

# REPORT

OF THE

## METEOROLOGICAL COMMITTEE OF THE ROYAL SOCIETY,

For the Year ending 31st December 1870.

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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 gentlemen who were nominated in 1866 by the Royal Society, 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 Committee hold a meeting of some hours' duration at least once a fortnight, 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.

The Committee consists of the following members :—  
GENERAL SIR E. SABINE, K.C.B., President of the Royal Society,  
*Chairman.*

Mr. FRANCIS GALTON.

Mr. GASSIOT.

THE HYDROGRAPHER OF THE ADMIRALTY.

Mr. DE LA RUE.

Mr. W. SPOTTISWOODE.

Colonel W. J. SMYTHE, R.A.

SIR CHARLES WHEATSTONE.

May 1871.



# REPORT

For the Year ending December 31, 1870.

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## PART I.

IN their fourth Annual Report the Committee have to describe the steady and satisfactory progress of the work they have undertaken to superintend. Introduction.

Before referring more particularly to these operations, they cannot but advert to the very severe loss they have sustained, in the course of the year, by the decease of one of their number, Professor William Allen Miller ; to whose clear-sighted intelligence and unremitting interest in the system they have set in operation, its successful establishment in the first instance and its subsequent practical organization are in no slight measure due.\*

The work of the year presents no very special features of novelty, excepting as regards the arrangements which have been rendered necessary for the reproduction of the automatic instrumental records, which will be described in their proper place. In all other respects the staff of the office and the distribution of duties remain almost unchanged. Mr. R. H. Scott is charged with the entire management of the system, including the supervision of the outlying observatories. In the department of Ocean Meteorology he has the assistance of Captain Henry Toynbee, the Marine Superintendent, who takes the immediate charge of that branch of the work.

The records from the seven self-recording observatories, as in previous years, are examined at Kew in accordance with the arrangements described in the Report for 1869, p. 19. They are then forwarded for discussion to the central office. The publication of the results of this discussion has been commenced, and the volume for the year 1869 has appeared, as will be described hereafter.

The three heads into which the operations of the Committee are divided are as follows :—

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. Subdivision of objects of inquiry.

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

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\* May 1871. The vacancy caused by the death of Professor Miller has been filled by the nomination by the President and Council of the Royal Society of Sir Charles Wheatstone as a member of the Committee.

II. *Telegraphy and Weather 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 instruments.

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 re-comparison 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.
- 1 Thermometer screen.
- 4 Hydrometers.

And in exceptional cases an azimuth compass is added.

No observations made with instruments which have not been supplied, or authentically verified, by the office are 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 all the 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 is entirely voluntary. They would here acknowledge the receipt of most valuable registers from two of the vessels of the flying squadron, H.M.S. "Phœbe," Captain John Bythesea, V.C., and H.M.S. "Liverpool," Capt. J. O. Hopkins.

Progress of discussions.

The strict systematic examination of the materials in the office has been carried out on the plan described in former reports. *The entire mass of arrears of old registers has now been*

*dealt with.* Every document has been carefully tested under Capt. Toynbee's own superintendence, so as to ascertain from internal evidence the probable accuracy of the observations it contains; and if the result of this scrutiny is unsatisfactory, the log is at once set aside as undeserving of notice. Up to the end of the year 1870 2,410 documents had been examined in this way, so that all the manuscript materials found by the Committee in the office when they took charge of it had been thoroughly overhauled.

In the Report for 1867 the idea was held out that the discussion of about 1,000 logs would furnish materials for the investigation which has been undertaken, that of the meteorological conditions of the equatorial portion of the Atlantic Ocean from 20° N. to 10° S. It is found that out of the 2,650 documents actually in the office not more than 900 will be available for extraction for the district forming the subject of inquiry.

The process of sorting the observations, correcting and copying them into data books according to their date and the geographical position of the locality in which they were made, is in an advanced stage, and it is confidently hoped that the extraction will have been completed by the close of the year 1871. It will then only remain to discuss the materials and prepare the results for publication.

The system of correction of the actual observations deserves more than a passing notice. The ship's position is, in general, given only at noon, so that for all other hours the latitude and longitude must be calculated from the course made good during the time which has elapsed since the preceding noon. Correction of observations.

The compass bearings must all be corrected for variation and deviation, and the direction of the wind must also be corrected for the same errors.

The force of the wind must be modified if it be found not in accordance with the distance made, regard being had to the fact of the ship's sailing "on a wind," or "free," during the time.

The corrections for index error, temperature, and reduction to sea level must be introduced into all barometrical readings, while the readings of the thermometers and hydrometers must also be corrected wherever necessary. A careful examination of the current observations is also requisite, in order to determine whether or not they are sufficiently accurate to be fit for use. These considerations are sufficient to show that the correction and copying of the observations is really a process involving serious care and responsibility.

The present practice as regards the issue of instruments is that 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 vessels leaving London, a few have been supplied in the ports of Liverpool, Glasgow, and Aberdeen, at each of Collection of observations.

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 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 extraction.

The result of these efforts has been that, in the course of the year, the number of ships supplied has been nearly doubled, and that this increase in quantity has not found its compensation in a diminution as to quality is clearly shown by the fact that the average proportion of first-class logs among those regularly received is far higher than the figure reached in previous years.

The practice of classifying the logs according to their quality has been maintained; the grades are four in number: excellent; very good; good; ordinary.

Presentation of  
Pilot Charts.

To all the observers who have obtained the mark "excellent" a copy of the Atlantic Pilot Charts 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:—

Captain's Name.	Ship.
Almond, Thomas Michael -	"Decapolis."
Angel, John Fry -	"Twilight."
Blake, Edwin John -	"Gilbert Thompson."
Bouchette, Francis Baines -	S.S. "European."
Bruce, John -	"City of Adelaide."
Capper, Edward Hall -	"Palm Tree."
Davidson, Charles -	"Perseverance."
Donkin, Thomas, R.N.R. -	"Inverness."
Finlay, James -	"Duncairn."
Gray, David -	S.S. "Eclipse."
Gray, John -	S.S. "Mazinthien."
Hassell, Thomas Edward -	"Mervyn."
Heggum, Edward Carl V. -	"Czar."
Kennedy, James Branch, R.N.R. -	S.S. "Blue Cross."
Leportier, Theodore -	"Kate."
Mackellar, D. E. -	Observations at Rapa Island.
Morton, John D'Arcy -	"Henry Bath."
Mossop, Clement -	"Candahar."
Murphy, Michael -	S.S. "Tarifa."
Petch, John A. R., Nav. Lieut. -	H.M.S. "Phœbe."
Reid, Carson William -	"Lord Strathnairn."
* Scott, Fergus -	S.S. "Hotspur."
* Scott, George Alexander Brown -	S.S. "Nestorian."

\* Chief officer.

Captain's Name.	-	-	-	-	Ship.
Sharp, W. H., Staff Com.	-	-	-	-	H.M.S. "Liverpool."
Simpson, Alexander	-	-	-	-	" Traveller."
Smith, David, F.R.A.S.*	-	-	-	-	" Wiltshire."
Stanhope, John	-	-	-	-	" Decision."
Symington, William	-	-	-	-	" Northfleet" and " Flying Venus."
Tucker, John Worth	-	-	-	-	" John Temperley."
Williams, James Agnew	-	-	-	-	S.S. " Wisconsin."
Wylie, James	-	-	-	-	S.S. " Austrian."

Two of the above names are those of officers in the Royal Navy, to whom the Committee do not feel themselves at liberty to present the Pilot Charts; they have, therefore, only received the letters of thanks. 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; among these may be cited the names of Capts. Alfred Fry, Thos. E. Hassell, James Branch Kennedy, Clement Mossop, Charles Rawle, and Frederick Wherland, who have all been observing for 10 years or more.

The Committee are very glad to be able to congratulate themselves on having enlisted the services of a staff of first-class observers, constantly increasing, not only in numbers, but in zeal, and above all in accuracy. This result is fairly to be attributed to the pains which are taken to secure the co-operation of the ablest officers in our merchant service, and to point out to each of them the merits or the defects which may be discovered in his work when it is received at the office.

The geographical distribution of the vessels in which observations were being taken at the close of the year 1870 was as follows :

Localities  
whence obser-  
vations are  
being derived.

Voyages.	-	-	-	-	Ships.
To Baffin's Bay or Greenland	-	-	-	-	5
„ North America, East Coast	-	-	-	-	22
On East Coast, North America	-	-	-	-	3
To West Indies	-	-	-	-	5
„ Brazil	-	-	-	-	4
„ West Coast, South America	-	-	-	-	11
„ West Coast, Africa	-	-	-	-	2
„ Australia and New Zealand	-	-	-	-	15
„ India, viâ the Cape	-	-	-	-	29
„ India, viâ Suez	-	-	-	-	4
In India Seas	-	-	-	-	2
To China Seas, viâ the Cape	-	-	-	-	11
„ China Seas, viâ Suez	-	-	-	-	2
					—
					115

\* The Committee would desire at this opportunity to express their deep regret at the early death of one of the best observers the office has ever had. Captain David Smith, F.R.A.S., who only received the charts a few weeks before his death in the month of March last, was one of the keenest and most trustworthy scientific observers

As has already been explained, every one of these 115 ships carries a set of standard instruments, each of which has been verified at Kew, and is re-compared at the port of arrival as soon as the voyage is over, so as to ensure that any, even the slightest, change in the corrections shall not pass unnoticed.

Appendix No. III. contains a list of the documents received during the year in this department.

Arrears of work.

Having spoken of the collection of materials, it remains to say a few words as to the progress of the completion of the arrears of work found by the Committee in the office, and which, as already explained in previous reports, is gradually being effected at extra hours.

Chart of meteorological data for west coast of South America.

The information for the west and south coasts of South America, to which allusion was made in the Report for 1869, has been discussed for five degree squares, and the results entered on monthly charts, which have been lithographed. The introduction and explanation of the charts is in an advanced stage, and will shortly be published. Although the number of observations in many parts of the charts is but scanty, it is hoped that the publication of the data will not be without considerable value. In every instance the number of observations, from which a mean value has been deduced, is stated, so that some idea of the relative importance of local discrepancies can be obtained, and other data can be readily combined with it.

Anemometry Bermuda and Orkney.

Steady progress has been made with the large mass of anemometrical data from Orkney and Bermuda. The first step of the discussion has been to resolve the hourly values of velocity and direction into their two components, northerly (or southerly) and easterly (or westerly). This has been effected by means of a traverse table, and is complete for five years for Bermuda, and for six for Orkney. The length of time for which the instrument was working at Halifax was too short to make any detailed discussion of the results advisable.

The next step will be to sum and mean the values for the several months, and finally to combine them so as to deduce the components and resultant velocities, together with the atmospheric translation, for the entire period under examination.

“City of Boston” gale.

One special investigation, which has been taken up by Capt. Toynbee, merits particular notice. The loss of the “City of Boston” steamer, at the beginning of February 1870, drew the attention of the public to the weather prevailing over the Atlantic at the time. The telegraphic reports from Heart’s Content showed that very serious gales had passed over New Foundland at the end of January, and at this side of the Atlantic a severe southerly storm set in at the end of the first week in February,

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in our Mercantile Marine. He constantly carried out astronomical observations demanding great accuracy, such as the occultations of stars, while at sea; and the whole of his work, astronomical as well as meteorological, was a model of what precise registration of scientific phenomena should be.

which will be remembered, at least in the North of Scotland, by its having swept away the harbour works at Wick.

This, then, seemed to be a favourable opportunity for testing the truth of the often mooted proposition, that storms actually cross the Atlantic, from continent to continent. In order to obtain as much information as possible, application was made to the leading ocean steamship companies for the loan of logs, even from vessels not furnished with instruments from the Meteorological Office, and by this means much valuable information was collected. In addition, Herr von Freeden, Director of the Norddeutsche Seewarte, has most kindly supplied extracts from the logs of the North German Lloyd's steamers, and of other vessels observing for his office. The result has been that a large mass of facts has been accumulated, the co-ordination and discussion of which have occupied a long time. The investigation is now in an advanced stage, and it is hoped that its publication will not be long delayed.

Capt. Toynebee has also contributed a chapter, "on the use of the Barometer to Seamen," to the new edition of the Barometer Manual (see p. 17).

The only important application for information which has been received during the year has been from Dr. A. von Wojeikoff, of St. Petersburg, who has expressed a wish to obtain observations bearing on the weather of the Atlantic at certain specified periods. In accordance with the rules of the office, Dr. von Wojeikoff has at once consented to defray the expense of copying the documents.

It remains to say a few words as to the stock of instruments, &c. in the office.

The Hydrographic Office of the Admiralty, having expressed a wish to undertake the entire management of the deep sea thermometers, to which allusion was made in the last Report, on the ground that these instruments were essentially hydrographical and not meteorological, the Committee have at once acceded to the request, and no addition has been made to the stock of these thermometers during the year.

In Appendix IV. 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 1870. This latter statement is prepared from the latest returns furnished by the storekeepers at the respective dockyards, &c.

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

The only point requiring explanation in these returns is owing to the fact that several of the instruments on the Admiralty account have of late years been supplanted by others better adapted for use in the Royal Navy, as for instance, "gun" barometers, the tubes of which are packed with india-rubber so as to resist the concussion of gun-firing, are almost exclusively

used in ships of war instead of ordinary Kew barometers with unprotected tubes. Accordingly a number of these latter instruments have been transferred to the Mercantile Marine Account, together with some maximum and minimum thermometers, of a kind which are unfit for use at sea, but are required for the telegraphic reporting stations. A small number of other instruments have also been included in the transfer.

## II.—TELEGRAPHY AND WEATHER WARNINGS.

Condition of stations.

The number of telegraphic reporting stations on our coasts has remained unchanged during the year, for the re-establishment of Dover was soon followed by the suppression of Cape Clear. The list of stations with the observers' names will be found at App. VI. The Committee are only awaiting the extension of telegraphic communication to the Hebrides, to establish a station on those islands. They have already availed themselves of the new cable to the Scilly Isles, and have given directions to found a station there,\* and they are also in treaty about a station in the Shetlands. With reference to the reports from Scilly, they have to acknowledge the cordial assistance they have received from Sir W. Mitchell, and from Mr. Augustus Smith, of Tresco Abbey, which has enabled them to secure the services of the man who is entrusted with the duty of attending to the signals for the shipping, and is therefore constantly on the watch.

Changes in stations.

The change in the telegraphic system of the United Kingdom brought with it considerable modifications in the *personnel* of the stations and in the arrangements for carrying on the observations. In two instances, at Plymouth and Portsmouth, the old observers found themselves unable to continue to discharge their duties, and as on the premises of the respective Postal Telegraph Stations there were no available satisfactory positions for either thermometers or raingauge, a total change has been made at each place. At Plymouth the office has been so fortunate as to gain the assistance of Mr. J. Merrifield, F.R.A.S., Master of the Navigation School, who has long kept a meteorological journal for the town. At Portsmouth, thanks to the kind co-operation of Professor Main, a situation has been obtained on the grounds of the Royal Naval College.

The only other important changes have been in Ireland, and have resulted from the discontinuance of telegraphic lines. Greencastle ceased to be a telegraphic station at the end of the year 1870, and the instruments were in consequence removed to Moville, which is situated two miles to the south of Greencastle, and also on the Innishowen shore of Lough Foyle. The two stations enjoy about equal exposure to the wind, and are similarly shel-

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\* This station commenced work on the 1st of January 1871, and after it had been in operation for three months, and was found to be thoroughly satisfactory, the adjacent station of Penzance was suppressed. The cost of that station, now rendered comparatively useless, will be saved to meet the expense of that in the Shetland Isles.

tered to the westward. As regards the observations of sea disturbance, Moville is even less favourably placed than Green-castle, as the latter station lies at the very entrance of the lough. There is unfortunately no prospect of obtaining a thoroughly satisfactory station, as regards exposure, on the north-west coast of Ireland until the telegraph wires have been carried much further westward than they extend at present.

The communication with Cape Clear was finally suspended in the month of August, and, as a temporary expedient, the instruments were transferred to Crookhaven. On Mr. Scott's visit of inspection in October, this locality was found to be so ill-suited for the purpose of observations of wind that it was resolved to remove the instruments altogether, a step which was taken in November.

Dover was reconstituted a station in May, after having been discontinued for six years.

All the stations were visited by Mr. Scott in the course of the year, and were found to be in good order on the whole.

The report from Heart's Content, for the free transmission of which over the ocean line of telegraph the Committee are indebted to the munificence of the Anglo-American Telegraph Company, were received regularly up to the period that the cable ceased working. Since that date they have arrived monthly by post.

No change has been made in the system of exchange of information with foreign countries during the year, excepting that which has unavoidably arisen from the temporary interruption of telegraphic communication with France owing to the war. The Committee can only express the hope that ere long the complete restoration of peace in France will render it possible to re-establish the daily service of telegrams from Southern and Central France and from Spain, which is all but indispensable for the satisfactory working of our weather system. Foreign stations.

The relations with Norway have been of the most satisfactory nature, each office sending to the other regularly three telegrams in the morning and one in the afternoon, from selected points on the coast, and in addition occasional messages in case of storms.

The hopes for the establishment of a direct daily exchange of telegrams with Hamburg have not as yet been realized. However, Herr von Freeden, the Director of the Norddeutsche Seewarte in that town, holds out a prospect of its being organized in the course of the present year. Meanwhile the offices exchange information of storms whenever these occur. A similar arrangement is in operation with the Royal Meteorological Institute of Holland, from which office the Committee also receive the daily report from the Helder.

The office receives, or would receive, were the continental telegraphic communications perfect, 35 reports every morning, and 9 every afternoon. The stations are situated along the entire coast of the continent, from Christiansund, in lat. 63° N.,

to Corunna, with the exception, already noticed, of the north coast of Germany, and also of Denmark.

Preparation of daily weather report.

The daily observations, with the exception of those at Heart's Content, are taken at 8 a.m., Greenwich time, and most of the telegrams arrive in London before 10 o'clock. An hour is required for their reduction, discussion, and the preparation of the daily weather report, copies of which are at once supplied for the afternoon issue of several of the London papers. A brief telegraphic *resumé* 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. Copies of the complete report are then sent by post to the newspapers for next day's morning issue, and to certain seaports, 19 in number, which have applied for it on the terms named in the circular issued by the Committee in March 1867. (See Report, 1867, p. 17.) In addition, copies are supplied to a number of gentlemen, most of whom send in regular observations to the office. The Report is also sent to nine societies, &c. in Great Britain, as well as to the Meteorological Committee of Calcutta, and to 17 foreign institutions. A complete list of the recipients will be found at App. VII.

Direct wire from Telegraph Street.

With the view to accelerate the preparation of the daily weather reports, negotiations were instituted with the Post Office authorities for a direct wire to the office from Telegraph Street, and the Committee are glad to be able to acknowledge the very cordial manner in which Mr. Scudamore has come forward to meet their views in this, as in all other matters on which they have had to deal with his department.\*

Telegraphic weather intelligence.

The intelligence of storms which is sent out from the office is of different characters, according to the requirements of the place which receives it. In App. VIII. 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 December 1867 (Report for 1869, App. VIII.). These stations were, at the end of December, 108 in number, situated, 57 in England, 13 in Wales, 26 in Scotland, 10 in Ireland, and 2 in Jersey.† Lamps for night use are supplied to a few of the stations. All the stations have been established and are carried on on 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 36 hours, *and no longer*, from the time of its receipt, unless modified by a subsequent telegram, which is

\* The direct wire has been laid down and the service commenced on April 1, 1871.

† A large increase in the number of stations has been made since December 31, as will be seen from Appendix VIII.

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 special telegram is sent to the Underwriters' Association of Liverpool, whenever the difference between any two barometrical readings taken that morning in these islands or on the adjacent French coast, exceeds half an inch. The message consists of reports of the atmospherical pressure and the wind at the most important stations. By this means intelligence of the general conditions of weather that morning reaches the underwriters' rooms daily before 1 o'clock, as long as the atmosphere continues in a disturbed condition. Half the expense of transmission of these telegrams is borne by the Association.\*

Telegraphy to  
Liverpool.

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

A very important step in advance has been made by the enterprise of Sir W. Mitchell and Capt. Chas. Chapman of the "Shipping and Mercantile Gazette." These gentlemen have proposed to publish daily in that paper, which appears at 3 p.m., a chart of the winds at the principal stations on the coasts. This plan, which was set in operation at the beginning of the year 1871, is calculated to be of great value to the cause of meteorology. It may be hoped that, ere long, the barometrical and thermometrical readings may be given, as well as the wind, but the serious difficulties which are met with in adapting such a chart to the exigencies of newspaper printing, though they have been satisfactorily surmounted by Sir W. Mitchell, are a sufficient reason for proceeding with caution.

Daily weather  
chart.

No change has 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 Report for 1869 gives full information on this point.

The issue of warning messages is conducted strictly on the principles which have been explained in the former reports of the office. Each case of such issue of a warning, and every storm which is felt in these islands is made the subject of careful study, with the view of, if possible, discovering the atmospherical conditions which indicate at any time that a storm is either actually existing, or is in process of formation, though as yet it has not reached our shores.

Warning  
messages.

The more experience is gained, the more must the extreme complication of the problem to be solved impress itself on the mind of anyone whose attention is directed to the interpretation of the causes of our weather changes. Situated, as these islands are, as the outposts of Europe in the Atlantic, they partake in part of the climate of the continent, though far more frequently our weather is governed by that prevailing over the ocean out-

Comparative  
value of eastern  
and western  
stations.

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\* Since the commencement of the year 1871 the Association has most liberally volunteered to bear the entire expense of transmission of these telegrams.

side. Of this latter, we can unfortunately gain no intelligence by telegraph, although the proposed extension of our reporting system to the Hebrides and Shetlands respectively may be expected in some measure to improve our knowledge of it. It is of course possible, though the process is costly, to keep ourselves informed of the changes which are taking place in the weather over Europe, but, unless in rare cases, the connection between these and our own weather is, though perhaps not very remote, yet certainly very intricate. We are almost always unable, judging from the reports from Norway and Central Europe, to speak confidently as to the probability of a southerly or westerly storm beginning on our extreme western coasts, although these same reports give us fair grounds for drawing conclusions as to whether such a storm will travel eastwards and be felt over the North Sea or not.

Thus, for instance, at the end of January 1870, while a hard frost, with northerly winds and a high barometer, was prevalent over England, a stiff southerly gale began to blow on the south coast of Ireland, and lasted for two days in the same district. In this case it was evident from the persistent steadiness of the atmospherical conditions over the North Sea and its eastern shores, even out into the interior of Russia, that there was no danger of a sudden change of weather setting in in that district.

On the other hand, these same eastern reports give us most important data for anticipating the approach of storms from the northward or eastward.

As soon as the practical usefulness to the office of a more extended telegraphic communication with the east of Europe shall have been satisfactorily proved, the Committee will not be behindhand in seeking to establish such a connexion with the meteorological offices of Copenhagen, Upsala, and St. Petersburg. The negotiations with the Norddeutsche Seewarte have already been explained. The bulletins\* which are published regularly in the respective countries of Europe, and received by post in exchange for the Daily Weather Report, furnish for the present

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

Place.	Whence issued.
Christiania - - -	Norske Meteorologiske Institut.
Hamburg - - -	Nord-deutsche Seewarte.
Lisbon - - -	Observatorio do Infante D. Luiz.
” - - -	Angra do Heroismo, Azores.
” - - -	Funchal, Madeira.
Paris - - -	Observatoire National.
Paris - - -	Observatoire Météorologique Central de Montsouris.
Utrecht - - -	Koninklijk Nederlandsch Meteorologisch Instituut.
Vienna - - -	K. K. Central-Anstalt für Meteorologie und Erdmagnetismus.

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ample materials for the study of continental weather and its comparison with our own.

It may not be amiss at this juncture to explain that much as the Committee would desire to publish daily reports of the wind, &c., at the principal trading ports, such for instance as Odessa, for the benefit of shipowners and merchants interested in our foreign trade, it is simply the consideration of expense which has precluded their doing so.

The daily weather chart has now been drawn for a period of nearly four years, and as the Weather Report is regularly entered in a book and analyzed as explained in the last Report, a large collection of materials for weather study is being amassed.

The information thus brought together is largely supplemented by observations furnished by gentlemen who are working in co-operation with the office, and by extracts from all ships' logs which contain observations taken within a reasonable distance of our coasts. The steps which have been taken to utilize these materials will be described in the third section of this Report, in connection with the Quarterly Weather Report.

Several of the observers at the telegraphic stations have now been reporting regularly for many years, and accordingly it has been thought that the calculation of mean results from their observations would afford useful information. In the 12th number of Meteorological Papers, Admiral FitzRoy has already published barometrical means for the stations which were furnishing reports in 1863. Since that date the quality of the observations has been materially improved, a result which may fairly be attributed in great measure to the annual inspections which have been carried out. It has therefore been decided to publish means for five years for the barometer and rainfall from the stations where the reports have been uniformly satisfactory.

Calculation of mean values from telegraphic weather reports.

No discussion of the thermometrical observations has been attempted. The statements in the Report for 1867 of the condition in which the thermometers were in many instances found, are a sufficient reason for caution in dealing with the back observations, and at present the exposure at several of the stations which are situated in towns, is unavoidably more or less unsatisfactory.

The tables will appear as an appendix to the Quarterly Weather Report for 1870.

In connection with the operations of this branch of the office, it should be stated that the Committee have given directions for the preparation of a new edition of the Barometer Manual, which was in the press at the end of the year.\* It contains special chapters on weather telegraphy, and on the use of the barometer to seamen, with descriptions of the most useful instruments, and tables for reduction of the observations.

Barometer Manual.

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\* Barometer Manual, Board of Trade, compiled by Robert H. Scott. Potter, Poultry; and Stanford, Charing Cross. Price 1s.

Fishery  
barometers.

The practice of lending fishery barometers to small ports and fishing stations, as described in previous reports, has been continued. Two of these instruments were issued during the year, and there are now 113 stations on our coasts supplied by the office with barometers for public use. They are situated 48 in England, 2 in Wales, 39 in Scotland, and 24 in Ireland. See App. No. IX.

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

The operations of this branch of the office have assumed a more definite form during the year, and are daily growing in interest and importance.

Condition of  
the observa-  
tories.

The seven observatories whose positions have been fully described in previous Reports, continue in active operation, and were found to be uniformly in a most satisfactory condition at the date of Mr. Scott's visit of inspection. The only change which has taken place with regard to them has been the erection at Armagh of an anemograph similar in construction to those at the other observatories, so that the outfit of all these stations is now uniform in all respects.

The Committee have to express their regret that, owing to the heavy claims made on their finances for the appliances requisite to reproduce their records for publication, they are still unable to see their way to the establishment of an eighth observatory in the extreme north of Scotland. Such an addition to their system would be, in every way, desirable, and the more so as it is now universally admitted that the study of continuous automatic records is indispensable for all investigations connected either with climate or with weather.

Relations with  
Kew.

The method of examination of the records and numerical tabulations at the central observatory at Kew is unaltered, and will continue so as long as that observatory remains in connexion with the British Association. Whenever that connexion is dissolved it will be necessary for the Meteorological Committee to make arrangements for this work being efficiently performed, and they have every reason to hope that the future governing body of Kew will not be unwilling to undertake to carry it out. The process of examination, as described in the Report for 1868, does not absolutely detect and remove *all* errors, but its working on the whole has been very satisfactory, and the final corrections are effected in the office.

Self-recording  
rain gauges.

The self-recording rain gauges, a description of which was given in the Report for 1869, have been constructed in the course of the year. It was hoped that they would have been ready to commence operations with the new year, but a serious obstacle was encountered in obtaining satisfactory graphical records of the rain which fell. In the original instrument the cylinder on which the pencil made its marks, was of biscuit ware. It became necessary to substitute for this recording surface a slip of paper which should be removable daily, and the difficulty which was found in obtaining a paper entirely

unaffected by moisture, and at the same time possessing a surface capable of receiving a printed impression, and easily marked by pencil, was very serious. Messrs. De La Rue & Co. have at last provided a paper which seems to meet every requirement.\*

In order to obviate the risk of a lengthened interruption of the continuous records at any station by accident to any of the instruments, the Committee have procured a supplementary set, which will be retained at Kew for issue in case of need. Spare set of instruments.

The most important feature of the operations of the year has been the appearance of the Quarterly Weather Report, of which the first two parts for the year 1869 had appeared by the beginning of December 1870.† Delays which unavoidably attend the commencement of so novel an undertaking as the reproduction of the records by instrumental means, have had the effect of retarding the rate of publication of the first two parts, but now that these have been in great measure overcome, the speed of production will be rapidly improved, and the arrears of work will ere very long be overtaken. It has been found necessary to employ additional assistance for the purpose of producing the curves in a form fit for publication. The mechanical process of copying the records will be described in Part II. of this Report. Quarterly Weather Report.

The Quarterly Report itself, which has been entirely drawn up by Mr. Scott, consists of four subdivisions: I. Introduction. II. Chronicle of weather, serving to illustrate the continuous records represented on the plates, 146 in number. III. Tables of numerical results. IV. Appendix, consisting of "Notes on Easterly Storms." The second of these is the only one that calls for special notice.

The chronicle of weather has been drawn up for the most part from the instrumental records at the observatories, and the extra anemometrical stations, combined with the Daily Telegraphic Weather Reports, but as these are far from sufficient to afford all the information which is desirable, recourse has been had to other available sources of information. In the first instance, the bulletins published on the continent, of which a list was given at p. 16, have been consulted; secondly, all the registers of ships observing for the office during the year have been searched, and the observations have been extracted which were taken as far south as the fortieth parallel, and as far west as the meridian of 16°. These ships' logs are especially valuable, because the observations are usually taken to the west of the Irish coast, and also because the observations are not suspended at night as those at observatories on land which are not furnished with self-recording instruments almost invariably are. In many instances storms which have subse-

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\* The rain gauges commenced to work in the month of March.

† Part III. appeared at the beginning of February, and Part IV., completing the volume, was published on the 5th of April. Part I. for 1870 will have appeared before the publication of this Report.

quently passed over the United Kingdom have been proved to have existed at sea off our coasts some hours before they betrayed their proximity to the observers, or even to the instruments at the land stations.

In addition, most valuable and important assistance has been derived from the volunteer observers who are working in connexion with the office, as will hereafter be explained.

Discussion of storms.

The difficulty of describing at any reasonable length the complex system of phenomena termed "weather," even were it possible to produce such a description with accuracy, has led to the necessity of confining this chronicle to a record of the various types of weather, and more especially the storms which have passed over or near our islands during the year. The storms have all been examined in the same way, and the particulars relating to the force of the wind have been entered in a tabular form.

It has been considered that, unless the velocity of the wind reached the speed of 30 miles an hour, it was not worth special consideration. Velocities of 40 miles, and upwards, per hour were taken as gales. In each case, therefore, the hours of commencement and cessation of the velocity of 30 miles an hour, with the direction of the wind, are given, as well as the hour at which the gale began to blow, its duration and average velocity, with its direction. Finally, the maximum velocity attained is noted, the point from which the wind blew, and the hour at which it occurred.

Effect of situation on wind observations.

An inspection of a few of these tables exhibits far more clearly than any verbal description how very limited is the extent of most of the storms with which we are visited. This is, however, in a great measure due to the fact that the full force of the wind is rarely felt at inland stations, and that it is exaggerated at prominent points on our coasts, such as Valencia, and above all at Holyhead. This fact is familiar to anyone who is acquainted with our western coasts, but it is brought very prominently into notice by a table such as the following, which is extracted from the Quarterly Weather Report:—

Valencia	-	-	1,584	Sandwick (Orkneys)	1,289
Armagh	-	-	155	Falmouth	- 1,374
Glasgow	-	-	450	Stonyhurst	- 272
Aberdeen	-	-	392	Kew	- 202

This table simply gives the number of hours in the year during which the wind blew with a velocity exceeding 30 miles an hour from any point of the compass. At Holyhead, in the last quarter of the year alone, the number of hours was 987.

Necessity for more stations.

Another conclusion at which anyone must arrive if he carefully examines these records is that all statements as to the mean motion of the air over England, based on the isolated records from one or two observatories, are as yet premature. The seven observatories and the extra anemometrical station of Sandwick

in the Orkneys, established by the Committee, are far from sufficient to give information on this point, and the office is endeavouring, as fast as its funds will allow, to increase the number of its anemometrical stations. The establishment at Holyhead and Great Yarmouth of anemometers of a pattern uniform with those at their observatories has already been noticed in last year's Report. The Committee have not as yet made any further additions to their system, but, on the other hand, they have to express their warmest thanks to the private observers who are coming forward to supply them regularly with anemometrical records of a nature precisely similar to their own. Such returns have been furnished by the Duke of Northumberland from Alnwick Castle; by Mr. Louis J. Crossley, from his observatory at Willow Hall, near Halifax; and by Mr. R. H. Barnes, from Kensington Park. In addition, results of anemometrical observations, made with instruments of smaller size, have been sent in by Dr. S. Elliott Hoskins, F.R.S., from Guernsey, and by the Rev. F. W. Stow, from Hawsker, near Whitby. Volunteer  
co-operation.

In addition to the above automatic records, several gentlemen have commenced supplying the office regularly with observations taken at special times of storms, and entered on forms sent out by the office, and in some instances with barometrical and thermometrical observations. These latter have, however, only been received from a few stations where the observers possessed standard instruments.

The list of these volunteer observers is as follows:—

Byron, Rev. J.	-	-	Killingholme, Ulceby, Lincolnshire.
Clouston, Rev. C., LL.D.	-	-	Sandwick Manse, Orkney Islands.
Cooper, Col. E. H.	-	-	Markree Castle, near Sligo.
Curtis, Prof. A. H.	-	-	Queen's College, Galway.
Delap, Rev. A.	-	-	Maghery, Dungloe, co. Donegal.
Falkner, Rev. F. B.	-	-	Appleby, Leicestershire ( <i>deceased</i> ).
Griffith, Rev. C. H.	-	-	Strathfield Turgiss, Winchfield, Hants.
Hicks, Robert	-	-	Collector of Customs, Campbelton.
Livesay, J. G., Esq.	-	-	Ventnor.
Malleson, Rev. F. A.	-	-	Broughton in Furness.
Moore, J. W., M.D.	-	-	Dublin.
Richards, W. Hosken	-	-	Penzance.
Sutherland, A.	-	-	Carrickfergus.
Wilson, J. M., Esq., F.R.A.S.	-	-	Rugby.

These gentlemen of course receive no pecuniary remuneration for their services, but a copy of the Quarterly Weather Report and of other works published from time to time by the office is sent to them regularly.

The Committee are glad to be able to say that the number of the independent observers who are co-operating with them on the above terms is steadily increasing. It is in this direction

that they venture to look forward to the most important development of the general system of British meteorology with the superintendence of which they have been entrusted by Her Majesty's Government—a system which was contemplated by the Board of Trade, under the presidency of Mr. Cardwell, so long ago as in the year 1855, but was not brought into practical existence until 11 years later, when in the year 1866 the Royal Society was requested by that Board to make arrangements for taking charge of the Meteorological Department.

### *Library.*

Appendix X. 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. The library at present consists of about 1,200 volumes, exclusive of small pamphlets, and of charts and M.S. records of observations. 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.

### *Expenditure.*

As regards their financial position, the Committee are glad to be able to say that their total expenditure during the year has fallen short of that incurred during the financial year 1869-70, by the sum of about 660*l.* This result is, however, in great measure attributable to the fact that the Post Office accounts for telegraphy for the past nine months have not yet been settled.

The balance sheet will be found in Appendix I.

As nearly as can be stated, the net income during the year has exceeded the net expenditure by the amount of 100*l.*

The individual items, however, exhibit some contrasts which serve to show how the ultimate work of the office is gradually developing itself.

—	1869-70.			1870-71.			Increase.			Decrease.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Office, salaries, &c. -	1,562	1	3	1,195	7	0	-	-	-	366	14	3
„ rent, attendance, and contingencies -	1,404	3	7	787	11	10	-	-	-	616	11	9
Observatories -	3,174	5	2	4,375	11	9	1,201	6	7	-	-	-
Telegraphy -	2,639	0	1	1,394	0	4	-	-	-	1,244	19	9
Ocean Meteorology -	1,639	1	6	2,007	16	8	368	15	2	-	-	-
<b>Totals</b> £	<b>10,418</b>	<b>11</b>	<b>7</b>	<b>9,760</b>	<b>7</b>	<b>7</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>658</b>	<b>4</b>	<b>0</b>

Under the head of salaries there is a reduction of nearly 400*l.*, owing to the discontinuance of the salary for a secretary to the Committee. The duties of that office are now discharged in part by Mr. Scott, and in part by the staff of Kew Observatory. Rent and office expenses also show a diminution which amounts to 617*l.*, inasmuch as nearly half the expenditure on this head was caused by the purchase of fittings and furniture for the new office in the year 1869. It should here be noticed that the Committee have found it necessary to secure additional accommodation for their pantagraphs, and have engaged three rooms at No. 113, Victoria Street.

The greatest increase has been in connexion with the land observatories. This is in part due to the serious cost of the new instruments, comprising pantagraphs, self-recording rain gauges, and a complete spare set of self-recording instruments, and in part to the expense involved in reproducing the records for publication, including the payment to an additional clerk for the purpose of engraving on the copperplates.

Telegraphy exhibits a reduction of over 1,200*l.*, owing simply to the fact that the Post Office account for the six months, July to December 1870, was only received at the end of March 1871, and has not yet been settled. The outstanding claims of the Post Office for the last three quarters of the financial year will exceed 1,000*l.*

Lastly, under the head of Ocean Meteorology an increase of 368*l.* is observable; this is attributable to the large increase in the number of ships supplied during the year, a step which has involved the purchase of a considerable number of new instruments.

On the whole, the Committee's accounts show an apparent balance of 1,826*l.* 17*s.* 3*d.* to their credit, but of this sum more than 1,000*l.* is due to the Post Office, as already explained; 250*l.* is required for instruments and apparatus already ordered in connexion with the observatories, and 75*l.* for other instruments for the Marine Branch of the office; so that as a final result the Committee close the year with a net balance of 456*l.*, being 116*l.* more than the sum with which they commenced it.

It appears from the foregoing remarks that unless the Government should call on them to extend the sphere of their operations, it will not be necessary for them to ask at present for an increase of their grant.

Appendix XI. gives a list of the present staff in the employment of the Committee, and of their several occupations and remunerations.

#### *Summary.*

The operations of the year may be conveniently summarized as follows :—

I. *Ocean Meteorology.*—The number of ships supplied with instruments by the office has been nearly doubled, the number

of barometers afloat on the 1st of January 1871 being 124, as compared with 69 twelve months previously.

In addition, all ships in commission in the Royal Navy have, as usual, received all their meteorological instruments from the office.

Forty-three gentlemen have sent in registers which have received the mark of "excellent."

As regards the progress of the work, all the old materials in the office have been thoroughly examined. The investigation into the meteorological conditions of the equatorial portion of the Atlantic Ocean is in an advanced stage.

Monthly charts of data for the west and south coasts of South America have been lithographed, and will shortly be published.

The discussion of the anemometrical observations made at Bermuda and Orkney has made satisfactory progress.

An investigation into the weather over the North Atlantic during the first week of February 1870, has been taken up by Captain Toynbee, which it is hoped will lead to some interesting results.

The cost of this department has been 2,007*l.* 16*s.* 8*d.*

II. *Telegraphy and Weather Warnings.*—No change of importance has been made in the system during the year. At the end of April 1871, the stations where the drum signal is hoisted were 123 in number, viz., 74 in England and Wales, 32 in Scotland, 12 in Ireland, 3 in the Isle of Man, and 2 in Jersey. In addition, warnings are sent to France, Holland, Hamburg, and Norway.

Copies of the lithographed Daily Weather Reports are sent out regularly to 10 newspapers, and to other applicants, including the authorities at seaports, 58 in number.

Since the commencement of the year 1871, the "Shipping Gazette" has published a daily wind chart for these islands, which has been drawn at the office.

Two fishery barometers have been issued during the year, making the total number of these instruments 113.

The cost of this department has been 1,394*l.* 0*s.* 4*d.*, but there is an outstanding account with the Post Office which amounts to upwards of 1,000*l.*

III. *Land Meteorology of the British Islands.*—The seven observatories are in active operation.

The publication of the Quarterly Weather Report has been carried on steadily, and the last part of the volume for 1869 appeared at the close of the financial year. The arrears are being steadily worked off.

Arrangements have been made for the production of the plates by copperplate printing, and consequently an additional clerk has been engaged for the purpose of working Wagner's pantagraph.

The cost of this department has been 4,375*l.* 11*s.* 9*d.*

*Office.*—The expenses of management in salaries and wages have been 1,195*l.* 7*s.*, as compared with 1,562*l.* 1*s.* 3*d.* in the previous year. This reduction is due to the resignation of Dr. Stewart the secretary, and the consequent transference of his work to Mr. Scott the director.

The other expenses incident on the office for rent, furniture, postage, &c., have amounted to 787*l.* 11*s.* 10*d.*

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## PART II.

### DESCRIPTION OF THE PROCESS BY WHICH THE TRACES OF THE SELF-REGISTERING INSTRUMENTS ARE REDUCED SUITABLY FOR PUBLICATION.

THE original traces made during five days by the various instruments, at each of the seven observatories, if placed side by side on a screen, would occupy an area of at least 12 feet by 4 feet. The whole of this information is compressed, with perfect clearness, into a single 4to. plate.

The difficulty which has had to be overcome, lay not only in the bulk, but also in the proportions of the traces varying in different dimensions. On the one hand it was found that the horizontal scale might be considerably compressed, without loss of clearness, when the somewhat blurred line of the original trace was replaced by the delicate clear line of a copper engraving. On the other hand, it was found that the vertical scales did not admit of much reduction with advantage, and again that the vertical scales of each separate barogram and pair of thermograms required small corrections, on account of small differences in the focal lengths of the lenses attached to the instruments.

In order to bring all the traces to a uniform and convenient standard, they are severally reduced by Mr. Galton's pantagraph (p. 30), which reduces in length and breadth, independently. By its means they are considerably compressed, and their vertical scales are rendered uniform. The *style* of this pantagraph is a steel cutter, which scratches the reduced copies deeply into zinc plates. A single zinc plate is allotted to each day at each station. The barogram and two thermograms are cut on its obverse, with fiducial marks attached, and the wind's direction and velocity are cut on its reverse.

The wind velocity trace is divided by means of the same pantagraph into hourly sections, starting afresh from the same base line—a plan which affords a more useful and intelligible representation than the original record. The merit of this improvement is due to Mr. De La Rue.

In respect of this mode of representation of the wind records, the Committee are glad to be able to say that it has received the approval of Dr. Romney Robinson, who is admittedly the highest living authority on all anemometrical questions, and whose instrument has been adopted at the observatories. By his permission, they reproduce the following extract from a letter lately received from him.

Armagh Observatory,  
4 May 1871.

I THINK the specimen curves which you have sent me are a great improvement on the former ones. They are beautifully distinct, and the scale is quite sufficient to convey all needful information.

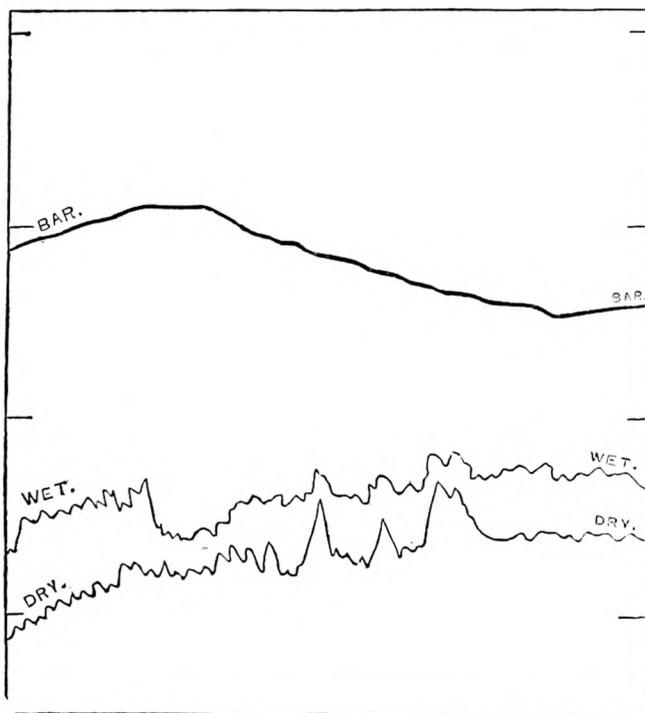
The velocity lines in particular are a great improvement.

Notwithstanding their want of parallelism, their extremities form a sufficient approximation to the velocity curve, of which I spoke in my last letter to you, to make an exact delineation of that curve unnecessary.

(Signed) T. R. ROBINSON, D.D.

In addition, the rainfall has been inserted for all the observatories at which it was measured at that time. The entry is made at 9 a.m., and refers to the preceding 24 hours.

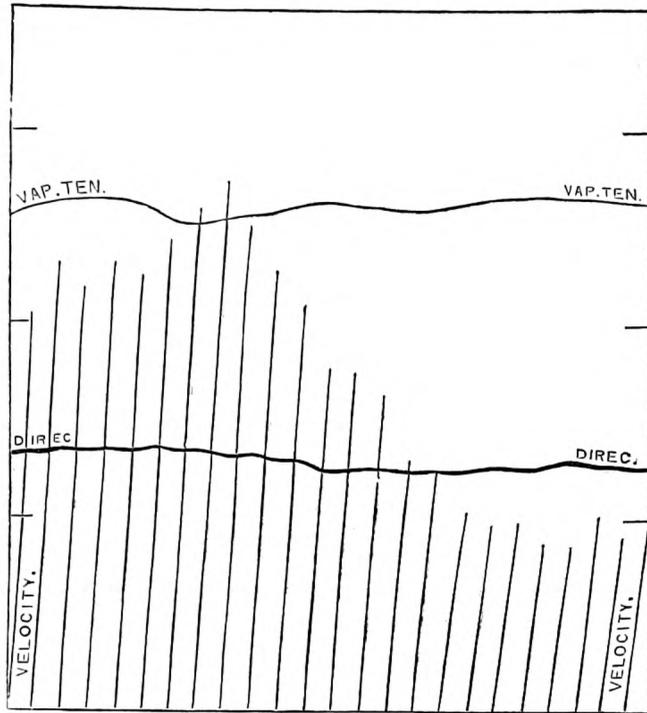
The accompanying diagram shows the exact size of these zinc plates, and contains the record for the observatory at Falmouth, for the storm in question.



Obverse.



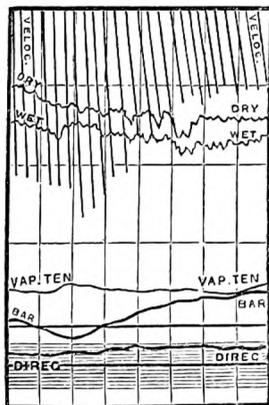




Reverse.

The next step is to bring five of these zinc plates into a row with their fiducial lines carefully adjusted, and to reduce them altogether to a little less than one half their scale by a pantagraph, of exceedingly delicate construction, made by Wagner of Berlin, which reduces equally in both dimensions, and contains numerous adjusting movements of the tables on which the zinc squares and the copper plate severally lie. Its pointer is guided by the hand along each of the lines cut in the zinc plates, as in a groove, and its style scratches, with a diamond, a reduced trace on the varnished surface of a copper-plate, which is afterwards bitten in with acid.

By this pantagraph, the reduced contents of both sides of each zinc plate are combined in a single square, as is shown in the annexed figure, which contains the reduction of the previous diagram.



The accompanying print from the copper-plate, Plate I., etched as described, measuring 10.5 inches by 4.85 inches, contains all that was referred to, in the first paragraph, in a very compact

form, with a clear outline, drawn to a scale which is perfectly uniform and capable of almost as accurate measurement as the larger original traces, whose outline is seldom perfectly sharp. The plate contains even more than the original traces, because the vapour tension, as calculated for each hour, has been inserted.

A few words explanatory of the records of wind contained on Plate I. may not be undesirable; they have been taken from the Quarterly Weather Report for 1870.

“ The subjoined Table and Plate I. prove that the gale was not felt in the north of Ireland, or in Scotland; in fact, at those observatories nothing but a moderate easterly breeze was felt; nor did it affect the Norwegian stations, where, as well as in Russia, the wind was moderate from S.E. and E. It, however, swept along the south coast of the North Sea, and reached Hamburg in the afternoon, lasting at that station for 24 hours, and averaging more than 50 miles an hour during the night of the 8th and 9th.

“ On our own coasts the gale was fortunately of short duration, ceasing at Valencia at 8 a.m. on the 8th. Its violence was very considerable while it lasted, the hourly velocity at Valencia and Falmouth exceeding 60 miles, and at Kew reaching 50, a figure which it had never once attained during the whole of the year 1869. The storm was accompanied by heavy rain at the Irish stations, and at Liverpool a thunderstorm was reported at 3 a.m. on the 8th.”

Observatories, Jan. 7th.	VELOCITY, 30-40 Miles per Hour.		VELOCITY, Exceeding 40 Miles per Hour.				VELOCITY Fell below 30 Miles per Hour.		MAXIMUM VELOCITY.			Remarks.	
	Com- menced.	Direction of Wind.	Com- menced.	Direction of Wind.	Mean Vel. in Hours.	Ended.	Direction of Wind.	Hour.	Direction of Wind.	Velocity.			
Valencia -	1 p.m. (7th).	S.E. by E.	2 p.m. (7th).	S.E. by E.	50	17	8 a.m. (8th)	W. by N.	19	9 p.m. (7th).	S.	64	—
Falmouth -	3 p.m. (7th).	S.W. by S.	4 p.m. (7th).	S.W.	52	22	4 p.m. (8th)	W.	25	7 a.m. (8th).	S.W.	66	—
Holyhead -	7 p.m. (7th).	S.S.E.	9 p.m. (7th).	S.S.W.	44	13	9 p.m. (8th)	W.	26	3 & 4 a.m. (8th).	S.S.W.	57	—
Stonyhurst -	2 a.m. (8th).	S.W. by S.	4 a.m. (8th).	S. by W.	41	2	8 a.m. (8th)	S. by W.	6	6 a.m. (8th).	S.	42	—
Kew -	11 p.m. (7th).	S.W.	7 a.m. (8th).	S.W. by S.	44	9	6 p.m. (8th)	S. by W.	19	11 a.m. & noon (8th).	S.W. by S.	50	—
Yarmouth -	8 a.m. (8th).	S. by W.	—	—	—	—	8 p.m. (8th)	S.W. by W.	12	noon (8th).	S.S.W.	40	—

Total No. of Hours  
the Vel. above 30 Mils.

*Vapour Tension Machine.*

An instrument has been invented by Mr. Galton, and constructed by Messrs. Beck, which renders it possible to deduce the trace of vapour tension from the thermometrical lines scratched on zinc in the method described at p. 25. Five of these latter zinc templates are placed in a row, and the curve of vapour tension obtained from them is reproduced on a single long zinc template. The instrument is expected to be in complete working order by the end of July.

The accompanying curves of vapour tension (Plate II.) were reduced by Wagner's pantagraph in the usual way from traces mechanically made by the new instrument.

They were made by the temporary establishment of a mechanical connection between two of its independent movements, for the purpose of ascertaining the degree of precision with which the instrument will do its appointed work.

The subjoined table gives a series of measurements made from the zinc templates, ranged side by side with the corresponding numbers taken from Glaisher's Hygrometrical Tables, 5th edition:—

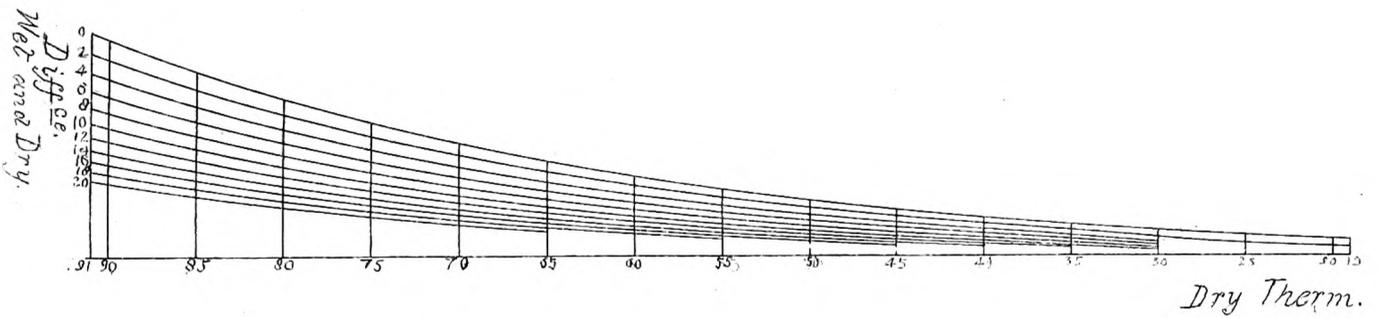
Temperature.	Difference.	Instrumental Reading.	Tabular Reading.	Error.	Temperature.	Difference.	Instrumental Reading.	Tabular Reading.	Error.
90°	0	1·400	1·411	-·011	60°	8	·297	·299	-·002
—	4	1·145	1·151	-·006	—	10	·256	·259	-·003
—	10	·830	·833	-·003	50	0	·355	·361	-·006
—	16	·590	·595	-·005	—	2	·315	·309	+·006
—	20	·470	·473	-·003	—	4	·263	·265	-·002
80	0	1·020	1·023	·003	—	6	·230	·226	+·004
—	4	·820	·820	·000	—	8	·193	·191	+·002
—	12	·515	·513	+·002	40	0	·248	·247	+·001
—	18	·360	·357	+·003	—	2	·210	·207	+·003
70	0	·732	·733	-·001	—	4	·170	·172	-·002
—	2	·650	·651	-·001	35	0	·203	·204	-·001
—	6	·505	·508	-·003	—	2	·165	·164	+·001
—	10	·390	·392	-·002	30	0	·170	·167	+·003
—	14	·300	·302	-·002	—	2	·120	·116	+·004
60	0	·515	·518	-·003	25	0	·138	·135	+·003
—	2	·455	·453	+·002	—	2	·080	·074	+·006
—	4	·390	·395	·005	20	0	·110	·108	+·002
—	—	—	—	—	—	2	·060	·051	+·009

The mean error of 35 readings is accordingly ·003 in., and the extreme error is -·011 at the extreme limit of the scale.

The accuracy attainable by the machine is therefore fully equal to that of any of the graphical representations issued under the authority of the Committee.

A description of the instrument must be reserved for a future Report.

*Curves of Vapour Tension from 19° to 91° temp. of dry Therm:  
for every 2° of difference from 0° to 20° between dry & wet Therms.*





DESCRIPTION OF THE PANTAGRAPH DESIGNED BY MR. GALTON.

(Constructed by Messrs. Beck, 30, Cornhill.)

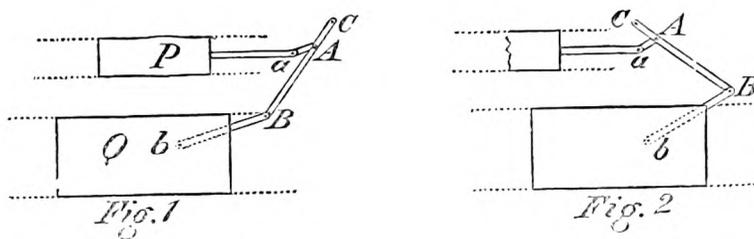
A full account of the principle of this instrument was published in the Annual Report of last year, page 32; its construction will now be described. I have been much indebted to Messrs. Beck, who made it, for many points of detail.

It is very difficult to draw the machine as a whole, in an intelligible manner, and it is impossible to do so by simple plans and sections, because its parts overlay and hide one another to a remarkable degree, and also because its appearance in different states of adjustment is greatly changed. Nevertheless, its construction may be made sufficiently clear by the perspective view of the complete instrument, Fig. 11, and by a few outlines of its principal parts, when they are placed in extreme positions.

The machinery may be separated into two independent stages, shown in Figs. 9 and 10, pp. 33 and 34, whose actions are governed by the same principle, though their details differ. The lower stage of machinery, Fig. 9, is worked by the operator's left hand, turning the milled head R, which gives a lateral movement  $\longleftrightarrow$  to two frames P and Q; the photograph intended to be reduced being set on Q, and the zinc plate, on which the reduction is to be scratched, being clamped to P. The upper stage of the machinery, Fig. 10, is worked by the operator's right hand, turning the milled head L, which gives a movement in the direction

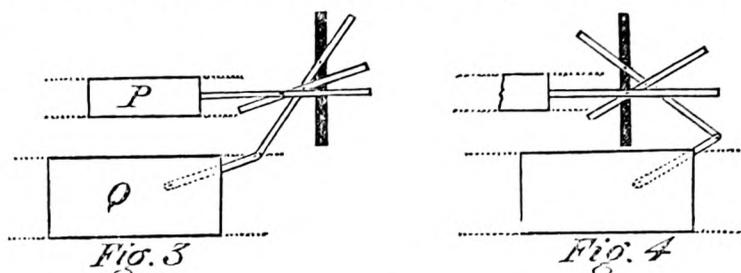
at right angles  $\updownarrow$  to that just described, to the pointer M which has to follow the outline of the photograph, and to the style N, (or drill, if one be used), which engraves the reduction on the zinc.

The connecting link-work attached to each of these separate stages of machinery, admits of adjustment through a wide range, and may be made to produce either a direct or a reversed reduction. But before entering into these somewhat complicated details, let the attention be confined to a single one of these stages, say to the lower one, which we will suppose adjusted to reduce to some definite scale, and we will disregard and exclude from our diagrams (1), (2), (5), and (6) all parts of the machine which are non-effective in that condition. First as regards direct reduction; two extreme positions are indicated in Figs. (1) and (2).



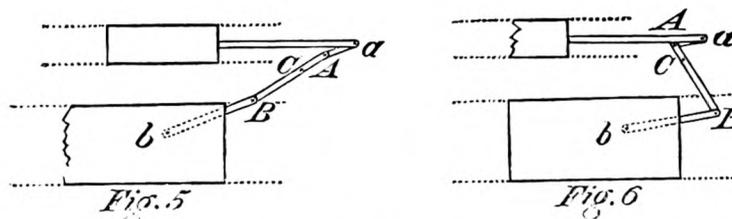
Q is the frame on which the photograph is set, P that on which the zinc plate is clamped; they both run on parallel tramways, shown by the dotted lines. C A B is a bar turning

round  $C$  as a centre; it is connected with  $P$  by the link  $A a$ , and with  $Q$  by  $B b$ , and the conditions of adjustment are, that when  $C A B$  lies perpendicularly across the tramways, then both  $A a$  and  $B b$  shall lie parallel to them, and also that the ratio of  $A a$  to  $B b$  shall be the same as that of  $C A$  to  $C B$ ; from which it follows, as can easily be shown, that  $C, a$ , and  $b$  are always situated in a straight line. To effect these adjustments, the position of  $C$  in the bar  $C A B$  (produced) admits of being shifted, just as the centre of a pair of proportional compasses admits of being shifted, and the same is the case as respects the position of  $a$  on the link  $A a$  (produced). The diagrams (3) and (4) show the bar and the link (produced) as they actually exist in

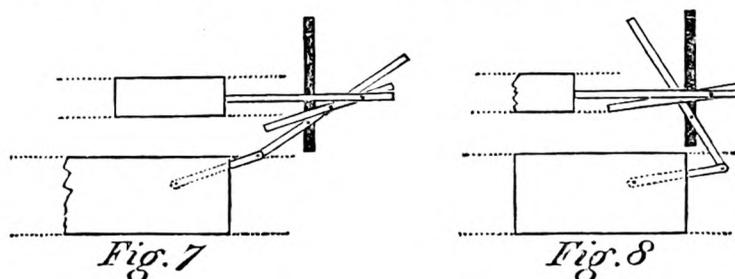


the machine, when it is placed in precisely the same position as in Figs. (1) and (2). The positions of  $C$  and the other centres are indicated in (3) and (4) by dots, the darkly shaded line is a slot in the iron frame of the machine, in which the sliding centre travels, when the adjustments are altered.

For reversed reduction, the position of  $C$  must lie between  $A$  and  $B$ , and the links  $A a$ ,  $B b$ , must be on opposite sides of  $A C B$ , as in Figs. (5) (6); the proportions of  $A a$  to  $B b$ , and the



parallelism of  $A a$  and  $B b$  being attended to in just the same way as before. In this case, just as in that of direct reduction, the points  $a, C$ , and  $b$ , will lie in a straight line.



Figs. (7) and (8) show the bar and link (produced), as they appear when the machine is in the position indicated by Figs. (5) and (6).

To effect a change in the adjustments, the machinery is brought into the position shown in Fig. 9, where  $A C B$  is perpendicular and  $A a$  and  $B b$  are both parallel to the tramways, and it is secured in that position to the iron table by pegs  $G$ , thrust

through A C B and A a. Then the clamps that hold the sliding centres firmly in their places are released; the winches W V are turned, that screw the sliding centres to their new positions (as indicated by graduations at the side); these are again clamped, and, lastly, the pegs are taken out. The principle on which the graduations are made, was fully explained in the Annual Report

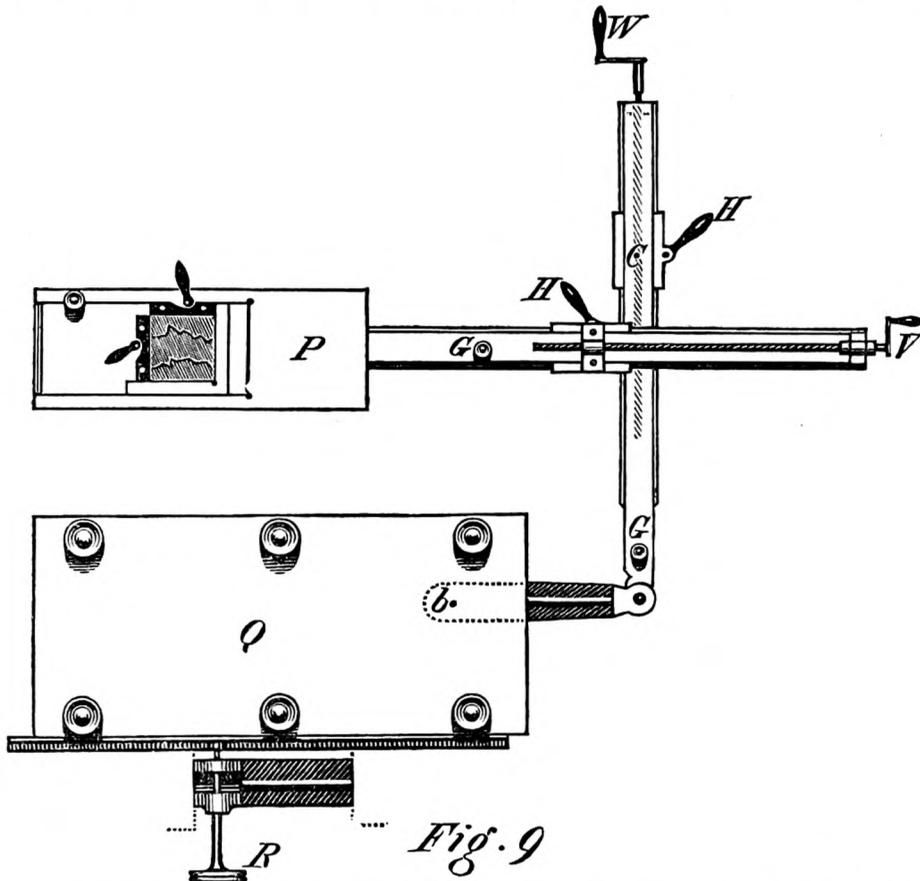
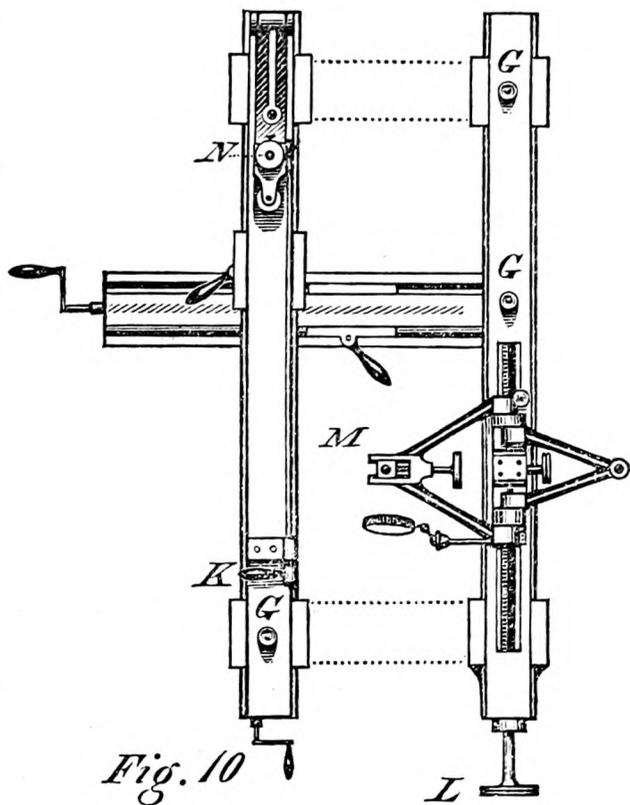


Fig. 9

of last year, already referred to. The result is as follows: A B is divided into 120 parts (being a convenient number of graduations, and one that is divisible in many ways); the graduations are numbered from A to B, and the word "reverse" is engraved by them. The same scale is continued on the other side of A, where it is separately numbered, beginning also from A, and the word "direct" is engraved by them. Then in order to reduce in "reverse," so that the scale of the reduction shall be that of the original, as 1 to c, set C at the graduation on the "reverse" side corresponding to  $\frac{120}{c+1}$ ; if direct reduction be wanted, set on the "direct" side at  $\frac{120}{c-1}$ . Thus, suppose the reduction was to be one-fourth of the original, then for "direct" the required number on the scale of graduations would be 40, and for "reverse" 24. The graduations on A a are determined graphically by the instrument maker, who sets C at each successive graduation, and laying a ruler through A a from C to b, graduates A a at its successive intersections with the line b C, and numbers the graduations on A a to correspond with those of A B and A B produced, and the words "direct" and "reverse" are engraved in the appropriate places.

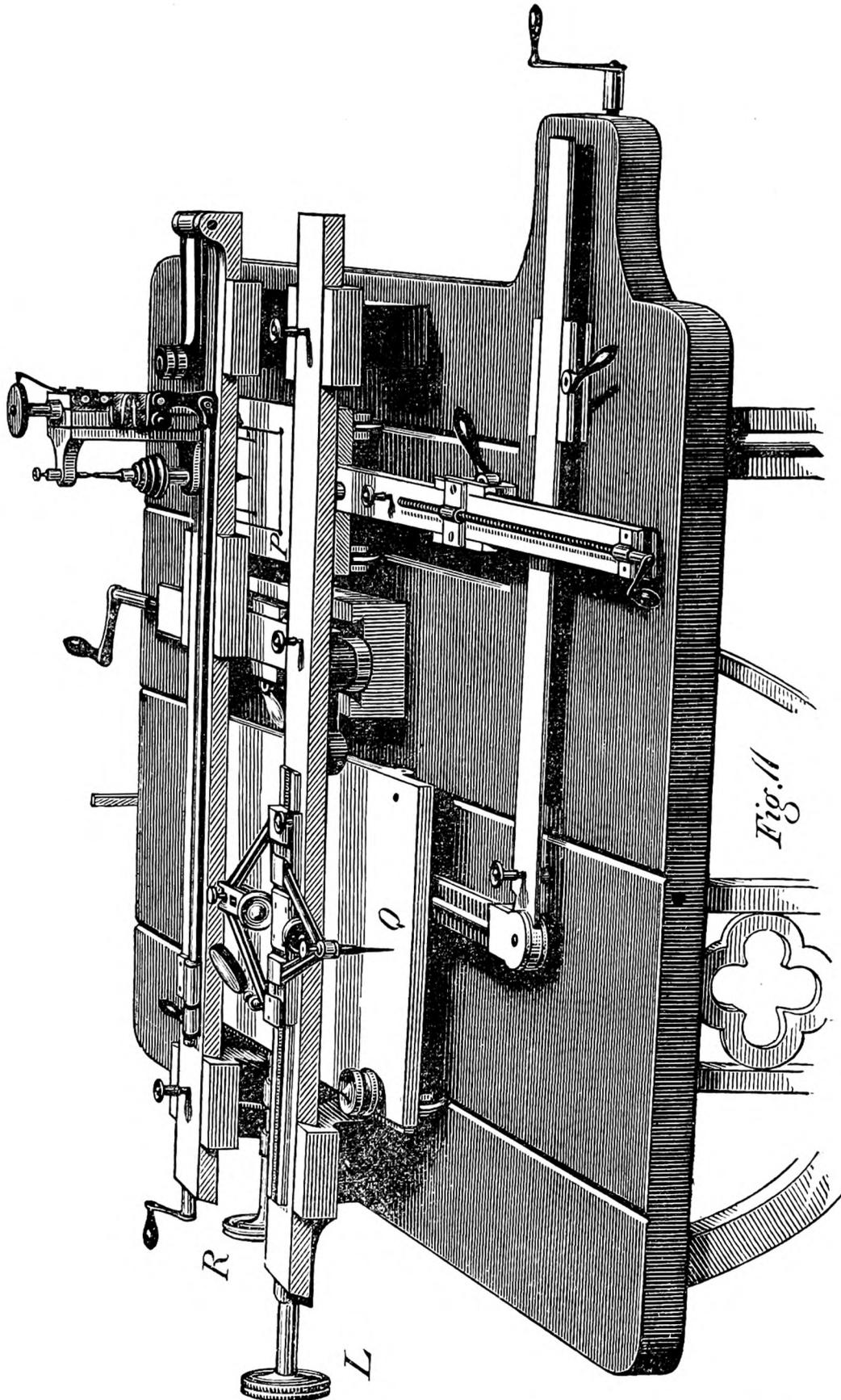
The minor details connected with this part of the machinery are as follows:—The handles *H* are used for clamping purposes; they are the long arms of levers, which, when pushed perpendicularly to the limb, squeeze powerfully by means of the bluntly curved heads of their short arms. The shaded square on *P* is the zinc plate, on which the reduction is made; this is clamped by two handles on to a brass slide, which is slid into grooves in *P*, and there clamped fast by the screw, whose head is seen in Fig. 9. The six milled heads on *Q* are screws with projecting flanges, to nip and hold firmly a long deal board, to which the photograph has been securely pinned.

As regards the upper stage, Fig. 10, which carries the pointer *M*, and the style or drill *N*, it consists of two brass bars sliding in solid iron cheeks; the bars are connected together by links on precisely the same principle as those already described. The link work is necessarily hidden in Fig. 10, but the position of the sliding centres is easily to be guessed; the link work is better seen in the perspective view, Fig. 11. The three pegs to fix this part of the instrument, when adjusting, are shown at *G*. In connection with the framework which carries the pointer *R*, there are several matters of detail, as follows. A second pointer will be observed outside the arm; and it



will be seen that the line connecting the two pointers is always parallel to the tramways; the use of the two pointers is to enable the operator to set the board to which the photograph is pinned in such a way, before it is clamped to *Q*, that the fiducial line of the photograph shall be truly parallel to the tramways. For, if when one point of the line is brought under *M*, and another point is brought under the second pointer, and the board be clamped in that position, the required object is attained. The framework that carries the pointers can be moved at will along the arm on which it is set by turning a milled head, the line connecting the two pointers always remaining parallel to the tramways. Also the pointer itself can be screwed out and in laterally, without of course, affecting the parallelism in question. These movements are necessary to enable the operator to get the pointer without difficulty upon the

beginning of the photographic trace, at the time when the style is at the edge of the zinc plate. Below M, a lens with a



jointed arm, movable in all directions, is attached, to help the operator to follow the trace more closely. A handle will be

observed at K, lying across the bar, with which a rod is connected that runs alongside the bar, up to the style (or drill); by turning the handle to the right, the style is lowered. There is a regulating screw to the style, best seen in the perspective view of the instrument, which enables the operator to control the depth of the scratch made by it.

The style is, in fact, a drill, and can be used as a drill if it be connected by a band with a wheel turned by a treadle. The original intention was, to cut a deep groove in the zinc, and the drill afforded the most promising means of effecting this. But experience shows that a very slight scratch, such as a common graver can make, is amply sufficient for what is wanted, and the drill is now never used as such.

The perspective view, Fig. 11, gives a good idea of the machine in its complete form.

FRANCIS GALTON.

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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 1871 (*see* Report, p. 8). 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	-	"Decapolis."
Angel, John Fry	-	"Twilight."
Banner, Frederick William	-	"Lady of the Lake."
Blake, Edwin John	-	"Gilbert Thompson."
Bouchette, Francis Baines	-	S.S. "European."
Brooks, Samuel	1	S.S. "City of Brooklyn."
Brown, Robert	1	S.S. "Moravian."
Bruce, John	-	"City of Adelaide."
*Bythesea, John (V. C.)	2	H.M.S. "Phœbe."
Capper, Edward Hall	-	"Palm Tree."
Carruthers, Forrest Priest	1	"Minero."
Davidson, Charles	-	"Perseverance."
Donkin, Thomas, R.N.R.	-	"Inverness."
Finlay, James	-	"Duncairn."
Fry, Alfred	1	"Foam."
Gray, David	-	S.S. "Eclipse."
Gray, John	-	S.S. "Mazinthien."
†Greenwood, William	-	S.S. "Scotia."
Hassell, Thomas Edward	-	"Mervyn."
Hayes, James	2	S.S. "Ptolemy."
Heggum, Edward Carl V.	-	"Czar."
Henderson, Henry	2	"Hope."
†Hodding, Samuel White	2	"Indus."
*Hopkins, John O. (R.N.)	1	H.M.S. "Liverpool."
Hunter, David	1	S.S. "Alpha" and S.S. "Delta."
Jones, Arthur Arundel	1	"Victoria Nyanza."
Kennedy, James Branch, R.N.R.	-	S.S. "Blue Cross."
Lecky, Squire Thornton Stratford, R.N.R.	3	S.S. "Uruguay" and S.S. "Halley."
Leportier, Theodore	-	"Kate."
Mackellar, D. E.	-	Observations at Rapa Island.
Martyn, John Artis	3	S.S. "Siberia" and S.S. "Samaria."
*Mayne, Richard C., R.N., C.B.	1	H.M.S. "Nassau."
Morton, John D'Arcy	-	"Henry Bath."
Mossop, Clement	-	"Candahar."
Murphy, Michael	-	S.S. "Tarifa."
*†Paterson, James Forrest	1	S.S. "Moravian."
*Petch, John A. R., Nav. Lieut., R.N.	2	H.M.S. "Phœbe."
Petrie, Peter Conrad	1	S.S. "Patagonia."
Potts, Thomas Crosbie	1	"Tenasserim."
Rawle, Charles, R.N.R.	-	"Star of the North."
Raymond, Charles Tenzer	1	"British India" and "British Consul."
Reid, Carson William	-	"Lord Strathnairn."

\* Pilot charts not presented.

† Second Officer.

† Chief Officer.

Captain's Name.	Letters of Thanks.	Ship.
†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. - -	1	H.M.S. "Hydra."
Simpson, Alexander - - -	—	"Traveller."
Smith, David, F.R.A.S. - - -	—	"Wiltshire."
Smith, William Henry, R.N.R. -	1	S.S. "Hibernian" and S.S. "Peruvian."
Stanhope, John - - -	—	"Decision."
Symington, William - - -	—	"Northfleet" and "Flying Venus."
†Stephen, John George - - -	—	S.S. "Moravian."
*Tandy, Dashwood G., Lieut., R.N.	1	H.M.S. "Nassau."
Tucker, John Worth - - -	—	"John Temperley."
Watson, William - - -	1	S.S. "Palmyra."
Wherland, Frederick, R.N.R. -	1	"Galatea."
Wight, Henry Potts - - -	2	"Gosforth."
Williams, James Agnew - - -	—	S.S. "Wisconsin."
Wylie, James - - -	—	S.S. "Austrian."

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.

APPENDIX III.—A LIST of DOCUMENTS received from SHIPS and LAND STATIONS during the year 1870.

The number of ships supplied during the year 1870 was 122, of which number 35 were steamers belonging to the various companies and others now collecting observations for this office.

The above statement does not refer to ships in the Royal Navy, all of which are supplied with meteorological instruments from the office.

In addition to the registers returned from the ships referred to, documents amounting altogether to 19 in number have been registered during the year 1870, containing observations made at the following places:—

Place.	Observer.	Nature of Observations.
Australia (west coast) -	Lightkeepers -	"Lighthouse" Registers (2 stations) Anemometrical Records. Daily observations and monthly means. "Lighthouse" Register. Daily observations and monthly means. "Weather Book" Register. "Lighthouse" Register. Windrose at Toronto for 1846. Diagrams of mean pressure between lat. 5° 39' N., and lat. 48° 41' S.
Bermuda -	Dockyard Authorities -	
Ceylon (Point de Galle) -	D. Blyth (Master Attendant)	
Falkland Islands (Cape Pembroke)	Lightkeeper -	
Gibraltar -	Serjeant P. Sheehan, Army Medical Staff.	
Rapa Islands -	Capt. D. E. Mackellar -	
Sombrero Island -	Lightkeeper -	
Toronto -	Col. Lefroy, R.A. -	
—	Sir J. C. Ross -	

LIST of DOCUMENTS received from SHIPS.

Captain's Name.	Ship.	Tons.	Owners.	Voyage.	Months of Register.
Almond, T. M.	Decapolis -	632	T. B. Walker, London -	To and from Brisbane -	7
"	Alfred Hawley -	420	Ditto -	Abstract of three voyages from Australia towards England.	—
Angel, I. F.	Twilight -	630	E. Bates, Liverpool -	To Singapore, Bombay, Cochin, and London.	8

List of DOCUMENTS, &c.—continued.

Captain's Name.	Ship.	Tons.	Owners.	Voyage.	Months of Register.
Baker, Thomas	Zoroaster	1,264	C. J. Fox, London	To and from Bombay, calling at Colombo.	9
<sup>1</sup> Balderston, R. J.	Bowfell	1,001	T. & R. Brocklebank, Liverpool	To and from Calcutta	8
Banner, F. W.	Lady of the Lake	307	Edwards & Co., Bristol	Glasgow to Callao; Iquique to New York.	7
Blake, E. J.	Gilbert Thompson	1,061	E. Bates, Liverpool	To and from Calcutta	8
Bouchette, F. B.	S.S. European	2,647	B. Allan, Liverpool	Three voyages to and from Quebec	3
Brooks, Samuel	S.S. City of Brooklyn	2,911	W. Inman, Liverpool	Five voyages to and from New York	4
Brooker, E. W.	Sylvia	695	H.M.S.	Inland sea of Japan	7
<sup>2</sup> Brown, Robert	S.S. Moravian	1,527	Allan Bros., Glasgow	Five voyages to and from Montreal, or Portland.	4
Bruce, John	City of Adelaide	791	J. Moore, London	To and from Adelaide	7
Bruce, William	Camperdown	424	Seal Fishery Co., Dundee	To and from Davis' Strait	5
<sup>3</sup> Bythesea, John, V.C.	Phœbe	2,896	H.M.S.	West Indies to Bermuda, Halifax, Bahia, Rio Janeiro, Monte Video, Cape of Good Hope, Melbourne, Sydney, Hobarton, Lyttelton, Wellington, Auckland, Yokohama, Vancouver Island, Honolulu, Valparaiso, Bahia, and Plymouth.	15
<sup>4</sup> Calver, E. K.	Porcupine	382	H.M.S.	Dredging off Ireland, Scotland, and in Mediterranean.	8
Capper, E. H.	Palm Tree	1,458	R. Gibbs, London	To and from Melbourne	7
Carruthers, F. P.	Minero	478	C. L. Claude, California	To Coquimbo, and from Pisagua	7
Cole, Edwin	S.S. City of Brussels	1,427	T. Harrison, Liverpool	To and from Buenos Ayres	2
<sup>5</sup> Coulan, J. N.	S.S. Cordillera	2,860	P. S. N. Co., Liverpool	To and from Valparaiso	3
<sup>6</sup> Cook, T.	S.S. Java	2,696	J. Burns, Glasgow	To and from New York	1
Cooper, Austin	Carlisle Castle	1,458	H. & F. Green, London	To and from Calcutta	7
Davidson, Charles	Perseverance	164	T. Arbutnot, Peterhead	To, at, and from Cumberland Sound	18

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

Captain's Name.	Ship.	Tons.	Owners.	Voyage.	Months of Register.
Donkin, Thomas	Inverness -	725	J. & R. Grant, London -	To Bombay, Madras, and back -	8
7 Douglas, David	(Not known) -	—	-	From River Columbia to San Francisco and Sandwich Islands.	2
Emslie, J. A. -	Sobraon -	2,131	R. H. Shaw, London -	Equator to Sydney and home -	5
Finlay, James -	Duncairn -	1,303	W. P. Sinclair, Liverpool -	To and from Singapore -	7
Gales, I. C. -	Flechero -	730	J. Hainsworth -	To and at Valparaiso, and from Pisagua	8
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 -	2
Gray, John -	S.S. Mazinthien -	397	R. Kidd, Peterhead -	To and from Greenland -	3
Green, W. C. -	S.S. Nevada -	3,125	L. & Gt. Wn. S. Co., Liverpool -	Two voyages to and from New York -	2
Hammill, M. D. -	S.S. Magellan -	2,856	Pacific S. N. Co., Liverpool -	To and from Valparaiso -	3
Hassel, T. E. -	Mervyn -	306	R. & W. King, Bristol -	To and from Cape Palmas -	4
Hayes, James -	S.S. Ptolemy -	758	Brazil and River Plate S. N. Co. -	Two voyages to and from Monte Video	5
Heggum, E. C. V. -	Czar -	1,147	R. Cuthbert, Greenock -	To and from Callao -	7
"	" -	"	" -	Two voyages to and from Quebec -	4
Henderson, H. -	Hope -	454	J. Robinson, South Shields -	To Queensland -	4
8 Hetherington, W. -	S.S. Hotspur -	1,081	J. Elliott, Newcastle -	To and from Calcutta, viâ Suez -	5
9 Hollway, S. S. -	S.S. Araucania -	2,877	Pacific S. N. Co., Liverpool -	To and from Valparaiso -	3
10 Judkin, C. H. E. -	S.S. Scotia -	2,125	Burns & MacIver, Liverpool -	Three voyages to and from New York -	2
Kennedy, J. B. -	S.S. Blue Cross -	1,075	G. Luckley, Newcastle -	Two voyages to and from Calcutta, viâ Suez.	7
Lecky, S. T. S. -	S.S. Uruguay -	1,301	G. B. Meiklereid, London -	Two voyages to and from Ceara, &c. -	4
"	S.S. Halley -	1,347	Brazil and River Plate S. N. Co. -	To Monte Video, New York, and Liverpool.	3
"	" -	"	" -	To and from Monte Video -	2
Leportier, Theodore -	Kate -	240	C. McGrigor, Aberdeen -	To, at, and from Cumberland Sound -	13
Mackellar, D. E. -	Midas -	555	C. Clark, Dunedin -	From Rapa to Tahiti -	1
Martyn, J. A. -	S.S. Siberia -	1,698	J. Burns, Glasgow -	Three voyages to and from New York, viâ Boston.	2

LIST of DOCUMENTS, &c.—continued.

Captain's Name.	Ship.	Tons.	Owners.	Voyage.	Months of Register.
Martyn, J. A.	S.S. Samaria	1,695	J. Burns, Glasgow	Five voyages to and from New York, via Boston.	4
<sup>11</sup> Miller, David	Sirius	1,268	H.M.S.	To and on West Coast of Africa	2
<sup>12</sup> Moodie, E. R.	S.S. Cuba	1,534	Burns & MacIver, Liverpool	Five voyages to and from New York	4
Morton, J. D'Arcy	Henry Bath	490	H. Bath & Son, Swansea	To Valparaiso, and from Pisagua	6
Mossop, Clement	Candahar	1,418	T. & R. Brocklebank, Liverpool	To and from Calcutta	7
Murphy, Michael	S.S. Tarifa	2,058	Burns & MacIver, Liverpool	Five voyages to and from New York, via Boston.	4
Murray, Alex.	Sir Colin Campbell	365	J. Rae, Aberdeen	To Greenland, Philadelphia, &c.	5
Nelson, J. E.	Philip Nelson	547	P. Nelson, Liverpool	To Port Chalmers, New Zealand	3
<sup>13</sup> Petrie, P. C.	S.S. Patagonia	2,867	Pacific S. N. Co., Liverpool	Three voyages to and from Valparaiso	9
Potts, T. C.	Tenasserim	1,419	T. & R. Brocklebank, Liverpool	Two voyages to and from Calcutta	13
Raymond, C. T.	British Consul	1,267	B. Shipowners Co.	To Bombay, Calcutta, and home	8
<sup>14</sup> Reed, J. W.	Rifleman	486	H.M.S.	In East Indies and Chinese Seas	24
Reid, C. W.	Lord Strathnairn	1,267	J. Farnworth, Liverpool	To Bombay, and from Calcutta	8
<sup>15</sup> Seymour, E. H.	Growler	464	H.M.S.	On West Coast of Africa	2
Shaw, Gilbert	S.S. Delta	644	W. Cunard, Halifax	Eight voyages from Halifax to St. Thomas, via Bermuda, and back.	5
Smith, W. H.	S.S. Hibernian & Peruvian.	—	I. & A. Allan, Glasgow	Five voyages to and from Quebec or Portland.	3
Stanhope, J.	Decision	1,208	D. Morgan, Liverpool	To Bombay, Rangoon, and home	9
Stockton, J. M.	Havana & Ivanhoe	—	S. J. Golding, St. John's, N.B.	London to Boston, London and Demerara, St. John's, N.B., to Portrush, Rosario, and Boston.	8
Stuart, W. H.	Richmond	183	Board of Trade	At Bahamas	8
Taylor, J. H.	Renown	1,293	H. Green, London	Equator to Madras and towards home	5
Thompson, J. M.	British American	1,207	C. Hill, Bristol	To Payta, Callao, Guanape Island, and home.	8
<sup>16</sup> Thwaites, Joseph	S.S. Douro	2,824	R. M. S. P. Co., London	Three voyages to and from Buenos Ayres	7

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

Captain's Name.	Ship.	Tons.	Owners.	Voyage.	Months of Register.
Tucker, J. W.	John Temperley	976	J. C. Hall, Durham	To Bombay, and from Java	8
Tully, Thomas	Baroda	1,364	T. Brocklebank, Liverpool	To and from Calcutta	7
Ward, John	Rifleman	486	H.M.S.	In East Indies and Chinese Seas	15
Warren, W. H. C.	Brilliant	303	C. Saunders, Liverpool	Twice to, and once from, Pernambuco	3
Watson, T. O.	Peter Joynson	956	P. Joynson, Liverpool	To Japan, and from Macassar Straits	10
Watson, W.	S.S. Palmyra	1,390	J. Burns, Glasgow	Four voyages to and from New York, viâ Boston.	4
Wight, H. P.	Gosforth	810	T. E. Smith, Gosforth	To and from Madras	7
Williams, Jas. Agnew	S.S. Wisconsin	3,220	L. & Gt. Wn. S. Co., Liverpool	Four voyages to and from New York	4
Williams, W. J.	S.S. Paraguay	1,444	J. G. Armstrong, Dublin	To and from New York	1
Wiseman, W.	Pioneer	142	H.M.S.	On West Coast of Africa	3
Woolward, R.	S.S. Douro	2,284	R. M. S. P. Co., London	To and from Rio Janeiro, also to and from Buenos Ayres.	4
Wright, A. R.	Rocket	464	H.M.S.	On West Coast of Africa	1
Wylie, James	S.S. Austrian	2,235	I. & A. Allan, Glasgow	Eight voyages to and from Quebec or Portland	6
Various	Seven German ships	—	—	In North Atlantic, February 1870	3
Various	Four English ships	—	L. & N. A. R. M. Co.	In North Atlantic, February 1870	1
Unknown	S.S. North American	1,673	I. & A. Allan, Glasgow	Six voyages to and from Quebec	4

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

- 1 Messrs. Cornett and Ellery.
- 2 J. F. Paterson, Chief Officer.
- 3 J. A. R. K. Petch, Navigating Lieutenant.
- 4 G. H. Browning, Navigating Lieutenant.
- 5 Robert Potts.
- 6 and 10 W. Greenwood.
- 7 Received from Sir Edward Sabine.
- 8 Fergus Scott.
- 9 Ed. Jackson, 3rd Officer.

11 15 18 20 C. H. C. Langton, Acting Navigating Lieutenant.

12 A. Scalby, 3rd Officer.

13 Ed. Brailey, 2nd Officer.

14 Alfred Doorly, Master's Assistant, and J. C. Roughton, Nav. Mid.

16 19 A. H. Dyke, 2nd Officer.

17 L. J. W. Thomas, Acting Second Master.

21 Abstracts received from Herr von Freeden, Hamburg.

22 Abstracts received from Captain Robert Inglis.

23 Benjamin Thomson, 3rd Officer.

APPENDIX IV.

INSTRUMENTS supplied, &c. to the Royal Navy.

Per Account.	Baro- meters.	Ane- roids.	Thermometers.			Hydro- meters.		
			Ordinary.	Max.	Min.			
January 1st, 1870, afloat	-	-	170	379	806	7	14	143
Issued in 1870	-	-	52	79	266	27	27	36
			222	458	1,072	34	41	179
Returned in 1870	-	-	47	92	245	22	18	48
January 1st, 1871, afloat	-	-	175	366	827	12	23	131

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

January 1st, 1870, in use	-	-	53	61	97	18	19	15
Issued in 1870	-	-	4	6	6	—	1	16
			57	67	103	18	20	31
Returned in 1870	-	-	5	10	24	8	6	4
January 1st, 1871, in use	-	-	52	57	79	10	14	27

DISPOSITION of ADMIRALTY INSTRUMENTS on January 1st, 1871.

Afloat in Royal Navy	-	-	175	366	763	12	23	131
„ merchant ships	-	-	—	—	—	—	—	53
In use at stations	-	-	52	57	79	10	14	27
In store, at M.O.	-	-	140	95	158	33	28	91
„ Chatham	-	-	2	5	18	2	2	17
„ Sheerness	-	-	10	12	13	3	1	10
„ Portsmouth	-	-	8	14	20	6	7	25
„ Devonport	-	-	5	15	30	7	7	24
„ Queenstown*	-	-	1	4	6	2	2	8
„ Gibraltar	-	-	3	4	—	—	—	4
„ Malta	-	-	6	10	40	1	2	28
„ Halifax	-	-	4	6	16	4	4	4
„ Bermuda	-	-	6	6	15	1	1	16
„ Jamaica	-	-	6	7	29	5	4	8
„ Ascension†	-	-	1	4	7	—	—	—
„ Cape of Good Hope	-	-	5	8	6	—	—	16
„ Hong Kong‡	-	-	11	31	57	—	—	24
„ Vaiparaiso‡	-	-	4	1	23	2	2	16
Total, per account	-	-	439	645	1,280	88	97	502
Lost or destroyed during 1870			4	2	138	16	10	20
Transferred to B. T. account			40	12	—	14	10	—

\* No return has been made since 1st January 1870.  
 † No return has been made since 20th October 1868.  
 ‡ No return has been made since 1st January 1869.

## APPENDIX V.

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

Per Account.:	Baro- meters.	Com- passes.	Thermometers.			Hydro- meters.
			Ordinary.	Max.	Min.	
January 1st, 1870, afloat -	69	8	430	—	—	283
Issued in 1870 - -	118	2	636	—	—	393
Returned in 1870 -	187	10	1,066	—	—	676
	63	4	334	—	—	212
January 1st, 1871, afloat -	124	6	732	—	—	464

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

January 1st, 1870, in use	94	5	224	35	36	58
Issued in 1870 - -	11	—	24	6	6	2
Returned in 1870 -	105	5	248	41	42	60
	14	2	57	4	4	17
January 1st, 1871, in use	91	3	191	37	38	43

## DISPOSITION of Board of Trade Instruments.

In merchant ships -	123	6	732	—	—	411
In naval ships - -	—	—	64	—	—	—
In use at stations -	91	3	191	37	38	43
In store at M.O. - -	52	40	179	24	17	158
At Southampton agency -	2	2	7	—	—	8
„ Liverpool „ -	5	9	24	—	—	17
„ Aberdeen „ -	5	—	35	—	—	20
„ Glasgow „ -	9	—	42	—	—	7
Total, 1st Jan. 1871 -	287	60	1,274	61	55	664
Lost, &c. during 1870	4	—	156	1	1	56

APPENDIX VI.

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

Thurso - - -	J. Trotter - - -	—
Wick - - -	J. Sandison - - -	Postmaster.
Nairn - - -	W. D. Penny - - -	Schoolmaster.
Aberdeen - - -	J. Gibson - - -	Telegraph Superintendent.
Leith - - -	T. Bolton - - -	Telegraph Clerk.
Shields - - -	J. Irvine - - -	Do.
Scarborough - - -	F. Shaw - - -	Do.
Yarmouth - - -	T. Robinson - - -	—
Ardrossan - - -	W. McNeil - - -	Telegraph Clerk.
Greencastle - - -	J. McGladery - - -	Do.
Holyhead - - -	T. Slater - - -	Do.
Liverpool - - -	S. Jones - - -	Do.
Valencia - - -	E. O'Sullivan - - -	Do.
Roche's Point - - -	W. Kennedy - - -	Do.
Pembroke - - -	J. C. Walker - - -	Do.
Scilly - - -	W. Thomas - - -	—
Penzance* - - -	J. G. Uren - - -	Postmaster.
Plymouth - - -	J. Merrifield, F.R.A.S. - - -	Teacher of Navigation.
Portsmouth - - -	J. Hoar - - -	—
Dover - - -	J. Costello - - -	Telegraph Clerk.
London† - - -	Clerks in Meteorological Office	—
Heart's Content - - -	J. Weedon - - -	Telegraph Superintendent.

\* Discontinued after 1st April 1871.

† Reports not sent by telegraph.

APPENDIX VII.

LIST of Persons, Places, &c. to which the Daily Weather Report is supplied.

*Newspapers :*

Daily News.  
 Echo.  
 Express.  
 Globe.  
 Lloyd's Shipping List.  
 Observer.  
 Pall Mall Gazette.  
 Shipping and Mercantile Gazette.  
 Standard (Morning and Evening).  
 Times (1st and 2nd editions).

*For Exhibition at following Seaports :*

Banff.	Hayle.
Belfast.	Hull.
Blackpool.	Newquay.
Buckie.	Port Dinorwic.
Carnarvon.	Porthcawi.
Cromer.	St. Ann's Head.
Cullen.	Silloth.
Exeter (2 copies).	Teignmouth.
Falmouth.	Ventnor.
Great Grimsby.	

*Societies, &c. :*

Association of Underwriters, Liverpool.  
 Do. Lloyd's.  
 Calcutta, Meteorological Committee.  
 Patent Office, London.  
 Press Association.  
 Reuter's Telegram Company.  
 Royal Society.  
 Scottish Meteorological Society.

*Individual Observers, in co-operation, &c. :*

Barnes, R. H., Kensington.  
 \*Dymond, W. P., Falmouth.  
 Griffith, Rev. C., Strathfield Turgiss.  
 Hoskins, Dr. S. E., Guernsey.  
 Malleson, Rev. F., Broughton-in-Furness.  
 Mansell, J. C., Longthorns.  
 Moore, Dr. J. W., Dublin.  
 Richards, W. H., Penzance.  
 \*Smith, Rev. F., Merville.  
 Sutherland, A., Carrickfergus.  
 Tennent, R., Edinburgh.  
 \*Whitehouse, W., Hampstead.

*Foreign Places :*

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

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\* Added since 31st December 1870.

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## APPENDIX VIII.

## 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, 74 in England and

Wales, 32 in Scotland, 12 in Ireland, 3 in the Isle of Man, and 2 in Jersey.

NORTH.	WEST.	SOUTH.	EAST.
*Kirkwall. Inverness. Nairn. Burghead. Lossiemouth. Buckie. Portsoy. Banff. Fraserburgh. Peterhead. Aberdeen. Stonehaven. Montrose. Broughty Ferry. Dundee. *St. Andrews. *Burntisland. Anstruther. *St. Monance. Alloa. Grangemouth. *Bo'ness. Granton. Leith. Fisherrow. Dunbar. Eyemouth.  Glasgow. Greenock. Campbelton. Girvan. *Rothesay.	*Castletown } *Ramsey } Man. Douglas. } *Silloth Maryport. Workington. Whitehaven. Barrow. Morecambe. Fleetwood. Blackpool. Lytham. Runcorn. Southport. Liverpool. Queensferry. Hawarden. Mostyn. Holyhead. Port Penrhyn. Carnarvon. Aberystwith. Milford. Pembrey. Llanelly. *Swansea. Briton Ferry. Porthcawl. Penarth. Cardiff. Newport. Weston-super-Mare. Burnham. Ilfracombe. Barnstaple. Fremington. Instow. Newquay. *Port Isaac. Hayle. Pendennis. Penzance. Falmouth.  Belfast Howth. Kingstown. *New Ross. Dungarvan. Youghal. Queenstown. Cork. Passage. Tralee. *Limerick. Galway.	Plymouth. Teignmouth. Exeter. Exmouth. St. Helier } Jersey. Gorey } *Poole. Cowes. Ventnor. Portsmouth. Littlehampton. Brighton. Hastings. Rye.  FRANCE.	Tynemouth. S. Shields. Sunderland. Middlesborough. Redcar. Whitby. Filey. Withernsea. Hull. Goole. Grimsby. Boston. Lynn. Cromer. Yarmouth. *Southwold. Ipswich. Harwich. Chatham. Sheerness. Faversham. Dover.  HOLLAND. HAMBURG. NORWAY.

\* The stations marked with an asterisk have been added since 31st December 1870.

## APPENDIX IX.

## LIST of PLACES supplied with FISHERY BAROMETERS.

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Those supplied during the years 1867-70 are distinguished by an asterisk.

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*Shetland Isles.*—Sandsair, Lerwick.

*Orkney Isles.*—Burray.

*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\* (Isle of Wight), Gorey (Jersey), Poole, Weymouth, Portland, Budleigh-Salterton, Cawsand, Mevagissey, Gorranhaven, Truro, Devoran, Penrhyn, Falmouth, Newlyn, Mousehole.

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

*Wales.*—Swansea, 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.*—Belfast, Bangor, Strangford, Ardglass, Carlingford,\* Dundalk, Malahide,\* Howth, Kingstown.

*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, Babyle, Obb, Ness.

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APPENDIX X.

DONATIONS RECEIVED DURING THE YEAR 1870.

Presented by Societies, Institutions, &c.

Adelaide	-	Observatory	-	-	-	Meteorological Observations, January 1870. By C. Todd, Government Observer.
Batavia	-	"	-	-	-	On the Diurnal Variation of the Inclination of the Magnet at Batavia, By Dr. P. A. Bergsma, Director.
Brisbane, &c.	-	"	-	-	-	Summary of Rainfall, 1860-8, and February and March 1870.
		"	-	-	-	Summary of Meteorological Observations, 1868, and January to March 1870.
		"	-	-	-	Summary of Observations at Toowoomba and Warwick, July 1869.
		"	-	-	-	Ditto, and at Cape Moreton, August to December 1869, and January to March 1870.
		"	-	-	-	Ditto at Sweer's Island, 1868.
		"	-	-	-	Ditto at Cape York, August to October 1869. By E. MacDonnell, Government Meteorological Reporter.
Bruxelles	-	Observatoire Royal	-	-	-	Annales, Vols. XVIII. and XIX. Annales Météorologiques, 1867-9, and January to May for 1870. Climat de la Belgique, Vols I. and II. Météorologie de la Belgique comparée à celle du Globe. Phénomènes Périodiques, 1841-5, 1850-9, 1860-8. Phénomènes Périodiques en général. Mémoire sur les Variations périodiques et non-périodiques de la Température. Mémoire sur la Température de l'Air à Bruxelles. Plan et Description des Instruments de l'Observatoire. Sur la Différence de Longitude entre Bruxelles et Greenwich. Nécessité d'un Système Général d'Observations Nautiques et Météorologiques. Notices extraites de l'Annuaire de l'Observatoire, 1851, 1855-61, 1863-70. Détermination de la Déclinaison et de l'Inclinaison Magnétique à Bruxelles en 1870. Étoiles Filantes du Milieu de Novembre 1867, et État de l'Atmosphère. Physique Sociale, ou Essai sur le Développement des Facultés de l'Homme, Vols. I. and II. Statistique International de l'Europe. Also some Excerpt Papers. By M. A. Quetelet, Director.
Calcutta	-	Meteorological Office	-	-	-	Reports to the Government of Bengal for the Year 1868-9, with Meteorological Abstracts for 1868 and 1869. On the Normal Rainfall of Bengal. By H. F. Blanford, Government Meteorological Reporter.

Calcutta	- St. Xavier's College	- Meteorological Register, 1868; July to December 1869, and January to June 1870.
	Surveyor General's Office	By the Rev. E. Lafont, S.J. Abstracts of the Results of Hourly Meteorological Observations, September 1869 to August 1870. Table of Mean Monthly Readings and Mean Hourly Variations of the Barometer, 1855-69.
Cape of Good Hope.	Royal Observatory	- Meteorological Observations, 1861-9, and January to March 1870. By Sir Thomas Maclear, Astronomer Royal. Ditto, April to June 1870.
		By E. J. Stone, Astronomer Royal.
Christiania	- Norske Meteorologiske Institut.	Meteorologisk Aarbog for 1869. Meteorologiske Jagttagelser i Norge, December 1869 to October 1870.
	„	- Température de la Mer entre l'Islande l'Écosse et la Norvège.
	„	- Om Tordenvejr i Norge, 1868-9.
	„	- Oversigt over Norges Klimatologi, Storm Atlas. By Professor H. Mohn, Director, and by the University.
Cincinnati	- Observatory	- Annual Report, June 1870. By C. Abbe, Director.
Coimbra	- Observatorio	- Observações Meteorológicas, February to November 1866.
	„	- Resumos Annuaes das Observações Meteorológicas, 1864-5 and 1865-6. By Sr. de Souza, Director.
Colombo, &c.	- Surveyor General's Office	Results of Meteorological Observations at various Stations in Ceylon, May 1869 to February 1870. By Captain A. B. Fyers, R.E., Surveyor General.
Constantinople	- Observatoire Impérial Météorologique.	Résumé des Observations Météorologiques, November 1869 to July 1870. By A. Coumbary, Director.
Copenhagen	- K. Danske Videnskabernes Selskab.	Forhandlinger, Nos. 5 and 6 for 1868; 2-4 for 1869; and No. 1 for 1870. By J. Steenstrup, Secretary.
Edinburgh	- Royal Society Scottish Meteorological Society.	- Proceedings, Vol. VI., No. 77. Journal, New Series, Vol. III., Nos. 25-27.
Falmouth	- R. Cornwall, Polytechnic Society.	Report for 1869. By W. P. Dymond, Hon. Secretary.
Florence	- Ministero d' Agricoltura Industria e Commercio.	Meteorologia Italiana, October 1869 to September 1870.
	„	- Supplement to ditto, pages 81-88 for 1869.
	„	- Climatologia Italica, No. 1-5 for 1870. By Dr. P. Maestri.
Greenwich	- Royal Observatory	- Report of the Astronomer Royal to the Board of Visitors, 1870.
	„	- Magnetical and Meteorological Observations, 1868. By G. B. Airy, C.B., Astronomer Royal.
Hamburgh	- Norddeutsche Seewarte	- Jahres-Bericht, 1869.
	„	- Mittheilungen, No. III., Über die Dampferwege zwischen dem Kanal und New York. "Hansa" 1870. Wetterberichte, for year 1870.

Hamburgh	-	Norddeutsche Seewarte	-	Zweite deutsche Nordpolarfahrt, Papers VII. and VIII. By Herr W. v. Freeden, Director.
Hobarton	-	Royal Society of Tasmania.	-	Monthly Notices, 1866-9.
		"	-	Results of Meteorological Observations at Hobarton, with summary for other places. By the Colonial Office.
Hong Kong	-	Harbour Office	-	Meteorological Observations taken at Praya West and Victoria Peak, Jan. to August 1870. By Captain H. Thomsett, R.N., Harbour Master.
		Government Civil Hospital	-	Meteorological Observations taken at Victoria, January to August 1870. By R. Young, M.D.
Kew	-	Observatory	-	Report of the Kew Committee for the year 1869-70.
		"	-	Results of the Monthly Observations of Dip and Horizontal Force, April 1853 to March 1869. Monthly Magnetic Determinations made at the University of Coimbra, December 1866 to May 1869. By Dr. B. Stewart. (See also Stewart.)
Kremsmünster	-	Sternwarte	-	Resultate der Meteorologischen Beobachtungen, 1868. By Dr. Reslhüber, Director.
Leipzig	-	"	-	Übersicht der Resultate aus den Meteor. Beobachtungen angestellt auf den K. Sächsischen Stationen, 1868, and June 1869 to April 1870. By Dr. C. Bruhns, Director.
Lemberg	-	K. K. Universität	-	Meteorologische Beobachtungen, June 1869 to October 1870. By Dr. A. Handl, Director.
Lisbon	-	Observatorio do Infante D. Luiz.	-	Annaes, Vol. VII., March to November 1869.
		"	-	Boletim Meteorologico for the year 1870. By Sr. F. Da Silveira, Director, and Sr. C. de B. Capello.
London	-	Admiralty	-	Tide Tables for 1871.
		"	-	Manual of Scientific Enquiry. By Admiral Richards, C.B., Hydrographer.
		Board of Trade	-	Report of Wrecks, Casualties, &c. for 1869. By Thos. Gray, Assistant Secretary.
		British Association	-	Report for 1869.
		British Horological Institute.	-	Journal, Vol. XII., Nos. 137-144. Vol. XIII., Nos. 145-148.
		Colonial Office	-	Meteorological Observations at Perth (West Australia), 1867-9, by W. H. Knight. The office is also indebted to the Colonial Office for numerous returns from various colonies.
		India Office	-	Catalogue of Maps of British Possessions of India and other parts of Asia.
		"	-	Sketch of the Mountains and River Basins of India. The office is also indebted to the same office for various works containing observations made in India.

London	-	Meteorological Society	-	Proceedings, Vol. V., Nos. 45-9. Vol. VI., No. 50.
		"	-	Meteorology of England, by J. Glaisher, F.R.S. Reports for three quarters, ended 30th June 1870.
		Royal Astronomical Society		Monthly Notices, Vol. XXX., and No. 1. of Vol. XXXI.
		"	-	General Index to the first 29 Vols. of ditto. Memoirs, Vol. XXXVII., Parts I. and II.; Vol. XXXVIII.
		"	-	On the Solar Eclipse of August 18th, 1868, by W. De La Rue, F.R.S.
		Royal Geographical Society		Journal, Vol. XXXIX.
		"	-	Proceedings, Vol. XV., Nos. 1-4.
		Royal Institution of Great Britain.		Proceedings, Vol. V., No. 51. Vol. VI., Nos. 52 and 53.
		Royal National Lifeboat Institution.		Report, 1870. Journal, Nos. 76-78
		Royal Society	-	Proceedings, Vol. XVIII., Nos. 116-122. Vol. XIX., No. 123.
		"	-	Address delivered at the Anniversary Meeting, 30th November 1870. by Sir E. Sabine, K.C.B., President. (See also Sabine.)
Madrid	-	R. Observatorio	-	Observaciones Meteorologicas, December 1868 to April 1869. By Sr. Aguilar, Director.
Melbourne	-	Flagstaff Observatory	-	Discussion of Meteorological and Magnetical Observations during 1858-63. By Dr. Neumayer.
		"	-	Results of the Magnetic Survey of the Colony during 1858-64. By J. Ellery, Director.
Moncalieri	-	Osservatorio del R. Collegio Carlo Alberto.		Bullettino Meteorologico, Vol. IV., Nos. 10-12.
		"	-	Osservazioni Meteoriche fatte al Collegio S. Francesco di Lodi, June to September 1869.
		"	-	Le stelle cadenti dei periodi di November 1868 ed Agosto 1869. By M. F. Denza, Director.
Munich	-	Königliche Sternwarte	-	Wochenbericht, Nos. 234-263. By Dr. J. v. Lamont, Director.
New York	-	Central Park Observatory		Annual Report, 1869. By D. Draper, Director.
Oxford	-	Radcliffe Observatory	-	Results of Meteorological Observations, 1867. By Rev. R. Main, Radcliffe Observer.
Palermo	-	R. Osservatorio	-	Bullettino Meteorologico, Vol. V., Nos. 9-12; Vol. VI., Nos. 1-2. By G. Cacciatore, Director.
Paris	-	Académie des Sciences	-	Comptes Rendus Hebdomadaires, Vol. LXX., and Vol. LXXI., Nos. 1-11.
		Association Scientifique de France.		Bulletin Hebdomadaire, Vols. VII. and VIII., Nos. 180-188.
		Observatoire Météorologique de Montsouris.		Bulletins Météorologiques for year 1870. By M. C. Sainte-Claire Deville. (See also Deville.)
		Observatoire National	-	Bulletin International for year 1870. By M. Delaunay, Director.
		Service Hydrométrique du bassin de la Seine.		Résumé des observations centralisées pendant l'année 1868.
		"	-	Observations faites sur les petits cours d'eau. 1 Mai 1868-30 Avril 1869.

Paris	-	-	Service Hydrométrique du bassin de la Seine.	Observations sur les grands cours d'eau. 1 Mai 1868-30 Avril 1869.
			"	Observations pluviométriques, 1868, Feuilles 1-3. By M. Belgrand.
			Société Météorologique de France.	Nouvelles Météorologiques, Vol. III., Nos. 1-8.
			"	Annuaire de la Société Météorologique, Vol. XVI.
Philadelphia	-		American Philosophical Society.	Proceedings, Vol. XI., No. 82.
Prague	-	-	K. K. Sternwarte	Magnetische und Meteorologische Beobachtungen, 1839-1869. By Dr. C. Hornstein, Director.
Rome	-	-	Osservatorio del Collegio Romano.	Bullettino Meteorologico, Vol. VIII., No. 12; Vol. IX., Nos. 1-11. By Sr. Padre A. Secchi, Director.
St. Petersburg	-		Central Physical Observatory.	Vorschläge betreffend die Reorganisation des meteorologischen Beobachtungs-systemes in Russland. By H. Wild, Director.
			"	Marche diurne de la Température à Barnaoul et à Nertchinsk. By Lieut. Rikatcheff, R.I.N.
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Stonyhurst	-	-	Observatory	Results of Magnetical and Meteorological Observations, 1869.
			"	Magnetic Survey of the West of France, 1868. By the Rev. S. J. Perry, S.J.
Stuttgart	-		Polytechnische Schule	Die Witterungsverhältnisse der Jahre 1868-1869, nach den Beobachtungen der Württembergischen Stationen. By Dr. H. Schoder.
Sydney, &c.	-	-	Observatory	Astronomical Observations, 1859.
			"	Astronomical Observations, with Meteorological Observations, 1860-2, by W. Scott, M.A.
			"	Meteorological Observations, 1863, by H. C. Russell, B.A., and G. R. Smalley, B.A.
			"	Abstract of Meteorological Observations made in New South Wales, June 1857 to December 1859 (except August 1859), and Means for 1864-6, and Monthly Observations, January 1867 to June 1869.
			"	Observations made at Paramatta Observatory, June 1857 to October 1858. By G. R. Smalley, B.A.
Toronto	-	-	Education Office	Journal of Education, Vol. XXIII. By Rev. E. Ryerson, D.D.
			Magnetical Observatory	General Meteorological Register, 1854-62, 1864-7, and 1869.
			"	Monthly ditto, 1856-69, and January to April 1870. By G. T. Kingston, M.A., Director.
Trieste	-	-	R. Academia di Commercio Nautica.	Osservazioni Meteorologiche, July 1869 to September 1870. By Dr. F. Ritter v. Schaub, Director.
Upsala	-	-	Observatoire	Bulletin Météorologique Mensuel, Vol. I., Nos. 1-5; Vol. II., Nos. 1-9. By MM. Svanberg and Rubenson.

Upsala - -	Observatoire - - -	Vindarnes freqvens i Sverige under Januari och Juli beräknade för quinquenniet 1859-63. By H. Hildebrandsson.
	„ -	Stormana, 13-21, October 1869. By the same.
Utrecht - -	K. Nederlandsch Meteor. Instituut.	Weerkundige Waarnemingen, for year 1870. Zeilaanwijzingen van Java naar het Kanaal, two parts. Écarts en Europe, December 1868 to November 1869. By Dr. B. Ballot, Director.
Vienna - -	K. K. Centralanstalt für Meteorologie und Erdmagnetismus.	Beobachtungen, October 1869 to October 1870 (except August). Telegraphische Witterungsberichte, October 1869 to November 1870. Jahrbuch, Vol. V., new series.
	„ -	Die Wärme-abnahme mit der Höhe an der Erdoberfläche und ihre jährliche Periode.
	„ -	Über die jährliche Vertheilung der Gewittertage nach den Beobachtungen an den Meteor. Stationen in Oesterreich und Ungarn.
	„ -	Über den jährlichen Gang der Temperatur zu Klagenfurt, Triest und Arvavaralja. By Dr. C. Jelinek, Director. (See also Jelinek.)
Washington -	Department of Agriculture	Report for 1868. Monthly Reports for the year 1869.
	Smithsonian Institution -	Report for 1868. Rain charts of the United States (Summer and Winter). An account of the Observations made at New Albany, Indiana, during the Total Eclipse of the Sun, August 7th, 1869. The orbit and phenomena of a Meteoric Fireball seen July 20th, 1860. Report of the U.S. Coast Survey, 1866. The Transatlantic Longitude as determined by the Coast Survey of 1866. By Professor J. Henry, Secretary.
	U. S. Naval Observatory -	Astronomical and Meteorological Observations for 1867. Reports on the Total Solar Eclipse of August 7th, 1869. By Admiral Sands, Superintendent.
	War Department - -	Preliminary Plans for Observation and Report of Storms by Telegraph. Annual Report of the Chief Signal Officer to the Secretary of War, 1870. Government Telegrams and Reports for the Benefit of Commerce. By General Myer, Chief Signal Officer.
Wellington, N.Z., &c.	Observatory - - -	Meteorological Observations at various Stations, 1866-9, and January to April 1870. By J. Hector, M.D., Government Meteorological Reporter.
Zurich - -	Meteor. Centralanstalt der Schweizerischen Naturforschenden Gesellschaft.	Meteorologische Beobachtungen, December 1868 to November 1869. By Dr. R. Wolf.

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Belavenetz, Capt., R.I.N. -	-	Russian Nautical Magazine, Nos. 11 and 12 for 1869, Nos. 1-11 for 1870.
Beverley, Rev. A. -	-	Abstract of Meteorological Observations taken at Aberdeen during 1869.
Capello, Sr. J. C. de B. -	-	See Lisbon.
Deville, M. C. Ste. Claire -	-	Des Perturbations périodiques de la Température dans les mois de Février, Mai, Août, et Novembre. Notes 2-7.
„	-	Des Variations comparées de la température et de la pression atmosphériques. (See also Paris.)
Hildebrandsson, M. H. -	-	See Upsala.
Hoskins, Dr. S. E., F.R.S. -	-	Meteorological Observations taken at Guernsey, 1869, and January to November 1870.
Jelinek, Dr. C. -	-	Über den Sturm des 14 November 1869. Über die Leistungen eines registrirenden Thermometers von Hipp. (See also Vienna.)
Johnston, K. jun., -	-	Atlas of the British Empire.
Loomis, E. -	-	Mean daily range of the Magnetic Declination compared with the number of Auroras observed each year.
Miller, Rev. J. N. -	-	The true Direction and Velocity of Wind observed from ships while sailing.
Moyle, M. P. -	-	Summary of the Weather at Helston (Cornwall) for the year 1869.
Mühry, Dr. A. v. -	-	Die Frage einer Meeresströmung in die Magellanestrasse.
„	-	Über die Ergebnisse der Meteorologischer Beobachtungen auf den St. Theodul Pass.
„	-	Der Golfstrom und Standpunkt der thermometrischen Kenntnisse des Nordatlantischen Oceans und Landgebiets im Jahre 1870. (Review.)
Prestel, Dr. M. A. F. -	-	Der Sturmwarner und Wetteranzeiger. Der Boden der ostfriesischen Halbinsel.
Prettner, Dr. J. -	-	Meteorologische Beobachtungen zu Klagenfurt. December 1869 to October 1870.
Rawson, Governor R. W., C.B. -	-	Averages of Monthly and Yearly Rainfall in Barbadoes, from 1847 to 1869.
Richards, W. Hosken -	-	Abstract of the Weather at Penzance and neighbourhood, 1869.
Rikatcheff, Lieut., R.I.N. -	-	See St. Petersburg.
Rubenson, Dr. R. -	-	„ Upsala.
Sabine, Sir E., K.C.B. -	-	On the Lunar Atmospheric Tide at St. Helena.
„	-	On the Diurnal Variation of the Magnetic Declination at St. Helena.
„	-	On the Lunar Atmospheric Tide at Singapore, by Capt. E. M. Elliott.
„	-	The Magnetic Survey of the British Islands, reduced to the epoch 1842-5. (See also Royal Society.) The office is also indebted to Sir E. Sabine for numerous works by various authors.
Scarpellini, Madame C. -	-	Bullettino delle Osservazioni Ozonometriche-meteorologiche fatte in Roma, Feb. to Aug. 1870. Catalogo degli Uranatmi (ossia stelle cadenti), 1861-7, &c.
Stewart, Dr. B. -	-	On the Recent Developments of Cosmical Physics.
Tarry, M. H. -	-	Sur les pluies de poussière et les pluies de sang. Two papers.
Tebbutt, J. jun. -	-	Meteorological Observations made at Windsor, N.S. Wales, 1863-6.
Zurcher & Margollé, MM. -	-	Manuel Barométrique. (Translation.)
„	-	Les Étoiles Filantes.
„	-	Bulletin de la Société Académique du Var, Vol. III.
„	-	Annuaire Scientifique, 1870.

## APPENDIX XI.

LIST of PERSONS in the EMPLOYMENT of the METEOROLOGICAL COMMITTEE on December 31st, 1870, 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 and accounts - -	180	0	0	—		
J. S. Harding, sen. -	} Copying, accounts of stores, registry of documents, &c. }	—			1	18	6
T. D. Bell -		—				0	16
<i>Commissionaire</i> -	Messenger - - - - -	—			1	1	0
<i>Land Meteorology (Observatories).</i>							
S. Jeffery - - -	} Discussion of returns and compu- tations. }	—			3	0	0
E. Magrath - - -		—			1	8	0
J. P. Cutts - - -		—			0	15	0
R. H. Curtis - - -	} Reproduction of observatory curves by pantagraphs, and preparation for publication. }	100	0	0	—		
E. C. Steventon - -		90	0	0	—		
C. Stodart - - -		—			2	0	0
<i>Land Meteorology (Telegraphy).</i>							
E. Gaster - - -	} Preparation of weather reports, and computations. }	140	0	0	—		
E. Brodie - - -		—			0	18	0
G. G. Francis - - -		—			0	17	0
<i>Ocean Meteorology.</i>							
Capt. H. Toynbee -	Marine Superintendent - - - -	400	0	0	—		
W. Salmon - - -	Examination of logs under discussion	230	0	0	—		
R. Strachan - - -	First examination of logs, care of instruments, &c. - - - -	210	0	0	—		
C. Harding - - -	Examination of logs under discussion	120	0	0	—		
J. A. Curtis - - -	} Computations - - - - - }	—			1	8	0
W. G. James - - -		—			1	8	0
J. W. McVeagh - -		—			0	12	0
Rev. Thos. Kerr -	Director of Valencia Observatory -	250	0	0	—		

## LIST OF PUBLICATIONS, &c.

ISSUED UNDER

### THE AUTHORITY OF THE METEOROLOGICAL COMMITTEE.

#### OFFICIAL.

- No. 1. Report for 1867. Presented to Parliament. 1*s*.
2. Instructions for Meteorological Telegraphy. 6*d*.
3. Fishery Barometer Manual. 6*d*.
4. Charts of Surface Temperature, South Atlantic Ocean. 2*s*. 6*d*.
5. Report for 1868. Presented to Parliament. 5*d*.
6. Report for 1869. Presented to Parliament. 10*d*.
7. Quarterly Weather Report for 1869. Parts I. to IV. Price 5*s*. each. [Published by Stanford, Charing Cross.]
8. Barometer Manual. 1*s*.
9. Quarterly Weather Report for 1870. Part I., January to March. Price 5*s*. [Published by Stanford, Charing Cross.]

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#### NON-OFFICIAL.

- No. 1. Report to the Committee on the Connexion between Strong Winds and Barometrical Differences.—By Robert H. Scott, Director of the Office. 6*d*.
2. Report to the Committee on the Meteorology of the North Atlantic.—By Captain H. Toynbee, Marine Superintendent. 1*s*.
3. Report to the Committee on the Use of Isobaric Curves.—By Captain H. Toynbee, Marine Superintendent. 1*s*.

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