

# REPORT

OF THE

## METEOROLOGICAL COMMITTEE OF THE ROYAL SOCIETY,

For the Year ending 31st December 1872.

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Presented to both Houses of Parliament by Command of Her Majesty.

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## P R E F A C E .

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THE Meteorological Committee consists of Fellows of the Royal Society who were nominated by its President and Council, at the request of the Board of Trade, for the purpose of superintending the Meteorological duties formerly undertaken by a Government Department, under the charge of Admiral FitzRoy.

The Committee are credited with a sum of £10,000, voted annually in the Estimates, for the administration of which they are wholly responsible, and over which they are given the entire control.

The Meetings of the Committee are held once a fortnight, or oftener when necessary, when every subject on which action has to be taken by their executive officers receives their careful consideration. The duties of the Committee are onerous, and *entirely gratuitous*; they were accepted, and are very willingly performed by the members, on account of the earnest desire they severally feel for the improvement of Meteorological Science.

### MEMBERS OF THE COMMITTEE:—

GENERAL SIR E. SABINE, R.A., K.C.B., *Chairman*.

MR. DE LA RUE.

MR. FRANCIS GALTON.

MR. GASSIOT.

REAR-ADMIRAL G. H. RICHARDS, C.B., Hydrographer to the Admiralty.

MAJOR-GENERAL W. J. SMYTHE, R.A.

MR. W. SPOTTISWOODE.

SIR CHARLES WHEATSTONE.

May, 1873.



# R E P O R T

For the Year ending December 31, 1872.

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## PART I.

THE internal management of the office in the year 1872, the sixth during which it has been under the superintendence of the Committee, has undergone no change since the date of the last Report. Mr. Robert H. Scott, as before, is responsible to the Committee for the entire direction of the system, and, for the special department of Ocean Meteorology, he enjoys the assistance of Captain Henry Toynbee as Marine Superintendent. Introduction.

In the month of July an invitation to a General Meteorological Conference, on questions relating almost entirely to Land Meteorology, was received from three continental meteorologists, Messrs. Wild, Director of the Central Physical Observatory of St. Petersburg; Jelinek, Director of the Central Institution for Meteorology and Terrestrial Magnetism at Vienna; and Bruhns, Director of the Observatory at Leipzig. The Committee at once instructed Mr. Scott to accept the invitation and attend the meeting as their representative. The conference was held at Leipzig in the month of August and lasted for three days. It was attended by about 50 gentlemen, and was entirely consultative, being intended as simply preliminary to a proposed General Meteorological Congress, to be held at Vienna in the autumn of 1873, the invitations whereto will probably be issued by the Austrian Government. Leipzig Conference.

The official report of the proceedings at Leipzig has appeared in the German language, and Mr. Scott has prepared a complete English translation, which was published in the month of February 1873.\* The Committee will have occasion to refer to this publication more than once in the course of the present report.

It will be seen from the following pages that the operations of the office have taken their natural course of development, and accordingly the present Report will contain what the Committee hope will prove a satisfactory account of progress made and of results obtained in the three several branches into which the establishment has been divided.

These branches may be briefly summarized, as heretofore, as—

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\* Report of the Proceedings of the Meteorological Conference at Leipzig.

Subdivision of  
objects of  
inquiry.

I. *Ocean Meteorology*, comprising the investigation of the meteorological conditions of the entire ocean by means of observations made at sea with instruments lent by the Office.

The supply of instruments to the Admiralty is also undertaken by this branch.

II. *Weather Telegraphy and Signals*, comprising the entire system of observation and of telegraphy required for the preparation of the Daily Weather Reports, and for the issue to our own ports and to foreign countries of telegraphic information of ordinary weather and of storms.

III. *Land Meteorology of the British Islands*, comprising the method of inquiry carried on at the seven self-recording observatories established by the Committee. The object of this branch is, firstly, to afford for the entire area of the United Kingdom accurate meteorological information, similar to that published in most European countries under the auspices of their respective governments; and, secondly, to furnish better data for the study of our weather than had previously existed, so as to place the investigations conducted in connexion with Branch II. on a satisfactory scientific basis.

#### I.—OCEAN METEOROLOGY.

Issue of instru-  
ments.

The office continues, as in former years, the practice of lending, to captains in the mercantile marine, instruments which have been tested at Kew, and are generally, except in short voyages, returned for recomparison with standards as soon as the ship returns to port. The loan is granted on condition of observations being regularly taken and entered in a meteorological register, which is issued with the instruments, and is sent to the office when they are returned.

The instruments supplied to a ship consist of—

1. Marine barometer (Kew pattern),
6. Thermometers with a thermometer screen,
4. Hydrometers;

and in exceptional cases an azimuth compass is added.

Observations made with instruments which have not been supplied by the Office, or authentically verified, are not employed in the investigations. Aneroid readings are never used.

Captains of merchant ships are allowed to purchase any of these instruments at cost price, on condition of their keeping a register of observations for the office.

The Committee undertake, in addition to their relations with the mercantile marine, the entire duty of supplying Her Majesty's navy with the regular meteorological instruments used in the service. The observations made with these instruments are not necessarily sent to the Meteorological Office, as the keeping of a special meteorological register, over and above the ship's log, is entirely voluntary. They would here acknowledge the receipt of

a most valuable register from H.M.S. "Orontes," Capt. John L. Perry, kept by Nav. Lieut. W. W. Vine, the same gentleman to whom they are indebted for the register mentioned in their Report for 1871.

The Committee would here draw particular attention to the fact, Control over instruments. that of all the meteorological establishments in existence that of the United Kingdom is the only one which can exercise a reasonably complete control over the character and condition of the instruments, especially the barometers, employed for the observations. This is rendered possible by the fact that the entire set of instruments, *almost without exception*, belongs to the Office, and that all the correction certificates for them, many hundreds in number, are carefully preserved and the corrections applied, while the instruments themselves are re-examined after each voyage. Great care is taken in the selection of observers, and especially for the less frequented routes, whence information is doubly valuable.

The present practice as regards the issue of instruments is that Collection of observations. a circular letter is sent to every captain arriving in London who seems likely to keep a good register, requesting him to call at the office, and, by a personal interview with Captain Toynbee, learn the nature of the observations, &c. required by the Office. In addition to the instruments supplied to vessels leaving London, a few have been supplied in the ports of Liverpool, Glasgow, and Aberdeen, at each of which places verified instruments belonging to the office can be obtained.

As soon as a register is received at the office it is examined, and classified according to its quality, and an acknowledgment is immediately made to the captain sending it; also, if extra explanations on any points arising out of the log are found to be requisite, a letter is at once written to the captain, asking him to furnish such additional information while the circumstances are fresh in his memory. His reply, when received, is registered, and all requisite notations are copied into the log before it is set aside, or handed into the Marine room for discussion.

The successful results, due to the care exercised in the selection of the observers, have been such that the proportion of the registers, sent in during the past year, which have received the highest mark, "excellent," has been 54 per cent., showing an increase of 2 per cent. on the year 1871, and a very remarkable contrast to the general character of the logs sent in in former years. The percentage of excellent registers in 1867 was only 25.

To all the observers who have obtained the mark "excellent" Presentation of Pilot Charts. a copy of the Atlantic Pilot Charts, or of the Wind and Weather Charts of the Atlantic, Pacific and Indian Oceans is presented. Any observers who have already received these charts, and who may continue to observe for the office, have the special thanks of the Committee for each register which has received the mark of "excellent."

The names which have been added during the financial year to the list given in last year's Report are as follows:—

*Presentation of Pilot Charts.*

Captain's Name.	Ship.
Fernie, Alexander Durward -	- " Sir John Lawrence."
Gaye, Gerrard -	- " Eliza Shaw."
Grigs, George, R.N.R. -	- S.S. " Helvetia."
Hayward, George Olive -	- S.S. " Durley."
Holdich, John Peach -	- " Agra."
Lewis, John Thomas, R.N.R. -	- S.S. " Scotia."
Lindsay, Henry Kay -	- " Valparaiso."
McKechnie, Duncan Ferguson -	- " Cottica."
Pearson, Charles William -	- S.S. " Strathclyde."
Price, James John -	- " Sorata."
Vowell, Michael -	- " Kelso."

In Appendix II. will be found a list of all the observers whose logs have been classed as "excellent," since the beginning of the year 1869. Some of the gentlemen mentioned in the list have been regular observers for the office for many years.\*

Localities  
whence obser-  
vations are  
being derived.

The geographical distribution of the vessels in which observations were being taken at the close of the year 1872 was as follows:—

Voyages.	Ships.
To Baffin's Bay or Greenland -	7
„ North America, East Coast -	10
On East Coast, North America -	3
To West Indies -	4
On East Coast, South America -	1
To West Coast, South America -	10
„ West Coast, North America -	5
„ West Coast, Africa -	3
„ Australia and New Zealand -	10
„ India, viâ the Cape -	24
„ India, viâ Suez -	3
In India Seas -	3
To China Seas, viâ the Cape -	3
„ China Seas, viâ Suez -	1
„ Mediterranean Ports -	2
„ Home Ports -	4

93

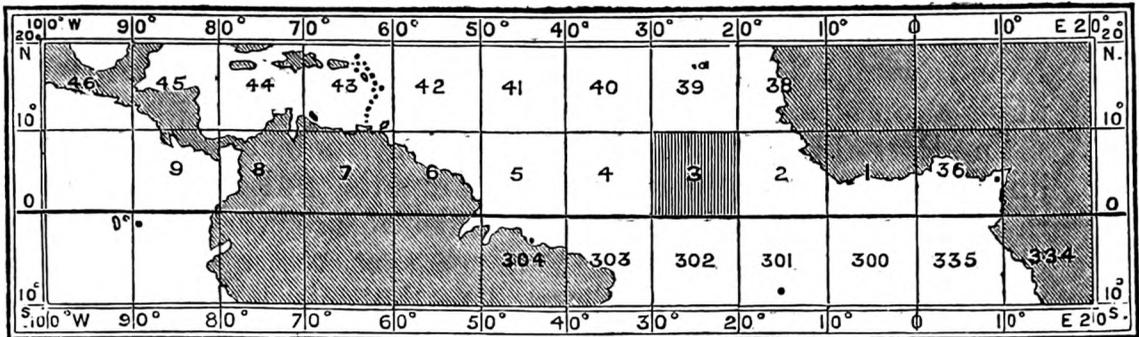
Appendix No. III. contains a list of the documents received during the year in this department, of which 125 are ships' registers.

Progress of  
discussions.

The modes of examination of the registers, as a test for their accuracy, and of correcting the observations, have been fully described in previous years, so that it is unnecessary to allude further to the subject.

\* The Committee would here express their sense of the severe loss which the office has sustained in the death of Captain Clement Mossop, of the "Candahar," one of their oldest and steadiest observers. He commenced to observe in the ship "Florence Nightingale" in April 1858, and during the successive period up to 1872 he sent into the office 16 registers, of which several were classed as "excellent."

The attention of the computing staff of this department has been entirely directed to the discussion of the materials collected for the district of the Atlantic, shown in the subjoined sketch chart, by the shaded square. Equatorial region of the Atlantic Ocean.



The question may well be asked, Why spend so much time on so limited an area? The answer is simple. It is almost the most important district over the whole ocean, as well as that for which material is most abundant, so that it has been thought well to investigate it as thoroughly as the nature of the subject permitted.

The abundance of existing material for this small area, in contrast to the adjacent squares, may be gathered from the fact that out of 124,600 observations collected for the area of the Atlantic shown in the diagram, no less than 73,100, or 59 *per cent.* fall in this single square.

In last year's Report it was stated that the materials had been sifted into single degree squares for each month. The mode in which this has been effected was fully explained in the Report for 1867, p. 8. It was further stated that the Committee had given directions to have the results for the month of January laid down on a chart and lithographed, for private issue to meteorologists and practical seamen, in order to obtain opinions on the scheme proposed and suggestions for future guidance.

The response to this application was most encouraging,—no less than 42 replies were received, and of these many showed that the writers had studied most carefully the question submitted to their judgment. The general tenor of the communications was to the effect that charts on so minute a scale would not be generally acceptable to the sailor, though of undoubtedly high value to the scientific man. The Committee have therefore given up the idea of publishing monthly charts of the precise character originally projected, and have resolved to issue monthly charts for two degree squares for the district under discussion, embodying in them many practical suggestions gathered from the various replies received in answer to their circular letter.

These charts will be issued as a monograph for this particular district, for which the materials, as already described, have been discussed *for single degree squares.* It has seemed to them well that this exceptional publication should appear, it being clearly understood that the office is in nowise pledged to issue hereafter another publication of precisely the same character.

Equatorial  
region of At-  
lantic Ocean.

In fact, it does not seem likely that for any district—except, perhaps, the entrance of the Channel—such an abundance of information could be available as has been collected; and if they had waited until the materials for the entire area shown in the sketch chart had been prepared, the delay would have been serious, and the results for monthly charts for almost all the squares except No. 3 would have been so meagre as hardly to justify the publication at all.

In Part II. will be found a brief summary of the most important results obtained for each month, and it is hoped that the charts themselves will be published ere very long. The Committee have issued instructions that the attention of the computing staff should be directed to the completion of the discussions for the entire area shown in the chart, commencing with the wind.

“City of Bos-  
ton” gale.

The investigation into the weather of the Atlantic north of 30° N. for the period from January 29 to February 8, 1870, when the steamer “City of Boston” disappeared, has been completed by Captain Toynebee, and published.\*

The method followed has been to give extracts from about thirty logs each day, which are followed by a few remarks: a daily chart shows the various instrumental observations, the direction and force of the wind, the weather, the state of sea disturbance, &c., recorded on board of each ship, as well as at certain stations on shore, at 8 a.m. Greenwich time, and on two days extra charts are given at evening hours also; while the continuous graphical records of the observations taken on board five of the steamers on their passages are shown in diagrams. A reduction of the charts on one page, for ease of comparison, enables the reader to gain a general idea of the sequence of changes of weather which were experienced over the entire ocean during the period, and of the manner in which these changes were propagated from west to east. It would appear that most of the systems of cyclonic disturbance to which the serious storms which occurred at the time were due, were generated off the coast of America, and advanced to the North-eastward over the Atlantic at a speed of about thirty miles an hour.

It is shown that the snowstorms of that period in the New England states were related to two areas of high pressure—one over the American continent as usual during winter, the other over the Horse latitudes in the Atlantic. Between these areas the warm Gulf Stream flows, and over it the barometer is permanently rather low. The prevailing wind, to the eastward of the first-named area of high pressure, is shown on the charts to be northerly, whilst the wind to the westward of the other similar area is southerly, in strict accordance with the well-known relations of wind to the distribution of barometrical pressure. These counter currents of air are supposed by Captain Toynebee to

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\* A Discussion of the Meteorology of the Part of the Atlantic lying North of 30° N. for the Eleven days ending 8th February 1870.

be constantly coming into collision, causing eddies which travel to the north-eastward along the coast, and pass out into the Atlantic, producing cold northerly winds with snow, on the seaboard of the States, at times when ships on the eastern side of the eddies are experiencing heavy southerly gales. "City of Boston" gale.

The paper calls attention to the fact that Mr. Meldrum has already pointed out that the cyclones of the Mauritius appear to take their rise between two counter currents of air having a lower barometrical pressure between them than over their own respective areas. This view has been maintained by other writers.

During the eleven days which are dealt with, five of these cyclonic gales were formed and their courses traced. Throughout the interval southerly winds prevailed in the British Islands, though these were frequently disturbed or intensified by the passage of the areas of low pressure as they took a north-easterly course to the westward of Ireland. The idea is thrown out that their course was determined by the existence of the permanent area of deficiency of pressure near Iceland during our winter.

A few practical suggestions for navigators are given, and the paper ends with the remark that it is only "a first attempt at the style of work which is needed to connect the excellent observations now being taken in America with those of Europe." A careful examination of the remarks and charts for a single day will show that the charts by themselves are quite insufficient to trace the progress of the weather changes, and that the amount of observations, although much more copious than that which was available for any previous discussion of extra-tropical Atlantic weather, either in this country or elsewhere, was still far from sufficient to justify the drawing of isobars with the accuracy which is desirable.

The carrying out of the above investigation has been possible by the kind and ready co-operation of several of our steam companies which have sent the logs of their vessels. This information has most usefully supplemented the records of the observations taken on board of the ships which have been supplied with standard instruments by the Office in regular course. The Office is further indebted to Herr von Freeden, Director of the Deutsche Seewarte of Hamburg, for extracts from the logs of several of his observers. From the Scottish Meteorological Society also some materials have been obtained, including returns from their stations in Iceland and the Färoe Islands.

The results already attained are sufficient to show that if the captains of all the Atlantic steam liners would observe systematically for a single year with standard instruments and on a uniform plan, it might be hoped that a mass of material would be collected, the ultimate discussion of which would probably throw great light on the causes and changes of our weather. Such an investigation would necessarily be very costly both as to time and expense, and it may be some time before the Office can undertake it.

The discussion of the anemometrical returns from Dr. Clouston's station of Sandwick Manse in the Orkneys, has been completed and published in the "Quarterly Weather Report" for 1871. Orkney anemometry.

Bermuda  
anemometry.

The discussion of the first four years of the similar returns from Bermuda has also been completed, on a plan nearly the same as that for Sandwich. This work is now in type, and its immediate publication is only delayed for the receipt of some information from Bermuda. The Committee are indebted to the Ordnance Survey Office for copies of the results of other meteorological observations taken in the colony in question during three of the years under consideration, the embodiment of which with the anemometrical data will render the whole more complete.

Diurnal range  
of barometer  
between the  
tropics.

Of other work which is in progress the Committee would notice the preparation of a report on the amount of diurnal range, both of barometrical pressure, and of temperature over the district of the Equatorial Doldrums to which they have above referred. A similar investigation was published by Admiral FitzRoy in No. 7 of the Meteorological Papers, but the materials at his disposal at that time were, comparatively speaking, very scanty. The Committee, therefore, hope that the results now attainable will tend to throw much additional light on these important scientific questions.

Antarctic  
meteorology.

The Committee have also authorized the re-examination and discussion of the observations made during the Antarctic expedition of Sir J. C. Ross in 1840, 1841, and 1842. The only previous publication of these results has been that in Sir J. Ross's Narrative in which monthly summaries are all that are given.

It has been thought that the materials from so inaccessible a region were well worth a further discussion, in which, in addition to being distributed into months, they should be considered with reference to the localities in which the expedition happened to be from time to time.

Contents of the  
publications of  
Office.

The Committee think that it may be useful if they append to this Report a complete table (Appendix IV.) of the contents of the principal publications which have from time to time emanated from the Office as well under the superintendence of Admiral FitzRoy, as under their own management. It will be seen that they contain a considerable amount of information on the meteorology of several little known districts.

Supply of  
unpublished  
information.

As in former years meteorological information has been supplied to several gentlemen who were engaged in various investigations; the expense of copying has been defrayed by the applicants whenever it amounted to more than a few shillings.

Leipzig Con-  
ference.

The subject of Ocean Meteorology did not form part of the original programme for the Leipzig Conference, as contained in the letter of invitation to that meeting which appeared in the number of the *Zeitschrift für Meteorologie* for June 15th, 1872. Nevertheless, on the motion of Dr. G. Neumayer, this branch of the science was discussed by a sub-Committee, composed of the gentlemen present at the Conference, who possessed experience in this special department. The result of their deliberation was generally to the effect that—

I. It is desirable to aim at thorough uniformity in methods of observation and in instruments.

II. Uniformity of scales is desirable, and at all events it is necessary that the standard instruments at the several central establishments should be carefully compared with each other.

III. It is desirable to devise some method of division of labour between the several meteorological establishments, with respect to the investigation of the meteorology of the ocean.

The Committee consider that the truth of the foregoing expressions of opinion is so obvious that the matter hardly calls for any remark on their part, inasmuch as no *recommendation* could be made to them or anyone by a Conference like that of Leipzig.

In Appendix V. will be found a list of all the instruments supplied to ships in the Royal Navy during the year, with a statement of the entire stock and distribution of instruments standing on the books to the account of the Admiralty on the 31st December 1872. This latter statement is prepared from the latest returns furnished by the storekeepers at the respective dockyards, &c.

Stock of instruments.

Appendix VI. gives similar information with regard to the Board of Trade instruments.

## II.—WEATHER TELEGRAPHY AND SIGNALS.

This department of the Office has experienced a considerable development in various directions during the year.

The most important new station which has been added to the list has been Stornoway, to which place the telegraphic cable was laid in the course of the year. The Committee, as indicated in their last Report, lost no time in securing so valuable an outpost as this station, off the exposed western coast of Scotland, has already proved itself to be. The Committee have here to express their sincere thanks to Sir James Matheson, F.R.S., for permitting his head gardener to undertake the duty of reporting to them. The service was commenced on the 1st of December.

Station at Stornoway.

The negotiations with the Post Office, to which allusion was made at p. 11 of the Report for 1871, were brought to a successful issue in the course of the summer, and have resulted in the addition of seven stations to the list.

Arrangements with Postal Telegraph Office.

The nature of these arrangements will be best understood if it is premised that under an old agreement handed on to them by the Electric Telegraph Company, the Intelligence Department of the Post Office has been in the habit of furnishing to certain newspapers daily telegraphic reports of wind and weather. The stations from which these reports were furnished were not well distributed around the coasts, and the clerks who furnished the intelligence were not under special scientific superintendence.

The possibility of effecting an improvement in this service had been mooted on various occasions between the Post Office and the Meteorological Office, and at last, in the month of May 1872, the

Arrangements  
with Postal  
Telegraph  
Office.

Committee received the information that the Post Office was prepared to enter upon negotiations with the view of remodelling the system. The agreement which has been made has been that in consideration of the Office being allowed to receive its reports at press rates, viz., at 1s. for 75 words, instead of for 20, it would allow the Post Office to use freely any portion of the daily telegraphic reports received from its British and Irish stations.

New coast  
stations.

The pecuniary saving which has resulted from this reduction of the scale of charges has enabled the Committee to establish two new stations on the east coast of Ireland, Kingstown and Donaghadee, and one on the shore of the Bristol Channel, Portishead, close to the mouth of the Avon.

New inland  
stations.

Furthermore, the opportunity seemed very favourable for attempting to meet the demand for information from inland stations in addition to their exclusively coast reports. The Committee have therefore added four inland stations to their list, Oxford, Cambridge, York, and Nottingham. At the two first-named places the reports are received from the University observatories, by the kind permission respectively of the Rev. R. Main, F.R.S., and Prof. J. C. Adams, F.R.S. At York the instruments have been placed in the grounds of the museum, and the reports are furnished by Mr. Wakefield, the curator, with the free sanction of the Yorkshire Philosophical Society. At Nottingham the Committee have been so fortunate as to enlist the willing services of the well-known observer, Mr. E. J. Lowe, F.R.S., and the reports are furnished from Highfield House observatory.

These eight additional reports have naturally rendered the record of our weather, published daily by the Office, much more complete and satisfactory than was formerly the case.

Changes in  
observers.

Several changes have been made in the observers. At Wick the duty of reporting has been transferred from the postmaster to Mr. Sinclair, a resident in the town. At Holyhead the telegraphic observer handed over the task to the keeper of the harbour lighthouse; and he, having been unable to discharge it, the work has been entrusted to the keeper of the Sailors' Home. At Yarmouth, the death of Mr. Robinson, the observer, made it imperative to effect a change; and here, too, the reports are supplied from the Sailors' Home.

The Committee regret to say that the interruptions to the service from the Shetland Islands to London have been even more serious during 1872 than in the previous year, owing to the fact that the cable has not been in working order. The station has therefore been, practically, nearly useless for telegraphic purposes.

All the stations, with the exception of Leith and Ardrossan, were as usual visited by Mr. Scott in the course of the year, and everything was found in good order. A list of the stations, with the observers' names, will be found in Appendix VII.

Continental  
arrangements.

The arrangements for exchange of information with the Continent have not undergone any material change except as regards the relations with the Offices of Copenhagen and Hamburg. In

the former city a Meteorological Institute for Denmark has now been established under the superintendence of Captain N. Hoffmeyer, and the reports from Fanö are now supplied by that office,\* and transmitted to London free of cost by the liberality of the Great Northern Telegraph Company. Continental arrangements.

The daily reports from Cuxhaven, furnished by the Deutsche Seewarte, to which allusion was made in the last Report, were received regularly during the winter. In the summer they were suspended for a time, but resumed in about three months, and have arrived regularly ever since. These reports have also been received in London free of charge.

In return, the Office has undertaken to supply to the two institutions named, a telegram containing the most important barometrical readings and wind observations, whenever the total amount of difference in barometrical readings over the area covered by the network of the British system amounts to 0·7 in. These messages also pass free over the Great Northern Telegraph Lines.

This system is very similar to that formerly in practice with regard to the intelligence sent to the Underwriters' Rooms, Liverpool, and to Prof. Buys Ballot at Utrecht. In fact, the occasional messages now sent to Holland are identical with those issued to Denmark and to Hamburg. The organization, in virtue of which Prof. Buys Ballot receives his *regular* reports from these islands, has been entirely established and managed by himself independently of the Office.

As regards the estimation in which the existing system of exchange of information is held by the Continental Offices, the Committee may quote the words of Herr von Freedon, Director of the Deutsche Seewarte at Hamburg, in the Report of that establishment for 1872, p. 34:—"Since the change in the system of telegraphy with London, not a single storm has reached us without our having received warning of it, while in the spring one south-west storm had so reached us."

The Office receives, or would receive, were the Continental telegraphic communications perfect, 46 reports every morning, and 9 every afternoon, being an increase of 8 on the number received last year. The stations are situated along the entire coast of the continent, from Christiansund, in lat. 63° N., to Corunna in lat. 43°.†

\* Before the close of the financial year Captain Hoffmeyer, the Director of the New Institute, notified to the Committee that he was prepared to accept the proposal for exchange of reports made in 1871 to the Ministry of Finance at Copenhagen, and to send reports from Skagen as well as Fanö, receiving in return intelligence from certain stations in the United Kingdom. This system was carried into effect before April 1st.

† In the month of April the Committee received a similar acceptance of their proposals, made to the Academy of Science in Stockholm, from Professor Rubenson, the Director of the New Swedish Meteorological Institute.

† These numbers have been increased since January 1st, 1873.

Preparation of  
Daily Weather  
Report.

The daily observations are taken at 8 a.m., Greenwich time, and most of the telegrams arrive in London about 9 o'clock, when the Intelligence Department of the Post Office extracts from them the portions required for its wind and weather reports. They are then at once transmitted to the Office by the private wire. About two hours are required for their reduction, discussion, and the preparation of the Daily Weather Report, copies of which are ready by about 11 a.m., and are at once supplied for the afternoon issue of several of the London papers. A wind chart for the day is also drawn for the "Shipping Gazette." A brief telegraphic *résumé* of the weather is despatched to the Marine Ministry in Paris, and if necessary, telegraphic intelligence of storms or of atmospherical disturbance is sent to our own coasts and to foreign countries. Later in the day the foreign telegrams, and subsequently the afternoon reports, come in. The daily weather charts are drawn by noon, and forwarded to the lithographers to be printed. The copies for postal distribution are received at the Office at about 3.30 p.m. The system of distribution will be explained later on in this Report.

Telegraphic  
weather in-  
telligence.

The intelligence of storms which is sent out from the Office varies in character, according to the requirements of the place which receives it. In Appendix IX. will be found a list of the stations which are furnished with drums, in accordance with circular 278 of the Board of Trade, issued in November 1867 (Report for 1869, Appendix VIII.). These stations were, at the end of December, 129 in number, situated, 64 in England, 14 in Wales, 32 in Scotland, 13 in Ireland, 3 in the Isle of Man, and 3 in the Channel Islands. Lamps for night use are supplied to a few of the stations. All the stations have been established under, and are in accordance with, the terms laid down in the circular, excepting the dockyards, which are of course under Admiralty management. The messages sent consist of an order to hoist the drum, accompanied by a brief explanation of the reasons why it is to be hoisted. The message is posted up as soon as it is received, for the information of the public. It continues in force for 48 hours, *and no longer*, from the time of its receipt, unless modified by a subsequent telegram, which is frequently sent, either when the danger is known to have passed over, or when there are signs of the approach of another storm.

In addition to the foregoing, a telegram consisting of reports of the atmospherical pressure and the wind at the most important stations, is sent daily to the Underwriters' Rooms, Liverpool, the entire expense of the transmission being borne by the Association.

All intelligence sent to the coasts is also forwarded to Lloyd's Rooms, where it is at once posted up for the information of the members.

No changes, excepting those already mentioned in regard to Denmark and Hamburg, have been made in the character of the intelligence sent to foreign countries, or in the conditions under

which the messages are despatched, so that the previous Reports give full information on this subject.

No further action has been called for as regards the receipt of information from the Azores, to which matter allusion was made in the Report for 1871.

In last year's Report mention was made of the return furnished to an order of the House of Commons on the comparison between the warnings issued and the weather experienced on the coasts of these islands in 1870. The practical benefit which has accrued to the Office from the preparation of this return has been considerable, and accordingly the Committee have given instructions to have similar returns made out for the two following years. They subjoin a summary of the results to which these investigations have led. Returns as to success of warnings.

The warnings which were issued were compared with the weather experienced on the coasts as recorded by the various continuously self-registering anemometers, by the telegraphic reporters and by the several gentlemen who have volunteered to observe for the Office.

The coasts were sub-divided into nine districts, as will be seen in the subjoined table. Two large tracts of coasts are entirely omitted, the west of Ireland from the Shannon to Malin Head, and the west of Scotland from the Mull of Cantyre to Cape Wrath. No warnings were issued to any place within the limits indicated except to Galway, and the amount of information as to weather received from the coasts in question is as yet very scanty.

It should be remembered that in analysing the reports, "all observations of the wind in which the force exceeded 7 (a moderate gale), or the velocity exceeded 40 miles an hour, have been quoted as instances of the occurrence of a gale, but it has not been considered that the drum *was hoisted late* or was *hauled down too soon*, unless the force of 9 (a strong gale) or the velocity of 50 miles an hour was reached *prior* to the issue of the order to hoist, or *subsequent* to the issue of the order to lower."

In the summaries all cases in which the signal has been shown to be partially late by one single report of force 9, or of the velocity of 50 miles, have been specially noted in the remarks, and marked with a *p*.

All telegrams which were late owing to the intervention of a Sunday or of telegraphic errors are marked with an *s*.

	Total No. of orders to hoist and repetitions.	Warnings justified by subsequent gales, force 8 and upwards.	Warnings justified by subsequent strong winds, forces 6 and 7.	Warnings not justified by subsequent weather.	Warnings, late, force 9 reached at two stations before issue.	Warnings partially late, force 9 reached at one station before issue.	Warnings late, owing to Sundays, or telegraphic errors.	Storms for which no warnings were issued.
1871.								
Ireland, South -	34	13	3	7	3	4	4	Jan. 9 <sub>p</sub> , Feb. 19 <sub>s</sub> , Oct. 27, Oct. 29, Dec. 27.
„ East -	37	19	4	9	1	2	2	Jan. 15, Feb. 19 <sub>s</sub> , Oct 27, Dec. 27.
Scotland, East -	30	14	8	7	—	—	1	Jan. 16 <sub>s</sub> , Mar. 7 <sup>p</sup> .
„ West (Clyde)	36	11	8	14	—	1	2	Jan. 16 <sub>s</sub> , Feb. 19 <sub>s</sub> , Feb. 22 <sub>p</sub> , May 3 <sub>p</sub> , Aug. 20 <sub>s</sub> , Oct. 27.
England, North-west	38	17	7	6	—	5	3	Jan. 15, Feb. 20 <sub>s</sub> , Aug. 20 <sub>s</sub> , Oct. 27, Nov. 17 <sub>p</sub> , Dec. 1 <sub>p</sub> , Dec. 28.
„ West -	36	24	5	3	2	1	1	Jan. 15, Jan. 16 <sub>s</sub> , Oct. 1 <sub>s</sub> , Oct. 29, Dec. 28.
„ South -	37	19	7	3	3	4	1	Jan. 15, Jan. 16 <sub>s</sub> , Mar. 16 <sub>p</sub> , Oct. 29.
„ South-east -	23	11	3	8	—	1	0	Jan. 16 <sub>s</sub> , Dec. 1.
„ East -	29	10	8	9	—	2	—	Jan. 16 <sub>s</sub> , Dec. 1.
Totals -	300	138	53	66	9	20	14	
Per-centages -	- -	46·0	17·7	22·0	3·0	6·7	4·7	
1872,								
Ireland, South -	48	23	10	6	1	7	1	Ap. 2 <sub>p</sub> , 21 <sub>s</sub> ; Oct. 17 <sub>p</sub> , 23; Nov. 9, 22; Dec. 22.
„ East -	48	36	6	3	1	1	1	Ap. 21 <sub>s</sub> , Oct. 17, Nov. 9 <sup>p</sup> .
Scotland, East -	30	18	5	5	—	1	1	Jan. 3 <sub>p</sub> , Ap. 16 <sub>p</sub> , Sept. 28 <sub>p</sub> , Oct. 4 <sub>p</sub> .
„ West (Clyde)	43	16	16	10	—	—	1	Ap. 16, Sept. 28.
England, North-west	49	34	7	3	3	1	1	Ap. 21 <sub>s</sub> , Sept. 28, Oct. 23, Nov. 9, Dec. 22 <sub>s</sub> .
„ West -	47	40	4	1	1	1	—	—
„ South -	61	35	17	6	1	2	—	Ap. 3, Nov. 22.
„ South-east -	25	15	4	4	—	2	—	Jan. 3, Ap. 21 <sub>s</sub> , Dec. 9 <sub>s</sub> .
„ East -	28	14	5	7	—	2	—	Ap. 3 <sub>p</sub> , 8 <sub>s</sub> ; Nov. 9, Dec. 17.
Totals -	379	231	74	45	7	17	5	
Per-centages -	- -	61·0	19·5	11·9	1·8	4·5	1·3	

The total per-centage of success is accordingly 63·7 in 1871 and 80·5 in 1872.

The Committee cannot but regard the per-centage figures just given, especially those for 1872, as very satisfactory. The figures for 1871 are almost identical with those for 1870 given in their last report. The improvement in the year 1872 is attributable to several causes. The telegraphic service at home has been gradually improving in regularity, while the exchange of information with the continent, and consequently our knowledge of the atmospherical conditions in the neighbouring countries has been more complete.

Secondly, the extension of the time for which the drum is kept hoisted, from 36 hours to 48, has proved decidedly beneficial; and lastly, the experience gained by noticing the number of apparently unnecessary telegrams issued in the years 1870, 1871, has made the Office more chary of issuing any warning if the gale did not seem likely to be serious.

Returns as to success of warnings.

It must, however, be remarked that the Office has experienced very serious difficulty in obtaining a thoroughly satisfactory record of the weather on our coasts. The number of stations, whence the information used for checking the warnings has been received, has been quite insufficient as regards quantity, while as to quality, the wind observations at every one of the stations are more or less affected by local conditions chiefly depending on the configuration of the ground, and must differ at times from what observations taken at freely exposed points, such as the Eddystone or the Tuskar, would show. This is very seriously the case with the Observatory records, as is abundantly shown by the enormous disproportion between the amounts of wind registered by the various self-registering anemographs erected by the Committee and by private gentlemen at several places over the United Kingdom.

The information, such as it is, is the most accurate at present attainable, and is, beyond comparison, more complete than any materials which have hitherto been available for the testing of storm signals.

Weather Telegraphy was mentioned among the subjects originally proposed for discussion at the Leipzig Conference, but time did not admit of a debate upon it. The only action taken was to refer the question to a sub-committee consisting of three members, Professor Buys Ballot, Dr. G. Neumayer, and Mr. R. H. Scott, who have been requested to prepare a report thereon for the projected Meteorological Congress at Vienna in the course of the year 1873.

Weather Telegraphy at Leipzig.

The sub-committee have arranged a plan of action, and have prepared a series of questions which they intend to forward to the several authorities on the subject in Europe as well as elsewhere. The questions are essentially practical in their nature, and the gentlemen to whom they are addressed are requested to give their opinion on the existing systems of warning the coasts of various countries; on the exchange of telegraphic information between contiguous countries, and on the nature of the signals by which intelligence of bad weather can be conveyed to ships at sea or at anchor in the offing.

The issue of a daily weather chart has met with very decided encouragement from the public. The first of these charts appeared on the 11th of March, as mentioned in the last Report, p. 43, and the charts were distributed gratuitously up to the end of the month. The regular issue to the public commenced on the 1st of April, by which date the regular demand for them had reached 200 copies daily.

Daily weather chart.

Daily weather  
chart.

This number has since been very largely increased, and by the end of the year no less than 600 copies were sent out daily.

In Appendix VIII. will be found a list of all the persons and institutions to whom copies of the charts are sent free. The remaining copies are supplied to subscribers.

The rate of subscription has been fixed at 1*l.* per annum, a sum which leaves a small margin to pay for extra clerical labour in preparing the charts, over and above the expense of wrappers, direction, and postage.

The systematic study of the weather has been kept up for the purpose of checking the issue of storm signals, and of preparing the Weather Chronicle for the Quarterly Weather Report. In order to supplement the information received from these islands the various continental bulletins are consulted, which are received regularly from the respective institutions which publish them.\* Other daily publications which are received are acknowledged in Appendix XI.

Fishery  
barometers.

The practice of lending fishery barometers to small ports and fishing stations, as described in previous reports, has been continued. Four of these instruments were issued during the year, and there are now 118 stations on our coasts supplied by the office with barometers for public use. They are situated, 49 in England, 4 in Wales, 40 in Scotland, 23 in Ireland, and 2 in the Isle of Man. See Appendix No. X.

### III.—LAND METEOROLOGY OF THE BRITISH ISLANDS.

There is no change to report in the arrangements of the seven observatories during the year. The establishments were all found in a satisfactory condition on the occasion of Mr. Scott's annual visit of inspection.

Quarterly  
Weather  
Report.

The publication of the Quarterly Weather Report has been steadily carried on, and good progress has been made in clearing off the arrears noticed in last Report.

In the course of the year 1872 five parts have been issued, including numbers for 1870, 1871, and 1872, as indicated in last Report, and there is every reason to hope that ere the close of

\* LIST of Daily Meteorological Bulletins received at the Meteorological Office in 1872 :

Place.	Whence issued.
Christiania - - -	Norske Meteorologiske Institut.
Hamburg - - -	Deutsche Seewarte.
Madrid - - -	Observatory.
Paris - - -	Observatoire National.
Paris - - -	Observatoire Météorologique Central de Montsouris.
St. Petersburg - -	Central Physical Observatory.
Utrecht - - -	Koninklijk Nederlandsch Meteorologisch Instituut.
Vienna - - -	K. K. Central-Anstalt für Meteorologie und Erdmagnetismus.
Washington - - -	War Office.

1873 the Committee will be able to say that there are no back numbers still unpublished.\*

Quarterly  
Weather  
Report.

The rate of appearance of the successive numbers is, per-force, ruled by the rate of production of the copper plates from which the continuous records are printed. These plates are all engraved by Wagner's pantagraph, and consequently the slightest interruption to its work, either by its own mechanism not working smoothly, or by any failure in the electrotyping process, causes serious inconvenience and delay.

The appendices which have from time to time appeared have included, in addition to the regular tables, the same as in former years, the results of the discussion of six years' anemometrical observations at Sandwick Manse in the Orkneys, and monthly rainfall averages for a number of stations in addition to those given in the Quarterly Weather Report for 1870.

Appendices to  
Quarterly  
Weather  
Report.

The discussion of the Orkney wind returns has been a serious undertaking, and though the results are for the comparatively short period of six years, the Committee hope that they will be found to constitute a not unimportant contribution to our knowledge of British Meteorology.

In the last Report the Committee mentioned their intention to employ Bessel's Interpolation Formulæ in the discussion of the results of their system of observations, and accordingly the constants for the monthly march of atmospherical pressure, temperature and vapour tension for the years 1869 and 1870 have been calculated.†

The following is the list of the Observatories established by the Meteorological Committee, which are situated, three in England, two in Scotland, and two in Ireland.

Observatories.

Observatory.	Superintended by	Latitude N.	Longitude W.	Height of Barograph Cistern above Sea Level.
Aberdeen -	D. Thomson, M.A., Professor of Natural Philosophy.	57 10	2 6	Ft. 88·5
Glasgow -	R. Grant, LL.D., F.R.S., Professor of Practical Astronomy.	55 53	4 17	184
Armagh -	Rev. T. Romney Robinson, D.D., F.R.S., Astronomer.	54 21	6 39	207·3
Valencia -	Rev. Thos. Kerr. -	51 55	10 18	23·0
Stonyhurst -	Council of Stonyhurst College.	53 51	2 28	360·7
Kew -	Kew Committee of Royal Society.	51 28	0 19	34
Falmouth -	Royal Cornwall Polytechnic Society.	50 9	5 4	210·8

\* At the present date (May 1873) the publication has been carried on up to October 1871 and 1872 respectively. The last part for 1872 is in hand, and this will, it is hoped, be followed by Part I. for 1873 in the month of July. If this arrangement be carried out, the issue will then be only three months in arrear, viz., the last three months of 1871.

† These have appeared as an Appendix to Part III. of the Quarterly Weather Report for 1871, published May, 1873.

Anemograph  
stations.

In addition, anemograms are received from the following stations, which are furnished with anemographs similar to those erected at the above observatories.

Station.	Supplied by	Superintended by
Alnwick Castle	- Duke of Northumberland.	F. Holland, Esq.
Halifax	- L. J. Crossley, Esq.	—
Holyhead	- Meteorological Committee.	Harbour Authorities.
Orkney	- Ditto.	Rev. C. Clouston, LL.D.
*Seaham	- L. J. Crossley, Esq.	G. H. Aird, Esq.
Yarmouth	- Meteorological Committee.	Secretary Sailors' Home.

Volunteer  
observers.

The list of volunteer observers who send in returns of various kinds has steadily increased. It now consists of 39 names against 28 last year. Those gentlemen who furnish the most complete monthly register (Form No. 19) receive a copy of the Daily Weather Charts in exchange.

#### VOLUNTEER OBSERVERS.

Name.	No. of Form.	Place.
Aird, G. H.	19	Seaham Harbour.
Amy, A. P.	19	St. Helier's, Jersey.
† Baxendell, J., F.R.A.S.	—	Fernley Observatory, Southport.
Bellingham, J. G.	14	Saffron Walden.
Byron, Rev. J., F.M.S.	17	Killingholme, Lincolnshire.
Clouston, Rev. C., LL.D.	12	Sandwick Manse, Orkneys.
Cooper, Col. E. H., F.R.A.S.	12	Markree Castle, near Sligo.
Cooper, W. F., F.M.S.	12	Sheffield.
Curtis, Professor A. H.	19	Queen's College, Galway.
Delap, Rev. A.	12	Dungloe, Letterkenny.
‡ Dunlop, W. H., F.M.S.	—	Annan Hill, Ayrshire.
Dun, F.	12	Moreton-in-the-Marsh.
Griffith, Rev. C.H., F.M.S.	17	Strathfield Turgis, Hants.
§ Hoskins, S. E., M.D., F.R.S.	—	Guernsey.
Irvine, J.	15	North Shields.
Jones, G. I.	19	Lymington.
Mackay, Rev. W. P., D.D.	19	Hull.
Mackrell, T.	19	Barnstaple Meteorological Committee.
McLeod, H.	19	Indian C. E. College, near Staines.
Mansell, T. L., M.D.	—	Guernsey.
Moore, J. W., M.D.	19	Dublin.
Morris, E. E.	19	Bedford Middle-class School.
Moyle, M. P., F.R.C.S.	12	Helston (Cornwall).
Prince, C. L., F.R.C.S., F.M.S.	12	Tunbridge Wells.
Quinton, J., jr.	19	Norwich Meteorological Committee.
† Redford, Rev. F., F.R.S.E.	—	Silloth, Carlisle.
† Richards, W. H.	—	Penzance.
Richardson, Rev. G.	19	Winchester College.
Rosse, Earl of, V.P.R.S.	19	Birr Castle, Parsonstown.
† Ryves, Rev. G. T.	—	Ironbridge, Salop.
Sawyer, F. E., F.M.S.	19	Brighton.

\* Erected by kind permission of the Marquis of Londonderry.

† Printed Weekly Register.

‡ Printed Monthly Register.

§ Complete Register and Printed Monthly observations.

|| Printed occasional observations.

Name.	No. of Form.	Place.
Spinks, W. - - -	19	Royal Horticultural Society, Chiswick.
Stanford, W. - - -	15	Gorleston, Yarmouth.
Stow, Rev. F. W., F.M.S.	19	Harpenden, St. Albans.
Sutherland, A. - - -	15, 17	Carrickfergus.
* Torrens, Mrs. - - -	—	Dromore, Coleraine.
* Valentine, W. - - -	—	White Abbey, Belfast.
Wheeler, Rev. R. F. - - -	—	Newcastle-on-Tyne.
Wilson, J. M., F.R.A.S.	19	Rugby School, Natural History Society.
Woollett, G. C. - - -	19	Acrise, Canterbury.

\* Rainfall only.

DESCRIPTION OF FORMS.

12. Monthly Tables, two observations daily. 14. Monthly Table and Diagram, one observation daily. 15. Monthly Register, diagram of barometer and thermometer. 17. Occasional Observations, wind and weather. 19. Complete Monthly Register.

The Committee have not as yet commenced the publication of mean results, excepting of rainfall, from any of these stations, but they hope to do so as soon as a definite scheme of publication may have been proposed for general adoption. At the present time it may fairly be stated that the meteorological publications of the various meteorological organizations in existence differ from each other not only as regards the form in which the information appears, but even in the very subject matter which is communicated to the public.

At the close of the year the Committee received communications from the Registrar-General with reference to the preparation of certain meteorological tables, which are issued from time to time with the periodical returns from his office. A small special pecuniary allowance for the collection of the information and calculation of the tables has hitherto been made; but the Committee have been informed by the Registrar-General that in the opinion of Her Majesty's Treasury the expense should henceforth be defrayed out of the vote for the Meteorological Office. The Committee have at once assured the Registrar-General of their readiness to comply with the wishes of the Treasury, and to assist him in this branch of his duties by furnishing him with the information required, which is of a very simple character, without making any additional claim on the public funds.

The deliberations of the Leipzig Conference were principally confined to subjects relating to land meteorology, and therefore falling within the province of this branch of the Meteorological Office. Most of the questions were of a strictly scientific character, and therefore hardly suited for notice in a Report like the present; but there were a few which have an immediate bearing on the matters to which allusion has just been made, and to these it may be well to refer briefly.

These questions bore upon the mode of discussion and publication of meteorological results, which would be most likely to meet

with general approval, so that the science should no longer lie open to the criticism which has been made above on meteorological publications.

It is hardly necessary to say that the Committee would hail most gladly the prospect of any general agreement between meteorologists which would render the information published in one country at once available to the scientific investigators in another. They will be most ready to adapt the form of their publications so as to be in accordance with whatever plan may be, on competent authority, proposed for general adoption.

### LIBRARY.

Appendix XI. contains a list of the donations made to the library during the year. Most of these have been received in return for the publications of the office. In addition a few volumes have been purchased.

In consequence of the constant reference which is made to the office for information on meteorological questions, it has been endeavoured to collect a small library containing the standard works on meteorology, and the subjects allied to that science. The Committee are glad to say that they have already succeeded in obtaining several of the most important works.

The library at present consists of nearly 1,800 volumes, and about 1,200 pamphlets, exclusive of charts and MS. records of observations. The pamphlets are bound in convenient volumes for reference. The books, &c. are lent to the staff of the office, under the usual regulations.

### EXPENDITURE.

The expenditure during the year has fallen short of that during the preceding year by the amount of 75*l.* 16*s.* 2*d.* The financial statement will be found at Appendix I. The following table shows the general distribution of the expenditure under the several heads :—

—	1871-72.			1872-73.			Increase.			Decrease.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Office, salaries, &c. -	1,222	15	2	1,255	12	2	32	17	0	—		
„ rent, attendance, and contingencies -	866	11	3	880	16	1	14	4	10	—		
Observatories -	3,621	5	7	3,463	9	6	-	-	-	157	16	1
Telegraphy -	3,022	15	2	2,762	16	10	-	-	-	259	18	4
Ocean Meteorology -	1,827	3	4	2,121	19	9	294	16	5	—		
<b>Totals</b> £	<b>10,560</b>	<b>10</b>	<b>6</b>	<b>10,484</b>	<b>14</b>	<b>4</b>	<b>341</b>	<b>18</b>	<b>3</b>	<b>417</b>	<b>14</b>	<b>5</b>

Net decrease, 75*l.* 16*s.* 2*d.*

The first two items show no change worthy of notice.

The decrease under the head of "Observatories" is due to the fact that no new instruments were purchased during the year, while in the preceding year there had been an amount of 225*l.* under this head.

The decrease under "Telegraphy" is due to the fact that the accounts for last year included payments for arrears due to the Post-Office, which had been kept back owing to delays connected with the transfer of the telegraphic business to the Post-Office. The saving due to the reduction of tariff mentioned at p. 14 has been employed in increasing the number of stations. The expense of issue of the Daily Weather Charts, which is met by subscriptions, has had the effect of increasing the outlay under the head of Telegraphic Work, to the extent of upwards of 400*l.*

The main increase has been in the matter of Ocean Meteorology. This has been in great measure due to increased demands for instruments for the service of the Admiralty. The work of preparing the charts of Square No. 3 for publication has also borne its share in swelling the expenditure on this head.

## SUMMARY.

The Committee subjoin the usual summary of their operations during the past year.

Mr. Scott, the Director, attended the Meteorological Conference at Leipzig in August, and the Committee have published an English translation of the proceedings, prepared by him.

I. *Ocean Meteorology.*—The number of barometers afloat on the 1st of January 1873 was 98, as compared with 105 in the preceding year. In addition all the ships in commission in the Royal Navy have, as usual, received all their meteorological instruments from the office.

Sixty-seven gentlemen have sent in registers which have received the mark of "excellent."

The investigation into the meteorological conditions of the equatorial portion of the Atlantic Ocean is in a satisfactory condition. A specimen chart showing the results obtained for single degree squares for a limited portion of the sea surface was issued in order to elicit opinions as to the proposed mode of publication. 42 replies were received containing many valuable suggestions from practical navigators and from scientific men.

It has been resolved to publish monthly charts for two-degree squares, with explanations, as a monograph of the meteorology of the district in question, as nearly *sixty per cent.* of all the observations extracted from the logs for the entire area under examination fall in this single square of 10 degrees of latitude and longitude. These charts are now in the press.

The investigation into the weather of the Atlantic at the time of the loss of the S.S. "City of Boston" has been published.

The anemometrical results from Sandwick Manse, Orkney, have been published, and those from Bermuda are in the press.

Investigations are in progress as to the diurnal range of the barometer at sea between the Tropics, and as to the meteorology of the Antarctic Ocean, as evidenced by the observations made by Sir J. C. Ross and others.

The cost of this department has been 2,121*l.* 19*s.* 9*d.*

II. *Weather Telegraphy and Signals.*—Eight new telegraphic reporting stations, including one at Stornoway and four inland stations in England, have been added to the list.

Arrangements have been made with the Post Office by which the tariff for reports has been reduced to that of press rates, in consideration of the Post Office being permitted to use the reports supplied to the Meteorological Office for supply of information to the provincial press, &c.

Warnings are sent to the coasts of Norway, Denmark, Germany, Holland, and France.

Reports are now received from Norway, Sweden, Denmark, Hamburg, Holland, France, and Spain, in return for reports from the United Kingdom.

The Daily Weather Chart has been issued, and its circulation on December 31, 1872, exceeded 500 copies daily.

The drum is hoisted at 64 stations situated in England, 14 in Wales, 32 in Scotland, 13 in Ireland, 3 in the Isle of Man, and 3 in the Channel Islands.

The number of stations to which fishery barometers have been lent has been increased to 118, situated 49 in England, 4 in Wales, 40 in Scotland, 23 in Ireland, and 2 in the Isle of Man.

The cost of this department has been 2,762*l.* 16*s.* 10*d.*

III. *Land Meteorology of the British Islands.*—There is no change to report in the arrangements of the Observatories. Good progress has been made in clearing off the arrears of the Quarterly Weather Report, and it is hoped by the Committee that *all the arrears* will be cleared off by the end of 1873.

The constants for Bessel's Interpolation Equations for all the Observatories for the years 1869 and 1870 have been calculated.

The list of volunteer observers has largely increased.

The cost of this department has been 3,463*l.* 9*s.* 6*d.*

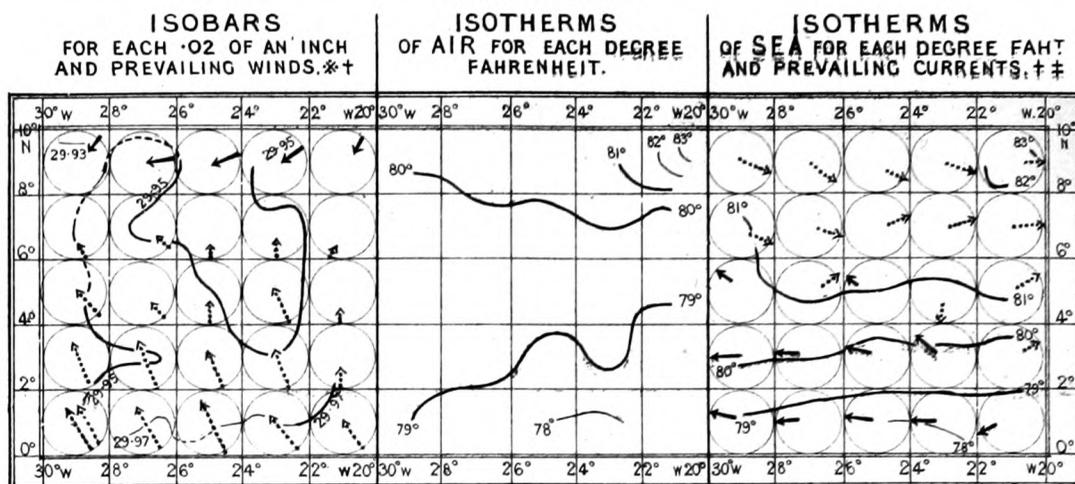
*Office.*—The expenses of management in salaries and wages have been 1,255*l.* 12*s.* 2*d.*

The other charges incident on the office for rent, furniture, postage, &c., have amounted to 880*l.* 16*s.* 1*d.*

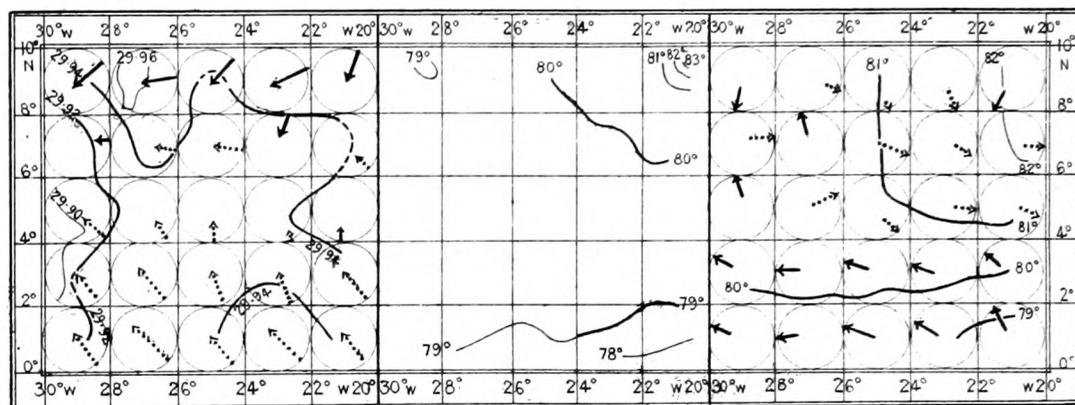
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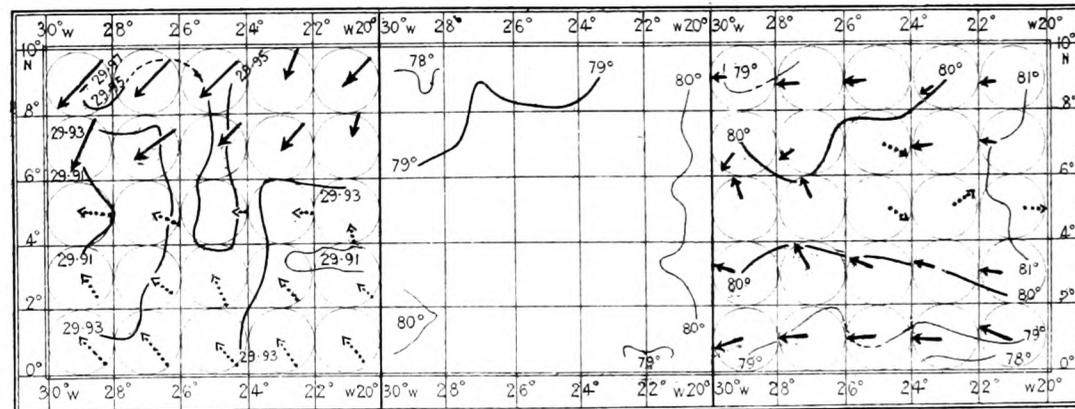
## OCTOBER.



## NOVEMBER.



## DECEMBER.



Note. When the isobars or isotherms are deduced from the data of 1° squares they are represented by a faint continuous line. Broken lines merely connect the different parts of an isobar or isotherm when the data do not authorize its being drawn.

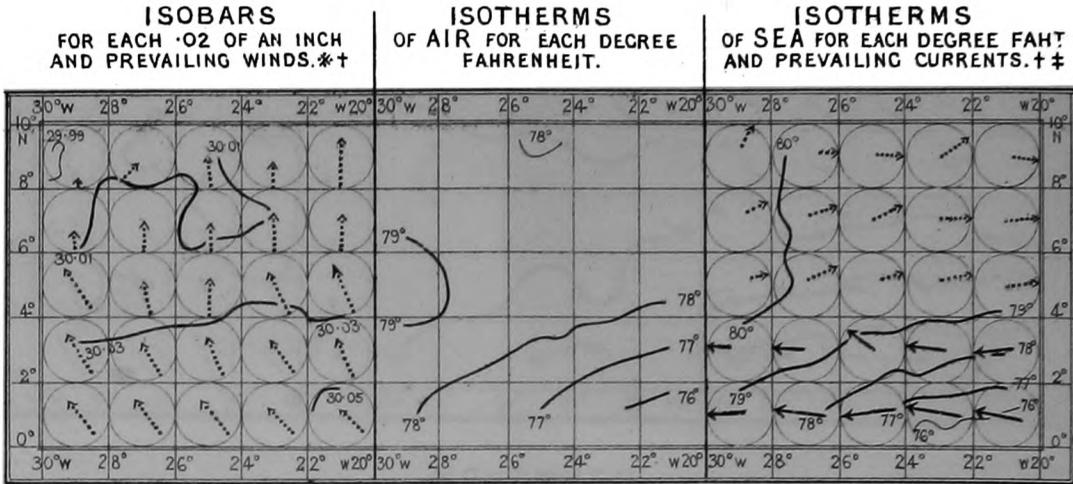
\* Each arrow flies with the most frequent wind of its square. The length shows its mean force and is proportional to the rate per hour at which the wind would drive Beaufort's ship; nine miles an hour (force 5 Beaufort's scale) extending across the circle.

† Northerly winds and Westerly currents have continuous, whilst Southerly winds and Easterly currents have dotted arrows

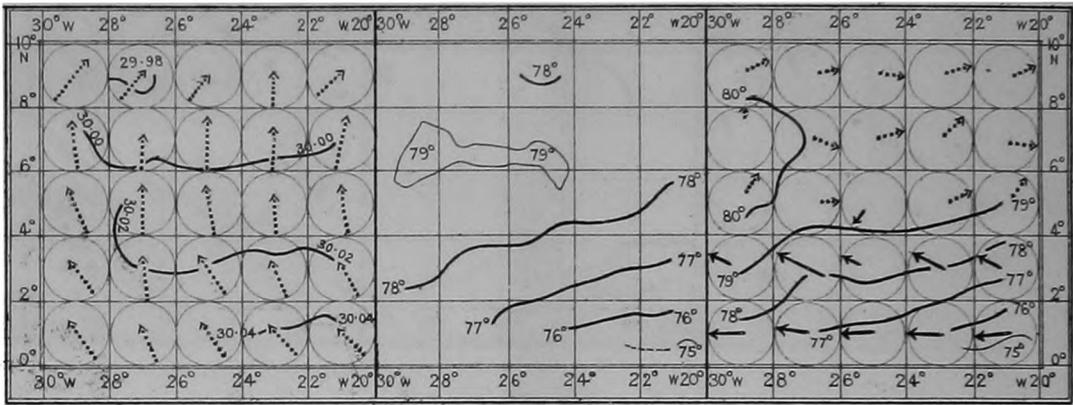
‡ The length of the current arrows is proportional to the rate in 24 hours; 50 miles extending across the circle.



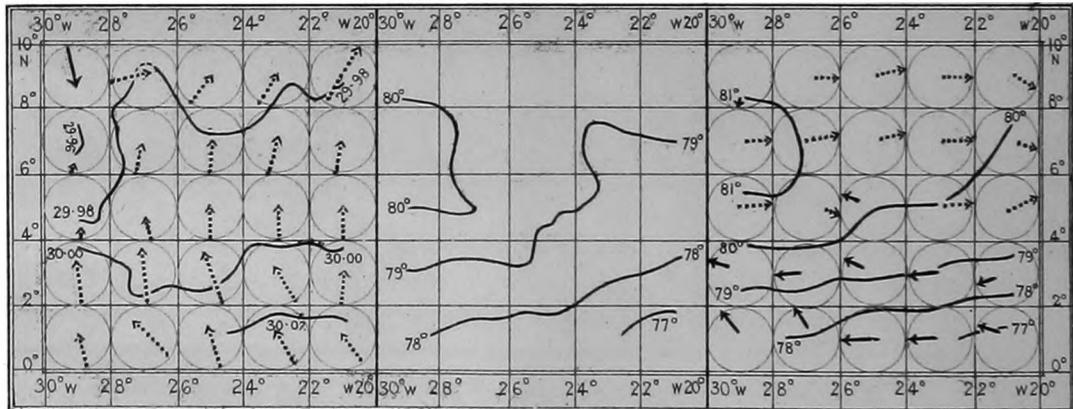
## JULY.



## AUGUST.



## SEPTEMBER.



Note. When the isobars or isotherms are deduced from the data of 1° squares they are represented by a faint continuous line. Broken lines merely connect the different parts of an isobar or isotherm when the data do not authorize its being drawn.

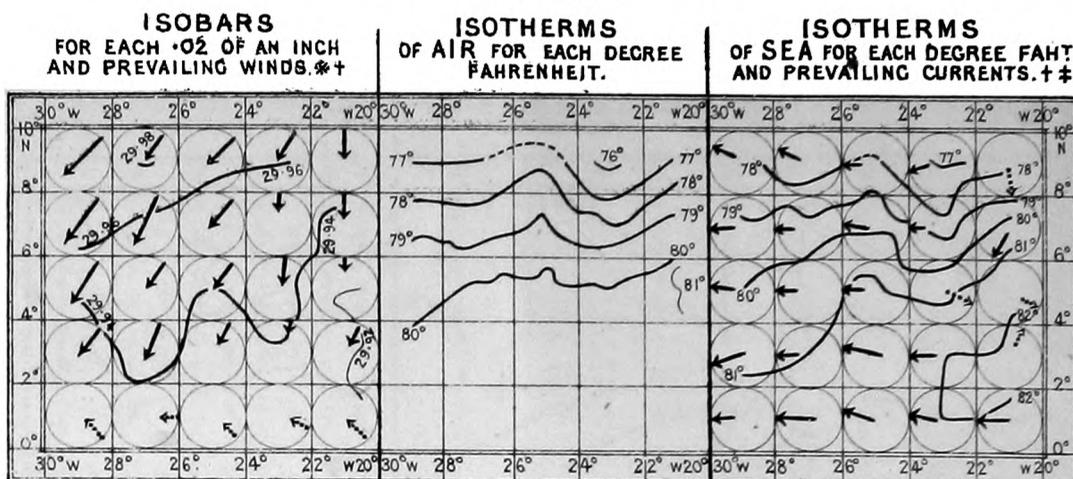
\* Each arrow flies with the most frequent wind of its square. The length shows its mean force and is proportional to the rate per hour at which the wind would drive Beaufort's ship; nine miles an hour (force 5 Beaufort's scale) extending across the circle.

† Northerly winds and Westerly currents have continuous, whilst Southerly winds and Easterly currents have dotted arrows.

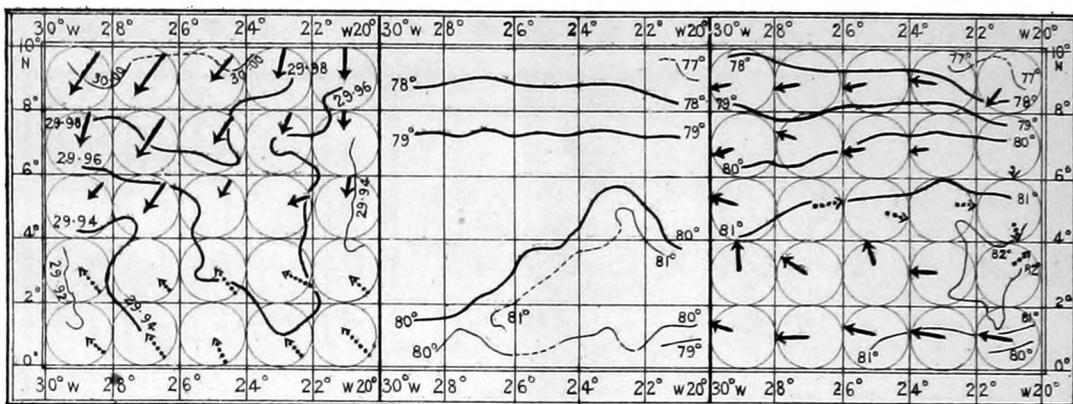
‡ The length of the current arrows is proportional to the rate in 24 hours; 50 miles extending across the circle.



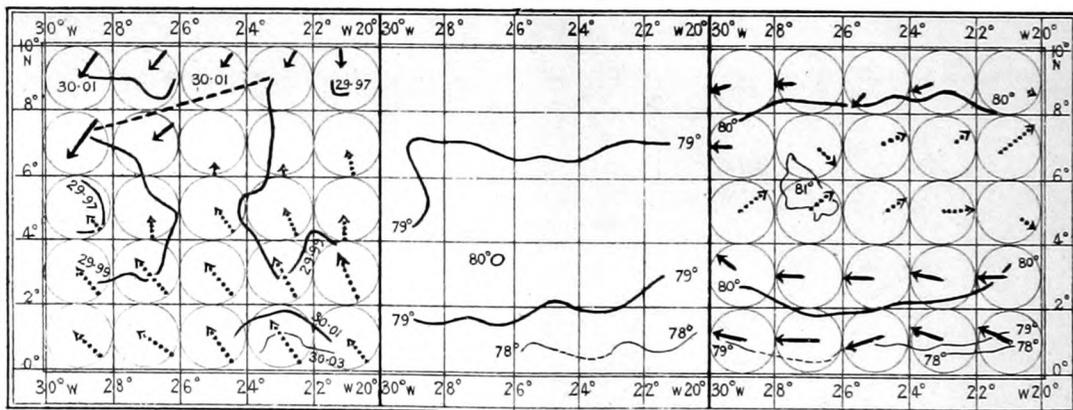
## APRIL.



## MAY.



## JUNE.



Note. When the isobars or isotherms are deduced from the data of 1° squares they are represented by a faint continuous line. Broken lines merely connect the different parts of an isobar or isotherm when the data do not authorize its being drawn.

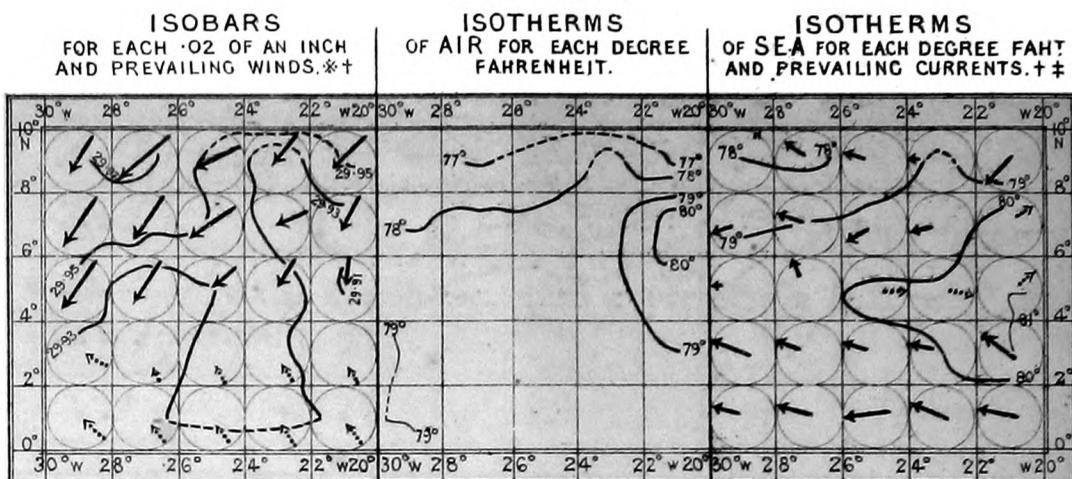
\* Each arrow flies with the most frequent wind of its square. The length shows its mean force and is proportional to the rate per hour at which the wind would drive Beaufort's ship; nine miles an hour (force 5 Beaufort's scale) extending across the circle.

† Northernly winds and Westerly currents have continuous whilst Southerly winds and Easterly currents have dotted arrows.

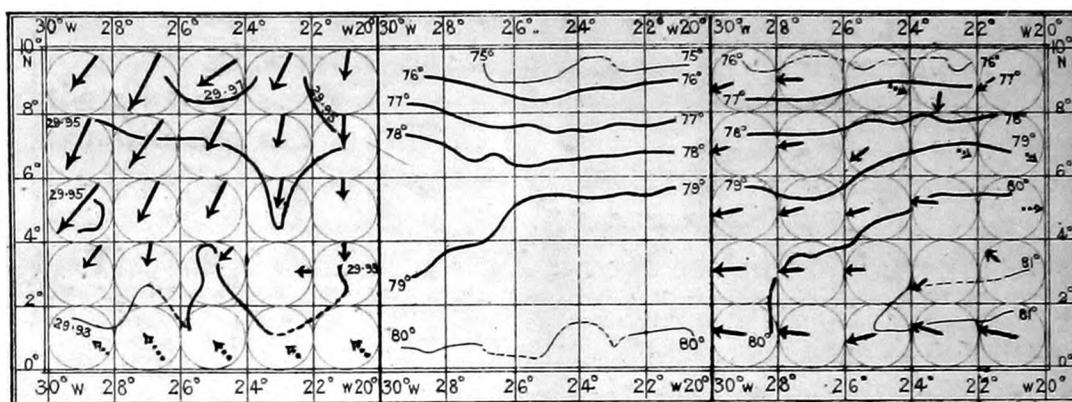
‡ The length of the current arrows is proportional to the rate in 24 hours; 50 miles extending across the circle.



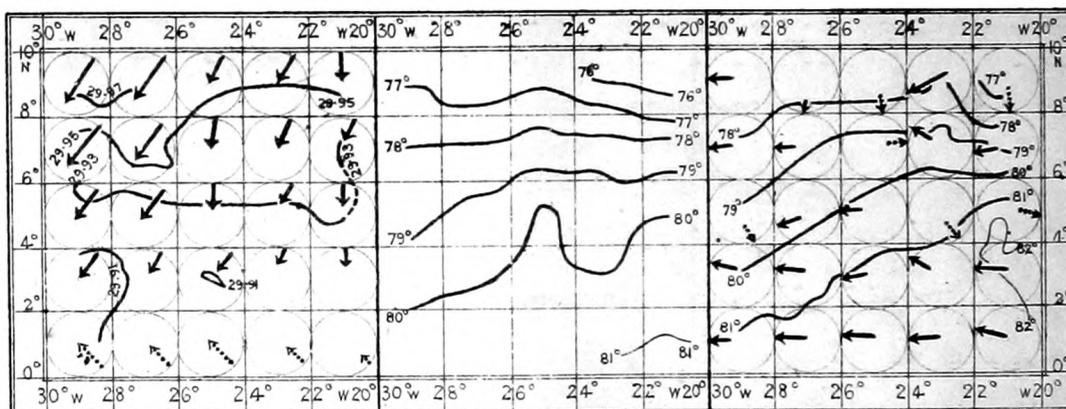
## JANUARY.



## FEBRUARY.



## MARCH.



Note. When the isobars or isotherms are deduced from the data of 1° squares they are represented by a faint continuous line. Broken lines merely connect the different parts of an isobar or isotherm when the data do not authorize its being drawn.

\* Each arrow flies with the most frequent wind of its square. The length shows its mean force and is proportional to the rate per hour at which the wind would drive Beaufort's ship; nine miles an hour (force 5 Beaufort's scale) extending across the circle.

† Northwesterly winds and Westerly currents have continuous, whilst Southerly winds and Easterly currents have dotted arrows.

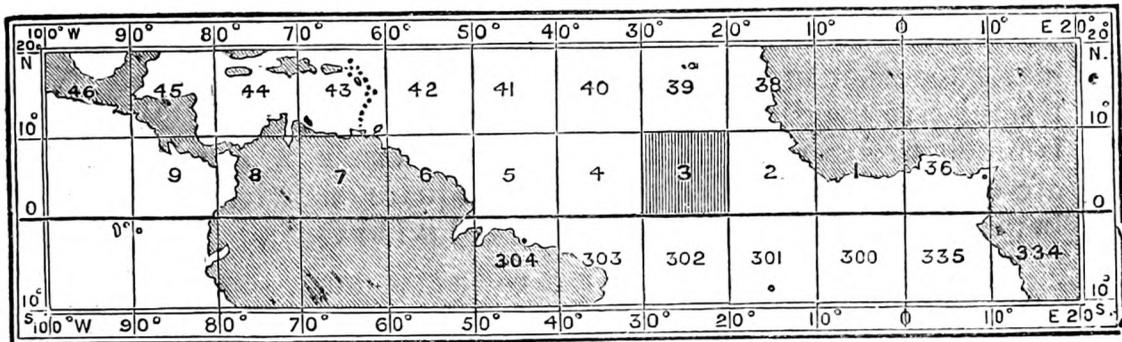
‡ The length of the current arrows is proportional to the rate in 24 hours; 50 miles extending across the circle.

PART II.

A SUMMARY of the RESULTS obtained from the DISCUSSION of the INFORMATION for SQUARE 3, being the Region of the Doldrums in the Atlantic. By Capt. H. Toynebee, Marine Superintendent.

The discussion of the meteorological observations taken in Square III. in the Atlantic having been completed for each degree square, and for each month, it may be of interest to mention briefly the general character of the results which have been obtained.

The district is shown in the subjoined chart, which has already appeared at p. 9. As to its general importance it may perhaps



be allowable to quote the words of the last letter received by Capt. Toynebee from the late Commodore Maury.

“ Being such a highway, in which observations are so frequent, and being in a meteorological position of such importance as it is, viz., at the meeting of the trade winds in the doldrums, and in the wedge of the westerly monsoon that feeds the springs of the Niger; all these circumstances conspire to make it an inviting field of research. Wisdom has been displayed in the selection of this square for minute investigation.”

The Committee reproduce here, Plates I. to IV., the small monthly diagrams which will appear at the foot of the monthly charts, for 2° squares, which are in process of preparation.

The following is the explanation of the three diagrams for each month.

1st. *Isobars*, or lines of equal barometric pressure for every two hundredths of an inch, on which are drawn arrows flying with the prevailing or most frequent wind for the month in each 2° square. Northerly winds and Westerly currents are shown by *plain* arrows, Southerly winds and Easterly currents by *dotted* arrows. The length of an arrow is in proportion to the force of the wind; if it amounts to 5 or more of Beaufort's scale, or 9 miles an hour of his ship, it extends across the circle.

2nd. *Air-isotherms*, or lines of equal air temperature for each degree Fahr.

3rd. *Sea-isotherms*, or lines of equal sea-surface temperature for each degree Fahr., on which are drawn arrows flying with the prevailing current for the month in each  $2^\circ$  square. The length of an arrow is in proportion to its rate in 24 hours, 50 miles or more extending quite across the circle.

The reader must remember that winds are named after the direction *from* which they come, whilst currents are named after the direction *towards* which they go; for instance an arrow pointing to the North-westward represents a S.E. wind, but a N.W. current.

#### JANUARY.

*Isobars and Wind Arrows* (Plate I.).—The lowest pressure (29·91) is on the eastern side of the square, and it increases to 29·97 in the north-western corner; the isobars are also much closer together in the north-western corner than elsewhere. Now the relative length of the wind arrows shows that the N.E. wind is much stronger in this north-western corner, where the isobars are closest, than in the rest of the square, showing the relation between the difference of pressure and wind force.

The dotted Southerly wind arrows are much shorter than the plain Northerly, indicating how much stronger the N.E. Trade is in these parts in January, than the S.E. This is a month in which the N.E. Trade is pressing its way to the southward. By referring to the diagram for December, the eye can make a very fair estimate of the monthly change.

First, we find that the isobar of 29·97, which only just showed itself in December, has now pressed well into the square, in fact isobars ·97, ·95, and ·93 have each come about  $2^\circ$  to the southward.

Then again, the N.E. Trade which only reached  $6^\circ$  N. in December, is now down to  $4^\circ$  N., and it has decidedly increased in force; between  $6^\circ$  and  $7^\circ$  N. we find that it has increased 0·7 of Beaufort's scale, or about  $1\frac{1}{2}$  miles an hour of his ship.

The S.E. Trade still prevails from the Equator to  $4^\circ$  N., but it has decreased very much in force over the whole zone, the decrease amounting to  $1\frac{1}{2}$  miles an hour in the speed of Beaufort's ship. This seems to show how in January the rarefaction of the air during the summer months of the southern hemisphere has rendered the pressure to the south of the Equator, close to our square, nearly the same as in the doldrum, so that the greatest rush of air into the low pressure of the doldrum is from the northward, where the cold air lies low and heavy. We also find that in January there is a great increase in the percentage of upper cloud moving from the south-westward, whilst there is a decrease in that of upper clouds from any northerly direction.

*Isotherms of Air and Sea.*—The isotherms of air for January show that the hottest air is in nearly the same position as the lowest pressure and hottest sea; since December the coldest air and sea have made their appearance in the north-eastern corner of the square where the hottest formerly existed; this sudden change seems to be due to the southerly progress of the N.E. Trade carrying with it the Southerly and South-westerly current along the coast of Africa.

A paper “On the Currents and Surface Temperatures of the North Atlantic Ocean” (Official No. 12), published by the Meteorological Office, shows that in December the sea-isotherm of  $80^{\circ}$  is in and to the northward of the north-eastern corner of Square 3, whilst in January that of  $70^{\circ}$  nearly touches the same part of the square. These facts support the wonderful changes which we find since December.

Here attention may be called to the great similarity in the trend of the isotherms of air and sea, the sea being nearly  $1^{\circ}$  warmer than the air. This difference is very much the same throughout the year.

*Current Arrows.*—The plain current arrows show a prevailing and moderately strong Westerly or rather W.N.W. current from  $0^{\circ}$  to  $4^{\circ}$  N.; whilst there is a Westerly and sometimes South-Westerly current from  $6^{\circ}$  to  $10^{\circ}$  N.; between these, in the neighbourhood of the hottest water, we find the dotted arrows showing an Easterly current. Now the prevailing wind arrows show us that the Easterly current is in the doldrums between the two Trades, where there is little or no wind, but no doubt a heaping up of the water caused by the meeting of the northerly and southerly winds, hence it is reasonable to suppose that when the wind which drove the water has stopped, it will return to the eastward as a back drift; it may well be the warmest water, for it has been the longest in the tropics. So here we find the lowest pressure, lightest wind, warmest air and water, and an Easterly current in nearly the same part of the square.

On comparing the sea isotherms of January with those of December, we find that the temperature of the sea has increased in the southern part of the square, whilst we have before remarked that it has greatly decreased in the northern. We cannot be surprised at this increase, for the water forming the Westerly drift of the S.E. Trade is brought up from a part of the sea which has been exposed to the southern summer's sun, whilst that brought down by the N.E. Trade has been exposed to the northern winter. Now that the coldest water is in the northern part of the square, we find the largest amount of dew there also; in December it was over the cold water to the southward. Another interesting fact is that with this increase of dew comes a large amount of red dust from Africa; in the north-eastern corner of the square there is 48 per cent. of mist or haze, whilst in the south-

western there is only 5 per cent. In the north-eastern corner we have such remarks as :

“ Air very close and suffocating. Very damp. Sun not seen below  $8^{\circ}$ , on account of the thick haze. All the sails and ropes red.”

#### *Remarks.*

*Winds.*—All steady winds, of a force of 7 or upwards, were from the North-eastward, also 64 per cent. of the squalls. The steady strong winds were all on the western side of the square. Between  $3^{\circ}$  and  $5^{\circ}$  N. there are terrific squalls from the North-eastward.

*Currents.*—An outward bounder, near St. Paul's Rocks, had a strong Westerly current of 2 miles an hour, still she got quickly to the southward, and only tacked to the eastward for 4 hours.

*Clouds.*—At the southern limit of the N.E. Trade, upper clouds were seen to move from the South-eastward, whilst further north they came from the South-westward, as if they were affected by the motion of the earth.

*Weather.*—Lightning was most frequently seen on some northerly bearing, from  $0^{\circ}$  to  $4^{\circ}$  N., and on some southerly bearing from  $4^{\circ}$  to  $10^{\circ}$  N., indicating that its origin was where the two Trades met.

Heavy chain-lightning and “corposants” were seen between  $5^{\circ}$  and  $6^{\circ}$  N. There was an awful thunderstorm, with “corposants,” at the mast-heads and yard-arms, between  $9^{\circ}$  and  $10^{\circ}$  N., during which time the wind was Southerly, though well in the region of the N.E. Trades.

*Natural History.*—Very few land birds or insects were seen: they were chiefly in the doldrums, between  $3^{\circ}$  and  $7^{\circ}$  N.

Sperm whales were seen between  $4^{\circ}$  and  $5^{\circ}$  N., and again between  $8^{\circ}$  and  $9^{\circ}$  N., both times going to the north-westward.

*Falling Stars.*—Falling stars were most abundant, in 1860, between the 1st and 5th instant.

*Temperature of Rain.*—The mean of ten observations showed the rain to be  $2^{\circ}$  colder than the air.

*Various.*—A very severe shock of an earthquake was felt at 1 p.m., the 25th, 1859, within 10 miles of St. Paul's Rocks.

Red dust was seen on the sails and ropes, chiefly between  $7^{\circ}$  and  $10^{\circ}$  N., where more than 40 per cent. of the weather observations recorded haze.

*Best Route across the Equator.*—A careful study of the data in SQUARE 3, and of that in the squares to the northward and south-westward of it, leads to the supposition that it would be well, for both outward and homeward bounders, to keep in its western half whilst passing through SQUARE 3.

## FEBRUARY.

*Isobars and Wind Arrows.*—In February, we find the lowest isobar (29·93) ranging across the square in about  $2^{\circ}$  N., whilst that of 29·95 is in about  $7^{\circ}$  N., and 29·97 in  $9^{\circ}$  N. All have advanced to the southward since January, and the pressure of 29·98 frequently shows itself in the northern part of the square.

The isobars are still closest in the north-western corner of the square, where the prevailing north-easterly wind is strongest. The N.E. Trade is not only stronger but more easterly on the western than on the eastern side of the square. From  $2^{\circ}$  to  $10^{\circ}$  N., between  $20^{\circ}$  and  $22^{\circ}$  W., the prevailing wind is nearly due north, whilst between  $28^{\circ}$  and  $30^{\circ}$  W. it is about N.E. by N.

The N.E. Trade has gained  $2^{\circ}$  to the southward since January, and now extends to  $2^{\circ}$  N.

The S.E. Trade has retreated  $2^{\circ}$  to the southward before the N.E., and decreased in force since January. It is strongest on the western side of the square.

*Isotherms of Air and Sea.*—The similar trend in the isotherms of both air and sea seems worthy of notice, as, also, the fact that the sea remains about  $1^{\circ}$  warmer than the air.

The air isotherm of  $75^{\circ}$  (being the coldest air in SQUARE 3, due to the N.E. Trade), shows in the northern part of the square this month.

The temperature of both air and sea has decreased in the northern and increased in the southern half of the square. Between  $9^{\circ}$  and  $10^{\circ}$  N., the air has decreased  $1^{\circ}\cdot8$ , the sea  $1^{\circ}\cdot5$ , whilst, between  $0^{\circ}$  and  $2^{\circ}$  N., the air has increased  $1^{\circ}\cdot5$  and the sea  $1^{\circ}\cdot1$ . There has been no change in the mean temperature of the air between  $5^{\circ}$  and  $6^{\circ}$  N., and none in that of the sea between  $4^{\circ}$  and  $5^{\circ}$  N. In spite of these great internal changes, the *mean* temperature of the whole square has not changed since January, but the difference in the position and trend of the various isotherms for the two months, shows the importance of this minute work.

*Current Arrows.*—Westerly currents prevail in the square, the strongest being between the Equator and  $2^{\circ}$  N., where the S.E. Trade prevails.

Easterly currents still show, on the eastern side of the square, between  $4^{\circ}$  and  $8^{\circ}$  N., they are where the prevailing wind is Northerly. Between  $4^{\circ}$  and  $5^{\circ}$  N., South-easterly currents prevail over all others.

*Remarks.*

*Wind.*—The remarks on wind show that there were some smart squalls in February, and that the wind is more unsettled on the eastern than on the western side of the square.

*Currents.*—There is only one mention of current rips between the Equator and  $2^{\circ}$  N., whilst they abound in other parts of the square.

*Clouds.*—The remarks on clouds are similar to those for January.

*Weather.*—The remarks on the direction in which lightning is seen show that its source is where the two Trades meet. Between  $8^{\circ}$  and  $10^{\circ}$  N. no lightning was seen.

*Natural History.*—No mention is made of any land birds or insects having been seen in February, as though the doldrums were too far S. for them. It will, also, be noticed that the prevailing wind on the eastern side of the square is northerly, instead of being north-easterly, or more from the land, as in the previous three months.

Stormy petrels seem to have been most abundant between the two Trades.

*Various.*—The only mention of red dust was between  $7^{\circ}$  and  $8^{\circ}$  N., on the eastern side of the square.

*Best Route across the Equator.*—In square 39, in February, the winds to the westward of the Cape Verd Islands are decidedly stronger than those to the eastward, by about a mile an hour of Beaufort's ship; and as the diagram shows them to be much stronger on the western than on the eastern side of SQUARE 3, there can be little doubt that both outward and homeward bounders should keep well to the westward, especially when we find that the homeward bounder would meet with a large percentage of north-westerly winds (the most trying of winds) on the eastern side of the square, whilst they do not exist on the western side. The winds near Cape St. Roque are favourable for getting to the southward in February.

### MARCH.

*Isobars and Wind Arrows.*—In March we find the lowest pressure ( $29 \cdot 91$ ) in the south-western corner of the square. The lowest monthly mean pressure for the whole square ( $29 \cdot 931$ ) exists in March. The isobars of  $29 \cdot 93$  and  $29 \cdot 95$  have shifted to the northward since February, and that of  $29 \cdot 97$  still exists in the north-western corner of the square. There has been a general decrease of pressure in the square, owing no doubt to the northern advance of the sun; the greatest decrease ( $\cdot 019$ ) was between  $2^{\circ}$  and  $4^{\circ}$  N.; between  $9^{\circ}$  and  $10^{\circ}$  N. it had increased.

The isobars are still closest in the north-western corner of the square, where the relative length of the wind arrows shows that the strongest wind prevails; the wind arrows also show that the N.E. Trade is still much more easterly in the western than in the

eastern half of the square. North-westerly winds are common on the eastern side of the square.

The N.E. Trade is more decided between  $2^{\circ}$  and  $4^{\circ}$  N. than in February: it has, however, slightly decreased in force generally. In February the northern part of the square was cooling whilst the southern was growing warm; now the whole is getting warmer, which may account for the decrease in force of the North-easterly wind.

The S.E. Trade still prevails from the Equator to  $2^{\circ}$  N., and is very little changed in force since February; it is strongest on the western side of the square.

*Isotherms of Air and Sea.*—The similarity in the trend of air and sea isotherms still holds, as also the fact that the sea remains about  $1^{\circ}$  warmer than the air.

The mean temperature of both air and sea in the whole square has increased about  $0^{\circ}\cdot6$  since February, most in the south-eastern part of the square: the greatest increase is between  $3^{\circ}$  and  $4^{\circ}$  N., where it averages  $1^{\circ}\cdot2$  in the air and  $1^{\circ}$  in the water. It seems worthy of notice that the greatest decrease of pressure has taken place where there was the greatest increase of temperature in air and sea.

*Current Arrows.*—The plain arrows show that Westerly currents prevail generally, and are strongest in the southern part of the square.

The dotted arrows show that South-easterly currents prevail in the north-eastern part of the square, where the wind is chiefly from the Northward, and not unfrequently from the North-westward. There is a large amount of Southerly current between  $7^{\circ}$  and  $10^{\circ}$  N.

#### *Remarks.*

*Wind.*—The remarks on wind show that the N.E. Trade acquired great force at times.

*Clouds and Weather.*—Those on clouds and weather lead to very similar conclusions to those derived from January.

*Natural History.*—A very large number of stormy petrels (nearly a hundred at once) were seen in the doldrums between  $1^{\circ}$  and  $2^{\circ}$  N. and  $21^{\circ}$  and  $22^{\circ}$  W.

*General.*—Red dust is met with to the northward of  $6^{\circ}$  N. No land-birds or insects were seen, which may be well accounted for by the winds being so northerly on the eastern side of the square.

*Best Route across the Equator.*—In square 39, lying to the North of SQUARE 3, we find the strongest winds to the westward of the Cape Verd Islands in March, and they are decidedly

stronger on the western side of SQUARE 3. The winds near Cape St. Roque in March are favourable for getting to the southward, so that an *outward-bounder* should keep well to the westward, and might safely cross the line in  $27^{\circ}$  W. A *homeward-bounder* should certainly keep to the westward.

#### APRIL.

*Isobars and Wind Arrows.*—In April, pressure has generally increased about 0.01 in., and the isobars run more north-easterly and south-westerly in their direction.

The greatest increase of pressure has been between  $2^{\circ}$  and  $4^{\circ}$  N. where the lowest pressure existed in March. This shows how gradually nature provides for the northern advance of the doldrum and its following S.E. Trade, for in May we shall find that South-easterly winds prevail between  $2^{\circ}$  and  $4^{\circ}$  N. which could not be the case if there were not a higher barometer there than in the zone to the northward.

Both pressure and temperature have increased this month, which is rare; perhaps it is a kind of heaping up of the air before the increased activity of the S.E. Trade sets in, causing freer egress to the upper current. Perhaps the great amount of Easterly wind experienced in higher northern latitudes at this season may be related to this heaping up of air in the doldrums; for before Easterly winds can blow in our islands, the barometer must be higher to the northward than to the southward of them, and any check to the upper current which supplies air to the area of high pressure in about  $35^{\circ}$  N. would tend to produce such a state of things.

The plain wind arrows show that the strongest North-easterly wind is still in the north-western corner of the square; that the N.E. Trade has increased in force between  $2^{\circ}$  and  $4^{\circ}$  N., especially on the western side of the square; also that between  $20^{\circ}$  and  $24^{\circ}$  W. the prevailing wind is still very northerly.

The dotted wind arrows show that the S.E. Trade prevails up to  $2^{\circ}$  N., and that it is weaker and more easterly than the N.E.

*Isotherms of Air and Sea.*—The isotherms of air and sea are remarkably similar in their shape and position. The air still remains one degree colder than the sea. From the Equator to  $2^{\circ}$  N. there has been a slight decrease in the temperature of the air, whilst that of the sea has increased. The sun having been a month in the northern hemisphere, we may expect the air of the S.E. Trade to be cooler, as it would feel the change sooner than the water. The temperature of both air and sea is remarkably uniform from  $0^{\circ}$  to  $5^{\circ}$  N., but there is a gradual decrease of about  $1^{\circ}$  Fahr. to each degree of latitude between this and  $10^{\circ}$  N.

The hottest air ( $81^{\circ}4$ ) and sea ( $82^{\circ}6$ ) experienced in the

southern part of the square during the year, appear in its south-eastern corner in April.

*Current Arrows.*—The plain current arrows show that Westerly currents are the most prevalent throughout the square, whilst their relative lengths indicate that they are strongest in the southern part.

The dotted current arrows show a back-drift to the Eastward, near the spot where the hottest air and water are met with. By referring to the wind chart for April we find a large per-centage of light North-westerly winds and calms where this easterly current prevails.

#### *Remarks.*

*Wind.*—Very heavy squalls were frequently experienced, especially between  $2^{\circ}$  and  $3^{\circ}$  N., where some ships lost masts and sails.

*Currents.*—Current rips are very abundant throughout the square. It will be noticed that the prevailing wind blew very much across the prevailing current, especially in the northern part of the square.

*Clouds.*—The upper clouds are frequently from S.E. when the wind was N.E., as remarked in January.

*Weather.*—The largest per-centage of lightning prevails between  $3^{\circ}$  and  $4^{\circ}$  N. The largest per-centage of mist is between  $6^{\circ}$  and  $7^{\circ}$  N. It has decreased in amount since March.

*Natural History.*—Two swallows were seen in the doldrums between  $3^{\circ}$  and  $4^{\circ}$  N. A moth between  $4^{\circ}$  and  $5^{\circ}$  N.

A hawk devouring a stormy petrel as it flew, between  $5^{\circ}$  and  $6^{\circ}$  N.

A butterfly between  $6^{\circ}$  and  $7^{\circ}$  N.

*Various.*—Red dust was twice seen on the sails and rigging of ships between  $7^{\circ}$  and  $8^{\circ}$  N.

*Best Route.*—In April we find that the strongest winds are to the westward of the Cape Verd Islands, especially in the southern part of square  $39^{\circ}$ . The prevailing wind arrows show that the western side of SQUARE 3 has much the strongest winds. Then again we find that April is a good month for getting to the southward near Cape St. Roque, for although the winds are lighter than in other months, still they are very Easterly in direction, so that a ship may safely cross the Equator to the westward of  $25^{\circ}$  W.

#### MAY.

*Isobars and Wind Arrows.*—Pressure has generally increased about  $\cdot 02$  since April. The isobars still have a North-easterly and South-westerly trend.

The greatest increase of pressure has taken place in the northern and southern parts of the square, though it has been very equally distributed.

The plain wind arrows show that the N.E. Trade has retreated  $2^{\circ}$  to the northward since April, and grown weaker in force, also that it is still much more easterly, and stronger, on the western than on the eastern side of the square.

The dotted wind-arrows show that the S.E. Trade has advanced  $2^{\circ}$  further N. since April, and increased in force.

*Isotherms of Sea and Air.*—The isotherms of sea and air are still very similar in their position, and the sea is about  $1^{\circ}$  warmer than the air. With both there has been a decrease of temperature since April in the south-eastern corner of the square, which is no doubt a result of the increased force of the S.E. Trade. In the  $1^{\circ}$  sub-square, which is in the south-eastern corner of the square, the decrease of temperature is more than  $2^{\circ}$  since April. The temperature of both air and sea has increased in the northern, and decreased in the southern part of the square, so that the mean for the whole square is the same as that for April. The air is a little in advance of the sea in its changes, as would be expected, making it as warm as the sea in the N.

*Current Arrows.*—The plain current arrows show that Westerly currents prevail, that they are stronger and more North-westerly in the southern than in the northern part of the square, where they are chiefly slightly S. of W.

The dotted current arrows show how the Easterly current has gained ground with the decline in the force of the N.E. Trade, also that it is still most common on the eastern side of the square where the winds are very light.

The distribution of wind and current in the square is very similar to that for January, only now the S.E. Trade is advancing, whilst the N.E. is receding. It will be noticed that there is also a slight resemblance in the trend of their isobars and isotherms.

#### *Remarks.*

*Wind.*—The remarks on wind show that squalls were more abundant in May than in April. Very heavy squalls were most abundant between  $5^{\circ}$  and  $6^{\circ}$  N., where two whirlwinds were experienced.

*Clouds.*—The amount of cloud generally, as well as of rain, has increased considerably since April, probably caused by the in-rush of cold air from the southward.

*Natural History.*—A dragon-fly was seen between  $4^{\circ}$  and  $5^{\circ}$  N. Several land birds between  $6^{\circ}$  and  $7^{\circ}$  N. A hawk between  $7^{\circ}$  and  $8^{\circ}$  N., and a snipe between  $9^{\circ}$  and  $10^{\circ}$  N.

*Variou.*—No red dust was reported in May.

*Best route across the Equator.*—In Square 39 the *outward bounders* will find a stronger and more steady N.E. Trade on the western side of the Cape Verd Islands. To the eastward of those islands there is a large percentage of N.W. winds, which are lighter than the N.E.

In SQUARE 3 the best wind seems to be in about  $26^{\circ}$  W., but perhaps it would be well to strike the parallel of  $4^{\circ}$  N. in about  $24^{\circ}$  W., as there is a S.E. Trade and Westerly current to the southward of this latitude, and the winds near Cape St. Roque are more Southerly than in the previous months.

The *homeward bounder* would certainly do well to pass the parallel of  $4^{\circ}$  N. in about  $26^{\circ}$  W., seeing that he will thus escape the large amounts of light North-westerly and Northerly winds which prevail in the north-eastern part of the square.

### JUNE.

*Isobars and Wind Arrows.*—Pressure has increased at a mean amount of  $\cdot 034$  in. over the whole square since May; this is the greatest increase during any month in the year. When we come to analyze this increase, we find that it amounts to  $\cdot 06$  between  $0^{\circ}$  and  $2^{\circ}$  N., whilst it is only  $\cdot 01$  between  $9^{\circ}$  and  $10^{\circ}$  N.; now between  $0^{\circ}$  and  $2^{\circ}$  N. temperature has decreased nearly  $2^{\circ}$ , whilst between  $9^{\circ}$  and  $10^{\circ}$  N. it has increased to the same amount.

The isobars are irregular, and for the first time the highest pressure shows in the southern part of the square, and it continues there till November.

The plain wind arrows show that the N.E. Trade has retreated  $2^{\circ}$  on the western and  $4^{\circ}$  on the eastern side of the square since May, also that it has grown weaker in force.

The dotted wind arrows show how much the S.E. Trade has gained both in amount and force, backed up, as we find it is, by an in-rush of high pressure from the southward.

*Isotherms of Sea and Air.*—The isotherms of sea and air show that there has been an increase of temperature in the N. and decrease in the S. since May, so that now for the first time, since November, both are colder in the S. than the N. The hottest air and water are now on the western side of the square in the neighbourhood of the lowest pressure.

*Current Arrows.*—The plain current arrows show that the Westerly current between  $0^{\circ}$  and  $4^{\circ}$  N., which is due to the S.E. Trade, has become more decided and stronger, but is still running a little to the northward of W., whilst that due to the N.E. Trade only holds in a few  $2^{\circ}$  squares in the north-western corner of the square where the N.E. Trade still prevails, it still runs a little to the southward of W. Between them comes the Easterly (dotted arrow) current, which inclines to the north-eastward into that corner of the square which has little or no wind, indicating how thoroughly it is a back-drift of water which has been heaped up by the Trades. It seems worthy of notice that the sea temperature in the north-eastern corner of the Square has increased  $3^{\circ}$  since May, which is no doubt caused by the appearance of the warm Easterly current where there had been a South-westerly one.

The Admiralty Current Chart of the Atlantic Ocean says that in the summer and autumn months this Easterly current extends as far as  $53^{\circ}$  W., and runs at a rate of 60 miles in 24

hours between  $53^{\circ}$  and  $40^{\circ}$  W., getting weaker as it comes to the eastward.

### *Remarks.*

*Wind.*—Between  $1^{\circ}$  and  $2^{\circ}$  N. and  $20^{\circ}$  to  $21^{\circ}$  W., there were three or four heavy squalls from N.N.E., though the chart shows no surface wind from that direction; this looks like a downward rush from the upper current which abounds from N.E. at this season.\*

There was a most terrific squall, with thunder, lightning, and rain, between  $5^{\circ}$  and  $6^{\circ}$  N., and  $21^{\circ}$  and  $22^{\circ}$  W. Between  $8^{\circ}$  and  $9^{\circ}$  N. and  $23^{\circ}$  to  $24^{\circ}$  W., a ship lost her top-gallant masts in a heavy squall.

*Clouds.*—"Cir. from N.E., wind S.E." is now a very common entry; whereas during the northern winter "Cir. from S.E., wind N.E." was a frequent remark.

*Currents.*—The remarks on currents show that much Easterly current was experienced between  $4^{\circ}$  and  $7^{\circ}$  N. Also that the Westerly current is frequently very strong near the Equator; from  $0^{\circ}$  to  $3^{\circ}$  N. it averages nearly 30' in the 24 hours.

*Natural History.*—A ringdove was seen between  $4^{\circ}$  and  $5^{\circ}$  N. Dragon-flies, butterflies, and a cloud of insects called "Mosquito hawks," between  $6^{\circ}$  and  $7^{\circ}$  N., and a swallow between  $7^{\circ}$  and  $8^{\circ}$  N. Locusts and butterflies between  $9^{\circ}$  and  $10^{\circ}$  N.

These seems to have been brought off the land by the tornadoes which blow from the eastward during the commencement of the rains.

*Best route across the Equator.*—In square 39, the strongest winds are still in the western half of the square, especially to the southward of  $16^{\circ}$  N.; on the eastern side of the square there is much light North-westerly wind between  $16^{\circ}$  and  $18^{\circ}$  N.

Considering the strong Westerly current near the Equator, and that Southerly winds extend so very far north, we are not inclined to recommend a westerly crossing to outward bounders in June, especially when we consider that the wind is frequently very far south near the American land in this month. Outward bounders should stand boldly to the eastward with the Southerly wind and Easterly current, crossing the Equator well to the eastward. Homeward bounders would probably do best by crossing the parallel of  $6^{\circ}$  N. in about  $26^{\circ}$  W.

### JULY.

*Isobars and Wind Arrows.*—The isobars show a decided increase of pressure since June, and the barometer is at its highest point for the year. The mean for the square is 30.023. The highest, 30.069, is in its south-eastern corner, whilst the lowest, 29.982, is in the north-western corner.

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\* These squalls were experienced by the same ship on the same day (June 9th).

The increase of pressure is irregularly distributed, for whilst it averages more than  $\cdot 04$  in the southern half of the square, it does not average  $\cdot 01$  between  $7^\circ$  and  $10^\circ$  N. Where the pressure has increased so rapidly, the temperature of sea and air has decreased nearly  $2^\circ$  Fahr.

Plain wind arrows have disappeared from the square, and Southerly winds prevail, though it will be noticed that they are very weak in the north-western corner of the square where the N.E. wind was prevailing in June, and where it always blew with so much more force than in other parts of the square.

*Isotherms of Sea and Air.*—The isotherms of sea and air have taken a very decided shape. They advance at the rate of about  $1^\circ$  Fahr. for each degree of latitude into the south-eastern corner of the square, until they come to  $4^\circ$  N., where they suddenly stop, and those for  $79^\circ$  of air, and  $80^\circ$  of sea, range round an area on the western side of the square.

*Current Arrows.*—The plain current arrows show that there is a very strong Westerly current from  $0^\circ$  to  $4^\circ$  N.: between  $1^\circ$  and  $2^\circ$  N., 63 per cent. of all currents are North-westerly, at an average speed of 40' in the 24 hours!

To the northward of  $4^\circ$  N. the dotted current arrows show that there is a prevailing Easterly current, and we have already remarked that in latitude  $4^\circ$  N., which is along the line of contact between Easterly and Westerly currents, the change of temperature in air and sea ceases.

To the northward of  $4^\circ$  N., where the prevailing current changes from W. to E., the prevailing South easterly wind becomes more Southerly, and to the northward of  $6^\circ$  it is S.

#### *Remarks.*

*Wind.*—The southerly wind frequently blows with a force of 7 in various parts of the square.

Between  $7^\circ$  and  $8^\circ$  N. there was a very heavy squall from N.N.E. force 9.

Between  $8^\circ$  and  $10^\circ$  N. there are three entries of wind S.W., 8; also hard puffs from S.W., with constant heavy rain.

Between  $8^\circ$  and  $10^\circ$  N., the southern limit of the N.E. Trades was met with five times, all in the early part of the month, and nearly all on the western side of the square.

*Weather.*—Mist is now most common over the cold water in the southern part of the square.

*Clouds.*—Upper clouds are still frequently from N.E. whilst the wind is S.E.; there are also some cases even in the southern part of the square when the upper clouds were from the South-westward, while the wind was South-easterly.

*Currents.*—Between  $4^\circ$  and  $5^\circ$  N. are the following remarks:—“Sea very rough and turbulent.” “Sea breaking like boiling water.” “Ship on the edge of two currents, one going E. the other N.W.”

*Natural History.*—The only allusion to land birds or insects was between  $5^{\circ}$  and  $6^{\circ}$  N. "Land birds, like hawks, flying to the north-eastward." As land birds are generally most ready to settle on ships, it is probable that these were sea birds; if so, there were no others seen during July.

Sperm and other whales, grampuses, and black fish were seen. Between  $8^{\circ}$  and  $9^{\circ}$  N. we have "water covered with porpoises and bottlenoses, lying perfectly still." So perhaps they like the easterly current. Fish and sea birds were abundant. Stormy petrels were abundant to the southward, but not mentioned to the northward of  $6^{\circ}$  N.

*Best Route across the Equator.*—The western half of square 39 has the strongest winds, whilst they are strongest in the eastern half of SQUARE 3. Off Cape St. Roque there is a good deal of Southerly wind in July. Considering the large amount of South-easterly wind and very strong Westerly current to the southward of  $4^{\circ}$  N. in SQUARE 3, it seems right that outward bounders should be well to the eastward, say in  $20^{\circ}$  W., or probably several degrees further to the eastward, before going to the southward of  $6^{\circ}$  N. for in July ships bound to the southward should not cross the Equator to the westward of  $25^{\circ}$  W. on account of the Southerly winds near Cape St. Roque.

Good outward passages have been made in July, by passing to the eastward of the Cape Verd Islands.

Homeward bounders will do well to pass the parallel of  $10^{\circ}$  N. in  $25^{\circ}$  W.

## AUGUST.

*Isobars and Wind Arrows.*—The isobars show a decided decrease in pressure since July.

The decrease of pressure has been slightly more, whilst the decrease of temperature has been less, in the northern than in the southern half of the square.

All prevailing winds are still Southerly, and they have generally freshened since July, especially between  $4^{\circ}$  and  $8^{\circ}$  N.; from  $8^{\circ}$  to  $10^{\circ}$  N., the winds are more South-westerly than in July. The gradual curve in the direction of the prevailing wind as it passes from S. to N. is very marked.

*Isotherms of Air and Sea.*—The isotherms of air and sea are very similar to those of July, they have all advanced about a degree further to the northward, causing a slight fall in the mean temperature of the square; no doubt the result of the influx of cooler air and water from the southward, which has not yet been checked by the sun's southern progress.

The coldest air and sea ( $74^{\circ}\cdot 4$ ) experienced in the southern part of the square, shows in its south-eastern corner in August.

*Current Arrows.*—The currents of August are very similar to those of July; there is however a decided decrease in the force of the Westerly current near the Equator. We have the same sudden check in the change of temperature as in July, only it takes place

about  $1^{\circ}$  further N., and we find by consulting the charts of  $1^{\circ}$  sub-squares that the prevailing Westerly current does lie a little further N., in August than in July.

*Remarks.*

*Wind.*—Between  $5^{\circ}$  and  $6^{\circ}$  N., about 5 per cent. of the winds were force 7 from the Southward. Between  $6^{\circ}$  and  $10^{\circ}$  N., about 2 per cent. of the winds were force 7 from the South-westward. Between  $9^{\circ}$  and  $10^{\circ}$  N., three South-westerly winds had a force of 8 and one had force 9.

*Weather.*—There was very little thunder or lightning. Mist and dew were much more abundant over the cold water near the Equator than elsewhere.

*Clouds.*—Clouds were still frequent from the N.E. whilst the wind was S.E., though there is also great confusion in their motion at times.

*Currents.*—Ripplings are very general throughout the square.

*Natural History.*—No mention is made of seeing any land bird or insect in August. Whales were seen twice, one small one between the Equator and  $1^{\circ}$  N. was going to the south-westward. Between  $1^{\circ}$  and  $2^{\circ}$  N. there was a shoal of grampuses going to the southward, where also many black fish were once seen.

Between  $0^{\circ}$  and  $1^{\circ}$  N., four strange-looking fish were seen swimming about a ship for some time; they were reported as red, with their fins on their heads, and were about  $2\frac{1}{2}$  feet long and a foot broad.\*

*Various.*—There were 27 entries of falling stars, of these 7 were in 1857, and 6 in 1860.

*Best Route across the Equator.*—In square 39 the western half has the strongest North-easterly and South-easterly winds, whilst the eastern half has the strongest and most abundant North-westerly and South-westerly winds. SQUARE 3 has very little difference in direction and force of wind depending on longitude. Near Cape St. Roque the winds are still unfavourable for outward bounders.

It would seem well for the outward bounder to come to the southward on the western side of the Cape Verd Islands, and to stand boldly to the south-eastward with the South-westerly winds which will be first met with, bearing in mind that to the southward of  $5^{\circ}$  N. the wind will draw South-easterly, and the current strong to the Westward, so that it would be well to be to the eastward of  $20^{\circ}$  W. before crossing the parallel of  $5^{\circ}$  N. Homeward bounders would do well to go to the northward in about  $25^{\circ}$  W., or even further W., as the winds in the western half of square 39 are stronger and more Easterly than those in the eastern.

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\* This remark is from the log of the ship "Ingleborough" of Liverpool, Captain James Robert Rea, which was kept by the mate, W. H. Tiverton. Dated Friday, August 17th, 1855.

## SEPTEMBER.

*Isobars and Wind Arrows.*—The isobars show a decided decrease of nearly  $\cdot 02$  in. in the pressure since August. The decrease of pressure seems to be very evenly distributed throughout the square. It has been greatest between  $3^{\circ}$  and  $5^{\circ}$  N.

There is only one plain Northerly wind arrow, which is in the N.W. corner of the square, and it will be seen that a plain current arrow shows in the same  $2^{\circ}$  square.

The dotted Southerly wind arrows are very similar in direction to those of August, changing gradually from S.E. in the southern to S.W. in the northern part of the square; but they have very decidedly lost in force to the northward of  $4^{\circ}$  N., especially on the western side of the square, where, it will be remembered, the N.E. Trade comes in with the greatest force.

*Isotherms of Air and Sea.*—The isotherms of air and sea show that the temperature has increased nearly a degree since August. It will be remembered that in August temperature had decreased, but now the southern progress of the sun has checked the influx of cold brought in by the Southerly winds, and the isotherms are, as it were, backing to the south-eastward, each one being about a degree further to the southward than it was in August.

*Current Arrows.*—The currents of September are very similar to those of August, the prevailing Westerly current near the Equator has again lost somewhat in force. The easterly current is not so Northerly as it was in August. The change in sea and air temperature again progresses from the S.E. to the N.W., stopping after passing into the Easterly current.

*Remarks.*

*Wind.*—Between the Equator and  $4^{\circ}$  N. there were several South-easterly winds, having a force of 7.

Between  $5^{\circ}$  and  $6^{\circ}$  N. there was the largest percentage of winds force 7, they were chiefly from the South-westward.

Between  $8^{\circ}$  and  $9^{\circ}$  N. there was a N.E. squall; force 6; and a heavy Easterly squall.

Between  $9^{\circ}$  and  $10^{\circ}$  N. South-westerly winds, force 7, were frequent, and sometimes with heavy gusts. There were also squalls from the same quarter, and a heavy Northerly squall.

Between  $8^{\circ}$  and  $9^{\circ}$  N. the N.E. Trades were twice experienced, about the 28th of the month.

*Weather.*—Coming from the southward, lightning was first seen between  $4^{\circ}$  and  $5^{\circ}$  N., where the Easterly and Westerly currents of water meet.

*Clouds.*—Upper clouds were most frequently seen coming from the North-Eastward.

*Natural History.*—Between  $4^{\circ}$  and  $5^{\circ}$  N. a bird was seen with a bill like a snipe and feathered like a plover.

Between  $7^{\circ}$  and  $8^{\circ}$  N. a martin, a swallow, and a hawk were seen.

Between  $9^{\circ}$  and  $10^{\circ}$  N. swallows and two other small land birds, butterflies and dragon flies, were seen.

Here we see that land birds and insects show themselves again in the northern part of the square, where the North-easterly wind shows itself towards the end of the month. They are probably brought off the land by the tornadoes.

No whales, grampuses, or black fish were seen; porpoises were frequent, between  $8^{\circ}$  and  $9^{\circ}$  N.

*Various.*—"4 A.M., between  $8^{\circ}$  and  $9^{\circ}$  N., passed through a strip of water, as white as snow, stretching E. and W. as far as could be seen, and about 20 yards broad; the rest of the sea very dark, and not at all luminous."

*Best Route across the Equator.*—In square 39 the strongest winds are on the western side of the square, so that it seems best for the *outward bounder* to come to the southward on the western side of the Cape Verds, and to stand boldly to the south-eastward when he gets the Southerly winds and Easterly current, tacking to the south-westward as the wind draws South-easterly, always remembering that there is a strong Westerly current to the southward of  $4^{\circ}$  N. The wind is still very Southerly near the land in the neighbourhood of Cape St. Roque, so that ships should not aim to cross the line far to the westward.

*Homeward bounders* would do well to go to the northward in about  $25^{\circ}$  W., or, at any rate, to be as far W. as  $25^{\circ}$  W. when in  $10^{\circ}$  N.

## OCTOBER.

*Isobars and Wind Arrows.*—The isobars of October show that there has been a general decrease of about  $\cdot 04$  in. in the pressure since September. This is the greatest decrease for any month in the year. On analyzing it, we find that it amounts to nearly  $\cdot 06$  between  $0^{\circ}$  and  $3^{\circ}$  N., whilst it is not quite  $\cdot 03$  between  $7^{\circ}$  and  $10^{\circ}$  N., indicating how the southern progress of the N.E. Trade has checked the decrease in the north.

The plain wind arrows show that the N.E. Trade appears in the northern part of the square, though it is very light and easterly.

The dotted wind arrows show that the Southerly wind has retreated  $2^{\circ}$  to the southward, and decreased in force.

*Isotherms of Air and Sea.*—The isotherms of air and sea show that both have increased in temperature, nearly  $1^{\circ}$  Fahr., since September. In both cases the increase has been greatest in the southern part of the square, where the air and water are coming in after having been under the influence of a vertical sun. The north-eastern corner of the square is an exception; it seems to be specially heated by the influx of Easterly wind from Africa.

*Current Arrows.*—The plain current arrows show that Westerly currents still prevail in the southern part of the square, and extend

a little further N. than they did in September, but their speed is not so great.

The dotted arrows indicate that Easterly currents still prevail in the northern part of the square, but their speed is not so great; hence we find that both winds and currents have become weaker since September.

#### *Remarks.*

*Wind.*—Between the Equator and 6° N. there were several entries of wind from S.E.; force 7.

Between 6° and 10° N. there were several severe squalls, but scarcely any steady winds of a force of 7. There were many severe North-easterly squalls, some extending as far S. as 4° N.

Between 1° and 2° N. there was a tremendous squall, lasting half an hour, with extremely heavy rain for 3 hours.

The N.E. Trade is remarked on as being once met with between 6° and 7° N.; five times between 8° and 9° N.; and three times between 9° and 10° N.

Between 9° and 10° N., on the 19th, 1864, a very heavy gale, force 10, was experienced. The Captain says, “I never felt such a determined force of wind, lasting so long, about this latitude. It blew hardest from S. and S.W., lasting 3½ hours.” This gale may have been related to a West India hurricane.

*Weather.*—Lightning was again first seen at the meeting of the two currents of water. From 3° to 8° N. it was most frequently seen to the northward, and from 8° to 10° N. to the southward.

*Clouds.*—Upper clouds were most frequently seen moving from the South-eastward, though there was still a large percentage from the North-eastward.

*Natural History.*—Swallows accompanied ships as far S. as between 3° and 4° N. They as well as other land birds and insects abounded between 6° and 10° N. The following entry gives an idea of their number:—“Between 9° and 10° N. an owl, say thirty martins, a few butterflies, and dragon flies about; wind E.N.E.”

In the N.E. corner of the square is the following entry:—“Strong smell of land,” although it is 250 miles off. In the same part, the temperature of the air has gone up 2°·7 since September, and it is remarkably dry, so that, at this great distance, we find several evidences of the tornadoes which blow from the land in this month.

Whales were seen between 2° and 3° N., and several between 6° and 8° N.; all the latter moving to the northward.

The sea abounded with jelly fish &c. from the Equator to 6° N. Stormy petrels were very abundant between 5° and 7° N.

*Various.*—Falling stars were noted 23 times. They were very abundant in 1859 and 1866.

An earthquake was experienced, near St. Paul's Rocks, at 11:30 p.m., 19th, 1859. It lasted about 3 seconds. The ship felt as if grating over rocks; the helmsman felt the wheel shake in

his hand. The captain was on deck at the time and can vouch for the truth of the statement. We have already remarked on one in the same place in January of the same year.

*Best Route across the Equator.*—Square 39 has decidedly stronger winds in the western than in the eastern half.

SQUARE 3 has lighter winds on the eastern than on the western side, and the currents are not so strong as in September.

Square 303 has a prevailing S.E. by E. wind, with sometimes a spurt of north-easterly wind near the land.

Hence it seems well for the outward bounder to pass to the westward of the Cape Verd Islands, and to stand boldly to the south-eastward, with the Southerly wind and Easterly current, until the wind will allow of a fair amount of southing on the port tack, when she may stand boldly to the south-westward, and, if necessary, cross the Equator as far west as  $28^{\circ}$  W.

Homeward bounders should go to the northward on the western side of the square.

#### NOVEMBER.

*Isobars and Wind Arrows.*—The isobars of November show that there has been an average decrease of about  $\cdot 02$  in. in the pressure since October, but we find that it is chiefly in the southern part of the square; for instance, between  $9^{\circ}$  and  $10^{\circ}$  N. it has not changed, whilst between  $0^{\circ}$  and  $1^{\circ}$  N. it has decreased nearly  $\cdot 04$ . Here, as in October, we have the effect of the N.E. Trade pressing to the southward in the northern part of the square. For the first time since May the highest pressure is in the northern part of the square. The isobars are also crowded in the north-western corner of the square.

The plain wind arrows show that the N.E. Trade has become more frequent in the northern part of the square, where it has also gained in strength. It is still very Easterly, which contrasts remarkably with its direction from February to May, when it is very Northerly, especially on the eastern side of the square.

The dotted wind arrows show that the S.E. Trade has retreated and lost in force, especially between  $3^{\circ}$  and  $5^{\circ}$  N., as shown by the chart of  $1^{\circ}$  sub-squares.

*Isotherms of Air and Sea.*—The isotherms of air and sea still run in similar directions, and the sea keeps nearly  $1^{\circ}$  warmer than the air. Both continue to show the highest temperature in the north-eastern corner of the square. This is a singular case of the wind blowing from greater heat towards greater cold; it is accompanied by a great difference between dry and damp bulbs, as also by the appearance of insects. The heat in the N.E. corner of SQUARE 3 is increased by the Easterly current still prevailing there. In December it is driven further south by the influx of a Westerly current.

*Current Arrows.*—The plain current arrows indicate that a Westerly current is again showing in the northern part of the

square, whilst it still prevails up to  $4^{\circ}$  N., though not quite so strong as in October.

The dotted current arrows show that Easterly currents still prevail from  $4^{\circ}$  to  $10^{\circ}$  N., but that they are not so strong as in October. It will be noticed that in the north-eastern part of the square the prevailing current is more to the southward of E. than it had been in previous months, as if it began to feel the influence of the freshening Northerly wind.

#### *Remarks.*

*Wind.*—Between the Equator and  $6^{\circ}$  N. there are still several entries of South-easterly wind having a force of 7: whilst from  $7^{\circ}$  to  $10^{\circ}$  N. those from N.E. are most frequent. Of the seventeen entries, five were South-easterly and twelve North-easterly. Between  $9^{\circ}$  and  $10^{\circ}$  N. very heavy squalls were experienced.

Between  $8^{\circ}$  and  $9^{\circ}$  N. we find “Wind variable, sometimes very hot, at others very cold.” This is interesting in connexion with the high temperature in the north-eastern corner of the square.

*Weather.*—Lightning has greatly increased since October; it is most frequently seen in the northern part of the square; from  $5^{\circ}$  to  $8^{\circ}$  N. it is chiefly seen on some northerly bearing, but from  $8^{\circ}$  to  $10^{\circ}$  N. on some southerly bearing. It was most abundant between  $6^{\circ}$  and  $8^{\circ}$  N., with stifling weather.

*Clouds.*—Upper clouds from the north-eastward have greatly decreased since October, whilst those from the south-westward have increased. Those from the south-eastward still greatly preponderate.

*Natural History.*—An owl, a teal, and some swallows were seen between  $3^{\circ}$  and  $4^{\circ}$  N.; between  $4^{\circ}$  and  $6^{\circ}$  N. there were several land birds. Some captains remark that they had followed their ships from the northward. Between  $6^{\circ}$  and  $8^{\circ}$  N. butterflies and a moth were seen, as well as land birds.

Whales, blackfish, and porpoises, as well as fish, birds, and medusæ, abounded between  $4^{\circ}$  and  $6^{\circ}$  N., which looks as if the verge of the two currents were favourable to animal life.

*Various.*—Falling stars.—There were thirty-six entries of falling stars, the most abundant seem to have been between the 9th and 10th, 1855, and after midnight of the 14th, 1869.

*Best Route across the Equator.*—Square 39 has decidedly stronger winds on its western than on its eastern side, especially between  $14^{\circ}$  and  $16^{\circ}$  N., for in the eastern half of that zone we find 17 per cent. of calms, against none in the western half.

SQUARE 3 has the lightest winds in its eastern half.

Square 303 has a good deal of North-easterly wind near the South American coast in November, so that it seems safe to stand boldly to the southward, after passing to the westward of the Cape Verds, and on getting the Southerly wind, to take the tack which gives the most southing; homeward bounders should be to the westward of  $25^{\circ}$  W. when passing  $10^{\circ}$  N.

## DECEMBER.

*Isobars and Wind Arrows.*—The isobars of December resemble those of November. There is scarcely any change in the mean pressure of the whole square since November, for there has been an increase in its northern and decrease in its southern half. The greatest increase is in the north-western corner of the square, and the greatest decrease in the south-eastern, so that now the highest pressure is very decidedly in the northern part of the square. The isobars are closest in the north-western corner of the square where the N.E. wind is strongest.

The plain wind arrows show that the N.E. Trade has worked its way down to  $6^{\circ}$  N., and increased in force, especially in the north-western corner of the square.

The dotted wind arrows show that the prevailing wind is nearly E. between  $4^{\circ}$  and  $6^{\circ}$  N., in which zone the two Trades seem to meet and combine to form a stronger wind than that which prevailed in November.

*Isotherms of Air and Sea.*—Here we find a lower temperature coming into the north-western part of the square where the N.E. Trade is so fresh; in the case of the air the lowest temperature of the square is there. The south-westerly trend of the isotherms in the northern part of the square, and the north-westerly trend of those in the southern, indicate that they are the result of the two Trades, whilst the hottest air and water now show on the eastern side, instead of in the north-eastern corner, of the square.

*Current Arrows.*—The plain current arrows indicate that where the N.E. Trade has increased, a Westerly current has set in, which inclines to the Southward.

The Equatorial Westerly current, which is a constant result of the S.E. Trade, has increased in force and inclines to the northward, especially on the western side of the square.

The dotted current arrows show that the Easterly current has decreased very much in amount since November, but that it still exists on the eastern side of the square where the sea is hottest; it inclines to the southward.

*Remarks.*

*Wind.*—We have twelve entries of steady winds amounting to force 7. Of these four were South-easterly, two Easterly, and six North-easterly.

Squalls were not so abundant in December as in November; they were most frequent from the South-eastward and Eastward.

*Weather.*—Lightning was most frequently seen to the northward, between  $1^{\circ}$  and  $6^{\circ}$  N., whilst from  $7^{\circ}$  to  $9^{\circ}$  N. it was much the most frequently seen to the southward.

*Clouds.*—There is a great increase in the percentage of upper clouds from the north-eastward, whilst that of others has decreased. This is not in accordance with the experience of November or January.

*Natural History.*—A small brown owl was caught between 3° and 4° N.

Four butterflies and a land bird were seen between 5° and 7° N.

Whales were seen between 3° and 4° N. Grampuses between 4° and 8° N.

Blackfish between 1° and 9° N. Porpoises between 4° and 8° N.

*Various.*—Falling stars were reported sixteen times. The most numerous were on the 2nd, 1839; the 12th, 1855, very abundant; the 11th and 12th, 1857.

Brown dust was seen on the sails between 1° and 9° N.

*Best Route across the Equator.*—In square 39 there are decidedly stronger winds on the western than on the eastern side of the square. There are 15 per cent. of calms between 14° and 16° N. on the eastern side, whilst, in the same zone, there are none on the western. On the western side there is a large percentage of South-easterly or Easterly winds, *especially in the northern part of the square*, where it amounts to 40 per cent. ! This fact is supported by the remarks in December, which say that the N.E. Trade has been more like the S.E.

In SQUARE 3 the winds on the western side are also very decidedly the strongest, whilst in square 303 nearly all winds are to the eastward of S.E., so that ships need not fear crossing the Equator well to the westward.

The foregoing is merely a summary of the work in hand, for, besides a series of monthly charts showing the data for the district in 2° squares, tables will be given of the most important data in strips of 10° of longitude by 1° of latitude, and *vice versâ*. Also the direction of all winds of which the force exceeded 6, and the localities where they were felt, as well as the direction and force of squalls, the limits of the Trade Winds, &c.

The different quarters from which the clouds and wind came are shown in a table, and also the direction in which lightning was seen.

Important remarks are accompanied by a note of the precise locality in which they were entered, and they sometimes show that phenomena are confined to special localities. Thus, in January, all the gales and strong winds, of force exceeding 6, and most of the squalls, occurred on the western side of the Square.

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# APPENDIX.

## APPENDIX I.

### METEOROLOGICAL OFFICE : ACCOUNT of RECEIPTS and PAYMENTS for the year ended the 31st March 1873.

RECEIPTS.		PAYMENTS.	
Balance from year 1871-72 -	£1,496 3 6	OFFICE :	
Parliamentary Vote -	10,000 0 0	Salary of Director -	£800 0 0
W. F. Cooper -	£0 13 0	"    Two Clerks -	297 13 2
C. Meldrum -	4 0 0	Office-keeper and Mes-	
Lt.-Col. Hamilton	2 15 0	senger -	157 19 0
Messrs. Power,			£1,255 12 2
Bros. -	3 6 8	Rent of Office -	538 17 0
Dr. C. Jelinek -	1 1 0	Fuel and Gas -	34 17 3
Mrs. Torrens -	1 19 6	Furniture and Fittings -	67 11 1
The Bishop of			641 5 4
Rupert's land -	21 9 0	Postage -	70 2 1
S. W. Hodding -	3 15 0	Printing, &c. -	57 12 1
E. E. Morris -	10 14 4	Attendance, and other	
G. Dornbusch -	10 0 0	Contingencies -	111 16 7
H. Lee & Sons -	2 10 0		239 10 9
Rev. W. P. Mac-		LAND METEOROLOGY :	
kay, D.D. -	7 6 2	Expenses at Observa-	
Royal Geographi-		tories -	2,632 1 8
cal Society -	10 10 0	Computations -	831 7 10
Dr. G. T. Kingston	72 13 0		3,463 9 6
Dr. C. Smallwood	6 1 6	Telegraphy -	1,769 2 4
F. Gaster -	2 0 0	Inspections, issue of	
Dr. Gilbert Smith	0 18 0	D.W. Charts, &c. -	458 16 7
W. Galloway -	2 19 6	Computations -	534 17 11
The Earl of Rosse	7 10 0		2,762 16 10
Sale of old In-		OCEAN METEOROLOGY :	
struments, &c.	2 2 0	Marine Superintendent	400 0 0
Sale of old books	2 12 0	Supply and Return of	
Subscriptions to		Instruments :	
D.W. Charts -	335 0 9	Admiralty -	277 3 8
Interest on deposit account	511 16 5	Mercantile Marine -	480 15 3
	120 6 10	Computations and Care	
		of Instruments -	964 0 10
			2,121 19 9
		Cash in hand -	95 8 8
		Advance to Valencia	
		Observatory -	50 0 0
		Bank of England	
		account -	143 13 11
		London and Westmin-	
		ster Bank -	1,354 9 10
			1,643 12 5
			10,484 14 4
			£12,128 6 9
			£12,128 6 9

Examined and compared with the vouchers and found correct.

(Signed) W. J. SMYTHE, Maj. Gen. }  
F. GALTON, } Auditors.

27th May 1873.

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## APPENDIX II.

LIST of CAPTAINS (and Officers) who have received from the Committee a Copy of the Admiralty Pilot Charts, to 31st March 1873 (*see* Report, p. 7). The figures opposite to each show the number of Special Letters of Thanks written to each Observer in acknowledgment of "Excellent" Registers *subsequently* returned to the Office.

Captain's Name.	Letters of Thanks.	Ship.
Almond, Thomas Michael, F.R.A.S.	--	"Decapolis."
Angel, John Fry -	—	"Twilight."
Banner, Frederick William -	2	"Lady of the Lake."
Barwood, William Richford -	1	"Fugitive."
Blake, Edwin John -	2	"Gilbert Thompson."
Bouchette, Francis Baines -	1	S.S. "European."
Brooks, Samuel -	2	S.S. "City of Brooklyn."
Brown, Robert -	1	S.S. "Moravian."
Bruce, John -	1	"City of Adelaide."
*Bythesea, John (V. C.), R.N.	2	H.M.S. "Phœbe."
Campbell, Archibald -	3	S.S. "Britannia" and S.S. "Europa."
Capper, Edward Hall -	1	"Palm Tree."
Carruthers, Forrest Priest	2	"Minero."
<i>Davidson Charles</i> -	—	"Perseverance."
Donkin, Thomas, R.N.R.	2	"Inverness."
Ellery, William -	1	"Bowfell."
Fernie, Alexander Durwood -	—	"Sir John Lawrence."
Finlay, James -	2	"Dun Cairn."
Fry, Alfred -	1	"Foam."
Gaye, Gerrard -	—	"Eliza Shaw."
Grange, James -	—	S.S. "Acantha."
Gray, David -	—	S.S. "Eclipse."
Gray, John -	—	S.S. "Mazinthien."
Gray, John McDonald -	2	"Speranza."
†Greenwood, William -	2	S.S. "Scotia" and "Assaye."
Grigs, George, R.N.R.	1	S.S. "Helvetia."
Harris, David -	1	S.S. "Medway."
Hassell, Thomas Edward -	1	"Mervyn."
Hayes, James -	5	S.S. "Ptolemy" and S.S. "Camoens."
Hayward, George Olive -	2	S.S. "Durley."
Heggum, Edward Carl V.	4	"Czar."
Henderson, Henry -	4	"Hope."
†Hodding, Samuel White -	—	"Indus."
Holdich, John Peach -	—	"Agra."
*Hopkins, John O., R.N.	—	H.M.S. "Liverpool."
Hunter, David -	3	S.S. "Alpha" and S.S. "Delta."
Jones, Arthur Arundel -	1	"Victoria Nyanza."
Jones, George Henry -	2	S.S. "Nile."
†Kennedy, Charles William -	—	S.S. "Scotia."
Kennedy, James Branch, R.N.R.	—	S.S. "Blue Cross."
Kerr, Thomas Coulter, R.N.R.	1	"Durham."
Lecky, Squire Thornton Stratford, R.N.R., F.R.G.S.	2	S.S. "Uruguay" and S.S. "Halley."
Leportier, Theodore -	1	"Kate."
Lewis, John Thomas, R.N.R.	—	S.S. "Scotia."
Lindsay, Henry Kay -	—	"Valparaiso."
Lunham, Robert Dowe -	2	S.S. "Berar" and S.S. "Durley."
* <i>MacDonald, John</i> -	—	S.S. "Europa."
McKechnie, Duncan Ferguson -	—	"Cottica."

\* Pilot charts not presented.

† Chief Officer.

‡ Second Officer.

Names of Officers, deceased, *in italics*.

Captain's Name.	Letters of Thanks.	Ship.
Mackellar, D. E. - - -	—	Observations at Rapa Island.
Maddison, John, R.N.R. - -	—	"Anglesey."
Manning, Henry - - -	—	S.S. "Kangaroo."
Martyn, John Artis - - -	7	S.S. "Siberia" and S.S. "Samaria."
*Mayne, Richard C., R.N., C.B. -	1	H.M.S. "Nassau."
†Menzies, Charles James - -	1	S.S. "Austrian" and S.S. "Sarmatian."
Moore, Thomas - - -	—	"W. E. Gladstone."
Morton, John D'Arcy - - -	—	"Henry Bath."
<i>Mossop, Clement</i> - - -	2	"Candahar."
Murphy, Michael - - -	—	S.S. "Tarifa."
†Paterson, James Forrest - -	2	S.S. "Moravian."
Pearson, Charles William - -	1	"S.S. "Strathclyde."
*Perry, John L., R.N. - - -	1	H.M.S. "Orontes."
†*Petch, John A. R., R.N. - -	2	H.M.S. "Phœbe."
Petrie, Peter Conrad - - -	1	S.S. "Patagonia."
Potts, Thomas Crosbie - - -	2	"Tenasserim."
Price, James John - - -	1	"Sorata."
Rawle, Charles, R.N.R. - - -	1	"Star of the North."
Raymond, Charles Tenzer - -	3	"British India" and "British Consul."
Reid, Carson William - - -	1	"Lord Strathnairn."
Renaut, Charles Henry - - -	1	"Celaeno."
†Scott, Fergus - - -	—	S.S. "Hotspur."
†Scott, George Alexander Brown -	—	S.S. "Nestorian."
*Sharp, William H., Staff Com., R.N.	—	H.M.S. "Liverpool."
*Shortland, P. F., R.N. - - -	—	H.M.S. "Hydra."
Simpson, Alexander - - -	2	"Traveller."
<i>Smith, David, F.R.A.S.</i> - - -	—	"Wiltshire."
Smith, William Henry, R.N.R. -	3	S.S. "Hibernian" and S.S. "Peruvian."
Stanhope, John - - -	—	"Decision."
Steele, John - - -	1	S.S. "Erl King."
Stephen, John George - - -	1	S.S. "Moravian" and S.S. "St. Patrick."
Stuart, George Rennie - - -	—	"Otago."
Stuart, William Henry - - -	3	"Richmond."
Symington, William - - -	3	"Northfleet" and "Flying Venus."
*Tandy, Dashwood G., R.N. - -	1	H.M.S. "Nassau."
Tilmouth, Robert J. C. - - -	—	"Peeress."
Townsend, William Henry - - -	—	"Valentine and Helene."
Trench, Chas. E. Le Poer - - -	—	"Newcastle."
<i>Tucker, John Worth</i> - - -	—	"John Temperley."
*†Vine, William W., R.N. - - -	1	H.M.S. "Orontes."
Vowell, Michael - - -	—	"Kelso."
Walker, John Burnett - - -	—	S.S. "Erik."
Watkins, Thomas - - -	—	"Emulation."
Watson, William - - -	5	S.S. "Palmyra" and S.S. "Parthia."
Wherland, Frederick, R.N.R. - -	3	"Galatea."
Wight, Henry Potts - - -	2	"Gosforth."
Wilcox, Henry George, R.N.R. - -	—	"St. Lawrence."
Williams, James Agnew - - -	—	S.S. "Wisconsin."
Wylie, James - - -	1	S.S. "Austrian" and S.S. "Sarmatian."

In addition the Committee have presented barometers to two gentlemen who have formerly kept registers for the office, but have now retired from the sea, viz., to Capt. A. D. Wood in 1867 and to Capt. Isaac Gales in 1870. A set of instruments was also presented to Capt. Alfred Fry in 1868.

\* Pilot Charts not presented.

† Chief Officer.

‡ Navigating Lieutenant.

Names of Officers, deceased, *in italics*.

## APPENDIX III.—SHIPS supplied and DOCUMENTS returned during the year 1872.

The number of ships supplied with standard instruments and meteorological registers during the year 1872 was 75. This number does not include ships in the Royal Navy, all of which are supplied with instruments by the Meteorological office, but in which the keeping of a special meteorological register is optional.

The number of meteorological registers and documents received during the year 1872, and registered in the office, amounted altogether to 203, of which 125 were returned from ships, and 78 from land stations outside the British Isles.

## LIST of DOCUMENTS received from LAND STATIONS.

Place.	Observer.	No. of Documents.	Nature of Observations.
Abaco (Bahamas)	Lightkeeper	2	"Lighthouse" Register, from July 1871 to June 1872.
Angra do Heroismo (Azores)	-	11	One observation daily.
Bermuda	Dockyard Authorities	18	Anemometrical Records.
Cay Sal (Bahamas)	Lightkeeper	1	"Lighthouse" Register, from July to December 1871.
Copenhagen	-	3	Three observations daily.
Dangaard (Denmark)	-	3	"Lighthouse" Register to June 1872.
Falkland Islands (Cape Pembroke)	Lightkeeper	3	Three observations daily.
Fanö (Denmark)	-	2	Three observations daily.
Funchal (Madeira)	-	11	One observation daily.
Gibraltar	Serjeants J. H. Hassell and J. Brewster.	12	Two observations daily and monthly means.
Inagua (Bahamas)	Lightkeeper	2	"Lighthouse" Register, from July 1871 to June 1872.
Kew	-	1	Chrono-Isothermals for each hour and each month during 1868.
Kurrachee	W. Parkes, C.E.	1	Non-tidal levels for each day at noon from 1 July 1868 to 30 June 1872.
Madras	N. E. Pogson, Assist. Govt. Astronomer.	1	Diagram showing height of barometer, direction and velocity of wind, &c. during cyclone of May 1872.
Noesgaard (Denmark)	-	3	Three observations daily.
Sombrero	Lightkeeper	1	"Lighthouse" Register from November 1871 to April 1872.
Woosung (China)	Charles Drighton Brayshu	1	Monthly results for years 1867-71.
Ytteroen (Norway)	A. S. Bachke	1	Monthly means of three observation daily for 1871.
—	Richard Leighton	1	On the practical application of the law of storms, cyclones, and rotatory gales.
		78	

LIST of DOCUMENTS received from SHIPS.

Captain's Name.	Ship.	Tons.	Owners.	Voyage.	Months of Register.
Atkinson, J. H.	S.S. Himalaya -	1,341	British India S. N. Co., Limited, London.	Trading between Calcutta, Bombay, Singapore, &c.	4
Balderston, R. J.	Rajmahal -	1,302	T. Brocklebank, Liverpool	To and from Calcutta -	8
Banner, F. W.	Kenilworth -	979	C. Hill, Bristol -	To Rio Janeiro, Batavia, and home -	8
Barlow, B. J.	S.S. Sharpshooter -	416	Tan Choon Sian, Malacca -	To Penang, via Suez -	2
Barwood, W. R.	Fugitive -	471	T. B. Walker, London -	To and from Launceston -	6
Baskfill, C. H.	Callixene -	1,337	W. & R. Wright, Liverpool -	To and from Calcutta -	8
<sup>1</sup> Bedingfeld, N. B., R.N.	Gladiator -	1,210	H.M.S. -	Voyage from Rio Janeiro, to Bahia, Pernambuco and home.	5
Bennett, E. C.	Medea -	1,066	J. H. Carmichael, Greenock -	To Bombay, Calcutta, Demerara, and home.	7
Blake, E. J.	Gitana -	1,367	E. Bates, Liverpool -	To and from Calcutta -	8
<sup>2</sup> Brooker, E. W., R.N.	Sylvia -	695	H.M.S. -	To Rio Janeiro, Cape of Good Hope, Ceylon, Andaman Islands, Singapore, Saigon, and Hong-Kong.	7
Brooks, Samuel	S.S. City of Brooklyn -	2,911	W. Inman, Liverpool -	Three voyages to and four from New York.	3
Bruce, John	City of Adelaide -	791	J. Moore, London -	To and from Adelaide -	6
Bushnell, J. H., R.N.	Dasher -	260	H.M.S. -	In Gorey harbour -	22 days
Cairncross, Robert	Wagoola -	550	Redfern & Alexander, London -	To Hobart Town and home from Equator	4
Campbell, Archd.	S.S. Europa -	1,840	T. & J. Henderson, Glasgow -	Twelve voyages to and from New York	12
Carruthers, F. P.	Minero -	478	C. L. Claude, Valparaiso -	To Valparaiso, Peru, and Philadelphia -	6
Carruthers, George	" -	"	" -	From Philadelphia, home -	1
Chambers, James	Duncairn -	1,303	W. P. Sinclair, Liverpool -	From Calcutta, home -	4
<sup>3</sup> Chimmow, William, R.N.	Nassau -	695	H.M.S. -	To Point de Galle, Singapore, and Hong-Kong, via Suez, and in China seas.	19

LIST of DOCUMENTS, &c.—*continued.*

Captain's Name.	Ship.	Tons.	Owners.	Voyage.	Months of Register.
Clarke, James, R.N.R.	Western Empire -	1,245	G. Cairns, Clapham, Surrey	To and from Melbourne	8
Cruikshank, William	Chrysolite -	1,278	J. Nevins, St. John's, N.B.	To Bombay, Rangoon, Akyab, and home	13
Cumming, John	Norfolk -	953	M. Wigram & Sons, London	Two voyages to and from Melbourne	10
Cummins, John	David Malcomson -	1,213	W. J. Fernie, Liverpool	To Aden and home from Rangoon	7
Donkin, Thomas	Inverness -	725	J. & R. Grant, London	To Bombay, Rangoon, Madras, and home	10
Dunn, G. E.	Hannibal -	1,198	W. H. Dixon, Liverpool	To Aden, Calcutta, and home	8
Ellery, William	Bowfell -	1,002	T. & R. Brocklebank, Liverpool	Two voyages to and from Calcutta	12
Fernie, A. D.	Sir John Lawrence -	879	Donaldson, Rose, & Co., Aberdeen	To and from Sydney	7
Finlay, James	Duncairn -	1,303	W. P. Sinclair, Liverpool	To Calcutta	4
Gambier, J. W., R.N.	Sylvia -	695	H.M.S.	Surveying in Japan Sea	4
Gaye, Gerrard	Eliza Shaw -	696	C. Shaw, London	Two voyages to and from Shanghai, &c.	17
Goddard, W.	La Hogue -	1,331	J. Moore, London	To and from Sydney	6
Gray, David	S.S. Eclipse -	435	J. Arbuthnot, Peterhead	To and from Greenland	5
Gray, John	S.S. Mazinthien -	397	R. Kidd, Peterhead	To and from Greenland	5
Gray, J. McD.	Speranza -	455	W. Nicholson, Sunderland	To and from Valparaiso	7
Grigs, George, R.N.R.	S.S. Helvetia -	3,975	National S.S. Co., Lim., Liverpool	Four voyages to and from New York	4
Hall, J. V.	S.S. Cordillera -	2,860	Pacific S. N. Co., Liverpool	Two voyages to Rio Janeiro, Monte Video, Valparaiso, and home.	5
Hammill, M. D.	S.S. Lusitania	3,825	"	To various places on the west coast of S. America and home.	3
Hansford, J. H.	Gosforth -	810	G. Luckley, Newcastle	To and from Madras	7
Harland, Charles	Nelly -	407	J. C. Brooks, Newfoundland	To Callao, Mauritius, and home	9
Harris, David	S.S. Medway -	1,846	J. Temperley, London	To and from Cape Town, and to and from Quebec.	4

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List of DOCUMENTS, &c.—continued.

Captain's Name.	Ship.	Tons.	Owners.	Voyage.	Months of Register.
<sup>7</sup> Hassell, T. E.	Mervyn	288	R. J. & W. P. King, Bristol	To and from Cape Palmas	4
Hayes, James	S.S. Camoens	1,053	Brazil and R. Plate S. N. Co.	To Rio Janeiro, and on S.E. coast of S. America.	8
Hayward, G. O.	S.S. Durley	785	G. Palmer, Greenwood, Hants	Two voyages to and from Mediterranean ports.	3
Hegum, E. C. V.	Rozelle	1,286	R. Cuthbert, Greenock	To Calcutta, New York, and home	8
Henderson, Henry	Hope	454	Killick, Martin, & Co., London	From Shanghai	6
Henderson, James	S.S. Venezia	656	T. Henderson, Glasgow	Two voyages to and from Mediterranean ports.	2
Hunter, David	S.S. Alpha	653	W. Cunard, Halifax, N.S.	Six voyages from Halifax to St. Thomas, and back, via Bermuda.	4
Johnson, C.	St. Lawrence	1,094	J. Lawrence, London	To and from Madras	7
Jones, A. A.	Victoria Nyanza	1,022	G. H. Fletcher, Liverpool	To and from Shanghai	8
Jones, G. H.	S.S. Nile	1,354	C. M. Norwood, London	To Rio Janeiro, Monte Video, and home	3
<sup>8</sup> Jones, T. M., R.N.	"	"	"	To and from Quebec	2
	Glasgow	3,037	H.M.S.	From Madeira to Cape of Good Hope, Zanzibar, Trincomalee, Mauritius, Madagascar, Zanzibar, and Seychelles.	7
Kennedy, J. B., R.N.R.	S.S. Yorkshire	2,273	W. H. Tindall, London	Two voyages to and from Calcutta, via Suez.	6
Kerr, Alexander	Ardgowan	1,283	G. Adam, Greenock	To Bombay, Calcutta, and home	9
Kerr, T. C., R.N.R.	Durham	1,286	G. Marshall, London	To Calcutta, New York, and home	7
Lewis, J. T., R.N.R.	S.S. Arabia	1,080	British India S. N. Co., Lim., London	Trading between Calcutta, Bombay, Singapore, &c.	4
"	S.S. Scotia	1,168	"	Trading between Calcutta, Rangoon, Port Blair, Singapore, &c.	5

## LIST OF DOCUMENTS, &amp;c.—continued.

Captain's Name.	Ship.	Tons.	Owners.	Voyage.	Months of Register.
Lindsay, H. K.	Valparaiso	730	S. Williamson, Liverpool -	To and from Chile	6
Lunham, R. D.	S.S. Durley	785	G. Palmer, Greenwood, Hants	To and from Calcutta, via Suez	3
"	"	"	"	To Bombay and back to Bordeaux, via Suez.	3
McKechnie, D. F.	Cottica	319	A. Pearson, Glasgow	Two voyages from and one to Surinam -	4
McLelland, Archibald	S.S. Britannia	1,392	T. & J. Henderson, Glasgow	To and from New York	37 days.
<sup>9</sup> McRitchie, D.	Assaye	1,281	J. Stewart, Greenock	To and from Calcutta -	7
Martyn, J. A.	S.S. Java	2,696	J. Burns, Glasgow	Six voyages to and from New York	4
<sup>10</sup> Miller, Thos., R.N.	Agincourt	6,621	H.M.S. -	On South Coast of England	1
"	Pembroke	1,758	"	In Sheerness harbour	12
<sup>12</sup> Moodie, E. R.	S.S. Cuba	2,668	Burns & MacIver, Liverpool	Eight voyages to and from New York	6
Mossop, C.	Candahar	1,418	T. & R. Brocklebank, Liverpool	Two voyages to and one from Calcutta -	9
Nares, G. S., R.N.	Challenger	1,462	H.M.S. -	South coast of England	3 days.
Owen, John	W. G. Russell	1,248	J. Thomas, Carnarvon	To Bombay, Colombo, Akyab, and home.	8
Pearson, C. W.	S.S. Strathelyde	1,951	Burrell & McLaren, Glasgow	Three voyages to Madras, Calcutta, and home, via Suez.	9
<sup>13</sup> Perry, J. L., R.N.	Orontes	2,812	H.M.S. -	One voyage to Gibraltar, Malta, and home, and one to Halifax, Quebec, Bermuda, and home.	6
"	"	"	"	To Trincomalee, Singapore, Hong-Kong, and back, via Suez.	6
Potts, T. C.	Tenasserim	1,419	T. & R. Brocklebank, Liverpool	To and from Calcutta -	6
Price, J. J.	Sorata	332	C. C. Dawson, Liverpool	Two voyages to and from Jamaica	6

LIST of DOCUMENTS, &c.—continued.

Captain's Name.	Ship.	Tons.	Owners.	Voyage.	Months of Register.
Rawle, Charles	Star of the North	662	A. Pardew, Plymouth	To and from ports in China and Japan Seas	19
Renaud, C. H.	Celaeno	702	T. Rhoades & Son, London	To and from Wellington	6
<sup>15</sup> Rich, F. D., R.N.	Malabar	4,173	H.M.S.	To Cape Good Hope and Bombay. Three voyages between Bombay and Suez.	8
Rollo, William	Colorado	545	W. F. Donaldson, Glasgow	To Valparaiso and back to Havre	6
Ross, David	Sultan	399	W. Davies, Greenock	To and from Demerara	2
<sup>16</sup> St. John, H. C., R.N.	Sylvia	695	H.M.S.	Surveying in Japan Sea	14
Simpson, Alexander	Traveller	196	A. Simpson, Peterhead	Four voyages to and from South Greenland, &c.	15
Simpson, J.	Star of Persia	1,227	R. Corry, Belfast	To Calcutta	3
Small, J. J.	S.S. Columbia	1,698	T. & J. Henderson, Glasgow	Four voyages to and from New York	4
<sup>17</sup> Smith, —	Worcester	—	Thames Marine Officers' Training Ship.	Off Greenhithe	4
Smith, W. H., R.N.R.	S.S. Peruvian	2,320	J. & A. Allan, Glasgow	Two voyages to and from Portland, two to and from Quebec, two to and from Quebec viâ Halifax, two to and from Baltimore viâ Halifax.	7
Stephen, J. G.	S.S. St. Patrick	1,200	"	Four voyages to and from Quebec	4
Stuart, G. R.	Otago	993	J. Galbraith, Glasgow	To and from Otago, N.Z.	5
Stuart, W. H.	Richmond	183	Board of Trade	At Bahamas	12
Symington, William	S.S. Hong Kong	1,881	E. H. Watts, London	Two voyages to and from China, viâ Suez.	10
Trench, C. E. Le P.	Newcastle	1,137	H. Green, London	To and from Cape Otway	7
Tully, Thomas	Baroda	1,364	T. Brocklebank, Liverpool	To and from Calcutta	7
Turnbull, W. S.	Langstone	746	H. Ellis, London	To Colombo, Akyab, and home	10
<sup>18</sup> Unknown	Falcon	—	-	From Sandalwood Island to Shanghai, Swatow, Saigon, Hong-Kong, and Java.	7

LIST of DOCUMENTS, &c.—*continued.*

Captain's Name.	Ship.	Tons.	Owners.	Voyage.	Months of Register.
Vowell, Michael	Kelso -	556	J. R. Kelso, North Shields	To Java, Hong-Kong, Foochow, New York and Bremen.	10
Vyvyan, G. R., R.N.R.	S.S. European -	2,242	Union S.S. Co. (Lim.), Southampton	To and from Cape Colony	3
Wadham, T. L.	Vere -	396	J. Anderson, London	Two voyages to and from Jamaica	5
Watkins, Thomas	Emulation -	392	W. Blain, South Shields	To Bangkok, Hong-Kong, and home	11
Watson, William	S.S. Parthia -	3,167	J. Burns, Glasgow	Six voyages to and from New York, two to and from Boston.	6
Wherland, Frederick	Galatea -	1,477	S. R. Graves, Liverpool	To and from Sydney	7
Wight, H. P.	S.S. Earl of Lonsdale -	1,543	Elliott, Lowrey & Co., Newcastle-on-Tyne.	To Madras Calcutta, and home, viâ Suez	3
<sup>19</sup> Wilson, J. C., R.N.	Pembroke -	1,758	H.M.S. -	In Sheerness harbour	18
<sup>20</sup> Wylie, James	S.S. Austrian -	2,458	J. & A. Allan, Glasgow	One voyage to and from Portland, two to and from Quebec.	2
<sup>21</sup> " "	S.S. Sarmatian -	3,647	" "	Two voyages to and from Portland, two to and from Quebec.	3
Young, Hugh	S.S. Dorian -	1,039	T. & J. Henderson, Glasgow	From Gibraltar to New York and home	1

In cases distinguished by marginal numbers the Meteorological Registers were kept chiefly by officers, as follows:—

- <sup>1</sup> C. E. Pritchard, Navigating Midshipman.
- <sup>2</sup> C. C. P. Bawden, Master's Assistant.
- <sup>3</sup> J. Hale Orlebar, Lieutenant.
- <sup>4</sup> Officers.
- <sup>5</sup> S. J. Olliff.
- <sup>6</sup> F. A. Harvey, and F. H. Keene.
- <sup>7</sup> Assisted by Chief Mate.
- <sup>8</sup> Robert Jackson, Navigating Lieutenant.
- <sup>9</sup> W. Greenwood.

- <sup>10</sup> T. J. Haran, Staff Surgeon.
- <sup>12</sup> J. N. Wardrop, 3rd Officer.
- <sup>13</sup> William Wallis Vine, Navigating Lieutenant.
- <sup>15</sup> James D. Maycock, Sub-Lieutenant.
- <sup>16</sup> Francis S. Wheeler, Navigating Midshipman.
- <sup>17</sup> Boys under superintendence of Rev. W. T. Read, M.A.
- <sup>18</sup> John Catnach.
- <sup>20</sup> C. J. Menzies, Chief Officer.

## APPENDIX No. IV.

## CONTENTS of the PRINCIPAL PUBLICATIONS issued.

1. By authority of the Board of Trade.
2. By „ Meteorological Committee.

## 1.

FIRST NUMBER, 1857. 4-to. 182 pp. 16 Plates.

Meteorological Observations at Bermuda, 1853-4 ; Halifax, 1854-5 ; Ascension, 1854-5 ; Valparaiso, 1853-5 ; Ceylon (three stations), 1854. Abstract of deep-sea temperatures obtained on board H.M.S. "Saracen" between Madeira and Cape of Good Hope, 25th February to 17th April 1858. Meteorology of New Zealand,\* the Cape of Good Hope,\* Mauritius\* (with diagrams), Isthmus of Darien, and Cartagena. Memoranda on the use and adjustment of instruments at sea. Specimens of Wind Charts and Trade Wind Chart for North and South Atlantic Oceans. Black Sea Wind Chart. Diagrams of Balaklava storm, 14th November 1854.

N.B.—A second abridged edition was published in 1863.

SECOND NUMBER, 1858. 4-to. 40 pp.

Tables showing the shortest and average lengths of passages (in days) by sailing vessels, steamers, or auxiliary steamers, using sails. Table of distances on arcs of great circles. An abstract of general sailing directions, by Admiral FitzRoy, with remarks on the use of instruments. Account of Prof. Airy's Method of sweeping an arc of a great circle on a Mercator's chart. A comparison of sailing (only), and sailing with auxiliary steaming, in long voyages, by Lieut. M. F. Maury, LL.D., &c.

A second edition was published in 1862.

THIRD NUMBER, 1858. 4-to. 100 pp. 1 Plate.

Translation of Professor Dove's "Law of Storms," with notes by Admiral FitzRoy.

The Appendix contains, *inter alia* :—A card to accompany weather glasses. Extracts from the "Barometer and Weather Guide." Remarks by Professor Espy and Admiral FitzRoy. Remarks on Aqueous Vapour. Suggestions to promote correspondence between observers. Table of the velocity and pressure of the wind.

A second edition was published in 1861, with notes by Sir F. W. E. Nicolson, Bart., K.C.B.

FOURTH NUMBER, 1860. 4-to. 61 pp. 2 Plates.

This number contains :—An "Abstract of Register of the Arctic Discovery Yacht, 'Fox.'" Capt. Sir F. L. M'Clintock, R.N., kept by D. Walker, Esq., M.D. ; with map of the Arctic Regions.

The Appendix contains :—A "Description of the Marine Barometer, "adopted by H.M. Government, in 1854;" and the Kew method of "Testing Barometers, Hydrometers, and Thermometers."

FIFTH NUMBER, 1861. 4-to. 99 pp. 3 Plates.

Observations at Natal, 1858-9, by Dr. R. J. Mann. Observations at Orotava (Teneriffe), 1856-7. Observations at Papiete (Tahiti), 1855-60. Temperature at Decima (Japan), 1845-55. A comparison

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\* Omitted in second edition.

between the mean temperature of each month at Funchal (Madeira), Decima, and Oglethorpe (Georgia). The Climate of Orkney, by the Rev. C. Clouston, LL.D.

SIXTH NUMBER, 1861. 8-vo. 39 pp. 2 Plates.

Translation of a paper by Professor Dove, "On the Periodic Variations of the Pressure of the Atmosphere," read before the Royal Academy of Sciences, Berlin, on Nov. 12, 1860. The measures are converted to English equivalents.

SEVENTH NUMBER, 1861. 4-to. 18 pp. 1 Plate. 1 Woodcut.

"Intertropical Diurnal Range Tables of the Barometer." Monthly means of Barometer Readings (reduced) in North Atlantic and North Indian Oceans. Monthly means of pressure of dry air in North Atlantic and North Indian Oceans. Mean monthly height of the Barometer for Square III. Mean monthly pressure for each five degrees of latitude from 30° N. to 30° S. Memorandum on the calculation of Diurnal Range.

*Note.*—The above calculations were based upon observations received prior to 1861. The Committee have thought the matter of sufficient importance to warrant the re-calculation of the tables for the Atlantic doldrums from the Observations received up to the present date, and the work will be published shortly.

EIGHTH NUMBER, 1861. 4-to. 83 pp.

"Anemometry at Bermuda, from April 1859 to September 1860," forms the substance of this number. This work has been continued down to the end of March 1863, and is now in the press. The method of tabulation and reduction is, however, entirely different. The Observations of Direction and Force have been resolved into their rectangular components, and treated on the principles recommended by the Rev. T. R. Robinson, D.D., and other authorities.

NINTH NUMBER, 1861. 8-vo. 78 pp.

The contents of this number are fragmentary, and contain, *inter alia*:—Remarks on Meteorological Progress, by Admiral FitzRoy. Account of Mr. Rush's balloon ascent in 1838. Note on the Portable Cup and Dial Anemometer. Remarks on gales, storm signals, &c.

TENTH NUMBER. 1861. 8vo. 88 pp. 5 Plates. Accompanied by an Atlas by Mr. Babington, in 4to, of 26 folding Plates.

This number contains:—"British Storms: Outline notices of remarkable instances—'Royal Charter' and other recent Storms." The two storms selected for illustration are the storm of October 26-27, 1859, during which the "Royal Charter" was lost; and another storm on November 1-2 of the same year. A paper by W. Stevenson, Esq., of Dunse, 1853, "On the interference of following or consecutive Cyclones," is reprinted, illustrated by a woodcut.

ELEVENTH NUMBER. 1862. 8vo. 284 pp.

Containing:—Mr. Babington's Analysis of Weather Reports for 1861-2, with remarks on the success or failure of the forecasts made by the office daily during the period in question. 2. Instructions for Meteorological Telegraphy.

TWELFTH NUMBER. 1865. 8vo. 50 pp. 13 Plates.

The contents of this number are :—1°. Specific Gravity of the Ocean and Sea Temperature. The observations, exceeding 50,000 in number, are all corrected and reduced. 2°. Icebergs in the Southern Ocean, from observations collected by Maury, Towson, and the Meteorological Department up to 1862, arranged in tabular form and also grouped into charts. 3°. Bessel's Hypsometric Tables, corrected by Plantamour, and reduced to English measures. 4°. Approximate "Normal Levels" (or Par lines) of Barometer, deduced from readings taken at 8h. a.m. daily (except Sundays) at the telegraphic reporting stations and some other places.

THIRTEENTH NUMBER. 1865. 4to. 109 pp. 2 Plates.

Anemometry at Halifax, N.S., for the two years ending June 1861. The manner in which these records have been treated is similar to the method adopted in the Eighth Number, with the addition of a few tables of general results.

FOURTEENTH NUMBER. 1865. 4to. 18 pp. 7 Diagrams.

This paper contains:—Observations on the Barometric pressure in high N. and S. Latitudes, and the conclusions arrived at are based on upwards of 114,000 observations extracted from the office registers.

#### WIND CHARTS.

N. and S. Atlantic, N. Pacific and Central America, Indian Ocean, S. and E. coasts Africa, in 10° squares; Coast of Brazil, 4° lat., 2° long.; Cape Horn, E. and W., 2° lat., 4° long.

The above, 15 in number, are for quarters, and give direction only.

Trade wind charts for North and South Atlantic oceans, published in 2° squares, monthly, with percentages of calms and rains.

Also charts embracing the following Ocean statistics, viz. :—Currents, Sea Temperature, Prevalence of Rain, Magnetic Variation and Dip, Wind (Direction and Force). 16 in number: North Atlantic Ocean, from Equator to 40° N., in squares of 5°, for the months February, May, August, November (the middle, or representative months of each quarter).

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#### 2. ISSUED UNDER THE AUTHORITY OF THE METEOROLOGICAL COMMITTEE.

Official No.

4. CHARTS OF SURFACE TEMPERATURE, SOUTH ATLANTIC OCEAN. 1869. Large Folio. 27 pp. 12 Charts.

Compiled from Office Registers and the Charts published by the R. Meteorological Institute of the Netherlands, for each month, and for squares of 5°. The region embraced extends from the Equator to 60° S. lat., and from 70° W. to 40° E. long.

7. QUARTERLY WEATHER REPORT FOR 1869. 1871. 4to. 141 pp. 146 Plates.

Containing *continuous* traces of the self-recording instruments at the seven British and Irish observatories, with a chronicle of the weather for the year 1869, compiled from every available source. This Report also contains tables showing—I. The mean monthly results of the records of the seven observatories for the year; II. Five-day means of ditto; III. Factors for the calculation of barometrical gradients; and an outline map showing the positions of the stations in connection with the Meteorological Office. The *Appendix* contains a paper on Easterly Gales by Mr. Scott.

Official No.

8. BAROMETER MANUAL. 1871. 8vo. 75 pp. 4 Plates.

This manual is based on that compiled by the late Admiral FitzRoy, but has been mostly re-written. It contains the following papers:— I. Meteorological instruments, and what they tell us; II. Weather Telegraphy; III. The use of the barometer to seamen; IV. The construction and management of instruments; V. Tables for reducing barometrical observations. VI. Ditto for English into French measures, and *vice versâ*.

9. QUARTERLY WEATHER REPORT for 1870. 1872. 4to. 128 pp. 73 Plates.

The information given in this Report corresponds to that in No. 7, and contains in addition particulars relating to the exposure of the Thermograph bulbs, illustrated by woodcuts.

The *Appendix* contains, I. Mean monthly results and five day means as before. II. Mean monthly and yearly Barometrical Pressure at Telegraphic Reporting Stations, for the five years 1866–70. III. Monthly and yearly amounts of Rainfall at ditto, 1866–70. IV. Translation of Bessel's Paper on the Determination of the Law of a Periodical Phenomenon.

11. CONTRIBUTIONS TO OUR KNOWLEDGE OF THE METEOROLOGY OF CAPE HORN and the WEST COAST OF SOUTH AMERICA, 1871, 4to. 36pp. 12 Charts.

This paper contains:—Monthly Tables, Charts, and Summaries, for the district lying between Lat.  $0^{\circ}$ – $60^{\circ}$  S. and Long.  $50^{\circ}$ – $100^{\circ}$  W., for Barometer, Temperature (Air and Sea), Wind, Weather, &c.; and in addition there are tables showing:—1. Mean Pressure from hourly observations of the Barometer, made on board H.M.S. "Erebus," by Sir James Clark Ross, at Port Louis (E. Falkland Island) April–December 1842, and St. Martin's Cove (Hermit Island) September 20 to November 6, 1842. II. Monthly averages of Barometer observations taken at Cape Pembroke Lighthouse (E. Falkland Island) in the years 1859–68 (not continuous). III. Results of Meteorological Observations made at Valparaiso by the officers of H.M.S. "Nereus" 1853–8. IV. Monthly means of observations at the following places in South America:—Punta Arenas (Patagonia), five to six years' observations; Puerto Montt (Chile),  $1\frac{1}{2}$  to six years' observations; Valdivia (Chile), 1853–64; Santiago (Chile),  $6\frac{1}{2}$  to 11 years; Copiapo (Chile), 1864 and 1867; Coquimbo (Chile), two years.

12. CURRENTS and SURFACE TEMPERATURE OF THE N. ATLANTIC OCEAN, 1872. 4to. 47 pp. 13 Charts.

The Charts show the Currents and Temperature from the Equator to  $40^{\circ}$  N. Latitude, *in each month of the year*, and for the whole year for areas of  $2\frac{1}{2}^{\circ}$  of latitude by  $2\frac{1}{2}^{\circ}$  of longitude. The data were obtained from the office registers and from Charts by Maury and Rennell.

13. DISCUSSION OF THE METEOROLOGY OF THE PART OF ATLANTIC LYING North of
- $30^{\circ}$
- N., for the 11 days ending 8th February 1870; 1872 4to. 164 pp. 19 Plates.

This period is that of the very heavy gales in which it is supposed the S.S. "City of Boston" foundered. A Synoptic Chart is drawn for 8h. a.m., for each day, Greenwich time, giving the isobars, isotherms of air and sea, direction and force of wind, &c.

14. } QUARTERLY WEATHER REPORTS, 1871–2. Publication not yet
- 
16. } complete.

APPENDIX V.

INSTRUMENTS supplied, &c. to the Royal Navy.

Per Account.	Baro- meters.	Ane- roids.	Thermometers.			Hydro- meters.		
			Ordinary.	Max.	Min.			
January 1st, 1872, afloat	-	-	169	369	838	12	27	128
Issued in 1872	-	-	56	92	269	35	36	37
			225	461	1,107	47	63	165
Returned in 1872	-	-	58	85	244	22	18	31
January 1st, 1873, afloat	-	-	167	376	863	25	45	134

INSTRUMENTS supplied, &c. for use at Naval Stations.

January 1st, 1872, in use	-	-	48	66	65	8	10	6
Issued in 1872	-	-	7	10	13	4	4	4
			55	76	78	12	14	10
Returned in 1872	-	-	4	4	7	2	2	—
January 1st, 1873, in use	-	-	51	72	71	10	12	10

DISPOSITION of ADMIRALTY INSTRUMENTS on January 1st, 1873.

Afloat in Royal Navy	-	-	167	376	828	25	45	140
In use at stations	-	-	51	72	71	10	12	10
In store at M.O.	-	-	91	81	97	12	10	121
"    Chatham	-	-	2	4	18	2	2	17
"    Sheerness	-	-	9	11	48	11	11	11
"    Portsmouth	-	-	9	6	38	5	7	28
"    Devonport	-	-	3	4	27	4	3	16
"    Queenstown	-	-	2	12	7	2	2	8
"    Gibraltar	-	-	5	6	—	—	—	4
"    Malta	-	-	4	6	23	1	1	24
"    Halifax	-	-	6	7	8	4	5	13
"    Bermuda	-	-	5	9	38	3	2	16
"    Jamaica	-	-	4	6	23	4	3	8
"    Cape of Good Hope	-	-	1	6	14	1	1	27
"    Trincomalee	-	-	2	2	12	—	—	—
"    Hong Kong*	-	-	8	22	51	4	4	25
"    Valparaiso†	-	-	4	1	23	2	2	16
Under repair	-	-	61	15	1	—	—	—
Total, January 1st 1873	-	-	434	646	1,327	90	110	484
Destroyed and lost during 1872			2	6	161	19	12	14

\* The figures are approximative, no return having been received since 1871, July 1st.  
 † No return has been made since 1869, July 1st.

## APPENDIX VI.

## INSTRUMENTS, &amp;c. supplied to Mercantile Marine.

Per Account.	Baro- meters.	Com- passes.	Thermometers.			Hydro- meters.
			Ordinary.	Max.	Min.	
January 1st, 1872, afloat -	105	5	638	1	1	382
Issued in 1872 - -	71	—	438	—	—	273
Returned in 1872 -	176	5	1,076	1	1	655
	78	3	481	—	—	284
January 1st, 1873, afloat -	98	2	595	1	1	371

INSTRUMENTS at Stations, viz., Telegraph Offices, Observatories,  
Navigation Schools, Lighthouses, &c.

January 1st, 1872, in use	91	3	186	40	42	53
Issued in 1872 - -	18	—	45	13	13	1
Returned in 1872 -	109	3	231	53	55	54
	7	—	14	3	4	—
January 1st, 1873, in use	102	3	217	50	51	54

## DISPOSITION of Board of Trade Instruments, on Jan. 1, 1873.

In merchant ships -	91	2	595	1	1	371
In naval ships -	—	—	35	—	—	—
In use at stations -	102	3	217	50	51	54
In store at M.O. -	24	44	147	11	11	66
At Liverpool agency -	8	8	58	—	—	34
„ Aberdeen „ -	8	—	51	—	—	31
„ Glasgow „ -	5	—	19	—	—	16
Under repair -	23	—	4	1	1	—
Total, Jan. 1st, 1873	261	57	1,126	63	64	572
Lost, &c. during 1872	14	1	236	17	12	61

APPENDIX VII.

LIST of STATIONS reporting Meteorological Observations by Telegraph to the Office, with the Observers.

Sumburgh Head	-	W. Lawrence	-	-	-	Schoolmaster.
Stornoway	-	J. Smith	-	-	-	Gardener.
*Thurso	-	J. Trotter	-	-	-	—
Wick	-	J. Sinclair	-	-	-	Watchmaker.
Nairn	-	W. D. Penny	-	-	-	Schoolmaster.
Aberdeen	-	J. McCormack	-	-	-	Telegraph Clerk.
Leith	-	T. Bolton	-	-	-	Do.
Shields	-	J. Irvine	-	-	-	Do.
*Scarborough	-	E. Shaw	-	-	-	Do.
York	-	C. Wakefield	-	-	-	Curator of Museum.
Nottingham	-	E. J. Lowe, F.R.S.	-	-	-	Highfield Ho. Observatory.
Ardrossan	-	W. McNeil	-	-	-	Telegraph Clerk.
*Greencastle(Moville)	-	J. McGladery	-	-	-	Do.
Donaghadee	-	J. MacGowan, jr.	-	-	-	Do.
Kingstown	-	G. Mitchell	-	-	-	—
*Holyhead	-	J. Tilston	-	-	-	—
Liverpool	-	J. Hartnup, junr.	-	-	-	Liverpool Observatory.
*Valencia	-	E. O'Sullivan	-	-	-	Telegraph Clerk.
Roche's Point	-	W. Kennedy	-	-	-	Do.
Pembroke	-	J. C. Walker	-	-	-	Do.
Portishead	-	W. Sandford	-	-	-	—
*Scilly	-	W. Thomas	-	-	-	—
Plymouth	-	J. Merrifield, F.R.A.S.	-	-	-	Teacher of Navigation.
Portsmouth	-	J. Hoar	-	-	-	—
Dover	-	J. Costello	-	-	-	Telegraph Clerk.
*London	-	F. Gaster, F.M.S.	-	-	-	—
Oxford	-	J. Lucas	-	-	-	Radcliffe Observatory.
Cambridge	-	H. Todd	-	-	-	Observatory.
Yarmouth	-	G. T. Watson	-	-	-	—

Summary :

England and Wales	-	-	-	16
Scotland	-	-	-	8
Ireland	-	-	-	5

Those marked with an asterisk, report twice daily. The office also receives daily reports from 18 places on the Continent (including two from Denmark).

APPENDIX VIII.

LIST of Persons, Places, &c. to which the Daily Weather Report has been supplied, free of cost, to 31st December.

Newspapers :

- Daily News.
- Echo.
- Express.
- Globe.
- Imperial Beacon.
- Lloyds' Shipping List.
- Mark Lane Express.
- Mechanics' Magazine.
- Morning Advertiser.
- Observer.
- Pall Mall Gazette.
- Shipping and Mercantile Gazette (with special daily chart).
- Standard (Morning and Evening).
- Times (1st and 2nd editions).

*For Exhibition at following Seaports :*

Banff.	Hull.
Barrow-in-Furness.	Nairn.
Belfast.	Newquay.
Blackpool.	Plymouth.
Boscastle.	Port Dinorwic.
Buckie.	Porthcawl.
Carnarvon.	Portland.
Cowes.	St. Ann's Head.
Cromer.	Scarboro'.
Cullercoats.	Silloth.
Dover.	Teignmouth.
Exeter (2 copies).	Thurso.
Falmouth.	Ventnor.
Great Grimsby.	Weston-super-Mare.
Hastings.	Yarmouth.
Hayle.	

*In exchange for Observations, &c. :*

Aird, G. H., Seaham.  
 Barnes, R. H.  
 Barnstaple Meteorological Committee.  
 Clouston, Rev. C., Sandwick, Orkney.  
 Cooper, Col., Markree, nr. Sligo.  
 Cooper, W. F., Sheffield.  
 Curtis, Prof. A. H., Galway.  
 Fernley Observatory, Southport.  
 Greenwich Observatory.  
 Griffith, Rev. C., Strathfield Turgiss.  
 Hills, Staff Comr., Liverpool.  
 Hoskins, Dr. S. E., Guernsey.  
 Jersey Submarine Telegraph Company.  
 Liverpool Observatory.  
 Malleson, Rev. F., Broughton-in-Furness.  
 Moore, Dr. J. W., Dublin.  
 Morris, E. E., Bedford.  
 Moyle, M. P., Helston.  
 Northumberland, Duke of, Alnwick.  
 Prince, C. L., Tunbridge Wells.  
 Radcliffe Observatory, Oxford.  
 Richards, W. H., Penzance.  
 Rosse, Earl of, Parsonstown.  
 Royal Horticultural Society.  
 Rugby Natural History Society.  
 Sawyer, F. E., Brighton.  
 Schomberg, Admiral, Holyhead.  
 Stewart, Dr. Balfour, F.R.S., Manchester.  
 Stow, Rev. F. W., Harpenden.  
 Sutherland, A., Carrickfergus.  
 Walker, J. C., St. Ann's Head.  
 Whitehouse, W. O., Hampstead.  
 Yorkshire Philosophical Society.

*Government Offices, Societies, &c. :*

The Queen.  
The Principal Government Offices : 20 in number.  
"Achilles," H.M.S.  
Association of Underwriters, Liverpool.  
Do. Lloyds'.  
"Britannia," H.M.S.  
British Museum.  
Calcutta, Meteorological Committee.  
International Exhibition.  
Meteorological Society, London.  
Patent Office.  
Plymouth Dockyard.  
Portsmouth, Commander-in-Chief.  
Do. R. N. College.  
Press Association.  
Reuter's Telegram Company.  
Royal Artillery Institution.  
Royal Military Academy.  
Royal Society.  
Royal United Service Institution.  
Scottish Meteorological Society.  
Sheerness Dockyard.  
Staff College.

*Foreign Places :*

Christiania, Meteorological Institute.  
Constantinople, Imperial Meteorological Observatory.  
Emden, Dr. Prestel.  
Hamburg, German Ocean Observatory.  
Lisbon, Observatory.  
Madrid, Royal Observatory.  
Paris, Meteorological Observatory, Montsouris.  
,, Meteorological Society.  
,, Ministry of Marine.  
,, National Observatory.  
Rome, Ministry of Agriculture.  
St. Petersburg, Central Physical Observatory.  
Upsala, University Observatory.  
Utrecht, Royal Meteorological Institute.  
Vienna, Imperial Meteorological Institute.  
Washington, Smithsonian Institution.  
,, United States Naval Observatory.  
,, Chief Signal Officer, War Office.

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APPENDIX IX.

TELEGRAPHIC WEATHER INTELLIGENCE.

The following stations, having been approved by the Board of Trade, are supplied with telegraphic information of storms free of expense, and "drum" signals have been furnished to most of them, all further expenses attendant on the maintenance and repair of the apparatus

being borne locally. The stations are situated, 78 in England and Wales, 32 in Scotland, 13 in Ireland, 3 in the Isle of Man, and 3 in the Channel Islands.

NORTH.	WEST.	SOUTH.	EAST.
SCOTLAND. EAST COAST.	ENGLAND, N. W.	ENGLAND, S. W.	ENGLAND, E.
Kirkwall.	Silloth.	Ifracombe.	Tynemouth.
Inverness.	Maryport.	Barnstaple.	S. Shields.
Nairn.	Workington.	Port Isaac.	Sunderland.
Burghead.	Whitehaven.	Boscastle.	Middlesborough.
Lossiemouth.	Ramsey.	Newquay.	Redcar.
Buckie.	Douglas.	Hayle.	Whitby,
Portsoy.	Castletown.	Pendennis.	Filey.
Banff.	Barrow.	Scilly.	Withernsea.
Fraserburgh.	Morecambe.	Penzance.	Hull.
Peterhead.	Fleetwood.	Falmouth.	Goole.
Aberdeen.	Blackpool.	Plymouth.	Grimsby.
Stonehaven.	Lytham.	Teignmouth.	Boston.
Montrose.	Runcorn.	Exeter.	Sutton Bridge.
Broughty Ferry.	Southport.	Exmouth.	Lynn.
St. Andrews.	Liverpool.		Cromer.
Dundee.	Queensferry.	ENGLAND, S.	ENGLAND, S. E.
Anstruther.	Hawarden.	Guernsey.	Yarmouth.
St. Monance.	Mostyn.	St. Helier, Jersey.	Southwold.
Burntisland.	ENGLAND, W.	Gorey, Jersey.	Ipswich.
Alloa.	Port Penrhyn.	Weymouth.	Harwich.
Grangemouth.	Holyhead.	Poole.	Chatham.
Bo'ness.	Carnarvon.	Cowes.	Sheerness.
Granton.	Port Dinorwic.	Ventnor.	Faversham.
Leith.	Aberystwith.	Portsmouth.	
Fisherrow.	Milford.	Littlehampton.	
Dunbar.	Pembrey.	Brighton.	
Eyemouth.	Llanelly.	Newhaven.	
	Swansea.	Hastings.	
	Briton Ferry.	Rye.	
	Porthcawl.	Dover.	
	Penarth.		
	Cardiff.		
	Newport.		
	Weston-super-Mare.		
	Burnham.		
FIRTH OF CLYDE.	IRELAND, E.		
Glasgow.	Belfast.		
Greenock.	Howth.		
Rothsay.	Kingstown.		
Campbeltown.			
Girvan.	IRELAND, S. and W.		
	New Ross.		
	Dunmore, East.		
	Dungarvan.		
	Youghal.		
	Queenstown.		
	Passage.		
	Cork.		
	Tralee.		
	Limerick.		
	Galway.		

APPENDIX X.

FISHERY BAROMETERS.

LIST of PLACES supplied with FISHERY BAROMETERS.

Those supplied during the years 1867-72 are distinguished by an asterisk.

*Shetland Isles.*—Sandsair, Lerwick.

*Orkney Isles.*—Burray. Kirkwall.\*

*Scotland, east coast.*—Stroma, Staxigoe, Sarclet, Lybster, Portmahomack, Cromarty, Avoch, Nairn, Burghead, Portessie, Port Knockie, Portsoy,\* Whitehills, Gardenstown, Roseheart, Pitullie, Findon, Portlethen, Arbroath, Broughty Ferry, St. Andrews, Crail, Cellardyke, St. Monance,\* Burntisland, Newhaven.

*England, east coast.*—Berwick, Beadnell, North Shields, South Shields, West Hartlepool, Staithes, Scarborough, Filey, Flamborough, Bridlington Quay, Withernsea, Hull, Lynn, Wells, Gorleston, Harwich,\* Brightlingsea,\* Wivenhoe,\* Margate, Deal, Kingsdown, Dover.

*England, south coast.*—Bognor,\* Portsea, St. Helens and Ventnor\*(2) (Isle of Wight), Gorey (Jersey), Poole, Weymouth, Portland, Budleigh-Salterton, Cawsand, Mevagissey, Gorranhaven, Devoran, Penryn, Falmouth, Newlyn, Mousehole.

*England, south-west coast.*—St. Ives, Hayle, Port Isaac, Boscastle,\* Fremington, Burnham, Highbridge.

*Wales.*—Briton Ferry,\* Swansea, Angle,\* Milford.

*England, north-west coast.*—Fleetwood, Morecambe, Maryport.

*Isle of Man.*—Port St. Mary,\* Peel.

*Scotland, south-west coast.*—Port Patrick,\* Stranraer.

*Ireland, east coast.*—Portrush,\* Cushendall,\* Belfast, Bangor, Strangford, Ardglass, Carlingford,\* Dundalk, Malahide,\* Howth, Kingstown, (2).

*Ireland, south coast.*—Dungarvan, Kinsale,\* Crookhaven.\*

*Ireland, west coast.*—Valencia, Dingle, Tralee, Ballina,\* Killybegs.\*

*Ireland, north coast.*—Bunbeg, Burton Port, Dunfanaghy, Rathmullen.

*Scotland, west coast.*—Campbeltown,\* Portree (Isle of Skye) Plockton.

*Hebrides,* Stornoway, Cromore, Babye, Obb, Ness.

SUMMARY of INSTRUMENTS on SERVICE.

England and Wales	-	-	-	-	56
Scotland	-	-	-	-	40
Ireland	-	-	-	-	24
					<hr/>
					120
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## APPENDIX XI.

## DONATIONS RECEIVED DURING THE YEAR 1872.

Presented by Societies, Institutions, &amp;c.

Albany, U.S.	- Dudley Observatory-	- Annals, Vol. II., 1866-70. By Geo. Hough, A.M., Director.
Barnstaple	- Lit. and Sc. Institution	- Meteorological Table for 1871.
Batavia	- Observatory - - -	- Magnetical and Meteorological Observations, Vol. I. Magnetical, July 1867 to June 1870. Meteorological, January 1866 to December 1868. By Dr. P. A. Bergsma, Director.
Berlin	- K. Statistische Bureau	- Preussische Statistik, Nos. 15, 25. (Monthly means of Pressure, Temperature, &c., for 1871.) Rainfall, 1848-70. By Professor H. W. Dove.
Bombay	- Colaba Observatory	- Magnetical and Meteorological Observations, 1865-70. By C. Chambers, Supt.
Calcutta	- Meteorological Office	- Meteorological Report for 1871. Abstract of Observations, 1870-2. By H. F. Blanford, Government Meteorological Reporter.
	St. Xavier's College	- Meteorological Register, July 1871 to June 1872. By the Rev. E. Lafont, S.J.
	Surveyor General's Office	Abstracts of the Results of Hourly Meteorological Observations, 1847-1869, and Sept. 1871 to Sept. 1872. By Col. Thuillier, F.R.S.
Carlsruhe	- Meteorologische Central-Station.	I Jahresbericht. 1869. Ergebnisse der meteor. Beobachtungen der badischen Stationen. By Dr. F. Söhnke.
Chiswick	- R. Horticultural Society	- Reduction of Meteorological Observations made in the years 1826-69. By W. Thistleton Dyer, F.L.S.
Christiania	- Norske Meteorologiske Institut.	Meteorologisk Aarvog for 1871. Meteorologiske Jagttagelser i Norge, December 1871 to September 1872. Aarsberetning 1868-9. By Professor H. Mohn, Director, and by the University.
Coimbra	- Observatorio da Universidade.	Observações meteorológicas 1866-70. By Sr. de Sousa.
Colombo (Ceylon).	Surveyor General's Office	Monthly results of Meteorological Observations made at 36 stations, October 1871 to October 1872. Rainfall returns, 1871. By Captain A. B. Fyers, R.E.
Constantinople	Observatoire Impérial Météorologique.	Résumé des Observations Météorologiques, June to December 1871. By A. Combarry, Director.

Copenhagen	-	K. Danske Videnskabernes Selskab. K. Landhus-holdnings-selskab	Forhandlinger, No. 1 for 1872. By J. Steenstrup, Secretary. Aars-beretning, 1870; Fem-aars-beretning, 1866-70; Vejrforholdene, November 1871 to November 1872. By H. J. Fjord and J. C. La Cour. The Danish Pilot. Sailing directions for Arsuk Fjord (S. Greenland), W. coast Greenland, and Iceland. With charts. By Commodore Rothe.
Cracow	-	K. K. Sternwarte	Meteorologische Beobachtungen, November 1871 to Materyaly do Klimatografii Galicyi. Rok 1871. By Dr. F. Karlinski, Director.
Dorpat	-	Kaiserliche Universität	Meteorologische Beobachtungen, 1870-71.  1866 "nebst fünfjährigen" Mittelwerthen, 1866 bis 1870. By Dr. A. v. Oettingen.
Edinburgh	-	Royal Observatory Royal Society Scottish Meteorological Society.	Scottish Meteorology, 1856-71. By C. P. Smyth, Astronomer Royal. Proceedings, Vol. VI., Nos. 71-76. " Vol. VII., Nos. 77-82. Journal, New Series, Vol. III., Nos. 33-35.
Falmouth	-	R. Cornwall Polytechnic Society.	Meteorology of West Cornwall and Scilly, 1871. By W. P. Dymond, Hon. Sec.
Fiume	-	I. R. Academia di Marina	Meteorological Observations, November 1871 to June 1872. Results of ditto, 1869-71.
Geneva	-	Société Géographique	Le Globe, Vols. V.—IX. " Vol. XI., Nos. 1-3.
Greenwich	-	Royal Observatory " " "	Report of the Astronomer Royal to the Board of Visitors, 1865-8 and 1872. Magnetical and Meteorological Observations, 1870. Daily Weather Reports, from 21st May 1872. Weekly Returns to Registrar-General, Vol. XXXIII. By Sir G. B. Airy, K.C.B., Astronomer Royal.
Gorizia	-	- - - -	Osservazioni delle stazione meteorologica, January to April 1872.
Hamburgh	-	Deutsche Seewarte " "	Jahres-Bericht, 1871. "Hansa" 1872. Wetterberichte, for year 1872. Die Normalwege der Hamburger Dampfer zwischen dem Kanal und New York. By W. H. v. Freeden, Director.
Hong Kong	-	Government Civil Hospital Harbour Office	Meteorological Observations taken at Victoria, Oct. 1871 to Oct. 1872. By R. Young, M.D. Meteorological Observations taken at Praya West and Victoria Peak, Oct. 1871 to Jan. 1872. By Captain H. Thomsett, R.N., Harbour Master.
Kremsmünster-	-	Sternwarte	Resultate aus den im Jahre 1869 ange- stellten meteorologischen Beobachtungen.

Lahore - -	Meteorological Department for the Punjab.	Meteorological Observations for the years 1868-71. By Dr. A. Neil, Government Meteorological Reporter.
Leipzig - -	Stern warte - - -	Übersicht der Resultate aus den meteor. Beobachtungen angestellt auf den K. sächsischen Stationen, July 1871 to July 1872. Results of ditto for year 1869. Meteorologische Beobachtungen angestellt auf der Leipziger Universitäts- Sternwarte, 1867 and 1870. By Dr. C. Bruhns, Director.
Lemberg - -	K. K. Universität - - -	Meteorologische Beobachtungen, Oct. 1871 to July 1872. By Dr. A. Handl, Director.
Lisbon - -	Observatorio do Infante D. Luiz. ”	Relatorio do Serviço do Observatorio do Infante D. Luiz, 1870-1. Boletim Meteorologico for the year 1871. By Sr. F. da Silveira, Director, and Sr. C. de B. Capello.
Liverpool - -	Observatory - - -	Reports of the Astronomer to the Marine Committee, &c., 1868 and 1871. By J. Hartnup, F.R.A.S.
London - -	Admiralty - - - ” Army Medical Department. Board of Trade - - - British Association - - - British Horological Institute. Colonial Office - - - India Office - - - London Institution - - - Meteorological Society - - - Royal Astronomical Society ” ” Royal Geographical Society ” ” Royal Institution of Great Britain. Royal National Lifeboat Institution. Royal Society - - - ” Royal United Service Institution. Society of Arts - - -	Tide Tables for 1873. Nautical Almanac for 1872. Wind and Current Charts for Pacific, Atlantic, and Indian Oceans. By R. Admiral Richards, C.B., F.R.S., Hydrographer. Reports for years 1865-70. Report of Wrecks, Casualties, &c. for 1871. By Thos. Gray, Assistant Secretary. Report for 1871. Journal, Vol. XIV., Nos. 161-8. Returns from various colonies and settlements. Returns from various Observers in India. Journal, Vol. II., Nos. 10-17. Quarterly Journal, Vol. I., Nos. 1-4. Monthly Notices, Vol. XXXII., Nos. 2-9. Monthly Notices, Vol. XXXIII., Nos. 1-2. Memoirs, Vol. XXXIX., Part 2. Proceedings, Vol. XV., No. 5; Vol. XVI., Nos. 1-4. Journal, Vol. XLI. Memoir on the resumption of North Polar Discovery. Proceedings, Vol. VI., No. 56. Report, 1872. Journal, Nos. 83-86. Proceedings, Vol. XX., No. 131-8. Vol. XXI., No. 139. Catalogue of Scientific Papers, Vol. VI. Journal, Vol. XV., No. 65a. ” XVI., Nos. 66-68. Journal, Nos. 997-1,051.

Lyons	-	Commission Météorologique.	Reports for 1868-9. By Mr. E. Lafon, President.
Madrid	-	R. Observatorio	Daily Weather Reports from 1st July 1872. By Sr. Aguilar, Director.
Manchester	-	Literary and Philosophical Society.	Proceedings, Vol. XI., Nos. 12-14. " XII. " 1-4.
Mauritius	-	Meteorological Society	Monthly Notices, November 1871. An Aurora Australis. By C. Meldrum, M.A.
Melbourne	-	Flagstaff Observatory	Observations at Melbourne and various places in Victoria, November 1871 to September 1872. By R. J. Ellery, Director.
Modena	-	R. Observatorio	La velocita del vento. Sui principali fenomeni della variazioni diurne del calore atmosferico. Le Stazioni pluviometriche della Provincia di Modena. Exposizione e discussione dei risultati del barometro registratore, 1867. Descrizione dell' Igrotermografo, &c., di Modena. Sui coefficienti ozonometrici dell' umidità e della temperatura. Il pulviscola atmosferico. Osservazioni sulla evaporazione, 1867, &c. Risultati delle osservazioni sull' elettricismo atmosferico. Descrizione della nuova finestra meteorologica. Sismografo registratore. Sulla latitudine del R. Osservatorio di Palermo. Descrizione del Barometro registratore. Stelle meteoriche di agosto, 1867. Notamento di varie pubblicazioni riguardanti scienze astronomiche e fisiche. Sulla pioggia normale di Modena. Sulle leggi che seguono in Modena le correnti atmosferiche, &c. By Sr. D. Ragona, Director.
Moncalieri	-	Osservatorio del R. Collegio Carlo Alberto.	Bullettino Meteorologico, Vol. VI., Nos. 1-11.
		"	Observations météorologiques faites dans les stations des Alpes Italiennes, May 1872. Intorno alle aurore polari del primo quadrimestre dell' anno 1872. By Sr. F. Denza, Director.
Munich	-	Königliche Sternwarte	Meteorologische und magnetische Beobachtungen, November 1871 to June 1872. Beilage, Nos. 9-11, 1872. By Dr. J. v. Lamont, Director.
Naples	-	Specola Reale	Osservazioni meteoriche, October 1871 to April 1872. Osservazioni barografiche e termografiche, October 1871 to April 1872. Sopra alcuni fenomeni Spettrali viati durante l'eclisse del 22 Dicembre 1870, &c. Sul calcola delle orbite delle stelle doppie, by A. de Gasparis. By Sr. Brioschi, Director.
New York	-	Central Park Observatory	Report for 1871. By Prof. D. Draper.
Ottawa	-	Ministry of Marine and Fisheries.	Report for year ending 30th June 1871. By P. Mitchell.

*Appendix to Report of the Meteorological Committee*

Oxford	-	Radcliffe Observatory	-	Results of Meteorological Observations, 1869. By Rev. R. Main, Radcliffe Observer.
Palermo	-	R. Osservatorio	-	Bullettino Meteorologico, Vol. VII. Vol. VIII., Nos. 1-4. By Sr. G. Cacciato, Director.
Paris	-	Académie des Sciences	-	Comptes Rendus Hebdomadaires, Vol. LXXIII., Nos. 24-26. " LXXIV. " LXXV.
		Association Scientifique de France.	-	Bulletin Hebdomadaire, Nos. 217-270.
		Dépôt des Cartes et Plans	-	Annales Hydrographiques, 2nd half of 1871.
		"	-	Phares des Côtes.
		"	-	Routes des batiments à vapeur dans l'océan Indien, &c. By Captain A. Le Gras.
		Ministère de la Marine	-	Revue Maritime et Coloniale. Vols. XXXII. to XXXV.
		"	-	Tableaux de Population, de Culture, &c., for 1868.
		Observatoire Météorologique de Montsouris.	-	Bulletins Météorologiques for 1872. By M. C. Sainte-Claire Deville, and M. Marié-Davy.
		Observatoire de Paris	-	Annuaire Météorologique, 1873.
		"	-	Atlas Météorologique annuel, 1869-71 (incomplete).
		"	-	Bulletin Météorologique mensuel, 1872. By M. Marié-Davy.
		Société Météorologique de France.	-	Annuaire, Vols. XVII., XIX.
Pesth	-	Academy of Sciences	-	Meteorological Observations, 1841-9. By M. S. Krusper.
Philadelphia	-	American Philosophical Society.	-	Proceedings. Vol. XII., Nos. 87-8.
		Franklin Institute	-	Journal, Vol., LXIV.
Pola	-	KK. Hydrographisches Amt.	-	Meteorologische Beobachtungen, February to October 1862. By F. J. Pick, Austrian Imperial Navy.
Prague	-	K. K. Sternwarte	-	Magnetische und meteorologische Beobachtungen, 1871.
		"	-	Über den Einfluss der Electricität der Sonne auf den Barometer-stand. By Dr. C. Hornstein.
Rome	-	Ministero d'Agricoltura Industria e Commercio.	-	Meteorologia Italiana, August 1871 to April 1872.
		"	-	Climatologia Italica, September 1871 to May 1872. By the late Dr. P. Maestri.
		Osservatorio del Collegio Romano.	-	Bullettino Meteorologico, Vol. X., No. 12. Vol. XI., Nos. 1-11. By Sr. Padre A. Secchi, Director.
Roorkee	-	Meteorological Department of N.W. Provinces of India.	-	Report for 1871.
		"	-	Abstract of Observations at Lucknow, 1871.
		"	-	Oudh Meteorological Report, April 1870 to March 1871. By Murray Thompson, M.D., Government Meteorological Reporter.

Rugby -	Natural History Society -	Reports 1868-71. By F. E. Kitchener, President.
St. Petersburg -	Central Physical Observatory.	Annales de l'Observatoire, 1870.
	" -	Repertorium für Meteorologie, &c., Vol. II., Part 2.
	" -	Jahres-Bericht for 1871.
	" -	Instruction zur Aufstellung der Anemometer und kleinen Windfahnen. Ergänzungen zur Instruction für meteorologische Stationen. Catalog der meteor. Beobachtungen im russischen Reich, von F. Claver. Über ein neues magnetisches Universal-instrument. Über ein neues Variations-instrument für die Verticalintensität des Erd-magnetismus. Études Métrologiques. By Dr. H. Wild, Director.
	Société Impériale Géographique	Travaux Météorologiques. No. 2. September 1871. By Dr. A. v. Wojeikoff.
Santiago -	Marine Ministry -	Memoria de Marina, 1871.
Singapore -	Convict Jail Hospital -	Meteorological Observations, September 1871 to September 1872.
	" -	Abstracts, 1869-71. By H. L. Randell, M.D.
Southport -	Fernley Observatory -	Weekly Abstracts of Observations and Results, 1872. By J. Baxendell, Esq., F.R.A.S.
Stockholm -	K-Svenska Vetenskaps Akademien.	Meteorologiska Iakttagelser i Sverige, 1867-70. By Prof. E. Edlund.
Stonyhurst -	Observatory - - -	Results of Magnetical and Meteorological Observations, 1871. Magnetic Survey of the east of France in 1869, No. 2. By the Rev. S. J. Perry, S.J.
Stuttgart -	Polytechnische Schule -	Uebersicht über die meteorologischen Verhältnisse Württembergs nach den Resultaten der württembergischen Stationen, December 1871 to September 1872. Die Witterungsverhältnisse des Jahres 1870. Normale Wärmemittel von Stuttgart und Heidenheim. Hülftafeln zur Untersuchung und Gebrauch der Aneroidbarometer. By Dr. H. Schoder.
Tiflis -	Imperial Observatory -	Materialien zu einer Klimatologie des Kaukasus, Vol. I., Part 3. Schemacha und seine Erdbeben. By Dr. A. Moritz, Director.
Toronto -	Education Office - -	Journal of Education, Vol. XXV. By the Rev. E. Ryerson, D.D.
	Magnetical Observatory -	Monthly Meteorological Register, January to June 1872. By G. T. Kingston, M.A., Director.
Trieste -	R. Accademia di Commercio e Nautica.	Osservazioni Meteorologiche, November 1871 to October 1872. Results of Observations for 1871.
Turin -	R. Osservatorio - -	Bollettino Meteorologico ed Astronomico, 1872. By Sr. Dorna, Director.
	" -	

Upsala - -	Observatoire - - -	Bulletin Météorologique Mensuel, Vol. I., No. 11; Vol. II., Nos. 10-12; Vol. III., Nos. 11-12; Vol. IV. Nos. 1-7. By MM. Svanberg and Rubenson.
Utrecht - -	K. Nederlandsch Meteor. Instituut.	Temperatur van het zeewater, &c. N. A. Oceaen, Jaarboek, 1868, Part II. 1871, Vol. I. Route voor stoomschepen door den indischen Oceaen, &c. Suggestions on a uniform system of Meteorological Observations. By Dr. Buys Ballot, Director, and M. Cornelissen.
Vienna - -	K. K. Centralanstalt für Meteorologie und Erdmagnetismus.	Beobachtungen, November 1871 to October 1872.
	„	Jahrbücher, Bd. VI. 1869.
	„	Telegraphische Witterungsberichte, December 1871 to November 1872. By Dr. C. Jelinek, Director.
	K. K. Sternwarte - -	Wiener Meteorologische Beobachtungen, 1867. By Dr. C. v. Littrow, Director.
	Oesterreichische Gesellschaft für Meteorologie.	Zeitschrift, Bd. VII. By Dr. C. Jelinek.
Washington -	Department of Agriculture	Report for 1870. Monthly Reports for 1871.
	Hydrographic Office -	Papers on the Eastern and Northern Extension of the Gulf Stream. First Supplement to do. By Commodore Jenkins.
	Smithsonian Institution -	Report for 1870. By Professor J. Henry, Secretary.
	U. S. Naval Observatory -	Astronomical and Meteorological Observations for 1869. Reports on the Solar Eclipse of 22nd December 1870. Discussion of Meteorological phenomena observed at U. S. Naval Observatory, June 1842 to January 1867. Reports on the Observation of Encke's Comet during its return in 1871. Papers on the transit of Venus in 1874. Part I. By Admiral Sands, Superintendent.
	War Office - - -	Daily Weather Reports and Maps, for 1872. Annual Report for year 1871. By Brigadier-General Myer, U.S.A.
Wellington, N.Z.	Observatory - - -	Meteorological Observations at various Stations, July 1871 to May 1872. By J. Hector, M.D., F.R.S., Government Meteorological Reporter.
Zürich -	Meteor. Centralanstalt der schweizerischen naturforschenden Gesellschaft.	Meteorologische Beobachtungen, Jany. to November 1871. By Dr. R. Wolf.

Presented by the Authors.

Abbé, C. - - -	On the connection between Terrestrial Temperature and Solar spots. Historical note on the method of Least Squares.
Aguilar, Sr. - - -	See Madrid.
Airy, Sir G. B., K.C.B., F.R.S.	„ Greenwich. Presidential Address to Royal Society, Nov. 30, 1872.
Allison, F., M.A. - - -	Synopsis of Climatological Statistics, Canada, January to March 1872. General Register for 1871, Halifax and Nova Scotia. Meteorological Observations at Halifax, to November 1872.
Babbage, B. H. - - -	The Currents of Air and Ocean.
Ballot, Buys, Dr. - - -	See Utrecht.
Baxendell, J. - - -	„ Southport.
Beazley, A., C.E. - - -	On Fog Coast Signals.
Belavenetz, Capt., R.I.N. - - -	Russian Nautical Magazine, Nos. 11-12 for 1871, Nos. 1-11 for 1872.
Blanford, H. F. - - -	Note on correction of Calcutta Standard Barometer. See also Calcutta.
Boguslawski, G. v. - - -	Beitrag zur Witterungskunde von Stettin, Nos. 2-4.
Brioschi, Sr. - - -	See Naples.
Bruhns, Dr. C. - - -	„ Leipzig.
Buchan, A., M.A. - - -	Address to Botanic Society (Edinburgh).
Cacciatore, Sr. - - -	See Palermo.
Capello, Sr. - - -	„ Lisbon.
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Wojeikoff, Dr. A. von	-	-	„ do.
Wolf, Dr. R.	-	-	„ Zürich.
Young, R., M.D.	-	-	„ Hong Kong.
Zurcher, M. F.	-	-	Les Naufrages célèbres.

## APPENDIX XII.

LIST of PERSONS in the EMPLOYMENT of the METEOROLOGICAL COMMITTEE on December 31st, 1872, with their Occupations and Amount of Salary.

Name.	Duties.	Salary.						
		Yearly.			Weekly.			
		£	s.	d.	£	s.	d.	
<i>Office.</i>								
Robert H. Scott -	Director of the office - - -	800	0	0	—			
J. S. Harding, jun. -	Correspondence, Accounts, Library -	200	0	0	—			
J. S. Harding, sen.	} Copying, accounts of stores, registry of documents, &c. }	—			1	18	6	
T. D. Bell - - -			—			1	2	0
<i>Land Meteorology (Observatories).</i>								
R. H. Curtis - - -	} Reproduction of observatory curves by pantagraphs, and preparation for publication. }	120	0	0	—			
F. C. Steventon - - -			110	0	0	—		
C. Stodart - - -			—			2	0	0
H. W. Woodward - - -			—			1	0	0
J. A. Curtis - - -			—			1	12	0
W. L. Dallas - - -	} Discussion of returns and compu- tations. }	—			1	10	0	
J. P. Cutts - - -			—			1	0	0
<i>Land Meteorology (Telegraphy).</i>								
F. Gaster - - -	} Preparation of weather reports, and computations. }	160	0	0	—			
F. Brodie - - -			—			1	3	0
G. G. Francis - - -			—			1	3	0
R. Sargeant - - -			—			0	15	0
<i>Ocean Meteorology.</i>								
Capt. H. Toynbee -	Marine Superintendent - - -	400	0	0	—			
W. Salmon - - -	Discussion of data - - -	250	0	0	—			
R. Strachan - - -	Care of instruments and reduction of meteorological returns.	230	0	0	—			
C. Harding - - -	Discussion of data - - -	140	0	0	—			
W. G. James - - -	} Computations - - - }	—			1	12	0	
T. E. Allen - - -			—			1	12	0
J. W. McVeagh - - -			—			0	16	0
<i>Commissionaire</i> - Messenger - - - - -								
Rev. Thos. Kerr -	Director of Valencia Observatory -	250	0	0	—			

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of the Meteorological Committee.**

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6. Report for 1869. Presented to Parliament. 10d.
7. Quarterly Weather Report for 1869. Parts I. to IV. Price 5s. each. [Stanford.]
8. Barometer Manual. 1s.
9. Quarterly Weather Report for 1870. Parts I. to IV. Price 5s. each. [Published by Stanford, Charing Cross.]
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15. Report for 1871. Presented to Parliament. 10d.
16. Quarterly Weather Report for 1872.—Parts I.—II.—III. January—September. Price 5s. each. [Stanford.]

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