced from the grouping of a large number of observations, they are of very little use for the purpose of predicting the disturbance on a particular day, especially when the disturbance is large; often they may indicate a lowering of level when the level is raised and the reverse.

Certain fallacious ideas have also grown up, such as that the level of the sea is always raised when the local wind is onshore. Fig. 1 is from a paper from Dr. Doodson published in 1924, and shows by arrows the directions of the local winds which are most effective in raising sea level at a number of places round the coasts of the British Isles. It will be seen that at certain places, as, for example, Felixstowe, the most effective direction may be nearly offshore.

To sum up we may say that a more complete understanding of how the meteorological tide is produced and the discovery of a satisfactory method of predicting it are probably the most important practical problems relating to tides awaiting solution.

A further and somewhat different reason for a more detailed study of storm effects is the importance, at places where flooding is possible, of a

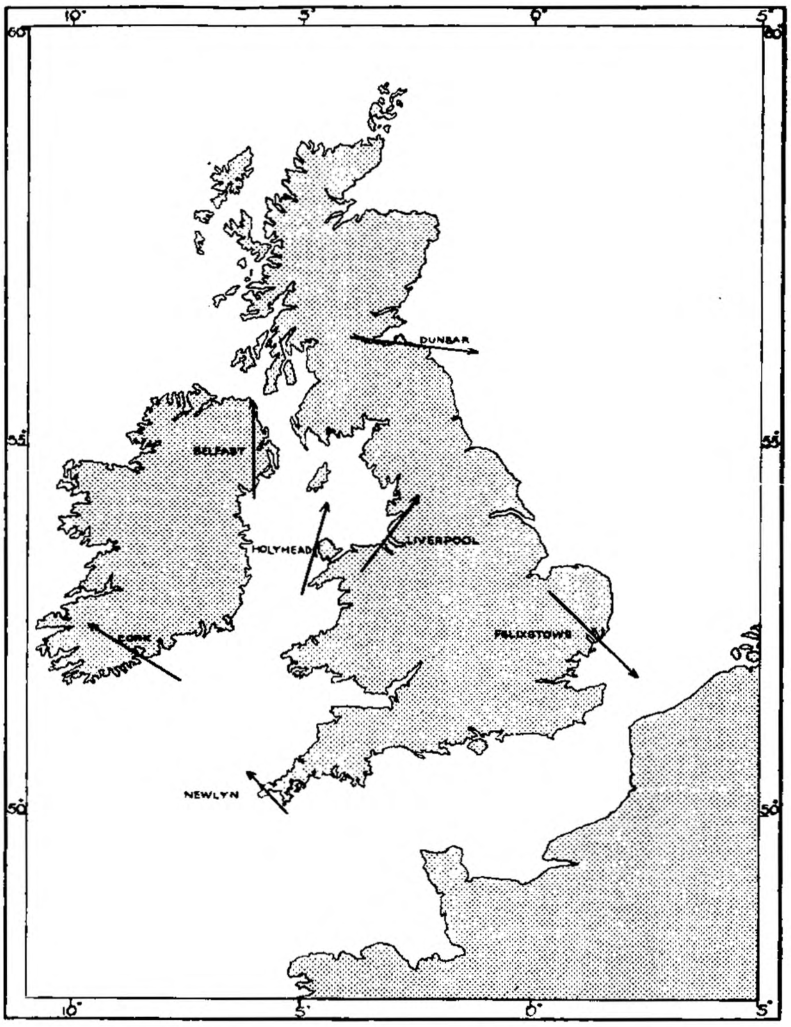


Fig. 1. The most effective winds for raising sea level at places on the British coasts

reliable estimate of the probability of the sea rising to specified levels, so that the sea defences may be suitably, yet economically, raised. When sufficient data are available this problem can be solved statistically. It is also sometimes desirable that forecasts may be issued of when the sea is likely to reach dangerous levels.

A preliminary investigation, for which these were the immediate requirements, was carried out by Dr. Doodson for the London County Council, after the flooding of the Thames and its disastrous results in 1928. Dr. Doodson traced the progression of several large surges in the North Sea, and also carried out extensive correlations between the disturbance and the pressure and pressure gradients, both local and far afield. From these he showed the importance of time relations and the necessity to consider the conditions over a large area.

A further and more detailed investigation has recently been completed by the writer and a report issued to the same authority. This recent investigation will form the basis of much that follows in this article.

2. The magnitude and some characteristic features of the meteorological tide at Southend

Some idea of the size and the relative importance of the meteorological tide may be obtained from the following table, showing the frequency of errors in the predicted high water heights at Southend during the winter months of the ten years, 1929 to 1938, inclusive. The total number of observations was 3,479.

Error in feet	−6 to −7	−5 to −6	−4 to −5	−3 to −4	−2 to −3	−1 to −2	0 to −1	0 to 1	1 to 2	2 to 3	3 to 4
Frequency	1	1	3	9	32	202	1333	1587	283	23	5

Neglecting sign, more than one in fifty of the high water heights had an error of 2 ft. and over, while more than one in 200 were in error by 3 ft. It will be realised, of course, that the maximum disturbance is in general greater than the disturbance at the time of high water, since it is only on rare occasions that the time of maximum disturbance and the time of high water coincide. The largest known disturbance at Southend since 1911 was a raising of level of over 11 ft. which occurred two hours after low water on 31st December, 1921.

The table of errors also indicates that the tides at Southend tend to be lowered by meteorological effects more than they are raised, and investigation has shown that this cannot be attributed appreciably to any fundamental difference in the response to conditions favouring a lowering of level to those favouring a raising of level. The more probable explanation is that in the North Sea the former conditions are, on the average, more intense.

Detailed examination of the meteorological tide at Southend has also shown that it is partly dependent on the range of the astronomical tide. When the range is small there is a greater tendency for large storm effects at the time of high water, particularly those in which the level is lowered, than when the range is large.

The probability of the tide reaching a specified level is usually based on a statistical study of a frequency table such as the above. Graduation of the table of errors gives the probability of errors of a specified size ; these results, when suitably combined with the probability of the predicted tide reaching specified levels, give the required probabilities for the height of tide.

A much simpler method, and one which gives good results when only a quick and easy approximation is required, may be based on the observed fact that the logarithm of the crude probabilities of the observed high water heights is approximately linear with the height for large heights at Southend ; using this method, the probability of the tide rising to the same level as that which produced the flooding in 1928 came out as one in thirty years, using the more exact method the probability was one in forty-four years, results which are in reasonably good agreement.

3. Storm Surges and how they are generated

The term storm surge strictly implies a disturbance in sea level which requires the use of dynamical rather than statical considerations to explain its origin. In practice the term is applied to all large meteorological disturbances of an oscillatory character in an enclosed or partly enclosed sea irrespective of whether the whole of the disturbance may be a surge in the true sense of the term or not.

The theory of surges, for the very simple case of an enclosed canal, was first given by Proudman and Doodson in 1924.

Previously, in 1905, Ekman had shown that a steady wind blowing along a canal would ultimately produce a uniform slope of the surface, the end nearest from where the wind blows being lowered and the other end raised, the total volume of necessity remaining constant. To the final disturbance he gave the name ' steady state ', and he also provided a simple formula involving the tractive force of the wind for calculating it. Previously, in 1881, Colding had shown empirically that the slope was directly proportional to the square of the wind velocity and inversely proportional to the depth.

Proudman and Doodson showed that if the wind suddenly commenced to blow and later remained at the same strength then the level at a particular point would approach the steady state in a series of oscillations after the manner of curve A in Fig. 2(*a*), where the line $\bar{g}$ marks the value of the steady state.

The period of the oscillations would depend on the natural or seiche period of the canal, and the time at which the level would reach its first maximum would be nearly one-quarter of a period later than when the wind commenced to blow. The rate at which the oscillations died out would depend on the effective internal friction of the water.

If the wind, after blowing for a short time, suddenly ceases, then later conditions may be found by superimposing the effect of an equal and opposite steady state as in curve B. Adding up curves A and B we get curve C, the effect of a wind blowing for a short interval of time.

When a curve for the steady state is known, we simply divide it up into suitable time intervals and assume conditions in each interval to be constant. The intervals are then treated as above and the results summed continuously.

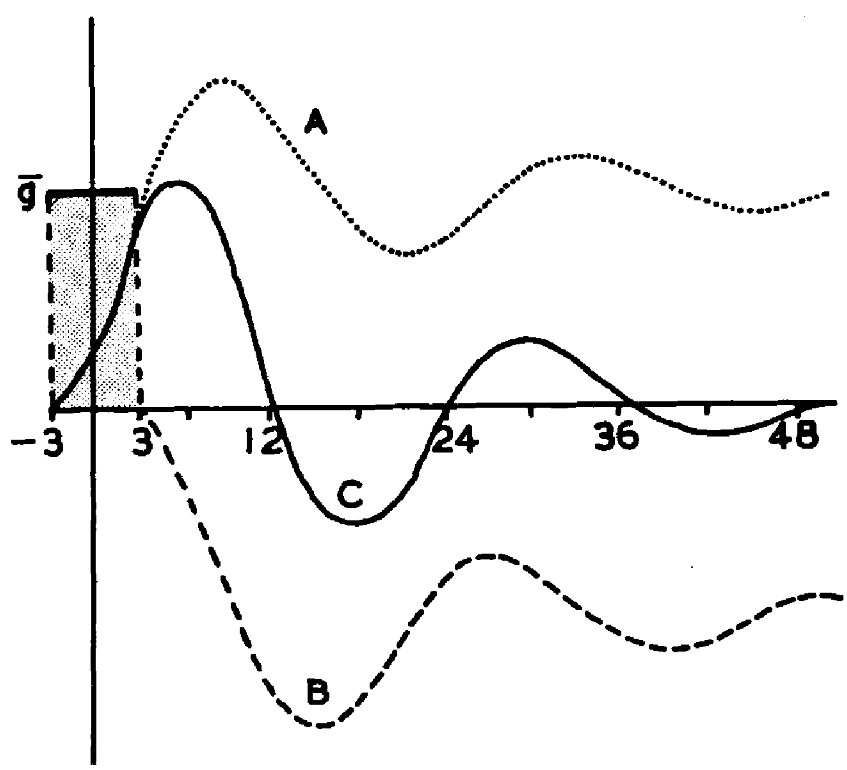


Fig. 2(*a*). Surge produced by a wind acting for a short interval of time

When the appropriate steady state for the effect of varying pressure gradients is known, it may be treated in exactly the same way as the steady state for the wind.

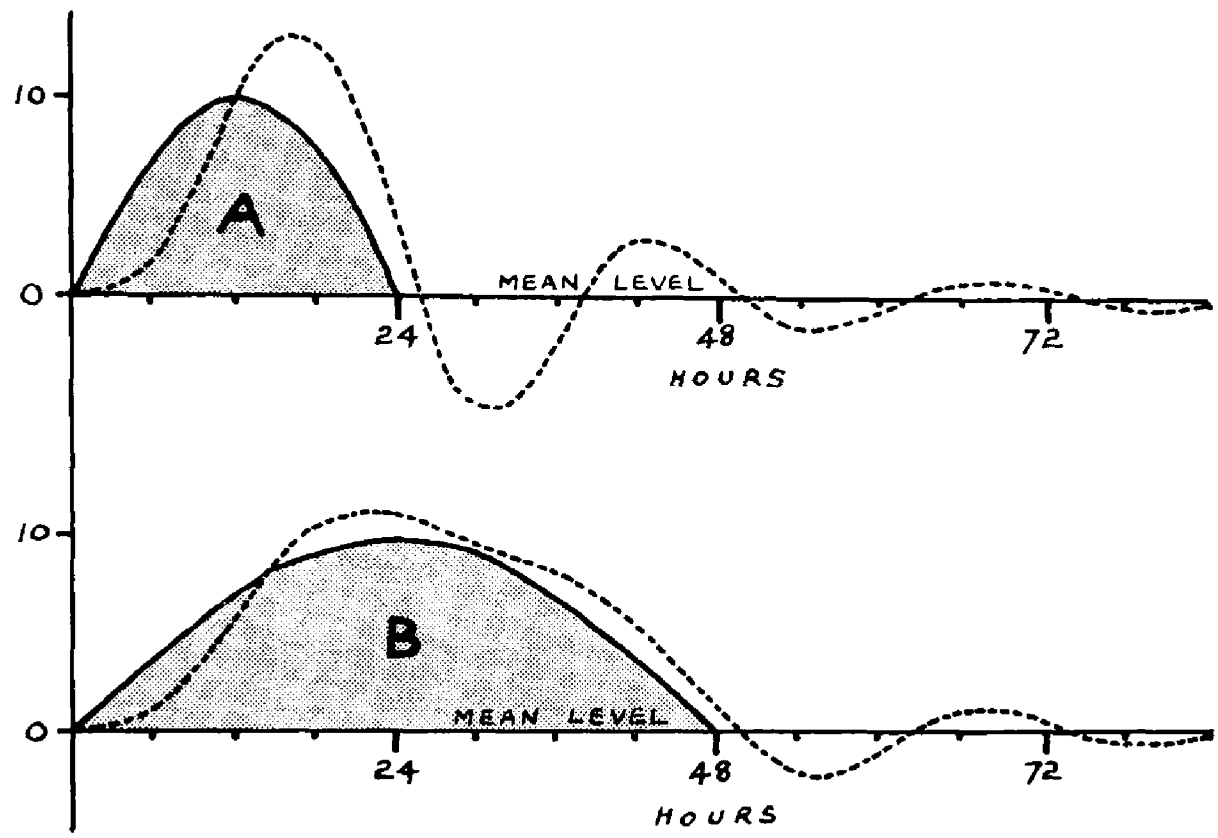


Fig. 2(*b*). Effect on surge of free period of oscillating area

The importance of the free period of the canal is shown in Fig. 2b. In both examples, the free period—twenty-four hours—and the magnitude of the internal forces have been assumed to be the same. The continuous curve gives the wind effect and the broken curve gives the surge.

In A, the period of the wind effect is the same as the free period of the canal; in B, the wind period is twice the free period of the canal. It will be noted that in both examples the surge lags on the wind. Also, to a certain extent, while the wind lasts, the surge follows the general character of the wind, but there are greater divergences and also larger oscillations in the surge when the periods of the wind and the canal nearly coincide than when they differ. After the wind stops, the sea level continues to oscillate with a period which is the same as that of the canal, and with a period which is independent of the original period of the wind. The latter conditions correspond exactly to the periodic oscillations or seiches which are set up in a lake when its level is disturbed.

In example A, there is a pronounced lowering of sea level shortly after the wind ceases, and this lowering occurs even though the wind has at no time been favourable to the lowering of level.

In example B, the maximum disturbance in the surge is earlier than the maximum disturbance in the wind due to the shorter period of the canal.

Proudman has also considered the effect of a travelling depression, and has shown that when the rate of travel reaches a critical value, depending on the depth, a large surge may be developed. This result has only received very limited application up to the present, but it may be fundamental in explaining the origin of certain large surges which originate outside the

North Sea and later enter from the north and travel southwards like progressive waves.

4. Storm Surges in the North Sea

According to modern theory the tides in the North Sea are standing oscillations maintained by the oceanic oscillations from the north. The tides in the English Channel have little effect on those in the North Sea due to the very narrow connecting channel in the Straits of Dover and, in fact, the tides in the North Sea would not be appreciably altered if a barrier was placed across the Straits.

The main oscillation in the North Sea is longitudinal and from north to south, but there is a smaller superimposed transverse oscillation due to the earth's rotation.

If we neglect the earth's rotation, the North Sea may be regarded to a first approximation as a long canal closed at its southern end and open to the ocean in the north. Internal storm effects over the North Sea as a whole may then be expected to be similar in a general way to those already indicated by simple theory.

External storm effects will enter from the north, and investigation has shown that in the North Sea they travel southwards like a progressive wave. The origin of all external storm effects has not been satisfactorily explained, but it is easy to allow for them at Southend, simply by observing the disturbance, several hours earlier, as they pass the northern entrance. The time taken for a surge to travel from Dunbar to Southend is found to be practically nine hours, while the ratio of amplitudes of surges at the two places is nearly unity, results which are in agreement with the progression of the tides. The same laws apply whether the level is lowered or raised.

In addition to the effect of the winds acting over the North Sea as a whole, there are also local effects produced by the local winds when these differ appreciably from the mean wind over the whole area. The local slope is then expected to be proportional to the square of the local wind velocity; empirical investigation also indicates that the local effect is nearly instantaneous with the wind.

In regions where there are large stretches of shallow water there may be a local effect which is related to the height of tide, since wind effect is greatest when the depth is least. Where there are large banks which become dry during a part of the tidal period, the smallest average depths and the greatest wind effects do not necessarily occur at the time of low water. At Southend there is a marked tendency for the greatest effect to occur two or three hours after low water.

In shallow water, part of the surge may also originate from interaction between the travelling surge wave and the ordinary tidal wave, in the same way as shallow water effects are produced by ordinary tides, i.e. through distortions of the waves. These effects take the form of short period oscillations, and at Southend they are sometimes very pronounced.

Also there may be local seiche effects, usually having very short periods.

In the recent quantitative investigations of storm surges at Southend, the differences between the disturbances at Southend and Dunbar were expressed in terms of the squares of the pressure gradients at two points A and B

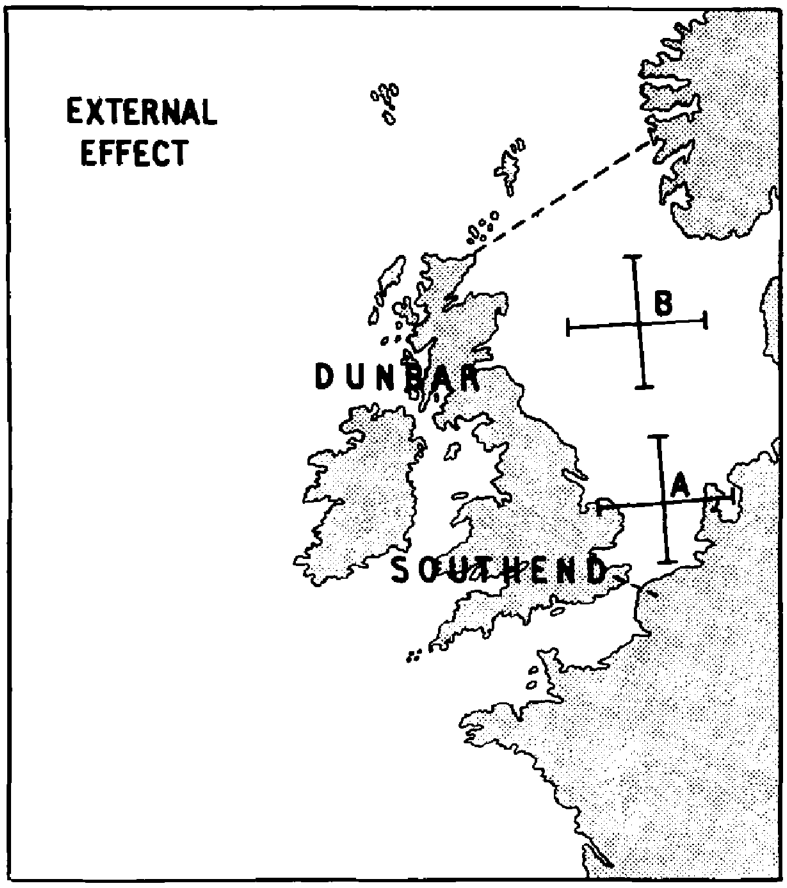


Fig. 3. Position of points A and B

situated as in Fig. 3. Theory indicated that this difference could be expressed most conveniently and yet very satisfactorily in the form

$$R_S - R_D = \alpha N |N| + \beta E |E| + \gamma n |n| + \delta e |e|$$

where R_S is the observed disturbance at Southend after correction for the effect of local pressure assuming a statical law.

R_D is the observed disturbance at Dunbar after correction for the effect of local pressure assuming a statical law, six to ten hours earlier.

N and E are the north and east gradients at A.

n and e are the north and east gradients at B, six to ten hours earlier.

α, β, γ and δ are constants.

The expressions $|N|$, $|E|$, etc., mean that the gradients are taken without regard to the sign. The constants α and β between them give a good representation of the local wind effect at Southend. The constants γ and δ give a representation of the wind effect over the North Sea as a whole, but also include a portion of the Dunbar local wind effect.

The laws governing the propagation of external effect inside the North Sea were first determined using surges in which the effects of the winds over the North Sea were either negligible or as small as possible.

Choosing surges in which external effect was small and the wind effect over the North Sea was large, the above formula was next applied to determine the four constants and the best time intervals. Conditions favourable to a lowering of level were considered independently of those favourable to a raising of level and, as already indicated, the two sets of constants were found to be in close agreement. The consistency of the

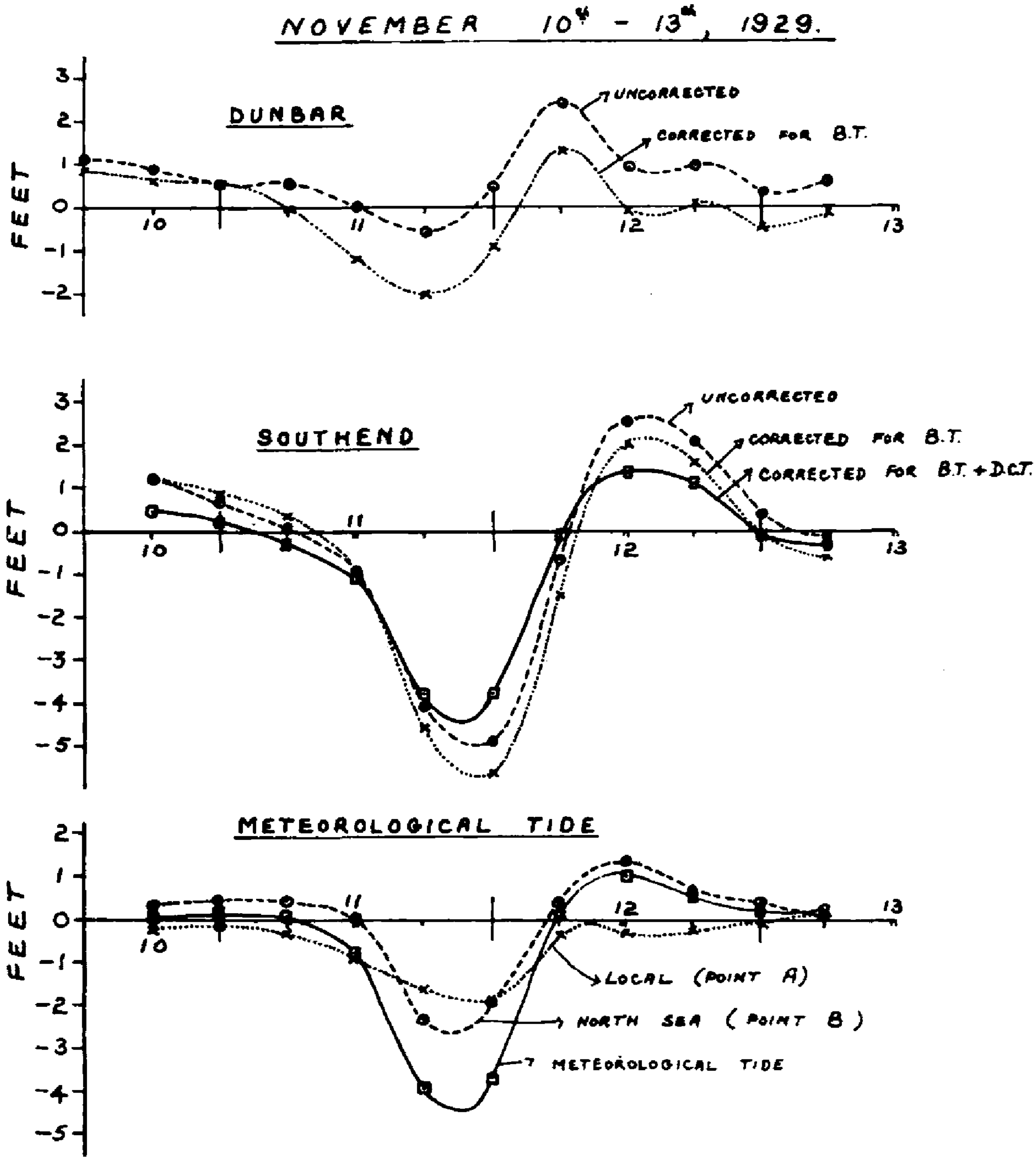


Fig. 4(*a*). Surge of 10th–13th November, 1929

constants under similar conditions were also examined. In every case special care was taken to choose only those surges which gave equations, for the determination of the constants, which were well conditioned. When necessary, surges were re-examined and second approximations were made, and in fact the whole process of analysis was one of successive approximation. Finally the accepted formula was thoroughly tested out and used to predict a wide selection of surges, most of which were unsuitable for the direct determination of the constants. In all, over thirty of the largest surges between 1928 and 1938 were examined in detail and satisfactory predictions obtained. The individual parts of each surge, external, local and North Sea effects, were also discussed in relation to the respective meteorological conditions which produced them.

Finally, after the completion of the quantitative investigation the whole of the data was re-examined qualitatively, making full use of the facts which had come to light.

It was found that practically all surges in the North Sea, both those in which the level is lowered and those in which the level is raised, can be expressed in terms of nine fundamental types, several of which are related in pairs. Three types produce a lowering of level and six types a raising of

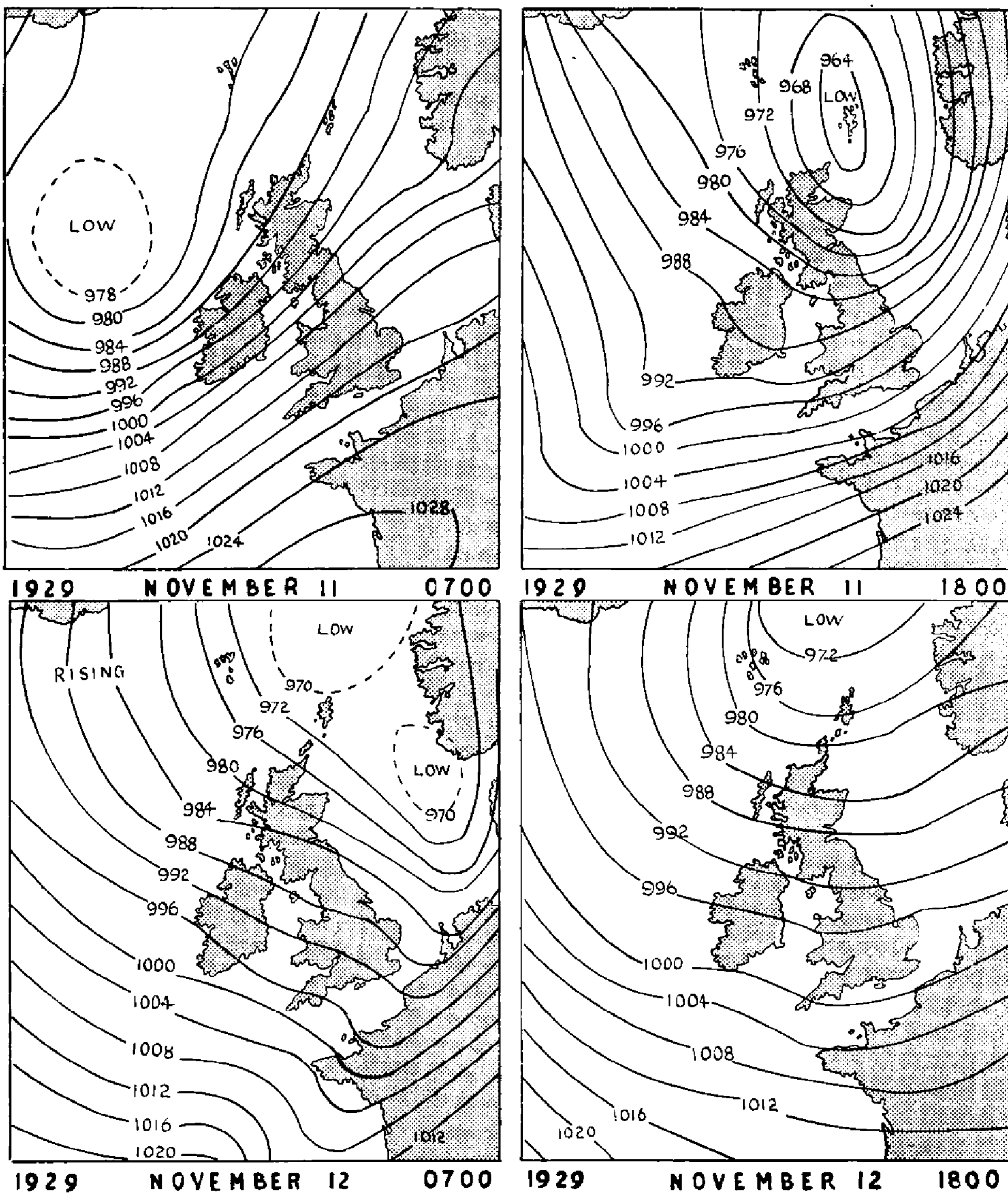


Fig. 4(*b*). Meteorological conditions during surge of 10th–13th November, 1929

level, and each type has a distinctive meteorological distribution and produces a distinctive effect on sea level. A particular surge may be made up of a single type or a combination of types. For example, one type may be producing a lowering at Southend through the local winds ; a second type

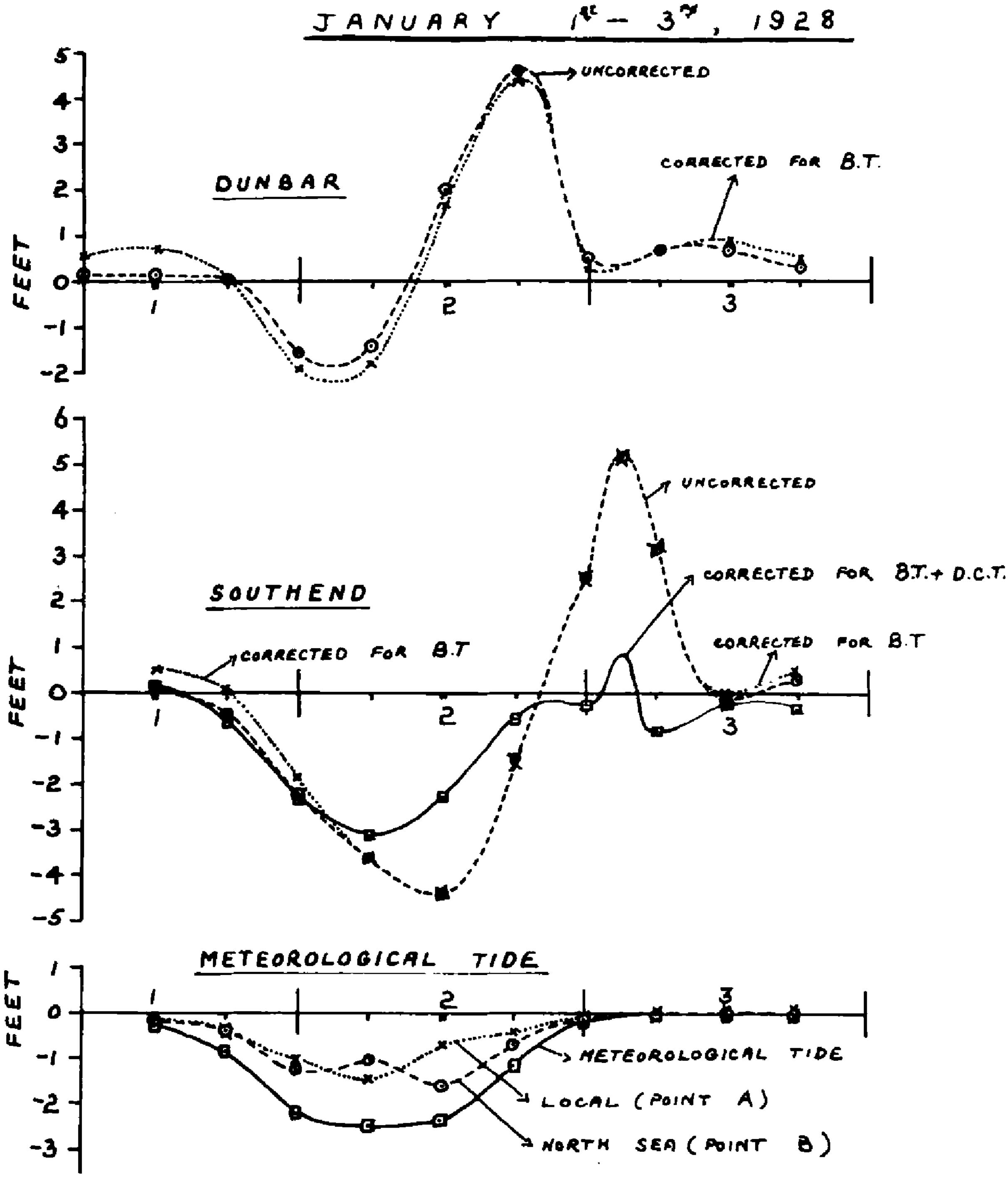


Fig. 5(*a*). Surge of 1st–3rd January, 1928

may be producing externally a raising of level. The observed surge will be the sum of the two effects and may be a raising of level, a lowering of level, or no apparent perturbation of level. One thing that is certain is that it is only by considering what happens both inside and outside the North Sea that a satisfactory prediction can be made.

5. Some examples of Storm Surges at Southend

We shall now give three examples, from the report, of typical storm surges at Southend, with the associated meteorological distributions.

Space does not permit of the inclusion of further examples of equally important types or of a detailed discussion of each surge, but the following notes should be sufficient to indicate what has been done and to bring out the points of interest in each example.

The diagrams have been drawn on a uniform plan and the interpretations of the curves are as follows :

1. **Dunbar**
   (*a*) uncorrected—the uncorrected surge ;
   (*b*) corrected for B.T. (Barometric Tide)—the surge after correction for the local barometer assuming a statical law.

2. **Southend**
   (*a*) uncorrected—the uncorrected surge ;

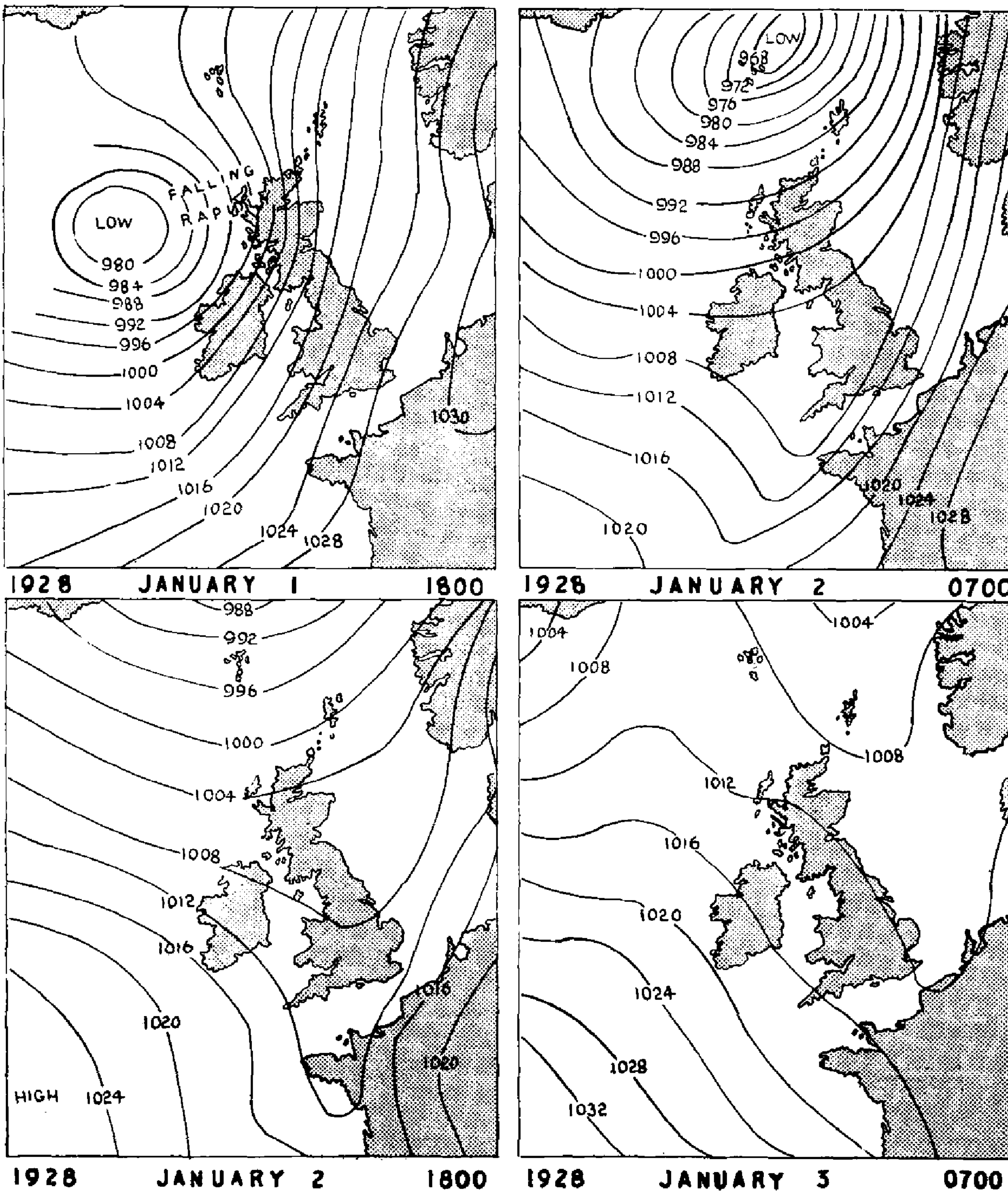


Fig. 5(*b*). Meteorological conditions during surge of 1st–3rd January, 1928

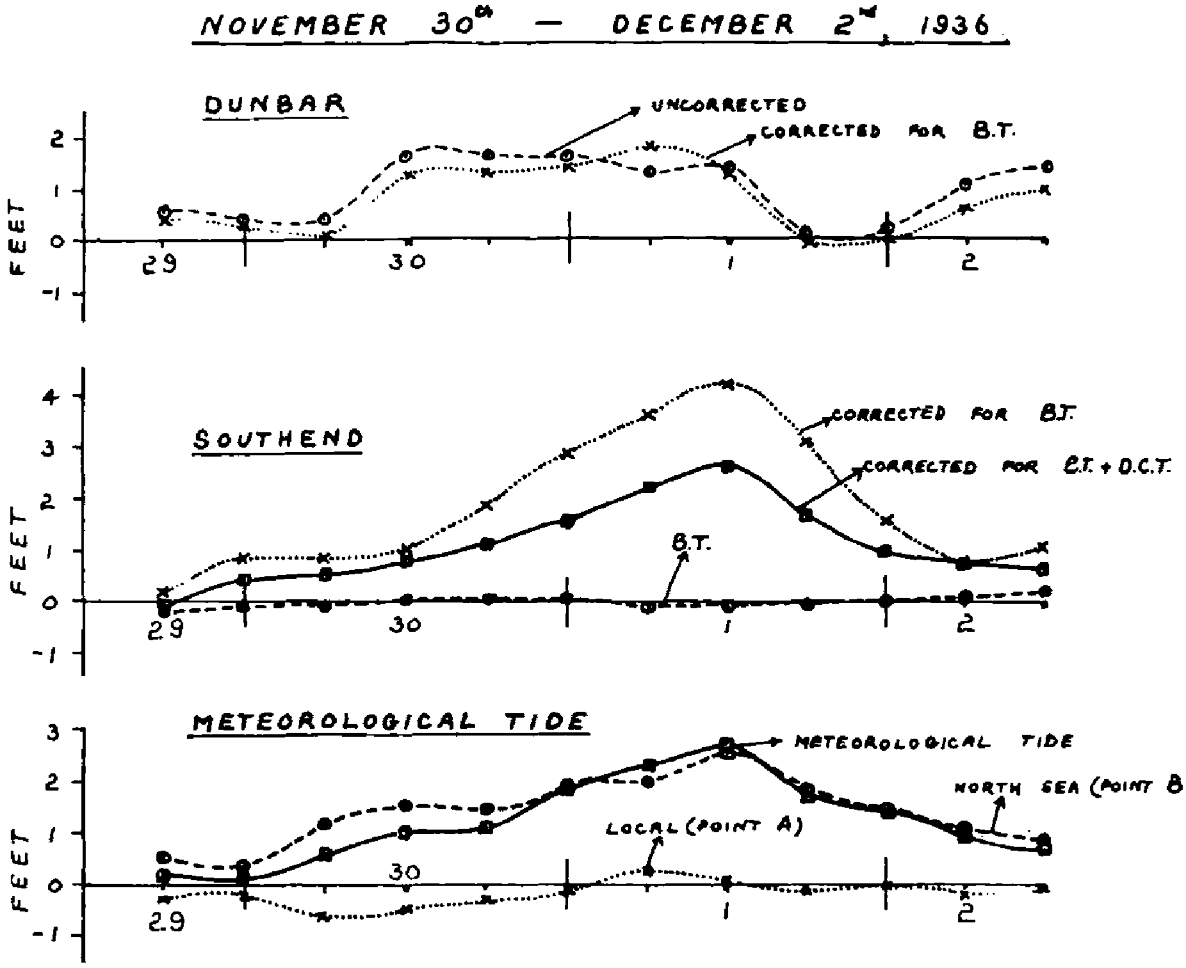


Fig. 6(*a*). Surge of 30th November–2nd December, 1936

(*b*) corrected for B.T.—the surge after correction for the local barometer assuming a statical law ;

(*c*) B.T.—the barometric tide (when given, the uncorrected curve is omitted since the barometric tide is very small) ;

(*d*) corrected for B.T. and D.C.T.—the surge after correction for the local barometer and also for the " Dunbar Correction Tide ", the corrected disturbance at Dunbar nine hours earlier.

3. **Meteorological Tide**

(*a*) local (point A)—the local effect at Southend as deduced from the gradients at the point A ;

(*b*) North Sea (point B)—the general effect over the North Sea and a portion of the local effect at Dunbar as deduced from the gradients at the point B. (No attempt has been made to separate the two effects since this was unnecessary for the purpose of prediction.)

(*c*) Meteorological Tide—the predicted meteorological tide from the pressure gradients at points A and B.

The importance of the externally generated surge is indicated by the difference between the curves 2(*d*) and 2(*b*).

The success of the prediction may be gauged from a comparison between the curves 2(*d*) and 3(*c*), but we must also remember that it is the uncorrected surge at Southend, the curve 2(*a*), that is being predicted, and that the corrections for the local barometer and the externally generated effect have played an important part in the prediction.

Example 1. Surge of November 10th-13th, 1929 (Figs. 4a and 4b)

This surge produced a very pronounced lowering of level of a simple type.

The p.m. high water on 11th November registered only 8·3 ft. above datum, or 2 ft. below mean tide level ; it was the lowest high water observed at Southend since 1916.

The pressure distribution over the North Sea at 1800 hours on the 11th and the strong south to south-west winds are typical of many large surges in which the level is lowered.

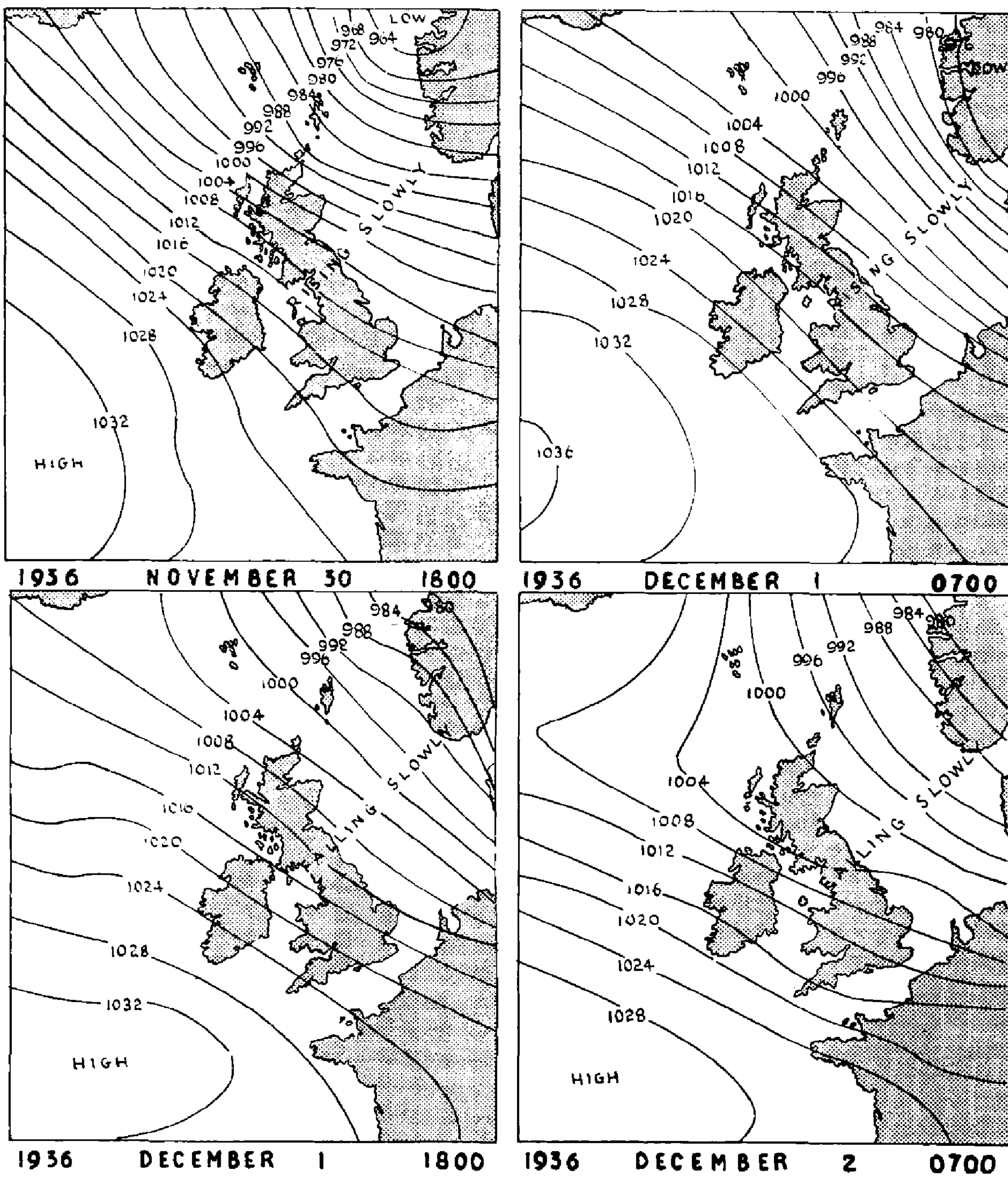


Fig. 6(*b*). Meteorological conditions during surge of 30th November–2nd December, 1936

There was an earlier lowering of level at Dunbar produced by the traction of the strong south to south-west winds farther north, and this effect moved southwards.

The centre of the depression was north of Scotland and either stationary or moving northwards. It is much more usual for the centre of a depression in this region to move eastwards over Scandinavia; the strong southerly winds over the North Sea then veer to the north-west and north, and a large raising of level is produced. When, as in the present example, the centre does not pass appreciably east of long. 0° a large raising of level is unusual and, before the conditions moderate, the winds veer only to a very limited extent. The local effect of the winds at Southend played an important part in producing the lowering of level on the 11th to 12th, but was negligible when the level was raised on the 12th.

Example 2. Surge of January 1st-3rd, 1928 (Figs. 5a and 5b)

The first part of this surge, in which the level was lowered by 4 to 5 ft., was nearly identical in origin with the surge previously discussed. This may be seen by comparing the meteorological charts for 0700 hours on 2nd January, 1928, and for 1800 hours on 11th November, 1929.

There were the same strong south to south-west winds over the North Sea, but in 1928 these winds were more prominent farther north; again they produced a lowering of level at Dunbar which travelled south.

Shortly after 0700 hours on 2nd January conditions as a whole appeared to be moderating, and at 0700 hours on 3rd January the winds over the North Sea were negligible. *Yet only a few hours earlier the level at Southend rose to between 5 and 6 ft. above the mean.*

The curves clearly indicate that the whole of this surge came in from the north and passed Dunbar about 6 p.m. on the 2nd.

A number of examples of the same type of surge are known but their origin is still a mystery, and they are not connected in any obvious way with the winds immediately to the north of the North Sea.

They are generated when a deep depression moves north-east between Scotland and Iceland, and they are closely related to the pressure changes along the shallow Wyville Thompson ridge which joins the two countries. Attempts to account for them, using the known theory for a travelling depression, have not been successful, but the magnitude of the disturbance is much larger when the centre moves steadily on than when it hesitates in its movement when over the ridge. There is also a fairly consistent interval of fourteen hours between the time of greatest rise at Dunbar and the time of minimum pressure at the Faroes.

This is a very good example of a surge for which predictions based on the local winds at Southend or those over the North Sea as a whole would have been a complete failure.

The surge occurred near neap tides, and the time of the greatest raising of level coincided with the time of low water. It passed unnoticed at the time when it occurred.

Example 3. Surge of November 30th-December 2nd, 1936 (Figs. 6a and 6b)

This surge is an example of a simple rise and fall in level of an unusually prolonged type.

The greatest disturbance was of the order of 4 ft. and both high waters at Southend on 1st December exceeded the level of Trinity high water, an unusual occurrence ; the p.m. high water reached 21·6 ft. above datum.

The surge was produced by a large depression centred over Scandinavia, and the distribution at 0700 hours on 1st December is typical of many large surges in which the level is raised.

Usually a depression moves eastwards across the northern entrance and at first the level is lowered as in Example 1 ; later when the centre passes over Scandinavia and the winds veer, we have the conditions of the present example.

In this particular surge there was no earlier lowering of level or eastward movement of a depression ; the depression simply developed, and with it strong north to north-west winds formed over the North Sea and farther north. The effect of the external winds in piling water into the North Sea was quite appreciable, as may be seen from the Dunbar curves. Inside the North Sea the local effect at Southend was slight, and practically the whole of the meteorological tide was generated by the winds over the area as a whole. There were no marked changes in the wind direction during the period of the surge,. but there were large changes in the wind intensities.

6. Conclusion

Provided predictions of the pressure distribution over the North Sea and continuous tidal observations near the northern entrance are available, it will now be seen that satisfactory predictions of the main part of the surge at Southend are possible, but there is still the problem of the short period oscillations to which reference has already been made and which have been ignored in the present discussion. This problem is due for attention in the immediate future, when it is also proposed to extend the investigation along the whole of the East Coast of England.

Later it is hoped to explore similar methods in the Irish Sea and English Channel.

The daily broadcasting of weather forecasts to shipping has been a regular feature for some considerable time ; is it too much to hope that in the not far distant future we shall be in a position to supplement those reports by forecasts of corrections to the predicted tides at all important ports around our coasts ?

We may be assured that such a service would be greatly appreciated by shipping and the port authorities.

ERRATUM

October, 1948, page 182, under " Special Long-Service Awards to Marine Observers ".

Amend line 9 to read : " Captain W. H. Downing—Manchester Liners, Ltd ".

THE MERCHANT SEAMAN AS A METEOROLOGIST

BY CDR. C. E. N. FRANKCOM, R.N.R.

(Abstract of a paper read before the Challenger Society in London on 23rd June, 1948)

Oceanography and meteorology are allied subjects and both are of considerable interest to the seaman, for they concern the elements in which he sails and which can make his life comfortable or uncomfortable, safe or dangerous. For scientific and practical purposes it is very desirable that oceanographers, meteorologists and seamen should get together and discuss problems of mutual interest.

This article is headed "The Merchant Seaman as a Meteorologist" because the major part of our knowledge on maritime meteorology is derived from observations voluntarily made at sea by the officers of merchant ships. Meteorological work is also done aboard naval ships, but the number of these and of ships of scientific expeditions is small compared with merchant ships.

The collection of organised meteorological observations at sea commenced about the year 1853, and was largely brought about by the activities of Maury, an American naval officer, who realised the importance of comprehensive information concerning winds and currents, etc., for the economical running of sailing ships. An International Conference, at which his was the guiding spirit, was held in Brussels in 1853, and all the principal maritime countries agreed to co-operate internationally in obtaining observations from ships.

In 1854, largely as a result of the Brussels Conference, the British Meteorological Office was opened as a Department of the Board of Trade, governed by a committee of the Board of Trade, Admiralty and Royal Society, under the direction of Admiral Fitzroy. Thus the original function of the Meteorological Office was to provide weather information for seamen. Under Fitzroy's guidance numerous ships were recruited for making voluntary meteorological observations at sea, and British ships have co-operated with the Meteorological Office in this way ever since.

In those early days there was no radio telegraphy, but the telegraph was in existence, and in 1861 the Meteorological Office began drawing weather charts and issuing forecasts, chiefly confined to gale warnings, for the benefit of shipping. These forecasts were not received with favour, perhaps owing to their inaccuracy, and they were discontinued. It was not until some years later that a regular forecasting service was introduced. In those days all ships kept a climatological record, i.e. they merely recorded the observations every four hours and sent in the logbooks to the Meteorological Office at the end of their voyages. From the data extracted from these, climatological atlases of all oceans were eventually compiled.

Towards the end of the nineteenth century, the activities of world meteorologists widened considerably and regular weather forecasting became a practicable proposition and the advent of radio in 1900 broadened its scope enormously. The technique of weather forecasting requires a number of widely distributed reporting stations from which synchronous reports of existing weather can be received, and the meteorologist in his search for clues as to the future behaviour of the weather realised that, to obtain a comprehensive picture, he had to know what the weather was at sea.

As a result of agreements brought about by the International Meteorological Organisation, arrangements were made for merchant ships to provide links in the chain of synchronous weather observations, whereby the meteorologist could draw his weather map. To do this, instead of merely "salting down" their observations in logbooks, they made the observations as before at regular intervals, but at the synoptic hours and then coded them and transmitted them by radio to appropriate shore stations and thence to the meteorological centres. At the same time, they also recorded the observations in logbooks, so that the meteorologists not only had the advantage of using their observations synoptically at the time, but also of making climatological use of them afterwards. The essential difference between the climatological and the synoptic type of observation is that the former are taken every four hours "ship time", whereas the latter are recorded every six hours G.M.T. These different systems of time-keeping raise technical difficulties when one endeavours to correlate observations of the two types, for it is obvious that the "ship's (apparent) time" changes as she moves in longitude. Owing to the relatively small diurnal ranges which occur at sea, however, the difficulties of correlation are not very serious, and it is quite practicable to make adjustments as necessary.

At a meeting of the International Meteorological Organisation in 1921, a scheme was drawn up whereby the maritime nations of the world agreed to provide, according to a pre-arranged formula, at least 1,000 Selected Ships—fitted with appropriate instruments for synoptic meteorological work in all oceans. Thus, at the outbreak of the last war in 1939, the United Kingdom had 360 Selected Ships.

It is an unfortunate fact that meteorology in war-time becomes a military secret, and as the technique of warfare advances the value of this information and consequently of its secrecy increases. Hence, during the 1914–18 war, and even more so during 1939–45, the radio transmission of weather information by merchant ships was not possible, nor, in fact, were they allowed to keep meteorological records for fear of their capture by the enemy. The result is that there are large gaps in our statistical knowledge of weather at sea during the war, apart from the information provided by naval ships.

After the last war was ended, the increase in demands for meteorological information, chiefly for aircraft, but also for shipping, commercial and other purposes, made it more than ever necessary that an adequate network of observations from the oceans should be obtained. At present we have no less than 495 Selected Ships, including twenty-six trawlers, who send reports from far northern waters. There are in addition eighty coasting vessels who report sea temperatures and five light vessels who send observations by radio telephony. (Fig. 1.)

At a Conference of Commonwealth Meteorologists held in London in 1946, it was agreed that all "Selected" Ships of the British Commonwealth should use the procedure adopted by British ships. All these ships send radio weather messages to the meteorological centre of any country who desires them, and the shipping of all maritime countries co-operates in a similar manner. Meteorology, like oceanography, knows no frontiers.

In 1947, at a Conference of the International Meteorological Organisation at Washington, it was agreed that the number of "Selected" Ships should be considerably increased, and maps were drawn up showing (*a*) the areas from which ships will transmit their weather messages to the various National Meteorological Services, and (*b*) the areas in which the same countries would

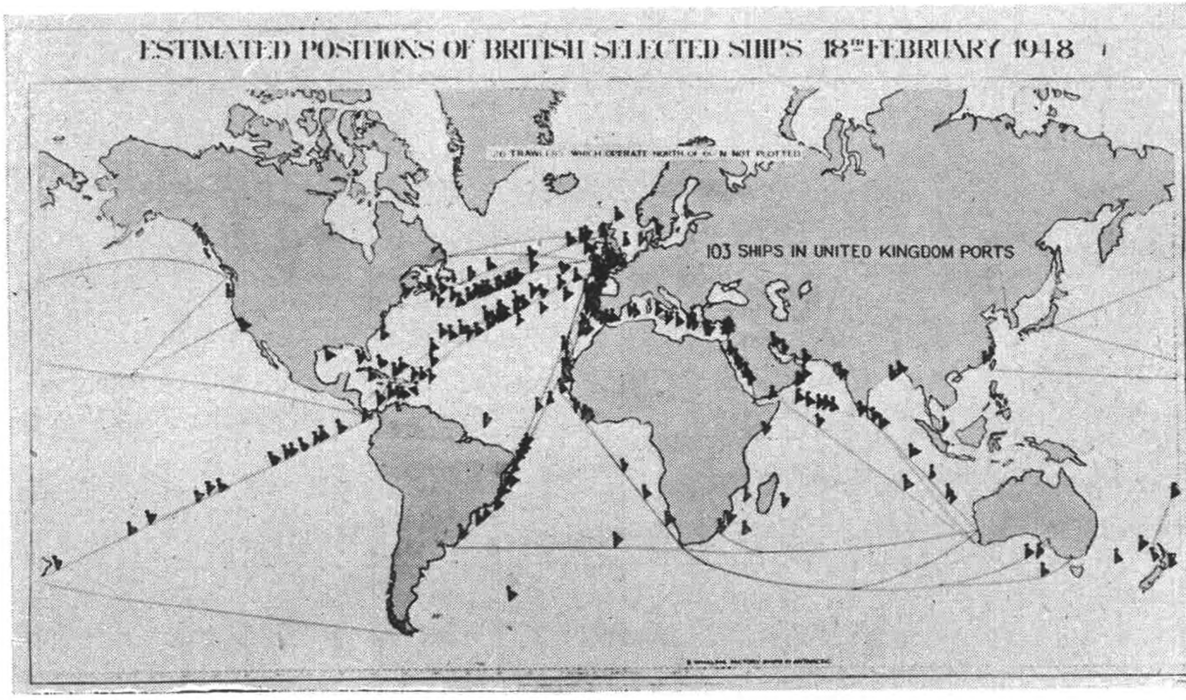


Fig. 1

be responsible for the issue of weather information for shipping. (Map [*a*] is shown in Fig. 2.) Thus definite steps have been taken on a world-wide basis to ensure that the seaman receives the information he needs for the safety of his ship and for the care of his cargo, in return for the weather messages he voluntarily provides for the meteorologists.

At this same Conference many other matters of importance to marine meteorology were decided, concerning improvements in observational technique and instruments, training of observers, and last but no least, the introduction of a universal code for reporting weather observations by radio. Previously, many codes were in existence, which was a great disadvantage ; the new code is universal for land, sea and air. Ships' officers, wherever

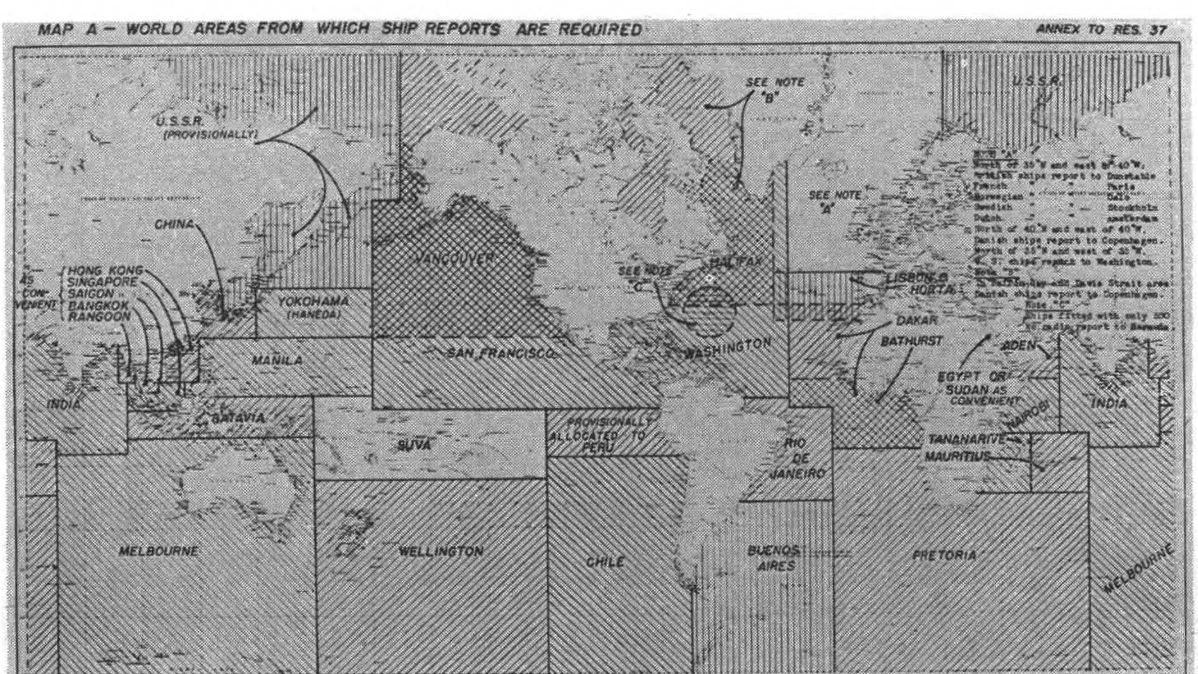


Fig. 2

they go, now need only to know one code, for it is used not only in reports from ships but in certain sections of weather messages to ships. To attain this end, however, sacrifice and compromise was necessary, and for this reason the code may seem unwieldy, but it allows for the reporting of all essential elements : date and time, position, course and speed of the ship, wind force and direction, visibility, barometric pressure and tendency, air and sea temperature, humidity, past and present weather, cloud formation, amount and height, wave disturbances and particulars of ice, if present.

All this information is contained in ten " 5 figure " code groups.

Remarks on the instruments and observations aboard merchant ships are given below.

Barometer. The mercurial barometer is found to be the most accurate for marine purposes, but it pumps rather excessively in heavy weather and takes up a lot of room, particularly in small ships. A really accurate aneroid, suitable for marine purposes, has yet to be produced, but experiments are being made to that end.

A Barograph is also supplied to Selected Ships. Vibration and violent motion of the ship at sea is liable to cause difficulties with this instrument, but these are being overcome by damping devices and, in small ships, by the use of a special slinging arrangement.

Air temperature and humidity. The correct exposure of the Stevenson screen, which has up to the present been used for air temperature and humidity, is very difficult aboard a ship. The screen has to be always moved to windward, and it is difficult to get it away from the influence of air contaminated by the local effects of the ship. An aspirated psychrometer with a hand-operated fan, which can be operated close to the ship's side, has therefore been developed, and will shortly be introduced for experimental purposes in our ships.

Sea Temperature. The canvas bucket which has been used for so many years for this purpose, has been found to be unsatisfactory on account of the possibility of temperature changes, which are sometimes rapid, before the reading can be taken.

We carried out some lengthy experiments into this problem of sea temperature measurement, and the question has also been actively investigated by Dr. C. F. Brooks, U.S.A. There are two alternatives for obtaining accurate results :

(1) Developing a more efficient sampling device ;

(2) Taking the sea water temperature from the intake water for the condenser.

As there is always doubt as to the accuracy of intake temperatures and, indeed, as to the gradient between the intake and the surface, we prefer the bucket method, and the Instruments Branch has produced an insulated bucket. In the Weather Ships comparative observations between an intake thermograph and the bucket method are being made, but it would obviously be expensive to fit a thermograph in the intake of each Selected Ship.

Non-instrumental observations include wind force and direction, a description of the weather, clouds, cloud height, visibility, state of sea and swell. The most difficult of these is probably cloud height, which in a merchant ship can only be estimated, and there is no doubt that considerable experience is necessary before one can correctly differentiate between the different types of cloud. Visibility is always a difficult estimation to make at sea.

Wave observations. Recent investigations have shown that the sea and swell observations made aboard ships have been, in many cases, very inaccurate. The reason for this is largely due to the fact that differentiation between sea and swell was frequently very difficult, particularly if the sea happened to be running in the same direction as the swell, and that general descriptive terms were used instead of actual measurements.

At the 1947 meeting of the International Meteorological Organisation, it was decided that for meteorological purposes we would no longer ask seamen to differentiate between sea and swell but merely to record the waves which they see, whether they are created by the local wind or by the wind at some distant source, and that they should note the period and, where possible, the height of these waves. The wave period, which is mathematically related to length, is the only element which is relatively easily measured, and without any instrument, except (perhaps) a stopwatch. The height has been introduced as it is felt that the seaman should be able to give a reasonable estimation of this element.

In addition to the above-mentioned observations, the observers are asked to record any special phenomena that they see, such as halos, aurora, meteors, etc. We have amassed considerable information in this manner, some of which has been admirably illustrated by the observers.

Ocean Currents. Another activity of the voluntary observers in merchant ships is that of obtaining observations of surface currents in all oceans. This subject is dealt with fully in the article by Mr. Barlow, which follows this one.

The Meteorological Office has not instigated any actual oceanographical work, but on behalf of the Ministry of Fisheries certain ships have been requested to take water samples on voyages across the Atlantic and to the Mediterranean. Oceanographical observations are made aboard Ocean Weather Ships as part of an international scheme ; these include taking water samples and streaming fine-mesh nets for plankton. We hope to make some investigations, in co-operation with oceanographers, into water temperatures in the upper layers (down to 10 m.) in the near future. Little is known about the temperature gradient in this layer and it is one in which all meteorologists are interested, although the prime interest to them is in the temperature of the " skin surface " of the water, as that is the water temperature most likely to affect the air in direct contact with it. In the climatological logbooks in use up to the beginning of World War II, the observers recorded density of sea water every day at noon. These observations have been discontinued, as their usefulness appeared to be doubtful.

All meteorological records from ships, as soon as they are received in the Department, are acknowledged, and then scrutinised and classified as to their general quality. Any obvious deficiencies are noted and the observer is informed verbally. The records are then coded, as necessary, as a preliminary to their being punched on to the machine cards of the Hollerith Machine Company. One of these cards is shown in Fig. 3 ; thus each card represents one set of observations, i.e. those made at a given time by one ship. When the cards are punched they are placed in boxes and sorted, as necessary, not in order of logbooks but in " Marsden squares " and months. The " Marsden " system is illustrated in Fig. 4. Once the observations are on these cards they can very readily be re-sorted or investigated, as necessary,

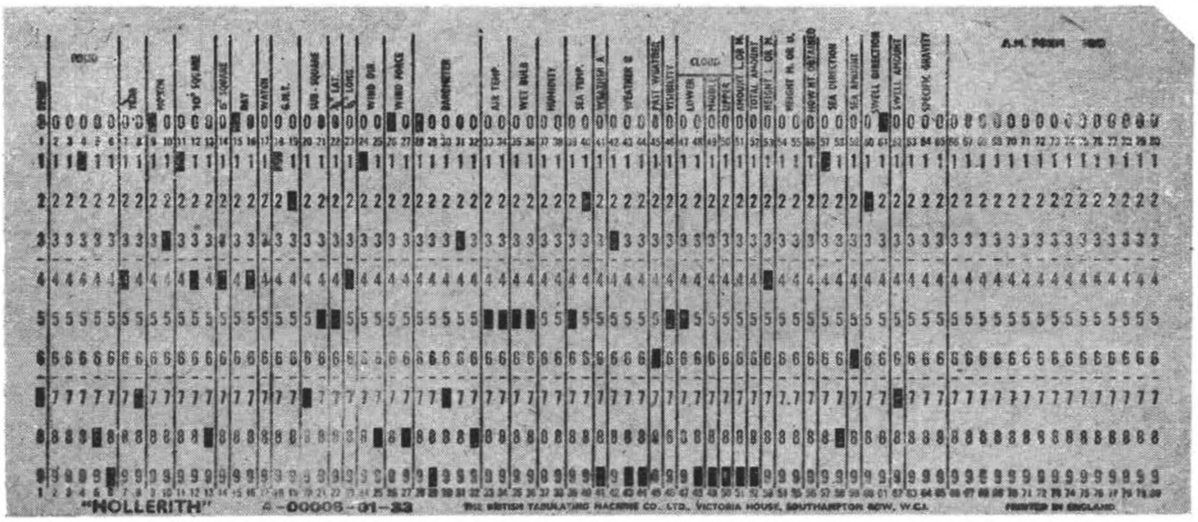


Fig. 3. Hollerith Card

by machine methods, the necessary machines being available in the Department.

Up to the present, the chief uses to which the observations have been put have been to compile climatological atlases for all oceans. This was a major work undertaken during World War II, in consultation with the Naval Meteorological Branch. No less than 3,500,000 observations, taken from the climatological logs only, were used in compiling these atlases. We have, in addition, 5,000,000 observations in synoptic logs which have not yet been extracted on to Hollerith cards, nor have our ocean current observations been so dealt with as yet. This work will be undertaken in the near future.

The atlases contain monthly charts of various information about winds such as frequency of gales, predominating direction, constancy and force of wind ; barometric pressure ; maximum, minimum, mean and range of air

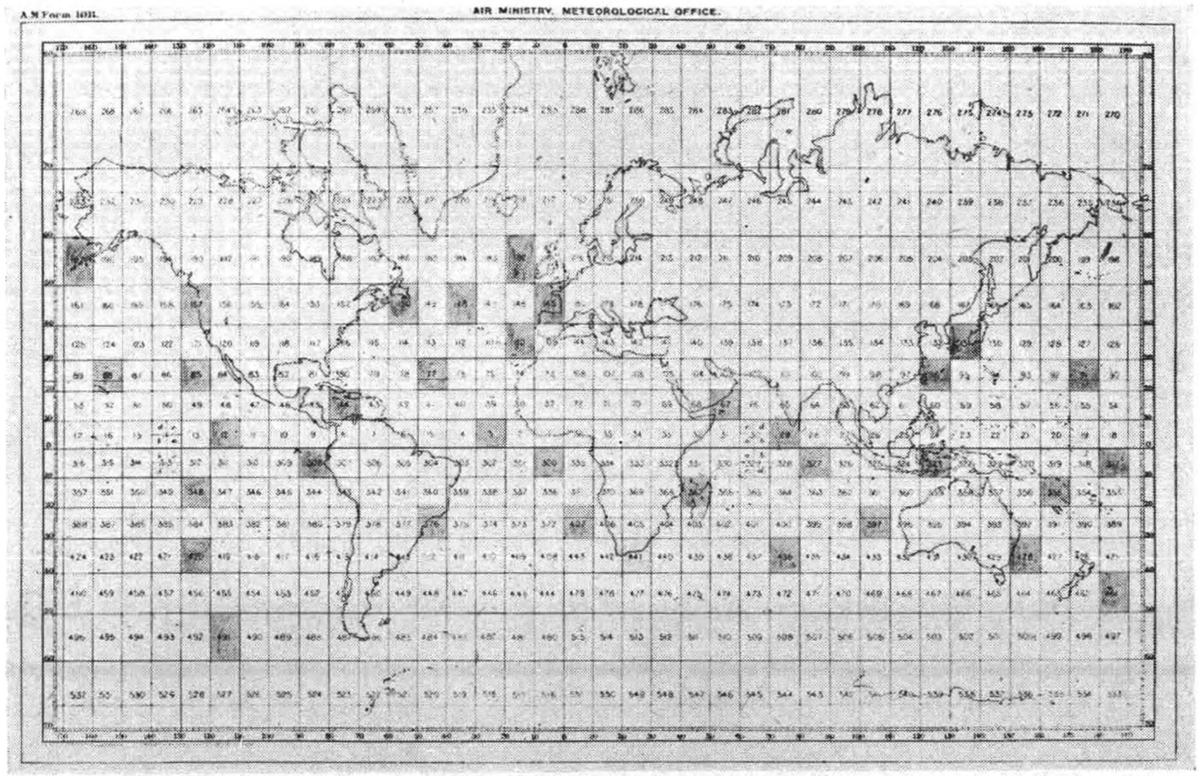


Fig. 4. Marsden Chart of the world. The shaded squares indicate areas for which relative humidity data has been computed

and sea temperature ; also visibility, weather, cloud, swell amount and direction. Selected tracks of tropical storms are also shown, and tables of diurnal variation of pressure. These atlases are of considerable value to meteorologists, not only for climatological purposes but also to forecasters. In the absence of a close network of observations, for example, it is very helpful to be able to refer to charts of normals to see if a particular observation departs markedly from that normal and is, therefore, significant. Other uses to which these atlases can be put are :

(*a*) the planning of air routes ;

(*b*) the investigation into variation of temperature and humidity on shipping routes, both for the care of cargoes and the comfort of passengers ;

(*c*) scientific research into marine climatology in general.

They thus have a commercial value, and I think they should prove of interest and perhaps of value to oceanographers. Specimen charts from the atlases are shown in Mr. Barlow's article.

All voluntary observing ships are supplied with " ice forms ", on which they are asked to record icebergs or other forms of ice which they encounter during their voyages. From these observations, combined with those which we receive from the published reports of the Ice Patrol, and from other foreign sources, we have been enabled to compile ice atlases both for the northern and southern hemispheres.

In addition to compiling atlases of normals, there are many other uses to which the meteorological data could be put ; for example, we could treat all our observations either synoptically or climatologically ; we could investigate the synoptic situation in any ocean for a given day of any year since 1854, if we so wished, and we probably will pick out significant days and investigate them as a matter of what might be called synoptic history. Alternatively, we could investigate our material in months, years or decades, as necessary. One investigation, on which we are already working, is that of diurnal range of various elements in the oceans. Such investigations are made relatively easy by means of Hollerith cards. It should be realised, however, that the machine cannot do everything, and all the work has to be carefully investigated personally by scientists. Marine observations are very different from those taken ashore. Ships are always on the move ; they tend to keep to fixed tracks and there may be a greater concentration of shipping in a given area at a certain time of the year, or even during a certain period of years, than at other times. In addition to this, we have to depend entirely upon voluntary observers, and the difficulty of making many of these observations has been referred to. Personal examination of every series of observations is therefore necessary before they can be plotted on a chart or before any analysis of them can properly be made. If in doubt, the scrutineer can easily refer to the original record and make his decision accordingly.

In sailing ship days, the importance of weather to the seaman was, of course, more obvious than at present, but even in the present time of large and powerful ships and modern aids to navigation, there are few marine casualties which are not directly or indirectly caused by the weather. An Atlantic liner can damage herself quite considerably in a heavy sea, fog may hold up shipping all round the coast, and the damage to cargo and to the interior of ships' hulls due to high humidity, rapid changes of temperature, inefficient or badly controlled ventilation, continues to cause anxiety to shippers and underwriters.

It is true to say that by diligently studying the weather and other phenomena at sea, the mariner sharpens his powers of observation and takes greater interest in what is going on around him, and thereby becomes more generally efficient in his profession.

THE CONTRIBUTIONS OF THE MERCHANT SEAMAN TO OCEANOGRAPHY AND SOME ASPECTS OF THE INTER-RELATION BETWEEN METEOROLOGY AND OCEANOGRAPHY

BY E. W. BARLOW, B.SC.

(Abstract of a paper read before the Challenger Society in London on 23rd June, 1948)

The bulk of the accumulating number of ocean surface current observations are those which are made by merchant ships proceeding on their ordinary voyages, as part of the routine work of navigation. The Marine Branch of the Meteorological Office receives these observations, together with those made by ships of the Royal Navy, which are forwarded by the Admiralty.

Up to comparatively recent years, current charts were made by plotting every available observation and then drawing lines of general flow through these by eye estimation. In 1924 the Marine Branch began to publish charts of portions of the oceans computed in such a way that the direction and rate of every individual current observed is given its full weight in the final representation. The work has now progressed so far that atlases of the whole of the Atlantic and Indian Oceans, and the western part of the North Pacific Ocean are available to seamen and others, while the remainder of the Pacific Ocean is in progress. On account of the scarcity of observations over large parts of the oceans the charts hitherto done have been mainly on a quarterly basis. Owing to the seasonal variation of currents it is very desirable that all current charts should ultimately be on a monthly basis, when sufficient observations have been received.

The published charts are of three types—the vector mean chart, the rose chart and the predominant current chart. The vector mean chart is computed for a network of areas, each 4° of longitude by 2° of latitude. The vector mean current for each of these areas represents the mean outflow of water from the area in the long run, and the vector mean chart as a whole gives the most accurate picture of the general circulation and its irregularities of detail. Each rose on the rose chart is constructed for a larger area, so chosen as to separate, as far as is possible, different general current trends, i.e. different parts of the general circulation. The rose chart indicates the degree of variability to which current in the same region is liable ; the variability is very great in many parts of the oceans.

Fig. 1 shows the predominant chart of the Gulf Stream region in November to January. The direction of the current at any place is that which exhibits the greatest degree of constancy. When the constancy exceeds 50 per cent, as happens over large areas of the oceans, the direction indicated is the most likely one to be experienced. Three thicknesses of flow-line are used on these charts, to represent constancies of 25–49 per cent, 50–74 per cent and over 74 per cent. The strength of the current shown against a vector mean arrow depends on both the strength and direction of the individual currents from which it is computed. It is always less than the arithmetical

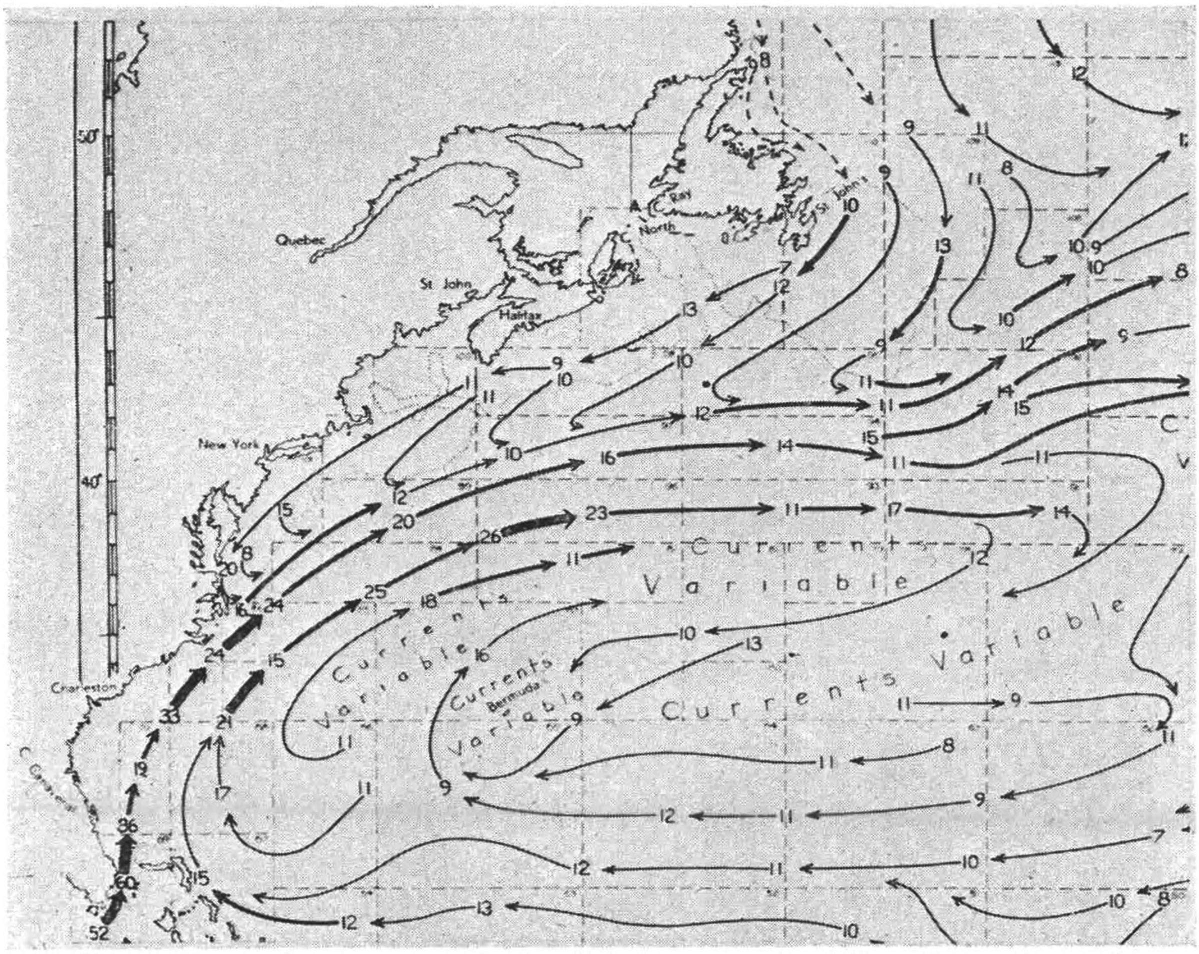


Fig. 1. Predominant currents in the Gulf Stream region (November to January)

mean of all the current strengths, and in regions of considerable variability of current direction it may be very low. The figures on the predominant chart, on the other hand, are the arithmetical means of the strength of all currents setting within 45° on either side of the direction shown. The predominant chart is primarily for navigational purposes, to be used in conjunction with the rose chart.

The method of computation of all three types of current chart is such that any number of new observations received can be added at any time. Periodical revisions of the charts are thus made.

In spite of the errors to which the navigational method of observing currents are liable, there are good grounds for the belief that the charts attain a considerable degree of accuracy. Fig. 2 gives a comparison between the vector mean winds of the Atlantic Ocean in February and the main flow of the current circulation, which does not change essentially throughout the year. The general agreement between wind and current, over most of the oceans, is obvious. Where there are differences the current is mainly produced by causes other than direct wind action.

In addition to the current charts, other investigations of the data are made in the Marine Branch, particularly those that might lead to knowledge of practical importance to seamen in making navigation as safe and economical as possible. As a result of the work in all its aspects much interesting new general and detailed information about surface current has been obtained in recent years. The data being accumulated will also be available for more detailed investigations of wind and current relationship, and of the seasonal variation of current, than has hitherto been possible.

To sum up, the main contribution which seamen make to oceanography is the accumulation of current observations, which can be used to establish the flows of surface current, with their details and variations, more and more accurately as time goes on. Surface current forms only a restricted part of the whole flow of current at all depths in the three-dimensional ocean, but it is a very important part, since all the stronger currents occur in a relatively shallow upper layer of the ocean. The three-dimensional picture of the flow of current, towards which oceanographers are working both by sub-surface observations and on theoretical grounds, must take into account, and be able to explain, all the details and variations of the actual surface current.

The work of seamen in observing sea surface temperatures also touches the realm of oceanography, and there are definite relationships between sea surface temperature charts and surface current charts. The currents transporting warm water to higher latitudes on the western sides of the oceans will deflect the isotherms of mean sea temperature, northward in the Northern Hemisphere and southward in the Southern Hemisphere. The degree of deflection and crowding of the isotherms will be greater in winter than in summer, as will be seen by a comparison of the Gulf Stream area in Fig. 3 and Fig. 4. Currents bringing cold water from polar regions to lower latitudes will also have a similar effect. In Fig. 5, the bending of the isotherms northward by the cold Falkland Current, off the east coast of South America, and their southward bending by the warm Brazil Current, closely adjacent, are well seen. On the other hand, the zonal currents, flowing in easterly or westerly directions, such as the Equatorial currents of all oceans and the Southern Ocean Current, give little or no indication on the sea temperature charts.

The areas of upwelling of colder water from sub-surface depths, which

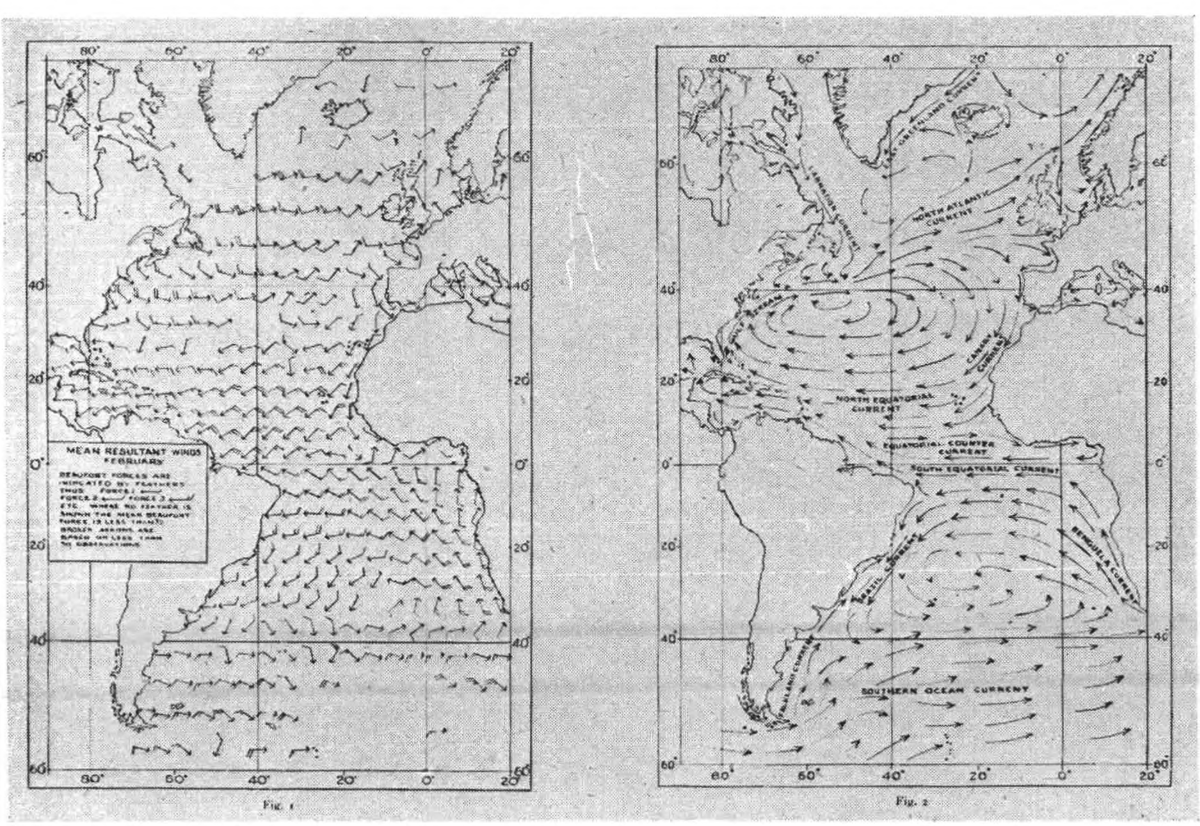


Fig. 2. Comparison of surface winds and surface currents, Atlantic Ocean

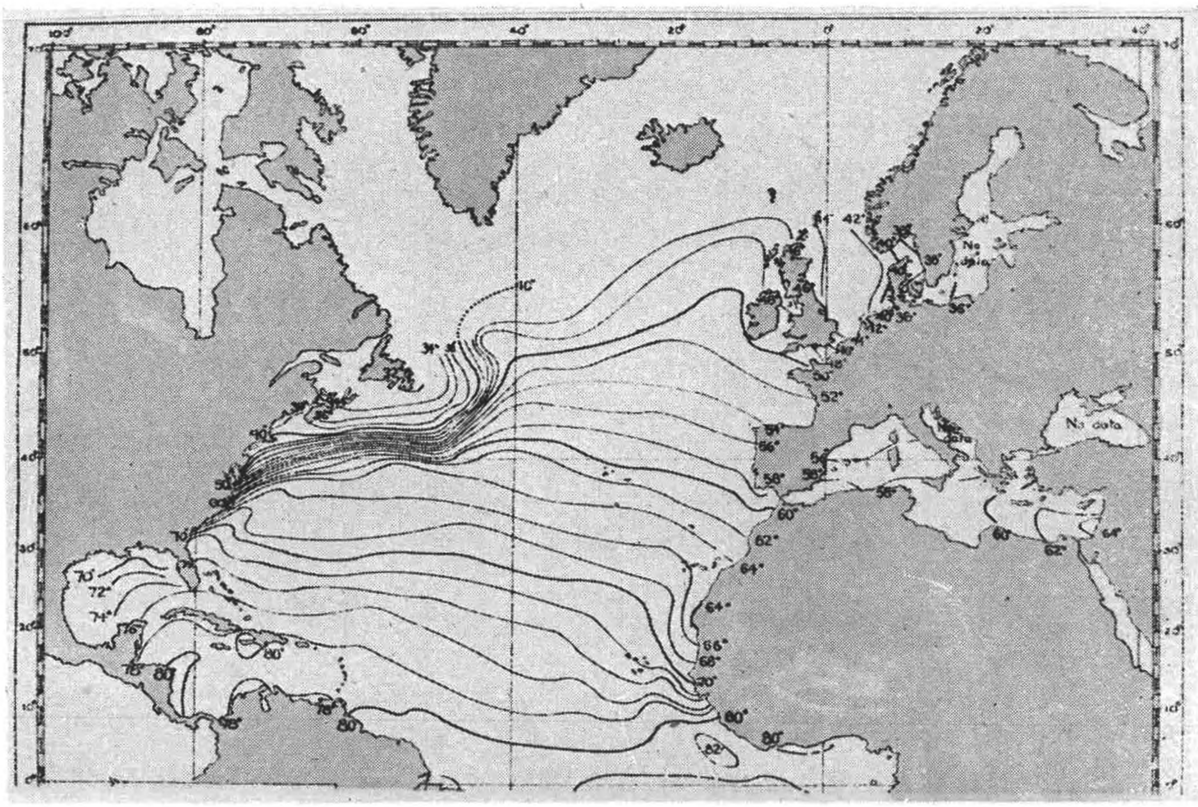


Fig. 3. Mean sea temperature, North Atlantic Ocean, January

occurs on the eastern sides of the circulations of most oceans, are conspicuous on the sea temperature charts of both summer and winter. Fig. 3 and Fig. 4 show the sharp southward deflection of the isotherms off the western coast of North Africa, in the region of the Canary Current, where upwelling occurs.

It remains to consider briefly some aspects of the interrelation between meteorology and oceanography. It is now realised that the atmospheric and oceanic circulations are so closely and fundamentally related that meteorologists and oceanographers must work together towards a future time in which they can be adequately treated as one indivisible system.

An oceanographical fact of primary importance to meteorology is the capacity of the ocean for storing the heat that it receives from the incoming solar radiation. This is due to the very high specific heat of water. Solar radiation is absorbed by only an extremely shallow layer of a land surface, and the subsequent downward conduction of heat does not go very far. Over the oceans the radiation is absorbed throughout a greater depth, and wave action and vertical mixing result in a dispersal of heat to much greater depths than in the case of a land surface. As is well known, the much lower specific heat of the land surface results in large diurnal and annual variations of temperature, while the diurnal and annual variations of the temperature of the sea surface are much smaller. The extreme range of sea temperature over the globe is only about one-third of that of the air. The land spends most of its heat income as soon as it receives it. The sea has been likened to a savings bank in which heat can be stored, and withdrawn at a later time, and also because of the mobility of ocean currents, at quite a different place from that at which it was received.

The warming of the atmosphere takes place chiefly through the agency of water vapour. A small percentage of the incoming short-wave solar radiation is directly absorbed by the air, but the bulk of it is not absorbed till it reaches the sea or land surface. It is thence re-radiated outwards in the form of long-wave radiation, a large part of which is absorbed by the water-vapour of the atmosphere. The warming of the atmosphere by radiation thus takes place mainly from below.

The other major source of atmospheric warming is the process of evaporation. No other liquid has such a high latent heat as water, so that evaporation produces a large transfer of heat from the sea to the atmosphere. So long as the water vapour remains as such, this heat is not available for warming the air, but when the vapour is condensed to water drops it is given out and becomes so available. Water vapour is easily transported by wind and may perhaps go a long distance before its heat is given up to the air ; the mobility of the stored heat in this stage is much greater than in the earlier stage of transport by ocean current. It is estimated that nearly half the total heat energy of the atmosphere is derived from the condensation of water vapour.

Conduction of heat from the land and sea surface assists in warming the air, but only in slight degree.

Evaporation from the sea is not universal in all regions and seasons, but on the average the sea surface is a little warmer than the air above it, and the process is fairly continuous over the greater part of the oceans. Other things being equal, the rate of evaporation is greatest when the sea surface is warmer than the air in contact with it. The other factors affecting the rate of evaporation are the relative humidity and the wind velocity. W. C. Jacobs, using a method proposed by Professor Sverdrup, has computed the total amount of heat, in gram calories per square centimetre per day, given off to the air from the North Atlantic and North Pacific Oceans, in summer and winter respectively. The resulting charts clearly show that in the tropics approximately the same amounts of heat are given off in the two seasons,

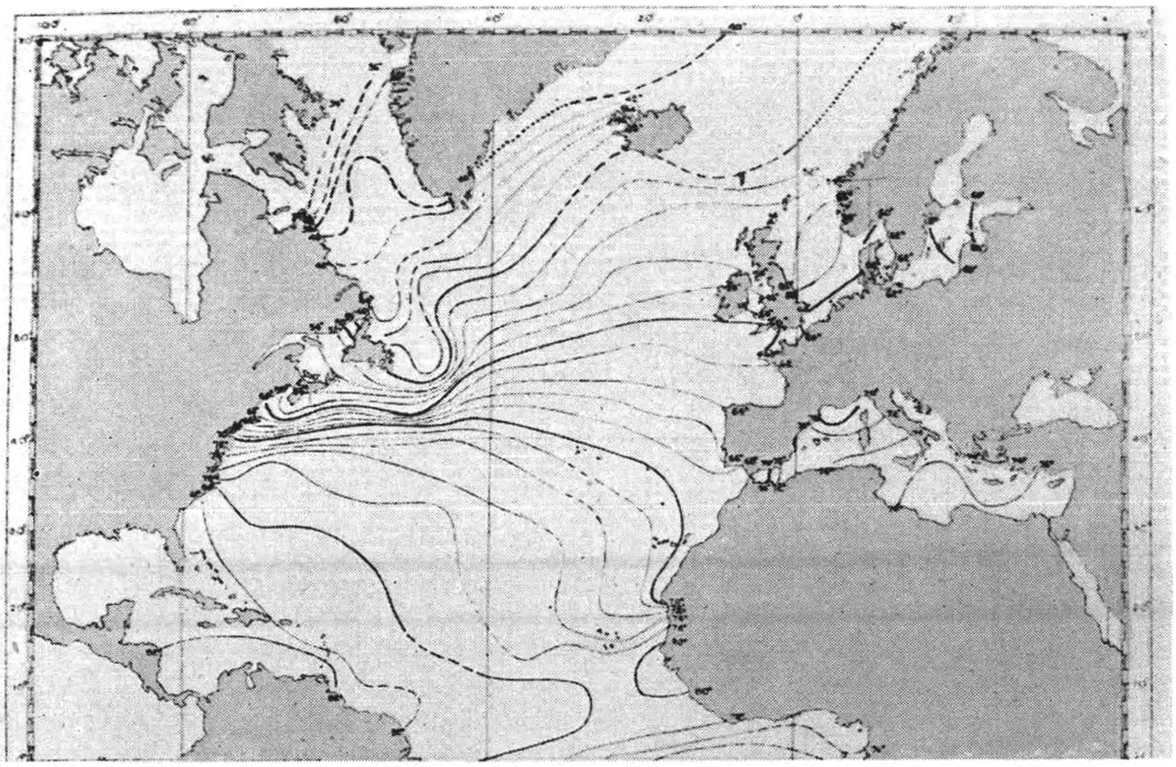


Fig. 4. Mean sea temperature, North Atlantic Ocean, July

whereas in middle and higher latitudes the atmosphere receives very little heat from the oceans in summer, and large quantities in winter. It is also seen that in winter by far the larger amounts of heat are transferred to the air in localised regions on the western sides of the oceans, in the flow of the warm currents, the Gulf Stream and the Kuro Shio, which carry the warm water of equatorial regions to higher latitudes.

Not only, therefore, do the oceans give off to the air the greater part of their stored heat in latitudes higher than those in which the main absorption of heat takes place, but the chief heat transfer occurs at the season when it will have the greatest effect in the mitigation of climate. The greater part of the heat absorption by the oceans takes place in summer, and the greatest amounts of heat are transferred to the air in winter. Though this main heat transfer is in winter and is largely localised, it must be realised that some degree of heat is also being given to the air from the greater part of the oceans at all seasons.

The observations collected from the sea have been utilised in the construction of charts of the sea minus air temperature difference for each month. In the Gulf Stream area in January the excess of sea over air temperature is as much as 11°F., the region where this excess occurs being almost exactly coincident with the computed area of maximum heat transfer. In July the excess of sea over air temperature in this region falls to 1°F.

Just as the oceanographer has to study water masses, characterised by differences of temperature and salinity, so the meteorologist must study air masses, characterised by differences of temperature and humidity. Of these, changes in temperature have much the greater effect in producing variations of density, since the amount of water vapour in the atmosphere is relatively small. The air masses acquire their specific characteristics by remaining for a sufficiently long time in one region. Thus the air mass to which the name of tropical maritime is given has acquired its warm, moist character from a sojourn in the oceanic anticyclonic region which is found in about lat. 30°. Polar maritime air, from the seas of high latitudes, is, on the contrary, cold and relatively dry. Other air masses are known as polar continental and tropical continental. The former originate in continental regions of high latitude, such as Siberia, and are cold and dry. The latter are warm and dry, since they originate in desert regions of low latitudes such as the Sahara.

The surface of separation between air masses of different character normally trends obliquely upward in the atmosphere. This surface intersects the earth's surface in a line, actually a very narrow zone, which meteorologists call a front.

The most important front from the point of view of the weather of north temperate latitudes is the polar front, which separates the polar maritime and the tropical maritime air masses. During the winter months this front occupies an approximately permanent position on the western side of both the North Atlantic and North Pacific Oceans, and this position is associated with the regions of maximum heat transfer from the warm currents to the atmosphere. The polar front extends to the eastern side of each ocean, but is there much more variable in position. Depressions, which give us the wet and windy weather characteristic of temperate latitudes, originate at some point on the polar front, by a process which is not yet fully understood.

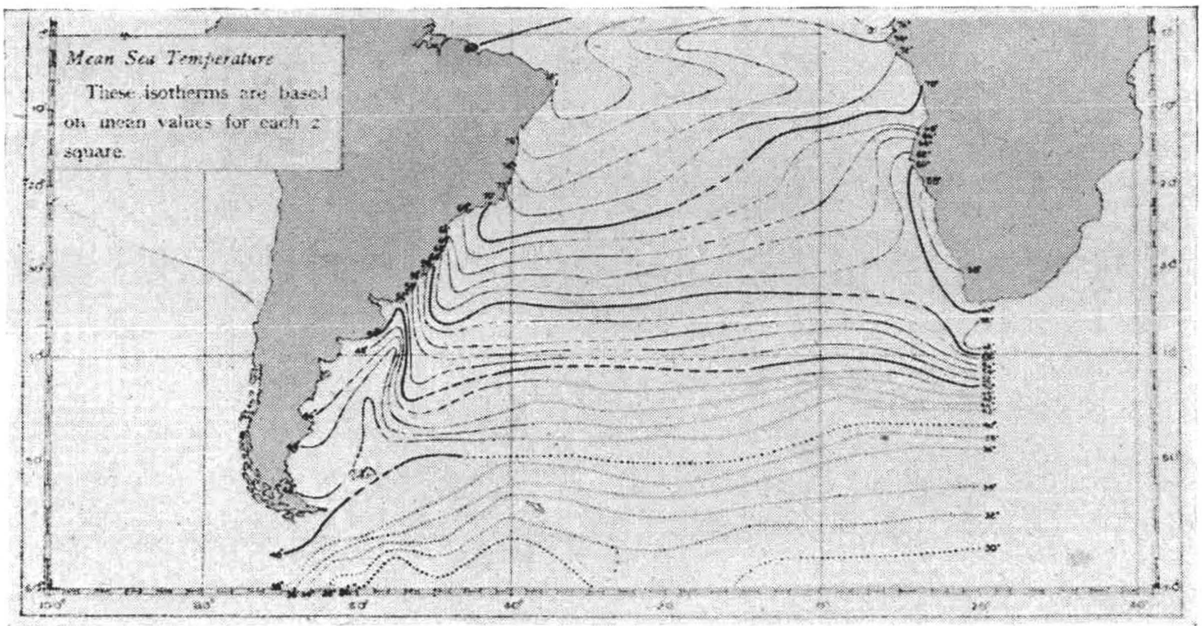


Fig. 5. Mean sea temperature, South Atlantic Ocean, July

This happens mainly on the western side of the oceans, i.e. in the region of maximum heat transfer. It is hoped that with the accumulation of data from the sea, the plotting of meteorological conditions on particular days will result in a more accurate knowledge of the points of origin and subsequent behaviour of depressions.

The energy which produces all the movements of the atmosphere is derived from the different degrees of heating of different parts of the air. All the circulations, major and minor, and in fact every transitory wind that blows, represent a process of adjustment tending towards an equilibrium which is never attained, since the causes of differential heating are always in action. It is undoubtedly true to say, if we consider both the direct and indirect effects of wind, that wind is responsible for by far the greater part of the current circulation. But the reverse does not hold. Although the oceans supply a large part of the heat energy of the atmosphere, they are far from being responsible for the greater part of the intensity of the main wind circulation. If the earth's surface were wholly land, there would still be an active wind circulation due to the differential heating of regions in different latitudes by solar radiation. The circulation would be simpler than the actual one and would be maintained by the convectional rise of warm air in equatorial regions and descents of cold air in polar regions.

The oceans act effectively in the mitigation of climatic extremes in two ways. One has already been described, consisting of the transfer of heat to the air in higher latitudes, mainly in winter. The second is that the oceans are ultimately responsible for the whole of the water vapour in the atmosphere. This water vapour has a most powerful effect in blanketing the earth's surface. We can hardly conceive the extremes of temperature range, both annual and diurnal, to which a completely dry earth would be subjected.

In addition there are two local effects of the ocean in tempering climate. In the temperate latitudes of the northern hemisphere the normal wind circulation is from west to east, so that regions on the western side of the continents, such as the British Isles, Norway and British Columbia, experience the warm westerly winds from the ocean, plus the approach of the warm currents to their coasts; the east coasts of the continents, in the same latitude, have severe winters, since cold winds from the interiors of the continents blow over them. The second effect is one depending on the mere presence of the ocean, not upon that of the flow of a warm current; on account of the relatively small diurnal and annual changes of sea temperature any island or coastal region has a more equable climate than a region which is well inland. In climatology the distinction of maritime and continental climates is fundamental.

In the absence of wind, there would still be some form of slow oceanic circulation, mainly due to differential heating of the oceans in differing latitudes. As things are, the energy required to maintain the current circulation is mainly derived from the stresses exerted by wind on the sea surface. The flows of current produced by the wind are continually tending to alter the distribution of density in the oceans. It is, however, found that this distribution of density remains approximately the same. The tendency to density change due to current flow must therefore be balanced by some other factor which affects densities in the reverse way and so produces a state of dynamic equilibrium. This factor comprises processes which are all related to the atmosphere. Evaporation, precipitation and heat conduction all affect the density of sea water. Also the amount of radiation absorbed locally by the oceans depends on the amount of cloud and water vapour present in the air at the time. Thus the whole oceanic circulation is profoundly affected by the atmosphere. On the other hand, we have seen that the oceans supply a large part of the heat energy necessary to the atmospheric processes, and so the interdependence of the oceanic and atmospheric circulations is complete.

PLANKTON INVESTIGATION IN THE OCEAN WEATHER SHIPS

BY A. SIMPSON, 2nd Officer, O.W.S. *Weather Watcher*

Throughout the upper layers of the ocean, suspended in the water and drifting with its movement, there exists a great variety of tiny forms of sea life. This life is known as plankton, a Greek word meaning that which is drifted, and is divided into two different groups, plant and animal.

The plant plankton or phytoplankton consists of minute dust-like specks which are too small to be seen by the eye, but when viewed under the microscope are seen to be tiny forms of growing plant life of many wonderful shapes, some being provided with spine-like projections to help them remain suspended in the water.

The animal plankton or zooplankton consists of an immense variety of small living creatures, tiny worm-like animals, miniature jellyfish, little shrimp-like creatures and many others. Young fish, before they are able to swim against the tides and currents of the ocean, are also included as plankton.

Both animals and plants are generally known as plankton. The plants are fed by the sunlight which penetrates the upper layers of the water, the mineral salts contained in the ocean and the carbon dioxide and oxygen dissolved into the water from the atmosphere.

The animal plankton feeding upon these tiny plants in turn itself forms the food of many fish such as herring and mackerel; it is also the food of

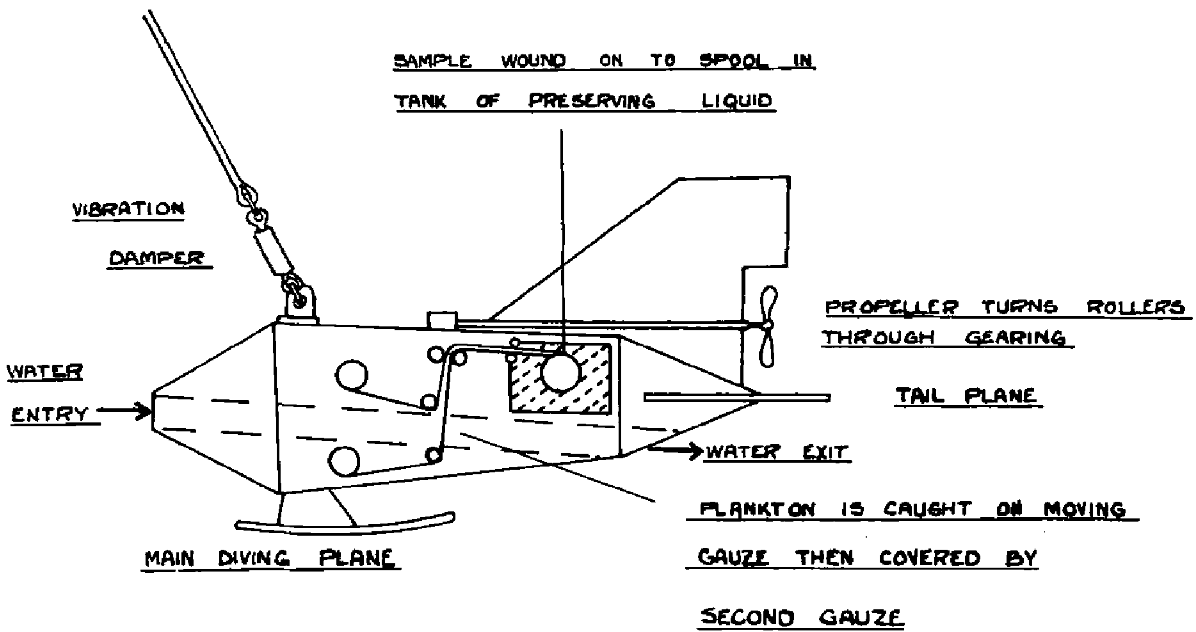


Fig. 1. Simplified diagram of continuous plankton recorder

the whale. Dead and dying plankton is continually dropping to the bottom of the ocean where it is eaten by the animals of the sea-bed, these in turn forming the food of the fish which live on the bottom of the sea such as cod and haddock.

Plankton therefore forms the fundamental foodstuff of all life in the ocean, and it will be seen that these small creatures which drift throughout the ocean must have an important effect on the fishing grounds, and that a study of them should prove beneficial to the fishing industry generally.

Such investigation is carried out by various marine laboratories and by the fishery laboratories of the Ministry of Agriculture and Fisheries. For the purpose of these investigations, samples of the water and life contained therein are continually being taken throughout the North Sea and around the coasts of the British Isles. Many research voyages have also been carried out in order to investigate the life in the oceans of the world.

The Ocean Weather Ships are in a good position to help in these investigations. Samples are taken while stationed in the North Atlantic and while on passage to and from the Clyde, and sent to the above laboratories where their contents are studied. A constant watch is thus kept on the plankton drifting towards the coasts of the British Isles and the probable effects on the fishing grounds predicted.

While on passage to and from station a sampling machine known as a continuous plankton recorder is towed at a depth of ten metres. This machine is square in section, a little over 3 ft. long and is fitted with main and tail diving planes so that it may be towed at a uniform depth depending upon the length of the towing cable. A continuous sample of the water through which it is being towed enters a tunnel in the nose of the machine and passes through a band of gauze which winds continuously over a system of spools. These spools are driven by a small propellor which revolves at the stern of the machine with the flow of passing water. The plankton contained in the water is deposited on the gauze and a second band is wound over the first, sandwiching the sample between the two ; the whole then winds on to a spool in a tank of preserving fluid.

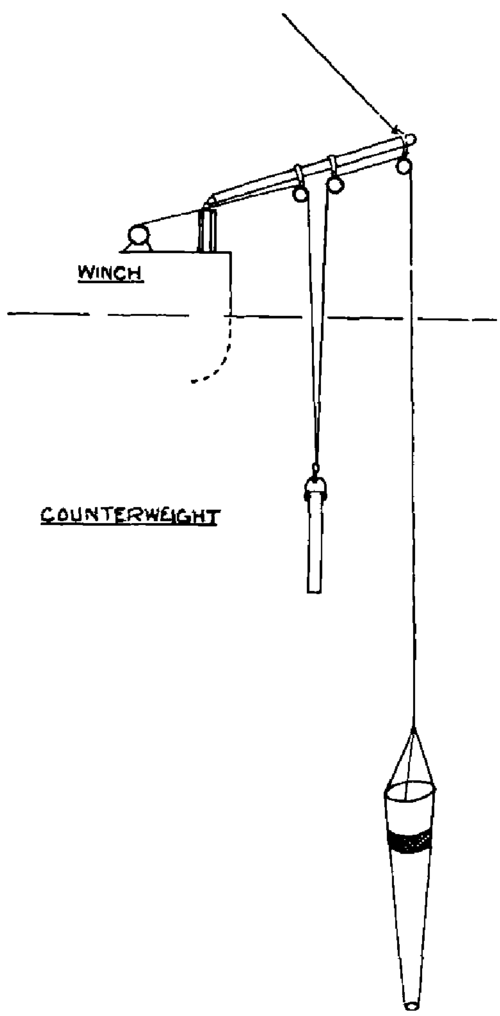


Fig. 2. Apparatus used for 50 metre plankton haul

The gearing of the spools is regulated so that the complete length of gauze covers the whole distance of the ships' passage, and the gauze is marked off in lengths representing miles. When studied with a chart of the ship's track, the exact position at which the various types of plankton were encountered is seen at a glance.

While on station, plankton samples are taken with a cone-shaped silk net. This net is about 8 ft. long and tapers from about 2 ft. diameter at the mouth to about 4 in. diameter at the bottom, where a circular silk gauze is fitted. The net is lowered to a depth of 50 metres, then steadily hauled up by means of a counterweight, balanced so that the speed of ascent is about 1½ cm per second. All the water entering the net is strained through the silk gauze on which the plankton is deposited. When the net is taken on board the gauze is removed and the plankton preserved in a jar.

Samples and temperatures of the surface water are taken daily on station and at three-hourly intervals while on passage. These samples are studied so that the physical and chemical condition of the water in which the plankton was caught can be investigated. A brass cylinder, into which a bottle to receive the sample and a thermometer are fitted, is used for this purpose. It is towed for a few minutes just below the surface and the water allowed to flow freely through it so that the true temperature can be recorded. When brought on board the bottle is removed and labelled with particulars of position, time and temperatures.

It is hoped that the samples taken and information recorded by the weather ships are proving of some help to the scientists of the marine laboratories in their studies of the life of the ocean. Perhaps in time this work on board the ships may be extended in so far as our other duties allow; it is felt that we should contribute to the fullest extent towards any work of this kind which may benefit by observations which the ships, in their singular position, are able to make.

SHIPS' OBSERVATIONS AND THE CLIMATOLOGIST

Part III. The Representation of Vector Quantities

BY H. JAMESON, D.SC.

The previous article of this series dealt with the representation of observations by isopleths. Data suitable for this method are those involving only one constituent, such as the magnitude of the pressure, the degree of temperature, or the frequency of occurrence of such phenomena as rainfall, lightning, etc.

There are, however, phenomena which involve two constituents, magnitude and direction, e.g. wind and current; such factors are known as vector quantities. The method of isopleths is not altogether suitable for representing them on charts and other methods are generally used. Isopleths, however, can be used when we are interested in only one constituent and can ignore the other; for example, isopleths are drawn of the percentage frequency of gales irrespective of their direction.

The most important vector quantity that the marine climatologist has to deal with is the wind. Wind observations are usually summarised in the form of wind roses. These are diagrams which show, for each place or area considered, the percentage frequency of winds from each of the chief points of the compass, by means of rays or arrows from those directions, the length of the ray being proportional to the frequency. In a more complex type of rose the ray from each direction is divided into segments, each segment representing winds of strength between certain limits.

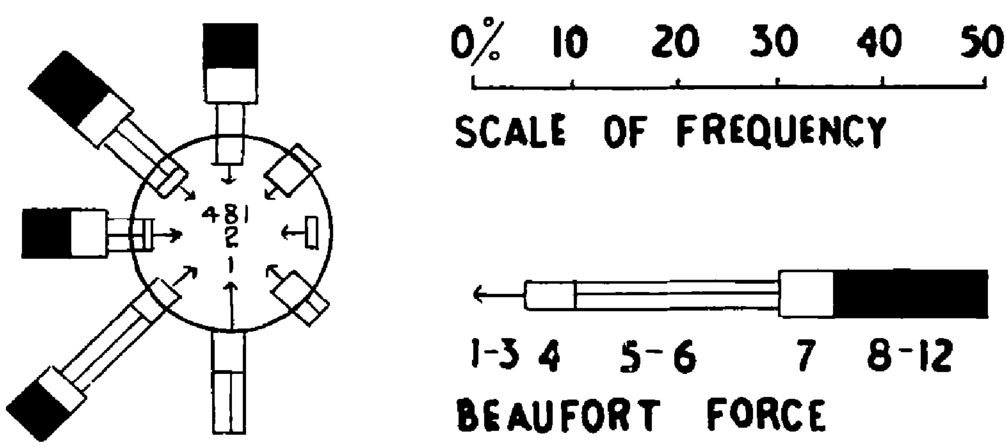


Fig. 1. Wind rose with scales

In the wind rose now used as standard in the Marine Branch of the Meteorological Office, the directions shown are the eight principal points of the compass, N, NE, E, etc., all directions between NNE and ENE being classed as NE, and so on all round the compass. Within 30° of the equator, however, the sixteen points N, NNE, NE, ENE, etc., are used. The reason is that trade winds and monsoons, with a high degree of constancy of direction, predominate in tropical regions, and to allocate the observed directions to only eight principal directions would frequently obscure this constancy of direction.

For each direction, the percentage frequencies of the Beaufort force groups 1–3, 4, 5–6, 7, 8–12 are given by the lengths of the appropriate segments of the arrow from that direction. The thickness and shading of the segments indicate which group of forces they represent.

Fig. 1 shows a typical wind rose of this type. A scale is given, so that the frequency of any direction, or of any group of forces from that direction, may be read off. The arrows indicate the direction from which the wind is coming. The distance from the head of the arrow to the circumference of the circle represents 5 per cent on the frequency scale, a relation which helps one to estimate, at least approximately, the frequency represented by any arrow, or any segment of an arrow, without measuring it against the scale. The figures within the circle give the number of observations on which the wind rose is based, the percentage frequency of variable winds and the percentage frequency of calms.

Although it is possible to make a rough estimate from the wind rose of the direction or directions from which the wind most often blows, it is preferable to show these directions explicitly on a chart, as arrows. Such wind directions are known as the directions of the prevailing or predominant winds. The simplest way of determining the prevailing wind in any area is to pick out that single direction which is recorded the greatest number of times in that area. When this is done, however, it is found that, unless the number of observations in each area is very large, the prevailing wind varies considerably and irregularly in neighbouring areas, as a matter of sheer chance. In statistical terms, the sampling errors of the data are too large.

These sampling errors are reduced by a smoothing process, grouping together the observations from a number of neighbouring directions. In the charts of the oceans published by the Meteorological Office during the war, predominant winds were computed by grouping together observations over a whole quadrant of the compass. The number of observations in a quadrant comprising, say, the directions N × E to E × S, were counted ; the quadrant was then moved through an angle of 2 points, 22½° (to comprise the directions from NE × N to SE × E), and the number of observations again counted. This process was repeated all round the compass. The number of observations in each of these overlapping quadrants was then plotted as ordinate against the mid-direction of the quadrant, and a curve drawn as smoothly as possible through the 16 points obtained. The process seems complicated, but by suitable tabulation of the data the necessary work was simplified and made much less laborious.

In tabulating the number of observations in any quadrant, only winds of at least Beaufort force 3 were counted, lighter winds being treated as calms. It was considered that not only had such light winds no great significance in this connection, but also that the difficulty of estimating their directions from a moving ship might lead to considerable errors in these directions.

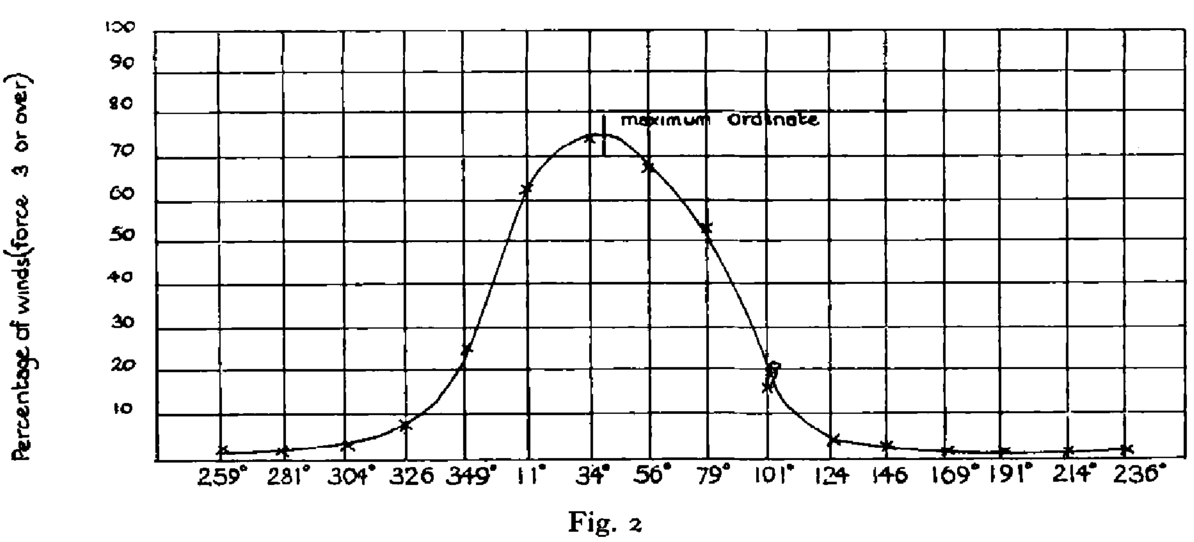


Fig. 2

Fig. 2 shows a curve obtained in this way, the number of observations from each quadrant being expressed as a percentage of the total number of observations taken over the whole square. The maximum of the curve is at 40°, which is adopted as the direction of the predominant wind. This maximum has the value 74 per cent, therefore in the quadrant centred at 40°, 74 per cent of all wind directions observed are to be found. This percentage expresses the constancy of the predominant wind.

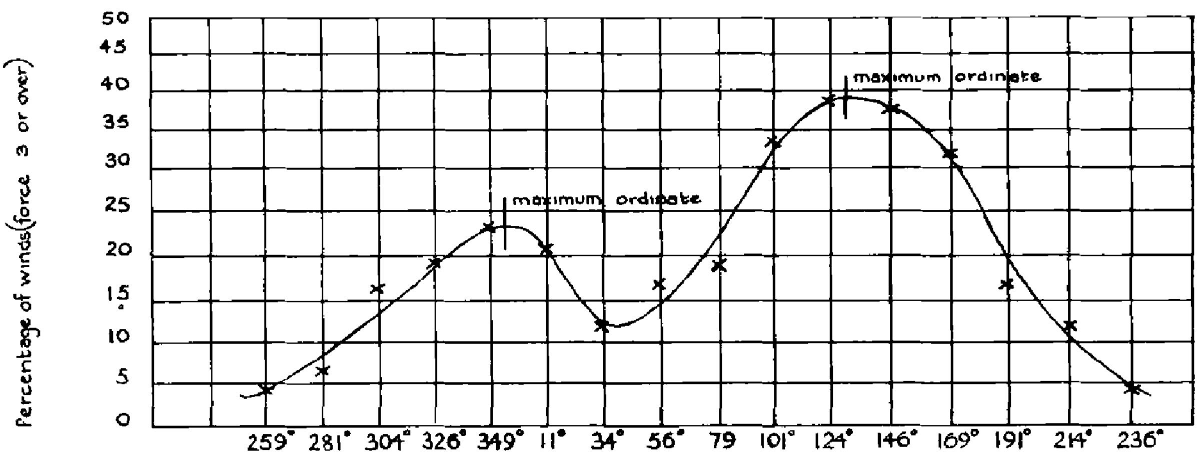


Fig. 3

In many cases these curves gave two maxima (see Fig. 3), and in such cases two predominant winds are assumed, provided each maximum is at least 21 per cent.

In plotting the predominant wind, four types of arrow are used, according as the constancy lies between 81–100 per cent, 61–80 per cent, 41–60 per cent, 21–40 per cent. Fig. 4 shows the predominant winds for August over the Indian Ocean.

Where there are two predominant winds, these are shown as either crossing one another, or lying side by side in opposite directions. A small curved arrow attached to the principal arrow indicates that there are a large number of winds backing or veering, as the case may be, from the direction of the predominant wind, but not sufficiently removed in direction from the predominant quadrant to form another distinct predominant wind. Occasionally such arrows are shown on both sides of the principal arrow. A star indicates that there is no quadrant containing as much as 21 per cent of all observations.

From the chart (Fig. 4) it will be seen that this method of summarising wind observations shows up very clearly the air-streams of high constancy of direction, the trade winds and the monsoons, and also the variations in direction and constancy within these streams. The "Roaring Forties", though of a much smaller degree of constancy, also show up well.

Another method of summarising wind data is to give the vector mean winds. The sum of two vectors AB and AC is, by the parallelogram of velocities, AD (see Fig. 5), and it is easily shown that the northerly component of a wind AD is equal to the algebraic sum of the northerly components of the winds AB and AC, and similarly for easterly components. The vector mean of any number of winds can be obtained in a similar way, by taking the mean of the northerly components of these winds, and the mean of their easterly components, and combining these to form the resultant wind. Here again, the labour involved can be minimised by suitable tabulation and other devices.

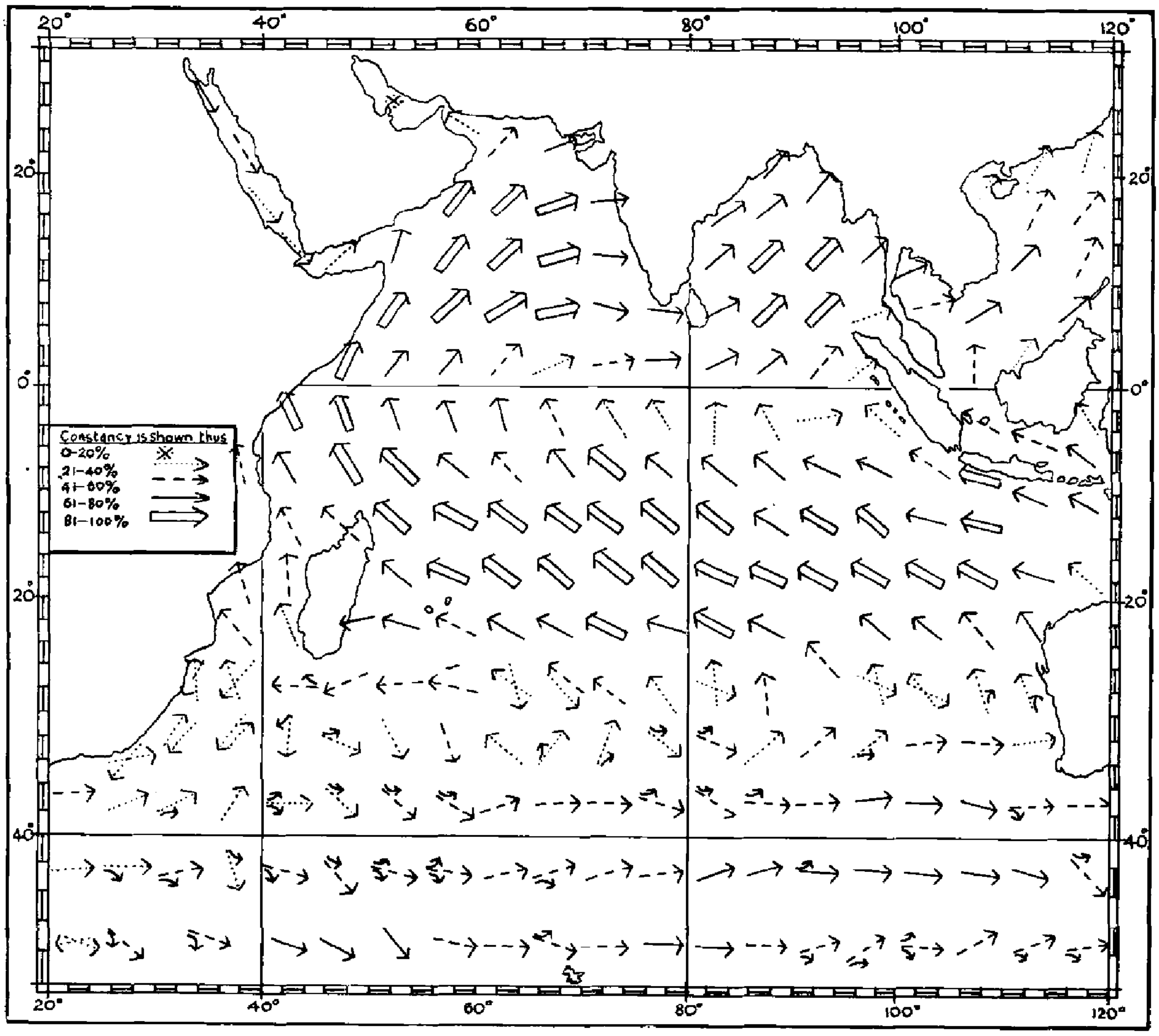


Fig. 4. Predominant winds over the Indian Ocean (August)

These vector mean winds are of importance in showing the general lines of flow of the main air currents, and for investigations into the relation between these and water currents, but they give no idea of the mean strength of the wind. To take a simple example, if for half the month there are easterly winds of force 5, and for the other half westerly winds of the same force, these two groups of forces will cancel out in the computation for the vector mean wind, which will be force 0, yet the mean strength of the wind during

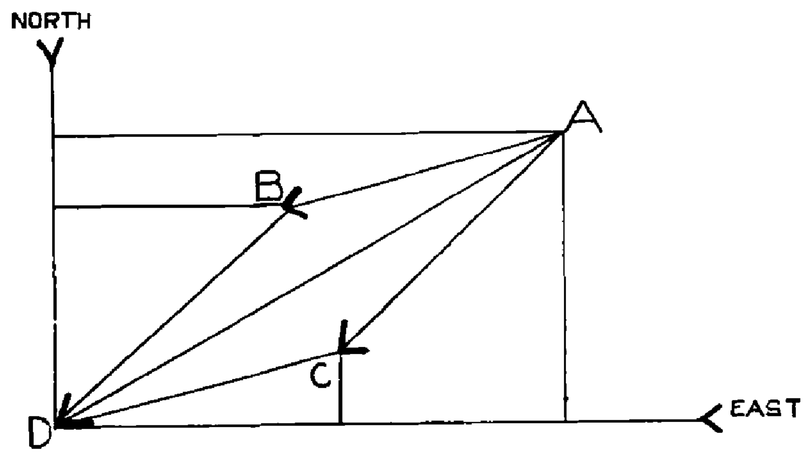


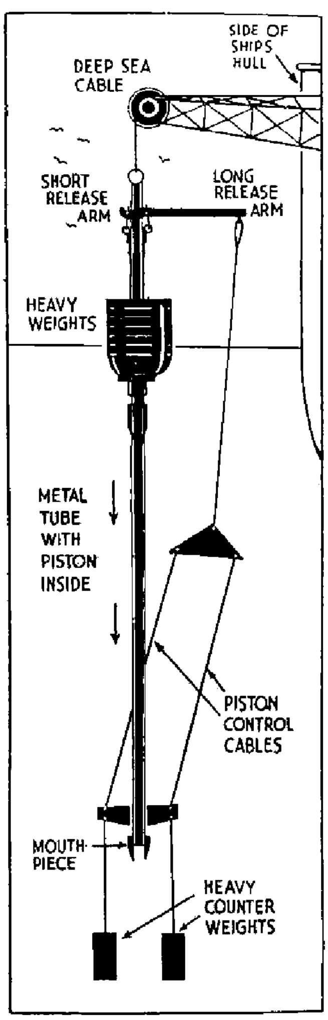
Fig. 5

the month, averaged irrespective of direction, is force 5. This is an extreme case, but it will usually be found that the strength of the vector mean wind is appreciably, and often considerably, below the mean strength of the wind, when that is averaged irrespective of direction. The strength of the vector mean wind must therefore not be used to obtain an estimate of the average strength of the wind experienced in any region.

THE SWEDISH RESEARCH SHIP *ALBATROSS*

The photograph on page 2 is of the 1,500 ton Swedish motor schooner *Albatross*. The vessel was in the London Docks last September *en route* for Gothenburg on the completion of a fourteen-month oceanographical voyage, during which she had circumnavigated the globe and, incidentally, twice crossed the Atlantic. Originally constructed as a sea-going training ship, she had been specially converted into a floating laboratory for the oceanographic purpose of the voyage in question.

In charge of the scientific expedition was Professor Hans Petterssen, the noted Swedish oceanographer, and he had a team of other distinguished scientists aboard to assist him. The fitting up of the vessel must have cost a considerable sum, having in mind the elaborate apparatus provided and the comprehensive nature of the activities upon which the ship was engaged. Amongst the facilities aboard were a powerful deep-sea winch, a biological, chemical, optical and main laboratory, an aquarium, a photographic room, a sediment investigation room, a radio-active room, a refrigeration room for storing samples and " cores " from the sea bed as well as ships' provisions, and a library.



Apparatus for core sampling

Among the activities undertaken by the ship during her long voyage were investigations into the penetration of light into the ocean, and into the salinity, density and chemical composition of sea water; the collection of specimens of marine life from great depths and of general biological specimens from all depths ; investigation of ocean currents at various depths, obtaining ocean soundings and taking cores of the sediment at the bottom of the ocean. The apparatus for core sampling was particularly interesting, being of such a nature that it could obtain a core of up to 70 ft. in length. This is a most phenomenal length, and it will be obvious to our readers that considerable ingenuity was needed to devise an apparatus for obtaining such a core. The apparatus, very briefly, consisted of a long cylinder with a piston inside it (see diagram).

These cores of the bottom sediment are not only of importance for examination by meteorologists and mineralogists but they have considerable archaeological value, for an examination of them, combined with knowledge of the rate at which certain materials are deposited on the sea bottom, provides exact evidence as to the age of the earth. Cores were obtained at depths of about 4,000 fathoms.

Another interesting method of obtaining information as to the composition of the bottom was that of recording the echoes on a special apparatus in the ship from explosions of small depth charges, set to detonate at a stated depth. The deep-sea echometer was widely used for obtaining contours of the bottom, and it was interesting to note that it was an instrument of British design. For taking sea water temperatures, reversing thermometers as well as a bathythermograph were utilised. Amongst the specimens of fishes obtained from abysmal depths were enormous prawns and a totally blind fish, something like a small eel.

The meteorologist was not aboard when I visited the ship, but I understand that no very elaborate meteorological programme was carried out. The ship carried a normal equipment of meteorological instruments, including an unusual type of anemometer at the masthead, the wind vane being composed of a series of four little " windmills ". The only really bad weather they seemed to have encountered on their voyage was a severe cyclone in the Indian Ocean.

EDITOR.

THE USE OF BAROGRAPHS IN SHIPS

BY J. R. BIBBY, B.A.

Autographic records from ships' barographs are often unsatisfactory because the pen draws not a line but a " ribbon " several millibars wide. For this reason open-scale barographs are rarely carried on ships, small barographs being normally used. Consequently ships are unable to report barometric tendencies with the high accuracy required for synoptic observations, and which is normally achieved at land stations.

There are four factors which may contribute to the broadening of the trace :

(*a*) Vibration due to the ship's engines, etc.

(*b*) Movement of the pen-arm caused by angular accelerations of the ship (rolling and pitching).

(*c*) Transient pressure changes caused by gusts of wind.

(*d*) Oscillations of pressure due to the rise and fall of the ship.

It is difficult to decide the relative magnitudes of these causes as all four usually act simultaneously, but two facts throw light on the question. First, barograms from the largest passenger liners are as a general rule no better than those from smaller craft. This indicates that gusts of wind play a large part in broadening the trace, as the other three factors would probably be much less in the case of a large ship. Secondly, trawlers' barograms often show sudden increases in the width of the trace when the steam winch is started up, showing that, here at least, vibration plays a large part.

It can therefore be concluded that, though different factors are likely to predominate in different types of ship, the chief causes of poor barograph traces are variations of pressure due to gusts of wind, and mechanical vibration. Experiments have recently been completed in the Instruments Branch of the Meteorological Office with the object of obtaining better records from ships' barographs, so enabling open-scale barographs to be used in ships. The experiments fell into two parts—one to reduce the effects of vibration and the other to reduce the effect of transient pressure fluctuations. The results of the experiments are described below.

Meteorological Office anti-vibration mounting for open-scale barographs.* This is illustrated in the photograph opposite, and consists of a metal tray to hold the barograph, suspended from fixed brackets by a number of elastic cords. The tray can swivel about an axis parallel to its longer edge, so as to prevent the ships' motion from throwing the pen off the chart.

Maximum freedom from vibration would be obtained by making the supporting elastics very weak, but a fairly stiff support is necessary to prevent excessive movement of the barograph in a rough sea. The present arrangement is thought to be about the best compromise in this respect, the supports being such that the period of oscillation of the shelf (with barograph in position) is about 0·5 seconds. Favourable reports have been received from the Ocean Weather Ships, and the only modification contemplated for the future is some elimination of the projecting edges and corners to reduce the risk of accidents.

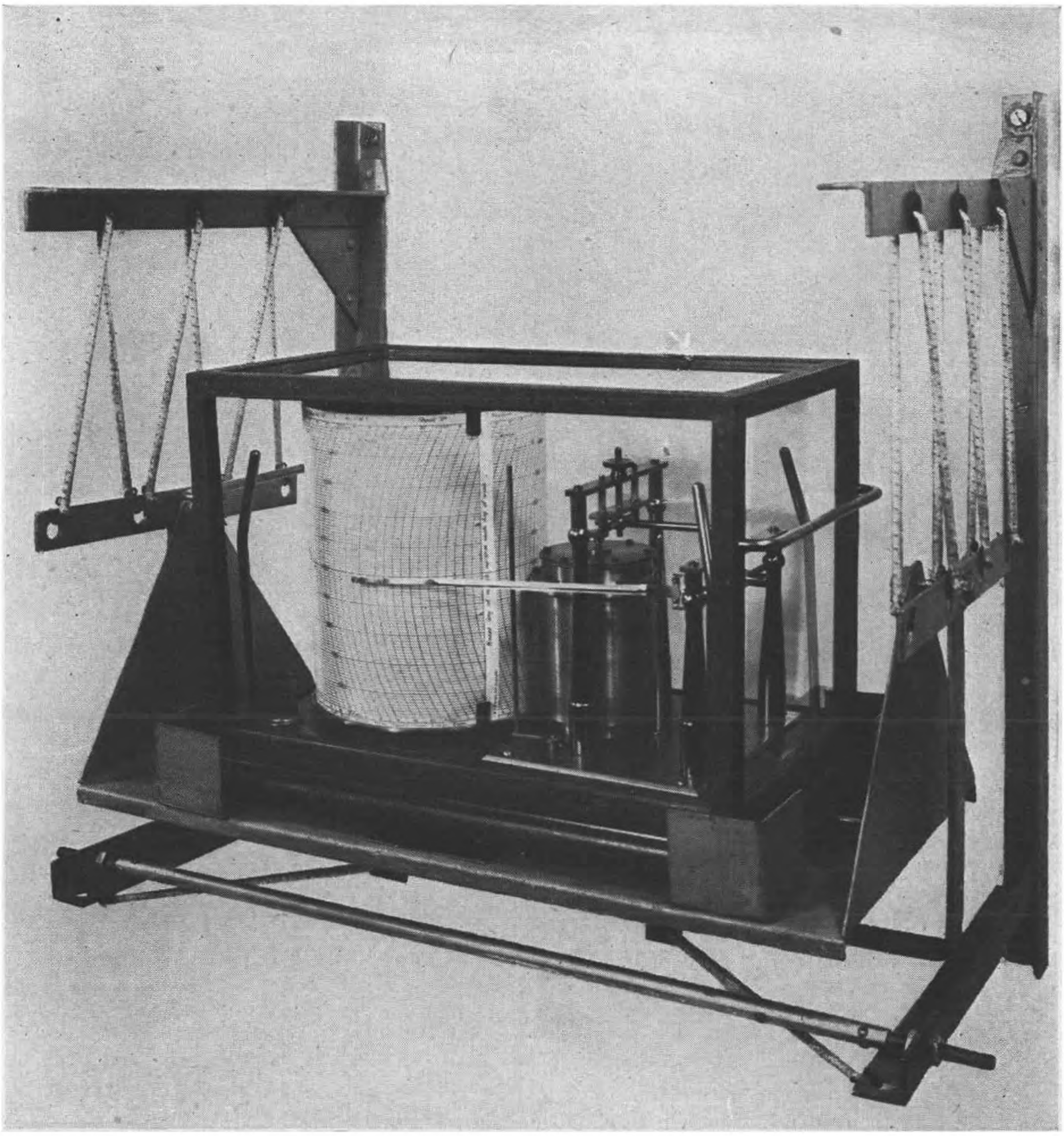
Oil-damped barographs.—To prevent the barograph recording transient pressure changes it is necessary to introduce a delaying or "damping" factor in its response, as in the case of the marine barometer. The optimum degree of damping requires a compromise between recording accurately large genuine barometric tendencies, but not recording spurious changes of pressure. Three extreme cases were considered, as follows :

(*a*) Gusts of wind raise the pressure by 5 mb. for periods of five seconds at a time.

(*b*) The ship rises and falls over a total amplitude of 25 ft. with a period of 20 seconds. The range of pressure variation corresponding to this range of height would normally be about 1 mb., but Sir Geoffrey Taylor has pointed out that this is only true if the velocity of the wind is the same as that of the waves. The pressure variation is doubled if there is no wind, and may be even greater if the wind has a component in the direction opposite to that in which the waves are travelling. Because of this the total amplitude of the pressure oscillation was assumed to be 3 mb.

(*c*) After falling at the rate of 6 mb./hr. the barometer starts rising at the same rate.

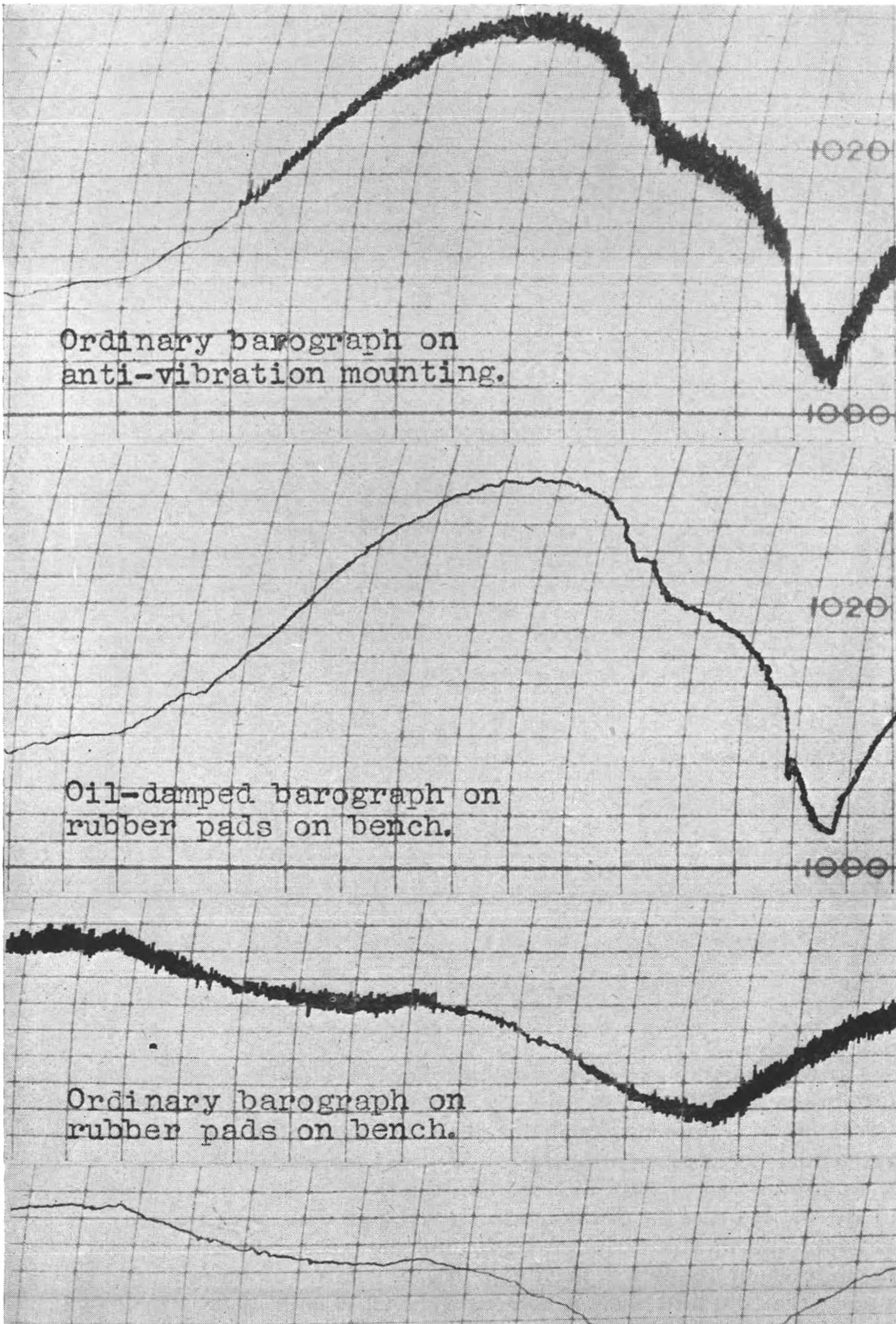
* This form of anti-vibration mounting is an improvement on a method originally suggested by Captain Dunn, Merchant Navy Agent at Hull, as a result of enquiries and investigations made aboard trawlers.—ED.



Oil-damped barograph on anti-vibration mounting

It was assumed in each case that the tendency (change of pressure in three hours), is required with an accuracy of 0·2 mb., and in (*a*) and (*b*) this was interpreted as restricting the total width of the trace to 0·4 mb. The required exponential lag coefficients can be calculated from these assumptions, and the minimum values were found to be 60 seconds in case (*a*) and 23 seconds in case (*b*). In case (*c*), if the tendency is required to an accuracy of 0·2 mb. the barograph must clearly not lag behind the actual pressure by more than 0·1 mb., which implies a maximum lag coefficient of 60 seconds. (This assumes that the time scale is sufficiently open to allow such a rapid change to be read accurately.)

These figures imply that the lag coefficient should be exactly 60 seconds with no variation allowable. As this was not expected to be practicable the calculations were repeated, allowing errors of 0·4 mb. in the tendency in extreme cases. The permissible lag coefficients were then found to be



Specimen barograms traced on board the *Weather Observer*
Upper two barograms from 1600 G.M.T., 20th September, to 1600, 22nd September, 1947; lower two barograms from 1900 G.M.T., 3rd October, to 1900, 5th October, 1947. Position of *Weather Observer*, Station I, 60°N., 20°W.

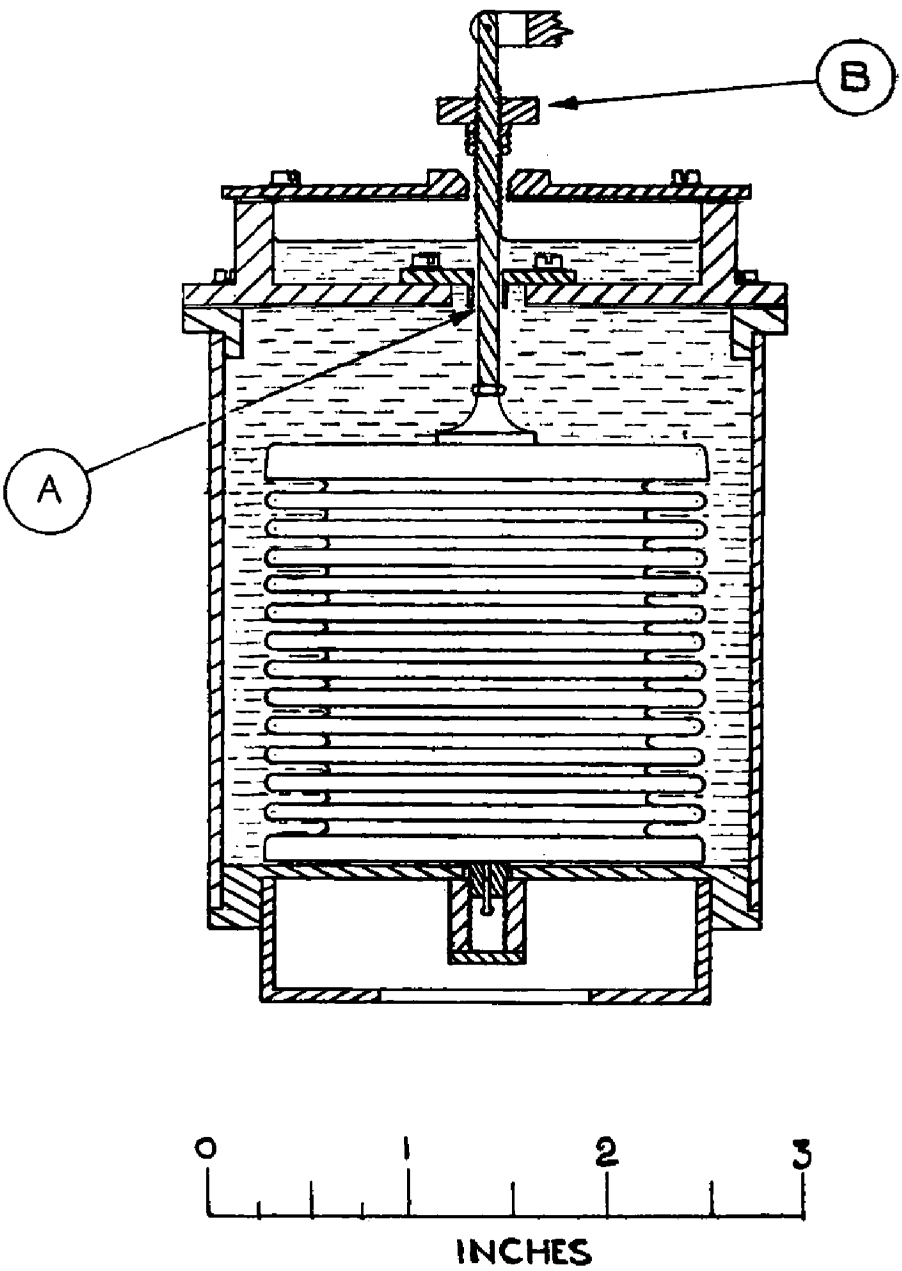


Fig. 1. Cross-section of bellows and oil container

(*a*) 29 seconds (minimum), (*b*) 11 seconds (minimum), (*c*) 120 seconds (maximum), so allowing a four to one ratio of lag coefficients.

The damping of the barograph movement was effected by the use of a viscous oil. This idea is not new, as a barograph widely used in the United States has vanes attached to the pen-arm spindle moving in oil-filled cylinders. In the present case, however, a different arrangement was used which eliminates any strain on the levers, and also prevents movement of the pen being allowed by looseness in the pivots. As shown in Fig. 1, the barograph bellows is inside a brass cylinder filled with oil, and can only expand or contract by forcing oil to flow through the narrow annular gap where the rod passes through the hole A in the top plate. (An enlarged view of the hole, with dimensions, is shown in Fig. 2.) For example, in the case of the Short and Mason open-scale barograph used for these experiments, a change

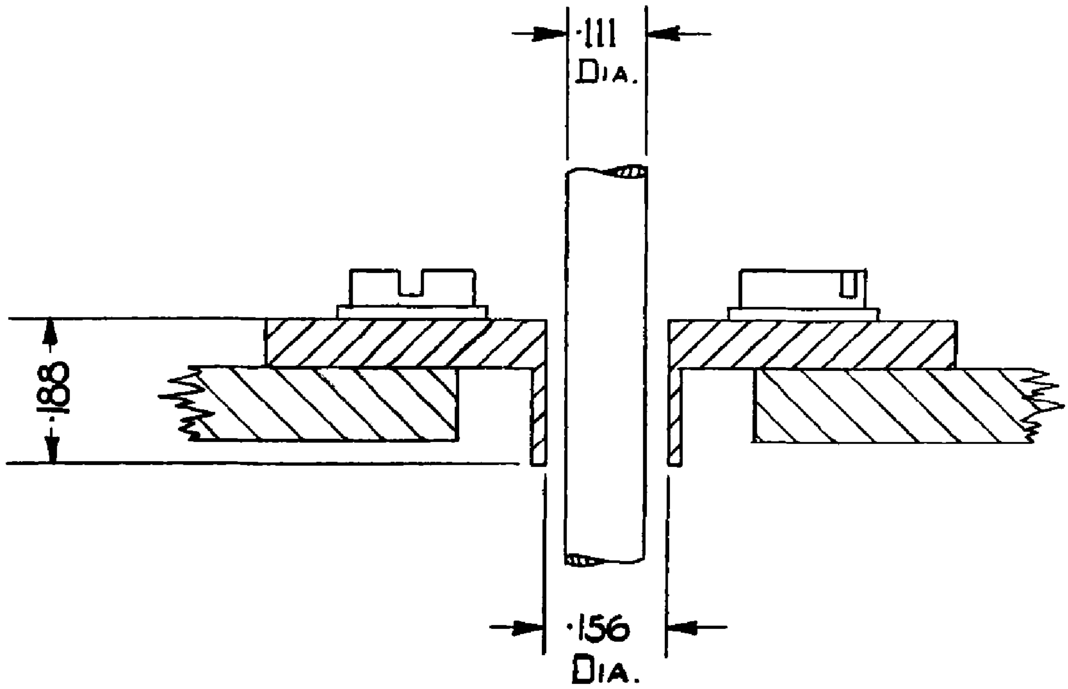


Fig. 2. Enlarged view of annular gap
(Dimensions are in inches)

of 1 mb. in the reading causes the passage of about 50 cu. mm. of oil through the annular gap. A brass plug B, threaded both internally and externally, can be screwed down into the lid of the cylinder, so sealing it and allowing the barograph to be transported already filled.

One difficulty in the use of oil for this purpose is the large variation of viscosity with temperature. Experiment showed that with a fixed size of gap the lag coefficient was roughly proportional to the viscosity of the oil used, so it was necessary to use an oil whose viscosity varied by not more than 4 : 1 over the range of temperatures likely to be experienced by a barograph in a ship. This was assumed to be 30°F. to 110°F.

The Government Chemist's Department was consulted, and they ascertained that the most favourable hydrocarbon oil had a viscosity variation of 12 : 1 over the required temperature range. They recommended the use of silicone fluids, which have a much lower temperature coefficient of viscosity. Several samples of different silicone fluids were tested and found to have viscosities varying by a factor of only 2·5 : 1 over the temperature range 30–110°F. The barograph, as finally made up for trials at sea, had the following lag coefficients :

100 seconds at 30°F.   70 seconds at 70°F.   40 seconds at 110°F.

(The corresponding viscosities of the silicone fluid were approximately 100, 70 and 40 gm./cm./sec. respectively.)

Results of trial at sea.—The oil-damped barograph and an ordinary open-scale barograph have been carried in O.W.S. *Weather Observer* since September 1947, during which time much rough weather has been encountered. One barograph stands on the anti-vibration mounting and the other on sponge rubber pads on a bench, the two being interchanged periodically. The chief conclusions to be drawn from the barograms obtained (typical sections of which are shown in the photograph) are as follows:

(*a*) The ordinary barograph often gives a trace 2–3 mb. wide, there being no visible improvement when on the anti-vibration mounting.

(*b*) The oil-damped barograph standing on the bench gives a trace hardly ever wider than 0·5 mb., and never wider than 1 mb.

(*c*) When the oil-damped barograph is on the anti-vibration mounting it is almost impossible to detect any broadening of the trace, which never exceeds 0·3 mb. This can be regarded as equivalent to a barogram at a sheltered land station.

It is therefore concluded that oil-damped barographs should be adopted for use at sea, and preferably also at land stations, or at least the more exposed ones. The relatively expensive silicone fluids (which cost nearly £1 per barograph) need only be used where wide variations of temperature are encountered, i.e. on voyages covering a big range of latitude. A much cheaper hydrocarbon oil could be used at land stations, and probably also on ships confined to temperate latitudes, including Ocean Weather Ships.

It appears that the anti-vibration mounting should be used at sea when the very best results are required, or in ships especially subject to vibration. But if in any case the use of this mounting would be inconvenient, e.g. for lack of space, an oil-damped barograph standing on sponge rubber pads would give reasonable records.

ADMIRALTY LIST OF RADIO SIGNALS

The Hydrographic Department, in their 1949 edition of the Admiralty List of Radio Signals have, we consider, introduced an improvement in dividing Vol. III into two parts.

Part A deals with meteorological services (codes, etc.), and includes all the information that the master of the merchant ship requires concerning weather forecasts and bulletins, all over the world, as well as that covering the preparation and transmission of weather messages by ships.

Part B contains a detailed list of meteorological observing stations, which is not necessarily of value to merchant shipping, except to those ships which wish to plot detailed weather maps. Some station index numbers (e.g. those contained in the Atlantic Bulletin) will be inserted in Part A.

TRANSMISSION OF RADIO WEATHER MESSAGES TO HONG KONG

We receive from the Royal Observatory, Hong Kong, a quarterly summary of radio weather messages received from British selected ships in that area. Readers of this magazine may be interested to see the figures, which are as follows:

Period	*Total*	*Monthly Average*
1st January–30th September, 1947	515	86
1st October–31st December, 1947	241	80
1st January–31st March, 1948	269	90
1st April–30th June, 1948	234	78
1st July–31st October, 1948	222	74

It is gratifying to note that so many of our ships maintain contact in this manner with this historical and colourful corner of the British Commonwealth.

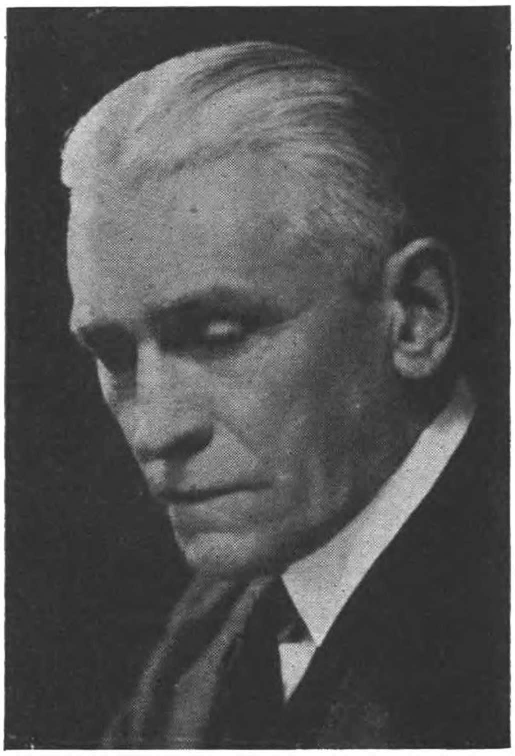
PERSONNEL

OBITUARY.—It is with regret that we record the death of CAPTAIN J. H. FORBES, of S.S. *Fukien*, whose account of a South China Sea typhoon was published in the October 1948 number of *The Marine Observer*.

The following note has been received from the Director of the Royal Observatory, Hong Kong :

" James Hardie Forbes was born in Aberdeen on 7th July, 1901. He joined the China Navigation Co., Ltd., on 11th June, 1925 and was promoted master in June, 1945. He was granted home leave to Australia on 23rd December, 1947, and died suddenly in Sydney, N.S.W., on 20th June, 1948." J. H.

OBITUARY.—With regret we record the death at the age of 74 of CAPTAIN FREDERICK FLETCHER SUMMERS, R.D., R.N.R., late of the Cunard White Star Line. F. F. Summers was born at Callao, Peru, in 1874, his father being at that time in command of a sailing ship. He first went to sea in 1890 as an apprentice in the London-owned ship *Ellesmere*, and was later 2nd Mate of the barque *Cordelia*, owned by Messrs. Bowring & Co. In 1899, being by then in possession of a certificate as extra master, he joined the White Star Line as 4th Officer. During the first World War, Summers served as a R.N.R. officer with the Grand Fleet. His first command was the *Gallic* in the Australian trade, and he was later Staff Captain of the *Majestic* on the Atlantic service. His other commands included the *Belgic*, *Megantic*, *Ceramic*, *Persic*. *Doric*, *Albertic*, *Britannic* and *Georgic*. He retired from the sea in 1934.
C. H. W.



Captain Sir Arthur Morrell, K.B.E.

RETIREMENT.—On 1st October, 1948, CAPTAIN SIR ARTHUR MORRELL retired from the post of Deputy Master of the Corporation of Trinity House.

Arthur Routley Hutson Morrell was born in 1878 and was educated at Bedford School. He made his first voyage to sea in 1896 in the full-rigged ship *Crusader*, owned by the Shaw Savill & Albion Line. He was also in the *Wellington* of the same company. Later he was second mate and then mate of the full-rigged ship *Mountstuart*. Leaving " sail " for " steam ", he joined the Royal Mail Steam Packet Company, remaining in that firm's employ only a short while before joining the West India & Panama Cable Company at the age of 25. Three years later he received his first command, the cable ship *Henry Holmes*, and was her captain for the next sixteen years. While in the *Henry Holmes* Captain Morrell contributed a number of meteorological logs. That ship was also his last command ; he had been elected a Younger Brother of the Trinity House in 1916, and on being made an active Elder Brother in 1922 he retired from the sea.

In 1935 he became Deputy Master in succession to Admiral Sir Robert Mansell, and he was created a K.B.E. in 1941. Remembering the immense amount of work carried out round our coasts by the Trinity House during the war, any seaman will realise how arduous must have been the duties and responsibilities of the Deputy Master. Sir Arthur is one of the foundation members of the Honourable Company of Master Mariners, and is also a trustee of the National Maritime Museum at Greenwich. In 1929 he was one of the British delegates on the International Conference for Safety of Life at Sea.

We wish him all happiness in his retirement. C. E. N. F.

APPOINTMENT.—The new Deputy Master of Trinity House is CAPTAIN G. CURTEIS, R.N. He was educated at the R.N. Colleges of Osborne and Dartmouth and entered the Navy in 1906. During the first world war he served afloat in various H.M. ships, and was in H.M.S. *Renown* when she took the present King, then Duke of York, to Australia in 1927. He was promoted captain in 1934, and in 1936 was placed on the retired list on being elected an active Elder Brother of Trinity House. During the recent war he served again in the Royal Navy. C. H. W.

LIGHTHOUSES OF THE BRITISH ISLES

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LONGSHIPS

A group of detached rocks 22–44 ft. high, named Longships, lies about one mile westward of The Peal, the extremity of Land's End (50° 04′N., 5° 43′W.). A light is exhibited at an elevation of 110 ft. from a grey circular granite tower situated on the highest Longships rock.

FLEET LIST (Great Britain)

VOLUNTARY OBSERVING SHIPS

The following is a list of British ships, voluntarily co-operating with the Marine Branch of the Meteorological Office.

The names of the Captains, Observing Officers, and Senior Radio Officers are given as ascertained from the last written return received. The date of receipt of the last return received is given in the sixth column.

All returns received from observing ships will be acknowledged, direct to the ship, by the Marine Superintendent.

The Port Meteorological Officers and Merchant Navy Agents at the ports will make personal calls on the Captains and Observing Officers as opportunity offers, or on notification from the ship at any time when their services are desired. (See under Notices to Marine Observers.)

Excellent awards are made at the end of each financial year. The names of the Captains, Principal Observing Officers and Senior Radio Officers gaining these awards are published in a special list in the *Marine Observer*.

It is requested that prior notification of changes of service, probable periods of lay up, transfer of Captains, or other circumstances which may prevent the continuance of voluntary meteorological service at sea, may be made to the appropriate Port Meteorological Officer or Merchant Navy Agent.

Captains are requested to point out any errors or omissions which may occur in the list.

Name of Vessel	Captain	Observing Officers	Senior Radio Officer	Owners	Last Return Received
Accra	A. Smith	J. R. Smith, L. Austin, C. Morrison	J. A. Stuart	Elder Dempster Lines, Ltd.	31.7.48
Admiral Sir John Lawford	W. B. Hicks			Iago Steam Trawler Co., Ltd.	
Afghanistan	S. L. Bashford	J. Linton, R. L. Cain, W. E. Wales	F. Dibble	Strick Line, Ltd.	7.7.48
Ajax	C. H. Whitehouse, O.B.E.	I. McK. Jackson, D. L. Emery, C. M. Best	F. G. Short, M.B.E.	Ocean S.S. Co., Ltd.	21.7.48
Akaroa	J. Steele	J. Tierney, J. Scott, D. A. C. Adams	J. S. Soulsby	Shaw, Savill & Albion Co., Ltd.	4.5.48
Amastra	M. A. Neeves	D. G. Roberts, R. Pengelly, C. Eastwood	A. Attlewell	Anglo-Saxon Petroleum Co., Ltd.	6.8.48
Andes	D. A. Casey, C.B.E., D.S.O., D.S.C., R.D., R.N.R.	F. M. Dickenson, R. Box, J. Ashworth	W. Smith	Royal Mail Lines, Ltd.	11.8.48
Apapa	J. J. Smith	J. A. Jackson, L. H. Hayman, S. Moffitt, J. W. Baggott	P. M. Booth	Elder Dempster Lines, Ltd.	
Aquitania	H. Grattidge, O.B.E.	E. J. Harding, G. H. Griffiths, R. B. Ibbottson	S. W. Brown	Cunard White Star, Ltd.	7.1.48
Arabia	G. H. Morris	R. Jones, D. H. Shinmin, E. E. Wilks	B. H. Long	Cunard White Star, Ltd.	6.5.48
Arabistan	J. H. Metcalfe	H. B. Watkins, R. P. Ashe	A. Hitchin	Strick Line, Ltd.	18.3.48
Araby	G. H. Taggart	J. A. Phillips, G. G. Chatterley, G. A. Keek, P. J. Robinson	P. Carbishley	Royal Mail Lines, Ltd.	13.10.48
Arakaka	J. A. Carter	W. Boyle, S. Armitage, E. G. Price	T. McBride	Arakaka S.S. Co., Ltd.	14.5.48
Argentina Star	D. R. Macfarlane, O.B.E., D.S.O.	K. White, D. G. Hastie, J. Allan	D. K. Murdock	F. Leyland & Co., Ltd.	7.9.48
Argyll	J. Dodds			B. J. Sutherland & Co., Ltd.	
Ariguani	S. Browne	J. Beatson, R. D. Philpott	A. N. Taylor	Elders & Fyffes, Ltd.	14.7.48
Artisan	W. Moore	C. A. V. Daly, J. Cubbin, J. Wright	C. Clancy	Charente S.S. Co., Ltd.	7.1.48
Arundel Castle	H. A. Dellar	K. A. Trowbridge	Pitt	Union Castle Mail S.S. Co., Ltd.	17.9.48
Ascania	J. Quayle, R.D., R.N.R.	J. B. Clemenson, J. Boyce, G. H. Drinkwater	M. A. Kempe	Cunard White Star, Ltd.	17.10.47
Asia	J. L. Croasdaile	C. A. Roy, D. S. Lomax, D. J. Steff	W. J. Rainey	Cunard White Star, Ltd.	
Asturias	J. W. Carr	F. Williams, G. H. Emerton, K. J. Colombo	A. Banberry	Royal Mail Line, Ltd. (Managers)	18.3.48

Name of Vessel	Captain	Observing Officers	Senior Radio Officer	Owners	Last Return Received
Athelchief	A. W. Pegg	G. W. Williams, W. Roberts, B. Jarrett	W. Bradbury	Tankers, Ltd.	3.9.48
Athelregent	C. Ray	A. Sugden, C. Ferguson, D. W. Waite, E. Peers	R. W. Evans	Athel Line, Ltd.	28.8.48
Athenic	D. Aithison	A. E. Smith, J. W. Webster, J. W. Wood, W. S. Allen	D. Haggart	Shaw, Savill & Albion Co., Ltd.	13.10.48
Athlone Castle	R. Wren, D.S.O.	K. T. McNish, M. Kenshole, J. R. Henderson, D. Lamb, C. E. Walker	J. H. Summers	Union Castle Mail S.S. Co., Ltd.	18.9.48
Auricula	H. Sangster	N. Douglas, R. R. Stonehouse, A. Phillips	J. Sanderson	Anglo-Saxon Petroleum Co., Ltd.	16.9.48
Australind	J. F. Wood	J. Stevenson, J. B. McCowan, N. M. Johnson	K. Morris	Australind S.S. Co., Ltd.	25.2.48
Balantia	F. A. C. Thacker	J. Mitchell, W. Sturrock, G. L. Fraser	J. J. Cameron	Royal Mail Lines, Ltd.	11.9.48
Baltara	G. E. Thomas	S. Bayliss		United Baltic Co., Ltd.	
Banff Park	E. Bursby	T. Burke, G. Dunn, R. Rutherford	J. Spicer	Sir Eric Ohlson (Manager)	
Barjama	M. Fraser	W. Flett, T. L. Harcus		Barline Transport, Ltd.	20.5.48
Baron Belhaven	H. Moore	G. J. McIntosh		Hogarth S.S. Co., Ltd.	
Baron Maclay	A. Campbell			Hogarth S.S. Co., Ltd.	
Basinghall	J. Hall	G. Baxter, J. R. Foster	J. Peacock	Bulk Storage Co., Ltd.	20.10.47
Baskerville	E. Pugh, O.B.E.	R. J. Lungley, J. F. Thompson, J. Cunningham	W. Maclaren	Barberry's S.S. Co., Ltd.	28.4.48
Bassano	G. Hodgson	B. W. Waldie, N. O. Cook, E. J. Beaumont	J. Williamson	Ellerman's Wilson Line, Ltd.	9.9.48
Beaconsfield	A. E. W. Woodcock	A. Cox, E. Curling, L. J. Atkinson	T. J. Booker	Britain S.S. Co., Ltd.	
Beaverburn	J. B. Smith, O.B.E.	S. Fieldhouse, J. F. Hercus, P. Le Patourel	T. Ainsworth	Canadian Pacific Railway Co.	4.6.48
Beavercove	C. E. Duggan, R.D., R.N.R.	P. F. Williams, R. D. P. Gillett, R. A. Jones	J. A. McAskill	Canadian Pacific Railway Co.	21.8.48
Beaverdell	S. W. Keary, O.B.E.	R. W. Savage, W. Williams, L. McDowell	L. Norton	Canadian Pacific Railway Co.	17.8.48
Beaverford	R. A. Leicester, O.B.E.	D. Wallace, E. R. Connorton, E. R. Shaw	W. Poingdestre	Canadian Pacific Railway Co.	6.8.48
Beaverglen	B. Ford	L. Kinns, D. Bryce, R. Rawlings	R. Burch	Canadian Pacific Railway Co.	21.9.48
Beaverlake	C. L. de H. Bell, D.S.C.	G. W. Bateman, G. Palmer, J. Waling	A. R. Humphries	Canadian Pacific Railway Co.	19.7.48
Beckenham	D. G. Martin	H. Blair, J. Hadley, H. M. Fortune	J. Brennan	Britain S.S. Co., Ltd.	18.5.48
Benarty	E. Massarilla	A. King, R. D. Robb, J. Amos		Ben Line Steamers, Ltd.	11.9.48
Bendoran	J. Cringle	F. Hamilton		Ben Line Steamers, Ltd.	
Benledi	A. P. Paterson	R. M. Drummond, T. P. Barr, J. Scott	B. J. Saltwell	Ben Line Steamers, Ltd.	6.8.47
Benreoch	J. B. Hastie	G. Pirie, C. Donnelly, K. R. Wilson	I. M. Fraser	Ben Line Steamers, Ltd.	3.1.48
Benvrackie	W. C. Wilson	W. O. Atkinson, M. J. Peyton-Bruhl, A. Wallace, A. King	J. L. Wells	Ben Line Steamers, Ltd.	13.10.48
Bibury	A. Roche	A. Jones		Alexander S.S. Co., Ltd.	
Black Prince	P. F. Owens	G. R. Sherlock, r. M. Giles, B. S. Biggs	H. MacLennan	Rio Cape Line, Ltd.	4.5.48
Brasil Star	G. Duff, G.M.	D. S. Gilmour, L. J. Thompson, D. M. McPhail	J. I. Waddell	F. Leyland & Co., Ltd.	
Bravo	E. Tyler	C. Everingham, J. McAndrew, J. H. Spandler	F. E. Smith	Ellerman's Wilson Line, Ltd.	
Brisbane Star	F. N. Riley, D.S.O.	M. R. Bremburg, R. H. Stark, G. Munro	D. J. Eastwood	F. Leyland & Co., Ltd.	19.5.48
Britannic	C. I. Thompson	J. Mort, W. Giles, R. Rawlinson	Kidson	Cunard White Star, Ltd.	4.9.48
British Colonel	E. L. Miller	W. S. Jaeger	R. A. MacLeod	British Tanker Co., Ltd.	16.4.47
British Commodore	N. Pinkney	R. Maybourn, E. W. Shingler, W. H. Thornton	J. Sheeham	British Tanker Co., Ltd.	7.5.48
British Endurance	W. Watkin-Thomas, O.B.E., D.S.C.	S. H. Falconer, A. D. Millar, P. C. Coyne	A. E. Adams	British Tanker Co., Ltd.	29.12.47

British Energy	J. G. Hill	E. Hornby, D. Mackinnon, F. Darby	F. J. O'Commer	British Tanker Co., Ltd.	6.8.48
British Escort	H. G. Jeary	J. A. S. Millar, G. S. Lawson, J. Mackay	P. Charlton	British Tanker Co., Ltd.	16.8.48
British Hussar	T. J. Picken			British Tanker Co., Ltd.	
British Lancer	W. S. Vittle	J. A. Picken, W. R. Symon, D. H. Ferrett	C. O'Mahony	British Tanker Co., Ltd.	18.12.47
British Marquis	G. W. Kemp	E. L. Mitchinson, S. E. Banyard, G. Lawrence	J. Appleton	British Tanker Co., Ltd.	24.8.48
British Patience	F. S. Hall	A. J. Brown, J. Hutchinson, C. D. Bishop-Laggett	R. J. Bellamy	British Tanker Co., Ltd.	2.4.48
British Pilot	R. O. Cash	L. McRitchie, H. Haigh, J. Baird	H. Dunne	British Tanker Co., Ltd.	7.7.48
British Piper	M. W. Good	H. D. Williams, A. F. Bowan, C. A. Patterson	A. E. Trim	British Tanker Co., Ltd.	10.5.48
British Power	R. Phillips, L/Cdr., R.D., R.N.R. (retired)	A. Fraser, P. F. Mason, R. N. Newbury	J. E. Coleman	British Tanker Co., Ltd.	15.10.48
British Prestige	W. Hill	A. L. Wheaton, F. Fowler, J. A. MacLeod	H. Holdridge	British Tanker Co., Ltd.	8.9.48
British Resolution	J. Bolger	T. Giffard, D. Battel	K. Morris	British Tanker Co., Ltd.	2.10.47
British Statesman	W. P. Booth	C. V. Harrison, J. B. Hunter, F. A. Lapper	G. W. Bayliss	British Tanker Co., Ltd.	29.12.47
British Swordfish				British Tanker Co. Ltd.	
Brittany	H. A. Wright	J. Fox, J. Kavanagh, A. N. Brook	E. E. Clancey	Royal Mail Lines, Ltd.	6.8.48
Brockleymoor	D. J. Jones	F. W. Gant, J. H. Looker	N. W. Hodgson	Moor Line, Ltd.	12.10.48
Bronte	J. Whayman, D.S.C. and Bar, R.D., R.N.R.	L. A. Sayers, Lt.-Cdr., R.N.R., W. T. Pitcher, B. E. Cole	T. J. Keily	Lamport & Holt Line, Ltd.	18.9.48
Bulby	G. Bull			Seddon Fishing Co., Ltd.	
Byron	J. W. Binns	A. Coratt		Lamport & Holt Line, Ltd.	
Cairnavon	A. Henderson	C. Sutherland, C. Percy, J. Holland	W. P. Grieves	Cairns, Noble & Co., Ltd.	13.5.48
Cairnesk	I. G. Foster	R. Preston, J. Hogg, J. S. Willmer	E. Johnson	Cairns, Noble & Co., Ltd.	
Cairnvalona	A. Molineux	T. D. Ridley, N. E. Forth, J. W. Cuthbertson	R. Young	Cairns, Noble & Co., Ltd.	8.7.48
Caledonia	J. H. Brown	T. L. Langlands, J. W. L. Gorrie, C. Milne	S. J. D. Taylor	Anchor Line, Ltd.	
Canton	G. Stable	R. K. Pannell, J. M. Donkin, M. D. Perney	Johnson	P. & O. Steam Navigation Co.	2.1.48
Cape Barfleur				Hudson Bros. Trawlers, Ltd.	
Cape Gloucester	C. Agerscow	J. A. Hamilton	J. A. Hamilton	Hudson Bros. Trawlers, Ltd.	
Cape Mariato	W. E. Woodall	W. E. Woodall, R. N. Dixon	R. N. Dixon	Hudson Bros. Trawlers, Ltd.	13.2.47
Cape Trafalgar	R. A. Cook			Hudson Bros. Trawlers, Ltd.	
Cape York	H. S. Todd	G. O. Lambert, D. E. Cormack, I. Thomson	S. Gracie	Cape York S.S. Co., Ltd.	14.6.48
Capetown Castle	W. D. Roach	L. MacEwan, A. George, R. J. King	J. Gilbert	Union Castle Mail S.S. Co., Ltd.	4.7.48
Carella	J. Crewdson	H. Butler	H. Butler	J. Marr & Son, Ltd.	
Carlton	K. Wardale	A. Dodd, W. A. Morriss, A. A. Abdullah	J. Park	R. Chapman & Sons	
Carnarvon Castle	J. B. McReynolds, D.S.C.	N. A. Rigg, W. S. Brown, G. W. Parker	W. A. Brown	Union Castle Mail S.S. Co., Ltd.	13.10.48
Carthage	S. H. French	B. D. Thomson, D. J. Parsons, D. T. Bolas	W. H. Chick	P. & O. Steam Navigation Co., Ltd.	
Cavina	S. A. Sapsworth	T. Burke, F. Barber, E. Harvey	A. Morton	Elders & Fyffes, Ltd.	9.9.48
Caxton	J. M. Cherry	J. Wilson, F. Hamilton, R. Crawford	A. Austin	Barberry's S.S. Co., Ltd.	17.9.48
Celtic Monarch	J. H. Keir	E. A. Muir		Monarch S.S. Co., Ltd.	22.11.47
Cerinthus	J. F. Auld	W. A. Arthur, W. V. Pike, J. D. Newbery	M. Ward	Hadley S.S. Co., Ltd.	14.9.48
Cheshire	F. C. Brooks	R. D. Fielder, P. Saunders, R. Sly	J. E. Unsworth	Bibby Line, Ltd.	13.1.48
Chinese Prince	F. S. Thornton, O.B.E.	M. Musson, H. Jennings, H. Bragg	T. Goodman	Prince Line, Ltd.	29.9.48
Chupra	J. D. Woods	R. W. Allerton, H. S. F. Strawbridge, W. Hillcoat	R. C. Whiting	British India Steam Navigation Co., Ltd.	13.10.48
Cilicia	A. C. Johnston	J. Henderson, J. Ballantyne, D. Russell	J. Malcolm	Anchor Line, Ltd.	27.5.48
City of Barcelona	E. M. Jenkins	R. G. Lewis, A. M. Bowman, J. B. Lister	W. E. G. Rickards	Ellerman Hall Line, Ltd.	18.7.48
City of Calcutta	W. H. Matheson, O.B.E.	D. Inglis, I. McDermid, N. Dalziel, A. Bickerton	G. C. Fyfe	Ellerman City Line, Ltd.	12.10.48
City of Canberra	F. Tibbetts	W. H. Wilson, E. G. A. Smith D. J. Curson	J. S. Forest	Ellerman Line, Ltd.	31.7.48
City of Capetown	W. S. Coughlan, O.B.E.	P. Redhead, W. E. Fletcher, H. C. Davey	D. R. Crombie	Ellerman Hall Line, Ltd.	13.8.48
City of Carlisle	L. E. Smith, M.B.E.	W. Taggart, J. Irvin, B. Pickering	P. J. McKeon	Ellerman & Bucknall S.S. Co., Ltd.	19.12.47

Name of Vessel	Captain	Observing Officers	Senior Radio Officer	Owners	Last Return Received
City of Chester	R. Longstaff, D.S.O.	K. B. James, R. M. Faulds, P. G. Thomas	J. A. Vallance	Ellerman Hall Line, Ltd.	23.6.48
City of Delhi	A. M. Hamilton	F. Chisholm, D. J. Inglis, J. A. Potter	J. Appleton	Ellerman Line, Ltd.	21.9.47
City of Derby	A. G. Melville	K. Dobson		Ellerman & Bucknall S.S. Co., Ltd.	
City of Dieppe	E. G. Chapman	A. G. Willa, R. J. Tyrell, D. J. Lloyd	J. J. Brennan	Ellerman Line, Ltd.	8.5.48
City of Dundee	F. M. Womersley	R. Jones, J. A. Whieldon, L. G. Powell	Slater	Ellerman Line, Ltd.	30.9.48
City of Durham	T. H. Speakman	H. McL. Farquhar, D. S. Taylor, J. W. Terris	J. Martwieu	Ellerman City Line, Ltd.	14.10.48
City of Evansville	A. F. Goring	A. Fry, J. Tattersall, J. Checkley	J. J. Brennan	Ellerman Line, Ltd.	13.12.47
City of Exeter	J. J. Andrew	R. Miller, N. Groundwater, D. H. Wardlaw	G. S. Creighton	Ellerman City Line, Ltd.	12.7.48
City of Hereford	G. A. Ring	J. Sapp, J. Webster, R. G. King	A. Hadden	Ellerman Line, Ltd.	25.8.48
City of Johannesburg	D. L. Lloyd, Cmdre., O.B.E.	H. Routledge, H. Lewis, J. S. Schofield, A. Ramsden	A. R. Henderson	Ellerman Hall Line, Ltd.	6.8.48
City of Khartoum	J. A. Beynon	D. B. Martin, R. Frame, R. Wakefield	S. Gracie	Ellerman Hall Line, Ltd.	6.5.48
City of Lille	E. Scrymeour	R. B. May, H. M. Steele, G. S. Garnet	A. Julius	Ellerman Line, Ltd.	
City of Lyons	H. Johnson	J. Morrison, A. R. Horam, R. Clark	W. Anderson	Ellerman Hall Line, Ltd.	17.3.48
City of Paris	H. Percival, Cmdre., O.B.E., R.D., R.N.R. (retired)	G. G. Francis, M. A. Perry, J. Brown	W. Rouffinac	Ellerman City Line, Ltd.	7.9.48
City of Pretoria	T. F. Labey			Ellerman & Bucknall S.S. Ltd.	
City of Swansea	G. Vickers	T. C. Dickinson, P. Seiffert, K. Haslam	W. Lupton	Ellerman Hall Line, Ltd.	25.5.48
City of Sydney	J. B. MacLaren	L. G. Powell, B. Walker, J. L. Blanch	R. Pickering	Ellerman Hall Line, Ltd.	2.3.48
City of Tokio	W. A. Owen	E. Bondfield, R. H. Bellhouse, E. Redshaw	W. Fosters	Ellerman Hall Line, Ltd.	
City of Windsor	T. G. Mathias	M. Graham, T. Rigg, E. F. Brick	A. C. Macaulay	Ellerman & Bucknall S.S. Co., Ltd.	27.10.47
Clan Brodie	B. Vernon-Browne	W. Kendal, E. J. E. Owen, P. Ingram	T. Gaffney	Clan Line Steamers, Ltd.	30.6.48
Clan Buchanan	T. W. Inman, O.B.E.	G. Hughes, F. King, G. Healy	W. Harper	Clan Line Steamers, Ltd.	9.9.48
Clan Campbell	J. A. Forster	D. Steele, J. Hay, P. Hodgman	R. F. Cole	Clan Line Steamers, Ltd.	8.7.48
Clan Chattan	H. C. Simpson, O.B.E.	J. W. Ward, F. Turton, D. R. Godfrey	J. Shillabeer	Clan Line Steamers, Ltd.	16.9.47
Clan Chisholm	J. H. Crellin	R. S. Russell, A. G. Allson, J. P. Marshall	J. A. Gray	Clan Line Steamers, Ltd.	27.9.48
Clan Forbes	H. S. Pengelly	J. West, F. C. Doyle, A. T. Campbell, C. J. Abbott	W. H. Saville	Clan Line Steamers, Ltd.	6.8.48
Clan Macaulay	A. G. Storkey	T. R. Halliday, C. G. Smeaton, C. M. Powell	R. G. Gooseman	Clan Line Steamers, Ltd.	6.9.47
Clan Macdonald	H. Cater	J. P. Dunphy, F. Lionnet, D. Milner	G. Martyn	Clan Line Steamers, Ltd.	8.6.48
Clan Macdougall	R. P. Galer, C.B.E., R.D., R.N.R.	G. Bagnall, J. C. Montgomery, R. C. Pearce	C. E. C. Crew	Clan Line Steamers, Ltd.	20.5.48
Clan Maclaren	W. R. Woodriffe	T. Harris, E. D. J. Cox, D. Richards	R. W. Moore	Clan Line Steamers, Ltd.	21.10.48
Clan Macnair	R. Buckley	W. G. Freestone, N. W. Wallace, P. L. Leslie	D. C. Munro	Clan Line Steamers, Ltd.	15.11.47
Clan Macneil	S. F. Carter	L. W. Gibbins, S. F. Nicholson, H. T. Morton	G. McCubbing	Clan Line Steamers, Ltd.	4.7.48
Clan Macrae	H. J. Anchor, O.B.E., R.D., Cdr., R.N.R.	R. E. Heywood, J. Chapell, P. C. W. Hobby	N. J. Braddon	Can Line Steamers, Ltd.	1.9.48
Clan Urquhart	C. G. Parfitt	W. C. Rodger, M. N. Ure, T. N. Geesin, J. Walker	A. F. MacIntyre	Clan Line Steamers, Ltd.	27.8.48
Clydebank	J. W. Griez	G. A. Gregory, A. R. Howson, E. A. D. Vergas	A. G. Roberts	Bank Line, Ltd.	14.7.48
Clydefield	H. Vaughan-Jones	G. S. Barker, J. Dunn	P. Dwyer	Northern Petroleum Tank S.S. Co., Ltd.	1.6.48

Comanchee	T. Potts	W. A. Willis, A. E. Hughes, F. P. Barber	W. E. Gilbert	Anglo-American Oil Co., Ltd.	1.10.48
Comedian	R. L. Williams	E. D. Ashdown, D. O. Percy, D. P. Rennie	A. Copeland	Charente S.S. Co., Ltd.	13.10.48
Comliebank	W. Mendus	A. J. Whiston, R. Clark, S. J. East	W. M. Fryer	Bank Line, Ltd.	16.2.48
Condesa	R. Smiles, O.B.E.	E. G. Roberts, R. F. Martin, A. Byers	M. McDougall	Furness-Houlder Argentine Line, Ltd.	19.2.48
Consuelo	G. Mussared	J. Hunter, G. Saltmarshe, R. C. Neesham	K. K. Klosser	Ellerman's Wilson Line, Ltd.	18.3.48
Corinthic	G. M. Robertson, D.S.C.	J. H. Wilde, Woodridge, Clifford	B. Baxter	Shaw, Savill & Albion Co., Ltd.	14.6.48
Cornwall	J. W. C. Pring	J. M. James, E. White, P. A. Ogden	J. D. Charter	Federal Steam Nav. Co., Ltd.	18.3.48
Corrientes	W. Anderson	J. Hendry, R. Allan, E. Knox	W. Docherty	Donaldson Line, Ltd.	1.7.48
Coulgorm	G. Robison	T. F. Tuomey, W. F. Kelly, J. Ridley	R. Andrews	Dornoch S.S. Co., Ltd.	13.1.48
Custodian	A. H. Thompson	C. S. S. Boam, A. P. Sandford	A. J. Long	Charente S.S. Co., Ltd.	22.4.47
Darro	B. A. Gammon	J. M. Barber, R. Finch, W. Tressider, B. Harrison	N. Bradbury	Royal Mail Lines, Ltd.	13.10.48
Deebank	B. Rivett	D. Campbell, I. McKay, T. Ridgeway	J. Freeman	Bank Line, Ltd.	21.5.48
Defoe	W. C. Blake	J. Crowe, P. Leighton, H. Smith	T. Stowers	Lamport & Holt Line, Ltd.	14.10.48
Delane	H. Pratt	M. D. A. Lee, C. T. Skrastin	B. Thompson	Lamport & Holt Line, Ltd.	28.9.48
Delilian	C. S. Low, M.B.E.	D. Stewart, J. Rodger, J. Wainwright	A. Read	Donaldson Line, Ltd.	25.5.48
Delius	H. W. Underhill	W. Jones, A. Bennett, P. Johnson	R. Pryer	Lamport & Holt Line, Ltd.	13.10.48
Denbighshire	W. F. Dark	W. S. Hargrave, E. G. Painter, L. Parsons	G. Heapy	Glen Line, Ltd.	17.8.48
Derryclare	G. Smith	A. M. Livingstone		McCowan & Gross, Ltd.	
Deseado	B. C. Dodds, O.B.E.	J. H. Napper, W. B. Avison, J. Holt, F. C. Allwoon	S. Fletcher	Royal Mail Lines, Ltd.	12.8.48
Devis	T. J. Sweeny	D. H. Cordova, G. Shackleton	L. Brazill	Lamport & Holt Line, Ltd.	9.7.48
Devon	A. Hocken	J. M. Mead, C. J. Cordran, J. Bryant, J. Crewdson	A. Williams	Federal Steam Nav. Co., Ltd.	29.5.48
Devonshire	J. E. Cullen, O.B.E.	J. Farrow, R. Driver, B. McMannus	J. Fletcher	Bibby Line, Ltd.	27.9.48
Dilwara	F. L. Sampson, D.S.C.	H. B. Cray, J. A. G. Bridgeman, J. W. Walker	S. J. Taylor	British India Steam Nav. Co., Ltd.	18.8.48
Dorelian	D. Macqueen	J. H. Stark, A. J. Dougall, A. T. Johnston	J. Cooper	Donaldson Line, Ltd.	28.9.48
Doris Clunies	J. G. Stevenson	J. B. White, K. M. Hamilton, M. Bracewell	G. M. Hargreaves	Doris S.S. Co., Ltd.	25.8.48
Drina	G. N. Anderson	R. M. Tysoe, J. Rutter, J. Fulford	J. Read	Royal Mail Lines, Ltd.	22.5.48
Dromore	R. E. L. Holland	J. McCool, R. Simmons, P. R. Farthing	G. A. Sutherland	Johnston Warren Lines, Ltd.	31.7.48
Dryden	C. L. Legg	K. Quirk, J. S. Peterkin, J. L. Radcliffe	S. J. Hardman	Lamport & Holt Line, Ltd.	17.7.47
Duke of Athens	J. G. Lomas, A.I.N.A.	J. Morris, L. Labistour, J. G. Perrin	D. R. Uglow	Trent Maritime Co., Ltd.	20.9.48
Dunkery Beacon	A. C. E. Green	J. D. B. Wylie		Crawford Shipping Co., Ltd.	
Dunster Grange	F. Kent	H. Neal, A. Gibbs, C. Mullings	J. Humphrey	Houlder Line, Ltd.	22.9.48
Durango	W. H. Roberts	J. G. Brennand, M. W. M. Weekes, M. J. Dean, J. M. Cree	A. S. J. Broadbent	Royal Mail Line, Ltd.	12.10.48
Durban Castle	C. G. Gorringe	J. M. Cairns, S. K. Smith	H. Liggins	Union-Castle Mail S.S. Co., Ltd.	14.6.48
Durham	R. J. Dunning	G. Fulcher, J. van der Straaten, G. Dunsford	E. R. Saunders	Federal Steam Navigation Co., Ltd.	31.7.48
Eastern	M. C. G. Stratford	W. S. Drew, C. D. Dykes, S. W. Mort	E. C. Bouel	Eastern & Australian S.S. Co., Ltd.	18.10.48
El Gallo	E. H. Richardson	W. Swan, A. Bramble	L. Sutton	Lobitos Oilfields, Ltd.	1.9.48
Empire Brent	J. Cook	J. Short, A. McCallum, S. Erving	L. Hooper	Donaldson Bros. & Black, Ltd.	13.10.48
Empire Halladale	E. Stormont, M.B.E.	G. Ramage, W. A. Brownlie, W. Marshall	D. Thompson, M.B.E.	Anchor Line, Ltd. (Managers)	14.10.48
Empire Kinsman	A. Richardson			Bullard, King & Co., Ltd. (Managers)	
Empire Martaban	E. Longster	G. McGowan, D. B. Butler	T. M. Keddie	Bolton S.S. Co., Ltd. (Managers)	19.6.47
Empire Pride	E. D. Brand	R. V. Perkin, R. Hammond, A. Moore	T. Prenton	Bibby Line, Ltd. (Managers)	4.7.48
Empire Star	S. J. C. Phillips, C.B.E.	R. H. Hall-Soloman, Lt., R.N.R., J. T. Brown, F. P. McGuckin	A. Morris	F. Leyland & Co., Ltd.	30.4.48
Empire Viceroy	M. D. Mackenzie	D. L. Jardine, A. C. Cable, A. Purvis	R. Porter	Counties Ship Management Co., Ltd. (Managers)	4.11.47
Empress of Australia	J. P. Dobson, D.S.C., R.D., Cmdr. R.N.R.	B. Snell, A. G. Ingram	W. Campbell	Canadian Pacific Railway Co.	14.9.48
Empress of Canada	E. A. Shergold	J. A. N. Bezant, I. K. Bryce, J. Waling	J. M. Butterworth	Canadian Pacific Railway Co.	13.10.48

Name of Vessel	Captain	Observing Officers	Senior Radio Officer	Owners	Last Return Received
Empress of France	H. H. Davies	W. R. Owen, R. Williams	E. Murphy	Canadian Pacific Steamships, Ltd.	
Epsom	R. D. Griffiths, O.B.E.	G. T. Sharpe, R. M. King, E. Thomson	R. T. Jonas	Briton S.S. Co., Ltd.	13.10.48
Eros	R. C. Vigurs	V. Irving, C. P. Turquand, W. Marvin	H. Lammas	Elders & Fyffes, Ltd. (Managers)	21.10.48
Esperance Bay	T. V. Roberts, R.N., Capt. R.N.R.	D. T. Mouldey, K. Murray-Brown, D. Wright	P. Moloney	Aberdeen & Commonwealth Line, Ltd.	12.7.48
Essex Trader	C. Arundell	H. P. Ellison, F. Stamps, R. E. Robson	A. B. Pilkington	Trader Nav. Co., Ltd.	18.9 48
Esso Glasgow	C. G. B. Broughton, M.B.E.	J. Cooke, W. Brians, D. Colebrook	C. C. H. Weeks	Anglo-American Oil Co., Ltd.	8.3.48
Ettrickbank	T. Watkins			Inver Transport & Trading Co., Ltd.	
Explorer	W. Moore	F. Allen, R. Ledger, P. A. Leighton	W. A. Townley	Charente S.S. Co., Ltd.	22.4.48
Fanad Head	E. W. Black	W. L. Nelson		Ulster S.S. Co., Ltd.	27.2.47
Fantee	J. W. Andrew	G. H. Griffiths, P. M. Ralston, S. Burley	W. A. Johnston	Elder Dempster Lines, Ltd.	2.3.48
Fenia	L. Robertson	J. M. Green	J. W. Leak	South Georgia Co., Ltd.	5.12.47
Ficus	C. R. J. Simmons	A. A. Alexander, D. E. Dobinson, G. Lowe	C. C. Wade	Anglo Saxon Petroleum Co., Ltd.	25.8.48
Finland	A. Wilson, O.B.E.	J. S. Drynan, J. W. Phimister		Currie Line, Ltd.	18.3.48
Fordsdale	R. G. Ireland	R. T. Welch, G. B. Moss, G. Lewis	H. S. Knight	Shaw, Savill & Albion Co., Ltd.	2.2.48
Fort Cadotte	F. E. Patchett	R. McClymont, J. S. Roe, H. Huntley	D. O'Brien	Cunard White Star Ltd. (Managers)	16.8.48
Fort Caribou	W. I. Evans	W. Thomson, M. O. Hamill, K. Caperwell	J. Farquahar	Goulandris Bros., Ltd. (Managers)	25.6.48
Fort Musquarro	E. A. Stewart	J. Robinson, J. D. Smythe, D. R. Button	M. J. Sheaham	Cunard White Star, Ltd. (Managers)	
Fort Nakasley	J. Johnson	A. M. Allan, R. E. Leithead, A. S. Kelly	J. K. McCormack	J. & J. Denholm, Ltd. (Managers)	16.8.48
Fort Spokane	J. V. Locke, R.D., Cdr., R.N.R.	J. Farrow, M. V. Meardon, R. J. Ogilvy	F. MacLaughir	Cunard White Star, Ltd. (Managers)	
Fort Steele	J. S. Binnie	L. Jamieson, K. Montgomery, J. Horne	W. Steele	Lyle S.S. Co., Ltd. (Managers)	
Fresno City	W. V. Doughty			Reardon Smith Line, Ltd.	
Geologist	W. L. Sawle	L. Richardson, M. Wardle, W. Owen	S. Slater	Charente S.S. Co., Ltd.	13.10.48
Geo. W. McKnight	A. G. Robins	E. Tunnicliffe, F. Bridges, A. L. Searle	R. J. Wealthy	Anglo-American Oil Co.	4.8.47
Georgic	H. Dixon	K. T. Jones, J. O. Springall, H. P. Williams	A. G. Hill	Cunard White Star, Ltd. (Managers)	19.7.48
Glaucus	W. T. Spencer	J. Lloyd-Jones, G. McInnes. P. Pratt	J. M. Lewis	Ocean S.S. Co., I td.	31.12.47
Glenartney	W. E. Coates	C. Lorimer, J. B. Mothersill	F. Wilson	Glen Line, Ltd.	16.9.48
Glenbank	T. Fraser	M. Murphy, J. J. Reed, J. R. Roe	C. H. Ball	Bank Line, Ltd.	7.4.48
Gloucester	M. D. Morwood	P. Slocombe, L. James, D. Moran	R. J. Devlin	Federal Steam Navigation Co., Ltd.	4.7.48
Goth	J. E. Bywater		A. Wright	Wyre Steam Trawling Co., Ltd.	10.4.48
Gracia	H. McLachlan	D. M. Allan, G. B. Manson, I. Barbour	J. Limpitlaw	Donaldson Line, Ltd.	6.8.48
Granpond	P. F. Ewart	H. Smallwood, A. R. Simpson, R. Master	H. Reynolds	Mediterranean & Atlantic Lines, Ltd.	6.9.48
Guinean	H. Coffey, R.N., R.N.R.	A. E. Pearson, T. Rylance, R. B. Dales	R. B. Read	United Africa Co., Ltd.	23.9.48
Haparangi	C. R. Pilcher, O.B.E.	J. T. Peattie, J. R. Ramsay, H. P. Lunn, E. B. Mallett	J. Matthews	New Zealand S.S. Co., Ltd.	23.6.48
Harmatris	J. N. Brundle			J. & C. Harrison, Ltd.	
Helicina	J. F. Rumbellow	P. S. Sharer, M. B. Mactavish	A. W. Hutchinson	Anglo-Saxon Petroleum Co., Ltd.	4.5.48
Herdsman	W. A. Short	J. W. Embleton, K. Cobb	I. Donald	Charente S.S. Co., Ltd.	
Herefordshire	T. J. A. Thomson	J. W. MacKinley, M. C. Mills, J. T. Whiteside	T. Greaves	Bibby Line, Ltd.	12.10.48
Highland Brigade	H. D. Hooper, O.B.E.	R. J. Hall, C. N. Wightman, B. Clarke	W. Gay	Royal Mail Lines, Ltd.	2.9.48
Highland Chieftain	G. A. Bannister	L. W. Green, J. P. Martin, G. W. T. Griffiths, H. R. Wright	T. Desborough	Royal Mail Lines, Ltd.	21.7.48
Highland Monarch	B. K. Berry, R.D., R.N.R.	A. Ferguson, J. Perkins, R. Stirling, G. Lillie	L. Cooper	Royal Mail Lines, Ltd.	12.8.48 12.8.48
Highland Princess	P. Cooper	M. Wardle, R. Mawley, H. Nixon	F. Goodall	Royal Mail Lines, Ltd.	19.5.47

Hopecrown	Stewart Wilson, O.B.E.	H. G. Strickland, G. D. Downes, J. D. Todd	A. O. Greer	Clive S.S. Co., Ltd.	14.8.48
Hopepeak	G. Grindrod	V. Thompson, C. E. Pain, J. A. Leech	M. J. Beirne	Hopemount S.S. Co., Ltd.	25.8.48
Hororata	A. E. Taylor, R.D., Cdr., R.N.R.	E. W. Clubb, S. R. Harding, J. H. Hedley	C. L. Lambe	New Zealand S.S. Co., Ltd.	7.5.48
Horsa	D. Dickson	W. Urquhart, A. Wotherspoon	None carried	Currie Line, Ltd.	7.7.48
Hubert	H. Sapsworth, D.S.C.	A. S. Richardson, P. J. Wahlberg, J. Mawhinney	F. N. Baskerville	Booth Line, Ltd.	19.10.48
Hurunui	F. Lougheed	J. Anderson, N. I. Collett, P. R. Moulton	C. Littleboy	New Zealand Shipping Co., Ltd.	
Inishowen Head	G. A. Moore	N. C. Stark, C. O'Connor, R. McKeague		Ulster S.S. Co., Ltd.	6.9.48
Inverbank	A. M. Williamson	S. Duncan, H. E. Hoyle	W. Chalmers	Bank Line, Ltd.	28.9.48
Jamaica Producer	P. D. Allen, O.B.E.	E. G. J. Roberts, F. Saunders, L. Musson	K. Hartley	Jamaica Banana Producers S.S. Co., Ltd.	13.10.48
Jersey City	J. M. Cox	J. H. J. Frost, D. L. Beynon, T. Thomas	C. Codling	Reardon Smith Line, Ltd.	19.5.48
Jessmore	A. C. Bailey	S. N. Coe, D. G. Waters, K. Rowland	P. Mahony	Johnston Warren Lines, Ltd.	19.7.48
John Biscoe	H. Kirkwood, Cdr., R.N.			Falkland Island Dependencies Govt.	
John Holt	A. Kennedy	W. L. Harrison, A. J. Eilly, R. Griffiths	P. A. Senior	John Holt & Co. (Liverpool), Ltd.	26.4.48
Kaipaki	T. Fenwick	D. M. Steven, J. R. Suffren, F. LeMessurier	F. Matthews	New Zealand S.S. Co., Ltd.	21.8.48
Kaituna	R. F. Hellings	J. Blake, C. F. Turner, W. Howgego	M. Garrett	New Zealand S.S. Co., Ltd.	21.1.48
Kallada	I. M. Reynolds	R. H. Wakefield, R. J. F. Riley, D. E. Ilsley	M. S. M. Harding	J. Nourse, Ltd.	20.8.48
Kelmscott	R. E. Richardson	P. F. Carnochan, J. M. Horne, J. Aitken	E. T. Lewis	Pachesham S.S. Co., Ltd.	3.9.47
Kenilworth Castle	J. E. R. Wilford	G. D. Attwood, J. Toogood, G. Beaumont, D. A. Davies	A. C. Cockburn	Union-Castle Mail S.S. Co., Ltd.	16.2.48
Kent	N. A. Thomas	R. W. W. Sims, D. A. G. Dickens, A. B. Stalker	L. Roberts	Federal Steam Navigation Co., Ltd.	13.10.48
Ketos	G. J. Gjertsen	H. Johansen, J. F. Jarvis	J. Murphy	United Whalers, Ltd.	
King Robert	G. Craze	G. Griffiths, W. Keith, P. Kidd	W. Fielding	King Line, Ltd.	10.10.47
King William	A. B. Drever	J. S. Gittings, J. C. Davies, A. J. Moore	P. Kelly	King Line, Ltd.	12.7.48
Kingston Pearl	A. R. Cornish	A. R. Cornish	W. Weaver	Kingston Steam Trawling Co., Ltd.	8.6.48
Kohistan	J. S. Smithson	W. G. Smith, A. Baird, J. Belt	R. Walsh	Shahristan S.S. Co., Ltd.	27.9.48
Lacklan	G. K. Billett	N. McRae, H. R. Machin, A. P. Watson	H. E. Morrison	Socony-Vacuum Transport Co., Ltd.	16.7.48
Laguna	R. C. Skillorn	A. H. Allenby, W. P. Goldie, P. H. Grant	J. Heenay	Pacific Steam Nav. Co.	11.3.48
Lambrook	H. F. McInnes	J. Orr, A. Sillars, R. F. Arnold	S. Gracey	Austin Friars S.S. Co., Ltd.	21.6.48
Lanarkshire	C. E. O'Byrne	J. S. Catterall, J. K. Robertson, D. Crawford	J. B. Allen	Scottish Shire Line, Ltd.	12.8.48
Lancashire	A. Kerbyson	J. C. Priest, W. H. Malley, J. W. Q.-K. Harwood	A. Jones	Bibby Line, Ltd.	24.6.48
Lassell	D. Roberts	S. Dickenson, J. Bicknell, P. V. des Landes	N. Moore	Lamport and Holt Line, Ltd.	13.10.48
Latia	R. S. Walker	W. J. Erskine, R. W. Lumsden, G. A. Hubbard	W. E. Delamere	Anglo-Saxon Petroleum Co., Ltd.	7.4.48
Leicester	H. L. Lawson, R.D., R.N.R.	J. Andrews, A. Collins, R. Stewart-Scott	P. Broome	Federal Steam Nav. Co., Ltd.	9.8.48
Levernbank	D. Gillies	C. G. Watterson, C. R. Eaddy, D. A. Kiddell	W. C. Doyle	Bank Line, Ltd.	26.2.48
Livorno	E. S. Green	F. Methan, F. E. Barnes, G. Dineley	L. Bradshaw	Ellerman's Wilson Line, Ltd.	1.6.48
Llangibby Castle	C. C. Page	E. H. I. Hall	J. Eager	Union Castle Mail S.S. Co., Ltd.	1.1.48
Lloydcrest	T. Walker	H. L. Halcrow, D. W. Verniers, A. H. Benson	M. Riley	Junecrest S.S. Co., Ltd.	
Lobos	R. H. Sissons	R. T. Riley, P. H. Ray, J. Norman	N. P. Sherin	Pacific Steam Nav. Co.	15.1.48
Loch Avon	W. W. Lowe	W. M. Morton, G. E. Leech, D.S.C., J. V. Bradbury, J. M. Ashworth	M. R. Littlejohn	Royal Mail Lines, Ltd.	18.3.48
Loch Garth	H. G. Whittle, O.B.E.	D. B. Keefe, E. A. E. Littlewood, J. G. Street, J. K. Cook	D. Morgan	Royal Mail Lines, Ltd.	6.8.48
Loch Ryan	A. R. Osburn	D. R. Bryden, R. C. Hunnisett, V. Charles	D. Douglas	Royal Mail Lines, Ltd.	30.9.48

NAME OF VESSEL	CAPTAIN	OBSERVING OFFICERS	SENIOR RADIO OFFICER	OWNERS	LAST RETURN RECEIVED
Lochmonar	H. H. Treweeks	G. B. Medleycott, J. E. Robson, Lt., R.N.R., P. Davies	J. Coutts	Royal Mail Lines, Ltd.	15.12.47
Lord Gladstone	J. Abuelo	A. H. Treikelder, J. Janczak	E. Lane	Norwood S.S. Co., Ltd.	2.9.48
Lord Glentoran	W. J. Leinster	J. Smyth, A. F. James, A. R. McMullen	D. O'Callaghan	Ulster S.S. Co., Ltd.	12.3.48
Lord O'Neill	R. A. Ferguson	R. G. Pass, W. R. Nelson	C. A. Murphy	Ulster S.S. Co., Ltd.	11.12.47
Loriga	G. B. Wardle	R. Lewis, K. Thomas, R. Mumford	H. M. Benson	Pacific Steam Navigation Co.	2.12.47
Losada	P. L. Hockey			Pacific Steam Navigation Co.	24.6.48
Lulworth Hill	J. Reed	H. Dewman, R. W. Curd	R. Rider	Dorset S.S. Co., Ltd.	11.8.48
Luminous	S. J. Smith	J. Billett		Aral S.S. Co., Ltd.	
Machaon	J. L. Johnston	E. R. Pollar, C. Hartmoll, T. H. L. Boyd	A. Akhurst	Ocean S.S. Co., Ltd.	20.8.48
Macharda	R. A. Penstone	Kirkham, T. H. Wardle, L. J. S. Saxty	Brady	T. & J. Brocklebank, Ltd.	21.6.48
Magdapur	A. Hill, O.B.E.	S. Baxter, N. H. Embleton, A. Halcrow	A. Orum	T. & J. Brocklebank, Ltd.	14.9.48
Mahanada	J. W. B. Robertson, R.D., R.N.R.	E. A. Anderson, J. Brand, J. C. Long, P. Greenall	T. Williams	T. & J. Brocklebank, Ltd.	9.7.48
Mahia	J. W. Hart			Shaw, Savill & Albion Co., Ltd.	8.10.47
Mahout	H. F. Scions	A. Anderson, O. Pritchard, G. Sinclair	A. Roberts	T. & J. Brocklebank, Ltd.	16.2.48
Mahsud	R. Humble	A. P. Briggs, J. W. Ross, D. Evans	D. Lloyd	T. & J. Brocklebank, Ltd.	12.5.48
Maihar	S. Broughton	M. H. Taylor, J. P. Pembridge, D. L. des Landes	A. G. Lea	T. & J. Brocklebank, Ltd.	21.6.48
Makalla	J. B. Newman	F. J. Watts, C. Grey, E. McAuily	A. E. Weston	T. & J. Brocklebank, Ltd.	13.10.48
Malakand	J. Owen	J. P. Hackworth, H. Defty, D. Hay	J. Caddy	T. & J. Brocklebank, Ltd.	22.4.48
Malancha	H. MacGregor	D. S. Carter, W. Gibson, J. Kemp	R. Burton	T. & J. Brocklebank, Ltd.	21.7.48
Malayan Prince	J. D. Fraser	P. B. Eccles, H. W. Gates, J. R. Stephens	B. Laird	Rio Cape Line Ltd.	11.8.48
Malmo	J. W. Calvert			Ellerman's Wilson Line, Ltd.	
Maloja	E. J. Parry	J. S. Anderson, R. M. Sinclair, J. C. Jenkins	A. Macbeth	P. & O. Steam Navigation Co.	27.9.48
Manchester City	F. L. Osborne	S. Hinchliff, W. Hine, G. R. Thompson	H. J. Coates	Manchester Liners, Ltd.	9.6.47
Manchester Commerce	H. Hancock	H. Nielsen, W. E. Quirk, J. E. Askew	H. C. Evans	Manchester Liners, Ltd.	8.6.48
Manchester Division	E. W. Espley	F. Robinson, D. Thomas	T. Parker	Manchester Liners, Ltd.	2.2.48
Manchester Port	F. Downing			Manchester Liners, Ltd.	
Manchester Progress	W. H. Downing	F. Lewis, L. Taylor, C. Marchant	W. C. Critchley	Manchester Liners, Ltd.	4.6.48
Manchester Regiment	F. D. Struss, O.B.E., D.S.C.	E. J. Eccles, J. L. McLaren, D. S. Millard	J. Reid	Manchester Liners, Ltd.	11.12.47
Manchester Shipper	J. Barclay	F. Lewis, D. Heaton, T. H. Lynn	E. Ambler	Manchester Liners, Ltd.	14.1.47
Manchester Trader	E. W. Raper	A. N. Fielding, N. Cockshoot, J. O. Eking	A. C. Gavin	Manchester Liners, Ltd.	21.6.48
Mandasor	J. E. Jeans	H. P. Ackerley, D. A. Morris, F. P. Attwood	G. W. Hazel	T. & J. Brocklebank, Ltd.	18.9.48
Maplebank	N. P. McLeod	N. P. McLeod	J. B. Anderson	Bank Line, Ltd.	
Marengo	F. Ellison	S. B. Wade, A. Burton, R. H. Story	G. Camm	Ellerman's Wilson Line, Ltd.	21.8.48
Margay	E. A. Prentice	M. G. Stevens, W. Forster, J. Bloomfield	J. Young	"K" S.S. Co., Ltd.	14.8.48
Marietta Dal	J. G. F. Brighty	L. D. Forster, R. H. Jenkins, A. C. Henderson	T. Laing	Dalhousie S.S. Co.	
Marinda	A. Crewdson	H. C. Coplin	H. C. Coplin	Seddon Fishing Co., Ltd.	
Markhor	W. Hill, O.B.E.	I. A. Maclaren, J. Ritchie, R. N. Bonnry	G. M. Caddy	T. & J. Brocklebank, Ltd.	27.4.48
Marna	R. R. Hume	R. J. Sinclair, W. Allen		South Georgia Co., Ltd.	27.8.48
Marquita	F. C. Jennings	J. Cush, T. Liddle, R. W. Guinebert-Check	G. Hardy	Coolham S.S. Co., Ltd.	6.8.48
Marsdale	M. Ferguson	H. Jones, J. Tiere, L. Mansell		"K" S.S. Co., Ltd.	
Martand	T. Fox-Lloyd	E. Watkins, G. J. Kenyon, L. Burn	D. H. Butterworth	T. & J. Brocklebank, Ltd.	16.9.48

Martita	H. Bunn	E. Prest, D. I. J. Thomson, P. Parker	P. A. Hayes	" K " S.S. Co., Ltd.	
Mataroa	S. Oswald	C. M. Williams, A. V. Mackay, T. Parell	A McMurray	Shaw Savill & Albion Co., Ltd.	2.10.48
Matheran	A. B. Bannatyne, O.B.E.	H. Simpson, J. A. Miller, R. J. Riding	P. Neeson	T. & J. Brocklebank, Ltd.	1.6.48
Matina	W. J. Mills	T. C. Crane, J. Nicholson, J. Mayo	A. C. Knight	Elders & Fyffes, Ltd.	11.5.48
Mauretania	R. B. G. Woollatt, R.N., Cdr., R.N.R.	T. R. Buckingham, J. Ward, G. R. Carter	F. Clarke	Cunard White Star, Ltd.	
Media	C. S. Williams	J. A. B. Munro, J. K. Finlay, C. F. Cooke	W. McArdle, M.B.E.	Cunard White Star, Ltd.	20.7.48
Memling	D. C. Roberts	G. J. Piper, W. A. Sparks, L. A. Ankers	J. H. Gregor	Lamport & Holt Line, Ltd.	22.7.48
Millais	J. F. Byrne, O.B.E.	R. J. Sampson, J. Edgar, D. S. Leicester, R. H. Turner	A. Hutchinson	Lamport & Holt Line, Ltd.	4.9.48
Mirror	S. A. Gammon	R. E. Small, P. B. Henderson, C. E. Burrill	J. Crouch	Cable and Wireless, Ltd.	5.12.47
Mooltan	C. H. Baxter	A. E. Clay, B. D. H. Thomson, P. G. Pattinson, J. Clifford	F. Ash	P. & O. Steam Navigation Co.	
Monarch	J. P. F. Betson	K. H. Joy, A. Hoar, Black-Tuckwell	E. Robinson	Postmaster-General	18.7.47
Moveria	T. S. Graham	I. M. MacFarlane, G. E. Waddel, R. S. Hopkins	R. H. Hallam	Donaldson Line, Ltd.	31.7.48
Murillo	W. Gillespie	P. Leighton, K. M. Maguire, J. D. Brown	G. Adamson	Lamport & Holt Line, Ltd.	21.6.48
Myrtlebank	F. Hale	G. G. Hodgson, J. T. Duncan, F. J. Adamson	N. Kehoe	Bank Line, Ltd.	23.8.48
Nab Wyke	P. E. Bedford			Wyre Steam Trawling Co., Ltd.	
Nairnbank	C. S. Holbrooke	B. Amstad, E. Reed, J. Appleby	J. Adamson	Bank Line, Ltd.	22.4.48
Napier Star	E. N. Rhodes	J. B. Kennedy, E. W. Jenkins, J. Bain	T. W. Murray	Union Cold Storage Co., Ltd.	7.7.48
Naticina	P. D. Seear	P. Kendall	W. J. Parkinson	Anglo-Saxon Petroleum Co., Ltd.	29.8.47
Nestor	E. W. Powell, M.B.E.	N. W. Martin, H. Spencer-Hogbin, B. Pays	L. Booth	Ocean S.S. Co., Ltd.	20.9.48
Newfoundland	A. T. Church, O.B.E.	J. B. Stewart, H. T. Sheffield, L. Rooney	T. Cahill	Johnston Warren Lines, Ltd.	
New Zealand Star	G. Owen, O.B.E., R.D., Cdr., R.N.R.	G. Munro, R. Stewart, F. Wood	C. J. Carter	F. Leyland & Co., Ltd.	14.6.48
Norfolk	A. T. Robinson, R.D., Capt., R.N.R.	R. S. Luly, D. Williamson, A. B. Moss	J. Heath	Federal Steam Nav. Co., Ltd.	21.8.48
Northumberland	F. Longheed	B. E. Crist, R. Webster, G. Wottan	J. Hassen	Federal Steam Nav. Co, Ltd.	22.3.48
Norwegian	J. Pollock	H. Wylie		Donaldson Line, Ltd.	
Nova Scotia	P. F. Owens	J. D. P. Williamson, R. Heys, E. Cunningham	W. C. Brock	Johnston Warren Line, Ltd.	4.6.48
Novelist	T. E. Steel	H. Skelly, W. G. Jackson, W. Grierson	J. Whitehead	Charente S.S. Co., Ltd.	21.9.48
Ocean Valley	W. McMellin	P. J. Leech, A. Dunsford	H. Renshaw	Houlder Bros. & Co., Ltd. (Managers)	2.9.48
Orari	F. Pover	W. Peto, A. Mackenzie, J. Edmondson	F. Wilman	New Zealand S.S. Co., Ltd.	19.7.48
Orbita	J. Sutherland	A. McLean, E. L. Sleeman, W. Singleton	W. McCormick	Pacific Steam Navigation Co., Ltd.	14.7.48
Orduna	J. Whitehouse	B. A. King, J. B. Olsson	G. Clarke	Pacific Steam Navigation Co., Ltd.	19.7.48
Orion	Sir A. J. Baxter, K.B.E., D.S.C., R.D., Cdre., R.N.R.	W. Thompson, A. Murray, D. K. Kinloch	T. Shannon	Orient Steam Navigation Co., Ltd.	28.9.48
Ormonde	T. L. Shurrock, O.B.E.	E. V. Harris, J. Farrell, L. C. Kingswood	R. Oatley	Orient Steam Navigation Co., Ltd.	20.8.48
Orontes	N. A. Whinfield	B. Noble, C. Grierson, F. Underwood	A. Murphy	Orient Steam Navigation Co., Ltd.	10.9.48
Pacific Enterprise	M. E. Cogle, O.B.E.	M. J. Brown, J. Crosthwaite, J. T. Cameron	A. F. Cory	Norfolk & North American S.S. Co. Ltd.	1.7.48
Pacific Importer	J. H. King	E. Cunningham		Furness, Withy & Co., Ltd.	
Pacific Shipper	E. V. Richards	W. E. Thomas, R. Hughes, S. G. Edwards	G. Mostyn	Furness, Withy & Co., Ltd.	14.9.48
Pacific Stronghold	F. H. Perry	D. R. Gibson, D. MacDonald, C. Howard	T. Keddie	Furness, Withy & Co., Ltd.	21.6.48
Pakeha	H. C. Smith	E. Snaith, A. H. N. Pugh, A. R. Stephenson	F. Slater	Shaw, Savill & Albion Co., Ltd.	22.4.48
Palacio	M. H. Atkinson, D.S.C.	C. A. Ellis, McKinley	P. McCarthy	MacAndrews & Co., Ltd.	10.5.47
Palana	F. R. Spurr	P. J. Passmore, W. B. Vickers, M. A. Frenfield	H. Olding	P. & O. Steam Nav. Co.	23.4.48
Palomares	D. L. Thomas, M.B.E.	F. Szanage	J. Stone	MacAndrews & Co., Ltd.	
Pampas	T. Powell	K. E. McChure, C. W. Williams, K. R. Towers	H. Booth	Royal Mail Lines, Ltd.	6.8.48

Name of Vessel	Captain	Observing Officers	Senior Radio Officer	Owner	Last Return Received
Papanui	B. Evans	G. R. Naylor, E. White, T. Bennett	A. R. Smith	New Zealand S.S. Co., Ltd.	13.9.48
Paparoa	E. Hopkins	H. A. Owen, C. B. Hewett, W. Dan	L. P. Rayner	New Zealand S.S. Co., Ltd.	8.9.48
Paraguay	H. V. Todd	D. E. Hogarth, G. A. Gibbons, E. A. Pearce	C. R. Wyllie	Royal Mail Lines, Ltd.	1.8.48
Pardo	R. N. Fletcher	M. Hawkins, C. G. M. Smith, S. D. Gibson	W. Harney	Royal Mail Lines, Ltd.	15.7.48
Parima	J. Smith, R.N.R.	J. T. Jones, R. C. Hunnisett	J. Barlow	Royal Mail Lines, Ltd.	6.8.48
Paringa	C. E. Pollitt	G. P. Blyth, P. C. Reed, A. W. Dallas	B. S. Magennis	P. & O. Steam Navigation Co.	31.7.48
Parthia	R. G. Thelwell, O.B.E., R.D., A.D.C., Capt., R.N.R.	J. Walton, F. Drake, D. G. Dalzier	A. O. Sullivan	Cunard White Star, Ltd.	
Pegu	M. M. Ramsay	J. Walker Brown, I. S. MacColl, L. O. Thornton	R. Wilson	British & Burmese Steam Nav. Co., Ltd.	11.8.48
Perim	J. C. Mellonie	P. E. Hewitt, H. Toon, R. T. Neve	F. Groves	P. & O. Steam Navigation Co.	13.10.48
Perthshire	A. J. Hogg	J. G. Smith, J. Brown, F. Sharps, M. Shillington	F. Rayner	Scottish Shire Line, Ltd.	30.6.48
Pilcomayo	T. Davies	D. P. Warren, P. Anthony, J. Egan	M. Coady	Royal Mail Lines, Ltd.	17.11.47
Pipiriki	R. G. Rees	M. J. Heron, E. Allan, J. Laidlaw	L. Wittingdon	New Zealand S.S. Co., Ltd.	25.5.48
Planter	J. J. Wallis	J. L. Cule		Charente S.S. Co., Ltd.	
Polar Chief	J. O. Bowie			Polar Whaling Co., Ltd.	8.6.48
Polar Maid	H. Leask	J. Gilman, E. Smith		Polar Whaling Co., Ltd.	
Port Chalmers	E. T. W. Lawney	C. M. Watkins, P. A. N. Thomas, R. D. Harris	M. J. Sheeham	Port Line, Ltd.	8.7.48
Port Hobart	T. F. Kippins, O.B.E., D.S.C.	A. J. Braund, J. D. Aitchison, J. A. Ashburner	B. Morley-Evans	Port Line, Ltd.	4.6.48
Port Jackson	F. W. Bailey, M.B.E.	D. M. MacKeith, C. Guest, R. E. C. Harris	R. C. Crompton	Port Line, Ltd.	31.7.48
Port Lincoln	H. H. Smith, O.B.E.	G. G. Carter, D. M. Robinson, M. W. Raggett	F. Griffiths	Port Line, Ltd.	31.7.48
Port Macquarie	E. Roswell	H. Thompson, T. S. Paton, P. M. Hudson, V. A. Hunt	P. Smyth	Port Line, Ltd.	13.8.48
Port Philip	J. G. Lewis, O.B.E.	F. M. Barton, Hopwood, Long	D. MacRae	Port Line, Ltd.	6.8.48
Port Pirie	W. J. Enwright, O.B.E., R.D., Capt., R.N.R.	A. W. Kensett, H. J. Haldrup, R. C. Matthews	W. Miller	Port Line, Ltd.	18.9.48
Port Wellington	W. G. Higgs, O.B.E.	J. M. Bedwell, D. Sinclair, K. Marshall	J. S. Macpherson	Port Line, Ltd.	12.7.48
Port Wyndham	H. Steele	P. G. Henneker, P. R. Lewis, C. P. Williams	J. N. Coutts	Port Line, Ltd.	25.5.48
Potaro	S. J. G. Hill	J. Green, R. R. Thompson, J. T. Price	D. Smith	Royal Mail Lines, Ltd.	11.5.48
Pretoria Castle	J. C. Brown, C.B.E.	D. Kernick, N. Knowles, C. Willis	N. Oliver	Union Castle Mail S.S. Co., Ltd.	
Priam	L. W. Kersley	C. C. J. Neaves, C. H. Jolly, N. R. L. Pierpoint	E. H. Power	Ocean S.S. Co., Ltd.	6.9.48
Princessa	E. J. Lougheed	A. Cochrane, H. Sargent, J. Newton	E. Whitehead	Furness Houlder Argentine Lines, Ltd.	12.8.48
Rakaia	P. B. Clarke, M.V.O., O.B.E., D.S.C.	T. Gibbon, J. Budgell, B. E. Crust, J. Milner	A. Lugar	New Zealand S.S. Co., Ltd.	7.8.48
Ranchi	R. E. T. Tunbridge, D.S.C.	K. A. Walker, C. J. Savage, C. E. Waller	R. V. Gregory	P. & O. Steam Navigation Co.	28.9.48
Rangitata	G. Kinnell, O.B.E.	P. M. Busby, M. Drake, N. Etherton	P. J. Smythe	New Zealand S.S. Co., Ltd.	29.5.48
Rangitiki	E. Holland, C.B.E.	S. Harding, P. M. Busby, N. Etherton	P. J. Smythe	New Zealand S.S. Co., Ltd.	22.9.47
Recorder	R. F. Longster	G. W. Sigsworth, R. J. Abbett	W. Jacobson	Charente S.S. Co., Ltd.	22.6.48

Red Charger	R. Nash	C. Noble		Iago Steam Trawler Co., Ltd.	
Red Crusader	B. Rogerson			Iago Steam Trawler Co., Ltd.	
Red Knight	E. Littler	R. Green	R. Green	Iago Steam Trawler Co., Ltd.	
Red Lancer	M. Wright			Iago Steam Trawler Co., Ltd.	
Red Sword	J. Tomlinson			Iago Steam Trawler Co., Ltd.	
Regent Hawk	J. Ward	F. S. Farrar, G. R. Arthur, A. L. Helmas	R. W. Jones	Trinidad Leaseholds, Ltd.	6.8.48
Reighton Wyke	G. Clixby		J. Moffat	West Dock Steam Fishing Co.	18.10.48
Rembrandt	J. J. Grugan	R. Thompson, T. J. Morgan, M. Barrett	R. Marsden	Bolton S.S. Co., Ltd.	8.3.48
Repton	D. Cownie	F. L. James, D. M. Muir, G. R. Watts	W. Keogh	Basra S.S. Co., Ltd.	9.9.48
Rhodesia Star	C. H. Watson	K. P. Crompton		Blue Star Line, Ltd.	
Richmond Castle	J. A. Sowden	J. W. Lewin, W. Kilgour, W. Shaw	J. H. Burgess	Union-Castle Mail S.S. Co., Ltd.	13.10.48
Richmond Hill	M. O'Neill	S. Sloan, A. Shafy, L. Gellie	R. White	Putney Hill S.S. Co., Ltd.	6.1.48
Riebeeck Castle	M. S. Hodson	J. A. Scott	S. Godfrey	Union-Castle Mail S.S. Co., Ltd.	22.4.48
Rimutaka	W. Wilson, O.B.E.	B. Linklater, I. Cubitt, T. Train, T. Wadie	S. Peeling	P. & O. Steam Navigation Co.	30.9.48
Rippingham Grange	L. Bearbank	R. Tinmouth, H. Butler, E. A. Prothero	J. Connelly	Houlder Line, Ltd.	22.4.48
Robert F. Hand	E. J. Instone, O.B.E.	J. Rattray, J. J. Jones, M. Devaney	R. Munro	Anglo American Oil Co., Ltd.	9.7.48
Robert Hewett	G. Elliot	H. Wilcock		Great Northern Fishing Co., Ltd.	
Rochester Castle	D. D. Mackenzie	P. G. Eckford, G. E. Matthews, E. H. Pickles	K. N. G. Ashford	Union-Castle Mail S.S. Co., Ltd.	19.8.48
Rockside				Andross S.S. Co., Ltd.	
Roslin Castle	H. L. Holland	S. K. Smith, W. R. Carr, T. Mayo	J. J. Smith	Union-Castle Mail S.S. Co., Ltd.	19.7.48
Roxburgh Castle	J. M. Rayner, R.D., Cdr., R.N.R.	R. St. J. Fancourt, H. N. Dryden, D.S.C.	J. H. Hillyer	Union Castle Mail S.S. Co., Ltd.	15.10.48
Royal Star	G. Aldridge	T. G. Hughes, M. Rideout, M. Drummond	M. Cahill	Union Cold Storage Co., Ltd.	8.6.48
Ruahine	A. E. Lettington, D.F.C.	I. Y. Batley, J. D. Guyler, J. Massy	J. Poyner	New Zealand S.S. Co., Ltd.	21.7.48
Rutland	W. Thom	J. A. Williamson	J. Macfarlane	Currie Line, Ltd.	8.1.47
Ruysdael	D. E. Norie	A. Mathison, J. T. Hibbert	H. Holdridge	Bolton S.S. Co., Ltd.	
Sacramento	J. Robinson, M.B.E.	A. C. Dick, A. D. Robinson, S. Wilkinson, Whiting	W. Parratt	Ellerman's Wilson Line, Ltd.	31.7.48
St. Crispin	A. E. Hall	D. L. Verity	D. L. Verity	West Hartlepool Steam Nav. Co., Ltd.	10.12.47
St. Just	V. A. Buschini	V. A. Buschini		Heward Trawlers, Ltd.	
St. Loman				T. Hamling & Co.	
St. Merriel	F. Meneight	H. Tock, W. R. Vickers, H. Harrison, J. A. Woolven		South American Saint Line, Ltd.	
St. Nectan		P. C. Spink		T. Hamling & Co., Ltd.	4.6.48
St. Zeno	J. H. Ellis, D.S.C.	L. Abbey, E. E. White	E. E. White	T. Hamling & Co., Ltd.	13.10.48
Salacia	H. McLachlin	G. M. Clark, R. S. Macaulay, D. K. Dickson	G. P. Hewitt		24.8.48
Salamanca	D. W. Hutchinson	R. B. Bryant, W. P. Duguid, J. Owen	J. M. Powell	Pacific Steam Nav. Co.	16.7.48
Salaverry	D. W. Hutchinson	P. D. O'Driscoll, J. Peters, A. Hudson	J. Bainie	Pacific Steam Navigation Co.	17.9.48
Salinus	J. Williams	A. Powell, R. Scaiff, L. H. Powell	W. Bennett	Pacific Steam Nav. Co.	15.3.48
Salmonier	J. D. Wilson	J. T. Fyffe, J. Brown, E. H. Booth	H. MacKay	W. Thompson & Co.	22.7.48
Saluta	S. Begg			Chr. Salveson & Co.	21.6.48
Samanco	A. Lyall	C. Stewart, A. Lang, W. McGuffin	R. M. Evans	Pacific Steam Navigation Co.	2.9.48
Samaria	D. W. Sorrell	J. Ormerod, J. Hughes, W. Marshal	E. P. Bishop	Cunard White Star, Ltd.	11.2.47
San Adolfo	F. R. H. Atkinson	M. E. Holdron, J. Wallace, G. Davies	A. Smith	Eagle Oil & Shipping Co., Ltd.	8.9.48
San Cirilo	M. A. Connell	T. B. Wright, R. G. Scarey, D. A. Ward	D. W. Powell	Eagle Oil & Shipping Co., Ltd.	15.3.48
San Felix	J. B. Macarthy, O.B.E.	R. B. McKenzie, G. G. B. Putt, B. S. Orange	W. L. Radcliffe	Eagle Oil & Shipping Co., Ltd.	20.10.48
San Velino	H. C. Archer, O.B.E.	J. Dixon, J. Munday, W. D. Hepworth	J. Clark	Eagle Oil & Shipping Co., Ltd.	14.5.48
San Veronico	R. M. Atkinson	J. J. Greener, R. Auric, R. Purvis	C. L. Carpenter	Eagle Oil & Shipping Co., Ltd.	26.1.48
San Vulfrano	J. Thomson, O.B.E.	R. V. Hartley, H. Fortnam, G. Lawson	J. W. Barry	Eagle Oil & Shipping Co., Ltd.	12.7.48
Santander	T. J. Naylor	H. Russell, J. E. Evans, D. T. Beamish	W. Davitt	Pacific Steam Nav. Co.	11.5.48
Sarmiento	G. H. Rice	O. A. Baker, P. H. Ray, F. Nuttall	F. E. Jones	Pacific Steam Nav. Co.	30.6.48
Saxon Star	D. J. Stralta	D. A. Van de Merwe, H. Tomsett, J. Reeve	H. Moore	F. Leyland & Co., Ltd.	21.6.48

Name of Vessel	Captain	Observing Officers	Senior Radio Officer	Owners	Last Return Received
Scholar	D. Wolstenholm	D. T. English, R. E. Harvey, J. H. Doran	E. A. Mills	Charente S.S. Co., Ltd.	6.8.48
Scythia	R. Sell, Cdr.	D. R. Rosling, E. D. Hall, R. G. Mossop	Moore	Cunard White Star, Ltd.	27.10.47
Selector	W. H. Slaughter	W. G. McGuiness, V. F. Harrison, R. J. Turnbull	J. Macdonald	Charente S.S. Co., Ltd.	
Settler	R. F. Phillips	W. Baker, H. P. Roberts, L. Broadbent	A. Smith	Charente S.S. Co., Ltd.	18.10.48
Silverbriar	Morgan			Silver Line, Ltd.	
Silvercedar	F. E. Godley	E. N. Stone, I. F. Robertson, G. K. Harrison	J. Lord	Silver Line, Ltd.	31.7.48
Silverguava	J. Duncan	N. C. Jones, J. M. Evans, D. M. Lamont	R. Burrow	Silver Line, Ltd.	22.12.47
Silveroak	W. N. Tulloch	K. A. Wise, P. Whitaker, J. R. Douglas	D. Hill	Silver Line, Ltd.	8.9.48
Silverplane	H. Woodrow			Silver Line, Ltd.	
Silversandal	E. Stark	J. McK. Batchen, P. Hildred, J. M. Beaumont	A. B. King	Silver Line, Ltd.	14.9.48
Silverteak	C. J. Metcalf	C. A. Felgate, J. M. Evans, H. Rose	S. Garnett	Silver Line, Ltd.	18.2.48
Silverwalnut	J. H. Leask	W. J. Ross, G. G. Pegler, F. A. Ferguson	A. G. Pearson	Silver Line, Ltd.	8.3.48
Sneaton	W. Armstrong	S. Webb, D. R. Crocker, J. Jameson	A. D. Carter		6.8.48
Socotra	C. F. Halliday	P. W. F. Holmes, F. W. M. Pearce, E. Owen, E. Snowden	H. Camp	P. & O. Steam Nav. Co.	23.8.48
Somerset	P. S. Calcutt			Federal Steam Nav. Co., Ltd.	
Southern Collins	D. Hunter	R. Cramb, J. McNaughton, T. Johnstone	W. S. Hayes	South Georgia Co., Ltd.	9.9.47
Southern Garden	W. J. Swanson	W. Scott, J. Jamieson, E. G. Sutton	J. D. Todd	South Georgia Co., Ltd.	
Southern Harvester	K. Granöe	T. J. Morgan, J. T. Petrie	J. Sprott	South Georgia Co., Ltd.	8.6.48
Southern Opal	J. O. Bowie	W. Spence, J. Bridge, J. Robertson	C. Houston	South Georgia Co., Ltd.	18.8.48
Southern Venturer	H. Nilsen			South Georgia Co., Ltd.	
Sovac	H. Anthony	C. E. Dodds, R. Jarrett, J. D. Nutter	D. V. McMurde	Socony-Vacuum Transportation Co., Ltd.	3.9.48
Speaker	C. C. Heaton	R. J. Abbott		Charente S.S. Co., Ltd.	
Specialist	L. F. Harriman	J. Beam, C. Rawlinson	W. Jacobson	Charente S.S. Co., Ltd.	
Springfjord	T. R. Mackle	J. Reid		Springwell Shipping Co.	
Staffordshire	H. Davies	T. R. Johnson, H. W. M. Treasurer, W. O. Thomas	A. Rodger	Bibby Line, Ltd.	31.8.48
Stancourt	F. H. Wainford	R. Muir	T. W. Bearman	Stanhope S.S. Co., Ltd.	10.11.47
Stanhall	S. G. Larrard	J. R. Sims, L. M. Davies, H. Brown	L. Sandfrey	Stanhope S.S. Co., Ltd.	18.10.48
Stanthorpe	R. G. Roberts	E. L. Davies, R. S. Drew, N. R. Brown	J. M. Bannerman	Stanhope S.S. Co., Ltd.	12.7.48
Stirling Castle	W. A. Pace, O.B.E.	R. Kerr, M. A. Gray	P. P. Williams	Union Castle Mail S.S. Co., Ltd.	21.8.48
Stirlingshire	T. McCrone	A. S. Palethorpe-May, G. A. Winter, A. Graham	J. Stott	Scottish Shire Line, Ltd.	12.8.48
Strathaird	H. S. Allen, R.D., R.N.R.	M. H. D'aeth, R. L. Pigeon, J. Owen	F. E. Ash	P. & O. Steam Nav. Co.	20.4.48
Stratheden	S. W. S. Dickson	H. R. Howard, J. W. Hamilton, B. S. Mordaunt	H. S. Horn	P. & O. Steam Navigation Co.	14.10.48
Suffolk	E. A. Burton	I. Davison, F. G. Bevis, J. Heeley	J. Turnham	Federal Steam Navigation Co.	4.9.48
Suncrest	T. G. Barwell	T. L. Ison, J. E. Collins, P. Tate	J. McMahon	Junecrest S.S. Co., Ltd.	6.2.48
Sutherland	R. W. Nicolson	A. L. Clement, R. Thwaites, R. Edgar	R. L. Sinclair	B. J. Sutherland & Co., Ltd.	30 8.48
Sutherland	J. McClure	C. Dick, D. Hogben			31.3.48
Swainby	J. E. Roddam	K. Jackson, R. Dunn, W. M. Fallan	T. J. Melville	Ropner S.S. Co., Ltd.	3.3.48
Sydney Star	T. F. McDonald, O.B.E.	J. C. Davies, J. G. King, I. Mackintosh	D. Hoyle	F. Leyland & Co., Ltd.	7.7.48
Tactician	A. Robertson	G. F. Pensron, H. Cowley, J. G. Jones	W. Williams	Charente S.S. Co., Ltd.	6.8.48
Talca	A. G. Litherland	D. I. Jones, J. Butterworth, W. R. Holmes	N. Brewer	Pacific Steam Navigation Co.	6.8.48
Tamaroa	H. J. Cox	D. T. Moulday, K. Murray-Brown, A. R. Stephenson	P. Moloney	Shaw, Savill & Albion Co., Ltd.	

Tamele	W. Munt	P. J. Finan, D. Thompson, A. Lamper	F. Broomfield	Elder Dempster Lines, Ltd.	14.5.47
Taranaki	F. A. Smith	T. de M. Ogier, N. E. Wood, C. C. D. Gough	L. Cottell	Shaw, Savill & Albion Co., Ltd.	21.9.48
Tarkwa	G. D. Simpson	C. St. H. Webber, J. White, G. H. Griffiths, J. Fraser	R. A. Bristy	Elder Dempster Lines, Ltd.	12.9.47
Tasso	H. Scarborough	F. Briggs, D. J. C. Martin, R. Whettleton	L. Richardson	Ellerman's Wilson Line, Ltd.	
Tekoura	F. Sutton	D. E. Edmonds	D. E. Edmonds	Heward Trawlers, Ltd.	26.2.47
Telemachus	J. F. Webster	R. P. S. Collins, P. D. F. Cruickshank, E. Brown	J. C. Wilson	Ocean S.S. Co., Ltd.	21.2.48
Teviot	H. E. Sang	R. J. Kistlen, T. A. Buckney	L. W. Bell	Royal Mail Lines, Ltd.	5.11.47
Thamesfield	R. Cunningham	J. P. Ross, R. L. Newcombe, P. B. Goudie	T. Carter	Northern Petroleum Tank S.S. Co., Ltd.	19.3.47
Tinto	S. H. Bennett, M.B.E.	A. Ledger		Ellerman's Wilson Line, Ltd.	
Tongariro	A. E. Williams	D. MacDonald, M.B.E., S. W. Lambuck, P. N. Jeans	K. H. Brooks	New Zealand S.S. Co., Ltd.	4.5.48
Torr Head	N. Kennedy	A. Fee, R. Coffey, D. D. Gault	G. Penketh	Ulster S.S. Co., Ltd.	17.3.48
Tower Grange	G. Robson	R. Clipsham, J. Settle	V. P. Moran	Tower Steamship Co., Ltd.	30.9.48
Tresillian	M. G. Symons	C. Downs, W. R. Bulmer, E. L. Cussons	D. Perks	Hain S.S. Co., Ltd.	24.6.48
Trevaylor	W. J. Spencer	J. R. Males, R. B. Oliver, D. R. Jenkins	J. Stewart	Hain S.S. Co., Ltd.	14.6.48
Tribesman	A. Smart	W. Lawton, J. S. Jones, J. Adams	J. T. W. Nixon	Charente S.S. Co., Ltd.	27.9.48
Tweed	D. R. Miller	Meldrum, J. Chester, D. S. Guinness	W. G. Fitzgerald	Royal Mail Lines, Ltd.	31.8.48
Twickenham	Wm. D. Shields, O.B.E.	D. V. Cameron, D. A. Forrester, J. L. Kirby	J. H. Parker	Britain S.S. Co., Ltd.	16.8.48
Umtali	F. E. O'Hea	J. A. Bonsley, F. Evans, D. G. Jupp, D. McNeill	S. Hewitt	Bullard, King & Co., Ltd.	25.5.48
Umtata	J. W. Miles	H. J. Thorn, H. K. Underwood, L. Farren	A. H. Coxhead	Bullard, King & Co., Ltd.	20.7.48
Valacia	W. L. P. Cox	J. D. Smythe, N. Jones, A. Hoyle	P. A. Hayes	Cunard White Star, Ltd.	13.12.47
Vancouver City	B. Cormaffan	J. Cooper, F. English, W. Rendall	W. Ansell	Sir Wm. Reardon, Smith & Sons	13.10.48
Vardulia	J. F. Drake, O.B.E., R.D., R.N.R.	J. M. Hughes, J. A. Stewart, A. Bull	F. Berry	Cunard White Star, Ltd.	14.10.48
Vasconia	G. S. Evans	R. H. Arnott, A. L. Davies, R. M. Graham	G. C. G. Reed	Cunard White Star, Ltd.	13.10.48
Vestra	D. S. Archibald	J. D. Mackenzie, I. Macalpine		J. T. Salveson & Co.	
Victrix	A. Garnett	C. F. Lawrence		Henriksen & Co	
Vienna	A. P. Sutton	E. Atkinson, J. A. Tully, W. V. Adams	F. Howell	British Railways (Eastern Region) (Managers)	
Vivien Louise	G. McLeod	R. E. Garisch		British Oil Shipping Co.	28.12.47
Volo	A. Morrinn	T. A. Firth, W. White	W. Ellison	Ellerman's Wilson Line, Ltd.	22.4.48
Waimana	L. J. Hopkins	J. W. Paine, A. S. Masters, K. C. Davis	T. P. Jones	Shaw, Savill & Albion Co., Ltd.	13.10.48
Waipawa	R. G. Ireland	R. Hutchinson, G. Watkins, J. Moore	W. Charlton	Shaw, Savill & Albion Co., Ltd.	4.9.48
Wairangi	W. G. West	E. D. L. Harper, V. H. Vizar, R. D. Fox	H. Jardine	Shaw, Savill & Albion Co., Ltd.	12.10.48
Waiwera	B. Forbes-Moffatt	J. L. Corrall, P. S. Yeoman, B. Hammond		Shaw, Savill & Albion Co., Ltd.	6.9.48
Wanderer	J. L. Curle	W. G. Davies, D. N. Mathews, E. A. Clarke	A. H. Stewart	Charente S.S. Co., Ltd.	25.8.48
Warwick Castle	J. Trayner	B. W. Mitton, A. M. McLean	Shaw	Union-Castle Mail S.S. Co., Ltd.	22.7.48
Welsbach	J. Bywater			Wyre Steam Trawling Co., Ltd.	
Winchester Castle	L. P. Wilkie	R. E. Neal, D. E. Harris, E. Holden	R. Brew	Union Castle Mail S.S. Co., Ltd.	4.7.48
Zent	C. R. Hodder	A. Bruce	T. Richardson	Elders & Fyffes, Ltd.	28.1.48
Conway, H.M.S.	T. M. Goddard, Capt., R.N.R.	The Senior Cadets	—	—	10.4.48
Pangbourne Nautical College	H. C. Skinner, O.B.E., Cdr. R.N.	The Senior Cadets	—	—	3.4.48
Worcester, H.M.S.	G. C. Steele, *V.C.*, Cdr., R.N.	The Senior Cadets	—	—	7.4.48

FLEET LIST (New Zealand)
VOLUNTARY OBSERVING SHIPS

The following is a list of observing ships, voluntarily co-operating with the Meteorological Service of New Zealand.

Name of Vessel	Captain	Observer	Radio Officer	Owners
Huia	A. J. Matheson			Nobel (Australasia) Proprietary Ltd.
Kaikorai				Union S.S. Co. of New Zealand, Ltd.
Kairanga	G. S. Beaton	B. R. Druce	G. M. Gormlie	Union S.S. Co. of New Zealand, Ltd.
Karetu	T. S. Nicol	A. Mackay	B. G. Hart	Union S.S. Co. of New Zealand, Ltd.
Karitane	W. E. Jones	E. W. Robb	L. M. Harvey	Union S.S. Co. of New Zealand, Ltd.
Kauri	G. Evans	D. H. Turnbull	A. E. Whalley	Union S.S. Co. of New Zealand, Ltd.
Komata	A. T. Adam	J. C. Young	G. M. Throp	Union S.S. Co. of New Zealand, Ltd.
Kopua	F. Chapman	E. Clark		Union S.S. Co. of New Zealand, Ltd.
Kurow	A. F. Inman	B. E. Avery	W. A. Hawkins	Union S.S. Co. of New Zealand, Ltd.
Manuka	J. Holm	E. R. Warner		Capt. J. Holm and crew.
Matua	A. R. Russel	G. H. Edwards	E. H. Ward	Union S.S. Co. of New Zealand, Ltd.
Maui Pomare	L. C. Boulton	J. Hare	W. A. Taylor	Government of New Zealand (Pacific Islands Admin.)
Pamir	H. S. Collier	A. F. Jenkins	A. J. Stanton	Government of New Zealand.
Port Waikato	J. Keith	E. Anderson		A. F. Watchlin.
Ranui	N. Worth			Public Works Department.
Wahine	W. Grey	K. Mitchell	J. G. Rea	Union S.S. Co. of New Zealand, Ltd.
Waipori	C. Burgess	D. S. Brayshay	S. J. Waters	Union S.S. Co. of New Zealand, Ltd.
Waitaki	F. W. Gibson	J. K. West	C. V. Hayes	Union S.S. Co. of New Zealand, Ltd.
Waitemata	W. Whitfield	J. W. Keyworth	E. L. Hulme	Union S.S. Co. of New Zealand, Ltd.
Whakakura	F. A. Barrett			Tasman S.S. Co.

FLEET LIST (Canada)
VOLUNTARY OBSERVING SHIPS

The following is a list of observing ships voluntarily co-operating with the Meteorological Service of Canada.

NAME OF VESSEL	OWNERS
Fort Amherst	Furness, Withy & Co.
Fort Townsend	Furness, Withy & Co.
Imperial Quebec	Imperial Oil, Ltd. (Marine Department).
Imperial Toronto	Imperial Oil, Ltd. (Marine Department)
Imperial Winnipeg	Imperial Oil, Ltd. (Marine Department).
Lady Nelson	" Lady Nelson ", Ltd. (Canadian National Steamships).
Lady Rodney	" Lady Rodney ", Ltd. (Canadian National Steamships).
Victoria County	Acadia Overseas Freighters, Ltd.
Waihemo	Canadian Union Line, Ltd.
Waikawa	Canadian Union Line, Ltd.
Wairuna	Canadian Union Line, Ltd.
Waitomo	Canadian Union Line, Ltd.

FLEET LIST (Hong Kong)
VOLUNTARY OBSERVING SHIPS

The following is a list of observing ships, voluntarily co-operating with the Royal Observatory, Hong Kong.

NAME OF VESSEL	OWNERS
Bris	China Siam Line.
Caroline Moller	Moller's (Hong Kong), Ltd.
Chak Sang	Indo-China Steam Navigation Co., Ltd.
Choy Sang	Indo-China Steam Navigation Co., Ltd.
Eastern Saga	Indo-China Steam Navigation Co., Ltd.
E Sang	Indo-China Steam Navigation Co., Ltd.
Fengtien	China Navigation Co., Ltd.
Foochow	China Navigation Co., Ltd.
Fuhsing	Chinese Maritime Customs.
Fukien	China Navigation Co., Ltd.
Hai Lee	China Siam Line.
Hang Sang	Indo-China Steam Navigation Co., Ltd.
Hanyang	China Navigation Co., Ltd.
Hermelin	China Siam Line.
Hin Sang	Indo-China Steam Navigation Co., Ltd.
Hiram	China Siam Line.
Hong Siang	Ho Hong Steamship Co., Ltd.
Hunan	China Navigation Co., Ltd.
Hunghsing	Chinese Maritime Customs
Hupeh	China Navigation Co., Ltd.
Junghsing	Chinese Maritime Customs.
Kut Sang	Indo-China Steam Navigation Co., Ltd.
Lot Sang	Indo-China Steam Navigation Co., Ltd.
Mau Sang	Indo-China Steam Navigation Co., Ltd.
Mei Shan	Standard-Vacuum Oil Co., New York.
Nanchang	China Navigation Co., Ltd.
Nellore	Eastern & Australian Steamship Co., Ltd.
Newchwang	China Navigation Co., Ltd.
Ninghai	China Navigation Co., Ltd.
Pakhoi	China Navigation Co., Ltd.
Poyang	China Navigation Co., Ltd.
Shansi	Australian-Oriental Line, Ltd.
Shengking	China Navigation Co., Ltd.
Szechuen	China Navigation Co., Ltd.
Tai Chung Shan	Shun Cheong Steam Navigation Co.
Tai Ping	China Pacific Shipping & Trading Co.
Tai Po Shan	Shun Cheong Steam Navigation Co.
Tak Sang	Indo-China Steam Navigation Co., Ltd.
Tehhsing	Chinese Maritime Customs
Wing Sang	Indo-China Steam Navigation Co., Ltd.
Wo Sang	Indo-China Steam Navigation Co., Ltd.
Yochow	China Navigation Co., Ltd.
Yunhsing	Chinese Maritime Customs.

MARID SHIPS

The following is a list of ships voluntarily observing and reporting sea temperatures from coastal waters of Great Britain.

Captains are requested to point out any errors or omissions in the list.

Name of Vessel	Captain	Owners
Accrington	R. Good	British Railways (Eastern Region).
Actuality	J. Lewis	F. T. Everard & Sons, Ltd.
Allurity	A. Fisher	F. T. Everard & Sons, Ltd.
Alouette	L. G. Horsham	General Steam Nav. Co., Ltd.
Antwerp	R. V. Adams	British Railways (Eastern Region).
Ariosto	W. Hill	Ellerman's Wilson Line, Ltd.
Atlantic Coast	M. Fleming	Coast Lines, Ltd.
Baltraffic	F. Waldron	Union Baltic Corporation, Ltd.
Belhaven	R. L. Irvine	London & Edinburgh S.S. Co., Ltd.
Belravock	T. Wallace	London & Edinburgh S.S. Co., Ltd.
Belvina	J. Phillip	London & Edinburgh S.S. Co., Ltd.
Bury	J. L. Davison	British Railways (Eastern Region).
Cambria	A .Marsh	British Railways (London Midland Region).
Clupea	I. Macrae	Scottish Home Department (Fishery Division).
Clyde Coast	G. Goldman	Coast Lines, Ltd.
Coldharbour	G. L. Hetherington	Coastwise Colliers, Ltd.
Coldridge	F. Granger	Coastwise Colliers, Ltd.
Corfen	E. Allen	Cory Colliers, Ltd.
Corfleet	R. J. Barrow	Cory Maritime, Ltd.
Corfoss	A. Greiffenhagen, M.B.E.	Cory Colliers, Ltd.
Cormist	H. H. Horley	Cory Colliers, Ltd.
Cormoat	R. B. Armstrong	Cory Colliers, Ltd.
Crane	J. S. Lickis	General Steam Nav. Co., Ltd.
Denbigh Coast	O. A. Drake	Coast Lines, Ltd.
Drake	K. Carmalt	General Steam Nav. Co., Ltd.
Duke of Argyll	F. Ardern, D.S.C.	British Railways (London Midland Region).
Duke of Lancaster	E. B. Serjeant	British Railways (London Midland Region).
Duke of Rothesay		British Railways (London Midland Region).
Duke of York	A. E. Willmott, D.S.C., R.D. Cdr. R.N.R.	British Railways (London Midland Region).
Eastern Coast	R. E. Holt	Coast Lines, Ltd.
Eildon	W. Jeffrey	G. Gibson & Co., Ltd.
Explorer	D. C. Sandison	Scottish Home Department (Fishery Division).
Falcon	S. W. Develin	General Steam Nav. Co., Ltd.
Foreland		Currie Lines, Ltd.
Goldfinch	W. Lockhart	General Steam Nav. Co., Ltd.
Granta	D. A. Hunter	Granta S.S. Co., Ltd.
Grebe	E. C. Painter, D.S.C.	General Steam Nav. Co., Ltd.
Guernsey Coast	H. G. Keilit	British Channel Islands S.S. Co., Ltd.
Harrogate	C. H. Tully	Wilson's & N.E. Railway S.S. Co., Ltd.
Hibernian	W. H. Hughes, D.S.C.	British Railways (London Midland Region).
Highwood	J. Coupland	High Hook S.S. Co., Ltd.
Hirondelle	R. Beatte, M.B.E.	General Steam Nav. Co., Ltd.
Isle of Guernsey	F. Front	British Railways (Southern Region).
Isle of Jersey	A. L. Light	British Railways (Southern Region).
Isle of Sark	C. E. Durley	British Railways (Southern Region).
Lairdsburn	J. McColl	Burns & Laird Lines, Ltd.
Lairdswood	I. McGuggan	Burns & Laird Lines, Ltd.
Lancashire Coast	H. Heppard	Coast Lines, Ltd.
Lapwing	K. R. Nicholls	General Steam Nav. Co., Ltd.
London Merchant	C. A. Piper	London Scottish Lines, Ltd.
Medway Coast	J. Richardson	Coast Lines, Ltd.
Melrose Abbey	J. Laverack	Hull & Netherlands S.S. Co., Ltd.
Minna	T. Mather	Scottish Home Department (Fishery Division).
Moray Coast	D. Mercer	Coast Lines, Ltd.
Ocean Coast	G. Mearns	Coast Lines, Ltd.
Otterhound	A. M. Kennedy	Coastal Tankers, Ltd.
Pass of Ballater	R. Reid	Bulk Oil S.S. Co., Ltd.
Persian Coast	T. Taylor	Tyne, Tees S.S. Co., Ltd.
Petrel	G. C. Longfield, M.B.E.	General Steam Nav. Co., Ltd.
Plover	W. J. Tait	General Steam Nav. Co., Ltd.
St. Andrew		Fishguard & Rosslare Railway & Harbour Co.
St. Julien	L. J. Richardson	British Railways (Western Region).
Salerno	F. Mason	Ellerman's Wilson Line, Ltd.
Scotia		Scottish Home Department (Fishery Division).
Scottish Co-operator	T. Robertson	Scottish Co-operative Wholesale Society.
Selby	A. W. Johnson	Wilson's & N.E. Railway S.S. Co., Ltd.
Slieve Bawn	F. G. J. Manning	British Railways (London Midland Region).
Slieve Bearnagh	J. Irwin	British Railways (London Midland Region).
Slieve Bloom	N. Lloyd-Williams	British Railways (London Midland Region).
Slieve Donard	W. E. Meade	British Railways (London Midland Region).
Slieve League	J. Hughes	British Railways (London Midland Region).
Slieve More	V. S. Phillips	British Railways (London Midland Region).
Smiling Morn	A. Adamson, M.B.E., Lt., R.N.R.	The Captain.
Southern Coast	W. Quirk	Coast Lines, Ltd.
Stork	C. Carr	General Steam Nav. Co., Ltd.
Tern	G. Thain	General Steam Nav. Co., Ltd.
Wandle	T. W. Corney, M.B.E.	Wandsworth & District Gas Co.
Welsh Coast	M. Fleming	Coast Lines, Ltd.

LIGHT VESSELS

The following Light Vessels voluntarily observe and report from coastal waters of Great Britain.

NAME OF VESSEL	MASTER
East Goodwin	A. Giblin
Humber	
Newarp	
Royal Sovereign	
Shipwash	H. L. Neale

NOTICES TO MARINE OBSERVERS

Postal Arrangements

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

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

Shipowners, Marine Superintendents, and all concerned in the despatch of mails to ships abroad are asked to kindly facilitate the despatch and delivery of postal matter, received at their offices from the Meteorological Office and Air Publications and Forms Stores, to their ships abroad.

This matter, addressed to the captains of ships, contains information which is required for the conduct of meteorological work at sea, and is most effective if received by the captains at the earliest possible date.

Much of the information referred to is published in *The Marine Observer* and is of a seasonal nature. This journal also contains advice to observing ships which enables them to perform voluntary service by wireless communication for the benefit of all shipping.

Ice Observation

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

See Appendix III, pages 106-108 of the *Marine Observer's Handbook*, Sixth Edition.

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

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

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

Return of Logbooks

Owing to the need for strict economy in the use of paper, observing officers should endeavour to fill up their logbooks (Forms 911), before returning them to the appropriate Meteorological Service, except when insufficient space remains for the recording of observations during a further complete passage.

Great Britain

Transmission of the 1800 G.M.T. Radio Weather Message from Single-Operator Observing Ships

In the eastern Atlantic, the 1800 G.M.T. radio weather message is a very important one from the viewpoint of shipping. The 2130 Atlantic bulletin for shipping, as issued from the United Kingdom, is normally based upon the weather map drawn from observations made at 1800. The 2030 coastal forecast issued by W/T and R/T may also be influenced by these observations. The 1800 weather map is at the same time of considerable general value, for if the messages both from ship and shore stations arrive punctually, the map is drawn in sufficient detail to influence the general forecast which is issued in the evening to the press for publication in the morning newspapers.

The attention of voluntary observers is, therefore, drawn to the fact that in single-operator ships, there is no objection to making out the 1800 weather message at, say, 1730, with the object of clearing it by radio before the radio officer goes off watch. In the coded message " GG " should then be coded to give the actual time of the observation to the nearest hour (G.M.T.).

Meteorological Services for Shipping

Captains of British ships are requested to notify the Marine Branch of the Meteorological Office of areas in which meteorological services for shipping appear inadequate. Suggestions for the improvement of these services are always welcome.

TRANSMISSION OF WEATHER MESSAGES THROUGH DETAILED STATIONS

When transmitting routine weather messages to Meteorological Services, observing ships are specially requested to transmit only through the radio stations detailed in Part II of the " Marine Observer's Guide."

When in a reporting area, messages should be transmitted *only through the radio stations appropriate to that area* (except when using Area Stations for short-wave transmissions).

Transmission of reports through stations other than those detailed, or through stations outside the appropriate reporting area may involve complications in the payment of telegraphic charges.

Gale Warnings and Storm Warnings
British Coastal Waters and Eastern North Atlantic

Attention is drawn to the fact that in the weather bulletins issued by the British Meteorological Office for shipping around the coasts of the British Isles, *gale warnings* are issued when the wind is expected to reach *Beaufort force* 8 *or above.*

The *storm warnings* in the Atlantic Weather Bulletin for Shipping, however, are only issued when the wind is expected to reach *Beaufort force* 10 *or above.* *Note.*—In some parts of the world *hurricane warnings* are issued ; these will infer that a wind of *Beaufort force* 12 *or above* is expected.

MARINE METEOROLOGY

Co-operation of British Shipowners, Masters and Mates

Captains and officers of ships registered in Great Britain and Northern Ireland, who wish to co-operate regularly with the Meteorological Office, should apply to the appropriate Port Meteorological Officer or Agent.

In accordance with the International Convention for Safety of Life at Sea, the Meteorological Office arranges for a number of ships to record meteorological observations at specified hours, throughout their voyage, and to transmit coded observations, by wireless telegraphy, for the benefit of other ships and the various meteorological services.

Ships performing these voluntary duties are known as Observing Ships—the whole as the Voluntary Observing Fleet—and the captains and officers of these ships as the Corps of Voluntary Marine Observers.

The list of observing ships is published in *The Marine Observer*.

The quarterly *Marine Observer* is sent regularly to the captain of every observing ship, for the information and guidance of his observing and radio officers. The captains of observing ships are also supplied on request with charts and atlases, according to trade, as meteorological equipment.

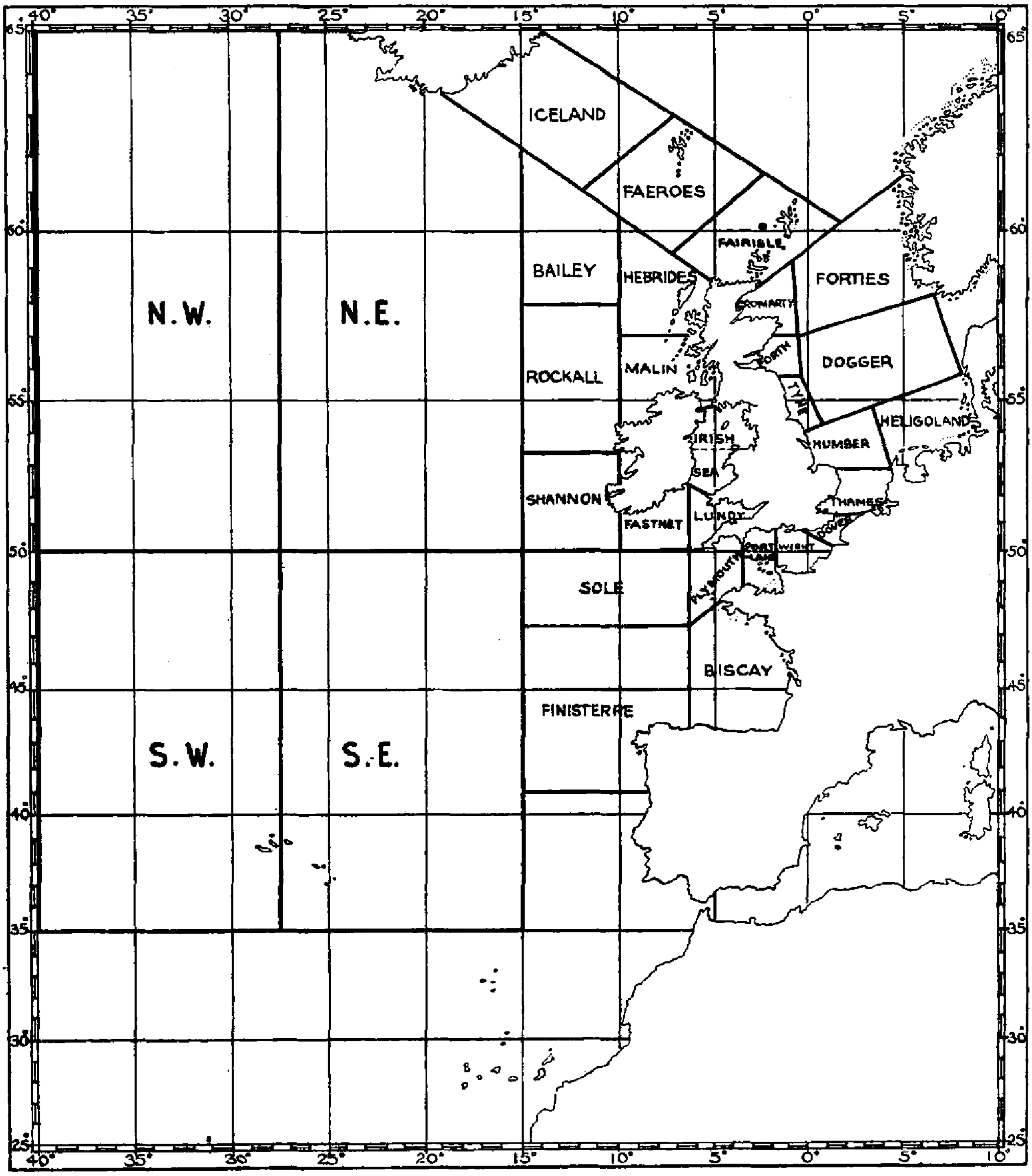
To ensure the accuracy of data collected for the purpose of research and for weather forecasting, ashore and afloat, and to provide a pattern, which may be copied with advantage to all concerned for general use in merchant ships, sufficient tested instruments are lent by the Meteorological Office to the captains of observing ships.

Captains of observing ships are requested to return their Fair Logbooks (Form 911) when full, or when insufficient space remains for the recording of observations during a further complete passage, together with the Record of Coded Messages (Form 911A) covering the corresponding period of observations, to the Meteorological Office.

The Port Meteorological Officers and Merchant Navy Agents inspect instruments quarterly, when possible, and they will replace, as necessary, any gear lent by the Meteorological Office. These officers will also check the accuracy of ships' barometers.

CHART SHOWING THE AREAS USED IN GALE WARNINGS AND WEATHER BULLETINS FOR SHIPPING

EFFECTIVE FROM 1ST NOVEMBER 1948



Note.—The chart given in the Marine Observer's Guide, Special Replacement (Washington Code, 1947), is out of date owing to the early printing of the Replacement

ATLANTIC WEATHER BULLETIN FOR SHIPPING
(Great Britain)

The bulletin consists of six parts, and is broadcast from Portishead as follows:

Parts	G.M.T.	October to March		April to September	
		Call Sign	Frequencies	Call Sign	Frequencies
I, II, III, V, VI	0930*	GIY GKB5 GKC3 GKC5	51·5 (5830) 16440 (18·25) 8210 (36·54) 16885 (17·77)	GIY GKB5 GKC5 GKC6	51·5 (5830) 16440 (18·25) 16885 (17·77) 22010 (13·63)
	2130*	GBZ GKB3 GKC4 GKC6	19·4 (15465) 8340 (35·97) 12612 (23·79) 22010 (13·63)	GBZ GKB4 GKC5 GKC6	19·4 (15465) 12678 (23·66) 16885 (17·77) 22010 (13·63)
IV	1145	GIY GKB6 GKC5 GKC6	51·5 (5830) 22020 (13·62) 16885 (17·77) 22010 (13·63)	GIY GKB5 GKC5 GKC6	51·5 (5830) 16440 (18·25) 16885 (17·77) 22010 (13·63)

Part I. Storm warnings in plain language. Warnings are issued when the wind is expected to reach Beaufort force 10 or over in the area concerned. When there are no storms in the forecast area, that fact is indicated by the words " No storm warnings ".

Part II. Synopsis of weather conditions in plain language.

Part III. Forecasts in plain language for areas Biscay, Finisterre and the NE, NW, SE and SW sections of the region of the North Atlantic from 35°N. to 65°N., between 15°W. and 40°W. These subdivisions are as shown on the accompanying chart. The forecasts are based on 0600 and 1800 G.M.T. observations and cover a period of twenty-four hours from time of issue.

Part IV. Particulars of pressure and frontal systems, including essential isobars in I.A.C. (FLEET).†

Part V. Selection of ships' reports based on 0600 and 1800 G.M.T. observations in form: $YQL_aL_aL_a$ $L_oL_oL_oGG$ Nddff VVwwW PPPTT.

Part VI. Selection of shore station reports based on 0600 and 1800 G.M.T. observations in form: (999II) $iiiT_dT_d$ Nddff VVwwW PPPTT.

* Preceded by marine intelligence.

† See M.O. 477, Marine Observers Guide or M.O. 509, Decode for use of Shipping. Published by H.M. Stationery Office (Price 9d.).

Note.—The schedule given in the Marine Observer's Guide, Special Replacement (Washington Code, 1947), is out of date owing to the early printing of the Replacement.

WEATHER BULLETIN FOR SHIPPING (COASTAL AREAS)
(Great Britain)

For the benefit of coastwise shipping, fishing vessels and yachts, appropriate portions of the Weather Bulletin for Shipping (Coastal Areas) are broadcast daily through British radio coast stations by W/T and/or R/T as follows:

Station	Position	W/T Transmission		R/T Transmission	
		Time G.M.T.	Coastal areas to which forecast refers	Time G.M.T.	Coastal areas to which forecast refers
*Wick (GKR)	58° 26′N. 3° 06′W.	* 0848 2048	*Northern Area*: Iceland, Faeroes, Fair Isle, Cromarty, Forties.	0930 2030	*Northern Area*: Iceland, Faeroes, Fair Isle, Cromarty, Forties.
Stonehaven (GND) ..	56° 57′N. 2° 13′W.	0830 2030	*Eastern Area*: Forth	0930 2030	*Eastern Area*: Forth.
Cullercoats (GCC) ..	55° 02′N. 1° 26′W.	0830 2030	*Eastern Area*: Dogger, Tyne, Humber, Heligoland, Thames	0930 2030	*Eastern Area*: Tyne, Dogger.
Humber (GKZ) ..	53° 20′N. 0° 17′E	—	—	0930 2030	*Eastern Area*: Humber, Heligoland.
North Foreland (GNF)	51° 22′N. 1° 25′E.	—	—	0930 2030	*South Eastern Area*: Thames, Dover.
Niton (GNI)	50° 35′N. 1° 17′W.	0848 2048	*Channel Area*: Dover, Wight, Portland	0930 2030	*Channel Area*: Wight, Portland.
Lands End (GLD) ..	50° 07′N. 5° 40′W.	0848 2048	*South Western Area*: Sole, Plymouth, Biscay, Finisterre	0930 2030	*South Western Area*: Sole, Plymouth, Biscay, Finisterre.
Portpatrick (GPK) ..	54° 51′N. 5° 07′W.	0848 2048	*Western Area*: Irish Sea	0930 2030	*Western Area*: Irish Sea.
Burnham-on-Sea (GRL)	51° 29′N. 2° 48′W.	0848 2048	*Western Area*: Lundy	0930 2030	*Western Area*: Lundy.
Valentia (GCK) ..	51° 56′N. 10° 21′W.	0848 2048	*Western Area*: Shannon, Fastnet	0930 2030	*Western Area*: Shannon, Fastnet.
Malin Head (GMH) ..	55° 22′N. 7° 21′W.	0830 2030	*North Western Area*: Hebrides, Bailey, Rockall, Malin	0930 2030	*North Western Area*: Hebrides, Bailey, Rockall, Malin.

Station will first make announcement on 600 metres (500 kc/s.) for W/T transmission and on 181·8 metres (1,650 kc/s.) for R/T transmission and then request ships to transfer to working frequency of the particular station for reception of weather forecast. R/T transmissions will be broadcast at dictation speed. Forecasts cover next twenty-four hours after time of issue.

* The bulletins broadcast from Wick by W/T at 0848 and 2048 include ice warnings for the Iceland area.

During the ice season, as necessary, warnings are broadcast when conditions in the Denmark Strait are favourable for ice to appear within 10 miles of the North Cape of Iceland. Each warning is repeated at 12-hour intervals, four times in all.

Note.—The schedule given in the Marine Observer's Guide, Special Replacement (Washington Code, 1947), is out of date owing to the early printing of the Replacement.

GREAT BRITAIN—LOCAL WEATHER FORECASTS

Masters of ships and others interested in the movements of shipping and in the loading and discharging of cargo can obtain local weather forecasts from the forecast centre nearest to the port, free of charge.

The addresses and telephone numbers of the forecast centres nearest to the main ports of Great Britain are given below, corrected to December, 1948.

Port	Address of Nearest Forecast Centre	Telephone No.
Aberdeen	The Meteorological Officer, Dyce Airport, Aberdeenshire	Dyce 332. Ex. 70
Bristol	The Meteorological Officer, Bristol Airport, Whitchurch, Bristol	Bristol 26451. Ex. 22
Cardiff	The Senior Meteorological Officer, Air Traffic Control Centre, Royal Air Force, Eastern Avenue, Barnwood, Gloucester	Gloucester 24465/6/7. Ex. 110.
Dundee	The Senior Meteorological Officer, H.Q. No. 18 Group, Royal Air Force, Pitreavie Castle, Dunfermline, Fife	Inverkeithing 264/5 Ex. 118/9.
Falmouth	The Senior Meteorological Officer, H.Q. 19 Group, Royal Air Force, Mount Wise, Plymouth, Devon	Plymstock 223/6. Ex. 109/110.
Glasgow	The Meteorological Officer, Renfrew Airport, Renfrewshire	Renfrew 2352. Ex. 21/3.
Hartlepool	The Senior Meteorological Officer, Royal Air Force, Watnall, Nottingham	Nottingham 45731/5. Ex. 230/1.
Hull	The Senior Meteorological Officer, H.Q. No. 1 Group, Royal Air Force, Bawtry, Doncaster, Yorkshire	Bawtry 363/7. Ex. 6 and 100.
Inverness	The Senior Meteorological Officer, Royal Air Force, Raigmore, Inverness	Inverness 1853/8. Ex. 114/5/6/7.
Kirkwall	The Meteorological Officer, Hatston Airport, Orkneys	Kirkwall 421. Ex. 2.
Leith	The Senior Meteorological Officer, H.Q. No. 18 Group, Royal Air Force, Pitreavie Castle, Dunfermline, Fife	Inverkeithing 264/5 Ex. 118/9.
London	The Director, Meteorological Office, Air Ministry, Kingsway, London, W.C.2	Holborn 3434. Ex. 629.
Liverpool	The Senior Meteorological Officer, Speke Airport, Liverpool, 19	Garston 1240. Ex. 21/2.
Milford Haven	The Senior Meteorological Officer, H.Q. No. 19 Group, Royal Air Force, Mount Wise, Plymouth, Devon	Plymstock 223/6. Ex. 109/110.
Newcastle	The Senior Meteorological Officer, Royal Air Force, Watnall, Nottingham	Nottingham 45731. Ex. 230/1.
Plymouth	The Senior Meteorological Officer, H.Q. No. 19 Group, Royal Air Force, Mount Wise, Plymouth, Devon	Plymstock 223/6. Ex. 109/110.
Southampton	The Senior Meteorological Officer, Southampton Airport	Eastleigh 87228. Ex. 10.
Swansea	The Senior Meteorological Officer, Air Traffic Control Centre, Royal Air Force, Eastern Avenue, Barnwood, Gloucester	Gloucester 24465/6/7. Ex. 110.

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

Captains and observing officers of the Voluntary Corps of Marine Observers will always be welcomed at headquarters, where the Marine Superintendent will be pleased to show them how their observations are utilised in meteorological research and weather forecasting.

Headquarters

Commander C. E. N. Frankcom, O.B.E., R.D., R.N.R., Marine Superintendent, Meteorological Office, Air Ministry, Headstone Drive, Harrow, Middlesex. (Telephone: Harrow 4331, Ext. 324.)

Commander J. Hennessy, R.D., R.N.R., Deputy Marine Superintendent. (Telephone: Harrow 4331, Ext. 323.)

Mersey

Commander M. Cresswell, R.N.R., Port Meteorological Officer, Room 617, Royal Liver Building, Liverpool, 3. (Telephone: Central 6565.)

Thames

Commander C. H. Williams, R.D., R.N.R., Port Meteorological Officer Room 4, Ibex House, Minories, London, E.C.3. (Telephone: Royal 1721.)

AGENTS

Bristol Channel

Captain E. Hall, Room 120, Exchange, Mount Stuart Square, Cardiff Dock.

Clyde

Captain W. W. Elliott, c/o Thomas Hastie & Son, 2–4 Tullis Street, Bridgeton, Glasgow. (Telephone: Bridgeton 3219.)

Forth

Captain G. More, " Craigneuk ", Dechmont, West Lothian. (Telephone: Dechmont 19.)

Humber

Captain R. E. Dunn, c/o Principal Officer, Ministry of Transport, Trinity House Yard, Hull.

Southampton

Captain Sir Benjamin Chave, K.B.E., Royal Mail House, Southampton.

Tyne

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

OFFICERS OF THE METEOROLOGICAL SERVICE OF CANADA

Headquarters

Controller, Meteorological Division, Department of Transport, 315 Bloor Street W., Toronto, 5.

Halifax

O.I.C. Dominion Public Weather Office, 728 Dominion Public Building, Halifax, N.S. (Telephone: 3–8314.)

Saint John

Mr. Francis N. Barnes, The Observatory, Saint John, N.B. (Telephone: 3–3500.)

Vancouver

Mr. C. H. Bromley (acting), 815 Bower Building, 543 Granville Street, Vancouver, B.C. (Telephone: PAcific 3032.)

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