M.O. 262

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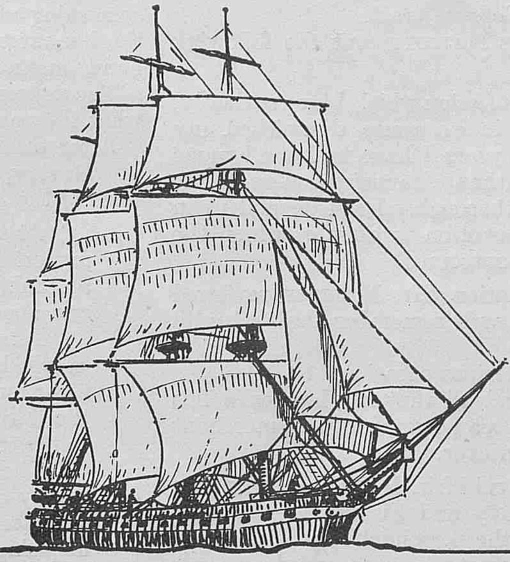

Vol. XII, No. 120.

THE MARINE OBSERVER

OCTOBER 1935.

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HIS MAJESTY KING GEORGE V REVIEWS THE BRITISH FLEETS AT SPITHEAD FOLLOWING THE OCCASION OF HIS SILVER JUBILEE.

On Tuesday, July 16th, 1935, His Majesty reviewed the combined Mediterranean, Home and Reserve Fleets, ships of the Merchant Navy, fishing craft, and yachts at Spithead.

There were present some 160 vessels of war, 28 merchantmen and fishing vessels, and many yachts and pleasure craft.

On coming to the throne in 1910, His Majesty sent the following message to the Navy :—

> "Educated and trained in that profession which I love so dearly, retirement from active duty has in no sense diminished my feelings of affection for it. For 33 years I have had the honour of serving in the Navy, and such intimate participation in its life and work enables me to know how thoroughly I can depend upon that spirit of loyalty and zealous devotion to duty of which the glorious history of our Navy is the outcome."

In 1911, immediately after his Coronation, His Majesty reviewed the Fleet at Spithead, and many of us well remember that splendid display of naval strength.

It was indeed a splendid sight and a glorious occasion.

So much has happened since then, and all that has happened has served to emphasize the true meaning of sea power, in which merchant shipping and fishing fleets are more than ever.

His Majesty by appointing His Son and Heir, H.R.H. The Prince of Wales, Master of the Merchant Navy and Fishing Fleets, gave such encouragement and recognition to the personnel of the Merchant Navy and fishing fleets as had never hitherto been accorded.

Immediately before the Review, he summoned on board the Royal Yacht *Victoria and Albert*, his Flag Officers, and representative masters and skippers of merchant ships and fishing craft, who were presented to him by the Master.

In this number Skipper Ralph Cobby, of the steam trawler *Kingston Cairngorm*, tells us something of his impressions of the Review, and something of the depth of his feeling of loyalty, and appreciation of the honour to the service, which every master, mate, skipper, second hand, engineer, seaman, and seafarer will understand.

The officers of a number of merchant ships present also describe what they observed.*

After the Fleet exercises, which took place on July 17th, following the Review, His Majesty sent the following message to the First Lord of the Admiralty :—

> "At the close of my visit to the Fleet, I wish to express to you my entire satisfaction with everything that I have seen, and to all ranks and ratings of the Royal Navy my hearty congratulations and good wishes.
>
> "I shall not easily forget the impressive spectacle of the Review, in which I am pleased to think that ships of the Merchant Navy have for the first time taken part, while the success with which the Fleet exercises have been carried out to-day bear witness to the traditional efficiency of the Royal Navy.
>
> "These two happy days spent by me at sea, accompanied by my sons, and with the Service to which I have had the honour to belong for so many years, will ever remain one of the most inspiring recollections of my Silver Jubilee."

July 23rd, 1935.

* Space does not permit the publication of a number of contributions.

HIS MAJESTY HONOURS THE MERCHANT NAVY AND METEOROLOGICAL OFFICE.

In the List of Honours conferred by The King on the occasion of His Majesty's Birthday, and in commemoration of the completion of the 25th year of His Majesty's reign, the appearance of five names is of particular interest to the Merchant Navy and the Meteorological Office.

Honorary Captain Sir Robert Burton Chadwick, R.N.R., Deputy Master of the Honourable Company of Master Mariners, has been created a Baronet.

Sir Burton, who deputizes in the Honourable Company of Master Mariners for the Master, H.R.H. The Prince of Wales, gave up his political career so that he could devote the whole of his services to the Merchant Navy.

All who know Sir Burton, and they are many, both afloat and ashore, know the warmth and depth of his sympathy and understanding of those whose business it is to go down to the sea in ships.

The merchant service is honoured in His Majesty's recognition of this master mariner who has done so much to further the service of the Merchant Navy in the national interest.

John Masefield, Esq., Poet Laureate, has been awarded the Order of Merit.

Affectionately known as "Jock" by a great many contemporary seamen, the Merchant Navy rejoices in this "Old Conway" and great man of letters, who followed the sea in his youth, and has since painted the sea and its moods, its ships and its men, in verse which has charmed the nation.

George Clarke Simpson, Esq., C.B., C.B.E., F.R.S., Director of the Meteorological Office, has been created a Knight Commander of the Bath.

Sir George has embraced meteorology since completing his University course. He became Reader of Meteorology at Manchester University, served in the Meteorological Service of India, was with the late Captain Sir Robert F. Scott, R.N., in the Antarctic during his last Expedition, and since the latter part of 1920 has been Head of the British State Meteorological Service.

The science of meteorology must be greatly encouraged by this gracious recognition of the work done by its official Head.

Captain William Arthur Hawkes, R.D., A.D.C., R.N.R., of R.M.M.V. *Britannic* has been created a Commander of the Order of the British Empire.

Captain Hawkes as the senior Captain on the active list of the Royal Naval Reserve, and one of the leading commanders in the Cunard-White Star Line, typically represents the sea-going officers of the British Merchant Navy; and the whole merchant service, ashore and afloat, would wish us to heartily congratulate him on the distinction conferred upon him, which honours the service.

Andrew Cockburn, Esq., R.D., R.N.R., lately Chief Engineer of R.M.S. *Mauretania*, has been created an Officer of the Order of the British Empire.

The service of Mr. Cockburn, in charge of the engines of the most famous Atlantic flyer of the era of the marine steam engine, being thus recognized by His Majesty will do much to encourage the whole service, especially in what in the past was said in our own parlance to be an impossible feat, the mixing of oil and salt water.

The deck and the engine room unite in their good wishes to Mr. Cockburn.

THE SURVEY OF OCEAN CURRENTS.

In this number is summarized the results of our work in the Marine Division during the past seven years in charting the observations of set and drift of current which have been returned since the year 1910 by British ships navigating the Indian Ocean and its neighbouring seas.

Some account is also given of the results which have been obtained by the sub-surface work of the *Discovery* Committee's ships, the JOHN MURRAY Expedition's Egyptian ship *Mabahiss*, and foreign ocean survey work, as far as possible connecting these with the surface work done by the British Corps of voluntary marine observers.

We commend to those who are interested in this scientific work of gaining knowledge of the currents of the oceans the article which appears on pages 153 to 163.

Navigators who desire a more compressed description of the currents through which they navigate their ships are referred to the HANDBOOK OF WEATHER CURRENTS AND ICE FOR SEAMEN.

The new Current Atlas of the Indian Ocean is now receiving finishing touches, and we hope that before very long it may be printed and published.

Looking back to the days before the Great War, when in navigating the Indian Ocean, we suspected that its currents were in fact more complex, strong, and variable with season than was generally shown in the publications of the time on the subject; and looking back to my early days at the Meteorological Office, when so many questions were asked as to the information desired from the sea, and the methods of making current observation or estimates, I must express my gratitude to all those who have worked at this survey.

The response of the corps of marine observers to our requests, put as far as we could in our own simple way of the sea, for observations of set and drift as ascertained in the ordinary way of efficient navigators, has produced a wealth of reliable data which is unsurpassed.

The clerks have first of all listened to our oft repeated advice, and so have learned when they should seek the instruction of those in the Marine Division who have experience in navigation, and who are able best to judge when an observation may be doubtful and therefore should be rejected; and secondly, they have diligently stuck to the tedious process of extracting and computing the observations into vector means and current roses.

The cartographers have done yeoman service in bringing the charting of currents up to its present pitch, and in changing the charts from what one navigator described as "sheets covered with coloured tadpoles" to the black and white productions of THE MARINE OBSERVER.

Mr. BARLOW has sifted the computations, and examined the charts, and studied closely the literature of oceanography. He is author of the descriptions given in this Journal, which have done so much to lighten the darkness where there was darkness in the published information.

His has been a long and trying task well done.

THE DISPOSITION OF THE BRITISH VOLUNTARY OBSERVING FLEET.

TODAY, July 11th, 1935, the number of British Voluntary observing ships, that is, all the seagoing ships in the Fleet List, and the oceans which they traverse, with the numbers of those which are detailed as Selected Ships, are shown in the following table.

Oceanic distribution of the voluntary Observing Fleet.

July 11th, 1935.

Ocean.	Form 911.	M.L.	Total.	Selected Ships.
North Atlantic including Home Waters and the Baltic ...	67	7	74	48
South Atlantic ...	41	0	41	40
North Indian ...	71	0	71	71
South Indian ...	65	0	65	58
North Pacific ...	12	22	34	26
South Pacific ...	41	5	46	38
Arctic	6	0	6	4
Antarctic	0	1	1	0
Stationary Ships and Stations	—	—	5	0
TOTALS	303	35	343	285

The Chart of the World on next page indicates the number of British observing ships doing all branches of the work on the different trade routes.

The total is exact, but the numbers on the different tracks are approximate.

Most observing ships commence and end their voyages in ports of Great Britain. A number are on station in the Pacific, and a few make round the world voyages only occasionally returning to the British Isles.

The number of observing ships shown on each track does not in all cases indicate the total observing ships using that track. For instance, on the track through the Mediterranean, only 10 observing ships are shown, but most of the observing ships shown as using the routes to the eastward of Perim also use the route through the Mediterranean; and the same of course applies to the route from the British Isles to the West Indies, for many ships navigating the Pacific pass through the Panama Canal.

With a total of 338 seagoing observing ships, the distribution at present is remarkably good; and 338 ships regularly returning written records and logs of carefully made observations, provide the Marine Division not only with sufficient data for all its own researches, but also enable it to secure a good service for the Forecast Division of the Meteorological Office, and to supply other countries with a reasonable number of observations made in British Ships.

Regarding the service of routine wireless weather reports at sea, it may appear to those who are not entirely familiar with the system which has been established, and which is being steadily extended, that 285 British Selected Ships are inadequate. This is not the case. Selected ships are the backbone of the system. They are the permanent voluntary working ships of this great service. They act as a valuable guide to all shipping in this matter of systematic routine wireless weather telegraphy.

When and where there are not selected ships, *any* British Ship is asked to carry on the service; and special guidance is published for all ships registered in Great Britain and Northern Ireland in the Pamphlet M.O. 329, which may be purchased from H.M. Stationery Office.

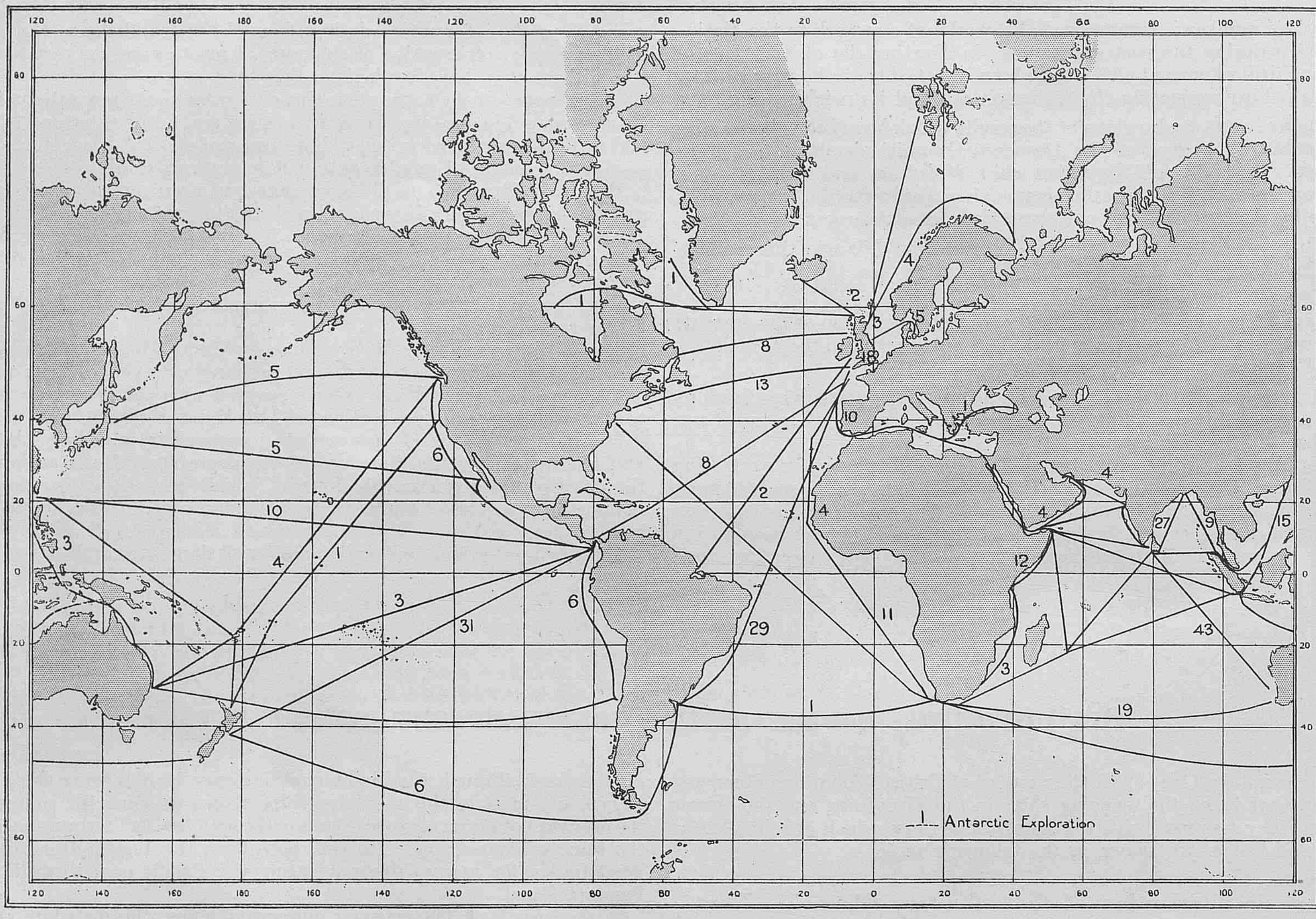
Recently, during my visits to the ports in Great Britain, the respective Shipowners' Associations have very kindly indicated that they would afford assistance in making known the desirability of all British ships having on board the Decode, and the guidance which is given in the pamphlet, M.O. 329.

Notices to Mariners have been published by the Admiralty and by a considerable number of Harbour Masters in the British Dominions and Colonies, requesting British ships to carry on this service, when and where necessary.

With the information given in the Pamphlet M.O. 329, and the HANDBOOK OF WEATHER, CURRENTS AND ICE FOR SEAMEN, the good judgment of the master of each British Ship will, we believe, in the long run be more effective than if hard and fast rules are attempted.

The British Merchant Navy has ever been able to organize itself to perform all necessary services required of it.

Chart of the World indicating the Number of British Observing Ships using the different Trade Routes on 11th July, 1935.



338 Foreign-going British observing ships indicated on routes.
5 Stations and stationary ships not indicated.

Total 343

TONNAGE.

Soon after we commenced our attempts to organize routine wireless weather reporting as an aid to navigation, it became evident that if foreign countries and ships at sea, as well as the British Forecast Service, were to be provided with a well regulated service of weather reports, some arrangement must be made for a division of the work.

The International Ice Patrol was and is paid for by the different nations whose ships navigate the Western North Atlantic, in accordance with their proportion of the world's tonnage.

No better way could be found than making an agreement, within the Contract of Article 35 of the Convention for Safety of Life at Sea, by which each maritime nation would provide the number of Selected Ships, proportionate to its share of the world's tonnage.

At present the total number of Selected ships of all nations agreed upon is 1,000; and the tonnage of steam and motor vessels of over 100 tons is used for calculating the number of Selected Ships which each nation party to the Convention should maintain.

Lloyd's Register of Shipping for 1935–36 is just published, and in accordance with our usual custom, we reproduce, with three additional columns, the revised table below.

It will be seen by the above table that the proportion of tonnage registered in the ports of Great Britain and Northern Ireland has fallen from 17,629,548 tons and 28·7 per cent. of the world's tonnage, to 17,298,432 tons and 28·5 per cent. of the world's tonnage.

Decreases of their proportion of the world's tonnage have been also suffered by Canada, one thousandth, United States of America, one thousandth, France, four thousandths, Holland, one thousandth, Panama, two thousandths; while the following countries' proportion of the world's tonnage has increased :—China, two thousandths, Danzig, one thousandth, Germany, one thousandth, Greece, three thousandths, Japan, one thousandth, Russia, three thousandths.

The number of British Selected Ships will be accordingly reduced from 287 to a total of 285.

These 285 British ships continue regularly to make routine weather reports for the benefit of all ships and most meteorological services in all parts of the world; and *all* British ships are asked, when and where necessary, to carry on this service, and so make as complete as possible the voluntary meteorological service of British Seamen, as an aid to navigation and an assistance to those who need weather intelligence ashore and in the air.

If for local reasons, British ships are asked locally to report weather at times other than those of the routine times for British Selected Ships, they are requested to do so if convenient; but British Selected Ships, and British ships carrying on the service where there are not selected Ships, should in such cases also report at the routine times laid down, so that there may always be a service of routine weather reports made at schedule times for the benefit of navigation.

Total Merchant Tonnage approximate (Steam and Motor) of the World

(Vessels over 100 tons, Lloyd's Register Book, 1935–36)

and Number of Selected Ships required for making W.T. Weather Reports in all Oceans, World Wide.

Country.	Steamers and Motor Vessels.		Percentage of World Tonnage.	Number of Selected Ships required.	Approximate Number of Ships fitted for C.W. Long Wave Transmission (July, 1935)
	Number.	Gross Tons.			
Great Britain and Ireland.	6,998	17,298,432	28·5	285	155
Australia and New Zealand.	525	609,107	1·0	10	—
Canada (excluding Lakes).	623	863,737	1·4	14	17
Hong Kong ...	121	305,154	0·5	5	3
India and Ceylon...	159	208,241	0·3	3	1
South Africa and Other Colonies*.	574	568,332	0·9	9	5
British Empire Total.	9,000	19,853,003	32·6	326	181

Country.	Steamers and Motor Vessels.		Percentage of World Tonnage.	Number of Selected Ships required.	Approximate Number of Ships fitted for C.W. Long Wave Transmission (July 1934)
	Number.	Gross Tons.			
British Empire Total.	9,000	19,853,003	32·6	326	181
America (United States)(excluding Lakes).	2,658	9,743,235	16·0	160	585
Argentine	298	316,747	0·5	5	1
Belgium	185	402,221	0·7	7	8
Brazil	293	485,995	0·8	8	12
Chile	90	142,136	0·2	2	—
China	267	454,258	0·8	8	—
Danzig	41	265,962	0·5	5	—
Denmark	694	1,098,648	1·8	18	28
Finland	302	417,890	0·7	7	—
France	1,382	2,989,386	4·9	49	16
Germany	2,070	3,693,298	6·1	61	42
Greece	589	1,711,165	2·8	28	—
Holland	1,397	2,553,776	4·2	42	22
Italy	1,041	2,838,354	4·7	47	123
Japan	2,146	4,085,650	6·7	67	253
Jugo-Slavia ...	166	346,618	0·6	6	—
Latvia	99	189,343	0·3	3	—
Norway	1,858	3,966,709	6·5	65	14
Panama	42	136,859	0·2	2	14
Portugal	183	237,840	0·4	4	13
Russia (Soviet Union).	575	1,110,811	1·8	18	10
Spain	877	1,164,271	1·9	19	12
Sweden	1,272	1,540,890	2·6	26	3
Turkey	182	199,284	0·3	3	—
Other Countries ...	659	871,885	1·4	14	9
Total ...	28,366	60,816,234	100·0	1,000	1,346

* Including Dominion of Newfoundland.

VOLUME XII.

Volume XII will be completed when the December, 1935, Supplement is published on November 27th next.

Binding covers may be purchased from H.M. Stationery Office as usual.

Some receivers of The Marine Observer have had the numbers, complete with cover, etc., bound together The result is cumbersome, and does not do credit to The Marine Observer.

The Marine Observer is so designed, that each year it may be bound into a neat and handy volume.

It is recommended that from each number, the cover, advertisement pages, fleet list and North Atlantic Ice Chart, all containing information which is not permanent, or will be repeated, should be removed.

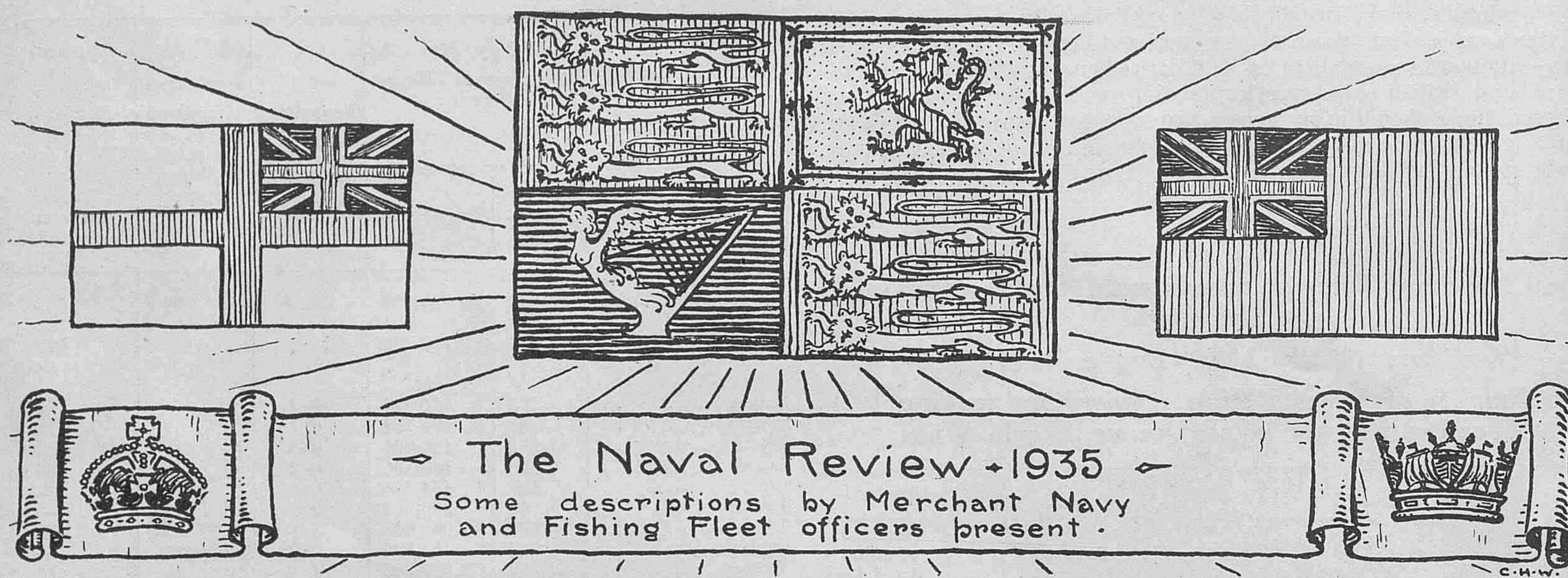
When these have been removed, there will remain pages numbered in sequence throughout each number, also pages unnumbered containing lithographic charts which follow the numbered pages in the quarterly numbers.

These should be placed in the volume cover, and bound.

We thank all most heartily who have contributed to The Marine Observer, the Captains and Officers of ships who have sent in remarks and articles for the Marine Observer's Log, Mr. Greenland of Portishead Radio, who provided such interesting information of the work of Post Office stations, the Merchant Navy Agents, the Branch Officers at the Ports, the Contributors of the Marine Division and the printers.

Marine Superintendent.

London,
July 11th, 1935.



IMPRESSIONS OF THE JUBILEE REVIEW AT SPITHEAD.

BY SKIPPER RALPH COBBY, S.T. "KINGSTON CAIRNGORM," HULL.

WHEN first I heard that the fishing fleet was to be represented at the Jubilee Review I felt very pleased that the King had recognized our trade as being of an importance greater than I had imagined. Little did I then think that it would fall to my lot to be the lucky skipper to take the *Kingston Cairngorm* of the Kingston Steam Trawling Co., to represent Hull at the Jubilee Naval Review. And it was only just before leaving Hull for Spithead that I learned that I had been selected as one of the representative fishing skippers to be presented to HIS MAJESTY.

We left the N.E. coast of Iceland on July 4th, and landed our trip of fish at Hull on July 8th. Our ship was taken in hand for a bit of a clean up the same day, and we sailed for Spithead on July 12th. The passage south was foggy, but we reached the Nab Tower early on Sunday, July 14th. By permission of the Commander-in-Chief, Portsmouth, we took up a berth in Portsmouth Dockyard, being fortunate enough to be placed alongside H.M.S. *Doon* of the Fishery Protection Service, whose officers gave us a hearty welcome. Shortly after we received a visit from Capt. E. J. SPOONER, R.N., Captain of the Navigation School, who was very interested to see one of the most modern trawlers, and to discuss the problems of our calling as fishermen.

This had been my first trip south since I was in a minesweeping trawler at Calais, 1916/17. Early on Monday, July 15th, we took up our berth with trawlers from Milford, Fleetwood, Lowestoft and Brixham, and it was not long before we again had occasion to appreciate the feeling of good fellowship of the Navy to us fishing folk. Shortly after anchoring, a Lieutenant-Commander from H.M.S. *Viscount* came to offer the services of their boats in getting to and from the shore. At the same time he extended to us the hospitality of the ship's ward room.

Passing through the lines on the way to our berth the smart appearance of all the ships made a great impression on my crew. During the day the opportunity was taken of visiting brother skippers from other ports and H.M.S. *Viscount*. It was a special privilege to meet Capt. WALTERS of the *Bluenose*, a crack ship of the Newfoundland Banks, with whom different methods of fishing were discussed. In the evening we dressed ship overall.

On Tuesday, July 16th, a picket boat conveyed skippers from *Bluenose*, *Phyllis Rosalie*, *Arthur Cavanagh* and myself to H.M.S. *Hood*, where we were received on the quarterdeck by Admiral Sir S. R. BAILEY, the ship's company being called to attention as we stepped aboard. Another picket boat brought the other trawler skippers. After a short stay, during which we were taken to the ward room and made to feel we were among real friends, we were reminded, all too quickly, by the officer of the watch, that the boat was alongside to take us to the *Victoria and Albert*. Completely strange to such a ceremony we were relieved to have a few moments respite whilst the Flag Officers were boarding the Royal Yacht before us. Then came a launch with five captains from the *Berengaria*, *Alcantara*, *City of Venice*, *Ranpura* and *Warwick Castle*, and immediately afterwards our launch was called alongside the gangway.

As plain fishermen we felt embarrassed and nervous of committing a breach of naval etiquette, but immediately on reaching the top of the gangway an admiral shook us by the hand, and in a few words put us at our ease. We felt that each officer by his handshake made us lose that diffidence we naturally felt in such unusual company. I personally felt particularly honoured that the First Lord of the Admiralty saw fit to come and chat with me about the general arrangements for assembling the fleet and express his satisfaction that everything thus far had passed off so well. Soon after the word was passed along to stand by for the presentation. We were placed in our correct order, and following the Flag Officers, the Masters of the Merchant Navy were presented by the PRINCE OF WALES as Master of the Merchant Navy and Fishing Fleets.

After this came the fishermen's turn, and I happened to be the first skipper to shake hands with HIS MAJESTY, followed by skippers from Fleetwood, Milford, Yarmouth, Lowestoft and Lunenburg. The KING said how pleased he was to meet us men and how satisfied he was with the favourable weather for the Review. He asked me how long I had served at sea. I replied 25 years, including 5 years in the Navy, and before I gave place to Skipper Homes of Fleetwood, HIS MAJESTY again said how pleased he was to meet us fishermen.

On completion of the presentation a group was formed in which the KING was photographed with his son and eleven master mariners. The KING himself directed the placing of the group, particularly insisting that Skipper MOXEY, who had drawn a little too far to the left, should move up so that all of him should be included in the group. Following this we left the Royal Yacht after an experience the remembrance of which I shall cherish all the days of my life.

Shortly after I got back to the *Kingston Cairngorm* the *Victoria and Albert* was approaching our position in the line. Without any pressure on my part the crew had already polished and scrubbed the ship to look worthy of the great occasion, and as the Royal Yacht approached they fell in in Navy fashion, and cheered with an enthusiasm which showed that the fishermen felt their position as loyal subjects of HIS MAJESTY honoured by his invitation to the Jubilee Review.

In conclusion, I may say that as an ex-service man and the chosen representative of Hull, the sight of this wonderful assembly of power and the genuine cheers of those thousands of sailors brought a lump to my throat and a confidence in the future welfare of our country.

THE ROYAL NAVAL REVIEW.

BY LIEUT. J. A. SERGEANT, R.N.R. SUPERNMY. 2ND OFFICER, R.M.S. "RANPURA," CAPTAIN G. H. S. FURLONG, C.B.E., R.D., R.N.R., COMMODORE OF THE PENINSULAR AND ORIENTAL STEAM NAVIGATION COMPANY.

IN the recent inspiring spectacle of the Naval Review at Spithead, the weather again lived up to its Jubilee reputation and played no small part in the brilliant success which attended HIS MAJESTY'S sojourn with his Fleet. At the critical moment when the Royal Yacht slipped her moorings and commenced her stately passage through the long lines of ships, a light breeze came away from the W.S.W., clearing away the smoke and haze, which for several hours previously had made ships at the opposite ends of the lines almost invisible to one another, the sun shone from between small white clouds, the flags stretched out and floated as though made of cardboard. There was only one word for it, the setting was perfect.

The meeting of might and splendour, although essentially a review of the Fleet, the scene would have lost a very great deal of its beauty had not the ships of the Merchant Navy been present. Many times have great fleets gathered together, but never before have so many fine liners been seen in one place, and doubtless it will be many years before the Merchant Navy will have a chance of putting up such a fine show again. These great ships added the colour and brilliance to an already splendid scene, and formed a fitting background to the awe-inspiring masses of grey might and power.

On Monday afternoon the *Ranpura* arrived off Spithead, and approaching the huge mass of ships just at the turn of the tide when they were swung in all directions, it was almost impossible to tell that they were in orderly lines, each the correct distance apart, in fact, it looked as though they must have just come in and dropped anchors haphazard, regardless of how they might swing; when, however, the tide began to run steadily, the nine long lines could be clearly seen. A lot of hard thinking must have been required in arranging the berthing of that huge assembly of ships of all sizes, ranging from *Berengaria* down to the smallest yacht, and so well was it done that there did not seem to be an inch of space wasted in which a ship could safely anchor.

Ranpura steamed through the fleets between E. & F. lines to her berth off the S.E. Ryde Middle Buoy, at a speed of about 6 knots, as anything greater than this would have been impossible, for the whole area was a seething mass of small boats of every shape and size, from steam yachts to sailing dinghys. On all the ships, which looked as well, perhaps, as they ever looked in their lives, the last touches were being administered to sides, superstructures and decks, and everything that could possibly be polished, shone at its best. No one who knew anything about ships or the sea could possibly fail to realize the marvellous control and organization which must have been exercised in getting all these ships into their correct positions in such a restricted space. The station keeping at the last moment must have been perfect. Each ship was moored and on a mooring swivel.

On Tuesday afternoon, during the period of the actual review no boats or craft were supposed to move in the area, and it was amazing to see within a few minutes of 1 p.m., the time fixed for the clearing of the area, the sudden change, where a few minutes before there had been an almost chaotic mass of craft, nothing beyond the patrol boats seemed to move, there was an almost flat calm, even the flags were still.

The ships of the Merchant Navy were all anchored to the southward of the fleet, the bigger ships being in two groups, one at each end of the Review area, while the representatives from the fishing fleet were to the northward in the neighbourhood of Stokes Bay. The berthing arrangements were very simple. Most of the ships lay at single anchor, and in addition to detailed instructions, in most cases a Dan buoy was placed in the position in which each ship should drop her anchor.

This is, I believe, the first occasion on which the Merchant Navy have been actually invited to send ships to a review, and their presence there was still further acknowledged when His Majesty did them the honour of receiving on board the *Victoria and Albert*, several captains and fishing fleet skippers. Among those presented by H.R.H. The Prince of Wales, was Captain G. H. S. Furlong, C.B.E., R.D., R.N.R., Commodore of the P. & O. S.N. Company, and commanding the *Ranpura*. This cruise to Spithead was Captain Furlong's last voyage, he retired on return of the *Ranpura* to London; a fitting ending to a long and fine career.

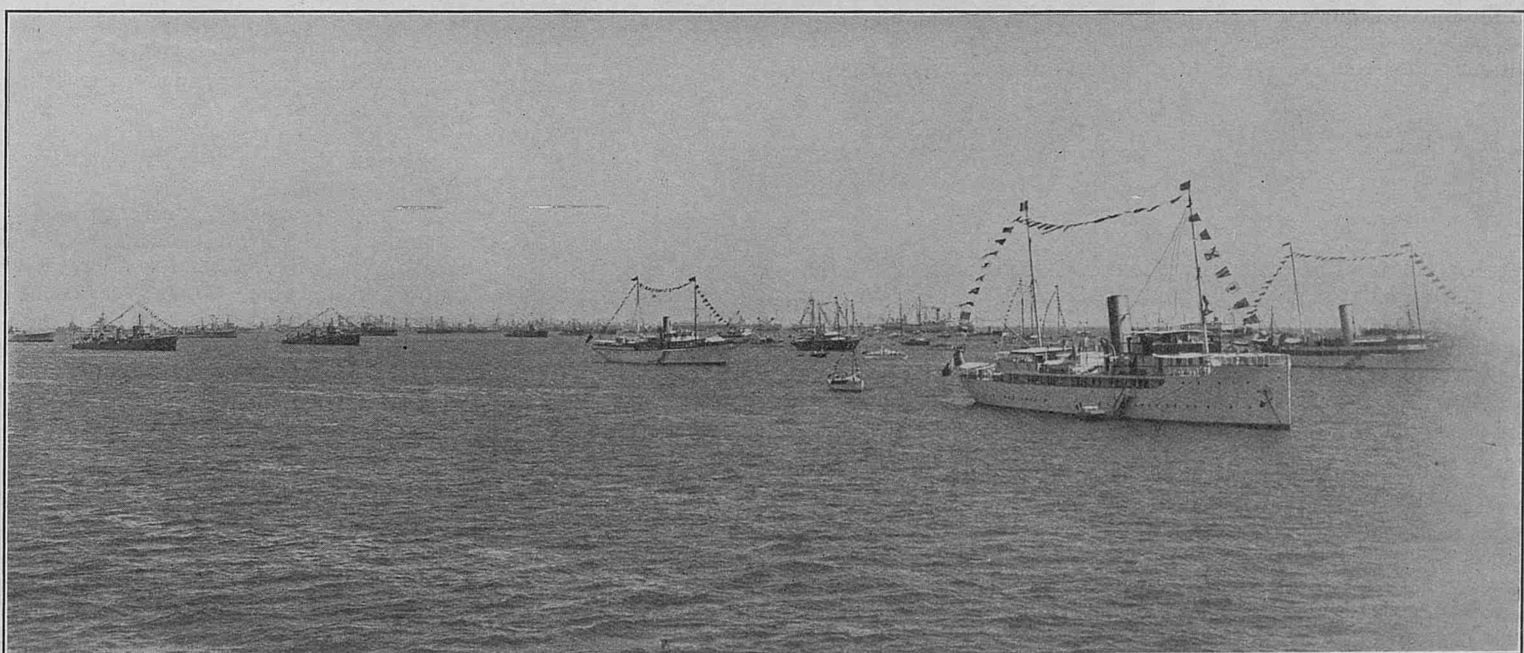
It is worthy of note that on Monday evening there were only about three of the liners in their berths, but by noon on Tuesday, despite the press of shipping, all ships were in their places apparently without the slightest hitch, and when the dispersing commenced shortly after midnight on Tuesday, the ships quietly slipped away at quarter of an hour intervals, either to sea or to new berths between the Nab Tower and Ryde to watch the fleet proceeding to sea the next morning.

From our position in the *Ranpura* we had an excellent view of all the proceedings; we were, perhaps, a little bit too far away for a good view of the battleships, and the breeze which came up in the afternoon drowned the sound of guns, and even of the cheering, but we could hardly have had a better view of the Royal Yacht and her attendant craft, and by night our view of the illuminations could hardly have been bettered. We were just far enough away to see everything without being right on top of it. They were worth seeing, too, and the precision with which all the various effects were carried out was perfect.

I don't think anyone could possibly forget what they saw during those two days. We were present, too, in St. Helens Roads when His Majesty led the fleet to sea on Wednesday morning. Some of the ships started at 6.00 a.m., and the long procession seeming almost interminable only came to an end at about 11.00 a.m. The remaining merchant ships then quietly went away, and thus ended one of the most mighty gatherings of ship of all classes and sizes that will be seen probably for many years. Favoured by glorious weather it was a brilliant success, and must remain a source of inspiration to all who were privileged to see it, for many years to come.

THE FLEETS AT SPITHEAD.

Taken from R.R.S. " Discovery II." Captain A. L. Nelson.



THE JUBILEE NAVAL REVIEW AT SPITHEAD ON JULY 16TH, 1935. AS SEEN FROM THE M.V. "ULSTER PRINCE." CAPTAIN W. J. PAISLEY.

By Lieut. J. B. Wright, R.N.R., 2nd Officer.

At 8.30 a.m. we weighed anchor in St. Helens Roads and proceeded towards the Fleet. At 9.15 we entered between lines E. and F., headed respectively by the flagships *Queen Elizabeth* and *Nelson*. Our attention was riveted on each warship as we passed, and each succeeding vessel only added to the pride we felt in our Navy. We completed the tour with the eastward run between lines D. and E., passing amongst others, *Hood*, *Courageous*, *Furious*, *Renown* and *Revenge*. We reviewed the fleet individually on our tour of the lines; but it was not until we anchored in our appointed position about 1 mile N.W. from Ryde Pier, that we really saw the vastness and completeness of the fleet assembled, together with the vessels of the Merchant Navy, fishing vessels and other small craft, all at anchor awaiting the King's inspection. The panorama spread out before our eyes was beyond the power of pen to adequately describe. Bunting was flying from the masthead of every type of vessel, from battleship down to patrol boat, and from ocean liner to fishing vessel.

At a few minutes after 2 p.m. we saw the Royal Yacht *Victoria and Albert*, with our King on board coming out of Portsmouth Harbour. The fleet thundered out its salute of 21 guns and the bands played the National Anthem. The Royal Yacht proceeded to take up a position at the head of the lines, and later many boats could be seen visiting her. At 4 p.m. the King began his progress through his Fleet. The *Victoria and Albert*, with the Royal Standard flying, was preceded by the Trinity House vessel *Patricia* and followed by the Admiralty Yacht *Enchantress*. As the Royal Yacht passed she was greeted by the cheers of each ship, to which was added those from the thousands assembled upon the shore. After completing her tour of the Fleet the Royal Yacht again took up her position, and the Fly Past of the Fleet Air Arm took place, consisting of seaplanes and aeroplanes flying in groups, each group diving simultaneously to salute before passing over the *Victoria and Albert*.

At 10 p.m. a rocket was fired from the Royal Yacht, and instantly the whole fleet became etched in lines of light, making a beautiful, and at the same time, astonishing picture, even the flags at the mastheads being framed in light. Another rocket, then total darkness, followed by all battleships being illuminated by red flares, every fourth man stationed along the rail of his ship holding a flare above his head. Presently yet another signal from the Royal Yacht, and then the whole sky seemed to be one large brilliant intricate patchwork pattern formed by the fleet's hundreds of searchlights. These were suddenly withdrawn, and then came the most wonderful sight of the whole day—every ship of the fleet sent up rockets throwing out coloured stars of red, white and blue, turning the night into day, and clearly outlining every ship at Spithead. The ships were then again illuminated and remained so until midnight, thus terminating a day of brilliant display, perfectly organized, and blessed with weather conditions which could not have been better for the occasion.

R.M.S. "LANCASTRIA." CAPTAIN E. EDKIN, O.B.E., R.D., A.D.C., R.N.R.

By Mr. O. V. Lucas, Third Officer.

We arrived off the Nab at 0729, and entered between E. and F. lines of the Fleet, and passed across F and G lines to take up our berth. The sight steaming up the lines was most impressive and a spectacle never to be forgotten.

We took up station at 0924. The wind being W.S.W. force 3, with a slight haze. By 1245 all ships were in their respective berths. Crafts of all kinds were gaily decorated with flags. At about 1300 the weather cleared, visibility becoming excellent with a moderate W.S.W. wind.

From our berth off the S.E. Ryde middle buoy, we could clearly see the Royal Yacht *Victoria and Albert* leaving Portsmouth Harbour preceded by the Trinity House Yacht *Patricia*, and followed by the Admiralty Yacht *Enchantress*. The Royal Yacht took up her berth at the S.E. end of E line. At this time one single aeroplane was flying overhead. The firing of the Royal Salute by the Fleet was not very distinct owing to our weather position; but we could clearly see the smoke from the guns as they were fired.

During the afternoon His Majesty received members of the Merchant Navy and the fishing fleets, amongst them being the Commander of the *Berengaria* and the *Warwick Castle*. These Commanders were given three hearty cheers as they boarded their respective vessels from the naval picket boat on the return from their presentation to His Majesty.

At 1600 the Royal Yacht, preceded by the Trinity House Yacht *Patricia* and escorted by the Admiralty Yacht *Enchantress*, steamed along between D and E lines and back between F and G lines, each ship giving three cheers as the Royal Yacht passed by. At this time several planes were rising in groups of three from their depots and flying away out of sight to take up formation.

We, in the *Lancastria*, had a splendid view, and could distinctly see His Majesty on the bridge of the *Victoria and Albert*, also other members of his staff in full dress uniforms. At about 1730 the planes came flying along in formation, approximately 150 of them, making a very grand sight.

At about 2200, by a given signal the whole of the fleet was illuminated simultaneously, which made a beautiful sight. Some time afterwards all lights were extinguished, and at another signal every vessel of the fleet sent up rockets which burst into red, white and blue stars. This was followed by a most wonderful searchlight display. At midnight lights were extinguished except for the necessary regulation lights.

At 0100 on the 17th we shifted our berth to one allotted to us approximately seven cables south of the Warner Light Vessel, in order to view the fleet proceeding to sea for firing practice. The first of them came by about 0430, and a continuous procession of vessels passed by until the last about 0930, after which we weighed anchor and proceeded to sea. The weather remained perfect throughout the whole of the review.

AN ACCOUNT OF THE ROYAL NAVAL REVIEW, AS SEEN FROM THE R.M.S. "ASTURIAS." CAPTAIN R. G. CLAYTON, D.S.C., R.D., R.N.R.

By Mr. H. R. Hendin, 1st Officer.

R.M.S. *Asturias* sailed from Southampton at 8.30 p.m. on July 15th 1935.

Proceeding down Southampton Water provided many sights of interest: the whole effect being enhanced by the beauty of a fine summer evening. It was almost calm until the ship approached the Solent, when a light S.W. wind was felt.

Arriving off Egypt Point, the ship was anchored at 9.42 p.m.

The lights of Cowes, vessels at anchor, and the moon, nearly full, rising over the Isle of Wight, made a very pleasing picture.

At 7.20 a.m. on Tuesday, July 16th 1935, the anchor was weighed and the ship proceeded towards the Royal Review area; entering the lines of H.M. ships at 7.48 a.m. and steamed down between "F" and "G" lines.

Approaching the Fleet many well known craft with familiar names were passed, *Bluenose*, *Yankee*, *Sunbeam* etc.

Passing down the lines was a most impressive experience.

Here was evidence of Britain's strength and power afloat. Each ship so exactly in position as to cause expressions of wonder. Famous ships were passed, *Iron Duke* of Jutland fame, *Vindictive*, *Renown* and *Hood*.

Passing out of the lines at 8.23 a.m. the ship was turned and proceeded towards her Review position, anchoring at 8.43 a.m.

During the forenoon Spithead was the scene of great activity; ships getting into their allotted positions, numerous small craft of various rigs, from ocean going yachts to small dinghies, all out to see the Navy and later to watch the King review his ships.

Brilliant sunshine prevailed with a cloudless sky. The heat tempered by a light S.W. breeze.

Shortly after 2.00 p.m. the Royal Yacht *Victoria and Albert* appeared, coming out of Portsmouth Harbour, flying the Royal Standard. She was preceded by the Trinity House Yacht *Patricia* and escorted by the Admiralty Yacht *Enchantress*.

His Majesty the KING was saluted by the guns of the Fleet as the Royal Yacht approached her moorings, which were reached at about 2.40 p.m.

During the afternoon various launches went alongside the Royal Yacht taking the Board of Admiralty, Flag Officers flying their Flags at Spithead, and the Captains of certain Merchant Ships, to be presented to His Majesty the KING.

At 4.00 p.m. HIS MAJESTY in the Royal Yacht steamed through the lines of the Fleet, again preceded by the *Patricia* and followed by the *Enchantress*, while a mile astern of these followed the *Maine* and several other vessels carrying members of the Government and other notable personages.

The Men-of-war made a brave show with all flags flying and their crews formed up, lining the decks, as HIS MAJESTY passed by.

At 5.30 p.m. the Royal Yacht arrived back at her buoy and almost immediately there followed a fly past of machines of the Naval Air Arm. This in itself was a magnificent spectacle. The formation was perfect and the " dip in Salute " over the Royal Yacht wonderful to watch.

At 10.00 p.m. the whole Fleet was illuminated simultaneously on a signal from the Royal Yacht, the larger ships outlined in thousands of white lights and the smaller craft with a span of lights from stem over mastheads to stern.

Later the ships were suddenly darkened and then illuminated with red lights (flares) which as they burned low were all thrown into the water together.

Then followed a Searchlight Display, hundreds of beams of light flashing and forming moving trellis work patterns in the sky.

Then darkness, and suddenly thousands of rockets shot upwards and bursting, showed splashes of coloured lights which hung in the air and then slowly descended and faded out.

After these displays the ships remained illuminated until midnight when they were suddenly darkened.

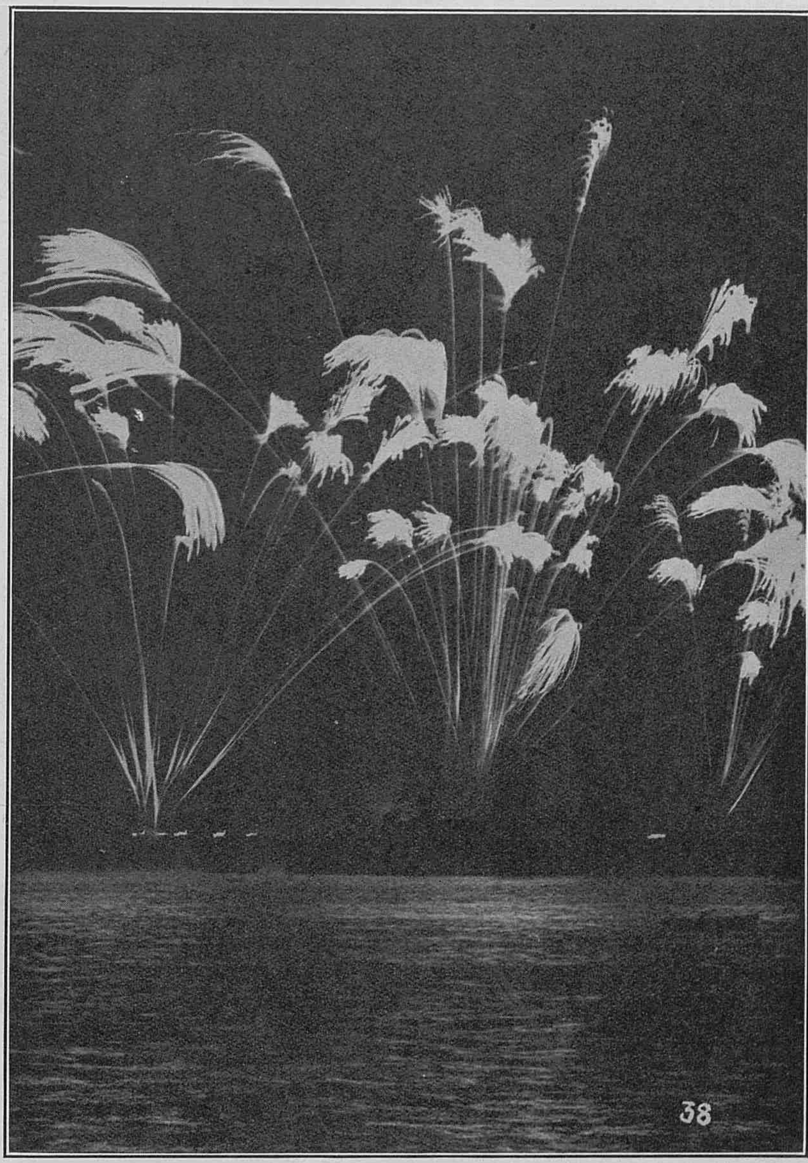
This terminated the Royal Naval Review.

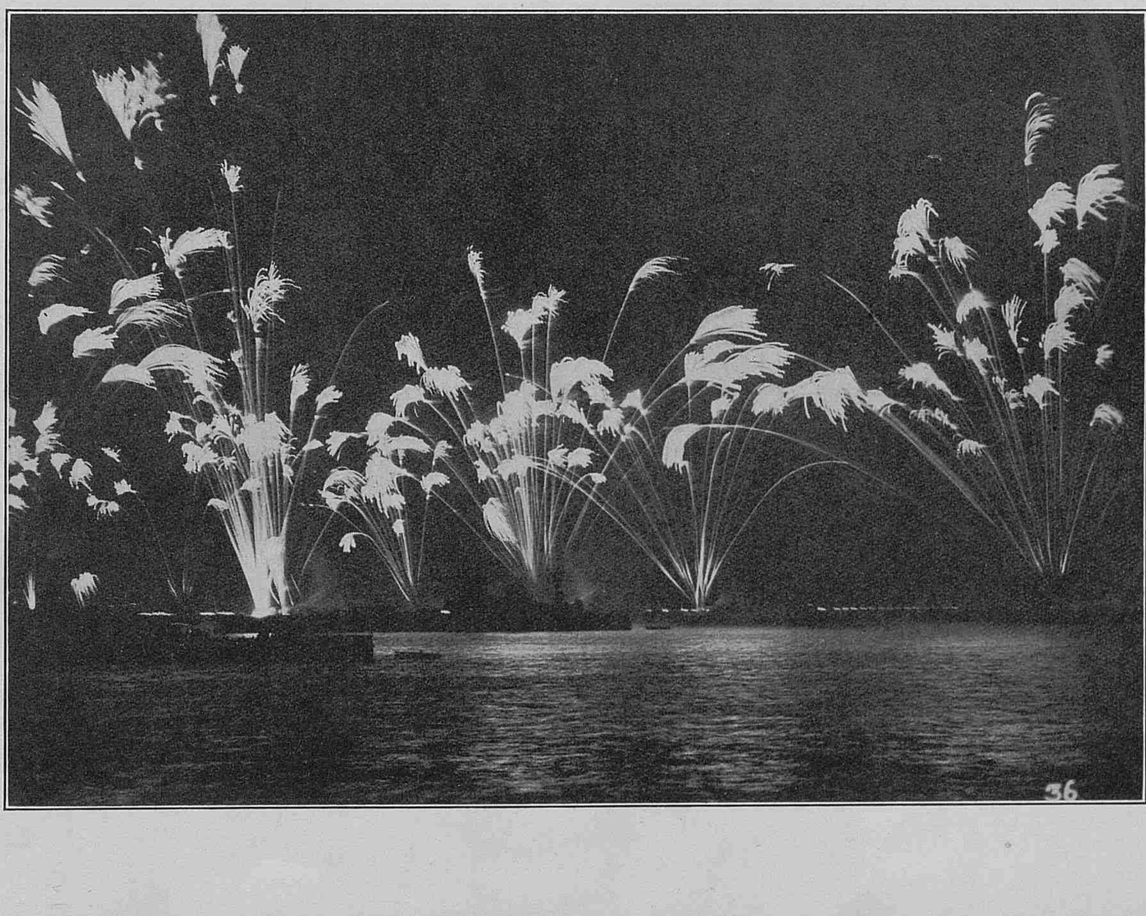
At 4.00 a.m. the Fleet commenced to disperse. First Destroyers unmoored and proceeded to sea. These were followed by Cruisers, and at 8.00 a.m. His Majesty the KING in the Royal Yacht led the Battle Fleet to sea for exercises, with the Aircraft carriers *Furious* and *Courageous* following astern.

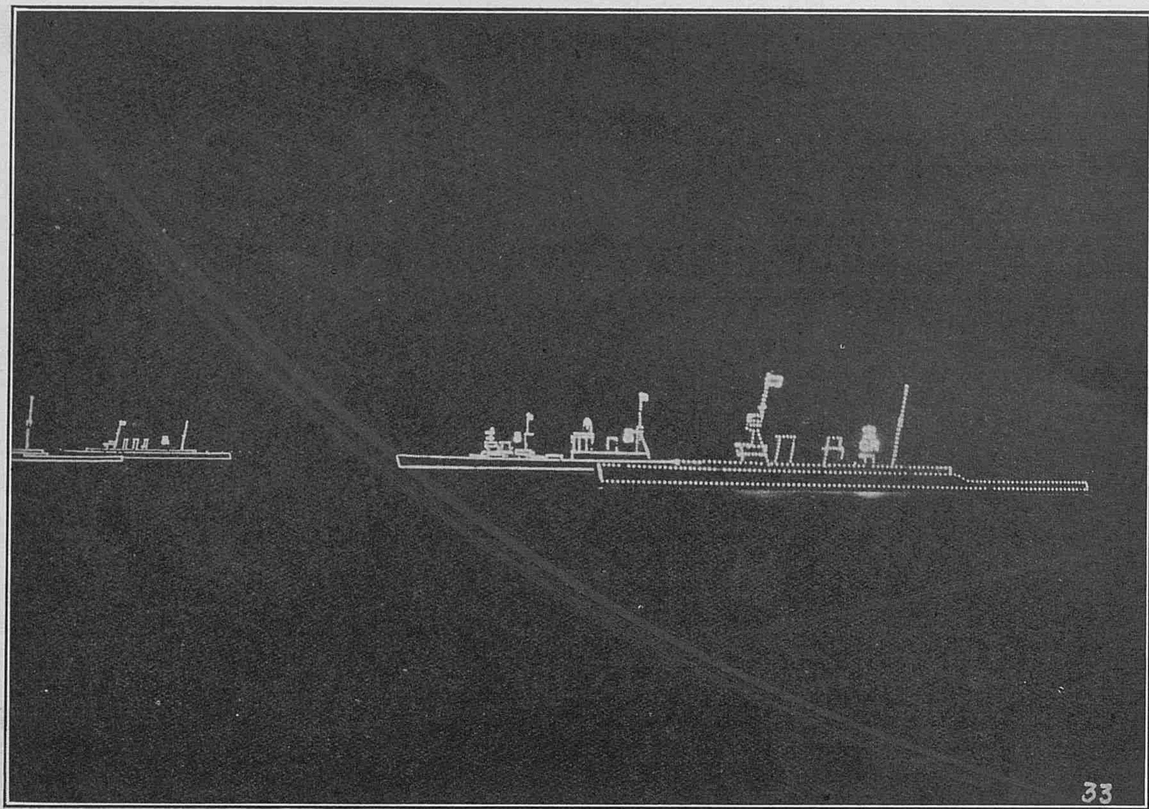
At 8.41 a.m. *Asturias* weighed anchor and taking station astern of *Alcantara* and followed by *Atlantis*, proceeded to sea.

The whole Review seemed to have been carried out in true Naval style and well done.

R.M.S. *Asturias* returned to Southampton on Thursday morning.





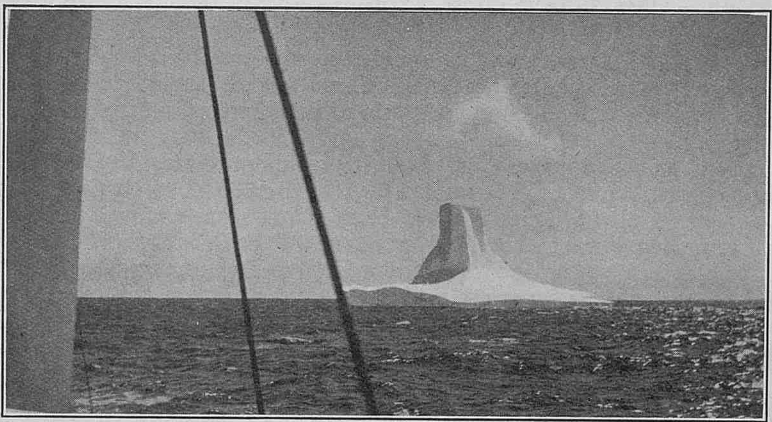


October, November and December.

It is hoped that these pages will be filled each quarter with a selection of the contributions of Mariners in manuscript, or remarks from the Logs and Records of regular Marine Observers.
Responsibility for statements rests with the Contributor.

SOUTHERN OCEAN ICE.

THE following report and photograph is extracted from the Meteorological Log of R.R.S. *William Scoresby*. Captain C. R. W. BOOTHBY. Observer Mr. E. E. CLIFTON. The photograph was taken by Mr. R. C. FREAKER.



The most northerly iceberg sighted was on December 2nd 1934 in Latitude 53° 36′ S. Longitude 30° 07′ E. It was also the highest one seen, being 370 feet high.

Pack ice was encountered on December 3rd in Latitude 56° S. Longitude 31° 13′ E. and during the next six weeks receded very rapidly as the edge of the pack on January 12th was only 30 miles from the coast east of Enderby Land in Latitude 66° 43′ S. Longitude 61° 18′ E. On March 14th and 15th, between Longitude 12° E. and 17° E., no pack ice was seen in Latitude 67° 30′ S. On numerous occasions it was noticed that the appearance of snow petrels was a very good indication of the proximity of pack ice.

South of Latitude 60° S., from December 16th to January 12th, icebergs between 60° E. and 100° E. were numerous and nearly all tabular bergs; but from February 13th until March 23rd, between 20° E. and Greenwich meridian, all the bergs were old and irregular and very numerous, some of them being partially a bottle-green colour. From January 12th to February 13th off Enderby Land, between 20° E. and 60° E., very few icebergs were sighted.

In the area south of Bouvet Island many days with poor and very poor visibility were experienced. No ice was seen on the passage from Bouvet Island to Cape Town, March 23rd to 29th.

HERON AT SEA.

North Atlantic.

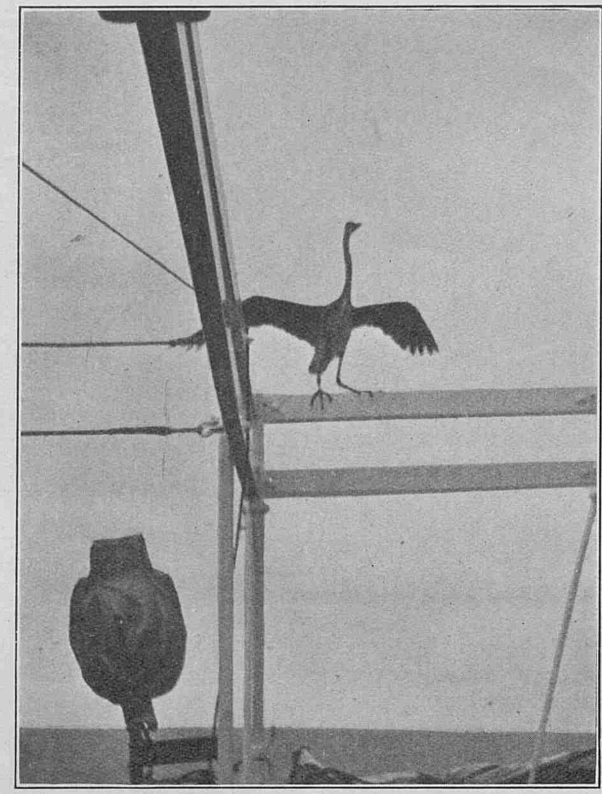
THE following is an extract from the Meteorological Record of M.V. *Rangitiki*. Captain H. BARNETT. Colon to London. Observer Mr. N. BADDELEY.

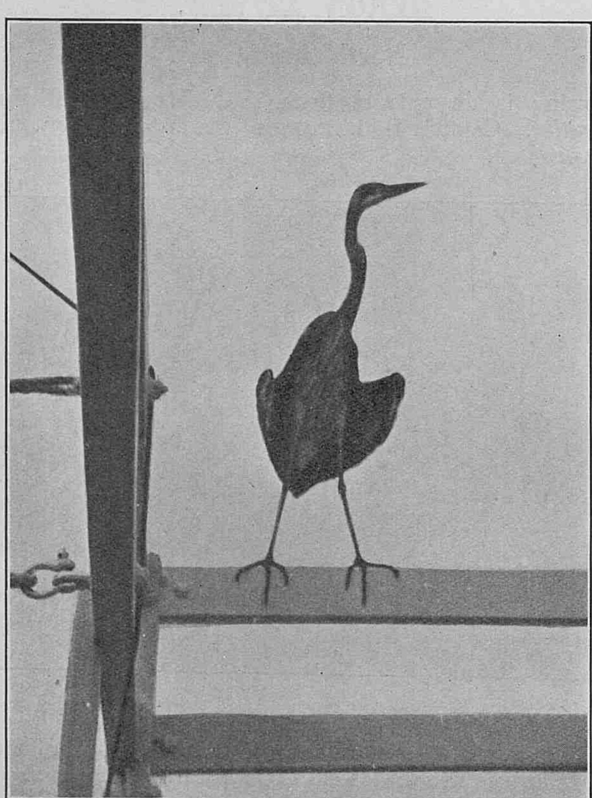
December 11th 1934, during the forenoon watch a large heron, which had been circling the ship for some time, came to rest on board. The plumage of this bird was fawn with a mottled fringe of varied colours on the front edge of its wings. The approximate distance of the nearest land was 750 miles. The bird remained on this vessel until 10 a.m. on December 12th, and the following day a wireless message was received from S.S. *Inanda* stating that a heron had come aboard that vessel at noon on December 12th, at that time the *Inanda* was approximately 15 miles to the N.W'rd. of the *Rangitiki*, and bound in a similar direction. The accompanying photograph was taken whilst the bird was aboard this ship.

Position of ship Latitude 28° 24′ N., Longitude 50° 47′ W.

The following is an extract from the Meteorological Record of S.S. *Inanda*. Captain W. GIBBINGS. Antigua, W.I. to London. Observer Mr. W. S. EUSTANCE, 3rd Officer.

December the 12th 1934 at 11.40 a.m. A.T.S., a large blue-grey heron alighted on deck in an exhausted condition. The bird seemed





very frightened and would not touch water or food placed near it. At 2.0 p.m. it circled round the ship several times and disappeared from view.

M.V. *Rangitiki* about 5 miles S.S.E. of us reported that the heron had been on board since 10 a.m. 11th and had left at 9.00 a.m. 12th heading in a northerly direction.

The presence of such a large bird over 1,000 miles from the nearest land (Bermuda) caused considerable interest on board, and much speculation as to where it came from and how many vessels it had boarded on its way to this position.

Position of ship Latitude 31° 30′ N. Longitude 45° 05′ W. Wind S.4. Moderate sea and confused swell. The accompanying photographs were taken when the heron was on board S.S. *Inanda*.

ASUNCION ISLAND.
North Pacific.

THE following is an extract from the Meteorological Log of S.S. *Malayan Prince*. Captain E. HARDCASTLE. Los Angeles to Manila. Observer Mr. C. S. SMITH, Chief Officer.

December 17th 1934 at 4 a.m. steering to pass about 15 miles south of Asuncion Island, and being fairly confident of ship's position, we altered course to pass about 2 miles south of the island.

Weather fine with some cumulus clouds near western horizon. About 5 a.m. picked up island about one point on starboard bow, at first resembling a stationary cloud, but appearing more distinctly as dawn approached.

The description in the Pilot (Pacific Is. Pilot Vol. No. 1) appears accurate, as the island was covered with dense scrub with a few palm trees showing on the slope at the S.W. end of the island. The wind gradually freshened as the island was approached and there was a rise of 3° in temperature of sea water which might have been caused by volcanic action.

There was a distinct cap of white smoke on the top of the peak, and most noticeable phenomenon regarding this was the fact that although the wind had freshened from N.E., this cap appeared to be anchored to the top, and did not trail away to leeward as one would have expected, so that the air current seemed to be only on the surface of the sea, and did not extend over 2,500 feet in altitude.

The only indication of life on the island was a few sea birds.

Many islands were distinctly visible in the distance to the northward.

MAGNETIC DISTURBANCE.
South Indian Ocean.

THE following is an extract from the Meteorological Record of S.S. *Berwickshire*. Captain E. H. EVENS. Cape Town to Fremantle. Observer Mr. J. C. ROBERTSON, 2nd Officer.

October 25th to 30th 1934. "Running the Easting Down" in Latitude 39° S. Steering 090° (E.S.E.'ly courses by Compass) Normal Deviation 2°W., the deviation of the Compass was found to increase westerly between the Longitudes of 50° and 70° E. reaching maximum 6° W. in Longitude 70° and decreasing from thereon, until normal in Longitude 85° E.

On successive voyages over a period of some years this identical change has taken place in varying Latitudes from 38° S. to 43° S. always commencing about Longitude 50° E. reaching maximum around 70° and returning to normal again from 85° to 90° E. Longitude.

The depth of water, in this vicinity, surely precludes any possibility of local magnetic attraction, and it is suggested that the variation curves may take a much sharper curve to the northward than is charted.

It would be interesting to note if other ships have experienced a similar change.

VOLCANIC ERUPTION.
Japanese Waters.

THE following is an extract from the Meteorological Record of S.S. *Alipore*. Captain E. F. HANNAN, R.D., R.N.R. Singapore to Japan. Observer Mr. G. D. COPELAND, 3rd Officer.

November 25th 1934 at 18·00 Japanese Standard Time, ship in Latitude 30° 48′ 30″ N. Longitude 130° 03′ 45″ E. a volcanic eruption close to the horizon was observed bearing 091°. Whilst the ship proceeded on course 079° speed 11 knots, several considerable eruptions were observed, and when to leeward of this volcano (wind S.S.E. force 4) the visibility, which had been excellent, shut down to 6 and the ship became covered with a fine white lava powder which fell like a sharp shower of rain. The smell of sulphur had been strong for some time previously.

Frequent bearings placed this volcano in Latitude 30° 48′ 30″ N., Longitude 130° 20′ 15″ E. (approx.), or about one mile E.S.E. of Take shima no oge (62 feet), and as far as could be observed, quite close to sea level.

SUBMARINE EARTHQUAKE.

North Pacific.

THE following is an extract from the Meteorological Record of M.V. *Rangitata*. Captain J. L. B. HUNTER. Balboa to Auckland, New Zealand. Observer Mr. R. H. BROWNE, 4th Officer.

November 30th 1934 at 2355 G.M.T. (6·43 p.m. at ship) vessel was shaken violently by what was assumed to be a submarine earthquake.

The first impression given was that some major disaster had occurred in the Engine Room, but although the engines raced slightly at the time they soon settled down to their accustomed speed.

The duration of excessive vibration was about 30 seconds. Standard and steering compasses remained unchanged, and vessel maintained a steady course. Owing to darkness no unusual appearance of the sea was manifest.

Position of ship Latitude 4° 40′ N., Longitude 82° 41′ W., D.R.

THUNDERSTORM.

North Atlantic.

THE following report has been received from S.S. *Erin*. Captain S. CLARKE. Kingston (Ja.) to Rotterdam. Observer Mr. R. C. VIGURS, 2nd Officer.

October 15th 1934 3.20 p.m. A.T.S. The vessel for the previous two days had been in the front right-hand quadrant of a depression moving at about the same speed and converging slightly, and apparently well clear of the trough. At Noon A.T.S. the weather was fine, sky half clouded Ci., Ci.-St., and St.-Cu., Aneroid 29·85 in. steady, wind S.S.E. force 3, dry bulb 76° wet bulb 73°. At 3.00 p.m. Aneroid 29·87 in. wind had freshened from the same direction, and a rain squall was observed approaching from the southward. Very little Cu.-Nb., was seen above it and the clouds had little appearance of wind. At 3.25 p.m. a very heavy rain squall struck the vessel with wind force 7. At about 3.30 p.m. a flash of lightning (no "fork" visible) was observed, followed in about five seconds by thunder. Five minutes later a peal of thunder was heard very faintly. Heavy rain had been falling steadily but at about 3.38 the sky became darker from the southward and two minutes later the rain fell so heavily that the forecastle was hardly visible. A moment afterwards the vessel was struck by lightning simultaneously with a terrific peal of thunder resembling an explosion. In fact many people on the ship thought the boilers had exploded! Smell of burning, as from an electrical discharge, was noticed in the air throughout the ship. Although the flash was of blinding intensity it is fairly definite that the foremast was not struck, no electrical fire being observed from the bridge or by men working on the foredeck. The vessel was therefore apparently only touched between the bridge and the poop.

The rope whistle-lanyard over "Monkey-island" was burnt through, as were the main signal-halliards. Electrical flame was observed running down the main-mast and along the cargo-light yards. It was not noticed on the funnel guys or davits as there was nobody in the vicinity at the time. Deviation of 4 degrees was shortly afterwards noticed on both steering and standard compasses and three days later when the vessel was swung, deviations from 15° E. to 13° W. were found, and remained so for rest of passage (10 days).

There was no more thunder or lightning and at 3.45 the rain cleared and a perfect cloud formation of a line-squall appeared from ahead to a point forward of the starboard beam, wind still in the same direction, force 6, aneroid steady; Temperature Dry 76° Wet 74° F. but it then commenced to rise slowly. At 8 p.m. weather was fine with occasional showers, aneroid 29·93 rising steadily, wind force 7 to 8 from the same direction (S.S.E.) where it remained for the next three days, gradually moderating.

Position of ship Latitude 39° 33′ N., Longitude 48° 23′ W. Course 58°, Speed 16¼ knots.

TYPHOON.

China Seas.

THE following account of an encounter with a typhoon in the China Sea is taken from a report forwarded to the Admiralty from H.M.S. *Adventure*, Captain W. H. Gell, D.S.O., R.N., a minelayer of 6,800 tons.

At 0800 on Wednesday, October 17th, 1934, *Adventure* was ordered to proceed from Hong Kong to the assistance of the tug *Taikoo*, in danger from stress of weather to the southward, caused by a typhoon crossing the China Sea. The *Taikoo*, with crew and passengers numbering 142, had left Pratas about noon Tuesday, October 16th.

At 1700 the wind had increased to force 8 from N.N.E. and by midnight *Adventure* had gradually to reduce speed from full speed to 14 knots.

A searchlight was kept trained ahead and about midnight the tug reported by W/T that she could see the glare astern. By 0100 (Thursday) *Adventure* had reached the tug and was able to inform her of her position, some 60 miles south-west of her D.R., after 38 hours in the gale since she left the Pratas.

The wind was now N., force 8–9, sea 57°, glass steady, with heavy rain. It was thought best to heave to so as to allow the typhoon to pass to the southward, as in October the track of the storm is often south of west. The tug, however, could not round up head to sea because of a deck cargo of boats and 20 tons of anchors which could not be jettisoned.

D/F bearings could occasionally be obtained from Tourane which was 240 miles distant, so it was decided to continue on the present course of S. 67° W., which would take the ships towards Tourane.

At 0800 the wind was N. by W. to N.N.W., force 9, inclined to back, sea 67°, glass inclined to rise slightly after a fall since 0100, but the tug with the wind on the quarter had made surprisingly light weather of it; in fact, she was drier than the *Adventure*.

Hong Kong had reported the typhoon still near the Macclesfield shoal and the backing wind and rising glass seemed to show that the ships were winning their race for Tourane. By 1400, however, the wind had definitely begun to veer again and the glass to fall, and although the sea was a trifle less, if anything the weather had become squally. A weather report from S.S. *Eumaeus* (Blue Funnel Line) estimated the typhoon as being nearly stationary north-west of Paracels. Although this, according to *Adventure's* observations, put it too far west and north, the report was useful in that the *Eumaeus* herself was west of the Macclesfield shoal with the typhoon to the westward of her. This was positive evidence of the highest value and showed that the storm area in rear of the centre was comparatively small. Course was continued for Tourane, in the hope that the typhoon was in fact stationary. There was nothing else to be done yet.

By 1600 the wind had veered to N., force 8, with strong squalls, heavy rain and low visibility; the glass had steadied a little but was now tending downwards. It was obvious that the typhoon was getting nearer and that it was moving in a westerly direction at approximately the same speed as *Adventure*.

At 1630 the tug signalled that a door had been stove in and that she had run out of fresh water, whilst seas were observed to be breaking over her starboard side.

The centre of the typhoon was judged to bear E.S.E. within 90 miles, moving west at 5–6 knots. At 1700 course was altered to S.S.W. from position 16° 54′ N., 109° 39′ E., as it was dangerous to close the coast with the probabilty of being boxed up close to it with a more or less stationary typhoon.

At 1800 course was altered to South; wind N. by W., force 8, sea 57°, getting confused, glass falling more rapidly than before. It seemed that the ships were round the head of the typhoon but that the centre would actually be closer to them by the time it passed. A southerly course could not be maintained after midnight because of land to the south and west.

The supply of coal in *Taikoo* was running short, but no attempt could be made to take her in tow until wind and sea moderated and so the course was continued so as to get away from the track of the storm as rapidly as possible. The danger was that the tug might capsize on the way, in which case very few hands could be saved as no man could have lived in that sea for more than a few minutes. The worst period was between 1930 and 2330. At 2130 the wind was N.W., force 10, with heavy squalls and rain, the glass showing an alarming tendency to start in the deep dip common on the approach of tropical storms. By 2200 the wind was backing for certain and reaching 80 knots in the squalls, the sea being very heavy and confused. It was estimated that the centre of the storm bore N.E. 50 miles. By 2300 the barometer after a slight dip was definitely rising. At 2300 course was altered to S.S.E. with the intention of heading for Kin How later after the sea had moderated.

The occasional failure of *Taikoo's* dynamo added much to her difficulties and the *Adventure's* anxiety, but the tug rode the seas in a way one would not have believed possible and her master answered all signals promptly and cheerfully. All signals were by W/T as it was not possible for *Taikoo* to read or make visual signals. Her Chinese telegraphist performed extremely well.

By midnight the *Adventure* had apparently crossed the trough, the wind backed rapidly and the squalls were less vicious; the sea, however, was still heavy and very confused. By 0130 (Friday) the tug was considered safe and arrival at Kin How was expected by 1400. At 0200 the weather was definitely on the mend and the clouds were breaking up. By 0400 it was a pleasant summer morning with only a long swell remaining. At 0230 visibility had increased to maximum and Kulao Rai Light was sighted 35 miles off, which put the *Adventure* considerably to seaward of her D.R. which was based on bearings of Kieran W/T station 300 miles to the northward.

The *Adventure* arrived at Kin How at 1100 and the *Taikoo* secured alongside her and was supplied with fresh water, ice and various comforts for the officers' mess. The 6 British officers and passengers bathed and lunched on board. Extract from the report of the Captain of *Adventure:* "They were all cheerful and showed little sign of the strain through which they had passed. They were extremely grateful for our company. I was particularly struck with the Master, Mr. Thirwell, who lunched with me. He was entirely unruffled and seemed quite fresh though he had been on his legs for almost 3 whole days since leaving Pratas Reef."

CLOUD FORMATION.

Peruvian Coast.

The following is an extract from the Meteorological Record of S.S. *Orduna*. Captain A. Ridyard, O.B.E. Balboa to Valparaiso. Observer Mr. R. Eckford, 3rd Officer.

October 24th, 1934, 1800 G.M.T. (1315 A.T.S.), wind S.E., force 5, the cloud or clouds within view, we found we were unable to classify. Apparently it was some form of cloud-cap of a dull grey colour, spread as a thick quilt over the land inland from point Olleros, but, thinning out considerably toward sea-level so that the beach, ten miles away, had the appearance of land at a distance seen through a thin blue haze.

The upper surface of the cloud was smooth and undulating as though conforming to the contours of the country immediately beneath, and, despite the fresh breeze, remained stationary.

From the far side arose a number of ever-changing efflorescences in the form of dazzling white wisps and tufts, waving and fluttering. Later, as we drew away south-eastward, from behind the grey blanket arose the cotton-wool-like base whence sprang the wisps and tufts. It was in a state of turmoil, curling and rolling within itself, expelling and withdrawing the above-mentioned tufts and wisps.

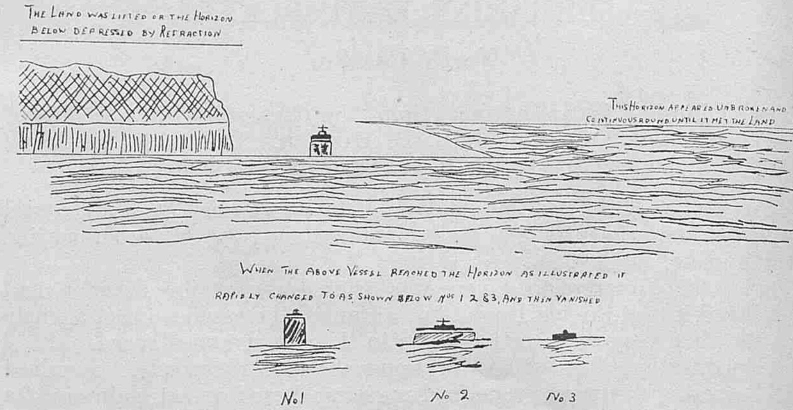
Position of ship Latitude 14° 57′ S., Longitude 75° 46′ W., Course 143°, speed 14 knots.

MIRAGE.

East Coast of Australia.

The following is an extract from the Meteorological Record of S.S. *Mongolia*. Captain H. R. Rhodes. Brisbane to Melbourne. Observer Mr. H. M. Flint, 3rd Officer.

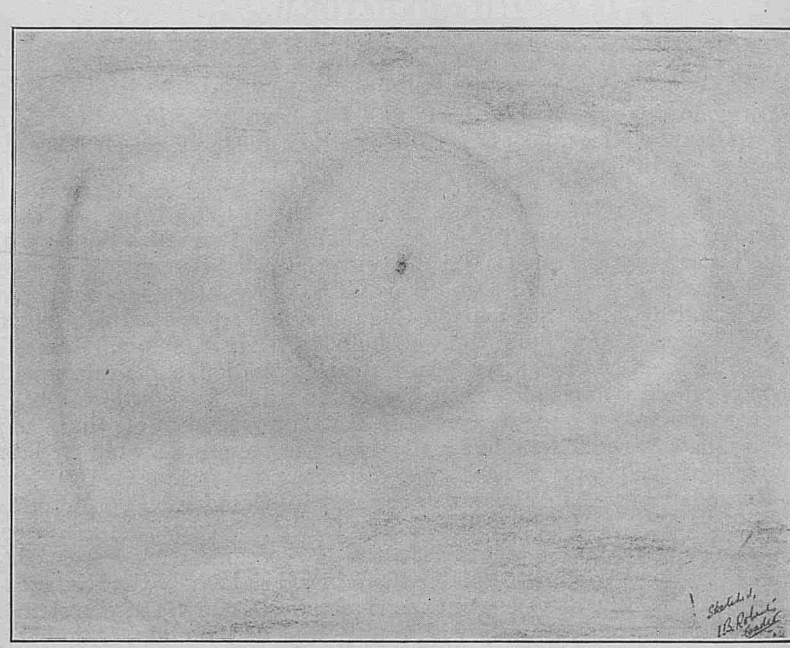
October 6th, 1934, at noon mirage observed between Gabo Island and Cape Everard. Wind N.N.E., force 3, sky overcast.



SOLAR HALO.

West Coast of South America.

The following is an extract from the Meteorological Record of M.V. *Lobos*. Commander E. H. Large, R.D., R.N.R. Liverpool to West Coast, South America. Observer Mr. D. Idris Jones, 3rd Officer. The sketch was made by Cadet I. B. Roberts.



October 12th, 1934, at 11.00 a.m. (standard time 75° meridian), 1600 G.M.T., while lying alongside the wharf of the International Petroleum Co., in Talara, Peru, observed spectacular solar halo.

The sun was at an altitude of 70° and was shining quite strongly through a thin layer of Ci.-St.

The halos were formed by two well-defined circles with a radius of 22°; the circle surrounding the sun was complete in colouring, red being nearest, then orange, yellow and green, etc. (These were clearly seen.) The other circle was completely white, having no colouring at all, its circumference passing through the sun, while its centre appeared to be near the edge of the coloured halo. At an angular distance of 25° from the last-mentioned was another line of colouring or arc with its curvature towards the sun. Again the colours in this were well-defined.

The following particulars were noted: Clouds, Ci.-St., A.-St., St. and St.-Cu., Wind South, Force 3.

The sun's altitude was taken by sextant and its limb was clear and not blotted as is sometimes the case.

Note.—The secondary halo, passing through the sun, was centred at the point on the common halo where the mock sun is often seen, and though the mock sun was not recorded in the above observation there was probably a brighter patch there which served to form the secondary halo. As stated in the note appended to the observation of S.S. *Montcalm* in the January 1935 number of The Marine Observer, page 9, these secondary halos are very rare. In both observations a portion of the 46° halo was also observed.

WATERSPOUTS.

Mediterranean Sea.

The following is an extract from the Meteorological Record of S.S. *Tactician*. Captain F. Trinick, O.B.E. Calcutta to London. Observer Mr. A. Moreton, 3rd Officer.

On December 16th, 1934, between 0545 and 0615 G.M.T., a considerable number of waterspouts was observed, about 5 miles N.E. to E. of the ship's position.

Each waterspout lasted only a few minutes, but during the phenomena 15 to 18 were observed, from three to seven at once and all of varying intensity.

The wind at the time was variable, force 3, barometer 29.88 in., but at 0615 when the spouts disappeared the wind steadied in the N.E. and increased to force 4–5.

The sky by this time was completely covered with Cu.-Nb. clouds and rain squalls occurred for the next half hour when the barometer began to rise and the squalls passed over to the S.W.

By 0715 G.M.T. the barometer had risen to 29·89 in., Wind E.N.E., force 4, and blue sky.

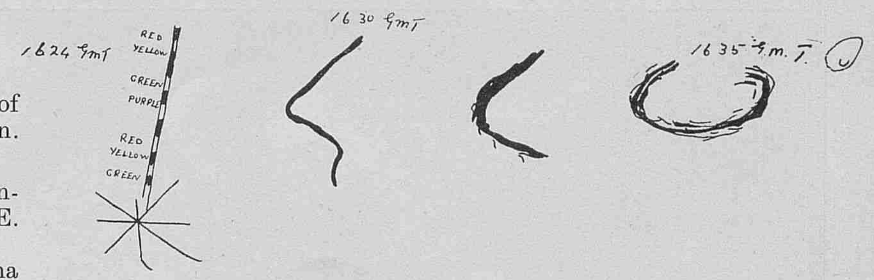
Position of ship Latitude 32° 00′ N., Longitude 30° 44′ E.

METEOR.

Gulf of Aden.

The following is an extract from the Meteorological Record of S.S. *Ormonde*. Captain M. J. Sarson. Australia to London. Observer Mr. J. M. Swanson, 3rd Officer.

November 5th, 1934, at 1624 G.M.T., vessel approaching Perim Island. Bearing about W. by S. and commencing about 5° below Altair, observed very bright light shooting at 190° through about 20° of arc, forming a very highly-coloured streak of light, finally bursting into a very bright star about 10° above horizon. For some considerable time after the final burst of light the long tail was visible, gradually expanding, changing its shape and finally fading out at 1635 G.M.T., looking like a wisp of a smoke circle. The colours of



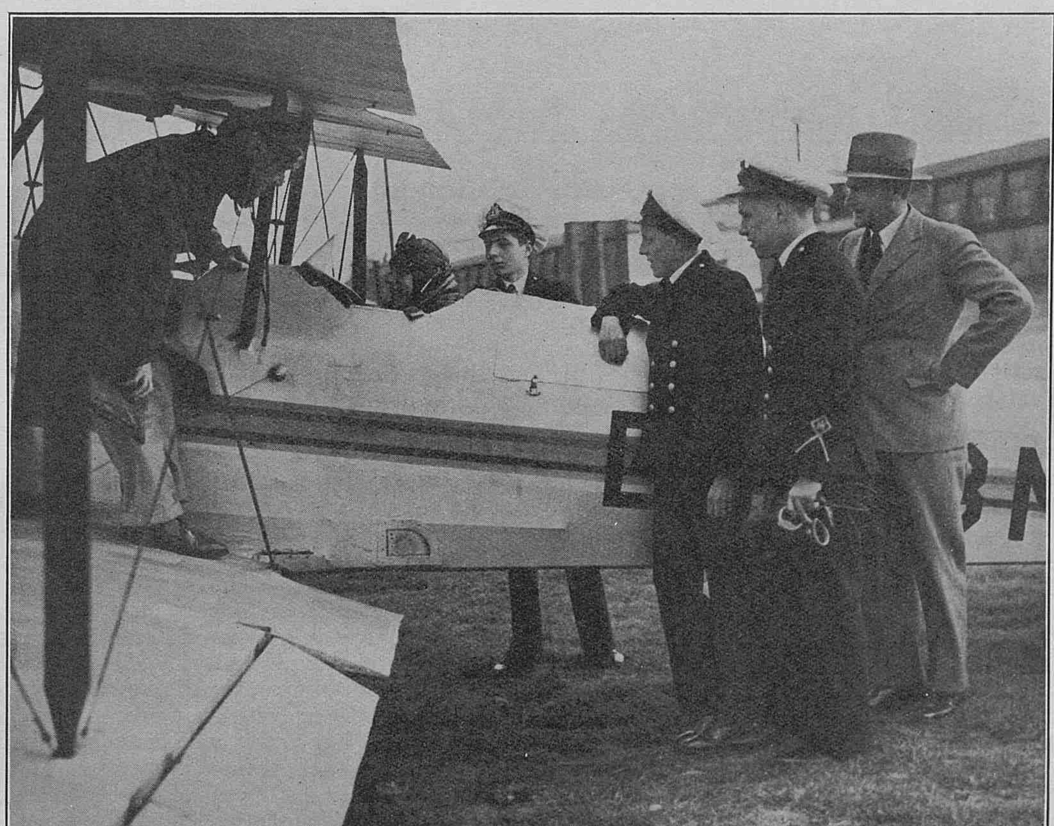
the spectrum were distinctly visible in the tail for a few seconds before and after the burst of light.

RECRUITING FOR THE MERCHANT AIR SERVICE.

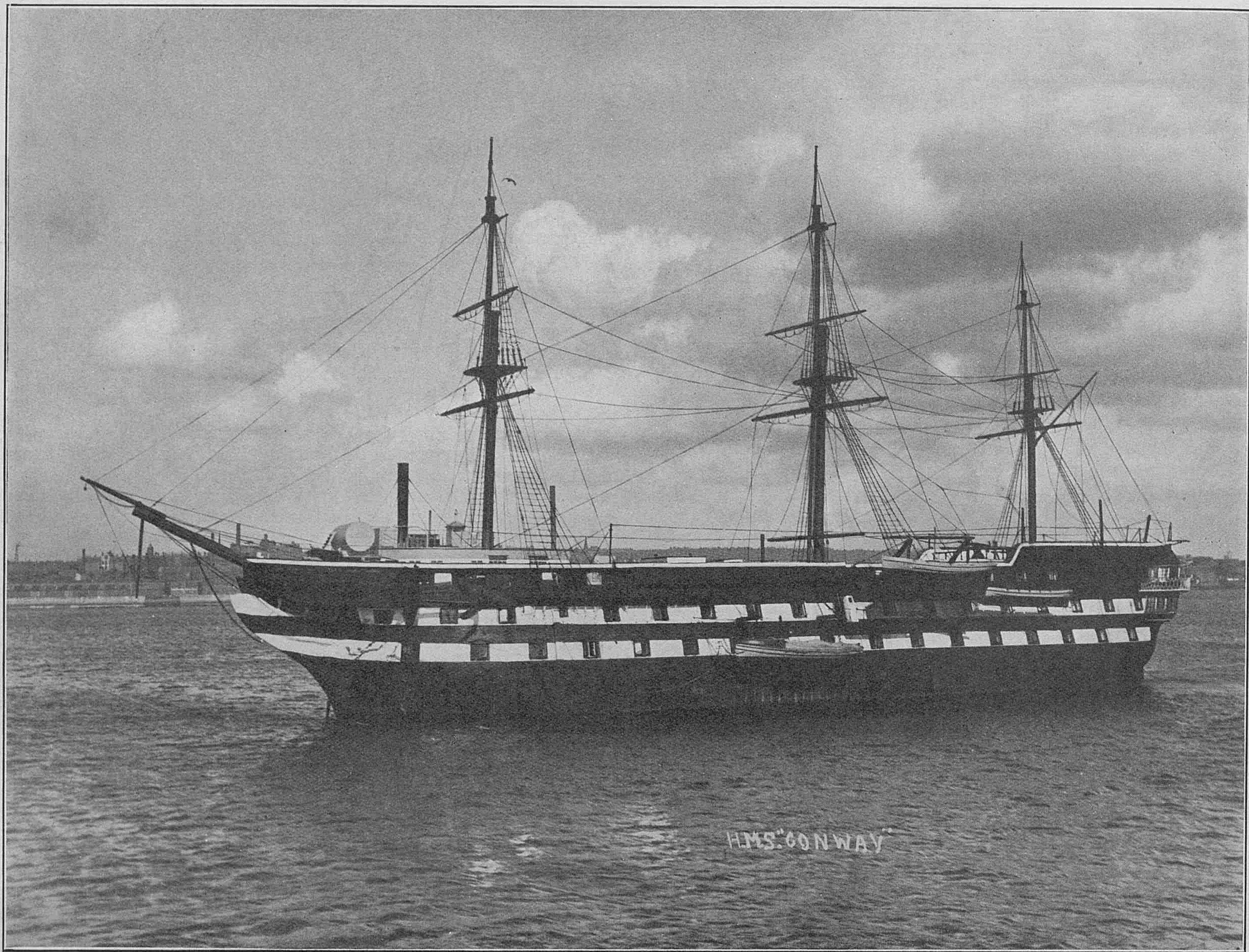
By Commander T. M. Goddard, R.N.R., H.M. School Ship "Conway."

It seems but yesterday that we were listening with bated breath to the news that Bleriot had flown the Channel in a heavier-than-air machine, and yet, between that day and this, the strides in air transport have been almost incredible. One development has followed hard upon the heels of another, until the miracles of yesterday are the commonplaces of to-day. With swift and inexorable hammer-blows the War drove home to the nation the enormous value of aircraft as an auxiliary to the fighting Services. To-day we are witnessing the steady increase in the Royal Air Force by sea and by land.

More slowly, perhaps, but no less certainly, is there also a growing appreciation of the value of aircraft in times of peace as a means of transport, both for passengers and goods. However much we may regret it, the sailing ship has vanished from the British Mercantile Marine, and steam reigns in its place. The thin line of smoke on the horizon has blotted out for ever the expanse of snowy canvas bellying to the breeze. He would be a daring man who would prophesy what the future holds, or who would set a limit to human ingenuity, courage and endurance. But he is a wise man who prepares himself for the contingencies which he can foresee.



Cadet W. Shaw receiving final instructions from the air pilot instructor before his first solo flight. Captain Goddard in plain clothes on right.



In surface vessels and in submarines the merchant service officer has mastered the sea. Now another step in his progress is materialising—his mastery of the air for long-distance flights. Nor is there anything revolutionary in this. There is, indeed, good precedent. Already the officers of the Royal Navy have been encouraged to fly, and many of them are among our best and most skilful pilots. Nor does this accomplishment at all detract from their value and status as deck officers. On the contrary, it enhances it. The argument that the same thing can and should be done in the Merchant Navy is unanswerable. Already many liners carry their own aeroplanes, and there is no reason why these should not be flown by officers of the ship. It will not be long before the large steamship companies have ancillary air lines and, if full advantage is taken of the opportunity thus provided, the necessity for releasing young officers for flying will entail the reinstatement of hundreds of older ones who are now without employment.

Where could better men be found for the purpose than these young officers? By their training in navigation, meteorology, compass work, etc., they have an enormous advantage over landsmen in piloting planes over the seas. In the case of a plane crashing at sea the sailor is undoubtedly the man to save the passengers if it is possible to do it. With these considerations in mind H.M.S. *Conway*—that splendid old ship of great traditions, which has, for 75 years, trained the commanders of our mighty vessels and been the recruiting ground for the officers of our great sea service—has inaugurated a scheme whereby cadets are trained to fly, without in any sense losing sight of her primary purpose, which is to train the future officers of the sea services. Indeed, this new scheme is a necessary supplement to that purpose, if she is to remain true to her tradition of turning out men of the highest efficiency. Progress knows no bar, and the height of efficiency is only attained by those who keep in the van of Progress in her onward march. To stand still means stagnation, and stagnation is death.

The normal course of every *Conway* cadet includes instruction in navigation, meteorology, signalling, chart work, compasses and their adjustment, electricity and magnetism, mathematics, etc., all of which is of great value to an air pilot.

Under the *Conway* scheme he will also receive instruction in flying, which will include a minimum of 15 hours, instruction in the air, which should be ample to ensure his obtaining his Air Ministry's Private Pilot's "A" licence. He will also receive instruction in practical airmanship and everything a pilot should know regarding aircraft. In engineering he will undergo a course of instruction in the dismantling and assembling of air engines and accessories, aeroplane construction and assembly, with practical instruction in maintenance and repair. Seventy-eight hours of practical tuition on actual engines and aircraft is given in hangars. The object of this is twofold; to supplement the instruction in practical airmanship so that on completion of the course a cadet should be well able to satisfy the requirements for the Commercial Pilot's "B" licence, should he decide to carry on his flying with that end in view, and also to give a good grounding to any cadet who may contemplate entering the design and constructional branch of aeronautics. The course is given in conjunction with the Liverpool and District Aero Club, whose instructors and pilots give the practical knowledge at Hooton Aerodrome. Instruction in air pilotage, theory of flight, rules of the air, etc., is given on board. The scheme is now in operation, and already *Conway* cadets have been in the air. They bid fair to carry into aeronautics the spirit and tradition which have made H.M.S. *Conway* famous far and wide.

HISTORY OF THE MAGNETIC COMPASS.

PREPARED IN THE MARINE DIVISION BY COMMANDER J. HENNESSY, R.D., R.N.R.

THE early writers as far back as HOMER (1000 B.C.) all drew attention in their works to the attractive power of the lodestone.

Lodestone derives its name from the Saxon word læden, to lead, and its power to attract is said to have been called magnetism by the early Greeks from Magnesia, a district in Macedonia, where this peculiar iron ore was abundantly found. Neither the Greeks nor the Romans, however, were aware of the fact that a piece of lodestone when suspended so as to move freely would always point in one particular direction.

This directive power of the lodestone is said to have been known to the ancient peoples of Eastern Asia in the reign of the fourth Emperor, HOANG TI, about 2600 B.C., but the first person to make this discovery and at the same time invent the compass is unknown. In the English translation of PÈRE DUHALDES' work on China (1736), the following statement appears with reference to HOANG TI giving battle to TCHI YEOU :—

" . . . He perceiving that thick fog saved the enemy from his pursuit and that the soldiers rambled out of the way and lost the course of the wind, made a carr which showed 'em the four cardinal points. By this method he overtook TCHI YEOU, made him prisoner and put him to death. Some say there were engraved in this carr, on a plate, the characters of a rat and a horse, and underneath was placed a needle to determine the four parts of the world."

In later vehicles, or magnetic waggons, as they are called, a freely floating needle directed a small figure whose outstretched hand always pointed towards the south. It is recorded by HUMBOLDT in his Cosmos, vol. v, that a waggon of this description called Fse-nan, meaning indicator of the south, was presented to the ambassadors of Tonquin and Cochin China during the dynasty of the Tscheu 1100 B.C., to guide them on their homeward journey over the vast plains which they would have to traverse.

FIG. 1, taken from Captain A. SCHÜCK'S "Der Kompass," shows the kind of device used by the Chinese on their magnetic waggons.

Fig. 1.

The application of the directive power of the magnet, or the use of the compass was, therefore, first utilized for travelling long distances on land, and it was not until many centuries later that its use was applied to navigation at sea. There is a difference of opinion amongst historians as to when this took place. Some declare that from the fourth century onwards Chinese vessels navigated the North Indian Ocean, and that through their contact with Persia and Arabia the use of the compass became known to Western civilization sometime after the tenth century. Others contend that Western navigators first introduced the use of the magnetic needle at sea, on learning of the use the Chinese made of it for land travel.

The earliest reference to the mariner's compass in Europe is recorded by the Norwegian historian ARA FRODE in an account of the discovery of Iceland written towards the end of the eleventh century. He wrote as follows :—

" FLOCKE VILGERDERSEN, a renowned Viking, the third discoverer of the island, departed from Rogaland in Norway to seek Gadersholm some time in the year 868. He took with him three ravens to serve as guides and in order to consecrate them to his purpose he offered up a great sacrifice in Smarsünd where his ship lay ready to sail, for in those times seamen had no lodestone in the northern countries."

That the mariner's compass was in general use at sea in Western waters during the twelfth century is confirmed by its description and use being made the subject of a poem by GUIOT DE PROVENS dated 1190. The original is written in old French, and the following literal English translation is taken from a work by J. LORIMER dated 1795 named " A concise Essay on Magnetism."

" This same (the pole) star does not move,
(and) They (the mariners) have an art which cannot deceive,
By the virtue of the magnet,
An ugly brownish stone,
To which iron adheres of its own accord,
Then they look for the right point,
and when they have touched a needle (on it)
And fixed it on a bit of straw,
Lengthwise in the middle, without more,
And the straw keeps it above;
Then the point turns just
Against the star undoubtedly.
When the night is dark and gloomy
That you can see neither star or moon,
Then they bring a light to the needle,
Can they not then assure themselves
Of the situation of the star towards the point? (of the needle)
By this the mariner is enabled
To keep the proper course;
This an art which cannot deceive."

From the above it will be gathered that the mariner's compass in its earliest form consisted of a magnetic needle which was kept afloat in a basin of water by means of a straw, and was thought to derive its directional power from the pole star. Later the straw was dispensed with, by passing the needle through a piece of wood as shown in FIG. 2, which depicts a magnetic needle of a date somewhere between 1185 and 1200. In 1269, as shown in FIG. 3, the needle was pivoted and placed in a bowl with a glass cover, to which was fitted a graduated scale and sighting arm for taking bearings.

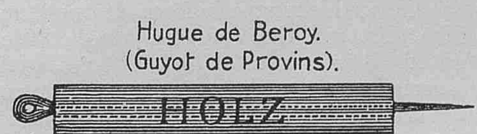


Fig. 2.

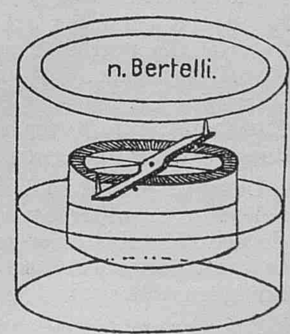


Fig. 3.

From Captain A. Schück's " Der Kompass."

At the beginning of the fourteenth century Italian designers improved the ship's compass by affixing to the pivoted needle a light card on which was painted the rose of the winds. The card was at first divided into eight equal divisions, each division being marked in Gothic capitals with the initial letters of the Italian names of the eight principal winds with the exception of the North and East points.

The north point was indicated by some special device such as an arrow head, a triangle, or a star, while the east point was almost invariably marked with a cross.

Fig. 4 shows an early Italian eight point compass card.

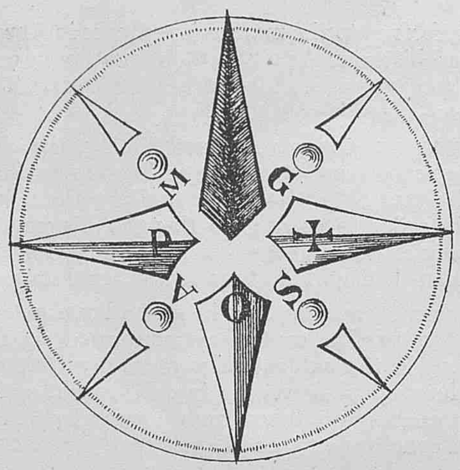


Fig. 4.
From Captain A. Schück's "Der Kompass."

As the compass became more universally used throughout European waters the eight point compass card was found to be insufficient for the purposes of navigation, and cards with 16 or 32 equal divisions were produced by the Italian makers. On the 32 point card the cardinal points were usually painted black and marked or named as on the eight point card, the quarter points were usually painted green, and the intermediate points red.

The fleur-de-lis or Prince of Wales' feathers, as it is termed by seamen, which is now universally used for marking the north point of the compass card, did not appear before 1500, and the origin of its use is somewhat obscure. Being a French heraldic emblem it is thought by some to have emanated from that country, but it first appeared more frequently on Portuguese compass cards. Another suggestion is that it represents a spear-shaped magnetic needle supported between two wooden floats such as was used in the early water compass.

In 1536 Flemish navigators used the Frankish names of the winds for marking their compass cards, and this system was soon followed by the Spanish and Portuguese. During the seventeenth century all coloration and the use of the Italian initials on compass cards was discontinued, and the Frankish system of marking was used by all European nations, since when there has been little change or variation.

In 1576 Robert Norman, an English sailor, scientist and instrument maker, when engaged on the design of an improved compass, was experimenting with the balance of a compass card on its pivot, when fitted with unmagnetized needles. On magnetizing the needles he found the balance of the card to be upset, it sloping downwards towards the north. From this he was led to the discovery of the dip of the needle.

In 1600 Dr. William Gilbert, a Physician in Ordinary to Queen Elizabeth, gave to the world his discovery of the true reason for the directive force of the compass needle.

Gilbert proved that it was the earth's magnetic force and not the pole star or other agency that directed the compass needle. He showed that this force permeated all iron or steel and differentiated between permanent and sub-permanent magnetism. He laid down fundamental laws, and so founded the science of terrestrial magnetism.

Another eminent scientist named William Barlow was working on the problems of terrestrial magnetism at the same time as Gilbert and to him also the world is indebted for the disclosing of many magnetical secrets.

In Gilbert's works he describes the mariners compass then in use, as follows :—

"In a round wooden bowl, closed above with glass, a pin fixed upright in the middle bears the fly-card. The glass cover protects the interior against wind or any impulse of air from without, and at the same time allows the card and inner lid of the bowl to be distinctly seen. The fly is circular and of light material as cardboard. The magnetized needles are fixed to it below. Its upper side is divided into thirty-two spaces, commonly called points, corresponding to that number of equal angular intervals of the horizon, or of the winds, which are distinguished by proper marks and a lily to mark the north point. The bowl with a lead weight attached to its bottom hangs balanced horizontally in a brass ring, which, in a sufficiently complete compass, is transversely pivoted on another ring, this last being attached to a proper stand or 'binnacle', fixed in the ship; thus the bowl levels itself to the plane of the horizon though the ship is tossed about in various directions by the waves.

"The needles are either two with their ends brought together, or one of nearly oval form with pointed ends which performs its duty more surely and swiftly. The attachment of the needle, or needles, to the card circle is such that its centre is in the middle of the magnetic iron; but on account of the variation of the compass from the meridian artificers in different regions and cities connect in different ways the needles to the card in respect to their directions relatively to the thirty-two points. The first prevails in the cities of the Mediterranean, in Sicily, Genoa, and the Venetian Republic. In all those places the magnetic iron is attached to the flycard with its length parallel to the diameter, through the rose or lily, so that at any place where there is no variation the true north and south points are shown by this diameter of the circle and where there is variation the amount is shown by the deviation of the point marked by the lily on the card from the true north. A second prevails in Dantzic, throughout the Baltic Sea and in the Belgian provinces. In it the needles are fixed three-quarters of a point to the east of the lily. In Russia the difference adopted is two-thirds of a point. Lastly compasses which are made in Seville, Lisbon, 'Rupella', Bordeaux, Rouen, and anywhere in England have an interval of half a point between the lily and the direction of the needles."

A knowledge of the lines of equal variation over the globe was of very gradual growth. In 1436 an atlas by Andrea Bianco was published which gave the observed variation at different places. In 1492 Colombus determined astronomically a line of no variation in the vicinity of the Azores and in the same year a Jesuit scientist named Acosta determined four such lines. Colombus also discovered as he sailed west across the Atlantic that the lines of variation gradually changed in direction from N.E. to N.W. which led him to attempt to determine the longitude by the position of variation curves which he believed ran parallel to the meridian. From this time on many eminent seamen and scientists occupied themselves with the study of magnetic variation, but it was not until 1683 that Halley having discovered the existence of magnetic poles as apart from the true poles of the earth produced his first variation charts showing the curves of equal variation and dip.

The lead having been given by such men as Gilbert, Barlow and Halley, research into the science of terrestrial magnetism was pursued by many nations but little was done to improve the mariners compass which remained for 200 years as described by Gilbert in 1600.

During the eighteenth century many navigators ascertained that, after making due allowance for the variation, their compass still indicated an appreciable amount of error which was assumed to be wholly due to the imperfect manufacture of the instrument. This led seamen to greatly mistrust the compass and place more reliance in astronomical observations.

In 1801 Captain Flinders R.N. when on a voyage to Australia sought and found the cause of the error other than that caused by variation, indicated by his compass.

When sailing in Northern latitudes Flinders found that his ship had a constant tendency to make southing especially when on east or west courses and to make northing under similar conditions when in southern latitudes. From this observation he found by experiment that the error was due to the transient induced magnetism in the iron of the ship which being built of wood consisted of a few vertical iron stanchions and the nuts and bolts in her planking. The compass being situated aft, this disturbing force attracted the needle towards the bow. Flinders suggested that the error could be entirely corrected by placing the compass in such a neutral position as to have the iron in the ship equally distributed before and abaft the binnacle but this being an inconvenient position in which to place the compass, he placed upright vertical iron stanchions abaft the compass to neutralize the error.

This method of adjusting the compass accounted for all the deviation met with in wooden ships at that time and it is still the practice today to correct that part of the error due to transient induced magnetism in vertical iron by what is now known as a FLINDERS bar.

A few years after Captain FLINDERS discovered the cause of the error indicated by his compass a whaling captain named SCORESBY who later became eminent in the world of science and is perhaps better known as Dr. SCORESBY established the fact that the horizontal force of the compass needle decreased as the dip increased from the equator polewards and showed that the deviation of a compass would grow larger as the equator is left behind. The practical application of this discovery was later worked out by Professor PETER BARLOW F.R.S., who introduced a method of compensation which was extensively used in wooden ships. (Marine Observers are familiar with the current articles published in THE MARINE OBSERVER, which are compiled by E. W. BARLOW, B.SC., a great grandson of Professor BARLOW mentioned above.)

With the extensive use of iron in shipbuilding the problem of installing an efficient compass became a very complicated one. Whereas the errors experienced in wooden ships rarely exceeded half a point on any course, in iron built ships deviations of from three to four points which increased greatly as the ship rolled or heeled, were found to be quite common. This state of affairs caused the Admiralty to set up a committee to deal with the question in 1837.

Dr. SCORESBY experimented with the magnetic properties of different kinds of iron and demonstrated that iron subjected to heavy hammering which he termed hard iron, became permanently magnetised, while the magnetism acquired by unhammered or soft iron, was of a transient nature. He contended, however, that after launching some part of the ships permanent magnetism would diminish gradually, and classified the magnetism of an iron ship as Permanent, Sub-permanent and Transient, thus supplying the theory of compass adjustment.

In 1839 Mr. G. AIRY who later became Sir GEORGE AIRY, Astronomer Royal, carried out a series of experiments on board two small naval vessels, the *Rainbow* and *Ironsides*. These experiments resulted in Mr. Airy being able to separate the different causes of deviation affecting the compasses of iron ships into three kinds namely semicircular, quadrantal and heeling errors, and he drew up practical rules for their correction with the aid of magnets and soft iron correctors.

Up to this time there had been but minor changes in the design of ships compasses to that described by Gilbert in 1600, with the exception that all nations had now adopted the original Italian method of fixing the needle in line with the north and south marking on the card. The Admiralty Committee set up in 1837 recommended certain improvements which resulted in the production of an Admiralty pattern compass. The bowl was made of copper or brass and the card was a thin disc of mica divided at the circumference into degrees with the 32 points marked inside the degree circle. The oval needle recommended by GILBERT was condemned and two or more pairs of parallel straight bars of flat clock spring substituted. A jewelled cap was fixed in the centre of the card to bear its weight on a fine point of hardened steel, or of a natural alloy of iridium and osmium which unlike steel would not rust. The size of the card was reduced from 12 inches to 7½ inches in diameter.

Later research into the problems of compass design by Sir WILLIAM THOMSON better known as LORD KELVIN resulted in his producing a compass which since 1878 has with minor improvements been standard throughout the sea services of most maritime countries to the present day.

FIGURE 5 shows Sir W. THOMSON'S compass card which consists of a light aluminium circular ring of 10 inches in diameter to which was attached in the centre a small inverted cup of aluminium with sapphire crown by strong silk threads. Eight needles of thin steel wire from 3¼ inches to 2 inches long are attached to the card by two parallel rows of silk thread. The card is marked at its edge in degrees as well as in points, half and quarter points. The cup is borne on a fine iridium pivot which is attached to the centre of the brass bowl. The entire weight of the card is 170½ grains this being about one-seventeenth of the weight of the ordinary compass card hitherto used, and its period is 30 seconds in Latitude 53° N. The air tight brass bowl is slung in the binnacle by means of a brass grummet ring and gimbals instead of with the hitherto customary rubber bands. This prevents any free pendulum action and ensures the pivot remaining vertical under all disturbing conditions, resulting in a steady card.

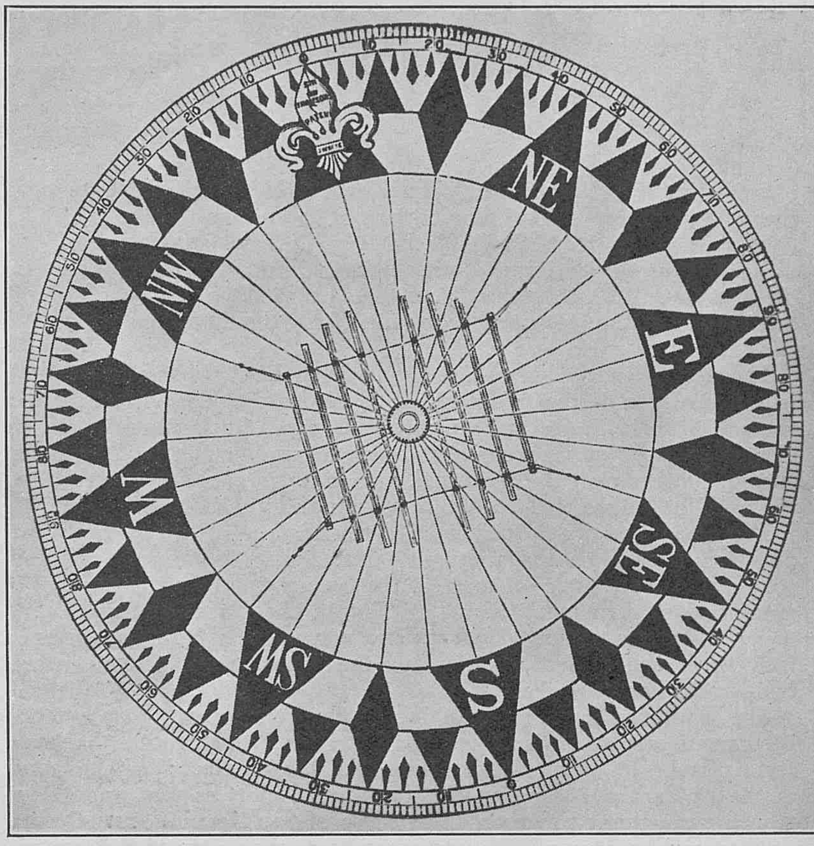


Fig. 5. Sir W. Thomson's compass card.

The binnacle of the new compass contained fitted appliances by which the compass could be fully compensated for all errors with ease and certainty by AIRY'S method, this being rendered practicable for the first time. Iron globes were substituted for the chain boxes previously used for correcting the quadrantal error, and an easy means of correcting the error caused by transient magnetism in vertical soft iron was provided by means of Flinders bars contained in a brass cylinder, which could be easily attached to the forward or after side of the binnacle as necessary. Adjustable magnet containers were fitted inside the binnacle for correcting the error caused by the permanent magnetism and the heeling error.

The increase in the size and speed of ships necessitating the compass being placed high up on the top of a series of deck erections subjected it to greater vibration and to combat which the liquid compass was introduced but the reduced diameter of the card and the increased size of the needles made this pattern compass more sluggish and more difficult to adjust than the dry card model.

Recent research and experiment carried out by the Admiralty Compass Department into the design of a magnetic compass suitable for use in aircraft, resulted in the production of the "Dead Beat" compass. This compass has a 6½ inch card contained in a 10 inch bowl. To the card is fixed two 2½ inch needles of a very high magnetic moment which renders the compass nearly free from the influence of all mechanical disturbance and allows heavy damping without making it sluggish. Its design renders it free from lag and the instrument remains steady under conditions that would disturb any other compass.

THE SEA SURFACE TEMPERATURE DISTRIBUTION IN THE INDIAN OCEAN.

Observations 1855 to 1917.

PREPARED IN THE MARINE DIVISION BY MR. H. KEETON.

In Volume V (1928) of this Journal were published month by month charts of mean sea surface temperature of the Indian Ocean.

In view of the fact that this issue marks the completion of the recharting of the currents of the Indian Ocean which has been in progress since 1929, these sea temperature charts have been re-examined in the light of the information obtained from this investigation of the currents.

The mean sea surface temperatures given on the charts were computed for areas of two degrees of latitude by two degrees of longitude for the years 1855 to 1917, and are thus too generalized for local variations or irregularities of surface current to be shown by them. The main currents, permanent and seasonal, can, however, be clearly traced by the trend of the sea surface isotherms, month by month.

The deviations of sea surface isotherms from a general east to west direction, over all oceans, are mainly due to the existence of warm and cold surface currents. In most of the oceans, these currents are of a more or less permanent character, but in the North Indian Ocean, owing to its geographical features and monsoonal winds, the currents vary with the seasons, and affect the distribution of sea surface temperature accordingly.

The Southern Indian Ocean is a wide open ocean with a large permanent area of high atmospheric pressure, which forms the basis for a permanent current circulation, and this is reflected in the trend of the sea surface isotherms which are much more regular, month by month throughout the year, than those of the North Indian Ocean.

The Southern Ocean Drift sets generally to the eastward right round the globe, subject to variations at all times and in all longitudes, and the currents in the South Indian Ocean between Latitude 38° and 50° S. form part of this Southern Ocean Drift.

Here there is a comparatively uniform distribution of surface temperature, the mean across the ocean decreasing regularly with increase of latitude.

In the vicinity of Latitude 50° S. the surface temperature does not undergo any important change during the year, the temperature near Kerguelen being approximately 38° to 40° F. in all months.

Further north there is greater variation in the temperatures month by month, until in Latitude 30° S. the maximum difference between summer and winter mean temperature (February and August) amounts to about 12° F.

Off the west coast of Australia between the parallels of 18° S. and 30° S., the South-East Trade Drift flows. This is a weak and variable current, particularly during May to October, and its effect on the mean surface temperature is negligible, except during January to March, when the charts indicate the influence of this current, the water in this region being cooler than in the same latitudes further to the west.

The Equatorial Current sets westward across the Indian Ocean, its northern limit varying from about Latitude 4° S. to 10° S., according to season and longitude, while its southern limit extends to Latitude 20° S. Here again the distribution of mean sea temperature is very regular, the monthly mean in the vicinity of Latitude 5° S. in the central portion of the ocean only fluctuating about 3° F. throughout the year. In Latitude 10° S. the range between summer and winter mean sea temperatures is about 6° F.

The Equatorial Current generally gathers strength as westing is made, and the greater volume of the current passes the northern end of Madagascar, and impinges on the African Coast near Cape Delgado. Here it divides, and great stream currents are formed running along the east coast of Africa, that going north being known as the East African Coast Current. The stream going south is known as the Mozambique Current as far as Delagoa Bay, and thence southward as the Agulhas Current. This south flowing stream is reinforced by another branch of the Equatorial Current flowing across from the southern coast of Madagascar, and the effect of these warm currents is clearly indicated on the monthly sea temperature charts, warm water being carried well to the southward of the Cape.

Where the southern edge of the Agulhas Current is deflected and mingles with the cold easterly Southern Ocean Drift, there are large variations of mean sea temperature, the change amounting to as much as 29° F. in 10° of latitude.

The crowding together of the sea isotherms in this region between Latitude 36° and 45° S., and from the Longitude of the Cape to 50° E., is a marked feature of the charts throughout the year, and large and rapid changes of sea temperature are frequently experienced in this vicinity.

In the North Indian Ocean during the northern summer, sea surface temperatures are generally higher than in the South Indian Ocean during the southern summer.

Over this ocean there is a seasonal alteration of barometric pressure, the heat of summer over the Asiatic Continent producing a low pressure, and the cold of winter producing a high pressure. These changes of pressure bring about the South-West and North-East Monsoons, and these in their turn, set up seasonal surface currents in opposite or nearly opposite directions.

During the first half of the North-East Monsoon season, an anti-clockwise circulation of surface current is set up in the Arabian Sea and Bay of Bengal, and the south-westerly set on the western sides of these waters is shown in the trend of the isotherms during these months. In the Arabian Sea the relatively cool water is carried down the East Coast of Africa as far as Latitude 2° S.

During the latter half of the North-East Monsoon season, February to April, this current circulation is reversed round the shores of the Arabian Sea and Bay of Bengal, but not in the central regions of these waters.

This reversal of current while the North-East Monsoon is still blowing, but with less force, has been attributed to the sea temperature distribution, the difference between the sea temperature at the head of the Arabian Sea and Bay of Bengal and at the parallel of Latitude 10° N. in February amounting to as much as 8° F.

This probably produces a flow of surface water towards the region of low sea temperature, which, with the effect of the earth's rotation and the trend of the coasts, produces the clockwise circulation.

During the South-West Monsoon season, May to October, a north-easterly to easterly set is developed in the Arabian Sea, which carries relatively cool water up the western side of this sea, the charts showing that the mean temperature here is 7° to 8° lower than on its eastern side in July.

In the China Sea, during the North-East Monsoon season the cool water off the Chinese coast is brought down by the North-East Monsoon drift, the effect being apparent on the surface temperature charts as far south as the Equator.

In the China Sea the difference between summer and winter temperatures reaches as much as 32° F.

In the Red Sea the difference between summer and winter mean sea temperature is from 12° to 15°, while in the Persian Gulf, where the highest mean temperature is recorded, 92° F. in August and September, the range is 28°.

THE 1910 TO 1935 SURVEY OF THE CURRENTS OF THE INDIAN OCEAN AND CHINA SEAS.

Prepared in the Marine Division by E. W. Barlow, B.Sc.

The present article contains a summary of the whole of the work of charting and investigating the currents of the Indian Ocean, the Eastern Archipelago and the China Seas south of Latitude 30° N., carried out in the Marine Division of the Meteorological Office between the years 1929 and 1935 inclusive. In the latter part of the article some information will be given about the sub-surface currents and their relation to the surface currents.

The Indian Ocean.—The Indian Ocean differs entirely from the Atlantic and Pacific Oceans in two ways. Firstly the area of the Indian Ocean north of the equator is extremely small in comparison with other oceans, secondly the cold waters of the Arctic Ocean have no access to the Indian Ocean. The effect of these differences will be briefly considered.

Not only is the northern part of the Indian Ocean of very small area, but it is divided by the Indian Peninsula into two bays—the Arabian Sea and Bay of Bengal—thus preventing any scope for a wide and general circulation of the water. Moreover, the 30th parallel of latitude where, following the analogy of the other oceans, there should be a permanent area of high pressure, is far inland over the Asiatic Continent. There is in fact over the continent and the Indian Ocean north of the equator, a seasonal alternation of mean pressure, the heat of summer giving rise to a low pressure, and the cold of winter to a high pressure. These changes of pressure give rise to seasonal winds, the South-West and North-East Monsoons respectively. These in turn develop seasonal currents in the surface water, in opposite directions according to the time of year. In the Indian Ocean currents of permanent direction are therefore to be found only in the main ocean, southward of the equator. There is thus no permanent North Equatorial Current.

The effect of the absence of cold water from the Arctic Ocean will be referred to more fully later, but it may be said here that it makes the sub-surface circulation of the Indian Ocean simpler than that of the other oceans.

Besides the two main differences from other oceans, explained above, there are also other differences, which are probably related to them. In both the Atlantic and Pacific Oceans the South Equatorial Current has its northern limit at about Latitude 3° N., so that in these oceans the Counter-Equatorial lies wholly north of the equator. In the Indian Ocean, on the other hand, the Counter-Equatorial Current lies mainly south of the equator, while the northern limit of the South Equatorial Current, known as the Equatorial Current in this ocean, is still further south, varying from about Latitude 4° S. to 10° S., according to season and longitude. Also the Counter-Equatorial of the Indian Ocean is a stronger current than that of the North Atlantic Ocean, and flows throughout the year. That part of the Counter-Equatorial Current of the North Atlantic Ocean known as the Guinea Current, on the eastern side of the ocean, flows throughout the year, but further west in the open ocean the Counter-Equatorial Current is only found during a part of the year.

A further difference between the Indian and other oceans is that the area of high mean atmospheric pressure which lies in the South Indian Ocean between the parallels of 30° S. and 35° S. is of somewhat different character from those that are found in either the South Atlantic or South Pacific Oceans. On the average for the whole year the area of highest pressure in the Indian Ocean lies in the central longitudes of the ocean. This is not the case in the other oceans. Also the area of highest pressure shifts in longitude, lying nearer the African coast from May to September, and nearer Australia from November to April. In the other oceans the shift is very little, and is mainly negligible in comparison with the width of the oceans. Furthermore, the anticyclonic ridge is narrower in a north to south direction in the Indian Ocean than in either of the others.

The Surface Circulation of the Indian Ocean.—The circulation of the Southern Indian Ocean, while indirectly influenced by the monsoon periods, contains no currents which reverse seasonally, and this will be described first. The mean set and drift of currents for the four quarters of the year for various parts of the ocean are shown in Tables 1, 2 and 3. It must be remembered that the actual currents experienced in any region may be considerably stronger than the mean set for that region. This especially applies to regions of weak and variable current as the means of these are more likely to be made up of currents of widely different directions, which partly neutralise one another when the mean is taken. These remarks apply to the relatively large areas for which means are given in Tables 1, 2 and 3, and equally to any one of the areas of two by four degrees for which mean arrows are given on the Marine Observer Charts. The strength of the currents which may be experienced in any region are better seen from the roses and from the tables of maximum drifts, in which particulars of the strongest currents are given. It is probable that drifts of 1 knot or even more may be occasionally experienced in any part of the Indian Ocean. Nevertheless, the work done in constructing the Marine Observer charts has made it clear that the currents shown on the older charts or described in the older books were in general more or less overestimated, and were sometimes more applicable to the maximum drifts encountered in the region than to the average strength of the currents. To avoid constant repetition it must be understood that in the summary of the circulation which follows mean sets and drifts are invariably referred to unless the contrary is distinctly stated.

Circulation of the Indian Ocean—South of the Equator.—This will be described in order, starting from the most southerly part, which is part of the Southern Ocean Drift flowing eastwards round the globe, due to the westerly winds of the Roaring Forties. Between Latitudes 38° S. and 50° S. and Longitudes 20° E. and 80° E. the Southern Ocean Drift sets E.N.E. Between Longitudes 80° E. and 100° E. it sets between E. and E.S.E. To the southward of Australia the set is also E.S.E. In the region of Latitude 30° to 38° S., Longitude 100° to 112° E., a part of the Southern Ocean Drift turns north-easterly, and is called the Connecting Current. Off the west coast of Australia up to about Latitude 18° S., the circulation continues as the South-East Trade Drift, setting N.W. by N. This passes gradually into the westerly flow of the Equatorial Current, between the longitudes of Christmas and Cocos Islands. The Equatorial Current widens towards the longitude of Mauritius. The main part of the current passes north of Cape Amber, carrying a great volume of water to the African coast in the neighbourhood of Cape Delgado, where it divides, forming two great currents running along the coast, the East African Coast Current flowing northwards, which will be described later, and the Mozambique Current flowing southwards. South of Latitude 26° S. this great current continues as the Agulhas Current. In the vicinity of Longitude 24° E., where the 100-fathom line trends outward from the coast to form the Agulhas Bank, the Agulhas Current spreads out and weakens, part of it continuing over the Agulhas Bank past Cape Agulhas, and entering the South Atlantic Ocean. During the greater part of the year a small portion of the Agulhas Current runs down the east side of the Agulhas Bank, and recurves to the south-eastward, completing the circulation of the surface current of the Indian Ocean south of the equator.

Part of the Equatorial Current sets westerly from the neighbourhood of Mauritius towards the east coast of Madagascar. This divides on reaching the coast, a part flowing northwards to swell the volume of water passing Cape Amber and a part going southwards to Cape St. Mary. Another part of the Equatorial Current flows direct from Mauritius to Cape St. Mary, where it is joined by the southerly flow down the east coast of Madagascar. During February to April this branch of the Equatorial Current flows from Cape St. Mary south-westwards, and joins the Agulhas Current in the neighbourhood of Durban, but it is not a steady flow, and many easterly sets are experienced. During the rest of the year there is little or no predominance of westerly over easterly sets in this region.

The Equatorial Current sets to the westward from the Arafura Sea, but is a narrow stream eastward of Christmas Island. Although the name of South-East Trade Drift has been given to the weak northerly current off the west coast of Australia it must be remembered that the whole of the Equatorial Current is primarily caused by the South-East Trade Wind, the current flowing westerly since it is deflected to the left of the wind direction by the earth's rotation.

The circulation which is described above is relatively weak on its southern part and very weak in its eastern part. The Equatorial Current gathers strength with decreasing east longitude, especially during the S.W. Monsoon period. The only really strong parts of this circulation are on the west side, the Equatorial Current from Cape Amber to Cape Delgado during the South-West Monsoon period and the Mozambique and Agulhas Currents all the year. The seasonal variations are as follows. East of Longitude 80° E. the Southern Ocean Drift is somewhat stronger in the southern summer than in the southern winter; between Longitudes 80° E. and 140° E. the reverse is the case. The Equatorial Current is strongest during the South-West Monsoon period, when the South-East Trade Wind is strongest, blowing farther north and passing without interruption into the South-West Monsoon. The South-East Trade Drift is strongest during the remainder of the year when the South-East Trade Wind is met farther south. The Mozambique-Agulhas Current is markedly stronger during the North-East Monsoon period (southern summer), and thus alternates in strength with the East African Coast Current, which is strongest during the South-West Monsoon period (northern summer). In other words the Equatorial Current dividing at Cape Delgado sends a larger proportion of the water southwards in November to April, and a larger proportion northwards in May to October. This is shown in FIGURE 1, in which the north or south components of these currents are plotted monthly. The Agulhas Current recurves into the Southern Ocean Drift from May to January, but not from February to April. The Agulhas Current is generally strongest between Durban and East London where, during the months of its greatest strength the mean drift is as much as 58 miles per day. The strongest part of the stream, as is usual with all strong coast currents, is near the 100-fathom line, where drifts of 5 knots may be occasionally experienced. Weak counter-currents between the Agulhas and Mozambique Currents and the coast may be experienced at times, but do not form a continuous flow. They are especially frequent in the Bight of Sofala. Northerly counter-currents are also experienced to seaward of the Mozambique Current in the Mozambique Channel.

Counter-Equatorial Current.—Before summarising the monsoon circulations, in which the currents are reversed seasonally, the Counter-Equatorial Current, flowing between Latitudes 2° N. and 6° S., will be described. During the South-West Monsoon period the Counter-Equatorial flows eastward from about Longitude 56° E. In the height of the North-East Monsoon period, November to January, the East African Coast Current, flowing southwards down the African Coast at this time, recurves into the Counter-Equatorial Current, which then commences from the coast. During February to April, when the North-East Monsoon is weakening, there is a strong westerly current in the region Latitude 4° to 0° N., Longitude 56° to 68° E., and Latitude 0° to 2° S., Longitude 60° to 64° E. This current recurves southward into the Counter-Equatorial Current between Longitude 48° to 52° E., north-west of the Seychelles. At the same time part of the Equatorial Current flowing past Cape Amber recurves northward into the Counter-Equatorial Current. The Counter-Equatorial Current west of Longitude 60° E. is not found farther north than Latitude 2° S. at this time of the year and as the Counter-Equatorial Current during the rest of the year fills the region occupied at this season by the strong westerly current mentioned above, we may regard the Counter-Equatorial Current as suffering a partial reversal during three months of the year. This is shown by FIGURE 2, in which the east or west components of the mean drift for each month of the year are shown for the region Latitude 4° to 0° N., Longitude 56° to 68° E., and Latitude 0° to 2° S., Longitude 60° to 64° E. This figure shows that the westerly current actually begins in January and is at a maximum in February. In computing the mean set and drift of the Counter-Equatorial Current during February to April for TABLE 2 the region of westerly current has been omitted so as to give a true idea of the strength of the easterly current to the southward.

The Counter-Equatorial Current west of Longitude 80° E. is strongest in November to January, when continuous with the East African Coast Current, and may set as much as 3 knots. It is weaker throughout the year east of Longitude 80° E. and shows no marked seasonal variation. During November to January the Counter-Equatorial Current not only flows across the ocean but continues down the south-west coasts of Sumatra and Java in the form of south-easterly and easterly sets.

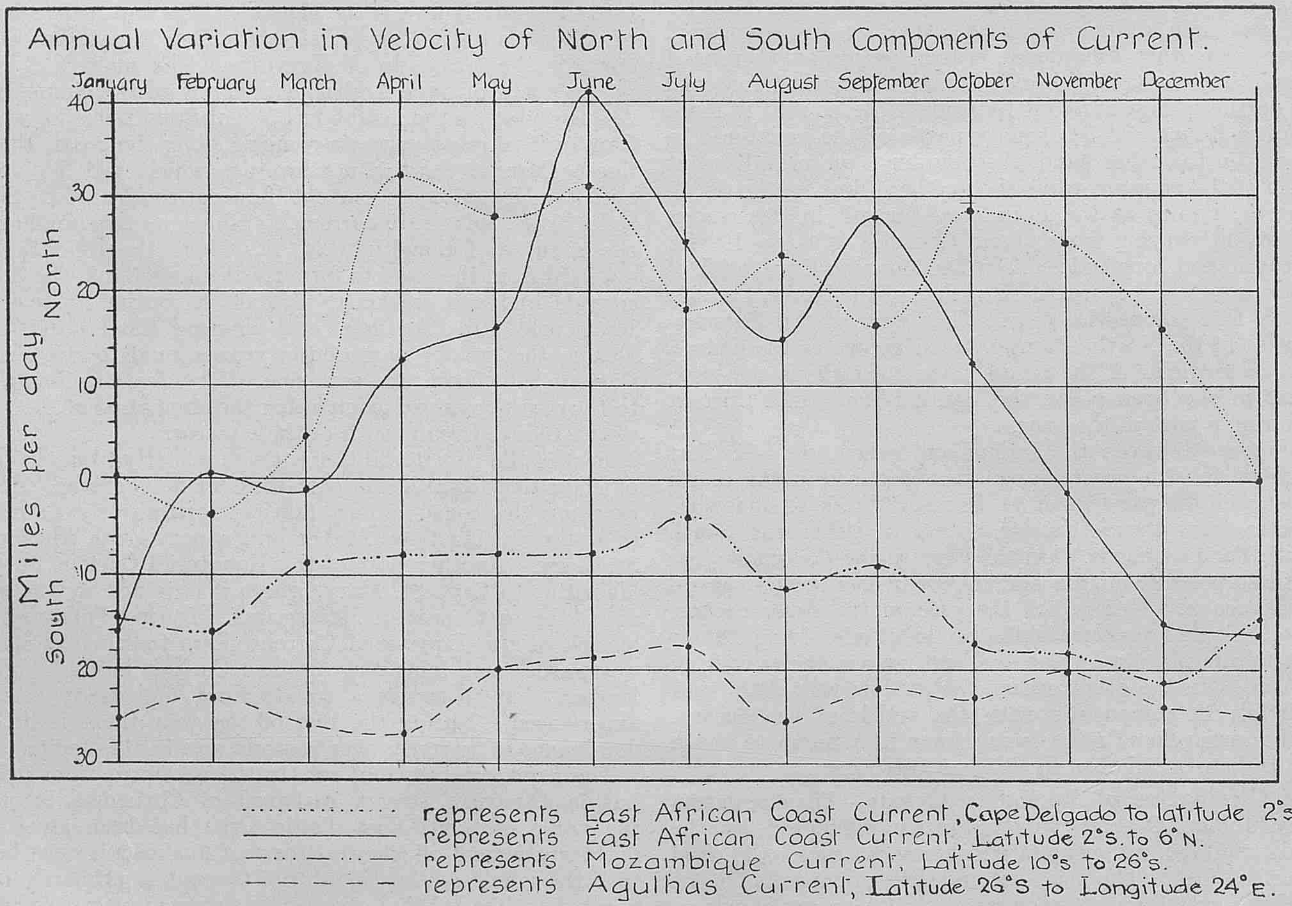


Figure 1

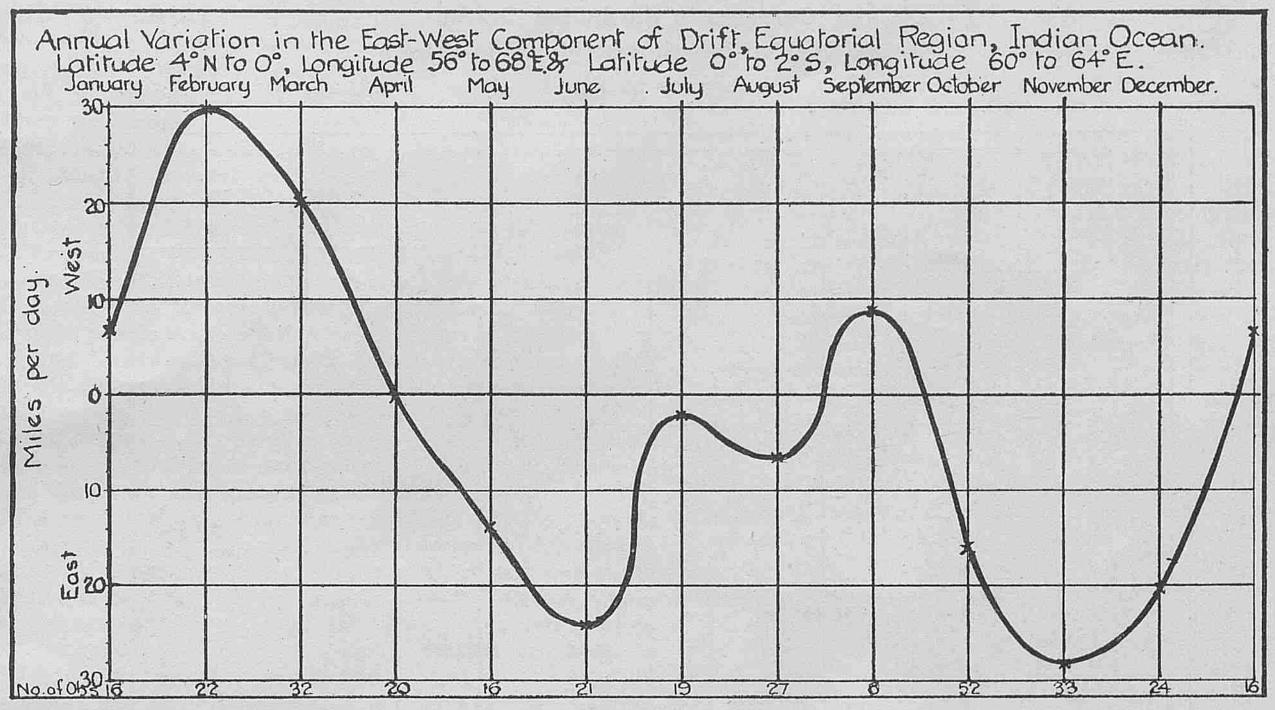


Figure 2.

The Monsoon Circulation, November to January.—The effect of the North-East Monsoon is to make the open waters of the Arabian Sea and Bay of Bengal set in a general westerly direction, varying in different parts from a little north of west to a little south of west, with weak to moderate strength. Owing to the coastal conformation the current of the coastal waters sets in a counter-clockwise direction round both the Bay of Bengal and the Arabian Sea. Between the latitudes of Ceylon and about 2° N., the northern limit of the Counter-Equatorial Current, the water is driven westwards from the Malacca Strait into the Arabian Sea. The current forming part of the counter-clockwise circulation of the coastal regions of the Bay of Bengal passes down the east coast of Ceylon and joins this general westerly current. The counter-clockwise circulation of the coastal regions of the Arabian Sea is continued as a stronger current down the east coast of Africa to about Latitude 3° S., recurving as previously stated into the Counter-Equatorial Current in the neighbourhood of the Equator. The general circulation of the Indian Ocean in November to January is shown in FIGURE 3.

Currents in the Indian Ocean.
First Half of North-East Monsoon Season.
November to January.

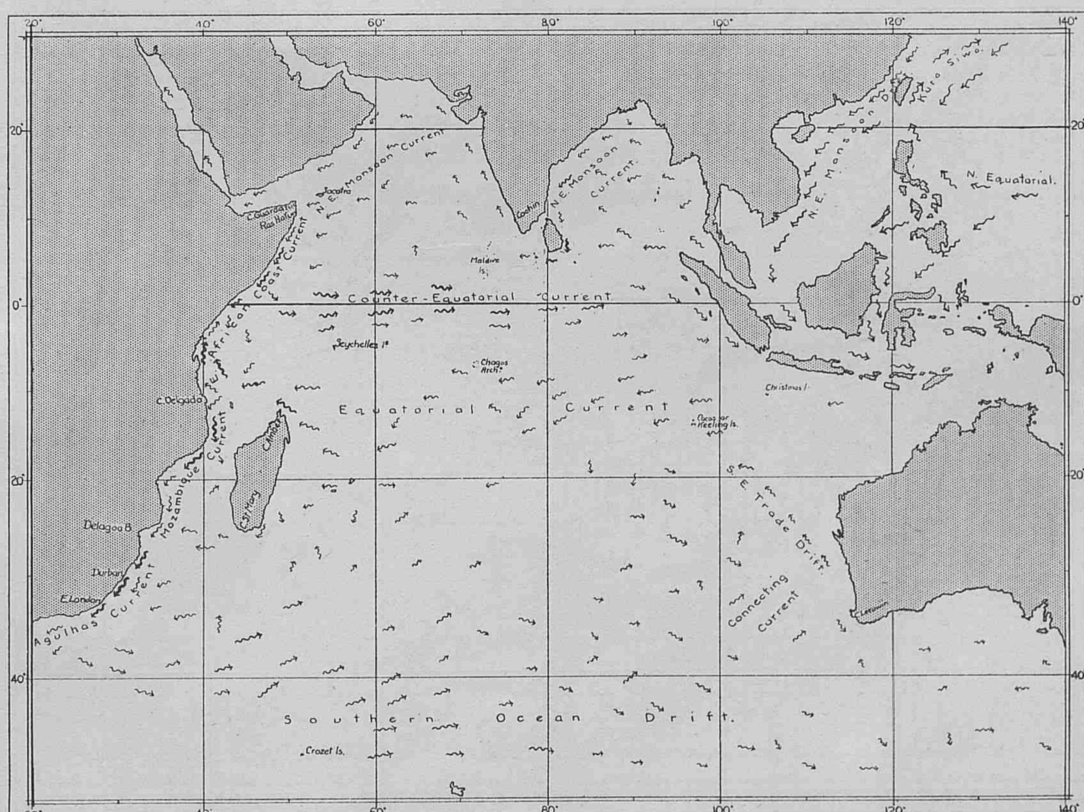


Figure 3.

Currents in the Indian Ocean.
Second Half of North-East Monsoon Season
February to April.

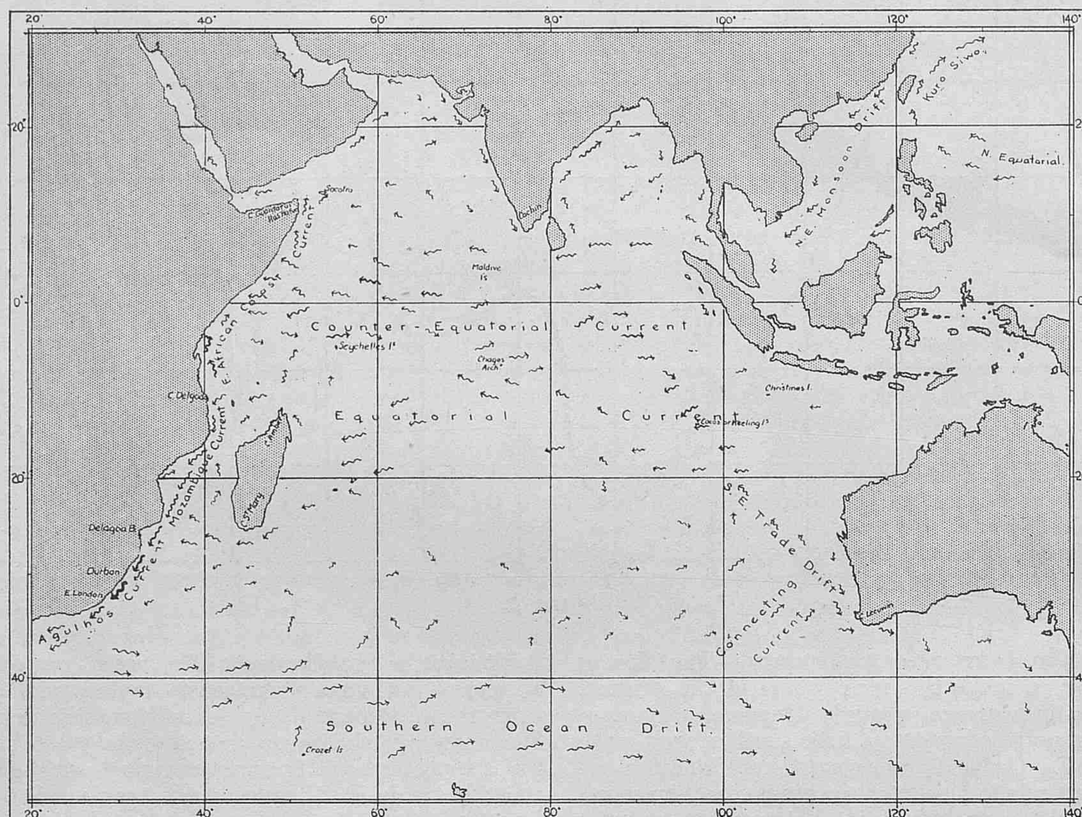


Figure 4.

Currents in the Indian Ocean.
South-West Monsoon Season.
May to October.

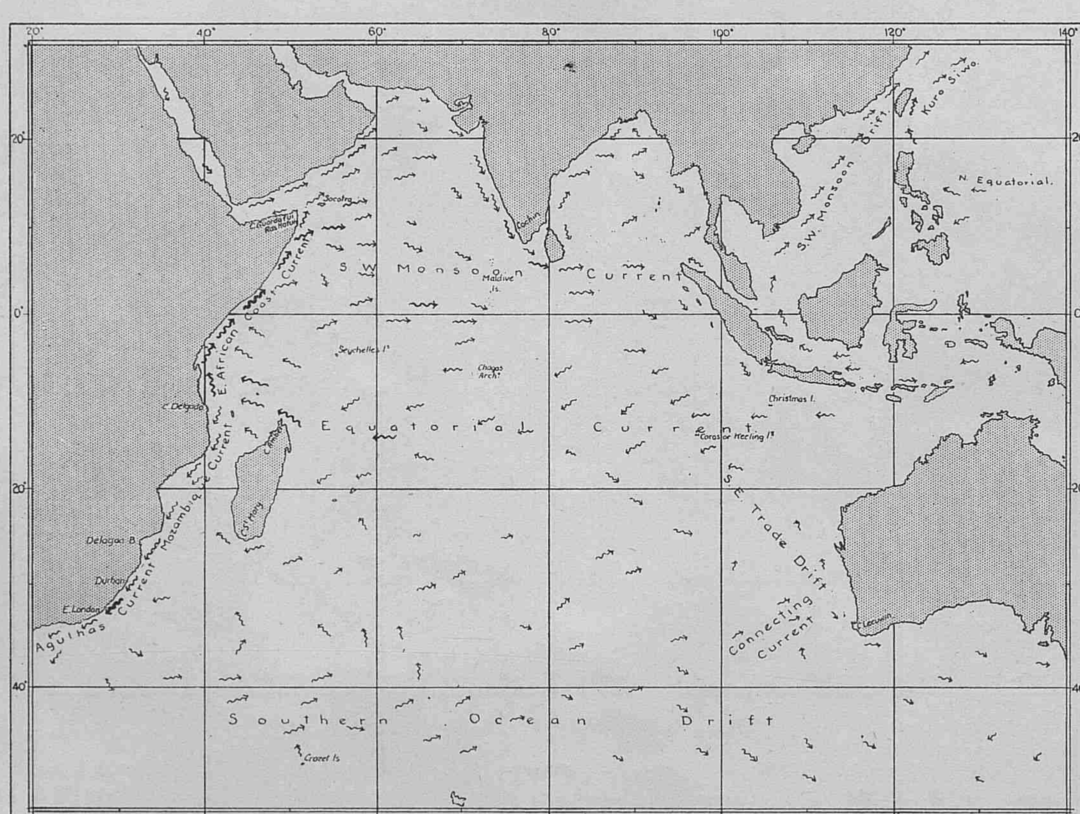


Figure 5.

The Monsoon Circulation, February to April.—During this quarter the North-East Monsoon is weakening. The circulation of the central parts of the Arabian Sea and Bay of Bengal is weak and variable but the mean sets remain westerly or north-westerly as during November to January. The westerly current to the south of Ceylon also continues to flow. The coastal circulation of the Arabian Sea and Bay of Bengal is however everywhere reversed to a clockwise direction. Thus the current off the west coast of India, which was N.N.W. during November to January, is now S.S.E., and the current off the east coast of India, which was S.W. and S., is now N. and N.E. Thus the counter-clockwise circulation produced round the coastal region by the North-East Monsoon during November to January is reversed before the North-East Monsoon season is over, and while it is still blowing over the greater part of the Indian Ocean north of the Equator, but with less force. In other words the circulation round the coastal regions of the Arabian Sea and Bay of Bengal changes to the direction in which it flows throughout the South-West Monsoon period before the South-West Monsoon is established. From about Latitude 4° N. the East African Coast Current is similarly reversed, flowing northward. The northerly flow from Cape Delgado extends only to the Equator; between the Equator and Latitude 4° N. the current off the east coast of Africa is westerly. This westerly current, though not so strong, is a continuation of the strong westerly current which as stated above replaces part of the Counter-Equatorial Current during this season. The reversal of current during February to April is probably caused by sea temperature differences as explained later in the present article. The time of reversal is not the same throughout all parts of the coastal circulation. The general circulation of the Indian Ocean in February to April is shown in FIGURE 4.

The Monsoon Circulation, May to October.—As the South-West Monsoon becomes established the counter-clockwise current flowing round the coastal regions of the Arabian Sea and Bay of Bengal is strengthened and the current in their open waters becomes easterly. The set is therefore eastward over the whole of the northern part of the Indian Ocean north of the west-setting Equatorial Current. The Counter-Equatorial Current is thus only distinguishable from the South-West Monsoon Drift by its stronger drift. Along the whole east coast of Africa from Cape Delgado to Cape Guardafui the East African Coast Current runs northward, reaching its greatest strength, which in local areas may equal or exceed a mean drift of 60 miles a day. In May to July, between Latitudes 3° S. and 3° N., the mean set is 55 miles per day over the stretch of 500 miles. Between Latitudes 3° S. and 8° N. this current frequently reaches 4 knots. From about Latitude 7° N. the East African Coast Current divides, part continuing to set along the coast past Cape Guardafui, but the main strength of the current recurves away from the land to E. and S.E., weakening west of Longitude 56° E. and passing into the general monsoon drift. In the vicinity of 170 miles due south of Sokotra this E.S.E. set occasionally reaches 7 knots during the height of the South-West Monsoon. The mean sets for (i) July and August (ii) September, for one-degree squares in the region of Sokotra, are shown in FIGURE 6.

Currents of the Red Sea and Persian Gulf.—The currents of the Red Sea may set to any point of the compass but the predominant direction depends upon the wind over the Red Sea, which varies with the monsoon blowing in the Arabian Sea. During the South-West Monsoon season the wind in the Red Sea is mainly between N. and N.W. and the mean set of the current is S.S.E. During the North-East Monsoon season the wind is mainly from between S. and S.E., south of Latitude 20° N., and the mean set of the current is N. or N. by W. During this season, north of Latitude 20° N., the wind is mainly from N. and N.W. and the mean set of the current is north-westerly against the wind, but weak.

The currents of the Persian Gulf are weak and variable.

Currents of the China Sea and East Indian Archipelago. The currents of the China Sea up to Latitude 30° N., the limit of the charts, are drifts depending on the monsoons. In the China Sea the North-East Monsoon is the stronger wind; the south-westerly current resulting therefrom is stronger than either of the monsoon drifts of the Indian Ocean. A further difference is that in the Indian Ocean the monsoon drifts cover the whole ocean north of the equatorial region, while in the China Sea they are concentrated into comparatively narrow streams following the coasts of China and Annam but cutting across the entrances of the Yellow Sea and the Gulf of Siam, the currents in the other parts of the China Sea being variable. The monsoon drifts of the East Indian Archipelago are mainly weak.

Currents of the North Pacific Ocean West of Longitude 140° E.—The North Equatorial Current flows between Latitudes 8° and 20° N. Eastward of Luzon this current becomes north-westerly and passes into the Kuro Siwo which flows N. and N.E. from the north coast of Luzon towards Japan. When the North-East Monsoon is blowing it opposes the Kuro Siwo and reduces its strength. During the North-East Monsoon season, November to April, a fairly strong counter-current flows in a south-westerly direction, east of the Kuro Siwo, from Latitude 30° N., the limit of the charts, to about Latitude 18° N.

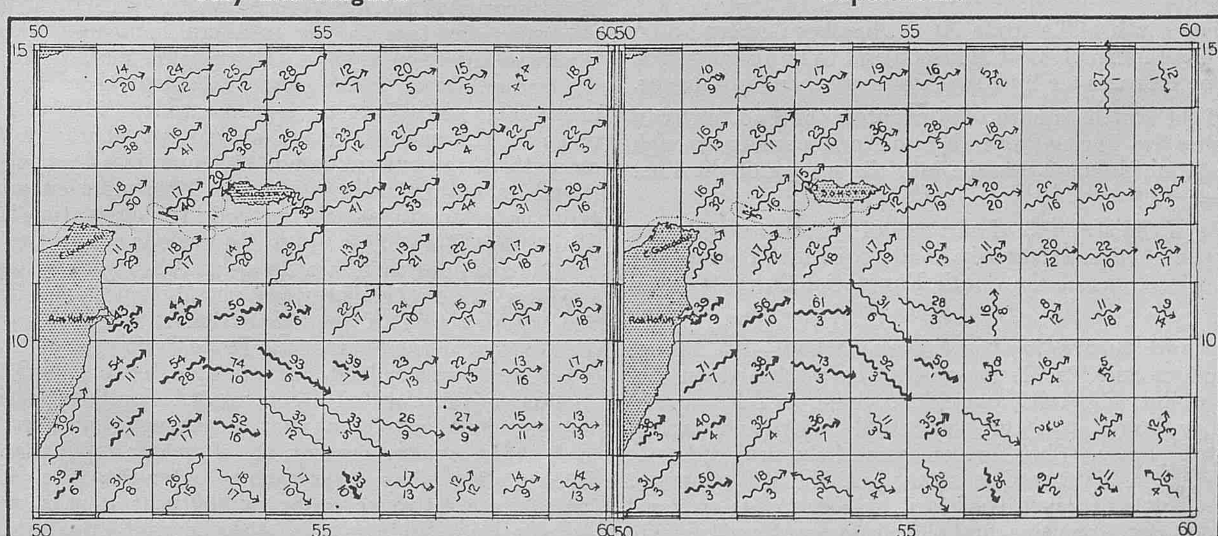
In November to April the southern part of the North Equatorial Current turns south-westerly and flows south through the Celebes Sea, passing through the Macassar Strait and Molucca Passage into the waters of the East Indian Archipelago, joining the general easterly flow of that region.

New Knowledge gained during the Present Investigation. The most important of the new facts gained during the charting and investigation of the currents of the Indian Ocean during the past seven years are summarised below :—

(1) Parts of the East African Coast Current and of its recurve seawards to the south of Sokotra, during the South-West Monsoon

Charts of Mean Currents for the region of Cape Guardafui during the South-West Monsoon period.

July and August. **September.**



Compiled from observations of British ships during the years 1870 to 1929.

Figure 6.

period, have the strongest mean drifts of any current in any ocean for which the MARINE OBSERVER charts have so far been constructed and it is highly probable that no stronger current exists.

(2) The seasonal alternation of strength between the Mozambique-Agulhas Current and the East African Coast Current.

(3) The reversal of the current round the coastal regions of the Arabian Sea, Bay of Bengal and the east coast of Africa south of Cape Guardafui during the latter half of the North-East Monsoon period, before the South-West Monsoon begins, is an entirely new and very important fact. Parts of this reversed circulation were well-known, but it was not grasped as a whole, and no explanation of the reversal had been attempted.

(4) A small counter-clockwise circulation has been found in the head of the Bay of Bengal occupying the area north of Latitude 18° N. during the South-West Monsoon period, giving westerly currents near the coast. This accounts for the fact that the mean drifts shown in TABLE 2 for this region during May to October are smaller than in any other part of the Bay of Bengal and Arabian Sea, the currents largely neutralising one another in the mean value.

(5) A special investigation showed that the increase in strength of westerly currents near the coast at the head of the Bay of Bengal is not an infallible indication of the approach of a cyclone.

(6) The new information obtained with regard to the Southern Ocean Drift, notably :—

(*a*) The greater strength of the current, west of Longitude 80° E., in the southern summer, which is in opposition to previous ideas. It is therefore of particular interest to note that the investigations of the Discovery in the South Atlantic Ocean, from 1926 to 1932, also show the currents of the Southern Ocean Drift to be strongest in summer in the corresponding part of that ocean, the longitudes east of Cape Horn, and that these results were obtained by oceanographical observation of temperatures and salinity, not by the combination of numerous observations of the surface current.

(*b*) The difference between the western and eastern part of the Southern Ocean Drift of the South Indian Ocean whereby the mean set in the region west of Longitude 80° E. is stronger and has a northerly component while that east of Longitude 80° E. is weaker and has a southerly component.

(*c*) The investigation of the latitude at which the greatest strength of the easterly current flows. Taking the year as a whole this was found to be in Latitude 40° to 42° S., west of Longitude 60° E., and in Latitude 44° to 46° S., between Longitudes 60° E. and 108° E.

(7) The very strong cross currents which were said to occur in the Red Sea do not exist, the supposed abnormal sets being really the result of errors in position found by sights due to excessive refraction.

(8) The monsoon currents of the China Sea have been found to be comparatively narrow streams, that flowing during the height of the North-East Monsoon period being stronger than the monsoon drifts in the Arabian Sea and Bay of Bengal at any time of the year.

(9) The Kuro Siwo south of Latitude 30° N. has been shown to be reduced in strength by the North-East Monsoon and to be accompanied during this season on its east side by a south-westerly counter-current.

(10) A branch of the North Equatorial Current to the Pacific Ocean flows into the Celebes Sea during November to April, passing through the Macassar Strait and Molucca Passage into the waters of the East Indian Archipelago.

(11) Comparisons of the strength of currents of different oceans can now for the first time be satisfactorily made. TABLE 4 gives the relative strengths of sections of the South Equatorial Currents in all oceans.

Drifts of Ships and Buoys in the Indian Ocean.—An article, "Drifts in the Indian and Pacific Oceans," was published in the MARINE OBSERVER, Vol. IX, 1932, page 203, giving a full account of the drifts of ships, buoys, etc., and also a table giving particulars of the drifts of bottle papers. Two further cases of the drift of bottle papers were published in MARINE OBSERVER, Vol. X, 1933, page 43. One of these was a bottle dropped overboard by S.S. *Pallas* on April 16th, 1921, off Santa Cruz, Argentina, and picked up near Cape Leeuwin Lighthouse on December 4th, 1923. This bottle was, therefore, carried by the Southern Ocean Drift across the South Atlantic and South Indian Ocean in two years eight months.

No further reference to bottle papers will be made here but it will be interesting to summarise the drifts of ships and other objects in the Indian Ocean. The *Waikato*, abandoned on June 5th, 1899, in Latitude 37° S, Longitude 21° E., was carried by the Southern Ocean Drift to Latitude 39° 30′ S., Longitude 64° 30′ E., 2,056 miles from the position of abandonment, but she was sighted in two intermediate positions and the actual drift was greater than this. A steel gas buoy broke adrift from the River Plate neighbourhood on July 18th, 1918, and was found 100 miles north of Fremantle five years later, having been sighted by S.S. *Poona* 122 days previously in a position 570 miles S.E. of where it was picked up. The buoy was, therefore, carried 8,500 miles by the Southern Ocean Drift, at the rate of 4·6 miles a day, assuming that it followed the most direct route. A derelict barge was observed by S.S. *Barrabool* in Latitude 39° 10′ S., Longitude 82° 00′ E. on January 24th, 1925, and nine days later was seen by S.S. *Themistocles* in Latitude 40° 12′ S., Longitude 85° 18′ E. On the assumption of shortest route it had been carried by the Southern Ocean Drift S. 67° E., 160 miles in nine days, a drift of 18 miles per day.

There are three interesting cases of long drifts not connected with the Southern Ocean Drift. A large buoy was lost by C.S. *Cambria* in August 1921 off the East African Coast and was picked up in Walvis Bay in June 1925. This buoy must have been carried by the Mozambique and Agulhas Currents right round South Africa and thence by the Benguella Current of the South Atlantic Ocean. It is impossible to say how it got into the Mozambique Current. Where it was lost the East African Current runs strongly to the N.E. at this season and so does the general north-easterly set of the S.W. Monsoon period. It may have gone a long way across the ocean, returning by the Equatorial Current to the neighbourhood of Cape Delgado and thence into the Mozambique Current. The Malay canoe which was cast ashore at Algoa Bay on February 15th, 1927, was probably carried across the ocean by the Equatorial Current, then by the Mozambique and Agulhas Currents. A life buoy lost overboard from R.M.S. *Orama* on December 11th, 1926, in Latitude 20° 03′ S., Longitude 104° 00′ E. was picked up on the East African Coast near Mombasa on February 6th, 1928, having probably drifted across the ocean in the Equatorial Current and thence in the East African Coast Current.

The remaining three drifts are shorter ones. The S.S. *Georges Philippar* drifted north-eastward from near Cape Guardafui under the influence of the South-West Monsoon current, between May 16th and 19th, 1932. The S.S. *King Cadwallon*, abandoned on July 13th, 1929, in Latitude 32° 01′ S., Longitude 40° 41′ E., was picked up 40 miles off Durban on August 14th, having drifted at least 475 miles under the influence of the westerly currents which may be encountered between Cape St. Mary and Durban. A large cable buoy belonging to the C.S. *Lady Denison Pender* broke adrift in Latitude 28° 00′ S., Longitude 44° 00′ E., south of Madagascar, in June 1924, and was found five months later in the Mozambique Channel off Cape Bazaruto.

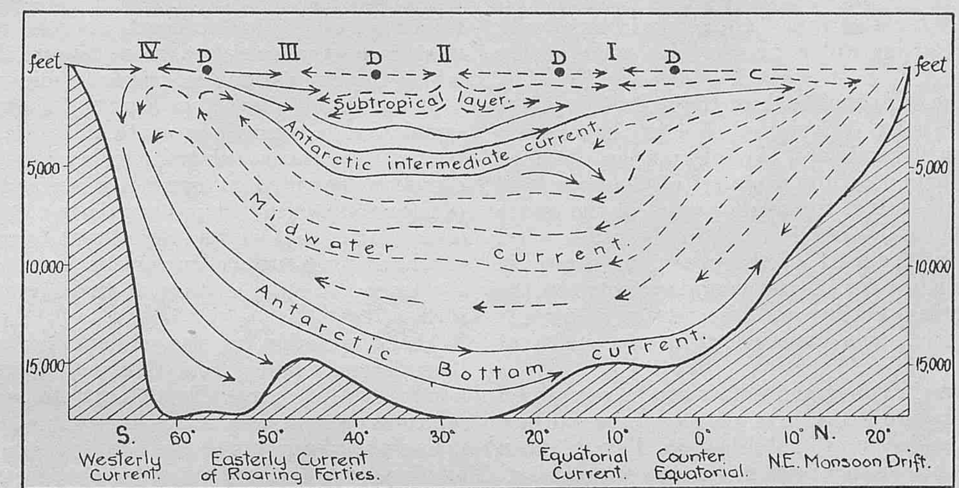
The Sub-surface Circulation and the Origin of the Surface Currents.—It is common to speak of the surface current circulation in all oceans as taking place round the permanent anticyclones, in a clockwise direction in the northern hemisphere and in a counter-clockwise direction in the southern hemisphere. The northern part of the Indian Ocean is of course excepted, there being no permanent anticyclone there. It is desirable to consider what this statement means. The merest glance at current charts will show that the strength of the current is not the same in all parts of the circulation round an anti-cyclonic region. A little more examination will show that the volume of surface water in the circulation is not the same at all points. For this to be so the regions where the current is strong would have to be narrow in extent and the regions where it is weak much broader. While the former is usually true, the latter is not. Thus the weakest part of the circulation round the South Indian Ocean anti-cyclone is the South-East Trade Drift west of Australia, but there is no broad well-defined current there, however weak. Neither is the weakness compensated by increased depth of current, for all our information goes to show that the stronger currents of the circulation, such as the Agulhas current, are of greater depth than the weaker ones. It is obvious that other factors enter into the circulation such as interchange between water at different depths and especially the compensating influence of the Counter-Equatorial Current which carries a large volume of water eastwards, in opposition to the circulation round the high-pressure area. Furthermore, the southern part of the current circulations of all oceans south of the equator is formed by the Southern Ocean Drift which flows as a continuous easterly current round the entire globe and so produces interchange of the waters of the different oceans. The idea of circulation round the high-pressure area must therefore refer only to the direction of the current, not to its strength or volume.

The South Indian Ocean is wider than the South Atlantic Ocean and the high-pressure area forms a belt across it parallel to the circles of latitude. The main currents in the open waters of the equatorial region and South Indian Ocean, comprising the Counter-Equatorial Current, the Equatorial Current and the Southern Ocean Drift, therefore flow in belts approximately parallel to the circles of latitude.

comprising cold water of Antarctic origin, with low salinity. These four layers of water are shown in FIGURE 7, and it should be noted that a precisely similar stratification has been observed in the South Atlantic Ocean where a description of it will be found in Discovery Reports, Vol. VII, "A General Account of the Hydrology of the South Atlantic Ocean" by G. E. R. DEACON, published in 1933.

FIGURE 7 also shows in broad outline the underwater circulation of the Western Indian Ocean, but as the diagram extends along a meridian, only the north and south components of the circulation can be shown. It will be noticed that there are four regions where water coming from different directions converges at the surface. In modern meteorology

The Sub-surface Circulation of the Western Indian Ocean during the North-East Monsoon Period. [*After Dr. M¨ller.*]



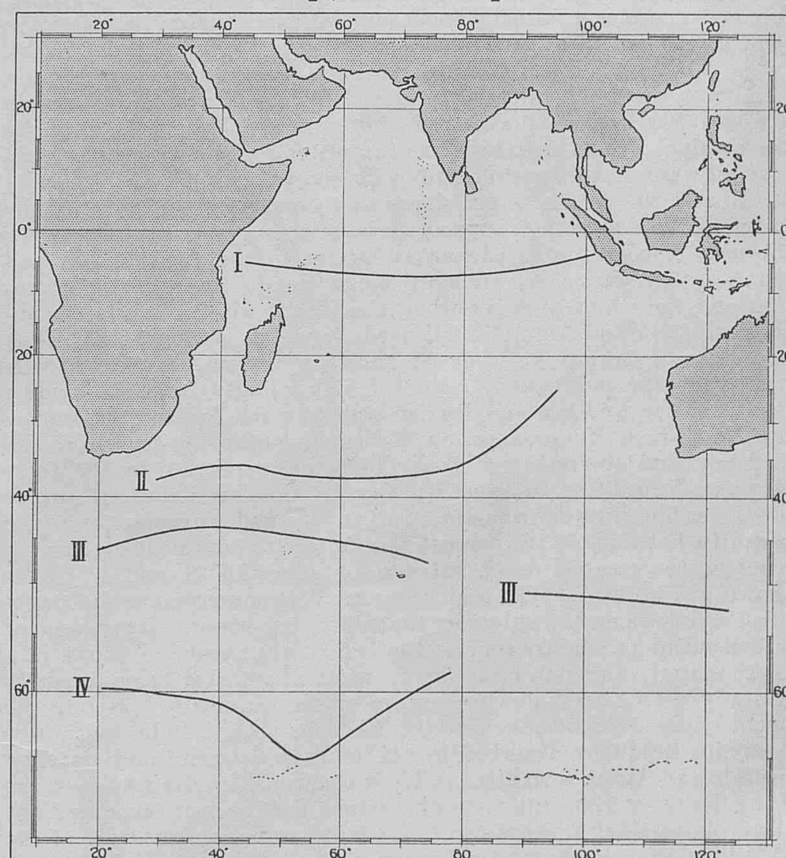
I Tropical Convergence.
II Sub-tropical Convergence.
III Sub-polar Convergence.
IV Polar Convergence.
D Regions of Divergence.

Figure 7.

Our information of the currents of the Indian Ocean is not yet complete, particularly as regards the sub-surface flows and it is, therefore, not possible to give a full account of the complex sub-surface circulation and its relation to the surface circulation in detail. The sub-surface conditions, temperature and salinity, and the circulation arising therefrom are better known for the period of the North-East Monsoon than they are for that of the South-West Monsoon. In 1929 Dr. MÖLLER published in Berlin the results of an investigation into the sub-surface circulation of the Indian Ocean based upon the oceanographical observations made at different depths by ships of the expeditions of various countries up to that date. In the present article only a general outline of these results will be given, the details being much too complex. In any case Dr. MÖLLER clearly states that the investigation can only represent a working hypothesis of the true movement of the water in the Indian Ocean, on the basis of the available material, and that systematic observations are needed in order to obtain a final solution of the many outstanding questions, and above all of the seasonal fluctuations. Since Dr. MÖLLER's investigation was made a British oceanographical expedition has been working in the Arabian Sea and north-western Indian Ocean, the JOHN MURRAY Expedition, in 1933 to 1934, to which 24 ships of the British Merchant Navy contributed observations of temperature and water samples. The full results of this expedition have not yet been published, but some of them will be referred to later.

It is found that four layers of water exist in the sub-tropical region of the South Indian Ocean, from latitudes 5° S. to 40° S., differing in temperature and salinity, and superimposed upon one another. These are in order of depth, (1) a warm upper layer, including the surface water, with high temperatures and salinities, known as the sub-tropical layer, (2) the Antarctic intermediate layer, composed of cooler and less saline water of Antarctic origin, (3) the midwater layer of warm water with a high degree of salinity, (4) the Antarctic bottom layer,

Regions of Convergence of Water in the Indian Ocean. [*After Dr. Möller.*]



I Tropical Convergence.
II Sub-tropical Convergence.
III Sub-polar Convergence.
IV Polar Convergence.

Figure 8.

we speak of fronts, which are lines where air masses of different temperatures and other characteristics converge together. In modern oceanography we find exactly the same idea, a convergence being a line where masses of water converge from different directions. The situation of the four convergence lines of the South Indian Ocean, as given by Dr. Möller is shown in Figure 8. The tropical convergence is marked by the Counter-Equatorial Current or forms the line of demarcation between the Counter-Equatorial and Equatorial Currents. Vertical movements of the water are at a maximum at the regions of convergence. The Marine Observer chart for the quarter May to July shows that the Counter-Equatorial Current flows very strongly to the eastward from about longitude 56° E., in the vicinity of the equator. There are no adequate surface flows to start a strong current here and it is apparently due to upwelling from below the surface. From the observations made in the John Murray expedition Lieutenant-Colonel R. B. Seymour Sewell states that " there is without doubt a very marked upwelling of deep water on the east side of the Seychelles."

The sub-tropical convergence is to the south of the main belt of the Equatorial Current. The sub-polar convergence lies in the easterly current of the region of westerly winds and the information obtained from the Marine Observer charts, that the mean set of the current of the Roaring Forties is north of east in the western part of the South Indian Ocean, agrees with the north-easterly trend of the sub-tropical and sub-polar convergences in this part of the ocean, as shown in Figure 8. The polar convergence lies on the boundary between the easterly currents of the Roaring Forties and the westerly currents which result from the easterly winds experienced to the south of latitude 60° S.

It must not be supposed that the convergence lines can be recognised by differences of sea temperature on charts of mean sea surface temperatures such as those which were published in The Marine Observer in 1928 and which are summarised in the present number. The areas of two degrees square for which the means are calculated are probably too large to show the differences and in any case the temperature differences on either side of a convergence may be small at the surface, especially in the tropical and sub-tropical convergences. A convergence is primarily an accumulation of water, whether the temperature and salinity differences at the surface are appreciable or not.

The sub-tropical layer is formed in the sub-tropical zones of maximum salinity on either side of the equator and extends to a depth of between 400 and 500 fms. The Antarctic intermediate layer is formed by the sinking of cold Antarctic surface water under the warmer sub-tropical water in the region of sub-polar convergence between latitudes 40° S. and 50° S. Figure 7 shows that north of 10° S. some of the water of the Antarctic intermediate layer rises gradually to near the surface. The midwater current is formed in the Arabian Sea and north-western part of the Indian Ocean. Here there is great evaporation and the water of this part of the ocean, which consists of sub-tropical water and Antarctic intermediate water, becomes more saline and sinks downwards to form the midwater current. This process is helped by the outflows of water of high salinity from the middle depths of the Red Sea and Persian Gulf into the Arabian Sea during the North-East Monsoon season. This sub-surface outflow from the Red Sea, first observed in January 1898, was confirmed by the John Murray Expedition in April to May 1934. The midwater current flows south-eastwards from the Arabian Sea and traverses the whole ocean to Latitude 60° S. beneath the Antarctic intermediary current, reaching the greatest depth between Latitudes 10° S. and 40° S., as shown in Figure 7. The cold Antarctic bottom current is the lowest of all and flows northward under the midwater current. Its movement is dependent on the contour of the bed of the ocean. It flows in a north-easterly direction up to 30° S., north of which it becomes north-westerly. This north-flowing bottom current gradually ceases to the north of the elevations connecting Madagascar and India, its waters becoming gradually absorbed by the midwater current and so taken back to the Antarctic region. This is confirmed by the results of the John Murray Expedition, to the extent that observations made at three places along the Arabian Coast failed to detect any trace of the upwelling of cold Antarctic bottom water. The Antarctic bottom current is formed by the piling up against the Antarctic shelf of the water of the midwater current which meets at the polar convergence the cold melted snow water of low salinity from the Antarctic continent and is cooled by this. Owing to convection processes and the vertical movements caused by the piled up water the more saline water gradually sinks to form the bottom current.

Below the sub-tropical layer the broad outline of the water circulation is quite simple. The Antarctic intermediate current and the bottom current both move northwards. Between them the warmer midwater current flows southwards. At about Latitude 60° S. the midwater current and water from melted snow pass into the bottom layer, and in the north-western part of the ocean the intermediate layer plus some water from the higher sub-tropical layer pass into the midwater current. Thus the circulation is continuous. The bottom current does not get so far north and is gradually absorbed into the midwater current, and so returns to polar latitudes by a shorter route. Whether the movements of these underwater-currents have measurable speeds everywhere cannot yet be decided. The bed of the western part of the Indian Ocean has a much more varied relief than that of the eastern part, and the underwater circulation of the western part is, therefore, more intense than that of the eastern part, where the circulation can proceed more smoothly.

It was stated above that Figure 7 shows only the components of the circulation in a north or south direction. The water in the southern part of the warm sub-tropical layer while tending to spread in all directions has predominantly a westerly motion so that the movement of the sub-tropical water is mainly in a belt from east to west, the same direction as that of the Equatorial Current at the surface. Farther north the sub-surface current is predominantly from east to west, the same direction as that of the Counter-Equatorial current at the surface.

The description of the underwater circulation given above has been derived mainly from observations made during the period of the northern winter, the North-East Monsoon period. So far as our information goes at present the whole of the underwater circulation below the warm upper layer is essentially the same throughout the whole year, but there are differences in the relative temperatures and salinities of the various layers so that the underwater circulation is stronger from May to September than from November to March. The reversal of the currents due to the influence of the Monsoons is thus confined chiefly to the upper layer of warm sub-tropical water.

Summarising our information as to the causes of the surface currents, the currents circulating round the permanent anticyclone, comprising the Southern Ocean Drift, the South-East Trade Drift, and the Equatorial Current, are primarily wind drifts. The strength of the current completing the circulation, the Mozambique-Agulhas Current, is due to the piling up of the warm surface and sub-surface waters of the sub-tropical layer against the African coast. This current is, therefore, a gradient current, which carries water round the south coast of Africa into the Atlantic Ocean. Only a small part of the Agulhas Current recurves eastward into the circulation of the South Indian Ocean. The East African Coast Current is also a gradient current flowing northwards from Cape Delgado during the South-West Monsoon period, caused initially by the pressure of the piled-up water against the African coast and given increased energy by the effect of the South-West Monsoon wind blowing up the coastline. During the strength of the North-East Monsoon in November to January, this current flows northwards up the coast only to the equator, at any rate so far as the surface is concerned. North of the equator the North-East Monsoon drives a strong reversed current southwards down the African coast, which leaves the coast in the neighbourhood of the equator and passes into the Counter-Equatorial Current. The Counter-Equatorial Current is a compensation current throughout the year, assisting to make good the loss of water on the eastern side of the ocean due to the constant movement of surface and sub-surface water westwards in sub-tropical regions. As just stated, it is fed from the Arabian Sea by the East African Coast Current during November to January, and it is also strengthened by the North-West Monsoon wind, but during the rest of the year it is probably largely dependent on upwelling from below. There is also upwelling of cooler water in the region south of Cape Guardafui during the South-West Monsoon period. The monsoon currents of the Arabian Sea, Bay of Bengal, China Sea and Eastern Archipelago, are wind drifts. A suggested explanation of the reversal of the coastal current in the Arabian Sea and Bay of Bengal before the South-West Monsoon begins, is that it is caused by the coolness of the sea surface temperature at the head of each of the bays relative to that at their openings, whereby a slight

Contour Chart of the North-West Indian Ocean.

Reproduced from a chart drawn by Lieutenant-Colonel R. B. Seymour Sewell, C.I.E., F.R.S., from soundings made by Lieutenant-Commander Farquharson, R.N., attached to the John Murray Expedition on H.E.M.S. "Mabahiss," Captain McKenzie, and previous surveys.

Figure 9.

slope of the sea surface occurs, producing, together with the earth's rotation, a current in a clockwise direction. This temperature difference is the result of the cooling effect of the North-East Monsoon upon the sea, and is at a maximum in the later part of the North-East Monsoon period. The currents of the Red Sea are wind drifts, but are complicated by eddies caused by the irregularities of the coastline, and by islands and other obstructions, and in the region of the Straits of Bab-el-Mandeb by tidal effects.

According to Dr. MÖLLER's investigation the surface of the Indian Ocean is higher than that of the Atlantic and Pacific Oceans, the upper 270 fms. of the Indian Ocean being filled with water of very low density. In consequence strong gradient currents flow out of the Indian Ocean round South Africa into the Atlantic, and south of Australia into the Pacific. These interoceanic flows do not, however, extend below a depth of 1,700 fms. That into the Atlantic is represented at the surface by the Agulhas Current, but that into the Pacific does not appear from the current charts as an appeciable surface current.

The small size of the North Indian Ocean and the fact that Arctic water has no access to it renders it unique. Greater contrasts of water of different temperatures and salinities exist than in other oceans, and it is inferred from this that the underwater circulation is more intense in the Indian Ocean. As the surface and underwater circulations cannot be independent of one another this fits in well with the fact that the strongest mean currents so far found in constructing the MARINE OBSERVER charts are in the Indian Ocean.

The John Murray Expedition.—As stated above the full results of this expedition have not yet been published. Three articles on the expedition, written by Professor J. STANLEY GARDINER, F.R.S., have appeared in the MARINE OBSERVER (Volume XI, 1934, pages 66, 109 and 155), also three articles by Lieut.-Colonel R. B. SEYMOUR SEWELL, C.I.E., F.R.S., were published in NATURE during 1934. Reference has been made above to some of the results of the expedition, but some further remarks will now be given. It was found that the floor of the Gulf of Aden is crossed by a succession of about ten hill ranges running in a N.E. to S.W. direction, but which do not reach the African coast, so that a deep gully runs along the south side of the Gulf. In the northern part of the Arabian Sea one submarine hill range runs westward from the neighbourhood of Karachi to the Gulf of Oman, parallel to the Baluchistan coast, and there are two others. The most interesting result of the echo-sounding work, which was done under the supervision of Lieutenant-Commander FARQUHARSON, lent by the Royal Navy, was the discovery of a large range running from Cape Guardafui and Sokotra south-westwards, then curving round and just touching the mass on which the Chagos Archipelago is situated. It thence continues in a southerly direction and probably connects up with the mass on which Rodriguez lies. This ridge has been named the Carlsberg Ridge, and is shown in FIG. 9. The late Profesor J. SCHMIDT in his account of the voyage of the *Dana* put forward the suggestion that there must be a deep ridge in this position. In its most elevated parts this ridge is 1,000 fms. below the surface, and while it must affect the deep water circulation it is not likely to directly affect the surface circulation. The Equatorial and Counter-Equatorial Currents in fact pass over it at almost a right angle. One point is, however, of interest. We found that the whirl which was supposed to exist south of Sokotra during the South-West Monsoon period does not exist as a complete whirl, but that between Latitudes 6° N. and 10° N., Longitudes 52° E. and 56° E., the East African Coast Current turns out from the coast, with very strong easterly and south-easterly mean sets. It should be noted that the trend of this strong current to the south-east appears to be due to the Carlsberg Ridge, the current practically rotating within the deep basin between the ridge and the coast, but we have as yet no exact knowledge of the depth to which the strong currents of the African coast extend.

Some vertical sections of the ocean showing the salinity of the water at various depths have already been published in the articles in NATURE referred to above, notably on the routes Bombay to Mombasa, and Kardiva Channel (Maldives) to Cape Guardafui, and in the Gulf of Aden. The latter shows that there is a very complex system of deep currents in the Gulf, especially in the neighbourhood of Cape Guardafui.

Sea Surface Temperatures.—An article on the sea surface temperatures of the Indian Ocean will be found in the present number. The distribution of the sea surface temperatures is mainly in belts roughly parallel to the circles of latitude. In other words the sea temperatures are primarily due to the effect of solar heating in different latitudes. The South-West Monsoon current and the East African Coast Current, however, transfer cooler water into the western half of the Arabian Sea during the South-West Monsoon period. The cooling effect of the North-East Monsoon wind on the waters of the north-western parts of the Arabian Sea and Bay of Bengal is also well shown. An example of the opposite process, the formation of currents in the Arabian Sea and Bay of Bengal due to differences of the sea temperature of adjacent regions has been given above.

It is hoped that enough information has been given in the present article to show that the circulation of an ocean is a very complex phenomenon produced by a balanced interplay of forces in which wind, temperature and salinity each plays its part.

Table 1.

Seasonal Mean Set and Drift (in miles per day) in the Indian Ocean South of the Equator.

Region.	November to January.		February to April.		May to July.		August to October.	
	Mean Set and Drift.	No. of Observations.	Mean Set and Drift.	No. of Observations.	Mean Set and Drift.	No. of Observations.	Mean Set and Drift.	No. of Observations.
Southern Ocean, Latitude 38° to 50° S., Longitude 20° to 40° E.	N. 83° E. 7	160	S. 89° E. 6	141	S. 87° E. 5	108	S. 76° E. 5	135
Southern Ocean, Latitude 38° to 50° S., Longitude 40° to 60° E.	N. 54° E. 8	246	N. 69° E. 9	218	N. 57° E. 6	166	N. 61° E. 6	204
Southern Ocean, Latitude 38° to 50° S., Longitude 60° to 80° E.	N. 58° E. 6	248	N. 53° E. 5	220	N. 43° E. 5	171	N. 43° E. 5	185
Southern Ocean, Latitude 38° to 50° S., Longitude 80° to 100° E.	N. 87° E. 2	234	S. 85° E. 2	226	S. 79° E. 2	146	S. 80° E. 4	166
Southern Ocean, Latitude 38° to 50° S., Longitude 100° to 120° E.	S. 75° E. 2	180	S. 63° E. 3	163	S. 33° E. 2	109	S. 32° E. 3	150
Southern Ocean, Latitude 38° to 50° S., Longitude 120° to 140° E.	S. 79° W. 1	170	S. 76° E. 2	144	S. 54° E. 0*	147	S. 30° E. 2	149
Connecting Current, Latitude 34° to 38° S., Longitude 100° to 112° E. ...	N. 25° E. 1	69	S. 15° E. 0*	74	N. 49° E. 1	76	N. 76° E. 4	50
Connecting Current, Latitude 30° to 34° S., Longitude 104° to 112° E. ...	N. 10° W. 2	77	N. 60° E. 4	67	N. 71° E. 3	92	N. 42° E. 4	87
Leeuwin, Latitude 30° to 36° S., Longitude 112° E., to Australian Coast. ...	S. 15° W. 1	76	S. 44° E. 5	90	S. 46° E. 3	84	S. 62° E. 2	113
S.E. Trade Drift, Latitude 18° to 30° S., Longitude 96° to 112° E.	N. 38° W. 3	431	N. 38° W. 3	382	S. 52° W. 0*	312	N. 13° W. 1	458
Equatorial Current, north of Madagascar, Longitude 44° to 56° E.	N. 74° W. 11	33	N. 88° W. 8	39	N. 66° W. 24	41	N. 82° W. 21	41
Equatorial Current, Latitude 6° to 18° S., West of Chagos Archipelago ...	S. 47° W. 3	72	N. 70° W. 8	39	S. 80° W. 8	58	S. 66° W. 5	96
Equatorial Current, Latitude 6° to 18° S., East of Chagos Archipelago ...	S. 67° W. 6	109	N. 76° W. 5	97	N. 70° W. 4	47	S. 31° W. 6	80
Equatorial Current, Latitude 6° to 18° S., Longitude 88° to 104° E. ...	S. 78° W. 6	344	S. 45° W. 3	342	S. 68° W. 5	312	S. 75° W. 8	377
Equatorial Current, Latitude 10° to 14° S., Longitude 112° to 124° E. ...	N. 53° W. 7	23	N. 82° W. 7	36	S. 75° W. 13·5	26	S. 86° W. 13·5	19
Equatorial Current, south of Madagascar, Longitude 40° to 48° E.	S. 45° W. 7	59	S. 86° W. 9	36	S. 59° W. 7	70	S. 58° W. 10	69
Mozambique Current, Latitude 10° to 26° S.	S. 20° W. 19	246	S. 30° W. 12	283	S. 32° W. 9	207	S. 25° W. 15	213
Agulhas Current, Latitude 26° S. to Longitude 24° E.	S. 43° W. 32	244	S. 41° W. 33	193	S. 40° W. 25	168	S. 41° W. 31	173
Agulhas Current, Longitude 20° to 24° E.	S. 74° W. 9	152	S. 72° W. 9	114	S. 36° W. 4	100	S. 75° W. 4	100
Agulhas Recurve, Longitude 20° to 32° E.	S. 54° E. 4	121	S. 13° W. 3	121	S. 61° E. 2	97	S. 7° E. 3	107

* Less than 0·5 mile per day.

Table 2.

Seasonal Mean Set and Drift (in miles per day) in the Indian Ocean North of the Equator.

Region.	November to January.		February to April.		May to July.		August to October.	
	Mean Set and Drift.	No. of Observations.	Mean Set and Drift.	No. of Observations.	Mean Set and Drift.	No. of Observations.	Mean Set and Drift.	No. of Observations.
Red Sea, Latitude 28° to 20° N.	N. 22° W. 1	950	N. 67° W. 1	748	S. 4° W. 1·5	771	S. 17° E. 2	853
Red Sea, Latitude 20° to 12° N.	N. 3	818	N. 16° W. 2	689	S. 18° E. 3	550	S. 25° E. 3	721
Gulf of Aden	N. 87° W. 7	456	N. 63° W. 4	712	N. 70° E. 7	515	N. 52° E. 6	453
Persian Gulf	N. 68° W. 3	24	S. 28° W. 1	27	S. 77° W. 3	31	S. 49° W. 3	27
Arabian Sea, Latitude 10° to 13° N., Longitude 56° to 72° E.	S. 84° W. 8	569	N. 70° W. 3	792	N. 77° E. 9	544	N. 82° E. 8	534
Arabian Sea, Central Part...	N. 88° W. 3	431	N. 20° W. 1	392	N. 80° E. 8	369	N. 69° E. 7	360
Arabian Sea, off coast of Arabia	S. 86° W. 5	305	N. 1° E. 2	235	N. 63° E.16	405	N. 61° E.11	319
Arabian Sea, North of Latitude 20° N.	N. 77° W. 2	213	S. 59° E. 2	166	S. 88° E. 6	243	S. 76° E. 5	194
Arabian Sea, Indian Coast, Latitude 12° to 18° N.	N. 22° W. 5	56	S. 25° E. 6	44	S. 36° E. 9	86	S. 24° E.10	75
North Indian Ocean, Latitude 2° to 10° N., Longitude 56° to 70° E. ...	N. 49° W. 3	740	N. 65° W. 4	1,008	S. 68° E. 7	793	S. 57° E. 5	676
Bay of Bengal, Latitude 4° to 10° N., Longitude 84° to 96° E.	N. 73° W. 8	536	W. 10	575	S. 85° E. 8	571	S. 73° E. 5	513
Bay of Bengal, Central Part, Latitude 10° to 18° N.	N. 59° W. 5	329	S. 74° W. 4	320	S. 88° E. 5	311	S. 86° E. 3	323
Bay of Bengal, Western Part, Latitude 10° to 18° N.	S. 74° W. 5	306	N. 33° E. 8	191	N. 56° E. 9	215	S. 73° E. 5	266
Bay of Bengal, Northern Part, North of Latitude 18° N.	S. 78° W. 4	155	N. 60° E.10	94	N. 72° E. 2	135	S. 11° W. 2	124
Bay of Bengal, Eastern Part, Latitude 10° to 18° N.	S. 79° W. 3	67	S. 24° W. 5	81	N. 75° E. 5	83	S. 78° E. 2	76
Bay of Bengal, Malay Coast, Latitude 4° to 10° N.	N. 71° W.11	92	N. 79° W. 7	96	N. 53° W. 4	97	N. 38° E. 1	80
Ceylon, South of, to Latitude 2° N.	S. 68° W.13	114	S. 79° W. 5	143	S. 87° E.12	114	N. 87° E.14	117
Ceylon, East Coast	S. 6° W.17	235	N. 75° W. 6	158	S. 23° E.10	210	S. 58° E. 9	185
East African Coast Current, Cape Delgado to Latitude 2° S.	N. 14° E. 13	86	N. 7° E.10	79	N. 11° E.27	52	N. 4° W.23	78
East African Coast Current, Latitude 2° S. to 6° N.	S. 48° W.18	105	N. 53° W. 7	125	N. 53° E.44	76	N. 47° E.27	104
East African Coast Current, Latitude 6° N. to Cape Guardafui	S. 85° W.11	43	N. 11° E.10	63	N. 44° E.18	35	N. 43° E.28	29
Sokotra, Latitude 8° to 14° N., Longitude 52° to 56° E.	N. 77° W. 6	309	N. 41° W. 3	406	N. 61° E.14	293	N. 66° E.20	309
Sokotra, Latitude 4° to 8° N., Longitude 52° to 56° E.	N. 71° W.12	9	S. 29° W. 7	5	S. 57° E.13	43	S. 56° E.18	38
Counter-Equatorial Current, Latitude 2° N. to 6° S., Longitude 58° to 76° E.	N. 88° E.17	143	N. 72° E.10†	75†	N. 84° E.14	97	N. 84° E. 9	151
Counter-Equatorial Current, Latitude 2° N. to 6° S., Longitude 80° to 92° E.	N. 82° E. 8	233	N. 88° E. 9	240	S. 83° E. 7	217	N. 89° E. 6	218

† For this quarter a part only of this area is taken in computing the mean current.

Table 3.

Seasonal Mean Set and Drift (in miles per day) in the China Seas, East Indian Archipelago and North Pacific Ocean West of Longitude 140° E.

Kuro Siwo, Latitude 24° to 30° N.	N. 56° E. 4	35	N. 50° E.16	30	N. 22° E. 6	41	N. 48° E. 7	43
Kuro Siwo, Latitude 18° to 24° N.	N. 9° W.13	11	N. 2° W.12	12	N. 1° E.23	12	N. 3° E.12	13
Kuro Siwo, Counter-Current	S. 61° W. 9	16	S. 59° W. 4	23	N. 51° W. 3	21	N. 54° E. 5	15
Monsoon Drift, China Sea, Latitude 22° to 30° N.	S. 44° W.11	160	S. 43° W. 6	136	N. 37° E. 9	166	N. 47° E. 1	205
Monsoon Drift, China Sea, Latitude 14° to 22° N.	S. 61° W.13	139	S. 82° W. 4	139	N. 35° E. 4	87	S. 50° W. 5	139
Monsoon Drift, China Sea, Latitude 4° to 14° N.	S. 38° W.16	462	S. 61° W. 6	433	N. 57° E. 7	355	N. 74° E. 8	383
Monsoon Drift, China Sea, Latitude 2° S. to 4° N.	S. 2° E.10	67	S. 8° E. 9	61	N. 1° W.10	61	N. 5° E. 7	65
North Equatorial Current, Pacific Ocean, Latitude 8° to 20° N.	S. 83° W. 9	29	N. 79° W. 7	40	S. 81° W. 6	30	S. 85° W. 3	34
Counter-Equatorial Current, Pacific Ocean, Latitude 2° to 8° N.	N. 59° E. 6	16	S. 37° W. 4	10	N. 64° W. 5	3	S. 17° W.12	5
Java Sea, Longitude 104° to 120° E.	S. 68° E. 6	25	S. 10° W.13	11	S. 83° W.13	30	S. 51° W. 6	20
Sulu Sea	N. 87° W.10	15	S. 70° W. 9	15	N. 37° E. 4	21	S. 47° E. 6	9
Celebes Sea	S. 13° W.12	23	S. 74° W. 9	22	S. 54° W. 4	17	W. 6	23

Table 4.

Mean Drifts of the South Equatorial Currents of the Atlantic, Pacific and Indian Oceans (in miles per day).

Region.	November to January.	February to April.	May to July.	August to October.
Atlantic Ocean, 3° N. to 6° S. (Cape Route)	8	7	12	8
Pacific Ocean, 2° N. to 6° S. (Panama to Australia, etc.)	11	11	11	15
Indian Ocean, 6° S. to 18° S. (Colombo Route)	6	3	5	8
Indian Ocean, 6° S. to 18° S. (Fremantle to Aden)	5	6	6	5
Indian Ocean, North of Madagascar	11	8	24	21

SOUTHERN ICE REPORTS.

During the Year 1934.

October.

Year.	Day.	Position of Ice. Latitude.	Position of Ice. Longitude.	Description.	Remarks.	Name of Ship reporting.
1934	4	55° 53′ S.	137° 26′ W.	Berg	120 feet high, 900 feet long (estimated)	M.V. *Port Hobart.*
	30	65° 47′ S.	79° 36′ W.	Loose Ice	... ...	R.R.S. *Discovery II.*

November.

Year.	Day.	Position of Ice. Latitude.	Position of Ice. Longitude.	Description.	Remarks.	Name of Ship reporting.
1934	3	64° 57′ S.	94° 28′ W.	Small irregular berg	... ...	R.R.S. *Discovery II.*
	4	65° 45′ S.	97° 42′ W.	Loose ice	... ...	Do.
	7	64° 50′ S.	109° 27′ W.	Growler...	... ...	Do.
	8	From 64° 48′ S.	109° 34′ W.	Growlers and a berg...	Berg irregular	Do.
		To 64° 47′ S.	110° 00′ W.			

SOUTHERN ICE REPORTS—(*Continued*).

Reports of Ice sighted in the month of November in Years previous to 1934, which have not previously been published in the Marine Observer.

Year.	Day.	Position of Ice. Latitude.	Position of Ice. Longitude.	Description.	Remarks.	Name of Ship reporting.
1933	11	48° 40′ S.	41° 02′ E.	Berg ...	...	S.S. *Anna Knudsen.*
	12	49° 44′ S.	45° 58′ E.	2 bergs ...	...	do.
	13	50° 57′ S.	51° 15′ E.	4 bergs ...	...	do.
	19	55° 52′ S.	75° 45′ E.	7 bergs ...	...	do.
	20	56° 38′ S.	77° 50′ E.	Pack ice and many bergs ...	...	do.
		From 57° 05′ S.	82° 08′ E.	Pack ice and many bergs ...	100 bergs sighted at one time...	do.
		To 59° 25′ S.	93° 33′ E.			

December.

Year.	Day.	Latitude.	Longitude.	Description.	Remarks.	Name of Ship reporting.
1934	6	62° 50′ S.	62° 36′ W.	4 bergs...	3 small irregular, one small tabular ...	R.R.S. *Discovery II.*
		63° 25′ S.	62° 58′ W.	8 bergs ...	One medium sized tabular, remainder irregular ...	do.
		From 63° 35′ S.	62° 57′ W.	3 bergs ...	All tabular, two about a mile long and approximately 100 feet high.	do.
		To 64° 00′ S.	62° 57′ W.			
		64° 11′ S.	62° 57′ W.	Several bergs.	Aground off Brabant Island ...	do.
		S. end of De Gulache Strait.		Drift Ice	Approach to De Gulache Strait from Schollant channel packed by drift ice.	do.
	7	64° 07′ S.	62° 49′ W.	Light stream ice ...	Several bergs aground off islands of the Melchier Archipelago	do.
		63° 35′ S.	62° 05′ W.	10 bergs ...	Mostly small ...	do.
	8	62° 52′ S.	60° 07′ W.	Berg ...	Small and irregular ...	do.
	2	53° 36′ S.	30° 07′ E.	Berg ...	A partly worn tabular berg 370 feet high by 700 feet long, sextant angles.	R.R.S. *William Scoresby.*
	2	From 54° 10′ S.	30° 18′ E.	7 bergs ...	Of various sizes, mostly worn tabular bergs, the longest being 220 feet high by 830 feet long.	do.
		To 54° 49′ S.	30° 33′ E.			
	3	56° 07′ S.	31° 13′ E.	Pack ice ...	Pack ice sighted 5 miles to Southward extending East and West.	do.
		From 56° 07′ S.	31° 13′ E.	15 to 20 bergs and pack ...	Mostly medium sized tabular with worn irregulars ...	do.
		To 56° 13′ S.	33° 08′ E.			
	4	From 56° 37′ S.	35° 16′ E.	Bergs and pack ...	Numerous small to medium bergs. Pack ice between 3 and 6 miles to Southward.	do.
		To 56° 36′ S.	36° 43′ E.			
	5	From 56° 47′ S.	39° 28′ E.	Bergs and drift ...	Numerous small bergs between 15 and 20 being in sight at all times, also sheets of brash and areas of drift ice.	do.
		To 57° 18′ S.	40° 16′ E.			
	6	From 57° 22′ S.	41° 42′ E.	Bergs and pack ...	5 to 6 bergs in sight at all times. Areas of pack with open leads.	do.
		To 58° 00′ S.	44° 00′ E.			
	7	From 58° 39′ S.	44° 01′ E.	Bergs and pack ...	5 to 6 bergs in sight at all times. Ship passing through leads in loose open pack and areas of drift.	do.
		To 58° 29′ S.	46° 51′ E.			
	8	From 58° 29′ S.	48° 34′ E.	Bergs and pack ...	5 to 6 bergs in sight at all times. Ship proceeding Eastwards and cleared loose pack in 58° 25′ S. 49° 49′ E.	do.
		To 58° 17′ S.	50° 00′ E.			
	9	From 58° 17′ S.	50° 00′ E.	Pack ice ...	Pack ice to Southward extending W.N.W. and E.S.E. ...	do.
		To 59° 12′ S.	51° 52′ E.			
	10	From 59° 12′ S.	51° 52′ E.	Loose pack ...	Mainly open water with area of loose pack ...	do.
		To 60° 12′ S.	54° 15′ E.			
	11	From 60° 12′ S.	54° 15′ E.	Bergs and pack ...	About 15 small bergs, three having dark markings. Large areas of loose pack to Southward (61° 50′ S. 55° 57′ E.).	do.
		To 62° 03′ S.	56° 28′ E.			
	12	From 61° 53′ S.	56° 43′ E.	28 bergs.	Clear of pack ice. 28 small to medium sized irregular bergs	do.
		To 61° 24′ S.	58° 18′ E.			
	13	From 61° 48′ S.	58° 57′ E.	25 bergs, and pack ice ...	Small worn bergs. In 62° 39′ S. 62° 27′ E. met loose pack with large floes in sight to the Southward extending East and West.	do.
		To 62° 53′ S.	63° 04′ E.			
	14	From 52° 55′ S.	63° 20′ E.	Bergs and pack ice ...	Several small worn bergs. Large areas of loose, heavy, soft pack on all sides with occasional open water.	do.
	15	To 62° 24′ S.	66° 46′ E.			
	15	From 62° 24′ S.	66° 46′ E.	2 bergs, and drift ...	2 small bergs. Ship to the Southward of loose pack in open water. Occasional small areas of drift pieces, and streams of brash extending to N.W. and S.E.	do.
		To 62° 06′ S.	71° 37′ E.			
	16	From 62° 06′ S.	71° 37′ E.	15 bergs ...	Tabular bergs, mostly large, one measured 4,000 feet long by 70 feet high.	do.
		To 60° 25′ S.	74° 40′ E.			
	17	From 60° 25′ S.	74° 40′ E.	2 bergs ...	Small worn irregular bergs ...	do.
		To 60° 12′ S.	75° 09′ E.			
	17	From 60° 12′ S.	75° 09′ E.	4 bergs ...	Small worn irregular bergs ...	do.
	18	To 60° 12′ S.	79° 20′ E.			
	18	From 60° 21′ S.	80° 34′ E.	28 bergs and pack ice ...	Large tabular bergs from 500 feet to 1,000 feet in length by 70 feet to 100 feet high. Ship proceeding to Eastward with edge of pack ice 1 mile to Southward extending East and West.	do.
		To 60° 13′ S.	82° 06′ E.			
	18	From 60° 13′ S.	82° 06′ E.	17 bergs ...	Clear of pack ice. Tabular bergs, from 500 feet to 1,000 feet long by 70 feet to 120 feet high.	do.
	19	To 60° 41′ S.	84° 05′ E.			
	19	From 60° 41′ S.	84° 05′ E.	Bergs, drift, and pack ice ...	Large area of loose pack extending to South-Eastward from first position. Small bergs and growlers very numerous with areas of drift. Streams of brash extending in N.N.W. and S.S.E. directions. 14 large tabular bergs reaching 1,000 feet long by 100 feet high.	do.
	21	To 60° 12′ S.	89° 12′ E.			
	21	From 60° 12′ S.	89° 12′ E.	Pack ice ...	Ship proceeding East with very heavy pack close to Southward, extending East and West.	do.
		To 60° 09′ S.	90° 33′ E.			
	21	From 60° 09′ S.	90° 33′ E.	Brash and drift ...	Small areas of brash and drift encountered ...	do.
		To 60° 07′ S.	91° 51′ E.			
	22	From 60° 07′ S.	91° 51′ E.	37 bergs ...	Various sizes and types, large tabular reaching 2,000 feet long by 100 feet high in the majority. Some of these were breaking up. Occasional small areas of drift encountered.	do.
	23	To 60° 20′ S.	96° 25′ E.			
	24	From 60° 20′ S.	96° 25′ E.	Pack ice ...	Encounter heavy pack with leads; extending to East and West. Clear of pack in latter position with open water to the Southward.	do.
		To 61° 43′ S.	97° 06′ E.			
	24	From 61° 43′ S.	97° 06′ E.	Bergs and drift ...	Small bergs, irregular shaped. Encounter small areas of drift with growlers.	do.
	27	To 61° 30′ S.	96° 30′ E.			
	27	From 61° 30′ S.	96° 30′ E.	Bergs and growlers ...	13 large tabular, and 30 to 40 small irregular bergs sighted	do.
		To 60° 49′ S.	96° 42′ E.			
	28	From 60° 49′ S.	96° 42′ E.	12 bergs ...	Mostly small tabular bergs ...	do.
	29	To 60° 37′ S.	96° 34′ E.			
	29	61° 03′ S.	94° 14′ E.	32 bergs ...	Mostly small to medium irregular bergs ...	do.
	29	From 61° 03′ S.	94° 14′ E.	Bergs ...	Numerous small bergs mostly irregular; also 2 large tabular—1,100 feet by 95 feet high and 2,400 feet by 100 feet high, and about 20 medium sized tabulars.	do.
	31	To 59° 59′ S.	90° 13′ E.			

Reports of Ice sighted in the Month of December in Years previous to 1934, which have not previously been published in the Marine Observer.

Year.	Day.	Latitude.	Longitude.	Description.	Remarks.	Name of Ship reporting.
1933	21	44° 52′ S.	34° 30′ E.	Large berg ...	About 1 mile long and 300 feet high, two distinct peaks ...	S.S. *Dalemoor.*
	22	45° 45′ S.	40° 11′ E.	Large berg and 7 growlers ...	Berg about 200 feet high, growlers within 10 mile radius of berg.	do.
		45° 55′ S.	41° 46′ E.	Huge berg ...	700 to 800 feet high, 1½ to 2 miles long ...	do.

Reports of Ice previous to January, February and March 1934, will be found in the Marine Observer, Volume XI, No. 113, p. 24.

WIRELESS WEATHER SIGNALS.

I.—SHIPS' WIRELESS WEATHER SIGNALS.

A full description of the world-wide system of voluntary "Selected Ships" routine weather reports with instructions was given on pp. 30–41 of the January number of this volume of THE MARINE OBSERVER.

The list which follows contains the latest information of stations to which "A Selected Ships" should report in accordance with those instructions, and stations detailed to intercept or receive reports from "B Selected Ships" also in accordance with those instructions.

To decode these reports, and for information of the system of communication of "Selected Ships", all concerned are referred to the PAMPHLET, M.O. 329, concerning which special notice to the masters of British ships will be found on p. 33, paragraph (27), and p. 34, paragraph (34) of the January 1935 number of THE MARINE OBSERVER.

WIRELESS STATIONS DETAILED TO RECEIVE ROUTINE CODED WEATHER REPORTS FROM "A SELECTED SHIPS."

Request for Information.

THE ATTENTION OF METEOROLOGICAL SERVICES IS INVITED TO THE INVITATION GIVEN ON PAGE 30 OF VOL. XII NO. 117, JANUARY, 1935, MARINE OBSERVER.

Ocean.	Station.	Position.	Call Sign.	Frequency and Wave Length.		Area and limits covered by Station.	Telegraphic address of Meteorological Centre.	Information required—Limit of Groups.	Notes.
				For Station to call up "Selected Ships."	For "Selected Ships" to report to Station.				
North Atlantic and North Sea.	Portishead.	Lat. 51° 28′ 41″ N. Long. 2° 47′ 30″ W.	GKU.	149 kc/s. (2013 metres).	143 kc/s. (2100 metres).	North Sea and Eastern North Atlantic East of Longitude 40° W. and North of Latitude 38° N., but not within 300 miles of station. (*see* Chart of the World.)	Weather London.	Weather only, up to seven groups, preferably No. 3 Supplementary Groups.	Control system. "Selected Ships" chosen to report in given order notified by station daily at 2230, 0330, and 1030 G.M.T. Roll call thus—Weather London—call sign of chosen "Selected Ships" to report through GKU at schedule times on 2100 m.
	Chatham Mass.	Lat. 41° 43′ N. Long. 70° 47′ W.	WCC.		142·9kc/s. (2098 metres).	North Atlantic West of Longitude 40° W.	Observer Washington	Weather only. First four groups of observations taken at 0000 and 1200 G.M.T. only required.	No control. All British "A Selected Ships" within area to address their 0000 and 1200 G.M.T. observations to Observer Washington and their 1800 G.M.T. observations to CQ in accordance with schedule.
	Sayville N.Y.	Lat. 40° 45′ N. Long. 73° 06′ W.	WSL.						
	Thomaston.	Lat. 44° 01′ N. Long. 69° 13′ W.	WAG.						
	Jupiter.	Lat. 26° 42′ N. Long. 80° 02′ W.	WMR.						
	Palm Beach.	Lat. 26° 42′ N. Long. 80° 02′ W.	WOE.						
Mediterranean and Red Sea.									
South Atlantic.	Slangkop (Cape Town)	Lat. 34° 08′ 46″ S. Long. 18° 19′ 18″E.	ZSC	—	143 kc/s. (2100 metres).	South Atlantic Westward of 25° E. and within a range of about 2,000 miles of station.	Met.	Weather only. Four universal groups and first group of No. 6 Supplementary groups.	No control. Only 0600 G.M.T. observation required. All British "A Selected Ships" within area should report, commencing at 0618 G.M.T.

WIRELESS STATIONS DETAILED TO RECEIVE ROUTINE CODED WEATHER REPORTS FROM "A SELECTED SHIPS."

(Continued.)

Ocean.	Station.	Position.	Call Sign.	Frequency and Wave Length. For Station to call up "Selected Ships."	For "Selected Ships" to report to Station.	Area and limits covered by Station.	Telegraphic address of Meteorological Centre.	Information required—Limit of Groups.	Notes.
Indian Ocean.	Jacobs (Durban).	Lat. 29° 55′ 40″ S. Long. 30° 58′ 50″E.	ZSD	—	143 kc/s. (2100 metres).	Indian Ocean S. of 20° S. and Eastward of 25° E. and within a range of about 2,000 miles of station.	Met.	Weather only. Four universal groups and first group of No. 6 Supplementary groups.	No control. Only 0600 G.M.T. observations required. All British "A Selected Ships" within area should report, commencing at 0618 G.M.T.
	Bombay.	Lat. 19° 04′ 55″ N. Long. 72° 49′ 54″E.	VWB	—	143 kc/s. (2100 metres).	Arabian Sea N. of line C. Comorin to Ras Fartak.	Weather.	Weather only. No. 6 Supplementary groups.	All British "A Selected Ships" are requested, when convenient, to report 0000 G.M.T. observations commencing at 0018 G.M.T. in addition to schedule times.
	Madras.	Lat. 12° 59′ 17″ N. Long. 80° 10′ 56″E.	VWM	—	143 kc/s. (2100 metres).	Bay of Bengal N. of line C. Comorin to Achin Head.	Weather.	Weather only. No. 6 Supplementary groups.	All British "A Selected Ships" are requested, when convenient, to report 1200 G.M.T. observations commencing at 1218 G.M.T. in addition to schedule times.
	Colombo.	Lat. 6° 55′ 14″ N. Long. 79° 52′ 46″E.	VPB	130 kc/s. (2300 metres).	143 kc/s. (2100 metres).	Indian Ocean South of a line Ras Fartak, C. Comorin and Achin Head, and within a range of about 1500 miles.	Weather.	Weather only. No. 6 Supplementary groups preferred.	No control—all British "A Selected Ships" within area should report in accordance with Schedule.
	Mombasa.	Lat. 4° 03′ 11″ S. Long. 39° 39′ 49″E.	VPQ	—	125 kc/s. (2400 metres).	From Ras Hafun to Lat. 20° S. when westward of the Colombo area.	Weather Nairobi.	Weather only. No. 6 Supplementary groups.	No control—all British "A Selected Ships" within area should report 0600 G.M.T. observations.
	Perth.	Lat. 32° 01′ 51″ S. Long. 115° 49′ 31″E.	VIP	125 kc/s. (2400 metres).	143 kc/s. (2100 metres).	Indian Ocean and Southern Ocean between Long. 90° and 135° E.; but not witl in 100 miles of the coast.	Weather.	Weather only. No. 6 Supplementary groups.	No control—all British "A Selected Ships" within area should report in accordance with Schedule. Reports not required for observation times not starred on Chart, p. 32, of the January 1935 number.
North Pacific and China Sea.	Cape d'Aguilar, Hong Kong.	Lat. 22° 12′ 39″ N. Long. 114° 15′ 11″E.	VPS.	8330kc/s. (36 metres) or 500 kc/s. (600 metres).	143kc/s.* (2100 metres).	China Sea and North Pacific to about 1,500 miles from station.	Royal Observatory.	Weather only, preferably No. 6 Supplementary Groups.	No control—all British "A Selected Ships" within area should report in accordance with Schedule. *Alternatively see particulars on p. 168 and use wave length and times for "B Selected Ships."
South Pacific.	Sydney.	Lat. 33° 46′ 00″ S. Long. 151° 03′ 09″E.	VIS	125 kc/s. (2400 metres).	143 kc/s. (2100 metres).	S. Pacific Coral and Tasman Seas and Southern Ocean between Long. 135° and 160° E.; but not within 100 miles of the coast.	Weather.	Weather only. No. 6 Supplementary groups.	No control—all British "A Selected Ships" within area should report in accordance with Schedule. Reports not required for observation times not starred on Chart, p. 32, of the January 1935 number.
	New Zealand.	—	—	—	—	—	Weather Wellington.	Weather only, four universal groups.	The Meteorological Office Wellington, will be glad to receive routine reports from British Selected Ships within range of New Zealand W/T Stations through the normal commercial channels.

WIRELESS STATIONS DETAILED TO INTERCEPT ROUTINE CODED WEATHER REPORTS FROM "B SELECTED SHIPS."

In cases where routine weather reports made to CQ might not be received by the appropriate station within range, indicated in this list, they should be made to that station by call sign, but so that they may be readily intercepted by all ships. 600 m. is used throughout.

Ocean.	Station.	Position.	Call Sign.	Telegraphic address of Meteorological Centre desiring information.	Information desired.	Notes.
North Atlantic.						
South Atlantic.	Salinas	Lat. 0° 37′ 00″ S. Long. 47° 23′ 00″ W.	PPL.	Meteoro Rio.	Weather only, including supplementary groups.	
	S. Luiz	Lat. 2° 31′ 28″ S. Long. 44° 16′ 30″ W.	PXM.			
	Fortaleza	Lat. 3° 42′ 49″ S. Long. 38° 30′ 56″ W.	PPC.			
	Natal	Lat. 5° 46′ 30″ S. Long. 35° 16′ 20″ W.	PXN.			
	Olinda	Lat. 8° 00′ 55″ S. Long. 34° 50′ 40″ W.	PPO.			
	Amaralina	Lat. 13° 00′ 50″ S. Long. 38° 28′ 27″ W.	PPA.			
	Abrolhos	Lat. 17° 57′ 35″ S. Long. 38° 42′ 00″ W.	PXH.			
	Victoria	Lat. 20° 18′ 52″ S. Long. 40° 19′ 06″ W.	PPT.			
	Rio	Lat. 22° 59′ 19″ S. Long. 43° 11′ 26″ W.	PPR.			
	Santos	Lat. 23° 59′ 22″ S. Long. 46° 18′ 18″ W.	PPS.			
	Florianopolis	Lat. 27° 35′ 22″ S. Long. 48° 34′ 17″ W.	PPF.			
	Junçao	Lat. 32° 03′ 22″ S. Long. 52° 08′ 13″ W.	PPJ.			
Indian Ocean.	Jacobs (Durban).	Lat. 29° 55′ 40″ S. Long. 30° 58′ 50″ E.	ZSD	Met.	Weather only, 4 universal groups and first group of No. 6 Supplementary groups.	
	Algoa Bay (Port Elizabeth).	Lat. 33° 57′ 16″ S. Long. 25° 35′ 30″ E.	ZSQ	Met.	Weather only, 4 universal groups and first group of No. 6 Supplementary groups.	
	Calcutta.	Lat. 22° 33′ 31″ N. Long. 88° 20′ 16″ E.	VWC.	Weather.	Weather only up to 6 groups, No. 6 Supplementary Groups preferred.	
	Rangoon.	Lat. 16° 45′ 57″ N. Long. 96° 11′ 51″ E.	VTR.			
	Madras.	Lat. 12° 59′ 17″ N. Long. 80° 10′ 56″ E.	VWM.			
	Bombay.	Lat. 19° 04′ 55″ N. Long. 72° 49′ 54″ E.	VWB.			
	Karachi.	Lat. 24° 51′ 05″ N. Long. 67° 02′ 32″ E.	VWK.			
	Matara.	Lat. 6° 01′ 07″ N. Long. 80° 35′ 39″ E.	GZP.			
	Mombasa.	Lat. 4° 03′ 11″ S. Long. 39° 39′ 49″ E.	VPQ	Weather Nairobi.		
	Dar-es-Salaam.	Lat. 6° 50′ 38″ S. Long. 39° 17′ 24″ E.	ZBZ	Weather Nairobi.		
	Mauritius.	Lat. 20° 23′ 41″ S. Long. 57° 35′ 25″ E.	VRS.	Observatory Mauritius.	Weather 4 universal groups and first of No. 6 Supplementary Groups.	
	Geraldton.	Lat. 28° 47′ 15″ S. Long. 114° 36′ 24″E.	VIN	Weather.	Weather only, including No. 6 Supplementary Groups.	
	Esperance.	Lat. 33° 52′ 40″ S. Long. 121° 53′ 34″ E.	VIE			

WIRELESS STATIONS DETAILED TO INTERCEPT ROUTINE CODED WEATHER REPORTS FROM "B SELECTED SHIPS."

(*Continued.*)

In cases where routine weather reports made to CQ might not be received by the appropriate station within range, indicated in this list, they should be made to that station by call sign, but so that they may be readily intercepted by all ships. 600 m. is used throughout.

Ocean.	Station.	Position.	Call Sign.	Telegraphic address of Meteorological Centre desiring information.	Information desired.	Notes.
North Pacific and China Sea.	Cape d'Aguilar, Hong Kong.	Lat. 22° 12′ 39″ N. Long. 114° 15′ 11″ E.	**VPS.**	Royal Observatory.	Weather only, preferably No. 6 Supplementary Groups.	
South Pacific.	Auckland.	Lat. 36° 50′ 37″ S. Long. 174° 46′ 08″ E.	**ZLD.**	Weather Wellington.	Weather only, four universal groups.	The Meteorological Office, Wellington, will be glad to receive routine reports from British Selected Ships within range of New Zealand W/T Stations through the normal commercial channels.
	Wellington.	Lat. 41° 16′ 26″ S. Long. 174° 45′ 55″ E.	**ZLW.**			
	Awarua.	Lat. 46° 30′ 47″ S. Long. 168° 22′ 24″ E.	**ZLB.**			
	Chatham Island.	Lat. 43° 57′ 28″ S. Long. 176° 34′ 25″ W.	**ZLC.**			
	Rarotonga.	Lat. 21° 11′ 52″ S. Long. 159° 48′ 52″ W.	**ZKR.**			
	Apia.	Lat. 13° 50′ 17″ S. Long. 171° 49′ 42″ W.	**ZMA.**			
	Thursday I.	Lat. 10° 35′ 14″ S. Long. 142° 12′ 43″ E.	**VII**	Weather.	Weather only, including No. 6 Supplementary Groups.	
	Townsville.	Lat. 19° 16′ 09″ S. Long. 146° 49′ 47″ E.	**VIT**			
	Brisbane.	Lat. 27° 25′ 34″ S. Long. 153° 07′ 19″ E.	**VIB**			
	Melbourne.	Lat. 37° 46′ 56″ S. Long. 144° 52′ 09″ E.	**VIM**			
	Adelaide.	Lat. 34° 51′ 14″ S. Long. 138° 31′ 55″ E.	**VIA**			

CHILE.

II.—WEATHER SHIPPING BULLETINS.

Santiago Central W/T Station, approximate position Latitude 33° 27′ S., Longitude 70° 42′ W.

Call sign **C C S.**

Wavelengths 3,000 metres and 25 metres C.W.

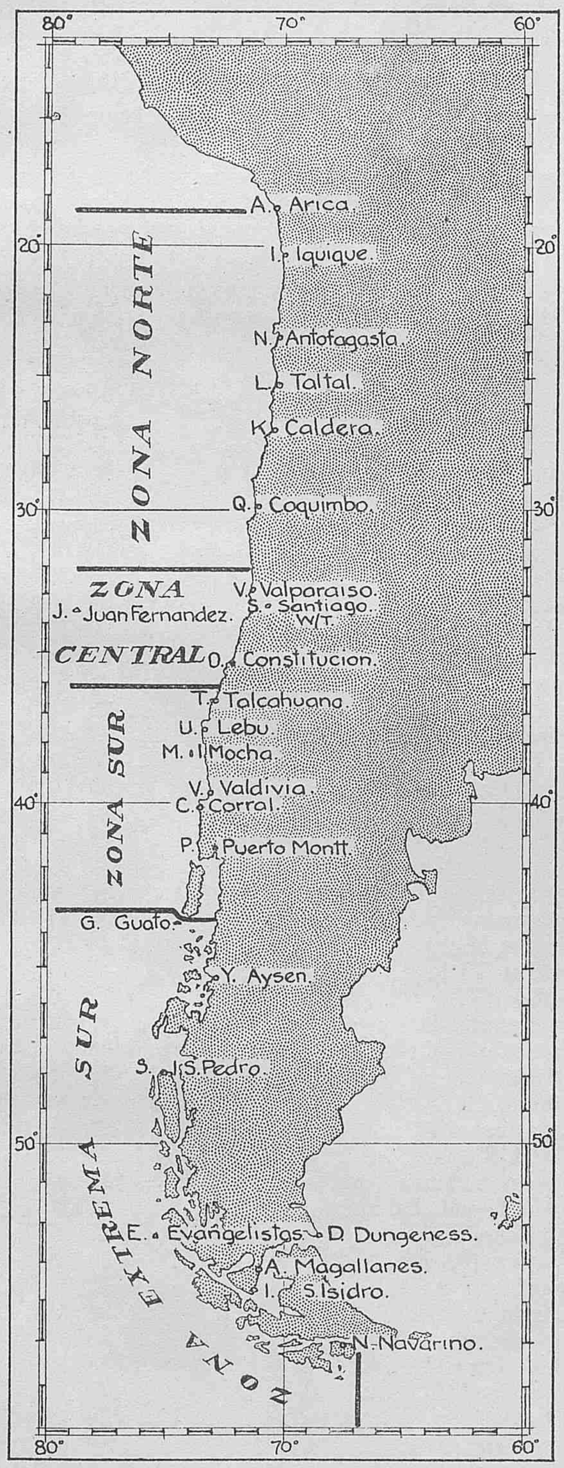
Times of transmission 0130, 1430 and 2030 G.M.T.

The messages are based upon observations taken at 2300, 1200 and 1800 G.M.T. respectively.

They consist of three parts :—

Part I.—General statement of weather conditions *en clair* (Spanish).

Chart showing Stations for Weather Shipping Bulletin for coast of Chile.



The sea areas for forecasts are indicated on the chart from information supplied by a British Selected Ship

Part II.—Weather Report in code giving actual observations at stations shown on the chart on this page.

Part III.—Forecast of weather in plain language.

The stations are sent in groups of five, the distinguishing letters of the stations, which are shown alongside each station, on the chart, forming the initial group of each eleven groups. The stations are transmitted in the order from North to South.

The station reports are made in the International Ships Wireless Weather Telegraphy Code.

To decode these reports the tables given in the Decode M.O. 329 are required. The Key letters are fully described on p. 38 of the January, 1935, number and in M.O. 329.

Key letters used for station reports—DDFww BBVTT.

WIRELESS STORM WARNINGS.

Valparaiso W/T Station, approximate position Latitude 33° 01′ S. Longitude 71° 39′ W., call sign **C C E,** broadcasts storm warnings when necessary, on a wavelength of 600 metres (I.C.W.)

III.—WIRELESS TIME SIGNALS.

W/T Station.	Call Sign.	Wavelength (Metres).	G.M.T. of Time Signal.
Valparaiso Lat. 32° 59′ 50″ S. Long. 71° 33′ 40″ W.	**C C L**	2,150 (C.W.)	h m s h m s 00 55 00–01 00 00

System.—The Time Signal commences at 00h. 55m. 00s. G.M.T. and continues for 5 mins., and consists of a series of dots which represent each second, except that the dots at the 29th, 51st, 52nd, 53rd, 54th, 55th, 56th, 57th, 58th and 59th seconds of each of the five minutes are omitted. The dot at the 60th second of each minute is the time signal.

Notes.—

Time Signal controlled by the Hydrographic Office.

In the event of failure or irregularities in the Time Signal the word " Señal nula " (Signal annulled) will be made three times in succession, one minute after 0100 G.M.T.

ARGENTINA.

II.—WIRELESS WEATHER BULLETINS.

The following W/T Stations broadcast a weather forecast, for 24 hours, for the coast of Argentina *en clair* in Spanish.

W/T Station.	Position.		Call Sign.	Time of trans-mission.	Wavelength.
	Lati-tude.	Longi-tude.			
Comodoro Rivadavia.	45° 52′ S.	67° 28′ W.	**L O X**	G.M.T 2000	600 metres C.W.
Buenos Aires —Darsena Norte.	34° 36′ S.	58° 22′ W.	**L O L**	0230	1053 ,, ,,
Buenos Aires —General Pacheco.	34° 28′ S.	58° 38′ W.	**L P D**	1700	600 ,, I.C.W.
Parana ...	31° 44′ S.	60° 27′ W.	**L P E**	1830	600 ,, C.W.
Formosa ...	26° 14′ S.	58° 07′ W.	**L O C**	1530	600 ,, I.C.W.

BRAZIL.

II.—WIRELESS WEATHER BULLETINS.

The Brazilian W/T coast stations given in the list below transmit, **every four hours** the state of weather and sea, and force and direction of the wind. The observations are made at the W/T Stations. They are sent in Portuguese *en clair*, on a wavelength of 600 metres.

W/T Station.	Position (approx.).		Call Sign.	Times of Sending. G.M.T.
	Latitude.	Longitude.		
Salinas	0° 37′ S.	47° 23′ W.	**PPL**	0245, 0645, etc., etc.
S. Luiz do Maranhão	2° 31′ S.	44° 17′ W.	**PXM**	0300, 0700, etc., etc.
Natal Norte... ...	5° 47′ S.	35° 16′ W.	**PXN**	0330, 0730, etc., etc.
Olinda (Pernambuco)	8° 01′ S.	34° 51′ W.	**PPO**	0000, 0400, etc., etc.
Amaralina (Bahia)...	13° 01′ S.	38° 28′ W.	**PPA**	0315, 0715, etc., etc.
Santos	23° 59′ S.	46° 18′ W.	**PPS**	0245, 0645, etc., etc.
Florianopolis ...	27° 35′ S.	48° 34′ W.	**PPF**	0315, 0715, etc., etc.
Juncçaõ (Rio Grande do Sul)	32° 03′ S.	52° 08′ W.	**PPJ**	0345, 0745, etc., etc.

III.—WIRELESS TIME SIGNALS.

W/T Station.	Call Sign.	Wavelength (Metres).	G.M.T. of Time Signal.
Rio de Janeiro— Lat. 22° 59′ 19″ S. Long. 43° 11′ 26″ W.	**PPR**	1,000 (I.C.W.)	h m s 14 00 00 and 24 00 00

The Time Signals are relayed from Rio de Janeiro Observatory in accordance with the New International system of W/T Time Signals.

The procedure is as follows :—

G.M.T. (h m s to h m s)	Signal.	Meaning.
13/23 56 05 to 13/23 56 50	— — — every alternate 5 seconds.	
57 00 ,, 57 49	— — — — — · · · etc.	
57 55 ,, 58 00	55 56 57 58 59 60 · · · · · ·	Time Signal.
58 08 ,, 58 10	— ·	
58 18 ,, 58 20	— ·	
58 28 ,, 58 30	— ·	
58 38 ,, 58 40	— ·	
58 48 ,, 58 50	— ·	
58 55 ,, 59 00	55 56 57 58 59 60 · · · · · ·	Time Signal.
59 06 ,, 59 10	— · ·	
59 16 ,, 59 20	— · ·	
59 26 ,, 59 30	— · ·	
59 36 ,, 59 40	— · ·	
59 46 ,, 59 50	— · ·	
13/23 59 55 ,, 14/24 00 00	55 56 57 58 59 60 · · · · · ·	Time Signal.

The duration of the dash is one second, and that of the dot 0.2 of a second. The final dot, therefore, terminates at

14h/24h 00m 00.2s, G.M.T.

In the event of failure, the time signals are transmitted thirty minutes later.

Note.—Sent daily except Sundays and public holidays.

UNITED STATES OF AMERICA, WEST INDIAN ISLANDS, AND BERMUDA.

Atlantic Coast.

II.—WIRELESS WEATHER BULLETINS.

Washington—Arlington W/T Station, approximate position Latitude 38° 52′ N., Longitude 77° 05′ W.

Call sign **NAA.**

Times of Transmission—0300 and 1500 G.M.T.

Wavelengths—2653 m. and 4690† metres C.W. simultaneously.

The bulletins are divided into two parts and begin with the words, "Weather Bureau Bulletin."

Part I is a summary in plain language of the general pressure distribution, including the location of high and low areas, and the barometric readings at their centres; wind and weather forecasts for the areas shown on the chart, p. 171.

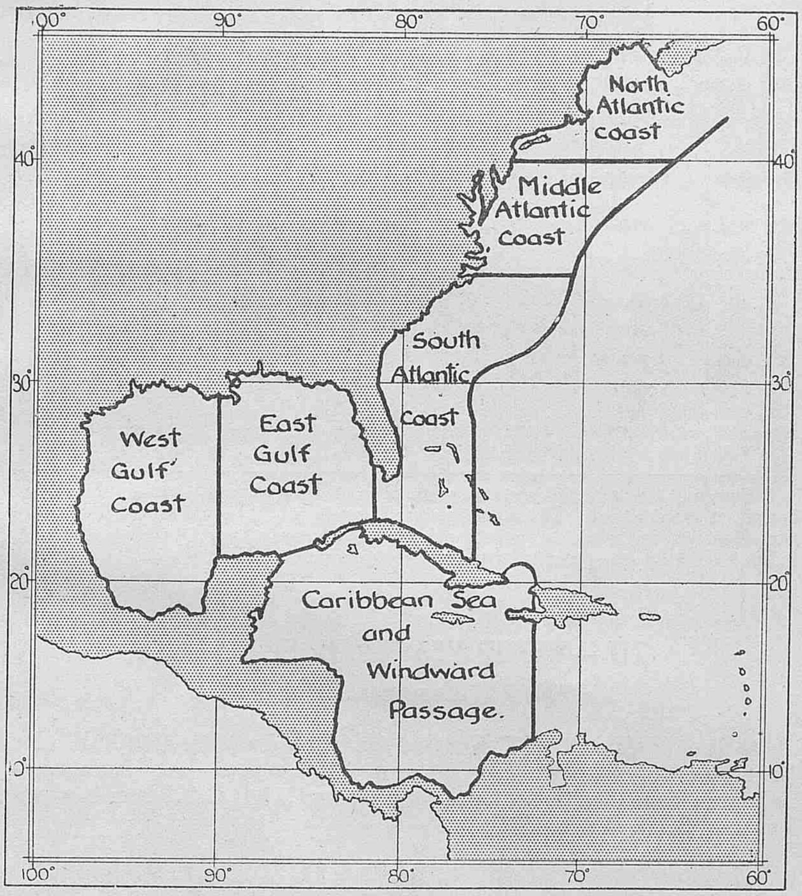
Part II—Actual weather observations in the United States code taken at 0100 and 1300 G.M.T. respectively from a number of stations in the list below.

Indicator letters	Name of station	Latitude north	Longitude west
TP	The Pas. Man.	53° 35′	101° 12′
WG	Winnipeg, Man.	49° 55′	97° 10′
BK	Bismarck, N. Dak.	46° 49′	100° 49′
O	Omaha, Nebr.	41° 16′	95° 58′
KC	Kansas City, Mo.	39° 05′	94° 35′
OK	Oklahoma City, Okla.	35° 29′	97° 31′
DA	Dallas, Tex.	32° 45′	96° 48′
GV	Galveston, Tex.	29° 19′	94° 50′
DU	Duluth, Minn.	46° 49′	92° 09′
M	Marquette, Mich....	46° 33′	87° 26′
LC	La Crosse, Wis.	43° 50′	91° 12′
CH	Chicago, Ill.	41° 50′	87° 40′
SL	St. Louis, Mo.	38° 39′	90° 13′
CN	Cincinnati, Ohio	39° 07′	84° 30′
NV	Nashville, Tenn.	36° 11′	86° 50′
LR	Little Rock, Ark.	34° 41′	92° 15′
VK	Vicksburg, Miss.	32° 17′	90° 50′
NO	New Orleans, La.	30° 00′	90° 05′
P	Pensacola, Fla.	30° 25′	87° 12′
L	Alpena, Mich.	45° 05′	83° 25′
D	Detroit, Mich.	42° 21′	83° 03′
F	Buffalo, N.Y.	42° 53′	78° 50′
PB	Pittsburgh, Pa.	40° 26′	79° 57′
CT	Charlotte, N.C.	35° 13′	80° 51′
AT	Atlanta, Ga.	33° 45′	84° 21′
TA	Tampa, Fla.	27° 59′	82° 29′
K	Key West, Fla.	24° 40′	81° 48′
MI	Miami, Fla.	25° 46′	80° 12′
NU	Nassau, Bahamas	25° 05′	77° 23′
TI	Turks Island, Bahamas	21° 20′	71° 10′
SJ	San Juan, P.R.	18° 29′	66° 06′
JA	Jacksonville, Fla.	30° 21′	81° 40′
C	Charleston, S.C.	32° 50′	79° 58′
WL	Wilmington, N.C.	34° 18′	77° 59′
H	Cape Hatteras, N.C.	35° 14′	75° 32′
WA	Washington, D.C.	38° 54′	77° 03′
BAL	Baltimore, Md.	39° 18′	76° 38′
AC	Atlantic City, N.J.	39° 22′	74° 27′
NY	New York, N.Y.	40° 43′	74° 01′
T	Nantucket, Mass.	41° 15′	70° 00′

† Transmission on 4690m. ceases at 0400 G.M.T. for 0300 G.M.T. bulletin.

Indicator letters	Name of station	Latitude north	Longitude west
BN	Boston, Mass.	42° 22′	71° 02′
N	Northfield, Vt.	44° 08′	72° 40′
E	Eastport, Me.	44° 54′	67° 00′
CK	Cochrane, Ont.	49° 04′	80° 58′
DC	Doucet, Que.	48° 17′	76° 40′
PN	Parry Sound, Ont.	45° 20′	80° 01′
ML	Montreal, Que.	45° 31′	73° 34′
FP	Father Point, Que.	48° 30′	68° 30′
BC	Port Aux Basques, N.F.	47° 33′	59° 10′
CR	Cape Race, N.F.	46° 40′	53° 04′
SAB	Sable Island, N.S.	43° 56′	60° 00′
HX	Halifax, N.S.	44° 38′	63° 35′
B	Bermuda (St. George's)	32° 18′	64° 42′
HT	Horta, Azores	38° 32′	28° 29′

Chart showing Forecast and Storm Warning Areas for Atlantic and Gulf Coasts of United States.



Weather Information broadcast for the benefit of Shipping approaching New York Harbour.

The following W/T stations broadcast weather conditions at Sandy Hook from observations made one hour previous to the times of transmission. The information will include barometric pressure, temperature, wind direction and force, state of sky, state of sea, and visibility.

W/T Station.	Call Sign.	Position (approx.). Latitude.	Position (approx.). Longitude.	Time. G.M.T.	Wave length. Metres.
Tuckerton, N.J.	**WSC**	39° 33′ N.	74° 23′ W.	1400, 2200	650, 2256 } (I.C.W. and C.W.)
Chatham, Mass.	**WCC**	41° 43′ N.	70° 46′ W.	1400, 2200	2326 (C.W.)
Thomaston, Me.	**WAG**	44° 09′ N.	69° 13′ W.	1400, 2200	720, 2420 } (I.C.W. and C.W.)
Sayville	**WSL**	40° 45′ N.	73° 06′ W.	1400, 2200	765, 2500 } (I.C.W. and C.W.)

WIRELESS STORM WARNINGS.

Storm warnings are broadcast when necessary by the following stations, at the times and for the areas stated below :—

W/T Station.	Call Sign.	Position (Approx.) Latitude, Longitude.	Time. G.M.T.	Wave-length. (Metres).	Area (see Chart).
†**Jupiter, Fla.**	**NAQ**	26° 57′ N. 80° 05′ W.	1630, 2300	1,621 (I.C.W.).	Middle and South Atlantic and E. Gulf coasts.
Savannah, Ga.	**WSV**	32° 05′ N. 81° 06′ W.	1600, 2330	735 (C.W.).	Do.
†**Charleston, S.C.**	**NAO**	32° 52′ N. 79° 58′ W.	1530, 2300	2,458 (C.W. and I.C.W.).	Do.
Baltimore	**WMH**	39° 17′ N. 76° 36′ W.	1530	720 (C.W. and I.C.W.).	Do.
†**Washington (Arlington)**	**NAA**	38° 52′ N. 77° 05′ W.	0300* 1500*	2,653, 4,690 C.W. simultaneously.	N. Atlantic and Gulf coasts.
†**New York**	**NAH**	40° 28′ N. 74° 00′ W.	1530, 2200	2,939 (C.W.).	N. middle and S. Atlantic coasts, Gulf and Caribbean Sea.
†**Boston, Mass.**	**NAD**	42° 21′ N. 70° 57′ W.	1630	2,941 (C.W.).	N. Atlantic Coast.

* In Part II of the Weather Bulletin.

† Transmit Urgent Hurricane warnings on receipt and at the first silent period on 600 m. These are repeated hourly for 12 hours, unless previously cancelled, on the working wavelength shown above.

The messages are preceded by the Safety Signal TTT.

III.—WIRELESS TIME SIGNALS.

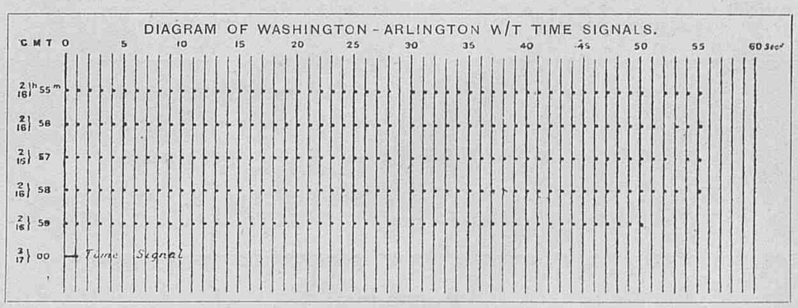
Time Signals are broadcast according to the United States System (See Diagram).

Washington—Arlington, Latitude 38° 52′ 05″ N., Longitude 77° 04′ 47″ W., call sign **NAA** on a wavelength* of 2,653 metres (I.C.W.) on high power, at 00h. 00m. 00s., 3h. 00m. 00s., 5h. 00m. 00s., 8h. 00m. 00s., 17h. 00m. 00s., and 21h. 00m. 00s. G.M.T.

The time signals are broadcast daily and are controlled by the Naval Observatory, Washington.

The transmission of each time signal will be followed by the letters **VA.** In case of error or failure another time signal will be sent one hour later.

The error of the time signal is generally less than 0.02 second.



* Sharp tuning to the transmitting wavelengths is necessary in order to receive satisfactorily.

IV.—WIRELESS ICE WARNINGS.

North Atlantic International Ice Patrol.

The North Atlantic International Ice Patrol commences in March, continuing during April, May and June and longer if necessary. The Patrol vessels, call sign **NIDK,** transmit wireless warnings giving the limits and position of the ice in the neighbourhood of the regular Transatlantic Lane Routes.

The warnings are broadcast daily at 0100 and 1300 G.M.T. on a wavelength of 1713m. C.W. and at 1000 and 2200 G.M.T. on a wavelength of 706m. I.C.W.

Ice information will also be sent on request at all times to any ship with which the Patrol Vessel can communicate, without charge.

The following W/T Stations broadcast messages received from the Patrol Vessel :—

W/T Station.	Call Sign.	Times of Transmission. G.M.T.	Wavelength. Metres.
Washington ...	**NAA**	0500, 1700	2653 C.W.
Boston	**NAD**	0518, 1630, 2200	2939 C.W.
New York ...	**NAH**	1530, 2130	2939 C.W.
Norfolk	**NAM**	0900, 1600, 2100	2458 C.W.

CARIBBEAN SEA, GULF COAST AND WEST INDIAN ISLANDS.

II.—WIRELESS WEATHER BULLETINS.

Weather forecasts are issued for the following stations at the times and for the areas given :—

W/T. Station.	Position.		Call Sign.	Times of Transmission, G.M.T.	Wave-length.	Area affected (see chart, p. 171).
	Latitude.	Longitude.				
Limon	10° 00′ N.	83° 03′ W.	**TIM**	1630	750 m.	E. Gulf, W. Gulf, Caribbean Sea, Windward passage.
Galveston	29° 20′ N.	94° 45′ W.	**NKB**	0500	833 m.	S. Atlantic, E. Gulf, W. Gulf, Caribbean Sea and Windward passage.
New Orleans	30° 00′ N.	90° 06′ W.	**WFB**	0430, 1630	3331 m. C.W.	E. Gulf, W. Gulf, Caribbean Sea, Windward passage.

W/T Station.	Position.		Call Sign.	Times of Transmission, G.M.T.	Wave-length.	Area affected (see chart, p. 171).
	Latitude.	Longitude.				
Key West	24° 33′ N.	81° 48′ W.	**NAR**	0400	2828 m. C.W.	S. Atlantic, E. Gulf, W. Gulf, Caribbean Sea, Windward passage.
				1800	2828 m. C.W.	S. Atlantic coast and E. Gulf coast.

Barbados.

Bridgetown W/T Station, approximate position latitude 13° 06′ N., longitude 59° 37′ W., call sign **VPO,** wavelength 600m. I.C.W., broadcasts the following weather information, received from the Meteorological Station, Codrington (latitude 13° 07½′ N., longitude 59° 36′ W.), when unsettled weather conditions prevail or indications of stormy weather are observed :—

Barometric pressure, barometric tendency, wind direction and force (or velocity in miles per hour), weather at time of observation, and G.M.T. of the observation.

If possible the approximate position of the centre of a tropical cyclonic disturbance will be broadcast.

WIRELESS STORM AND HURRICANE WARNINGS.

Storm Warnings are broadcast by the following W/T Stations for the areas shown on the Chart, p. 171.

When a storm exists that is likely to affect the area, the location and expected direction of movement of the storm centre will be given.

Hurricane Warnings are broadcast when necessary and repeated at the intervals as stated in the last column below.

W/T Station.	Call Sign.	Position (approx.) Latitude. Longitude.	Wave-length. Metres.	Time (G.M.T.) of Storm Warnings.	Area (see Chart, p. 171).	Intervals at which hurricane warnings are repeated.
Galveston, Tex.	**WGV**	29° 18′ N. 94° 48′ W.	720 (C.W.)	1400 and when issued.	West Gulf Coast	—
* „ „	**NKB**	29° 20′ N. 94° 45′ W.	833 (I.C.W.)	0000, 1700	E. and W. Gulf and Caribbean Sea.	—
Port Arthur ...	**WPA**	29° 52′ N. 93° 56′ W.	600 and 720 (C.W.)	When issued.	E. and W. Gulf Coasts. Caribbean Sea. S. Atlantic Coast of U.S.A.	—
New Orleans...	**WFB**	30° 00′ N. 90° 06′ W.	3331 (C.W.)	0000, 1330	E. and W. Gulf Coasts. Caribbean Sea. and S. Atlantic coast.	—
				0430, 1630	E. and W. Gulf coasts and Caribbean Sea.	
*Pensacola ...	**NAS**	30° 21′ N. 87° 16′ W.	2653 (C.W.)	1548	E. and W. Gulf coasts.	—
*Key West ...	**NAR**	24° 33′ N. 81° 48′ W.	2828 (C.W.)	0400, 1800	S. Atlantic Coast and E. and W. Gulf Coasts.	—
Guantanamo (Cuba.)	**NAW**	19° 55′ N. 75° 09′ W.	600 (I.C.W.)	When issued.	—	About 4 hourly.
San Juan ...	**NAU**	18° 07′ N. 66° 10′ W.	600 (C.W.)	Following silent period after receipt.	—	Hourly.
			2653	0200 (1 July to 15 Nov.).	—	
Ensenada (Porto Rico.)	**WPR**	17° 58′ N. 66° 56′ W.	600	When issued.	—	4 hourly.

* Transmits urgent Hurricane warnings on receipt and at the first silent period, on 600 metres. These are repeated hourly for 12 hours, unless previously cancelled, on the working wavelength shown above.

The messages are preceded by the Safety Signal TTT.

III.—WIRELESS TIME SIGNALS.

Panama.

Darien (Balboa) W/T Station, position Latitude 9° 07′ 12″ N., Longitude 79° 45′ 24″ W. Call sign **NBA** relays the Washington–Arlington time signals sent out at 0200 and 1700 G.M.T. on a wavelength of 6,518 metres C.W.

BERMUDA.

II.—WIRELESS WEATHER BULLETIN.

Bermuda W/T Station, approximate position Latitude 32° 23′ N. Longitude 64° 40′ W.

Call sign, **VRT**.

Times of Transmission—0100 and 1300 G.M.T. on wavelength of 665m. I.C.W. and 0130 and 1330 G.M.T. on wavelength of 2250m. C.W. giving 0000 and 1200 G.M.T. observations respectively at Bermuda of Barometer, Barometric tendency, wind direction and force, past weather, and visibility when it reaches 5 or less.

SAMPLE MESSAGE—" *Barometer* 30.03 *falling, wind N.E.* 4. *Weather cloudy.*"

A brief weather forecast for the area 30° to 40° N., 60° to 70° W. (20° to 40° N., 60° to 70° W. during August and September), and 30° to 40° N., 50° to 60° W. when conditions are exceptional, is broadcast at 2100 G.M.T. on a wavelength of 665m. I.C.W. repeated at 2118 G.M.T. on 2250m. C.W.

CANADA, NOVA SCOTIA, NEWFOUNDLAND, LABRADOR, ETC.

II.—WIRELESS WEATHER BULLETINS.

THE following stations broadcast weather bulletins, giving forecasts. Where the times of transmission are omitted, forecasts are sent on request. Stations marked with an asterisk (*) are open during the season of navigation only.

Country.	W/T Station.	Call Sign.	Position (approx.). Lat. N.	Long. W.	Time, G.M.T.	Wave-length.
Canada (Nova Scotia).	Lurcher Lt. Vsl.	VDR	43° 49′	66° 32′	—	600 m.
	Yarmouth ...	VAU	43° 46′	66° 07′	0430, 1630	720 m.
	Camperdown ...	VCS	44° 30′	63° 31′	0440, 1640	750 m.
	North Sydney	VCO	46° 13′	60° 15′	—	600 m.
	Sable Island ...	VCT	43° 56′	60° 02′	—	600 m.
	Louisburg ...	VAS	46° 09′	59° 57′	0400, 1600	2804 m.
Canada ...	Grindstone ... Island	VCN	47° 23′	61° 54′	—	600 m.
	*Fame Point, Que.	VCG	49° 07′	64° 36′	0430, 1630	660 m.
	*Clarke City, Que.	VCK	50° 11′	66° 37′	—	600 m.
	*Father Point, Que.	VCF	48° 31′	68° 28′	0420, 1620	600 m.
	*Quebec ...	VCC	46° 48′	71° 12′	0410, 1610	600 m.
	*Montreal ...	VCA	45° 34′	73° 38′	0400, 1600	600 m.
Canada (New Brunswick).	St. John ...	VAR	45° 14′	66° 03′	0400, 1600	650 m.
Newfoundland and Labrador.	St. John's ...	VON	47° 34′	52° 41′	0400, 1600	600 m.
	Belle Isle ...	VCM	51° 53′	55° 22′	0440, 1640	620 m.
	Cape Race ...	VCE	46° 39′	53° 04′	0420, 1620	660 m.
	Point Amour ...	VCL	51° 27′	56° 50′	—	600 m.
Hudson Bay and Strait.	†*Port Churchill	VAP	58° 47′	94° 09′	1500	600 m.
	†*Cape Hopes Advance	VAY	61° 05′	69° 33′	—	600 m.
	†*Nottingham Is.	VCB	63° 06′	77° 56′	—	600 m.
	†*Resolution Is.	VAW	61° 20′	64° 50′	1620	600 m.

† Forecast and weather conditions for Hudson Bay and Strait and N. Atlantic adjacent thereto.

Wireless Telephony R/T Issues.

THE following stations broadcast weather forecasts, issued by the Canadian meteorological service, by word of mouth.

Country.	Station.	Call Sign.	Position (approx.). Lat. N.	Long. W.	Time, G.M.T.	Wave-length R/T.
Canada (New Brunswick).	St. John... ...	CHSJ	45° 14′	66° 03′	1000, 1200	268 m.
Canada (Nova Scotia).	Sambro Outer Bank Lt.-V.	VGX	44° 22′	63° 26′	1200, 1730	435 m.
	Louisburg ...	VAS	46° 09′	59° 57′	0400, 1700	441 m.

WIRELESS STORM WARNINGS.

Storm warnings are broadcast by the following W/T stations on receipt, on 600 metres and repeated in the Weather Bulletins shown above.

Yarmouth VAU.	Camperdown VCS.
Louisberg VAS.	Fame Point VCG.
Father Point VCF.	Quebec VCC.
Montreal VCA.	St. John VAR.
Belle Isle VCM.	Cape Race VCE.
Port Churchill VAP.	Resolution I. VAW.

Gulf of St. Lawrence Ice Patrol (repeated in ice report, *see* below)

III.—WIRELESS TIME SIGNALS.

Camperdown W/T Station, Latitude 44° 31′ 13″ N., Longitude 63° 32′ 30″ W., call sign **VCS** broadcasts a time signal daily (Sundays excepted) at 14h. 00m. 00s., G.M.T., on a wavelength of 750 metres (spark).

The procedure is as follows :—

G.M.T. h. m. s.	h. m. s.	Signal.
13 58 00 to	13 58 57	A dot (•) is transmitted at each second.
13 59 00		(•) Time signal.
13 59 03 to	13 59 50	A dot (•) is transmitted at each second.
14 00 00		(•) Time signal.

For the purpose of these signals the observatory at St. John (New Brunswick) is connected by land telegraph to Camperdown W/T Station.

IV.—WIRELESS ICE WARNINGS.

The following W/T stations broadcast ice warnings :—

W/T Station.	Latitude N. (approximate.)	Longitude W.	Call Sign.	Wavelength (Metres).	G.M.T. of issue.
Lurcher Lt.-V....	43° 49′	66° 32′	**VDR**	600 (Spk.)	On request.
***Camperdown ...**	44° 30′	63° 31′	**VCS**	750 (I.C.W.)	0440, 1640.
Sable Island ...	43° 56′	60° 02′	**VCT**	600 (Spk.)	On request.
***North Sydney ...**	46° 13′	60° 15′	**VCO**	600 (Spk.)	On request.
***Louisburg ...**	46° 09′	59° 57′	**VAS**	2804 (C.W.)	0400, 1600.
***Grindstone Island**	47° 24′	61° 51′	**VCN**	600 (Spk.)	On request.
Fame Point ...	49° 07′	64° 36′	**VCG**	660 (I.C.W.)	0430, 1630.
Clarke City ...	50° 11′	66° 37′	**VCK**	600 (Spk.)	On request.
***Cape Race ...**	46° 39′	53° 04′	**VCE**	660 (I.C.W.)	0420, 1620.
St. John's ...	47° 34′	52° 41′	**VON**	600	0400, 1600.
Pt. Amour ...	51° 27′	56° 52′	**VCL**	600 (Spk.)	On request.
Belle Island ...	51° 53′	55° 22′	**VCM**	620 (I.C.W.)	0440, 1640.
Port Churchill...	58° 47′	94° 11′	**VAP**	600 (I.C.W.)	On request.
Cape Hopes Advance	61° 05′	69° 33′	**VAY**	600 (I.C.W.).	On request.
Nottingham Is..	63° 06′	77° 56′	**VCB**	600 (I.C.W.)	On request.
Resolution ...	61° 19′	64° 53′	**VAW**	600 (I.C.W.)	On request.

* Broadcasts Gulf of St. Lawrence Ice Patrol report as explained below.

THE GULF OF ST. LAWRENCE ICE PATROL.

The Gulf of St. Lawrence Ice Patrol commences from the opening of navigation in the Gulf and continues until the route is clear of ice.

The Patrol Vessel, call sign **VCQP,** transmits wireless warnings of ice conditions from Cape Race to Quebec and recommendations as to route to be followed.

The warnings are broadcast at 0100 and 1300 G.M.T. on a wavelength of 1621 m. I.C.W. preceded by the general call C.Q. on a wavelength of 600 m.

The warnings will also be sent on request to any ship, ships should call **VCQP** on 600 m.

The above list warnings are also transmitted by the stations marked* in the list above.

PACIFIC COAST.

II.—WIRELESS WEATHER BULLETIN.

San Francisco, California, W/T station, approximate position Latitude 38° 06′ N., Longitude 122° 17′ W.

Call sign **NPG.**

Times of Transmission—0330 G.M.T. and 1530 G.M.T.

Wavelengths—7009 and 2778 metres (CW) simultaneously.

The bulletins commence with "Weather Bureau Bulletin" and are in two parts.

Part I—In plain language giving summary of general pressure distribution and forecasts of wind and weather for the off-shore areas—N. of Cape Blanco ; between Cape Blanco and Point Conception ; and S. of Point Conception.

The period covered by the forecasts in the 0330 G.M.T. bulletin is for 24 hours beginning at 0800 G.M.T. and in the 1530 G.M.T. bulletin for 24 hours beginning at 2000 G.M.T.

Part II—Actual weather observations in United States code for stations in the list below, taken at 0100 G.M.T. for the 0330 G.M.T. bulletin and 1300 G.M.T. for the 1530 G.M.T. bulletin, except as follows, where the observations do not synchronise :—

Observations at Alaskan stations are taken at Midnight and Noon G.M.T.

Honolulu observations taken at 0630 and 1830 G.M.T.

Guam, Manila, China and Japan observations taken at 1400 G.M.T.

Observations taken at Midway Island at 0630 G.M.T.

Indicator Letters and Stations.

Indicator Letters.	Station.	Position (approx.). Latitude.	Longitude.
	Alaska.		
NM	Nome	64° 30′ N.	165° 24′ W.
SPI	St. Paul	57° 15′ N.	170° 10′ W.
DH	Dutch Harbour	53° 55′ N.	166° 30′ W.
TN	Tanana	65° 10′ N.	152° 06′ W.
EA	Eagle	64° 46′ N.	141° 12′ W.
KD	Kodiak	57° 47′ N.	152° 22′ W.
CV	Cordova	60° 32′ N.	145° 42′ W.
JU	Juneau	58° 18′ N.	134° 24′ W.
	Canada.		
ED	Edmonton, Alberta	53° 33′ N.	113° 30′ W.
KA	Kamloops, B.C.	50° 41′ N.	120° 29′ W.
CY	Calgary, Alberta	51° 02′ N.	114° 02′ W.
SC	Swift Current, Sask.	50° 19′ N.	108° 02′ W.
PR	Prince Rupert, B.C.	54° 18′ N.	130° 18′ W.
	United States, etc.		
TAT	Tatoosh I, Wash.	48° 23′ N.	124° 44′ W.
SE	Seattle, Wash.	47° 38′ N.	122° 20′ W.
NH	North Head, Wash.	46° 16′ N.	124° 04′ W.
PD	Portland, Oreg.	45° 32′ N.	122° 41′ W.
RO	Roseburg, Oreg.	43° 13′ N.	123° 20′ W.
EUR	Eureka, Calif.	40° 48′ N.	124° 11′ W.
RB	Red Bluff, Calif.	40° 10′ N.	122° 15′ W.
SM	Sacramento, Calif.	38° 35′ N.	121° 30′ W.
SF	San Francisco, Calif.	37° 48′ N.	122° 36′ W.
FN	Fresno, Calif.	36° 43′ N.	119° 49′ W.
SPE	San Pedro, Calif.	33° 44′ N.	118° 16′ W
PAR	Point Arguello, Calif.	34° 35′ N.	120° 39′ W.
LA	Los Angeles, Calif.	34° 03′ N.	118° 15′ W.
DI	San Diego, Calif.	32° 43′ N.	117° 10′ W.
SPO	Spokane, Wash.	47° 40′ N.	117° 25′ W
WW	Walla Walla, Wash.	46° 02′ N.	118° 20′ W.
BA	Baker, Oreg.	44° 46′ N.	117° 50′ W.
HL	Helena, Mont.	46° 34′ N.	112° 04′ W.
BS	Boise, Idaho	43° 37′ N.	116° 13′ W.
LD	Lander, Wyo.	42° 50′ N.	108° 45′ W.
WM	Winnemucca, Nev.	40° 58′ N.	117° 43′ W.
R	Reno, Nev.	39° 32′ N.	119° 49′ W.
SLC	Salt Lake City, Utah	40° 46′ N.	111° 54′ W.
MD	Modena, Utah	37° 48′ N.	113° 54′ W.
DV	Denver, Colo.	39° 45′ N.	105° 00′ W.
GJ	Grand Junction, Colo.	39° 04′ N.	108° 34′ W.
SA	Santa Fe, N. Mex.	35° 41′ N.	105° 57′ W.
PH	Phoenix, Ariz.	33° 28′ N.	112° 00′ W.
YU	Yuma, Ariz.	32° 45′ N.	114° 36′ W.
HO	Honolulu, Hawaii	21° 19′ N.	157° 52′ W.
MDI	Midway Island	28° 12′ N.	177° 22′ W.
FMA	Manila P.I.	14° 35′ N.	120° 59′ E.
FGM	Guam.	13° 27′ N.	144° 45′ E.
	China and Japan, etc.		
FHO	Hong Kong, China	22° 18′ N.	114° 10′ E.
FSH	Shanghai, China	31° 15′ N.	121° 29′ E.
FBI	Bonin Island	27° 05′ N.	142° 11′ E.
FKO	Koshun, Formosa	22° 00′ N.	120° 45′ E.
FNA	Naha, Japan	26° 13′ N.	127° 41′ E.
FKA	Kagoshima, Japan	31° 34′ N.	130° 33′ E.
FTO	Tokio, Japan	35° 41′ N.	139° 45′ E.
FNE	Nemuro, Japan	43° 20′ N.	145° 35′ E.

San Francisco W/T Station also transmits a report containing barometric pressure, wind direction and force and state of weather in the Bonita Channel, at 0000, 0430, 0600, 0800, 1200, 1630 and 2000 G.M.T. Wavelength 2,776 metres (C.W.).

WIRELESS STORM WARNINGS.

The following W/T Stations broadcast storm warnings at the times stated below. Ships may request any of the stations mentioned to furnish the latest storm warning. The warnings are for a period of 24 hours beginning at the hour indicated in the messages.

W/T Station and position (approx.).	Call Sign.	Wave-length. Metres.	Broad-casting Time, G.M.T.	Particulars.
†Puget Sound ... Lat. 47° 42′ N. ... Long. 122° 37′ W.	NPC	2,941 (C.W.)	0100, 0300 0400, 1300 1700, 2100	Storm Warnings.
†Tatoosh Island ... Lat. 48° 23′ N. ... Long. 124° 44′ W.	NPD	800	0100, 0400 1300, 1700 2100	Puget Sound and Strait of Juan de Fuca.
†Astoria ... Lat. 46° 09′ N. ... Long. 123° 50′ W.	NPE	2,941 (C.W.)	0130, 1330 1730, 2130	——
†Eureka, Calif. ... Lat. 40° 42′ N. ... Long. 124° 16′ W.	NPW	2,776 (C.W.)	0018, 0433 0818, 1218 1633, 2018	Storm Warnings for the N. coast of California, Washington and Oregon coasts.
†San Francisco, Calif. Lat. 38° 06′ N. ... Long. 122° 17′ W.	NPG	7009 (C.W.) 2,778 (C.W.)	0330, 1530	Storm Warnings. In second part of weather bulletin.
,, ,, ...	,,	2,778 (C.W.)	0000, 0430 0600, 1200 1630, 2000	Storm Warnings, for N. California coast.
†San Diego, Calif. Lat. 32° 42′ N. ... Long. 117° 15′ W.	NPL	600	When issued and repeated after the first silent period.	——

† Transmit Urgent Hurricane warnings on receipt and at the first silent period, on 600 metres. These are repeated hourly for 12 hours, unless previously cancelled, on the working wavelength shown above.

III.—WIRELESS TIME SIGNALS.

For method of transmission of the undermentioned Time Signals, *see* diagram, p. 171.

W/T Station.	Call Sign	Wavelength. Metres.	Time of Signal being made, G.M.T.	——
San Francisco, Calif. Lat. 38° 05′ 55″ N. Long. 122° 16′ 37″ W.	NPG	2,778 and 7,009 (C.W.)	h. m. s. h. m. s. 2 55 00– 3 00 00 7 55 00– 8 00 00 16 55 00–17 00 00	Sent daily.

Note.—The above time signal is a rebroadcast of Arlington Va. time signal and is normally correct to 0.02 second.

HAWAIIAN ISLANDS.

II.—WIRELESS WEATHER BULLETIN.

Honolulu-Pearl Harbour W/T Station approximate Latitude 21° 12′ N., Longitude 157° 58′ W., call sign **NPM,** broadcasts weather forecasts daily (except Sundays and holidays), for the Hawaiian Islands and neighbouring ocean areas at 2230 G.M.T., on a wavelength of 600 metres. The station also broadcasts the barometric reading, wind direction and force and state of weather at Honolulu at 0200, 0600, 1830, 2230 G.M.T. on wavelengths of 600 and 2830 metres.

III.—WIRELESS TIME SIGNALS.

For method of transmission of the undermentioned Time Signals, *see* diagram, p. 171.

Honolulu, Pearl Hbr. Lat. 21° 20′ 45″ N. Long. 157° 57′ 56″ W.	**NPM**	2,828 (I.C.W.)	h. m. s. h. m. s. 23 55 00–0 00 00	Sent daily.

NOTE.—These time signals are relayed from the standard clock at Pearl Harbour, which is checked periodically by means of the time signal broadcast from San Francisco. They are normally correct to less than 0·5 sec. having a generally constant lag.

PERSONNEL.

The Marine Superintendent will be glad to receive information of distinctions gained and retirements, &c., of Marine Observers.

Captain H. C. Norris.

Captain H. C. NORRIS, late commander of the M.V. *Kangaroo* of the Western Australian Government Shipping Service, has retired from active service after over 50 years afloat.

Captain NORRIS commenced his sea career in 1884, serving his time in the ships *Talavera* and *Albuera*, of Glasgow. He later served as second and first mates in the same vessels.

On obtaining his Master's certificate in 1893 he transferred to steam, joining Messrs. T. & J. Brocklebanks as a junior officer, and nine years later obtained his first command in their service. In 1911 he transferred from Messrs. T. & J. Brocklebanks to Messrs. J. Birrell, of Glasgow, to take command of their S.S. *Strathdie*, and remained in that vessel until 1915, when he obtained command of the then newly built motor vessel *Kangaroo*, in which ship he remained until his retirement.

Captain NORRIS intends to settle down on his son's farm at Kenwick in Western Australia.

Captain L. Ward, R.D., R.N.R.

CAPTAIN LUKE WARD, Chief Marine Superintendent of the Cunard White Star Line has retired after 38 years' service with the Cunard Company.

Captain WARD served his apprenticeship in the four-masted barque *Drumcliff*, owned by Messrs. Gillison and Chadwick, of Liverpool. He continued to serve in sail as an officer for some years before transferring to steam in 1897, when he joined the Cunard Line as a junior officer. In 1912 when serving as Chief Officer of the R.M.S. *Mauretania*, he was appointed Assistant Marine Superintendent at Liverpool, which position he occupied when called up in 1914 for active service in the Royal Navy. On demobilization at the end of the war Captain WARD was appointed Marine Superintendent of the Cunard Line at Avonmouth, and was later transferred to London. He was subsequently appointed principal assistant to the Chief Marine Superintendent at Liverpool, and in 1925 was promoted to the senior post, which position he retained on the amalgamation of the Cunard and White Star Lines.

Captain G. J. Whitfield.

Captain G. J. WHITFIELD, commander of the R.M.S. *Arundel Castle*, has retired from active service after nearly 40 years with the Castle and Union-Castle Companies.

Captain WHITFIELD served his apprenticeship in the ships of Messrs. John Lidgett and Son, of London, and remained in sail until he obtained all his certificates.

In 1896 he joined the Castle Line as a junior officer, and in 1915 was appointed to his first command, the *Carisbrook Castle*. Since then Captain WHITFIELD has commanded several vessels of the company's fleet.

OBITUARY.

The death of Captain GEORGE FFRENCH HARFORD LLOYD, Marine Superintendent of the Coast Lines, which took place suddenly while on holiday at Bristol on September 4th, is noted with regret.

Captain LLOYD commenced his sea career in 1896, serving his apprenticeship in the barques *Glencova* and *Glenfyne*, of Dundee. On passing for second mate in 1900, he joined Messrs. Elder Dempster & Co., and transferred to the Royal Mail Steam Packet Company in 1906 after obtaining all his certificates. In 1914 he was called up for active service in the Royal Navy, wherein he served throughout the war.

In 1920 he was appointed Port Meteorological Officer at Liverpool, and resigned this position four years later to take up the post of Assistant Marine Superintendent, Coast Lines. In 1933, Captain LLOYD was appointed Marine Superintendent of the Coast Lines in succession to Captain HUMPHREYS.

SHIPS' WIRELESS WEATHER SIGNALS.

CHART OF THE WORLD.

Stations for Reception of Routine Wireless Weather Reports from "Selected Ships".

The dotted line indicates the area in which British "A Selected Ships" report under control to Portishead

A pecked line indicates the reporting area round stations in other countries to which British "A Selected Ships" should report. The names of such stations being underlined with a pecked line

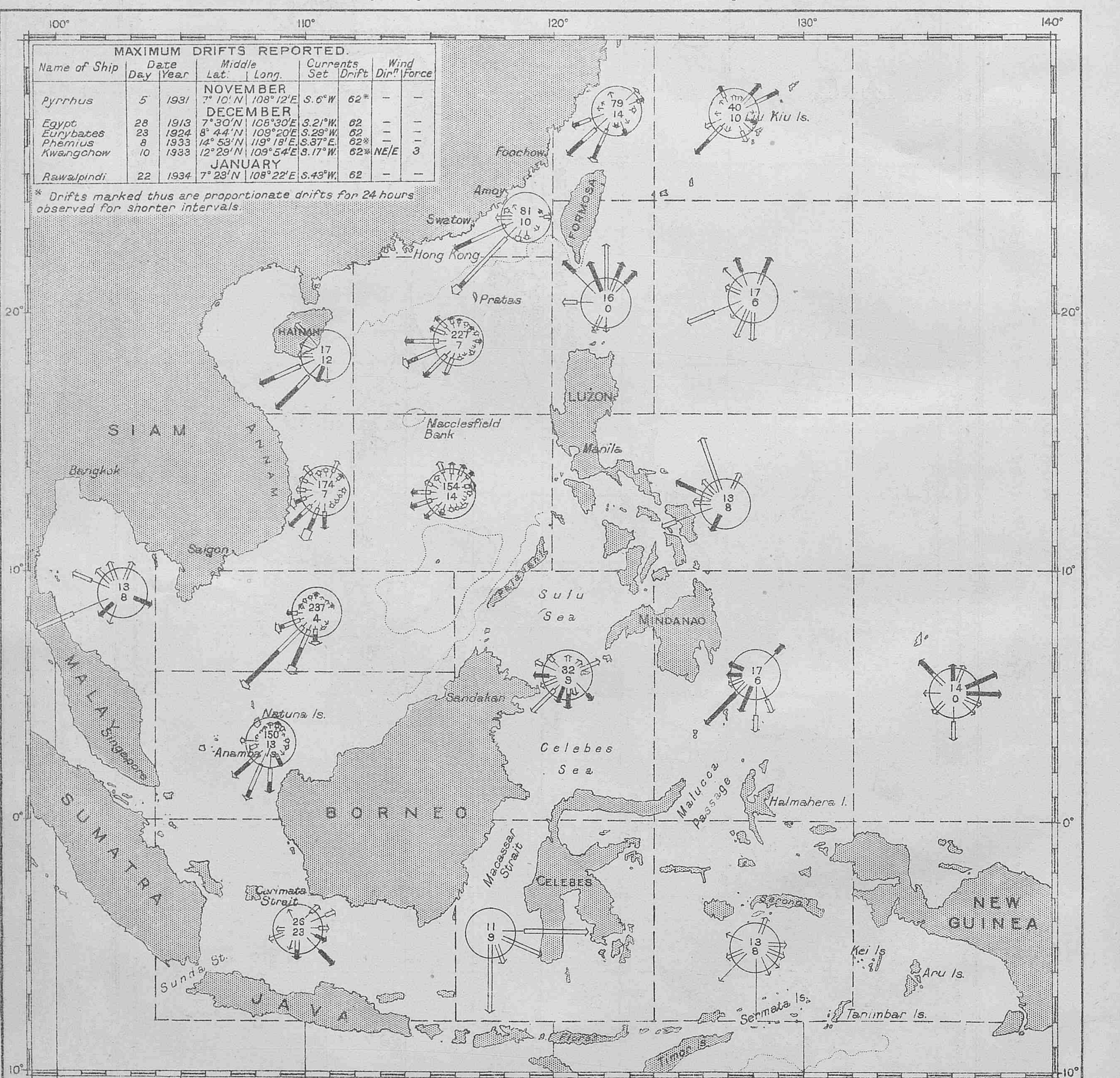
The small shaded areas round stations detailed to receive reports from "A Selected Ships" indicate where these ships should not report on account of congestion.

The full circles indicate the areas round islands and coast stations which are detailed to intercept "B Selected Ships" reports made to CQ on 600 metres.

CURRENTS IN THE CHINA SEAS AND EAST INDIAN ARCHIPELAGO.

NOVEMBER DECEMBER and JANUARY.

Observations of ships regularly observing for the British Meteorological Office, 1910 - 1934.



MAXIMUM DRIFTS REPORTED.

Name of Ship	Date Day	Date Year	Middle Lat.	Middle Long.	Currents Set	Currents Drift	Wind Dirⁿ	Wind Force
			NOVEMBER					
Pyrrhus	5	1931	7° 10' N	108° 12' E	S. 6° W	62*	—	—
			DECEMBER					
Egypt	28	1913	7° 30' N	108° 30' E	S. 21° W.	62	—	—
Eurybates	23	1924	8° 44' N	109° 20' E	S. 29° W.	62	—	—
Phemius	8	1933	14° 53' N	119° 18' E.	S. 37° E.	62*	—	—
Kwangchow	10	1933	12° 29' N	109° 54' E	S. 17° W.	62*	NE/E	3
			JANUARY					
Rawalpindi	22	1934	7° 23' N	108° 22' E	S. 43° W.	62	—	—

* Drifts marked thus are proportionate drifts for 24 hours observed for shorter intervals.

EXPLANATION OF CURRENT ROSES.

The current roses are drawn from observations within the pecked lines. Arrows flow with the current, length represents frequency, thickness strength,:-

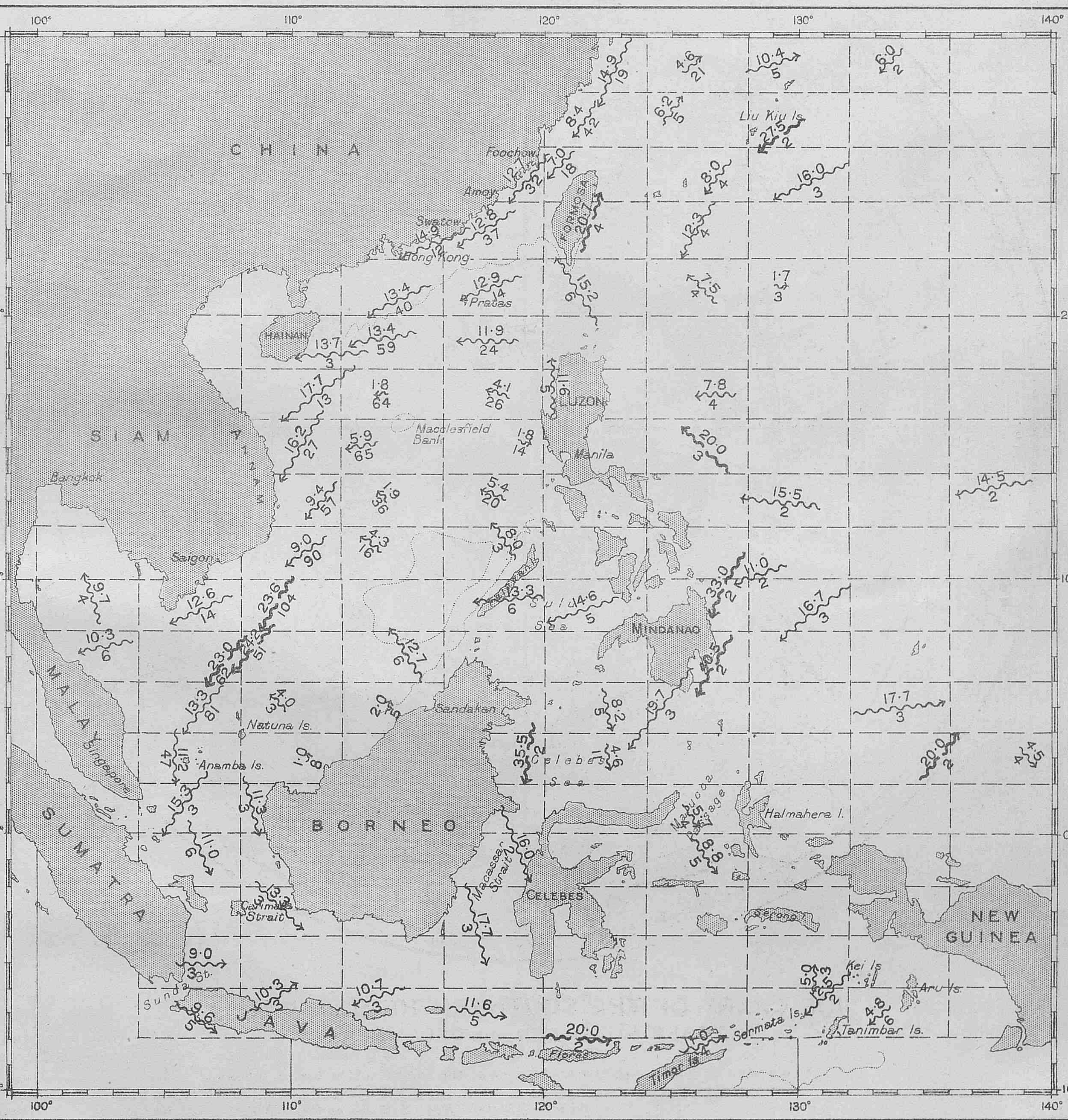
6 - 12 miles per day ⟶, 13-24 miles per day ⟹,
25-48 " " " ➡, 49-72 " " " ⟹,
73 miles per day and above ➡.

Distance from tail of arrow to circle represents 5%. Scale. 0 10 20 30 40 50%.

The upper figure in centre of rose gives total number of observations, the lower figure the percentage frequency of currents less than 6 miles per day.

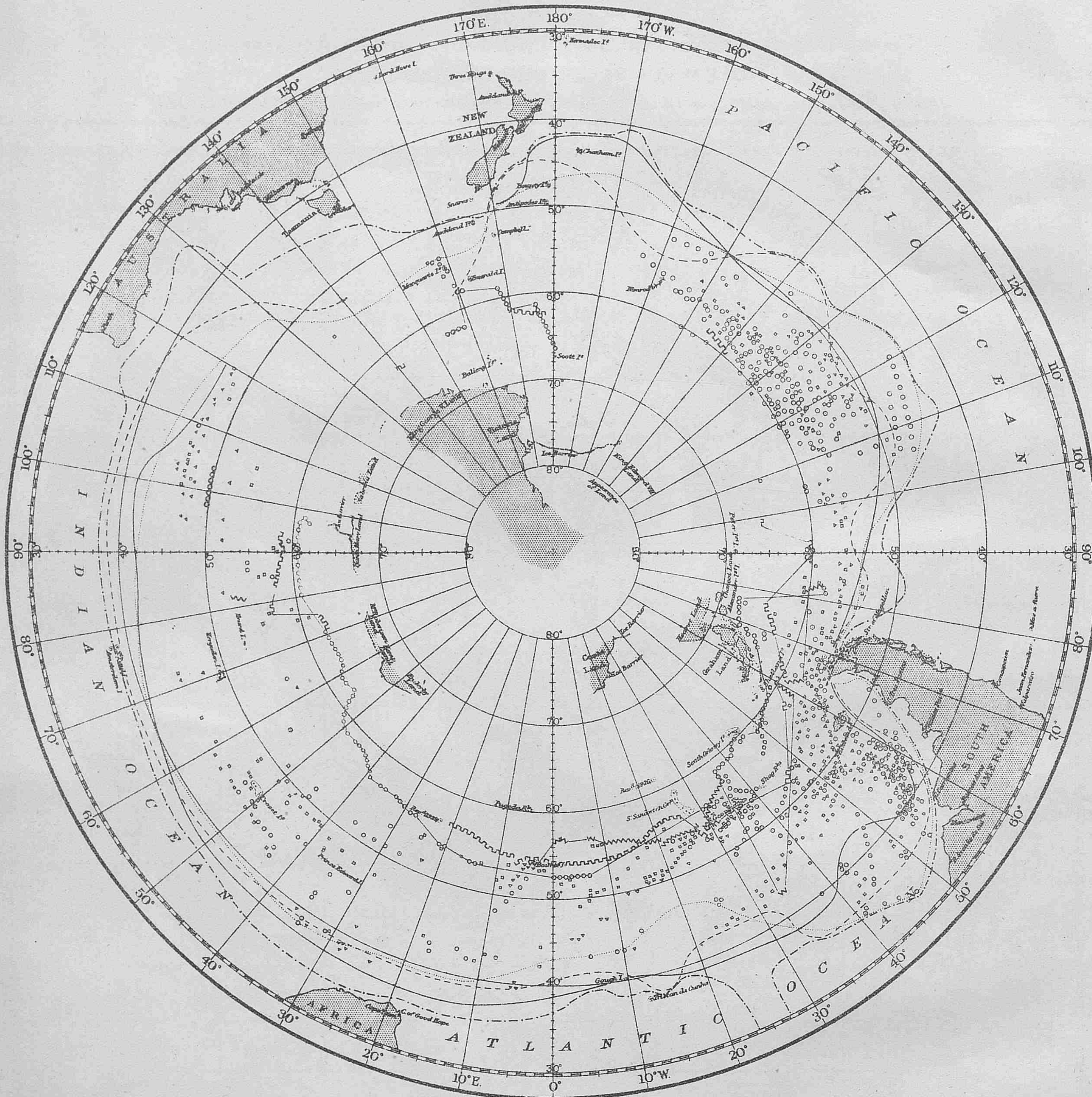
CURRENTS IN THE CHINA SEAS AND EAST INDIAN ARCHIPELAGO.
NOVEMBER DECEMBER and JANUARY.

Observations of ships regularly observing for the British Meteorological Office, 1910-1934.



EXPLANATION OF CURRENT ARROWS.

The arrows flow with the current and represent the resultant of currents observed within the pecked lines. The centre of each arrow lies in the mean position of observation. The figures above the arrows give the velocity of current in miles per day; the figures below the arrows the number of observations. In cases where the arrows drawn to scale are inconveniently long the symbol ⁓⁓→ is substituted.



ICE CHART OF THE SOUTHERN HEMISPHERE,

OCTOBER NOVEMBER and DECEMBER

EXPLANATION.

The symbols used to distinguish the ice of each of the three months are as follows:–

	Bergs, 1902-1934.	Position of northernmost pack ice actually observed 1885-1934.	Extreme limit of all ice, 1772-1934.
October	△	∧∧∧∧∧∧∧∧∧∧∧∧	————————
November	□	⊓⊓⊓⊓⊓⊓⊓⊓⊓⊓	— — — — — —
December	○	–○–○–○–○–○–○–	………………

Extreme limit of all ice, all months. —·—·—·—·—·—

Note — The symbols for pack ice are joined by hair line where desirable.

The coast line of the Antarctic continent as shown on this chart is not completely corrected to accord with the latest survey information. It is intended in a later volume of The Marine Observer, after the Admiralty Ice chart of the Southern Hemisphere Nº 1241 has been revised, to again publish this chart in The Marine Observer with coast lines as complete as possible and to bring the ice information up to date annually.

H.M. Stationery Office Press, Kingsway W.C.2.

G 480/2930 Wt.17A. D.22. Gp.908 1225. 9/35.

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