

NINTH ANNUAL REPORT
OF THE
METEOROLOGICAL COMMITTEE

TO THE
LORDS COMMISSIONERS OF HIS MAJESTY'S
TREASURY.

For the Year ended 31st March, 1914
(the Fifty-ninth Year of the Meteorological Office).

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



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THE METEOROLOGICAL COMMITTEE, 1913-14.

Constituted by Minutes of the Lords Commissioners of H.M. Treasury, dated 20th May, 1905, and 31st March, 1910.

Appointed till

- March 31, 1915 ... MR. W. N. SHAW, Sc.D., F.R.S., Director,
Chairman.
- Sept. 2, 1914 ... Rear-Admiral H. E. PUREY CUST, R.N.,
Hydrographer to the Navy.
- March 31, 1915 ... Captain J. M. HARVEY, Principal Examiner
of Masters and Mates, Board of Trade,
Nominated by the Board of Trade.
- Dec. 2 [1916] ... T. H. MIDDLETON, C.B., M.A., M.Sc., Assis-
tant Secretary of the Board of Agriculture
and Fisheries. Nominated by the Board
of Agriculture.
- March 31, 1915 ... Professor ARTHUR SCHUSTER, F.R.S. Nomi-
nated by the Royal Society.
- Feb. 25, 1918 ... Captain H. G. LYONS, D.Sc., F.R.S. Nomi-
nated by the Royal Society.
- March 31, 1915 ... Mr. G. L. BARSTOW, C.B. Nominated by the
Treasury.
-

Subject to the discretion of the authorities by which they were respectively nominated, the members of the Committee hold office for a period not exceeding five years, but are eligible for reappointment.

THE GASSIOT COMMITTEE, 1913-14.

Appointed in accordance with Treasury Letter of 26th February, 1910, by the Royal Society on 17th March, 1910, to administer the Gassiot Trust, and to promote the scientific study of the branches of science to which the Trust relates, viz., Meteorology, Terrestrial Magnetism, Atmospheric Electricity, Seismology, and the cognate subjects.

Sir William Crookes, O.M. (*President of the Royal Society*).

Captain H. G. Lyons (*Chairman*).

Dr. C. Chree.

Mr. W. H. Dines.

Mr. F. W. Dyson (*Astronomer Royal*).

Sir Archibald Geikie, K.C.B.

Dr. R. T. Glazebrook, C.B.

Sir A. B. Kempe (*Treasurer of the Royal Society*).

Sir Joseph Larmor, M.P.

Prof. H. F. Newall.

Prof. J. H. Poynting [*dec. March 30th, 1914*]

Sir Arthur Rücker.

Sir E. Rutherford.

Prof. Arthur Schuster (*Secretary of the Royal Society*).

Dr. W. N. Shaw.

Dr. G. T. Walker.

Mr. G. W. Walker.

Mr. C. T. R. Wilson.

**THE STAFF OF THE METEOROLOGICAL OFFICE
AND OF THE OBSERVATORIES OF THE
METEOROLOGICAL COMMITTEE, 1913-14.**

DIRECTOR.

William Napier Shaw, LL.D., Sc.D., F.R.S.

METEOROLOGICAL OFFICE.

SECRETARIAL STAFF.

<i>Secretary</i> ...	...	R. Corless,* M.A.
<i>Principal Clerk</i> ...	...	T. D. Bell.
<i>Professional Assistants</i> ...	...	C. E. P. Brooks, B.Sc., H. W. Braby, M.A., Miss H. M. Powell, B.Sc.
<i>Clerk Assistant</i> ...	...	H. L. B. Tarrant.
<i>Clerk Computers</i>	...	Misses R. E. Smith, D. M. Buckeridge, D. Chambers, E. V. Turney.
<i>Probationer</i> ...	...	H. J. Dormer.
		1 Office Boy.

ACCOUNTS.

<i>Chief Clerk and Cashier</i> ...	John A. Curtis.
<i>Clerk Assistant</i> ...	... E. L. Ardley.
<i>Clerk</i> ...	... E. J. Hood.
<i>Boy Clerk</i> ...	... N. C. Bradnock.
<i>Office Keepers</i> ...	... W. H. Parsons, A. G. Goad.
	4 Messengers, 1 Office Boy.

MARINE DIVISION.

<i>Marine Superintendent</i> ...	M. W. Campbell Hepworth,* C.B., R.D., Commander, R.N.R.
<i>Principal Clerk</i> ...	... W. Allingham.
<i>Staff Assistant</i> ...	... W. G. James.
<i>Clerks</i> ...	... J. T. Williams, H. Kecton.
<i>Clerk Computer</i> ...	... A. A. Lovie.
<i>Probationers</i> ...	... W. B. Greening,† J. L. Gray.
<i>Boy Clerks</i> ...	... E. L. Clinch, A. J. Tabor.†

* Inspectors of Meteorological Stations.

† Member of the corps of observers for the instruments installed at the Office.

FORECAST DIVISION.

<i>Superintendent</i> ...	... R. G. K. Lempfert,* M.A.
<i>Principal Clerk</i> ...	... F. J. Brodie.*
<i>Forecast Assistants</i>	... H. Harries,* R. Sargeant.*
<i>Clerks</i> ...	... F. W. Snell, A. T. Bench.
<i>Clerk Assistant</i> ...	... W. Hayes.
<i>Clerk Computers</i> ...	... A. G. W. Howard, R. Pyser.
<i>Probationers</i> ...	... W. R. Berry, C. F. J. Jestico.

The staffs at the Branch Office at Farnborough and at the Weather Station at Falmouth (*see below*) are associated with this division.

STATISTICAL DIVISION.

<i>Superintendent</i> ...	... E. Gold,* M.A.
<i>Staff Assistants</i> ...	... J. Sheerman, A. H. Bell, A. R. Simpkins.
<i>Clerks</i> ...	... C. A. Bracey, L. H. Powers.
<i>Clerk Assistant</i> ...	... M. T. Spence.†
<i>Clerk Computer</i> ...	... C. W. Heinemann.
<i>Supernumerary Clerks</i> ...	... A. E. Pycock, W. J. Tomkins.†
<i>Probationer</i> ...	... C. V. Ockenden.
<i>Boy Clerk</i> ...	... M. H. Megrah.†

1 Office Boy.

INSTRUMENTS DIVISION.

<i>Superintendent</i> ...	... F. J. W. Whipple,* M.A.
<i>Staff Assistant</i> ...	... R. F. Wallace.
<i>Clerk Assistant</i> ...	... A. E. Gendle.
<i>Mechanical Assistant</i> ...	... J. H. James.†
<i>Attendant</i> ...	... B. G. Brame.†

1 Messenger.

Lithographers—Messrs. Wyman & Sons, Ltd. (A. G. King, *Artist*).

METEOROLOGICAL OFFICE, SOUTH FARNBOROUGH.

<i>Meteorologist-in-Charge</i> ...	J. S. Dines,* M.A.
<i>Professional Assistant</i> ...	H. Billett, B.Sc.
<i>Mechanic-Computer</i> ...	H. Allnutt.

METEOROLOGICAL OFFICE, EDINBURGH.

<i>Superintendent</i> Andrew Watt,* M.A.
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* Inspectors of Meteorological Stations.

† Members of the corps of observers for the instruments installed at the office.

OBSERVATORIES.

CENTRAL OBSERVATORY.

Kew Observatory, Old Deer Park, Richmond, Surrey.

<i>Superintendent</i> ...	... C. Chree, Sc.D., LL.D., F.R.S. <i>Assistant-Director of Observatories.</i>
<i>Professional Assistants</i> ...	C. D. Stewart, B.Sc., E. H. Nichols, B.Sc. (temporary).
<i>Staff Assistants</i> ...	... E. Boxall, B. Francis.
<i>Boy Clerk</i>...	... F. Levin.
<i>Probationer</i> ...	... L. G. Hemens.
<i>Observer and Caretaker</i> ...	W. R. Corrin. Miss K. R. Corrin.

MAGNETIC OBSERVATORY.

Eskdale Observatory, Langholm, Dumfries-shire.

<i>Superintendent</i> ...	... L. F. Richardson, B.A.
<i>Professional Assistant for Seismology.</i>	} L. H. G. Dines, M.A.
<i>Clerk Assistant</i> ...	... P. N. Skelton.
<i>Clerk Computer</i> ...	... H. G. Harris.
<i>Mechanic-Caretaker</i> ...	... A. Stonier.
<i>Attendant</i>...	... R. Laidlaw.
<i>Boy Clerk</i>...	... J. Beck.

WESTERN OBSERVATORY.

Valencia Observatory, Cahirciveen, co. Kerry.

<i>Superintendent</i> ...	... J. E. Cullum.
<i>Assistant</i> ...	... M. Sugrue.
	1 handyman.

AEROLOGICAL OBSERVATORY.

Pyrtton Hill, Watlington, Oxon., afterwards moved to Benson, Oxon.

<i>Director of Aerological Investigations.</i>	} W. H. Dines, F.R.S.
<i>Mechanical Assistant</i> ...	H. W. Baker.

WEATHER STATION, FALMOUTH OBSERVATORY.

<i>Professional Assistant</i> ...	A. H. R. Goldie, M.A.
<i>Assistant</i> J. B. Phillips.

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For the Year ended 31st March, 1914 (the Fifty-ninth
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MAY IT PLEASE YOUR LORDSHIPS.

Meetings of the Committee have been held on 30th April, 25th June, 19th July, 22nd October, 26th November, 1913, 28th January, 25th March, 1914.

No change has taken place in the membership of the Committee during the year.

Office and Observatory Staff.—A list of the members of the staff at the close of the year is given on pages 6-8.

The increase of grant submitted by Your Lordships for the approval of Parliament for the financial year 1913-14 has enabled the Committee to improve the organisation of the work of the Office on the occasion of the re-appointment of the Superintendents of the Forecast Division and the Statistics Division and of the Director's Secretary at the close of the first period of those appointments.

The most important step was the institution of a grade of junior professional assistants. For these posts applications were invited from graduates who had just completed their University course and were prepared to take up professional work in Meteorology, Terrestrial Magnetism and Seismology. Four appointments were filled in the quarter which began with 1st July, 1913, one of which went to a member of the Office staff who had joined some years ago as a probationer and who had taken the degree of B.Sc. in the University of London, with honours in Geology, from the South-Western Polytechnic Institution. One of the appointments was assigned to Kew Observatory and another to the Branch Office at South Farnborough in connexion with work for the Advisory Committee for Aeronautics; another was associated with the Forecast Division in connection with new arrangements for the Weather Station at Falmouth which will be referred to later. The fourth was retained for work at the Office in connexion with the library and especially for dealing with the meteorological reports coming to the Office from remote

countries, chiefly British Colonies, either in the form of manuscript returns or as printed schedules included in the official publications of the Colonies. In previous reports attention has often been called to the importance of making these reports easily available for co-ordination with the observations of other countries in the study of the meteorology of the globe, but all the dispositions hitherto made have been rendered nearly inoperative by the automatic growth of the work of the Office in the divisions concerned.

The work has now been incorporated with that of the Secretarial staff and a graduate assistant has been attached to that staff for special duty in connexion with this *réseau mondial*. It is hoped that henceforward regular progress may be reported.

Later in the year two more professional assistants with University qualifications were appointed temporarily, one for the work at Kew Observatory to enable the Superintendent to devote a definite part of his time to the discussion of the observations of Captain Scott's Second Antarctic Expedition, and the other to assist the Marine Superintendent in the preparation of a report on ice for the Board of Trade. The latter was coincident with the retirement on account of continued ill-health of Miss E. D. Anderson, who had been for many years the principal of a staff of female clerks originally appointed for the preparation of synoptic charts of the Atlantic Ocean for 13 months of 1882-3. After the completion of that work the female staff was employed generally in the work of the Marine Division, but with the change of circumstances it has been found desirable to alter that distribution, and they now form part of the Secretarial staff which deals with correspondence, inquiries, accounts, the library, publications, colonial and foreign observations, and the general administration of the Office. At the same time the number of the establishment of the clerical staff that come within the regulations for superannuation allowance arranged by the Meteorological Council in 1900 has been revised and the terms of appointment have been somewhat improved. The number of probationers has been increased.

Special leave of absence has been given to Mr. E. Gold, Superintendent of the Statistics Division, in order that he may take part in the Meeting of the British Association in Australia as one of the Secretaries of Section A.

Meteorological Office Press.—The press has been in regular operation throughout the year, and the regular issues of the Daily Weather Report, the maps for the Weekly and Monthly Weather Reports, and the meteorological charts of the North Atlantic Ocean and of the Indian Ocean have been made without fail.

In addition, orders for 27 lithograph forms for recording instruments, &c., have been executed, as well as the following special orders:—

Maps to illustrate the Eighth Annual Report. •

Diagrams to illustrate "Instructions for Meteorological Telegraphy," "Geophysical Memoirs," and "Fourth Report on Wind Structure."

“One Hundred Years of Rainfall for London.”

Outline charts of the Arctic Sea.

Forecasts by Telephone.—The Committee have decided to make arrangements for the supply of forecasts and other information about the weather in reply to inquiries by telephone. For many years arrangements have been in operation under which information can be given in reply to inquiries by telegraph on payment at any telegraph office of the charges for the telegrams of inquiry and reply, with a fee of sixpence for departmental expenses. The organisation necessary for a corresponding arrangement to enable subscribers to the telephone exchanges and others to obtain information is under consideration and will be brought into operation in the current year.

Storm Warnings.—In connexion with the revision of the code of storm warnings the Committee have given careful consideration to the system which has been in operation for many years for the issue of warnings of gales to seaports. The practice has been for the Office to provide the cones for signal stations and to pay the cost of the telegrams notifying the warnings, while the signal-mast and gear, and the necessary attendance are provided locally. The Office has in each case to decide whether the application from any particular port shall be complied with. It is felt that it has not sufficient information to form an independent opinion upon the requirements of the different ports in this matter, and in consequence it has to invite an expression of opinion from the Departments which have the necessary knowledge. This practice, however, leaves out of account the financial aspect of the matter as affecting the Office, and it has been therefore thought desirable to make a rule that in future the number of the signal stations to which warnings may be sent at the expense of the Office should not exceed 200, and to provide that applications from ports beyond that number may be complied with if the ports are willing to defray the cost of the telegrams.

INTERNATIONAL CO-OPERATION.

A meeting of the International Meteorological Committee was held at Rome on April 7th to 12th, 1913, the local arrangements being undertaken by the Director of the Italian Central Office for Meteorology and Geodynamics. The meeting was under the presidency of the Director of the London Meteorological Office, who was accompanied on this occasion by Mr. Lempfert, Superintendent of the Forecast Division. Of the 17 members of the Committee 11 took part in the proceedings, representing the meteorological organisations of Canada, Denmark, France, Germany, Great Britain, Holland, Italy, Portugal, Russia, Sweden, and Switzerland. The subjects discussed are indicated by the following programme:—

1. Report of the Officers.
2. Questions not disposed of at the last meeting of the Committee in 1910:—
 - (a) List of Observatories (Report of Berlin Meeting, English Ed., p. 8).

(b) Extension of the synoptic charts of the North Atlantic Ocean (p. 8).

(c) Commission on Atmospheric Electricity (p. 16).

(d) M. Eiffel's Meteorological Atlas (p. 23).

3. Agricultural Meteorology.—A report on this subject drawn up by MM. Angot and Palazzo has been distributed with circular letter N.S. No. 8.

4. Investigation of the Upper Air.—The report of the seventh meeting of the Commission for Scientific Aeronautics held in Vienna in May, 1912, has been printed and circulated by the Austrian Meteorological Office. The sixth resolution of this meeting reads as follows:—

The Commission resolve that atmospheric pressure be expressed in the publications of the Commission in bars or in one of their decimal submultiples, decibars, centibars, or millibars instead of in millimeters of mercury; but this resolution is only to become operative after receiving the approval of the International Meteorological Committee.

Mr. Walker, who is unable to attend the meeting at Rome, has communicated his views on this subject in a letter dated January 8th, 1913, which has been circulated to the members of the Committee.

A proposal by M. Rykatcheff dealing with the establishment of upper air stations within the polar circle.

5. Solar Radiation.—M. Maurer's report on the meeting of the Radiation Commission held at Rapperswyl in September, 1913, has been circulated and will serve as the basis for the discussion.

Mr. Hunt, of Melbourne, has submitted the following proposal for consideration, through Mr. Shaw:—

“That it is desirable that the resolution of the International Committee at St. Petersburg recommending the Campbell-Stokes sunshine recorder as the instrument which furnishes the most comparable values, be given effect to by the adoption of a precise specification of the dimensions, weight, permeability of the glass spheres, etc.”

6. Meteorological Telegraphy.—A printed report of the last meeting of the Commission on Weather Telegraphy held in London in September, 1912, has been circulated by the President of the Commission, Mr. Shaw.

M. Angot has written to suggest “that it may be desirable for the Committee to discuss some of the questions recently raised by the International Commission on Time Signals, particularly that of the receipt and dispatch by radiotelegraphy, of reports of observations made at sea and on land. The changes in the arrangements for the issue of time signals approved at this Conference will probably come into operation on July 1st, 1913. It seems to me desirable to start a service of meteorological radiotelegrams on the same date.”

7. Storm Warnings and Maritime Meteorology.—A printed report of the last meeting of the Commission on these subjects, held in London in September, 1912, has been distributed by its President, Mr. Shaw.

M. Ryder suggests “that a resolution be adopted which asks the different meteorological institutes to assist the Danish Meteorological Institute in gathering information about the state of ice in the Arctic Sea, to be used in the report thereof, which is published each year by this institute.”

8. Questions by Mr. Shaw:—

(a) “Is sleet to be reckoned as qualifying for a day of snow?”

(b) “Can a symbol for sleet be added to the international scheme?”

9. Report of the Commission for Terrestrial Magnetism.

10. The next Conference of Directors.

11. A letter from M. Hildebrandsson regarding the Commission on the Réseau Mondial.

12. A question submitted by M. Mohn regarding the depth of snow.

13. A proposal made by M. Rykatcheff, relating to comparisons between the English (Stevenson) screen and the aspiration psychrometer.

A report of the proceedings was prepared by Dr. Hellman, Director of the Royal Prussian Meteorological Institute, the Secretary of the Committee, and was issued in June, 1913. In accordance with the usual practice a translation has been prepared for the use of the English-speaking communities, and it is now ready for issue.

The duty of giving effect to the decisions of the Committee with reference to the change of the international code devolved upon the Meteorological Office, and gave rise to a good deal of correspondence with the European Institutes in order to secure that the changes should be made on the 1st May, 1914, in all the countries concerned, without any confusion. The correspondence was increased by reservations being made and modifications suggested by various institutes when the time for a final decision arrived. In the end, however, the necessary understanding was arrived at and all preparations were concluded for the changes to be made without hitch on the 1st May.

The modifications introduced in the code for reporting British observations in order to provide for the additional information to be included in the international system, made it necessary to reconsider the units in which the measurements of pressure and rainfall are expressed, and the Committee, in accordance with the conclusions indicated in their last report, decided to give the readings of pressure in millibars, and of rainfall in millimetres, in the Daily Weather Report. By way of explanation of this action a circular was prepared and issued, which is reprinted in Appendix III, p. 63.

Scottish Meteorological Society.—In the report for last year it was announced that, in compliance with Your Lordship's request, negotiations were in progress for the augmentation of the annual contribution of the Office towards the expense incurred by the Scottish Meteorological Society in collecting and editing meteorological returns from stations in Scotland for the use of the public. The negotiations have been carried through and it was arranged that the Committee should contribute £350 a year towards the maintenance of an institution for the supply of information to the public to be called the Meteorological Office, Edinburgh, and to be in the charge of a Superintendent who might be at the same time Secretary of the Scottish Meteorological Society. The customary annual grant of £100 on account of the schedules supplied to the Registrar-General of Births, Deaths, and Marriages for Scotland was continued so that the sum under the control of the Committee of the Meteorological Office, Edinburgh, amounts to £450 a year. At the same time the costs of the Superintendent's visits to London and his travelling expenses as Inspector of Stations on the combined scheme are defrayed separately out of Office funds.

The terms arranged with the Scottish Meteorological Society are set out in Appendix I., p. 60.

The Committee regard the satisfactory conclusion of these negotiations as a subject of congratulation for all concerned and as securing a substantial advantage to the public. In accordance

with the terms arranged all available returns from Scottish stations were included in the Monthly Weather Report from January, 1914, and for the first time since the collection of meteorological information began to be organised some 50 years ago the available climatological information for all parts of the British Isles is included in a single publication. The Committee are glad to report that the Office has been able to deal with the additional number of stations without interference with the arrangement with the printer under which the monthly report for one month is printed and issued by the 27th of the following month, and is therefore cleared out of the way before the work for the new month begins.

The report of the Edinburgh Office for the first year is given on page 49.

Weather Station at Falmouth.—Since 1868 it has been the practice to make a grant of £250 a year to the Royal Cornwall Polytechnic Society for the maintenance of a Meteorological Observatory with self-recording instruments similar to those at Kew. As indicated in the report for last year, this arrangement was brought to an end by the discontinuance of the grants of various public bodies made to the Royal Cornwall Polytechnic Society in consideration of the maintenance of magnetic observations. Mr. E. Kitto, who had been Superintendent since July, 1882, retired on 30th June, 1913. The Committee take this opportunity of recording their appreciation of his services and of the high standard which he maintained in the meteorological work of the Observatory.

From the point of view of modern meteorology the recording instruments for pressure and temperature set up in 1868, which are photographic, are unsatisfactory as they only disclose what has been happening after the sensitive paper has been removed and developed. It seems to the Committee essential that a meteorological observatory to be really effective should keep itself in touch with the study of the daily weather as represented in the Daily Weather Report, and not merely register the things that can be registered for deliberate consideration after the event. It did not therefore seem desirable to carry on the Meteorological Observatory at Falmouth on the old lines after the departure of Mr. Kitto. During the continuance of the Observatory there had occurred the installation by the Office of a pressure-tube anemograph on the tower, Pendennis Castle, the exhibition of the record in a case at the Custom House, and the establishment of a separate Climatological station by the Corporation of Falmouth for supplying information in the evening when the Observatory was closed. It was thought desirable to take in hand the various functions that can be discharged by a Weather Station, viz., observations in relation to the Daily Weather Service, including the investigation of the upper air and the supply of meteorological information to persons in the locality.

Further, it is felt in the Office in view of the increasing demand for forecasts and other information for aircraft and for other purposes that it has become essential to provide means for a survey of the work of the forecast division from the point of view of an external observer and a recipient of the information at a considerable distance from the Office. It appeared that this could be done very effectively by employing a professional assistant for work in alternate periods of three months or more at an observing station like Falmouth and at the Office.

A proposal was accordingly drawn up embodying these ideas and was accepted by the Royal Cornwall Polytechnic Society, whose contribution to the scheme is to lend the Observatory premises rent free, and to supervise the local arrangements.

The proper working of the scheme requires two professional assistants, one at the Office and one at Falmouth, who can exchange places at proper intervals, but the funds set free by the termination of the old arrangement do not permit the full working of the scheme. Mr. A. H. R. Goldie, B.A., of St. John's College, Cambridge (M.A. St. Andrews) was selected as professional assistant for the purpose of the work, and after some months' training at the Office was in charge of the experimental work at the Observatory from October to December. In the meantime, the regular observations at the Observatory and the custody of a revised equipment of recording instruments rests with Mr. J. B. Phillips, who is assisted in the observations by Mr. R. H. Brenton, the Observer for the Corporation. The terms of this arrangement are set out in Appendix II.

OBSERVATORIES: PREMISES, FITTINGS, AND STAFF.

Central Observatory.—*Buildings, Equipment and Grounds.*—The year has been a very eventful one at the Observatories.

As regards the Central Observatory in the Old Deer Park at Richmond, known for so many years as Kew Observatory, provision had already been made by the Office of Works, at the urgent representation of the Meteorological Committee, for the reconstruction of the interior as soon as the building was set free by the transfer of the staff of the National Physical Laboratory to new buildings erected for the purpose at Teddington.

Various unavoidable causes delayed the completion of the transfer, but it was at last effected on May 13th, 1913, and orders were given for the temporary accommodation of the staff of the Observatory and of the various instruments, with the exception of the standard barometer, the thermograph, the electrograph and the Robinson anemograph, in the outbuildings, so that the contractor's workmen might be admitted to deal expeditiously with the main building on June 1st, 1913. The completion of the work was promised for the beginning of October, but the many circumstances incidental to the reconstruction of an old building led to some delay, and the operations were not completed until the close of 1913.

The reconstruction is in every way a notable improvement, and opportunity has been taken to make some considerable additions to the equipment and arrangement for the work of the Observatory.

The octagon room known as the North Hall has been provided with a gallery which gives easy access to the upper tier of glass cases. Also a number of new instruments have been installed in such a way that the recording parts are within the room itself, and an observer can therefore watch the progress of events without difficulty. Hitherto it has been a peculiarity of the Observatory that, although provision was made for recording many physical properties of the atmosphere, the observer was not put in possession of the information until the development of the photographic records, which only took place at intervals of two days. He was therefore possibly less well-informed about atmospheric changes than an observer with ordinary instruments who had no automatic record to look forward to. The new instruments include:— (1) A Dines pressure-tube anemograph with the provision for recording the direction of the wind which was designed by Mr. W. H. Dines, and has been adopted by the Meteorological Office for the anemometers at Pyrtan Hill, Spurn Head, and Eskdalemuir, and will be introduced at Falmouth, Yarmouth, and other stations as soon as the necessary funds are available. The head of the anemograph at Kew is fixed to a new staging erected for the purpose of mounting anemometers permanently or temporarily. (2) A Callendar self-recording thermometer, the "bulb" of which is in the screen on the north wall, wherein the bulbs of the photographic thermograph have been exposed since they were originally installed. (3) A mercury barograph with a recording pen governed by a float, designed by Mr. W. H. Dines, F.R.S., and constructed under his direction, by his mechanical assistant, Mr. H. W. Baker, at Pyrtan Hill. (4) A Bendorff electrograph, lent by the Director, with an Ionium collector that has been in use for some time at South Kensington, and gives a visible record of the variation of electrical potential close to the north wall of the Observatory building. (5) A mercury barometer of the Kew pattern graduated in millibars. (6) An instrument for registering the minor fluctuations of atmospheric pressure, which goes by the name of the Shaw-Dines microbarograph. This is one of two instruments originally obtained by the late Professor Chrystal, F.R.S.E., with the aid of a subvention from the Government Grant Committee, for the Scottish lake survey, and placed in charge of the Meteorological Office by the Government Grant Committee. After temporary erection in the North Hall it has been ejected on account of the magnetic properties of its case. It will be replaced in position when a non-magnetic case has been provided.

In the same room are also accommodated, on new pedestals, busts of Professor Stephen Rigaud, Savilian Professor of Geometry in the University of Oxford, who shared the superintendence of the Observatory during the long term of office of the Revd. S. Demainbray on the original foundation of 1769; General Sir E. Sabine, who was President of the Royal Society, and one of the leading scientific authorities connected with the second foundation

of the Observatory under the auspices of the British Association in 1842; and Mr. J. P. Gassiot, F.R.S., a colleague of Sabine's, and the munificent donor of the fund by which the Observatory was maintained when the British Association withdrew its financial support, and which is still devoted to its maintenance.

A very old circular table from the Computing Room now occupies the centre of the North Hall, and carries models of the magnetic recording apparatus, and other objects of historical interest.

The South Hall, which is in the basement, has been very much improved by the reconstruction of the hut wherein the seismograph was housed. The seismograph room is now an octagonal structure about 8 feet high, placed centrally, with a gangway round it. Within it a well has been made by means of which the level of the ground water can be continuously recorded. It is a curious and satisfactory circumstance that, although the repeated flooding of the basement was the primary cause of urgency for the reconstruction of the interior of the building, the time during which the reconstruction was effected was remarkably dry, so much so that the well had to be excavated to a depth of 10 feet below the level of the basement floor before water could be reached. The record of variation of water-level promises therefore to be eventful and of great interest. If possible, the temperature of the water in the well will also be recorded, because the temperature of underground water, like the depth, represents the result of a process of integration which is deserving of study from various points of view.

In the basement story, but with raised floors, three excellent rooms have been provided. The two adjoining rooms on the west side form a photographic dark room and a photographic laboratory, and that on the east side a physical laboratory and time room, where the standard clock is housed and the time signal received. Provision has already been made for an aerial by which radiotelegraphic signals may be received, and the necessary apparatus has been obtained. By permission of the Postmaster-General the aerial will be erected by the engineers of the Post Office.

On the ground floor the North Hall already mentioned, which forms an entrance hall, leads to the south octagon, which has now become the superintendent's room and committee room, and on either side, to the library, wherein the standard barometers are housed, and the computing room, which has been formed out of what was previously two rooms with an awkward projecting staircase.

The upper floor has been converted into rooms for a resident observer and for the caretaker, one room being reserved for the use of the Director.

Suitable lavatory and domestic offices have been provided, partly in the main building and partly in an out-building erected by the National Physical Laboratory for a workshop. The remainder of this out-building will be refitted as a workshop as soon as it can be cleared of a collection of odds and ends for which the Observatory has no use.

No change has been made in the other out-buildings, except that provision has been made to accommodate the water-dropping electrograph in the "clinical house" instead of the main building, where the constant drip is liable to cause dry rot.

It has been found necessary to spend a considerable sum upon refurnishing the Observatory, as the furniture and fittings left after the withdrawal of the laboratory staff disclosed a deplorable state of dilapidation. Among the furniture were found six arm-chairs of old design, which probably formed part of the original furniture of the Observatory. They have been restored with most satisfactory results. A number of new cabinets have been provided.

The removal of the books in packing cases and their restoration to the main building has been the occasion of a good deal of confusion in the library, and it has transpired that the accumulation of unbound books and pamphlets in the possession of the Observatory amounts to the equivalent of about 6,000 volumes. The cost of the sorting, binding, and cataloguing necessary to bring the library into proper working order cannot be less than £1,000.

When the contractors' work was completed, the ground on the north and east sides, by which the Observatory is approached, was left in a state of disorder, and required attention. The Observatory stood originally quite unprotected in the Old Deer Park, with an enclosure for a lawn and the out-door instruments beyond it. In 1894 the use of five acres of additional land was obtained from the Office of Woods and Forests at a rental of £27 a year, and it was enclosed in a fence provided by Sir Francis Galton at a cost of about £350. The enclosure was let to the Mid-Surrey Golf Club for pasturing horses at a rent of £5, and the horses had the run of the ground up to the Observatory walls. In view of recent investigations into the relation between atmospheric electricity and the growth of plants, it seemed desirable that the Observatory should be in the position to make experiments upon the electrical state of the atmosphere in relation to growing plants of various kinds. The practice hitherto has been for portions of the garden ground not required for the exposure of instruments to be allotted to members of the staff. In the new circumstances the practice is not convenient, and, for the time being, the Director has taken over the care of the grounds. About an acre of land on the north and east sides of the Observatory has been protected by means of a chestnut-pale fence, a border 10 feet wide round this enclosure has been laid out as a shrubbery, and two experimental plots, each 10 metres square, to accommodate suitable growing plants with a view to electrical observations, have been arranged.

In this connection the Committee have to acknowledge the cordial co-operation of Lieutenant-Colonel Sir David Prain, F.R.S., Director of the Royal Gardens, Kew, and of his Assistant Curator, Mr. W. J. Bean, not only in giving advice as to the course to be adopted, but also for the presentation of a large number of plants for the shrubbery.

Since the close of the financial year the work necessary for setting out the grounds in the manner described, together with material required for remaking of the roads and the formation of a

gravel terrace round the building, has been provided by the Director. These operations have resulted in a considerable improvement in the arrangement of the grounds.

Staff.—There have been a number of changes in the staff of the Observatory. Under the programme of 1913-14 a professional assistant was appointed with special reference to terrestrial magnetism, to date from July 1st, and under an arrangement with the Trustees of the National Antarctic Fund, whereby part of Dr. Chree's time is set free for the discussion of the magnetic observations of Captain Scott's last expedition to the Antarctic, a second professional assistant was appointed for one year from 7th October, 1913. A new probationer was appointed in October, 1913, to replace one of the members of the staff transferred to Eskdalemuir, and more recently, in order to help in bringing the library into order again, Miss K. R. Corrin, daughter of the caretaker, has been employed under the guidance of Miss H. M. Powell, professional assistant in the secretarial division of the office, in sorting the books.

The Superintendent's report upon the work carried on at the Observatory will be found on pages 51 to 54.

Eskdale Observatory.—*Buildings and Grounds.*—At Eskdalemuir the year has been eventful in quite a different way. Nothing has been done to the buildings except re-decoration on the change of occupation. The magnet house has been under the attention of the Office of Works, and the drainage of the land in the immediate neighbourhood has been improved. The reports of work of the Superintendent have from time to time included complaints as to the state of the atmosphere in the underground chambers, partly on account of the dampness and partly on account of the preparation with which the wood has been treated to prevent dry rot. The Office of Works asks for further attention to the question of ventilation, and that difficult matter must be taken up. It will be remembered that the original scheme was found to be defective partly owing to the accidental inclusion on the completion of the work of a sack in the main flue where it had been put originally for the useful purpose of preventing the flue being choked with rubbish.

The Meteorological Committee have realised that some extension of the accommodation for residence at the Observatory is desirable in view of the difficulty or impossibility of obtaining accommodation in the neighbouring village of Davington, and they have represented the matter to Your Lordships. It has become apparent that the existence of a telephone at the Observatory must ultimately lead to the establishment of an office to which the public have access, because it seems unreasonable to expect the residents in the locality to carry telegrams three and a half miles along a visible telephone wire. Yet the loan of the Observatory telephone for private use by the locality must in time give rise to difficulty. The Committee have, therefore, included the question of a public telephone call office or post office in that of additional buildings, and they hope to be in a position to report favourably on the whole question next year.

Meanwhile some progress has been made with laying out the grounds. In the course of the year the Committee were gratified by an intimation received from the Royal Society that a donation of £200 by Mr. Matthew Gray was available for the continuance of the salary of an assistant in seismology for another year beyond the period provided for by the grant out of Royal Society funds referred to in the Report for 1911-12, page 51. The funds thus set free have enabled the Committee to sanction the purchase of a motor-car which Dr. Harker acquired originally for his own use, and which was found to be useful at the Observatory, and to acquire 4,500 trees for planting on the borders of the Observatory grounds in order to secure protection for the site from the worst of the winds and enable part of the vacant land to be brought into cultivation.

Equipment.—The measurement of the vertical component of the earth's magnetic force is still under consideration. The recorder lent by Dr. W. Watson, F.R.S., is still being used, and the Adie recorder has not yet been restored. An electro-magnetic dip-instrument has been obtained from the firm of Messrs Schulze of Potsdam after being tested by the observatory of the Royal Prussian Meteorological Institute. The Dines anemograph erected by the National Physical Laboratory has been replaced by one which records also the direction of the wind.

Staff.—Mr. L. F. Richardson took over the duty of Superintendent from Dr. J. A. Harker on August 1st, 1913, as previously arranged. Before reporting himself for duty at the Observatory provision was made for him to visit a number of observatories in the United Kingdom and on the Continent, and to carry out a comparison of a Kew set of absolute instruments with those of the various observatories visited. The Committee desire to express their thanks to the authorities of the observatories visited, which included, besides Kew, Valencia and Eskdale, Greenwich, Falmouth, Val Joyeux, de Bilt, Potsdam.

The rest of the staff remained unchanged, and it was thought desirable to arrange that of the two assistants who had been employed at the Observatory since its opening, the senior should come to London and the junior should get a step in promotion. This was to take place on 1st July, but the arrangement was disturbed by the selection of the junior of the two assistants for an appointment in the magnetic department of the Carnegie Institution of Washington, followed up by the wish for release before the expiration of the prescribed notice. A new assistant was therefore transferred from Kew on 1st June. It was thought desirable not to countermand altogether the arrangement previously arrived at, but the transfer of the senior assistant to London was postponed till 1st October, and a new assistant from the division of the office which deals with the work of the observatories, after some months' special training at Kew, was sent to the northern observatory.

As intimated in the programme for last year, it has been decided as a matter of general principle to bring the Observatory into touch with the study of the daily weather by the sending of daily reports of observations at 7 a.m. and 6 p.m. by telegraph for the

service of the Daily Weather Report. As this duty would entail the additional work of making up and despatching the telegrams and of attendance at the unaccustomed hour of 7 a.m., the employment of a boy clerk living in the neighbourhood was authorised as an addition to the Observatory staff. The appointment was authorised in the early part of the year, and took effect from 5th May, but in view of the numerous changes in the staff and the arrears of work that had accumulated, the telegraphic reports were not brought into operation until 1st January, 1914.

It may be noted that beginning with the departure of Mr. and Mrs. Black, caretaker and housekeeper, in May, 1912, followed by that of Mr. Southern in September, 1912, Mr. Walker on 31st December, 1912, Mr. Parkinson in May, 1913, and Mr. Gendle on September 30th, 1913, the whole of the staff originally employed at the Observatory has been changed. Besides the general inconvenience which is inseparable from changes of any kind, it has been noticed that in every case, except that of the transfer of Mr. Gendle to the Office, for some reason or other, the notice prescribed in the terms of appointment has been disregarded. The growth of this practice makes administration difficult, and the Committee think it will be necessary to make it clear that the conditions of appointment, as regards notice, apply to both sides equally.

A report on the work of the Observatory during the year, drawn up by Mr. L. F. Richardson, Superintendent, will be found on page 54.

Valencia Observatory.—The building had gradually fallen into a state of disrepair, and in consequence it has been overhauled and put in order on the advice of Messrs. W. H. Hill and Son, architects, at a cost estimated at £71 10s.

A remarkable feature of this work was that it was difficult to find a contractor to undertake it. Ultimately it was taken up by a firm that had other work going on in Cahirciveen, provided it could be commenced before the other work was completed.

There has been no change in the staff of the Observatory during the year. Mr. Cullum, Superintendent, who is graded in the Office list as a classified clerk, reaches the age of retirement for classified clerks during the current year.

PUBLICATIONS.

At the close of the financial year the publication of the results of the observations at the Observatories as indicated on pp. 46 and 47 were a good deal in arrear.

Exchanges of publications have been arranged with the following:—

Meteorological Observatory of the Salesian College, Punta Arenas, Chile; Royal Bavarian Academy of Sciences, Munich; Nobel's Seismological Observatory, Baku; Institute for Cosmical Physics, Czernowitz, Austria; Haynald Observatory, Kalocsa, Hungary; Astronomical and Meteorological Observatory, Quito, Ecuador; Committee on the climate of Devon, Plymouth; Meteorological and Geophysical Institute, Frankfurt-on-Main;

Geophysical Institute, Leipzig; Astronomical and Meteorological Observatory of the Puebla State College, Mexico; University of California, Berkeley, California.

The official publications issued or signed for press during the year are as follows:—

PERIODICAL.—The Daily Weather Report.

Monthly Meteorological Charts of the Atlantic Ocean and the Mediterranean.

Monthly Meteorological Charts of the Indian Ocean and Red Sea.

The British Meteorological and Magnetic Year Book, comprising:—

Part I.—**The Weekly Weather Report** with Quarterly and Annual Summaries, and a wind-force Supplement (up to date).

Part II.—**The Monthly Weather Report**, with a summary for the year (up to date).

Part III. (1).—**Daily Readings** at Meteorological Stations of the First and Second Order (up to date).

Part III. (2).—**Geophysical Journal. Daily readings** in Meteorology, Solar Radiation, Seismology, Atmospheric Electricity and Terrestrial Magnetism, with the results of Soundings of the upper Air by means of kites and balloons. [To February, 1913.]

Part IV. (1).—**Hourly Values from Autographic Records: Meteorological Section.** Hourly values for pressure, temperature, humidity, rainfall, and sunshine for Kew, Eskdalemuir, and Valencia. [To end of 1912.]

Part IV. (2).—**Hourly Values from Autographic Records: Geophysical Section.** Hourly values for terrestrial magnetism, atmospheric electricity and meteorology, for five observatories. [None issued. Volume for 1912 in the press.]

Observer's Handbook, 1913 edition.

Calendar, with notes and diary of operations for the use of observers, for 1914.

Codes of Signals adopted and recommended by the International Meteorological Committee, 1910–1913, for **Storm Warnings**, together with a **list of the Maritime Weather Signals** at present in use in the various countries of the globe. 1913 edition.

OCCASIONAL.—GEOPHYSICAL MEMOIRS.—Vol. I., Part II., for 1912:—

No. 5. **The International Kite and Balloon Ascents.**
By Ernest Gold, M.A., Superintendent of Statistics.

No. 6. **The Free Atmosphere in the Region of the British Isles (Third Report).—The Calibration of the Balloon Meteorograph and the reading of the traces.** By W. H. Dines, F.R.S.

No. 7. **A Comparison of the Electrical Conditions of the Atmosphere at Kew and Eskdalemuir, with notes on observations of atmospheric electricity made in other countries.** By Gordon Dobson, B.A., Graduate Assistant.

ONE HUNDRED YEARS OF RAINFALL FOR LONDON.— General fall over the district for each month from January, 1813, to December, 1912. A series of diagrams prepared from data compiled by J. S. Dines, M.A., in extension of the diagrams issued by the Meteorological Council in 1879, from data compiled by George Dines; printed at the Meteorological Office Press, price 7d.

Other publications for which authority has been given and which are in preparation, but had not been issued on the 31st March, are as follows:—

The Seaman's Handbook of Meteorology. A companion to the Barometer Manual for the use of Seamen. (*Issued 15th April, 1914.*)

Monthly Meteorological Charts of the South Atlantic Ocean.

Meteorological Charts of Davis Strait and Baffin Bay. (*In the Press.*)

Instructions for Meteorological Telegraphy. 1914 edition. (*Issued 16th April, 1914.*)

Report of the tenth meeting of the International Meteorological Committee, Rome, 1913. (*Issued 4th June, 1914.*)

Climatological Report for certain British Stations overseas.

The Computer's Handbook.

The Tabulator's Handbook.

The Marine Observer's Handbook; a reprint of instructions for keeping the meteorological log.

The Seasons in the British Isles, with normals for four observatories, and tables for their application in climatology.

Atlas of Tropical Hurricanes.

GEOPHYSICAL MEMOIRS.—Vol. I., Part II., for 1912:—

8. Lag in Marine Barometers on Land and Sea, by Charles Chree, Sc.D., LL.D., F.R.S., Superintendent of Kew Observatory. (*Issued 4th June, 1914.*)

Part III., for 1913:—

9. On the relation between the velocity of the gradient wind and that of the observed wind at certain M.O. Stations, by J. Fairgrieve. (*In the Press.*)

10. The effect of the Labrador current upon the surface temperature of the North Atlantic, and of the latter upon air temperature and pressure over the British Isles. Part II. (*see* Memoir, No. 1). By M. W. Campbell Hepworth, C.B., R.D., Commander R.N.R., Marine Superintendent. (*In the Press*)

The report on the issue of the *British Meteorological and Magnetic Year Book* during the year will be found on pp. 45 to 47.

Three numbers of the series of *Geophysical Memoirs* have been published during the year, as noted in the above list, of which one is Mr. Gold's prize essay on "The International Kite and Balloon Ascents," referred to in last year's Report. Three further memoirs are in the press, and the publication of these will complete the first volume of the memoirs.

The 1913 edition of the *Observer's Handbook* was issued at the end of 1913. The handbook contains a new memorandum on meteorological units based on the C. G. S. system, new meteorological tables adapted for the C. G. S. system and tables for the conversion of meteorological observations from the British units to the new units. The handbook also contains a number of illustrations of clouds, mostly from photographs by Mr. G. A. Clarke, of Aberdeen Observatory, showing examples of different kinds of cloud forms, with two sets of four illustrations each, showing part of the life history of clouds and the sequence of forms exhibited during the history.

Of the publications which are not yet issued the *Meteorological Charts of Davis Strait and Baffin Bay* are being prepared at the request of the Board of Trade in connexion with inquiries concerning Ice in the North Atlantic Ocean. A *Memoir on the Distribution of Ice in relation to Navigation* is being prepared by Commander M. W. Campbell Hepworth, Marine Superintendent, at the request of the Board of Trade, but the form of publication has not yet been decided. Arrangements are also under consideration for the publication of a *Climatological Atlas of the British Isles* which is being compiled under the superintendence of a joint Committee of the Office and the Royal Meteorological Society.

The publication of the following papers, &c., may also be mentioned:—

By Dr. W. N. Shaw, F.R.S., Director—

Principia Atmospherica: a Study of the Circulation of the Atmosphere.
Proc. R. S., Edin., vol. 34, part 1, p. 77, 1913-14.

Upper Air Calculus and the British Soundings during the International Week (May 5-10), 1913. Journ. Scott. Met. Soc., 3rd series, vol. 16, p. 167, 1913.

The Interpretation of the results of Soundings with Pilot Balloons. Q.J. R. Met. Soc., vol. 40, p. 111, 1914.

On Seasons and Crops in the British Isles. Journ. Scott. Met. Soc., 3rd series, vol. 16, p. 179, 1913.

By Dr. Charles Chree, F.R.S., Superintendent of Kew Observatory—

Some phenomena of Sunspots and of Terrestrial Magnetism. Part II.
Phil. Trans., vol. 213, pp. 245-277.

By Mr. W. H. Dines, F.R.S.—

The Vertical Distribution of Temperature in the Atmosphere and the Work required to alter it. Q.J. R. Met. Soc., vol. 39, p. 185, 1913.

The Daily Temperature Change at Great Heights. Q.J. R. Met. Soc., vol. 40, p. 1, 1914.

By Mr. E. Gold, M.A.—

Determination of the Radiation of the Air from Meteorological Observations.
Q.J. R. Met. Soc., vol. 39, p. 253, 1913.

By Mr. Andrew Watt, M.A.—

On the Correlation of Weather and Crops in the East of Scotland. Journ. Scott. Met. Soc., 3rd series, vol. 16, p. 184, 1913.

By Mr. J. S. Dines, M.A.—

Pilot Balloon Observations in Barbados, 1910-12. Q.J. R. Met. Soc., vol. 39, p. 295, 1913.

By Mr. H. Harries—

Eddy Winds at Gibraltar. Q.J. R. Met. Soc., vol. 40, p. 13, 1914.

By Mr. C. E. P. Brooks, B.Sc.—

The Meteorological Conditions of an Ice-sheet, and their Bearing on the Desiccation of the Globe. Q.J. R. Met. Soc., vol. 40, p. 53, 1914.

By Mr. H. W. Braby, M.A.—

The Harmattan Wind of the Guinea Coast. Q.J. R. Met. Soc., vol. 39, p. 301, 1913.

INQUIRIES.

The inquiries dealt with during the year were 1,051, of which 646 were by letter and the rest personal inquiries. The following table gives a classification of the inquiries with the corresponding figures for previous years:—

—		For Scientific or Commercial Purposes.	For Evidence in Legal Proceedings.	From Newspaper Correspondents for Special Information.	Miscellaneous.	Answered by Letter.	Answered Personally.
1903-4	...	253	94	217	65	166	468
1904-5	...	259	116	221	70	136	530
1905-6	...	293	99	206	84	160	522
1906-7	...	427	73	166	24	243	447
1907-8	...	503	94	97	24	294	492
1908-9	...	540	99	99	87	297	528
1909-10	...	469	98	112	39	298	420
1910-11	...	516	107	115	62	351	449
1911-12	...	582	129	113	33	456	401
1912-13	...	533	159	106	24	459	363
1913-14	...	790	144	91	26	646	405

The inquiries included in this table are concerned exclusively with the "keeping of the public memory" of the weather and are in addition to the occasional demands for forecasts of weather which numbered 605.

LIBRARY.

The Author Card Catalogue has been kept up to date. The index numbers corresponding with the classification adopted in the International Catalogue of Scientific Literature are entered on the cards so that the subject-catalogue can be prepared directly from them.

The subject card catalogue for the books added to the library since the last list of additions was printed *in extenso*, as an appendix to the Report of the Meteorological Council for the year 1904-5, has been completed up to the end of 1912. The additions to the library received during the past year include about 780 books and pamphlets. The total number of books in the library is now about 24,000.

The alterations of the shelf-mark of the books in the library have been completed, and some progress has been made also with the consequent alterations necessitated in the original catalogue and in the Authors' and Subject Cards.

In the *Report of the Tenth Meeting of the International Meteorological Committee at Rome, 1913* (M. O. No. 216), will be found (1) a list of persons and institutions from whom publications containing meteorological data have been received during

the last ten years with a brief indication of the nature of the information given; (2) a list of periodicals containing memoirs on meteorological subjects, which are received by the Office.

Among the most important presents to the library during the past year may be mentioned:—

L'aurore boréale par H. Arnauld.

Rainfall of the Bombay Presidency for the years previous to 1891. Vol. 2.

Leitfaden der Wetterkunde, 3 Aufl. von R. Börnstein.

Atlas météorologique, 1912, par G. Eiffel.

Atlas der Meereströmungen in dem Indischen Ozean, herausgegeben von der Deutschen Seewarte.

Bathymetrical survey of the Scottish freshwater lakes conducted under the direction of Sir John Murray and Laurence Pullar during the years 1897 to 1909. (5 vols.)

Lessons in elementary practical physics by B. Stewart and W. W. H. Gee. Vols. 1-2.

Among those acquired by purchase have been:—

Fishermen's weather, by F. G. Aflalo; The South Pole: an account of the Norwegian Antarctic Expedition in the "Fram," 1910-12, by Roald Amundsen, translated by A. G. Chater, vols. 1 and 2; Rainfall reservoirs and water supply, by Sir A. R. Binnie; South Indian Ocean cyclones of 1911 and 1912, by C. W. Brebner; Britannica Year Book, 1913; Die Tätigkeit der Ionen in der Natur von R. Bürgi; Tägliche synoptische Wetterkarten für den nordatlantischen Ozean, 1907-8; Dr. A. L. Crelle's Rechentafeln, neue Ausgabe besorgt von O. Seeliger; Vol. 1 of Report on Danish oceanographical expedition, 1908-1910, to the Mediterranean and adjacent seas; Encyclopædia Britannica, 11th edition; Aeronautische Meteorologie von F. Fischli; The pulse of Asia, by E. Huntington; Jahrbuch der Astronomie und Geophysik von H. J. Klein, Jahrg. 1912; The Royal Observatory, Greenwich, by E. W. Maunder; The Realm of Nature, by H. R. Mill; Norwegian Aurora Polaris Expedition, 1902-1903, Vol. 1. Second section; Jelinek's Psychrometer-Tafeln, 6. Auflage; Scott's last Expedition, Vols. 1-2; Modern seismology, by G. W. Walker; and a selection of the volumes of the International Catalogue of Scientific Literature.

RÉSEAU MONDIAL.

A list of the foreign and colonial stations from which documents are received is given in Circular 001.

The additions to the list during the year under review include documents received from Malta (the University), from Ankpa, Birnin Kebbi, Ibi, Jebba, Kadura, Nafada, Naraguta, and Offa,

in the Northern Provinces of Nigeria; and from Nambeya-Bulemezi, Katigondo, Kitumbzi River, Lugombe, Masindi Port, Kabyaza, Kadoma, and Kitalya in Uganda.

The returns received from many stations have been examined and summarised month by month.

The copies of meteorological returns reprinted from Colonial Government publications and sent to the office for distribution have been issued for the year 1911. The reprints for the year 1912 are ready for distribution.

Forms for the entry of monthly meteorological statistics for a selection of stations representing the land areas of the globe have been prepared and commencement of the preparation of the data for 1911 has been made.

FINANCE.

A statement of the receipts and payments during the year ended 31st March, 1914, is given on page 28. The amount of the Parliamentary Grant-in-aid for Meteorology, which was paid direct to the Committee by the Treasury was £20,000, an increase of £3,000 on the previous year. In addition to this, monies from grants voted by Parliament to the Royal Society and the Advisory Committee for Aeronautics were paid by those bodies respectively to the Meteorological Committee on account of Eskdale Observatory and experimental work in connexion with aviation, while a payment from the National Physical Laboratory on account of the joint occupation of Kew Observatory during the early part of the year in question, a grant from the Royal Society for Seismology at Eskdale Observatory, and the dividends of the Gassiot and Rosse Trust Funds administered by the Royal Society in respect of Kew and Valencia Observatories, respectively, have also been added to Observatory revenues. By arrangement with the trustees of the Scott Antarctic Fund a sum of £82 has been received to provide additional staff at Kew Observatory, in accordance with the arrangement referred to on page 10.

The sum total of these items was £2,192 0s. 8d., which, together with the grant of £20,000, provided £22,192 0s. 8d. as the revenue available for the work of the year. Miscellaneous repayments and receipts totalled £7,092 1s. 5d., making a grand total of £29,284 2s. 1d.

Expenditure, including the amounts recoverable, amounted to £28,129 3s. 2d., so that there remains to be added to the balance at the beginning of the year a sum of £1,154 18s. 11d.

Certain heavy liabilities in connexion with alterations at Kew Observatory and other items of expenditure authorized during the year are not brought to account. They will amount to about £500, and shortly before the close of the year an amount of £630 was received in advance for instruments on order.

ACCOUNT of RECEIPTS and PAYMENTS for the year ended 31st March, 1914:—

RECEIPTS.				PAYMENTS.												
	£	s.	d.	£	s.	d.	£	s.	d.							
Balance from year 1912-13	—			95	17	9	Director	—	1,000	0	0					
Parliamentary vote ..	—			20,000	0	0	OFFICE SALARIES (in- cluding Insurance):									
OBSERVATORIES:							Monthly	8,225	5	2						
Kew	780	15	5				Weekly	1,006	3	10	9,231	9	0			
Eskdale	1,302	15	4													
Valencia	96	8	4				M.O. OBSERVATORIES:									
Farnborough	254	11	8				Kew	1,951	1	9						
Sale of Forms, &c. ..	107	10	1	2,482	0	10	Eskdale	1,881	15	4						
DEPARTMENTAL EXPENSES REPAID:							Valencia	571	5	9	4,801	13	3			
Forecasts, &c.	159	2	11				Farnborough	497	10	5						
Marine, Statistics, and Observatories	127	15	11				OFFICE EXPENSES:									
Instruments	164	19	3	451	18	1	Rent, Fuel, &c.				689	0	7			
INCIDENTAL EXPENSES REPAID:							Furniture, Fittings, &c.	134	7	9						
Forecasts, &c.	492	18	10				Incidental Expenses ..	496	8	3	630	16	0			
Other Branches	126	18	7				POSTAGE:									
Stationary Office Ac- count	57	16	9	677	14	2	General	313	9	0						
TELEGRAPH CHARGES REPAID:							Daily Weather Report	414	0	2	727	9	2			
Home	361	1	6				TELEGRAMS, &c.	—			2,681	13	11			
Telegrams sent abroad	452	4	2	813	5	8	TRAVELLING EXPENSES:									
INSTRUMENTS:							Inspections, &c.	—			444	19	4			
Royal Navy	912	5	7				SUPERANNUATION:									
Mercantile Marine, Sta- tions, &c.	2,658	4	2	3,570	9	9	Funded Annuities	821	0	0						
INSPECTIONS							Non-funded Annuities and Fund	1,160	7	10	1,981	7	10			
	—			210	13	0	COST OF INSTRUMENTS:									
SUPERANNUATION ACCOUNT:							Royal Navy	912	5	7						
Annuities	794	9	3				Mercantile Marine, Sta- tions, &c.	2,484	0	5	3,396	6	0			
Interest on Investments	29	8	0	823	17	3	AUXILIARY OBSERVA- TORIES, &c.				2,287	3	9			
LECTURES AND EXPERI- MENTS							LECTURES AND EXPERI- MENTS				157	4	4	2,444	8	1
	—			254	3	4	BALANCE:									
				£29,379	19	10	Cash at Bank	1,204	1	2						
							" at Office	46	15	6	1,250	16	8			
											£29,379	19	10			

Note.—On 31st March, 1914, the amount of 2½ per cent. Annuities held for the provision of Superannuation Annuities was £1,380 5s. 11d.

The following abstract shows approximately the net payments for this and the preceding years, together with the increase or decrease in 1913-14, as compared with 1912-13:—

NET EXPENDITURE.	1912-13.	1913-14.	Increase.	Decrease.
SALARIES :	£	£	£	£
<i>Director</i>	1,000	1,000	—	—
<i>Office and Observatories</i> ...	11,186	12,007	821	—
GENERAL ADMINISTRATION				
of Central Office :				
<i>Rent, Fuel, and Lighting...</i>	700	689	—	11
<i>Furniture, fittings and incidental expenses.</i>	422	282	—	140
<i>Postage</i>	371	399	28	—
TELEGRAMS, &C.	1,997	1,868	—	129
TRAVELLING EXPENSES ...	152	234	82	—
INSTRUMENTS	633	[— 174]*	—	807
OBSERVATORIES (Expenses other than Salaries) :—				
<i>Kew</i>	268	381	113	—
<i>Eskdale</i>	338	845	507	—
<i>Valencia</i>	84	129	45	—
<i>Farnborough</i>	142	136	—	6
<i>Allowances to auxiliary Observatories, Observers, &c.</i>	2,141	2,082	—	59
SUPERANNUATION ACCOUNT	591	1,158	567	—
Total £	20,025	21,036	1,011	—

* An amount of £630 was received in advance and not expended until after the close of the year.

A complete list of observing ships, observatories, and stations in connexion with the office with the names of the observers is given in a separate circular (No. 001) entitled "Statement of Provisions for the Supply of Information to the Public." A statement of distribution of official copies of the publications of the office, including the exchanges with the meteorological institutes and observatories of other countries is printed as an appendix to the *Report of the 10th Meeting of the International Meteorological Committee*. M. O. Publication No. 216.

The reports of the Superintendents upon the work of the four divisions of the office, of the Meteorological Office, Edinburgh, of the observatories maintained by the Meteorological Committee, with a note on the stations inspected, are given in the following pages 30-59.

I.—MARINE DIVISION.

*Report by M. W. Campbell Hepworth, C.B., R.D.,
Commander, R.N.R., Superintendent.*

Collection of Information.—The number of vessels entered in the Office books as having been equipped with the full set of meteorological instruments which are requisite for keeping a four-hourly meteorological log was 209 as compared with 192 during the previous financial year. In addition, there were 11 Atlantic liners among those from which reports are received by radio-telegraphy that are provided with mercury barometers lent by the Office. The allocation of full sets of instruments has been studied with a view to acquiring the largest possible number of reliable observations from oceanic regions for which information is most needed, bearing in mind the fact that the number of meteorological instruments available for marine purposes is limited.

Meteorological four-hourly logs, registers, and other documents, to the number of 2,738 were received during the year, as compared with 2,710 in 1912-13.

Meteorological Logs.—Of the meteorological log books which contain four-hourly observations, 173 have been classed "excellent," or "very good," after careful examination of the data they contain, as compared with 188 for the previous financial year.

Supplementary Information.—The arrangements for obtaining meteorological observations from the captains and officers of ocean-going ships who offer their co-operation, but who for various reasons are unable to keep the full log, or to whom the instruments requisite for that purpose cannot conveniently be lent, have been continued. Under these circumstances the observers have used their own instruments or those supplied by the owners of the ships; the corrections for which are ascertained from time to time by comparison with standards at home and abroad. By this means a large amount of information, which is noted on registers supplied by the Office, has been collected, and many of these data are immediately utilised in connexion with the preparation of the Monthly Meteorological Charts of the North Atlantic and Mediterranean, and of the Indian Ocean. Co-operation in this form is not confined to the personnel of British ships; the registers are kept by a number of captains and officers under foreign flags also.

As in previous years, a number of barograms have been received from ships of H.M. Navy and the Mercantile Marine which give a continuous record of pressure in various parts of the world.

The number of contributions received, classified according to the different lines of route, is shown in the following lists:—

Four-hourly Logs.

Cable Ships	...	{ United Kingdom	1
		{ North Atlantic ...	1
East Indies, viâ Suez	...	...	1

Four-hourly Logs—continued.

	Canada	6
North Atlantic ...	United States ...	16
	Gulf of Mexico ...	24
	West Indies ...	6
	Canary Isles ...	1
Mediterranean	3	
Black Sea	3	
Africa	S.E. and E. Coasts	5
	West Coast ...	1
China, coasting	6	
East Indies	viâ Cape ...	7
	viâ Suez ...	53
China and Japan	viâ Cape ...	2
	viâ Suez ...	22
Australia	viâ Cape ...	32
	viâ Suez ...	34
Trans-Pacific	1	
New Zealand	viâ Cape ...	23
	viâ Suez ...	1
South America, East Coast ...	23	
United States, West Coast ...	1	
Surveying	Australia ...	3
	West Coast of Africa	1
	S.E. Africa ...	1
River Thames	1	

“Short” Logs.

China, viâ Suez	2
East Indies, viâ Suez	2

North Atlantic Registers (Form No. 121), Indian Ocean Registers (Form No. 122), and Radio-telegraphy Registers (Form No. 138).

Routes.	North Atlantic Registers. Form No. 121.	Indian Ocean Registers. Form No. 122.	Radio-telegraphy Registers. Form No. 138.
North Atlantic... {	Canada	478	—
	United States ...	648	—
	Gulf of Mexico ...	119	—
	West Indies ...	7	—
	Cable Work ...	7	—
Mediterranean... {	Canary Isles ...	5	—
... ..	137	—	
Africa	West Coast ...	15	—
	S.E. and E. Coasts	2	1
East Indies	viâ Cape ...	—	4
	viâ Suez ...	—	114
China and Japan	viâ Suez ...	—	25
	Coasting ...	—	12
Australia	viâ Cape ...	—	8
	viâ Suez ...	—	3
South America... {	East Coast ...	9	—
	West Coast ...	4	—
Pacific Islands... ..	—	3	—
Totals	1,427	170	858

“Excellent” observers.—A list of the 26 captains who, during the past year, have contributed logs classed as “excellent” is given in a special Circular, 001. Several of these observers have co-operated with the Office for many years; some have to their credit a number of logs that are “excellent,” and among these should be mentioned Captain F. C. Mullan, F.R.G.S., who has kept 35; Captain G. H. Harris, Lieut. R.N.R., and Commander C. D. Bennett, R.D., R.N.R., who have kept 26 and 19 respectively, and Captain W. G. Lingham, F.R.A.S., F.R.Met.Soc., who has kept 14 of that class. Those whose names appear in the “excellent” list for the first time are, Captain G. Byers, S.S. *Kashing*; Captain F. J. Downes, S.S. *Matina*; Captain W. S. Main, F.R.G.S., S.S. *Hesperian*; Captain P. E. Mello, S.S. *Marere*; Captain D. McInnes, S.S. *Matina*; Captain E. H. McLeish, S.S. *Arracan*; Captain C. F. Osborne, Comm., R.N.R., R.D., S.S. *Circassia*; Captain A. D. Riseley, S.S. *Matina*; Captain J. Roberts, Comm., R.N.R., R.D., S.S. *Medie*; and Captain S. C. Smiles, S.S. *Fulwell*.

As a mark of recognition of valuable co-operation, various publications of the Office have been presented to observers who have returned well-kept meteorological log books. The publications which have been chiefly used for this purpose are:—Monthly Wind Charts of the South Atlantic; Monthly Wind Charts for the Coastal Regions of South America; Meteorological Charts of the Southern Ocean, between the Cape of Good Hope and New Zealand; Meteorological Charts of the Red Sea; Charts showing the Surface Temperature of the Atlantic, Indian and Pacific Oceans; Monthly Current Charts for the Atlantic Ocean; Monthly Current Charts for the Indian Ocean; Quarterly Current Charts for the Pacific Ocean; Bound Copies of the Monthly Meteorological Charts of the North Atlantic and Mediterranean, also of the Meteorological Charts of the Indian Ocean.

Obituary.—The Committee have noted with regret the deaths of ten of their old observers during the year ended 31st March last:—Captain T. R. Blanchard, Lieut. R.N.R., S.S. *Derbyshire*, October; Captain J. Brown, S.S. *Thetis*, April; Captain G. Burton, Lieut. R.N.R., S.S. *Rangatira*, August; Captain C. Crowley, Ship *Verajean*, May; Captain J. W. King, Ship *Philomene*, April; Captain F. C. A. Lyon, Comm. R.N.R., S.S. *Vectis*, January; Captain A. Murray, S.S. *Active*, November, 1912; Captain C. M. L. Sommerfelt, S.S. *Clan Urquhart*, July; Captain H. F. Watt, Barque *Elissa*, June; and Admiral H. R. Wratislaw, C.B., H.M.S. *Ranger*, July.

Use of Information received.—The information collected has been used, as already mentioned, as much as possible, on receipt, in the preparation of the Monthly Charts. The Monthly Charts of the Atlantic Ocean and the Mediterranean Sea and of the Indian Ocean and Red Sea have not been altered, except in detail during the year. The weekly instalment of these charts with daily maps on the back, showing the distribution of pressure, winds, &c.,

over the Atlantic Ocean, prepared by the incorporation of the reports by radio-telegraphy from the ocean, with information received by telegraph from the other side has been continued. On these weekly issues five weekly maps are shown exhibiting the results of recent sea surface and air temperature observations, recent reports of ice, and of derelicts, and of fog.

Observations from the logs of ships navigated in the Indian Ocean between the parallels of 10° N. and 20° S. and the meridians of 40° E. and 80° E. have been supplied to the Director General of Observatories, Simla, as in past years. Similar data relating to selected oceanic areas have been prepared for, and forwarded to, the Royal Dutch Meteorological Institute in compliance with a wish expressed in a resolution of the International Meteorological Committee. Information relating to drifting ice in the North Atlantic has been forwarded to the *Shipping and Mercantile Gazette* and *Lloyd's List* regularly upon receipt of the reports; and, during the cruise of the Ice Observation Ship *Scotia*, to British and Foreign Steamship Companies contributing towards the cost of the cruise; also to *Lloyd's*, and to the London and Liverpool Shipping Newspapers.

The Admiralty have been furnished at the request of the Hydrographer to the Navy with the tabulated results of observations taken at various places on the coasts of Norway and the Mediterranean.

Information is given to seamen, upon application, either in person or by letter, regarding the meteorological conditions that are likely to prevail along a proposed route, either for sailing vessels or steamships.

II.—FORECAST AND STORM WARNING DIVISION.

Report by R. G. K. Lempfert, M.A., Superintendent.

Daily Weather Report.—The arrangements for the issue of the Daily Weather Report and Forecasts have remained generally the same as those which were in operation last year. The Report has been issued each day at about 12.30 p.m.

There has been a steady increase in the number of subscribers to the Daily Weather Report during the last ten years, and at the end of the year under review the issue was 900 copies a day, of which 462 are for subscribers. In 1900 the numbers were 415 and 165 respectively. The increase is largely due to the subscriptions from schools. It will be remembered that the subscription of £1 per annum is only intended to cover the cost of postage and wrappers.

Observations from several additional stations have been incorporated in the Report during the year. As explained in the Annual Report for 1912, provision has been made for daily telegraphic reports from Glasgow and Eskdalemuir in order to meet the wish for additional stations in Scotland in connexion with the Daily Weather Service.

The station at Glasgow is on a site in Springburn Park granted by the Municipal Authority. It is in charge of Mr. James Whitton, V.M.H., the Superintendent of Parks for the Corporation, and the observations are taken by Mr. Robert Thompson, the Head Gardener of the Park. The observations have appeared regularly in the Daily Weather Report since May 1st, 1913.

The observations at Eskdalemuir are taken by the staff of the Observatory. They have been included in the Daily Weather Report since 1st January, 1914.

The arrangements for the exchange of observations with the Bureau Central Météorologique of Paris have been revised, and in return for the discontinuance of reports from a few French stations of which little use was made in our own service, the Bureau has been good enough to arrange with the Telegraph Administration of the Republic for the daily telegrams received by the Bureau from Rome, Vienna, and St. Petersburg to be transmitted from Paris to London. This arrangement came into operation early in March.

The great delay in the receipt of the reports from Corunna had for many years been a source of inconvenience and of weakness in the forecasts. The messages were never received until after the forecasts had been drawn up, and not infrequently they were too late for inclusion in the Daily Weather Report, which goes to press at 11 a.m. After consultation with the Director of the Spanish Meteorological Service, the Direct Spanish Telegraph Company was approached with a view to securing a more effective service. The Company has co-operated cordially by granting special rates and by arranging for the prompt transmission of the messages, which are now under favourable circumstances received at the Office within little more than half an hour of their despatch from Corunna.

The absence of evening reports from Germany had been a source of weakness in the evening forecasts. Each year there are a number of occasions on which the development of change of weather progresses from East to West instead of normally from West to East, and in such circumstances forecast failure was frequent. With the assistance of the Director of the Deutsche Seewarte it has been possible to arrange for evening telegrams from Hamburg, Frankfurt, and Munich at the cost only of the telegrams.

By the courtesy of the Portuguese Government and the Director of the Meteorological Service of the Azores a useful addition has been made to the meteorological reports received from those islands by including reports from Santa Cruz in Flores, the most westerly of the group.

Wireless receiving apparatus has been installed at the Office with which it is possible to receive the weather reports issued by the Eiffel Tower. The morning report, received at 10.40 a.m., adds but little to the information received by wire and cable, but the afternoon report received at 5 p.m., and reporting observations

made at 1 p.m., contains information for Biarritz, Brest, Paris, Nice, and Rome, which is not otherwise received at the Office. It is anticipated that these reports will be of considerable value in summer time when the development of low-pressure systems over the Bay of Biscay not infrequently gives rise to thundery weather over the British Isles.

Reports from Health Resorts.—The arrangements for the collection of evening reports from health resorts and for their issue to the newspaper press in a comprehensive report has remained unchanged. Data are only accepted for publication in these reports from stations which arrange for annual inspection by a representative of the Office. About 48 health resorts have availed themselves of the arrangement.

Wireless Telegrams.—During the year ended March 31st, 42 wireless telegrams were received from the ships of His Majesty's Navy. These reports were received for the most part from the Bay of Biscay, and as the Office does not receive reports from ships of the mercantile marine crossing the Bay, they were specially acceptable.

Special mention may be made of the reports received from H.M.S. *New Zealand* on her homeward voyage across the Atlantic in December. One of these reports was sent from as far west as the 41st meridian and reached the Office within 12 hours of the time at which the observations were taken. Subsequent reports from positions further East were received sufficiently early for consideration with the current observations.

During the year 5,752 wireless reports were received from Atlantic liners, over 350 more than during the previous 12 months. It is gratifying to note that there has been some improvement in the rate of transmission of these reports. Whereas in 1912 only 272 out of 5,400 messages, or only about 5 per cent. of the total, reached the Office in time for inclusion in "to-day's" map in the Daily Weather Report, in the year under review, 394 messages, or 7 per cent. of the total, reached the Office in time for inclusion. 3,268 messages, or 57 per cent. of the total, reached the Office in time for inclusion in "yesterday's" maps in the Daily Report, as compared with 50 per cent. of the messages of the previous year. Thus, whereas during 1912 about 50 per cent. of the messages suffered so much delay in transmission as to be only useful from the point of view of the collection of material for study, the percentage was reduced to 43 in 1913. As the improvement has been most marked in the later months it may be hoped that the figures for the next year will show a further advance.

Even with the improvement that has taken place comparatively few messages reach the Office within one hour or an hour-and-a-half of the time of observing, *i.e.*, sufficiently early to be considered with the latest set of observations from land stations at the time of issue of the forecasts. Still there have been a number of occasions on which this could be done, and the utility of such

observations has been great. For example, on March 19th effective storm warnings were issued to the south-western districts which were based entirely on reports received by wireless telegraphy.

The improvement in the transmission of the reports has drawn attention once again to the necessity for accuracy in the barometric readings and in the coding of the positions and other information given in the reports. Errors may also be introduced in course of transmission. On occasions the inaccuracies may prove actually misleading. A serious case of this kind occurred on January 23rd, when the storm cones were hoisted throughout the south-western districts in consequence of reports received from two ships which confirmed one another in reporting low barometer readings indicating the existence of a rather deep disturbance out at sea. No appreciable increase of wind followed, and when subsequent reports came to hand from the same vessels from positions in close proximity to the land stations the barometer readings were found to be discordant from those on shore, owing to the fact that the necessary corrections had not been applied.

As occasion arose the officers concerned have been written to regarding doubtful or obviously incorrect reports, and by this means a great improvement has been effected since the early days of the application of wireless telegraphy to the collection of meteorological reports. In the case of marine reports it is not possible, on account of the time which must necessarily elapse between the receipt of a report and an opportunity for communicating with the observer by letter, to refer back every doubtful observation for confirmation by the observer, as is done in the case of reports received from the observers at the stations which contribute information to the Daily Weather Report.

Weekly Weather Report.—In anticipation of the introduction of absolute pressure-units into the Daily Weather Service on May 1st, 1914, the maps published in the Weekly Weather Report have been drawn in the new system since January 1st, 1914. The temperatures shown on the maps are given in degrees of the absolute scale. The area included in the maps and the sources from which the information plotted is taken have remained the same as in previous years. Specimens of the maps in absolute units were issued with the Annual Report for last year.

Special Investigation.—On October 27th a violent disturbance, which did great damage locally, swept over South Wales. The phenomenon was made the subject of investigation at the special request of Mr. Clement Edwards, M.P. Mr. H. Billett was sent to collect information on the spot that might throw light on the meteorological conditions incidental to the occurrence. Mr. Billett spent three days in the Taff Valley and the result of his investigations leaves little doubt that the disturbance was of the tornado type, familiar in parts of America

but fortunately rare in this country. A report on the phenomenon will be published.

Inquiries for Forecasts.—The inquiries for forecasts of various kinds dealt with during the year reached 605, about the same number as in the previous year. The numbers were as follows:—Telegraphic prepaid replies 249, other inquiries answered by telegram 179, telephonic inquiries 131, personal inquiries 46. In addition regular forecasts have been telegraphed to subscribers for varying periods. The arrangements for the supply of forecasts to H.M. dockyards remained the same as in previous years.

Forecast messages have been prepared twice a day for communication by wireless telegraphy to H.M. ships in home waters. At the request of the Lords Commissioners of the Admiralty brief reports and forecasts of the weather over the Bay of Biscay and off the Iberian coast have been prepared twice a day since March 9th for communication by wireless telegraphy to the Captain Attendant and King's Harbourmaster at Gibraltar.

Weather Information for Aviators.—Telegraphic reports and forecasts have been sent daily as in the previous year for the Royal Flying Corps to the Naval wing at Eastchurch, to the Military wing at South Farnborough, to the Central Flying School at Upavon, and to the Officers in command of the establishments at Salisbury Camp, and at Montrose. After the establishment of the Branch Meteorological Office at South Farnborough in January 1914, all information intended for the various naval and military establishments at Farnborough was communicated to the Branch Office and distributed from there. Arrangements have been made for telegraphing once a day to the Branch Office and during term time to the Central Flying School at Upavon, the data for the construction of the day's map.

At the request of the Lords Commissioners of the Admiralty, arrangements have also been made to send telegraphic reports and forecasts twice a day to the Naval Air Stations at the Isle of Grain, Warsash, Harwich, Great Yarmouth, Cromarty. Thus the supply of reports and forecasts for the use of different branches of H.M. Services has increased considerably during the year.

Harvest Forecasts.—During the summer months, June to September, the usual arrangements for the supply of telegraphic forecasts for agriculturists were carried out. The service takes the form either of a daily forecast of the weather for the following day, extended, whenever conditions appear sufficiently definite to justify it, to cover two or more days, or of "Special Notifications" sent only on occasions on which spells of several consecutive days of fine weather are anticipated. Notice of the impending break up of settled conditions is also issued in connexion with these spell forecasts.

The number of subscribers for each series of forecasts was appreciably larger than in 1912. For the ordinary daily forecasts, issued either in the morning, afternoon or evening, the

number of applications was 83, as against 66 in the previous year. For Special Notifications of a probable spell of fine weather the number of applications in the two years was respectively 111 and 87.

As in former years the recipients of the forecasts were invited to supply on special forms a daily record of the weather actually experienced during the periods of their subscriptions in order to obtain an independent check of the accuracy of the forecasts. Returns of this description were received from 41 persons, 17 of whom resided either in the Midland Counties or in England, S.E. A result of the comparison made in the Office between the forecasts and the subsequent weather, as notified on these returns, shows that of the daily forecasts, 81 per cent. were successful, 52 per cent. receiving the mark of complete success. The best results were attained in England, N.W., 94 per cent. of the forecasts were successful, 78 per cent. receiving the mark of complete success, and next to that 90 per cent. in England, S.W. The lowest percentage, 77, was attained in the western part of the Midland Counties. In the case of the Further Outlook, issued occasionally, and intended to cover a period of at least 48 hours from the time of issue, the comparison shows that for the country as a whole, 75 per cent. of the forecasts were successful, 58 per cent. receiving the mark of complete success.

The summer of 1913, although for the most part fair and dry, was cool and somewhat changeable, and in the course of the entire season there were only four occasions upon which the conditions were regarded as sufficiently settled to justify the issue of notifications of an approaching spell of fine weather to any considerable part of the country.

A distinction must be drawn between fine weather and "settled" weather, judged from the point of view of synoptic meteorology. It not infrequently occurs that the weather over a district is fine and rainless for several consecutive days, but the conditions, as judged by the weather in surrounding districts and off our western coasts, hold out no promise of permanence. Under such circumstances the Office is not justified in issuing notices to the effect that fair weather may be expected to continue for several days. Conditions of this type were experienced very frequently during the summer of 1913. In the south and east of England a spell of fine weather commenced about June 11, but it was not until the 14th that the type of pressure distribution became sufficiently settled to justify the issue of a "Special Notification." For those districts the notice was, therefore, not received until after the favourable change had commenced; in other parts of the country it arrived in good time. Notices of a partial break issued on June 17th were generally correct, but notices of a complete break issued on June 23rd were incorrect for most of the western and southern districts where the fine weather lasted until the end of the month.

Notifications issued at various times between June 30th and July 2nd appear to have been fully justified. A partial and

temporary break in the weather which occurred in the south-east of England on July 2nd and 3rd was, however, not predicted.

Notifications of a spell of fair weather issued on July 20th were not successful. A shallow depression was suddenly developed off our north-west coasts the same night, and on July 21st it was considered necessary to issue a notice of approaching rain to all districts. A forecast of a renewal of fine weather issued on July 25th or 26th proved completely successful.

Notifications of a fair spell issued on August 20th were unsuccessful. A large anticyclone had then been formed over the country, but in the course of the ensuing 24 hours a depression spread southwards from Iceland, and during the next day or two showery weather was experienced very generally. The break was only temporary and a second issue of fair weather notifications on August 26th was fully justified. Notice of a complete break issued on September 8th was correct for the western districts, but only partially so for the north and east.

Results of Forecasts:—A comparison of the forecasts for the United Kingdom issued at 8.30 p.m., with the subsequent weather is given on p. 31. In checking the forecasts the weather is considered under the aspects (1) Wind, its direction and force and the sequence of its changes within the period of the forecast; (2) Weather, state of the sky in respect of cloud, together with precipitation in its various forms; (3) Temperature of the day and night and its sequence, as represented mainly by the maximum and minimum temperatures; and (4) Fog.

A forecast is regarded as successful if it has given a fair representation of the actual facts for a majority of the aspects, and unsuccessful if the aspects which were correctly anticipated were less than half. If all aspects of the facts are adequately indicated in the forecast the mark of complete success is assigned to it. On this understanding the evening forecasts for 1913 have given the following percentage successes:—

January ...	92	per cent.,	of which	67	were correct	in all points.
February	91	"	"	58	"	"
March ...	88	"	"	58	"	"
April ...	86	"	"	52	"	"
May ...	94	"	"	62	"	"
June ...	96	"	"	70	"	"
July ...	95	"	"	75	"	"
August ...	91	"	"	77	"	"
September	86	"	"	65	"	"
October ...	89	"	"	67	"	"
November	88	"	"	65	"	"
December	86	"	"	57	"	"

The method of setting out the data for the purpose of checking forecasts was described in the Report for last year.

The mean for the whole year with the corresponding means for earlier years were as follows:—

Year.	Percentage Number of Successes.	Percentage of Complete Successes.
1903-04	86	56
1904-05	88	57
1905	88	56
1906	91	61
1907	91	54
1908	92	58
1909	93	58
1910	93	60
1911	94	62
1912	91	59
1913	90	64

A "Further Outlook" extending the period covered by the forecast to two or more days was appended to the ordinary daily forecasts for the ensuing 24 hours on 116 occasions. Of these notifications 59 were issued in connexion with the morning forecasts, and 57 in connexion with the evening forecasts. In a large majority of cases the notification indicated the probability of a continuance of the existing conditions, but in eight instances it referred to a change or partial change in the type of weather. 93 per cent. of the notifications were justified by subsequent events, of which 75 received the mark of complete success.

STORM WARNING SERVICE.

The arrangements made with the Post Office in 1912 for the distribution of the telegrams containing instructions to hoist or lower storm cones have remained unchanged. A further slight improvement in the service may be noted. As in the previous year the cones have generally been displayed within $1\frac{1}{2}$ to two hours of the despatch from the Office of the instruction to hoist, except in cases of interruption of telegraphic communication. Frequently the cone has been up within less than one hour from the time of despatch.

The checking of the results of the storm warnings has been carried out in the manner described in the Report for last year. As explained in that Report, each warning has been regarded as dating from two hours after the time of despatch of the telegram from the Office, as the returns received from the signal stations have shown that the telegrams reach their destinations within that time in the great majority of cases.

The material used for checking the warnings consists of (1) the records of all coastal anemometer stations, (2) the wind observations made at the telegraphic reporting stations and published in the Daily Weather Report, and (3) the wind records—Beaufort estimates—contained in the logs and registers from selected lightships and lighthouses, which are kindly lent for the purpose by the various lighthouse authorities. In the aggregate records

from about 100 stations distributed along the coasts of the British Isles are examined for the purpose of checking the warnings. The results for the year 1913 are given in the following table:—

STORM WARNING CHECKING, 1913.

District.	Summary of Occasions for Warning.		Summary of Warnings Issued.			
	Total Number of Occasions on which Warnings were necessary.	Percentage of Occasions of Gale effectively Warned.	Total Number of Issues.	Issues justified by subsequent Gales. Force 8 and upwards.	Issues justified by subsequent Strong Winds. Forces 6 and 7.	Percentage of Issues justified either by Gales or Strong Winds.
1A. Scotland, N.E. (Northern Part)	{ 22 } { 20 }	88	{ 35 } { 31 }	20 17	{ 12 } { 12 }	92
1B. Scotland, N.E. (Southern Part)	{ 21 } { 12 }	91	{ 32 } { 25 }	18 12	{ 6 } { 9 }	79
2. Scotland, E. ...	{ 5 } { 7 }	75	{ 27 } { 19 }	6 3	{ 15 } { 8 }	70
3. " N.W. ...	{ 10 } { 18 }	89	{ 38 } { 29 }	11 14	{ 21 } { 11 }	85
4. " W. and North Channel ...	{ 12 } { 8 }	100	{ 37 } { 27 }	12 8	{ 19 } { 12 }	80
5. Ireland, N. ...	{ 29 } { 20 }	92	{ 44 } { 31 }	27 18	{ 9 } { 6 }	80
6. " S. ...	{ 20 } { 8 }	96	{ 41 } { 26 }	19 8	{ 17 } { 16 }	90
7. Irish Sea ...	{ 21 } { 14 }	86	{ 36 } { 25 }	18 12	{ 15 } { 7 }	85
8. St. George's Channel	{ 15 } { 11 }	96	{ 36 } { 22 }	15 10	{ 16 } { 8 }	84
9. Bristol Channel ...	{ 27 } { 17 }	93	{ 39 } { 23 }	26 15	{ 9 } { 1 }	82
10. England, S.W. ...	{ 25 } { 16 }	83	{ 39 } { 19 }	23 11	{ 11 } { 4 }	84
11. " S. ...	{ 14 } { 11 }	80	{ 31 } { 17 }	12 8	{ 16 } { 5 }	85
12. " S.E. ...	{ 15 } { 8 }	87	{ 29 } { 17 }	15 5	{ 13 } { 8 }	89
13. " N.E. ...	{ 13 } { 6 }	74	{ 26 } { 12 }	12 2	{ 11 } { 6 }	82
14. " E. ...	{ 11 } { 7 }	83	{ 25 } { 12 }	10 5	{ 11 } { 4 }	81
Average per District	{ 17.3 } { 12.2 }	88	{ 34.3 } { 22.3 }	16.5 10.5	{ 13.4 } { 7.7 }	83

NOTE.—In order to facilitate comparison with the statistical tables of the Board of Trade, which are made up for the year ending June 30, the figures for the two halves of the year 1913—January 1 to June 30, and July 1 to December 31—are given separately for each district. The upper line of figures in each case gives the particulars for the first half of the year.

The table is divided into two sections. The first deals with "occasions for warning," i.e., occasions on which the wind

reached gale force at two stations at least in a district, and failure to hoist a cone in good time would therefore count as a gale missed. On the average, adequate warning was given of 88 per cent. of all gales experienced. The second part of the table deals with the number of warnings issued to each district, and those "justified" by subsequent increase of wind. The percentage of success given in this part of the table is rather lower, as there were a number of occasions on which the issue of warnings was not followed by appreciable increase of wind.

For reasons explained in the Report for last year, the figures of this table are not comparable with those for earlier years. The percentage of success attained differs little from that recorded for 1912, when the figures were 87 per cent. of occasions of gale effectively warned, and 80 per cent. of issues justified by gales or strong winds. The number of occasions when warnings were required was rather smaller than in 1912; the average number per district was only 29.5, as compared with 30.8 in 1912.

There were in each district occasions when the wind attained the force of a gale, on which warnings were either not issued at all or issued too late. There were, however, no occasions of gales over a wide area for which no cones were hoisted on any part of our coasts. The failures consisted generally in the omission to issue warnings in adequate time to the outlying districts. Occasionally, also, gales for which adequate warning had been issued to the outlying districts extended over a wider area than was anticipated, with the result that a gale nearer home was missed. The most conspicuous failures occurred on November 17th and December 26th.

On the first occasion mentioned a deep depression made its appearance unexpectedly during the night from November 16th to 17th in the Iceland region. Warnings were issued to all but the southern districts at 8.50 a.m. on November 17th. They proved effective over a considerable area, but were too late in the west of Scotland and north of Ireland. A second gale, however, occurred in the course of November 18th in these areas before the warnings expired. Unfortunately the gale spread further southward than was anticipated and affected the south and south-east coasts to which no warnings were issued.

On December 26th warnings were issued at 2 p.m. to the southern and south-western coasts. They proved late in many cases, wind of gale force being attained before the warnings reached the signal stations. A decided increase in the strength of the gale took place during the ensuing night, thus partially justifying the hoist. On the following day a steeper north-westerly gradient than was anticipated developed in the rear of a depression over Scandinavia, and gave rise to strong north-westerly gales in the north of Ireland and the east of England. Warnings had not been issued to these coasts.

WEATHER STATION: FALMOUTH OBSERVATORY.

The new arrangements for the work of the observatory, to which reference has been made on p. 15, came into operation on June 1st. Under the arrangement made with the local

authority reports have been telegraphed to the Office each evening for incorporation in the reports to the newspaper press.

Mr. A. H. R. Goldie was in residence at Falmouth from October 1st until the middle of January, and during this period experiments with pilot balloons formed a regular part of the work of the observatory. A commencement was also made with the systematic observation of cloud by photography and with the nephoscope. Arrangements were also made for sending to the observatory for analysis and tabulation the records from the anemometers at Scilly and Plymouth, in pursuance of the suggestion to make the observatory to some extent a branch office for stations in the south-west of England.

Arrangements for an effective display of meteorological information at the Customs House at Falmouth have also been completed.

During Mr. Goldie's absence the routine observations have been continued without interruption. Mr. H. Harries, one of the forecasters of the Office, was in temporary charge of the observatory for a brief period at the end of the year.

BRANCH OFFICE AT SOUTH FARNBOROUGH.

Report by J. S. Dines, M.A., Meteorologist in Charge.

The accommodation for the branch Office at the Royal Aircraft Factory was completed in the late autumn of 1913, and the work was transferred from Pyrton Hill at the beginning of December. There was some delay in the supply of furniture and fittings but by the end of the financial year 1913-1914, the equipment of the Superintendent's room, computing room and workshop was nearly complete and the arrangements for the erection of an anemometer were well forward. The thermometer screen and rain gauge have been erected in the grounds of the Royal Aircraft Factory, and eye readings have been taken daily at the telegraphic hours of observation (7, 13 and 18h.) for the last month of the year. Since the 1st of January an evening weather map and forecast have been prepared on the five days, Monday to Friday, of each week.

In the course of the year the investigation of the upper air currents by means of pilot balloons has been continued. A discussion has been prepared of the data on vertical currents collected by this means at Pyrton Hill during the past three years. This will be published in the next annual report of the Advisory Committee for Aeronautics. The work done on the relation between surface and gradient winds for various stations has also been put together and discussed, but is at present awaiting a fuller discussion in conjunction with a recent paper on the same subject by another worker.

During the autumn of 1913, in company with Mr. Gordon Dobson of the Central Flying School, I visited six of the principal stations in Germany at which forecasting and other work for the especial use of aviators is carried out. A joint report was prepared dealing with the work and equipment of these stations.

Since the 1st of January, Mr. H. Billett has been working at the Branch Office for the Advisory Committee for Aeronautics. He has assisted in the regular pilot balloon and other work, and has also carried out special experiments on air structure as opportunity has offered. Previously, under my direction, he had prepared a discussion of the records during 1912 of five anemometer stations in the south-east of England with a view to throwing some light on the travel of squalls.

III.—CLIMATOLOGY AND STATISTICS DIVISION.

Report by E. Gold, M.A., Superintendent.

CLIMATOLOGY OF THE BRITISH ISLES.

Distribution of Stations.—A list of stations in connexion with the Office, in which particulars are given of the orders of the stations and of the Official publications for which the returns have been prepared is issued as a separate circular.

The distribution of the stations in the various districts may be summarised as follows:—

	Observatories.	Normal Climatological.	Auxiliary Climatological.	Telegraphic Reporting.	Sunshine (including Observatories).	Additional Rainfall.	Additional Anemograph.	Additional Barograph.
0. Scotland, N.	0	9	2	4	8	3	1	6
1. " E.	1	17	10	3	12	2	3	4
2. England, N.E.	0	9	10	2	12	9	3	2
3. " E.	0	11	10	2	16	14	3	2
4. " Midlands	0	12	29	2	23	23	2	6
5. " S.E.	0	8	33	2	35	17	4	5
London District	1	3	9	1	10	8	1	2
6. Scotland, W., and Isle Man.	1	15	8	2	12	4	1	3
7. England, N.W., and N. Wales.	0	12	22	2	23	12	4	5
8. England, S.W., and S. Wales.	1	6	28	3	28	37	2	2
9. Ireland, N.	0	4	2	3	2	4	1	1
10. " S.	1	9	9	3	9	8	4	4
11. Western Channel	0	1	1	2	4	0	1	1
Total	5	116	173	31*	194	141	29	46

* Of these, 16 observe at 7 a.m., 1 p.m., and 9 p.m., and thus come under the international definition of a station of the second order. These stations have not been included in the 94 normal climatological stations. Aberdeen, Kew, Valencia and Eskdalemuir are given under Observatories and also under Telegraphic Reporting Stations.

Records have also been received from 6 additional thermograph stations, 12 additional autographic raingauge stations, 62 sea temperature stations. An autographic record of the intensity of radiation received on a horizontal surface is obtained at South Kensington, and the results from it are published in the Daily Weather Report and the Geophysical Journal. Daily reports are received by telegraph from 45 foreign stations.

Observatories are also maintained at Greenwich (The Royal Observatory), Oxford (Radcliffe Observatory), Bidston (Mersey Docks and Harbour Board), Southport (the Corporation), and

Berkhamsted (E. Mawley, Esq.), and from these, records for occasions of special interest are courteously supplied from time to time.

NORMAL METEOROLOGICAL OBSERVATORIES, ANEMOGRAPH AND SUNSHINE STATIONS.

Observatories.—The work of the observatories is reported upon separately, pp. 51 to 57.

In connexion with the publication of the records in absolute units it had been necessary to convert the tabulated values from degrees Fahrenheit, inches of mercury and miles per hour into degrees absolute, millibars and metres per second, but during 1913 the records of pressure began to be tabulated in millibars for Kew, Valencia and Eskdalemuir, and from the beginning of 1914 the same practice has been followed at Aberdeen.

Anemograph Stations.—The number of anemograph stations which are maintained by the Office, or from which records are regularly received at the Office, is now 33. The autographic records are tabulated or analysed week by week, and a summary of the results published in the Weekly Weather Report, so that the information may become available for public use without delay. A similar summary for the month is included in the Monthly Weather Report. Information from four of them is published monthly in the Geophysical Journal (British Meteorological Year Book, Part III. (2)), and an annual summary of gales is published as an appendix to the Weekly Report (Year Book, Part I.).

Records of Sunshine.—The number of stations from which returns of "bright sunshine" are received is 194. With three exceptions they are all situated in the British Isles, the exceptions being Georgetown, British Guiana; the Falkland Islands; and Chinkiang, China. The original records from 121 stations are retained in the Office, whilst those from the remainder are sent to the Office monthly for examination and are then returned.

Changes in Stations.—The observations at Swarraton, which had been used in the preparation of District Values in the Weekly Weather Report since 1900, were discontinued at the beginning of 1913. Its place in the Weekly Report has been taken by Wilton House, Salisbury, where a station has been maintained by the Earl of Pembroke, for which a summary has been included in the Monthly Weather Report since 1906. The returns from Thrapston, Seathwaite and St. Asaph have also been discontinued.

Among the stations which have been started or have come into connexion with the Office during the year, must be mentioned anemograph stations at Hexham and at the Coats Observatory, Paisley. The following climatological stations have been added to the list: Copdock (Ipswich), Ryde, Hythe, Bude, Exmouth, Seskin (Carrick-on-Suir), Walton-on-Naze. In addition to these about 30 normal and auxiliary climatological stations in Scotland, in connexion with the Scottish Meteorological Society, are now included among the stations from which records are received and summaries published.

Obituary.—The Committee record with regret the death of Miss E. A. Morrow, Carrigallen. The records are being continued by Miss H. M. Beattie.

Inspections.—A list of stations inspected during the year by representatives of the Office is given on pp. 57 to 59.

Publications.—The statistical publications of the Office which represent “the public memory of the weather” of each year for the purpose of future reference, have been grouped together under the general title “The British Meteorological and Magnetic Year Book.”

Part I., Weekly Weather Report, Part II., Monthly Weather Report.—No changes were made in the Weekly Weather Report for 1913, but from the beginning of 1914 the tables were rearranged and the space allotted to general remarks was reduced. In the Table of Summaries for Stations a column was added for the heights of the stations above mean sea level and the column for the difference from average of the percentage duration of bright sunshine was omitted; the order of the columns was altered. A new table was introduced giving a summary of wind for the different stations from which pressure-tube anemograms are received. It shows the dates and duration of gales and high winds and the duration of fresh or moderate winds, and of calms and light airs, as well as the dates and times of extreme velocities.

In the Table for Districts, values of pressure for the week, the season, and the year are included. They are expressed in millibars. These values of pressure are essential for statistical research on the sequence of weather as exhibited in weekly mean values.

Simultaneously with these changes in the tables, a change was made in the units used in the daily synoptic charts of the Weekly Report. (*See* p. 36.)

New averages of temperature, rainfall and bright sunshine have been prepared for the period ending with the year 1910, and are being published as an Appendix to the Weekly Weather Report for 1913.

Monthly Report.—No change was made in the monthly issues of the Monthly Weather Report for 1913, but in the Annual Summary tables giving lowest day temperatures and highest night temperatures and frequencies of occurrence for temperature and sunshine at certain stations were added. In 1914 the report was modified and enlarged in consequence of the new arrangements with the Scottish Meteorological Society, for the establishment of a Branch Office at Edinburgh, and for the publication of additional data for Scotland.

Year Book.—Part III. (1) **Daily Readings at Meteorological Stations of the First and Second Orders**, has been issued regularly about five weeks after the end of each month. It contains daily observations at eight Climatological Stations. From the beginning of 1912 the results have been expressed in absolute units. (2) The “*Geophysical Journal*” has been issued with less promptitude. The monthly parts up to and including April, 1913, are now completed. It contains daily meteorological, magnetic, electrical, solar and seismic data for Kew and Eskdalemuir,

meteorological and magnetic data for Valencia and values of the wind components for four hours each day for Deerness, Holyhead, Scilly and Yarmouth. It includes also the results of the investigation of the upper air previously published in the Weekly Report, and particulars of the intensity of radiation recorded at South Kensington by the Callendar Instrument for recording the vertical component of the direct and diffuse solar radiation.

A special summary of the upper air data for the year 1912 has been prepared by Mr. W. H. Dines for publication as an annual supplement to the Journal for that year.

Part IV. (1) Hourly Values from Autographic Records. Meteorological Section.—The publication of the hourly values of the meteorological elements at the normal observatories in connexion with the Office is not yet up to date, owing to the increased work in connexion with the necessary conversion from the units in which the results have been tabulated. The monthly issues for 1913 for Kew, Valencia, and Eskdalemuir, have been completed up to March, and the monthly summaries for Aberdeen are prepared up to the end of January. The photographic barograms are now tabulated directly in millibars, but the corresponding alteration for the thermograms has not yet been made.

Part IV. (2) Hourly Values from Autographic Records. Geophysical Section.—The meteorological summaries for the five observatories for this Section were completed for 1912 and a note upon them, which includes a short discussion of the diurnal variation of pressure at Eskdalemuir, is published in the volume for that year which is now in the press. The work involved in the publication of this volume and in the preparation for publication of the results of registering and pilot balloon ascents in the Geophysical Journal has fallen upon the staff which deals with the preparation of Part IV., Section (1) of the Year Book. In consequence that section is further in arrears than it was a year ago.

Returns for Registrars-General.—Weekly summaries have been prepared regularly for the Registrars-General of Births, Deaths and Marriages for England and Wales and for Ireland.

A quarterly return of rainfall with general remarks upon the weather of the quarter is supplied to the Registrar-General for England and Wales.

A special quarterly summary of observations at Dublin, with remarks on the weather of Ireland during the quarter, has been supplied to the Registrar-General for Ireland.

Seasons in the British Isles.—Little progress has been made with the preparation of the Report on the Seasons in the British Isles, referred to on p. 35 of the Report for last year, and it has been impossible to complete the work.

Information based upon the weekly values of rainfall, temperature, and sunshine for the past 30 years has been sent regularly to the different agricultural shows at the request of the Board of Agriculture. The information has included a note of the weather of the week preceding the date of the show in the current year, and an indication of the statistical connexion

between the weather of the corresponding week and of the following week during preceding years.

Miscellaneous.—Exhibits of charts and diagrams were prepared for the Royal Agricultural Show at Bristol and for the meeting of the British Association at Birmingham. The latter was arranged specially to illustrate the normal meteorological conditions in July and September on the route from England to Australia.

IV.—INSTRUMENTS DIVISION.

Report by F. J. W. Whipple, M.A., Superintendent.

Supply to the Navy.—The instruments necessary to maintain the establishment numbers at H.M. Naval Dockyards have been sent from time to time. The new system of book-keeping is found to work smoothly.

The Mercantile Marine.—Instruments were issued from the Office to 32 ships of the Mercantile Marine during the year.

The stock of instruments at the Agents of the Office was maintained.

New instruments were sent to 34 sea temperature stations. Eight storm warning cones were issued.

Telegraphic Stations.—Barometers with millibar scales in addition to the ordinary inch scales have been issued to the majority of the telegraphic stations in preparation for the change to the new units to take place on May 1st. Rain-gauge glasses for measuring rainfall in millimetres have been issued to all the telegraphic stations maintained by the Office.

One new telegraphic station, Glasgow, was equipped in April, 1913.

Observatories.—Thermometers graduated on the absolute scale have been supplied to all the observatories.

The Bendorff electrometer from the Office has been transferred to Kew as well as a Callendar electrical thermograph.

A thermograph, a hygrograph, two nephoscopes, and a balloon theodolite have been added to the equipment at Falmouth.

A cloud-camera and an earth-indicator have been sent to Eskdale. The Dines pressure-tube anemometer at that observatory has been replaced by one with a direction recorder attached. A similar transformation is being made at Kew.

Instruments have been supplied on repayment to about 100 observers. Included in this number are the outfits of new stations at Carrick-on-Suir, South Farnboro', and Rathgar (Dublin).

The principal colonial orders have come from the Union of South Africa and the Commonwealth of Australia. The photographic barograph and thermograph formerly at Glasgow University have been renovated and sent to South Africa; a pair of recording theodolites with special cloud-pointers attached have been provided on the same requisition. The total value of the instruments supplied on colonial orders amounts to about £1,593.

Exhibitions.—Certain instruments and diagrams were lent to the International Exhibition at Ghent in 1913.

The Office was fully represented for the first time at the Royal Agricultural Show, which was held at Bristol in 1913. A climatological station was arranged and demonstrations were given regularly by Mr. Skelton, the representative of the Office.

Fishery Barometers.—Inspectors of the Fishery Board for Scotland and of the Board of Agriculture and Fisheries in England and Wales have continued to examine and report upon the barometers supplied for the use of fishermen in their respective districts. The stations supplied with these barometers now number 233, of which 65 are in England, 6 in Wales, 66 in Ireland, 91 in Scotland, 4 in the Isle of Man, and 1 in Jersey.

Equipment of the Office.—A photographic camera and a Mercedes-Euklid calculating machine have been added to the equipment of the Office. An Aitken dust-counter and a Michelson actinometer have been purchased and are being used for regular observations. A soot-gauge of the pattern approved by the Committee for the study of atmospheric pollution has been in operation since January 1st, 1914.

An electrical cup-anemometer has been erected on the roof of the Office. This instrument is of the Robinson-Beckley type with 9-inch cups: current from the ordinary house supply is used for transmitting impulses from the cups to the recorder. The details of the transmission device, which was designed originally by Sir William (then Mr. W. H.) Preece for use at Valencia, have been modified (*vide* Annual Reports, 1884, p. 24; 1885, p. 20; 1886, p. 20; 1890, p. 24; 1891, p. 19; 1892, p. 20).

Aneroid Barometers graduated in centibars have been presented to the Office by the Director. These are of two types; (1) the sea barometer on which the mean pressures at different latitudes are shown, and (2) the land barometer on which the frequencies of pressure within various limits, 95 to 96 cb., 96 to 97 cb., and so on, are set out. The frequencies are averages for Aberdeen, Kew, and Valencia. Part of the dial of the land barometer rotates, and can be set according to the altitude of the station, so that the observer can read off the pressure at sea-level as well as at station-level. (*See* Figs. 1 and 2, pp. 66, 67.)

V.—METEOROLOGICAL OFFICE, EDINBURGH.

Report by A. Watt, M.A., F.R.S.E., Superintendent.

This Office was constituted as at April 1st, 1913, under the control of the Meteorological Committee, Edinburgh, and is accommodated in the rooms of the Scottish Meteorological Society, 122, George Street, Edinburgh. At April 1st the staff consisted of the Superintendent; Miss K. I. Cameron, M.A., who had been in the service of the Society since July, 1912; and Miss M. Crawford, who had been in the service of the Society since January, 1913. Miss Cameron was absent on account of

ill-health during part of the summer and autumn and had to resign her appointment. Miss W. Hume joined the staff in October, 1913.

Reports to the Registrar-General for Scotland.—The Registrar-General for Scotland has been regularly supplied with the Monthly and Quarterly Reports required by him.

The Monthly Report is based on returns from eight of the large towns of Scotland, and is lodged as a rule on 5th of each month. The discussion is as a rule based chiefly on the statistics of the eight towns, but occasionally a rather wider outlook is taken if there have been events of exceptional interest, and if it has been possible to work up other returns.

The Quarterly Report consists of three Monthly Reports, and is lodged about the 20th of January, April, July, and October. At present statistics are given for about 75 stations. The figures for the Telegraphic Stations of the Meteorological Office (Wick, Nairn, &c.) and for the observatories at Aberdeen and Eskdalemuir are extracted from the Monthly Report of the Meteorological Office, the figures for the third month of each quarter being sent in manuscript from London.

Much additional information is considered and analysed before the descriptive sections of the Report are written, such as rainfall returns from other stations, weather records kept at the Northern Lighthouses, and newspaper cuttings.

Supply of Returns to the Meteorological Office, London.—The Office at first supplied to the Meteorological Office, London, 16 Monthly Summaries for inclusion in the Monthly Weather Report. Since the beginning of 1914 all the Scottish statistics except those for the Telegraphic Stations and the two Observatories have been prepared in Edinburgh and for March, 1914, summaries for 59 Scottish Stations were prepared in Edinburgh and included in Table III. of the Report. For 27 of these stations additional summaries were prepared for inclusion in Table II. Daily values in absolute units have been prepared for two stations.

Inquiries.—A considerable number of general inquiries has been dealt with either by correspondence or at an interview. In nine cases a fee has been charged for information supplied, and in one instance the Superintendent attended in the Sheriff Court at Glasgow as a witness in a shipping case. The total fees received on account of the Office have amounted to £5 4s. 6d.

Inspections.—The Superintendent inspected the following stations during the year:—Ardtornish, Bangour, Cally, Castlebay, Comlongon, Crieff, Cupar, Drumlanrig, Glasgow (Springburn Park), Glencarron, Inverness, Leith, Oban, Poltalloch, Rothesay, and Stornoway.

The Superintendent attended at the London Office for about a week in April, and again in October, 1913, and also in March, 1914.

OBSERVATORIES.

VI.—CENTRAL OBSERVATORY—KEW OBSERVATORY, RICHMOND, SURREY.

*Report by C. Chree, Sc.D., LL.D., F.R.S., Superintendent,
Assistant-Director of Observatories.*

Buildings and Staff.—A number of changes have been made in the course of the year, which have been already dealt with on pp. 15-19.

Self-recording instruments and eye-observations.—The thermograph and recording rain-gauge were not disturbed by the building operations, and remained in continuous operation throughout the year. The Robinson cup anemograph had its record interrupted for only a few hours while the roof of the new wooden structure containing it was being fitted. The Dines pressure tube anemograph was moved on June 9th from its old position on the roof to the hut erected in 1912 beside the old cloud camera stand, near the entrance to the Park. A gale delayed the completion of its erection, so that two days' records were lost. The water-dropping electrograph retained its old position, but the presence of scaffolding required for the external painting of the building and other operations introduced uncertainties into the records during several months. There was also, unfortunately, some additional uncertainty as to the scale value from June to September, owing to an accident to the portable electrometer, which it took the makers several months to repair. The table of hourly values of potential gradient got out for 1913 is thus less reliable than those got out for some years previously.

The changes in the basement entailed moving the mercury barograph and the magnetographs to a site outside the "Experimental House." The barograph was moved outside on May 26th and restored to its old position on December 29th. Only eight hours' record was lost on the first occasion, but on the second it was decided to get Mr. Adie to repair the clock pallets, which were in a dangerous state. This entailed two days' loss of trace. Whilst the mercury barograph was out of action, a continuous record was obtained from the Dines float barograph, which is now erected in the hall.

The magnetographs suffered more disturbance than the other instruments. Their transfer to the Experimental House in the end of May and re-transfer to their old site in the basement in the end of December each took several days to accomplish. The work was carefully and, on the whole, very successfully carried out by Mr. Adie. The suspension of the declination magnet was, however, broken on the first occasion, and the new suspension stretched. It was some days before this was discovered, during part of which time the magnet was apparently not free to move. The trace from the horizontal force magnet also for some time presented features suggestive of slight striction. Thus the magnetic records during June were much less satisfactory than usual. Subsequent to June the behaviour of the magnetograph

was fairly satisfactory, but the interpretation of the horizontal force record, so long as the instrument was outside, presented unusual difficulty, owing to the large diurnal range of temperature in the Experimental House. Careful measurements were made of the distance between the declination magnet mirror and the photographic drum prior to the first dismantling and subsequent to the second erection of the instrument, and in both cases the result obtained for the scale value, $1 \text{ mm.} = 0.87'$, was in exact agreement with the value which has been always in use. As erected in the Experimental House, the scale value of the declination instrument was $1 \text{ mm.} = 1.15'$.

The building operations necessitated the dismantling of the Ångström pyrheliometer on July 7th, and of the Milne seismograph on August 8th. The seismograph was restarted on its original site on December 30th, but a new site had to be prepared in the basement for the recording part of the pyrheliometer, which was not ready until February 12th.

All the meteorological records obtained, except those from the pressure-tube anemograph and the float barograph, have been tabulated for each hour at the Observatory. The electrograms have been measured each day at 3h., 9h., 15h., and 21h., and the daily electrical "character" has been assigned up to the end of January. The table of hourly values of potential gradient for the year 1913 from ten selected quiet days a month has been prepared. The maximum and minimum daily values of magnetic declination and horizontal force have been measured, and the magnetic "character" assigned for all days up to the end of January. All the magnetic "character" data for the year 1913 have been sent to the international centre for these data at the Royal Netherlands Meteorological Institute at de Bilt. The declination and horizontal force curves for the first nine months of 1913 have been measured at each hour on the five quiet days selected internationally for each month. The calculation of the resulting diurnal inequalities is not yet, however, complete. The seismograms have been studied for that part of 1913 during which the instrument was in operation, and the results have been sent to Shide for inclusion in the lists issued by the British Association.

Regular cloud observations have been made with the Fineman nephoscope, and have been contributed to the international scheme of investigation of the upper air for publication at Strassburg. On days of bright sunshine observations of the intensity of solar radiation have been made with the Ångström pyrheliometer within half an hour of noon. These were suspended during the building operations. Observations of the air-earth vertical electric current have been made with the Wilson apparatus, and observations of the positive and negative charges per c.c. associated with the more mobile electric ions in the atmosphere have been taken with the Ebert apparatus. These electrical observations have been taken on most fine afternoons between 2 and 4 p.m. All the observations taken with either the Wilson or the Ebert apparatus up to the end of January have been reduced and checked.

In addition to the work represented by the tables of results published in the *British Meteorological and Magnetic Year Book*,

the following experimental work has been conducted at the Observatory:—

Fog and Mist.—The observations of a series of distant objects have been continued as in previous years.

Electrical Observations.—Some additional observations have been made with the Wilson and Ebert apparatus, covering the time of sunset.

Antarctic Magnetic Observations.—It has been arranged that the magnetic records obtained by the National Antarctic Expedition in 1911 and 1912 shall be reduced at the Observatory, with a view to their discussion by the Superintendent, part of whose official time is being given to the work, in accordance with an arrangement made between the Meteorological Office and the Committee administering the Captain Scott Antarctic Fund. Messrs. J. Foster and C. Turl are engaged on the measurement of the magnetic curves.

Publication of the Results.—*The Geophysical Journal (British Meteorological and Magnetic Year Book, Part III., Section 2)* gives month by month particulars of barometric pressure, air temperature, humidity, wind direction and velocity, amount of cloud and weather at two fixed hours daily, also the daily totals of rainfall and duration of bright sunshine. It further includes for each day the minimum temperature on the grass, earth temperature at two depths, values of the potential gradient at four fixed hours, the electric and magnetic "character," the extreme values of magnetic declination and horizontal force, and the ranges of these elements. The results are also given of all the observations of solar radiation with the Ångström pyrheliometer, and of electrical observations made near 3 p.m. with the Ebert and the Wilson apparatus.

Monthly summaries of the diurnal and seasonal variation of the magnetic declination and horizontal force and of the electric potential gradient in the atmosphere are given with corresponding data for other meteorological office observatories when they are available, in *Hourly Values, Geophysical Section, Part IV., Section 2*, of the same publication, which also contains mean monthly values of magnetic inclination, total force and vertical force, and north and west components, along with a table giving recent mean values of the magnetic elements at the observatories whose publications are received at Kew Observatory.

Verification Work.—Pending the erection of a special building at Teddington, the testing of ship and other compasses and compass bowls was carried on until the end of 1913 on behalf of the National Physical Laboratory. The instruments thus tested subsequent to April 1st, 1913, were as follows:—

Theodolite compasses...	...	...	...	...	20
Liquid compasses	...	...	...	...	6
Prismatic compasses	...	...	...	...	2
Compass bowls (with one card each)	...	...	...	...	3
Additional or separate cards	...	...	...	...	28
Kelvin azimuth mirror	...	...	...	...	1

Nine solar maximum thermometers were also compared with the Observatory standard for the National Physical Laboratory.

The verification of magnetographs, magnetometers, and collimator magnets, inclinometers and dip needles, and other similar instruments will continue to be carried out at Kew Observatory on behalf of the Meteorological Office. The instruments of this species tested since April 1st, 1913, were as follows:—

Unifilar magnetometers	...	...	...	...	5
Separate collimator magnets	...	...	...	...	2
Inclinometers (with 2 needles each)	...	...	...	...	7
Additional or separate dip needles	...	...	...	...	30

Course of Magnetic Instruction.—A course of instruction in the use of the ordinary absolute magnetic instruments was given to Lieut. W. A. Galbraith, R.I.M.S., at the request of the India Office.

Requisitions.—Prepared photographic paper, as used at Kew, has been supplied on requisition to the other observatories of the Meteorological Office and to the Radcliffe Observatory, Oxford.

Library.—The great majority of the books used to be accommodated in the upper story of the main building, and all had to be packed in boxes and stowed away in outbuildings while the building operations were proceeding. The packing, unpacking and transport of the books were carried out under considerable pressure of time, so that when brought back to the Observatory they were in a very confused state, and a great deal of work remains to be done to get them properly re-arranged and re-catalogued. This work is being carried out by Miss Powell, who is devoting part of her time to it, assisted by Miss Corrin.

Loan of Instruments.—The following instruments, apparatus, &c., the property of the Meteorological Office, are at the present date out of the custody of the Superintendent on loan from the Observatory:—

To whom Lent.	Articles.	Date of Loan.
Board of Education, Science Museum, South Kensington.	Articles specified in the list given in the Annual Report of the Kew Committee for 1893.	1876
New Zealand Government.	Dip Circle, by Barrow, with one pair of needles and bar magnets, and a tripod stand.	1899
" "	Unifilar Magnetometer, by Jones, marked N. A. B. C.	1909

VII.—MAGNETIC OBSERVATORY—ESKDALE OBSERVATORY, LANGHOLM, DUMFRIESSHIRE.

Report by L. F. Richardson, M.A., Superintendent.

Magnetics.—Continuous records have been obtained of the north and west components of the earth's magnetic field. The registration of the vertical component was made the subject of a number of experiments by Dr. Harker, and as a result a magnetograph,

kindly lent by Professor Watson, was installed in the place of the previous one. Professor Watson's magnetograph has since given satisfaction. The magnetographs, being sensitive to changes in temperature, are housed in an underground room, in which the temperature is remarkably constant, changing only 0.1° C. or so per week. The dampness of the air and walls in this chamber, which still remains a matter of considerable anxiety, has partly abated since the drains were deepened in the spring and summer of 1913, and the growth of mould on the woodwork has been delayed by the use of creosote.

Special attention has been given to making an accurate determination of the sensitiveness of the magnetographs and to orienting their axes along the true geographical north and west directions. Absolute observations of the earth's magnetic field have been made weekly, and by their means, and by means of the curves given by the magnetographs, numerical values of the north and west components are being computed for every hour throughout the year, and of the vertical component for every hour from August 1st for publication in *Hourly Values, Geophysical Section*. Preliminary values are being printed in the *Geophysical Journal*. The absolute value of the dip is now being determined weekly with an inductor made by Schulze, of Potsdam, an instrument considerably more accurate than the dip circle.

The classification of the days of the year as magnetically "calm," "moderately disturbed," and "highly disturbed" has been continued, and the results are forwarded periodically to the International Magnetic Commission.

With a view to determining the differences between the magnetic standards of the following observatories, observations were made at each of them with the same magnetometer and dip circle:—Potsdam, De Bilt (near Utrecht), Val Joyeux (near Paris), Greenwich, Kew, Falmouth, Valencia, Eskdalemuir.

This tour was undertaken in June and July by Mr. L. F. Richardson at the Director's instruction.

Meteorology.—From 1st January, 1914, the observatory has contributed telegraphic reports to the Daily Weather Service. Values of the temperature, barometric pressure, humidity, wind direction and force, sunshine and rainfall have been obtained for every hour throughout the year, from the traces of autographic instruments, standardized by eye-observations. They are prepared for press at the Meteorological Office, and will be printed in the *Meteorological and Magnetic Year Book, Part 4*. The weather and cloud are observed and noted six times daily between 7 a.m. and 9 p.m., and a diary is kept. Observations of the intensity of solar radiation have been recently recommenced.

On many clear days during 1914 the wind velocity and direction at heights of one kilometre or more above sea level have been observed by a pilot balloon and theodolite, and published in the Daily Weather Report for the following Sunday.

A comparison is in progress between two types of thermometer screen.

Atmospheric Electricity.—A continuous record has been obtained of the voltage per metre of height near the earth's surface. The days are classified according to the amount and character of the disturbance of the record. The average daily oscillation of voltage is being determined for the quieter days, and the times of the more notable disturbances obtained for publication in "Hourly Values." Pressure of other work and changes in staff have caused the other electrical observations to be discontinued, but it is hoped to renew them during the coming months.

Seismology.—The three Galitzin seismographs continue to give beautiful records of the components of the natural tremors of the ground in the north, west, and vertical directions. Some ten earthquakes per month on the average are to be seen, and in the better defined examples it is possible to say from the trace from what part of the globe they have reached us. In addition there is almost always present a small undulation of the ground known as the microseismic movement. The earthquakes and microseisms are tabulated and printed in the *Geophysical Journal*. In addition a series of special measurements of microseisms have been sent to the International Seismological Association at their request.

A report has been written for the British Association Seismological Committee on the comparison between the Galitzin and Milne instruments.

A few inquiries from private individuals have been answered.

The Omori and Milne instruments have been running in addition to the Galitzin.

A wireless receiving apparatus was installed by Dr. Harker and is in regular use for obtaining Greenwich time from Paris.

VIII.—WESTERN OBSERVATORY.—VALENCIA OBSERVATORY, CAHIRCIVEEN, CO. KERRY.

All the self-recording apparatus of a first-order meteorological station have been kept in continuous operation throughout the year, and the hourly tabulations are being published as usual. Cloud observations in connexion with the International investigation of the upper air have been made on the prescribed days of each month.

The fortnightly absolute observations of magnetic declination, inclination and intensity, have been regularly made throughout the year by the Superintendent. The results have been published monthly in the *Geophysical Journal*.

IX.—ABERDEEN OBSERVATORY.

Besides the ordinary work of a meteorological station of the first order, observations of cloud motion in connexion with the international investigation of the upper air have been made, and more recently, daily observations of cloud motion for transmission to de Bilt. Observations of the upper air by means of pilot balloons have also been made regularly under Professor Niven's direction.

X.—AEROLOGICAL OBSERVATORY AT PYRTON HILL.

Report by W. H. Dines, F.R.S., Director of Aerological Investigations.

The ordinary work of the station was carried on in the usual manner throughout the year.

Registering balloons were sent up on the dates appointed by the International Committee, and on other occasions when I judged the weather conditions to be of especial interest.

The conditions proved very different to the preceding year (1912). Until October nearly all the instruments sent up were returned and the reward claimed, but bad luck set in about that time, and since then to the present date (April 1st, 1914) most of the balloons have been lost.

There are 28 satisfactory records for the year at Pyrton Hill, the highest number yet attained there for any one year; in nearly all cases the stratosphere has been reached, but the mean maximum height continues to show a steady decline. This is almost certainly due to the use of inferior rubber for the balloons, and I have tried the result of obtaining balloons from another firm, but without success. In another way too the year has been unfortunate, it has repeatedly happened that clouds prevailed at the time a balloon was sent up, so that few observations with a theodolite have been obtainable. I went to Eskdalemuir for the international week in May and was fortunate enough to recover eight balloons out of nine sent up. A theodolite was taken, but owing to persistent cloudiness it could not be used. Another balloon was sent up in June from Eskdalemuir, and reported, but every single balloon, seven in all, since that date has apparently been lost.

The observatory was removed to Benson, near Wallingford, at the end of the year.

XI.—STATIONS IN CONNEXION WITH THE OFFICE:
INSPECTIONS IN 1913.

The inspectors were as follows:—

Districts 0, 1 and 6	...	...	...	Mr. A. Watt, Mr. E. Gold.
District 2	...	...	...	Mr. E. Gold, Mr. J. S. Dines.
„ 3	...	...	...	Mr. R. Corless.
„ 4	...	...	...	Mr. F. J. Brodie, Mr. R. Corless, Mr. J. S. Dines.
„ 5	...	...	...	Mr. H. Harries.
„ 7	...	...	...	Mr. J. S. Dines, Mr. R. Sargeant.
„ 8	...	...	...	Mr. R. G. K. Lempfert, Mr. F. J. Brodie.
„ 9	...	...	...	Mr. R. Sargeant, Mr. F. J. W. Whipple.
„ 10	...	...	...	Mr. F. J. W. Whipple.

The following is a list of the stations visited:—

OBSERVATORIES.	
Aberdeen.	Falmouth.
Armagh.	Valencia.

ANEMOGRAPH STATIONS.

†Brighton.	†Kingstown.	†Roche's Point.
†Dover.	Pendennis Castle	Scilly.
Fleetwood.	(Falmouth).	Yarmouth.
Gorleston.	†Plymouth.	
Holyhead.	†Quilty.	

TELEGRAPHIC REPORTING STATIONS.

Aberdeen.	Glasgow.	Nottingham.
†*Bath.	Holyhead.	Portland Bill.
Birr Castle.	Leith.	Roche's Point.
Blacksod Point.	Lerwick.	St. Ann's Head.
Castlebay.	†Liverpool.	Scilly.
†*Clacton-on-Sea.	Malin Head.	Stornoway.
Donaghadee.	*Nairn.	Valencia.
†*Dover.	†*Newquay.	Wick.
Dungeness.	North Shields.	*Yarmouth.

HEALTH RESORTS CONTRIBUTING TO THE EVENING REPORTS FOR THE PRESS.

Aberystwyth.	Hastings and St.	Rhyl.
Boxhill-on-Sea.	Leonards.	Ryde (I. of W.).
Bettws-y-coed.	Hythe.	St. Andrews.
Blackpool.	Ilfracombe.	Scarborough.
Bournemouth.	Leamington Spa.	Southend-on-Sea.
Brighton.	Littlehampton.	Southport.
Buxton.	Littlestone-on-Sea.	Southsea.
Carnoustie.	Llandudno.	Stonehaven.
Colwyn Bay.	Lowestoft.	Teignmouth.
Douglas.	Malvern.	Torquay.
Eastbourne.	Margate.	Ventnor (I. of W.).
Exmouth.	Morecambe.	Walton on Naze.
Felixstowe.	Oban.	Weston-super-Mare.
Folkestone.	Paignton.	Weymouth.
Harrogate.	Ramsgate.	Worthing.

CLIMATOLOGICAL STATIONS.

Aberdovey.	Dunrobin.	Poltalloch.
Alnwick Castle.	Fortrose.	Raunds.
Ampleforth.	Fowey.	Ross.
Arlington.	Geldeston.	Rothamsted.
Ballinacurra.	Glencarron.	Rothesay.
Balruddery.	Grayshott.	Rousdon.
Basingstoke.	Haverfordwest.	Ruthin.
Bawtry.	Hercford.	Ruthwell.
Belper.	High Wycombe.	Selsey Bill.
Belvoir Castle.	Hoylake.	Shaftesbury.
Berkhamsted.	Huddersfield.	Sheepstor.
Birmingham.	Hutton (Lancs.).	Shoeburyness.
Blundellsands.	Leyland.	Sidmouth.
Bolton.	Limerick.	Strelley.
Bradford.	Lisburn.	Swansea.
Cahir.	Massingham.	Thrapston.
Cally.	Matlock.	Totland Bay.
Cambridge.	Meltham.	Tynemouth.
Cardiff.	Midhurst.	Wellington.
Coventry.	Minehead.	West Witton.
Crieff.	Northwich.	Wexford.
Cromer.	Norwich.	Wilton.
Cullompton.	Oxford.	Woolacombe.
Deerness.	Penzance.	York.
Dublin.	Peterborough.	

* Information from this station is included in the evening reports from Health Resorts supplied to the Newspaper Press.

† These stations are maintained by the Local Authority or by the Harbour Authority, or, in the case of Quilty, by the Railway Authority.

Besides the stations which are wholly or partially maintained by the Office in connexion with the daily weather service, the list includes a large number of stations maintained by local authorities and private persons to whom the Committee are indebted for their co-operation in maintaining an adequate public record of the weather in the British Isles.

At the observatories and anemograph stations the instruments were dismantled and cleaned and all necessary repairs were carried out. At telegraphic reporting stations and climatological stations the instruments, their exposure and the arrangements for the work, were examined. In a number of cases the inspectors were able to make suggestions for improving the observations by bringing them into line with recognised conventions. Points requiring attention which could not be settled on the spot have been dealt with by correspondence. Certificates of efficiency have been given to those stations which complied with the requirements of the Office in regard to the incorporation of the observations in the official publications.

W. N. SHAW,
Chairman.

Meteorological Office,
June 24, 1914.

APPENDIX I.

REGULATIONS FOR THE METEOROLOGICAL OFFICE, EDINBURGH.

(1) The objects of the Office are:—

- (i) The collection of trustworthy meteorological statistics from municipal and voluntary stations in Scotland and the preparation of summaries for the meteorological reports issued by Government, and for the statistical reports of the Registrar of Births, Deaths, and Marriages for Scotland.
- (ii) The supply of meteorological information in reply to inquiries.
- (iii) The promotion by all available means of public technical instruction in meteorology and of the applications of meteorological science in the interests of the public health, of agriculture, fisheries, and other industries.
- (iv) The promotion of meteorological researches, including researches on an international basis, which depend on the organisation and compilation of observations.

(2) £100 a year is now paid to the Society by H.M. Treasury on account of the Registrar-General for Scotland. In addition to this sum the Meteorological Committee will allocate from the grant placed at their disposal by Parliament a sum of £350 for the service of the Edinburgh Office, which will be paid to the Society in quarterly instalments by the Meteorological Committee.

(3) The grants will be administered by a Committee consisting of:—

The Director of the Meteorological Office.

One member appointed by the Board of Agriculture for Scotland.

One member appointed by the Registrar-General for Scotland.

Three members appointed by the Scottish Meteorological Society.

The Director of the Meteorological Office will preside at meetings of the Committee which he attends, and the Society will appoint one of its representatives to be chairman in his absence.

(4) The Committee will present to the Meteorological Committee a report of the work done by the Meteorological Office, Edinburgh, to be incorporated with its Annual Report to the Lords Commissioners of H.M. Treasury, and will account for the expenditure of the funds in such form as may be required.

(5) Out of the grant of £450, not less than £250 shall be applied in payment of the salary of an officer who will act as Superintendent of the Office.

(6) In consideration of the services rendered to the Society by the Superintendent and staff of the Office, the incidental expenses of the Office (*viz.*, rent, fuel, lighting, rates, taxes, caretaking, and cleaning) will be borne by the Society.

(7) The staff of the Office will be appointed by, and be subject to, dismissal by the Society.

(8) Part of the duty of the Superintendent will be to act as Inspector for the Meteorological Office, travelling expenses and subsistence allowance being paid for on the same understanding as heretofore.

(9) The Superintendent will be at liberty to act as Secretary of the Society, and to receive such stipend in addition to his salary as Superintendent as the Society may from time to time determine. He may also undertake paid work as lecturer and contribute occasional articles to periodicals, but he may not act as the regular correspondent of a daily newspaper, nor receive payment for contributing information for copyright publication which is, or might reasonably be, part of the work of the Office in the interests of the public.

(10) Information will be compiled in the Office without charge, in accordance with the requirements of the several departments concerned—

(i) for the periodical weather reports of the Meteorological Office.

(ii) for the periodical returns of the Registrar-General or other Government Department.

(11) Information will be compiled and supplied in response to inquiries from solicitors or private persons on terms similar to those in force at the Meteorological Office, London, and a similar scale of fees will be applicable for the "proof" of any evidence before His Majesty's Courts, citations for Scottish Courts being accepted by the Superintendent of the Meteorological Office, Edinburgh, for this purpose. The sums received by the Edinburgh Office for these services will be paid in to the account of the Society.

(12) For the purposes of compiling information to be produced before His Majesty's Courts in Scotland, or supplied in response to inquiries from solicitors or private persons, all records of all kinds preserved at the Meteorological Office, London, are to be regarded as available, due provision being made for their safe custody; and with the same proviso, the Committee will, as far as possible, facilitate the supply of the information for use in His Majesty's Courts in England direct from the London Office. The original schedules for Scottish stations, other than those of the Observatories and Telegraphic Reporting Stations of the Meteorological Office, are to be stored at the Office in Edinburgh for production when required. The schedules used in the preparation of the Weekly Weather Report are to be stored in London.

(13) The Observers at Stations in connexion with the Meteorological Office, Edinburgh, will enjoy the same privileges as to the supply of instruments, forms, &c., as those in direct connexion with the Meteorological Office in London.

(14) Copies of the Monthly Report of the Meteorological Office will be supplied to the Society for distribution to its members on the same terms as those on which they are supplied to the Royal Meteorological Society, that is to say for the cost of paper, working off, and stitching, of the additional copies required.

(15) These regulations may be modified as regards the arrangements for the administration of the Meteorological Office in Edinburgh and the co-operation of that Office with the Meteorological Office in London, by agreement between the Meteorological Committee and the Scottish Meteorological Society.

Meteorological Office,

London, S.W.

30th April, 1913.

APPENDIX II.

PROPOSALS FOR FUTURE WORK AT FALMOUTH WEATHER STATION, APPROVED BY THE METEOROLOGICAL COMMITTEE ON 25TH JUNE, 1913.

1. That upon the termination of the present work of Falmouth Observatory on June 30th, the Meteorological Committee accept the offer of the Royal Cornwall Polytechnic Society of the use of the Observatory premises, rent free, for experimental meteorological work in connexion with the Forecast Division of the Office, on the understanding that the expenses of the work and of the up-keep of the premises are defrayed by the Office. The arrangements should be from year to year terminable by six months' notice to expire on 31st December.

2. That the Society provide and pay a housekeeper to look after the premises, a gardener to look after the garden.

3. That the sunshine recorder and raingauge be maintained in operation; that the Office provide other suitable self-recording instruments as auxiliaries for the experimental investigation, and that the present observatory assistant be taken over by the Office at his present salary (until otherwise ordered) to look after the self-recording instruments, to take observations at 7h., 13h., and 18h. for the climatological reports and for telegraphic reports to the Office at 18h. for communication to the Press, and such other work of tabulation of instrument records as the Director may assign.

4. That the 6 p.m. observations be placed at the disposal of the Corporation and be transmitted to the Office for communication to newspapers on condition (a) that the Corporation defray the cost of the telegrams; (b) That the Corporation observer share with the observatory assistant the duty of the observations; (c) The Office will instal a telephone at the Observatory for the transmission of the reports to the Post Office or elsewhere.

5. That the distribution of accommodation in the Observatory building be so arranged that the present office, photographic room and instrument room be available for Office and laboratory purposes, and that provision be made for [two] sitting rooms and two bedrooms for the accommodation of observers.

6. That as a commuted sum for the outlay of the Society, the Office pay a retaining fee of £30 a year, and that during residence

at the Observatory the first observer pay 10s. a week and the second 5s. a week for quarters, including service.

7. That the observers make their own arrangements with the housekeeper about their board, paying either the cost of the materials or a commuted sum for board, at their discretion.

8. That the experimental work consist in the first place of daily soundings with pilot balloons between 11h. and 13h., observations of clouds at 7h., 13h., 18h., photographs of clouds as a record of the conditions under investigation.

9. That the observer, during his residence, supervise and act as inspector for the instruments and observations at Falmouth, Pendennis, Scilly, Newquay and any other stations in Devon, Somerset and Cornwall; and that it be also his duty to watch the Storm Signal Service and the Fishery Barometer Service in operation in the locality and to report upon them from time to time.

10. That application be made to the Office of Works for the erection of a board for the display of meteorological information at the Custom House at Falmouth, and that a display of information of importance to the locality be organised under the supervision of the observer. That the Office send a daily forecast for exhibition in the frame.

11. That a wireless receiving apparatus be installed at the Observatory and that the weather reports of the Eiffel Tower, Norddeich and Cleethorpes be taken in daily and telephoned for exhibition.

12. The observer will be stationed at Falmouth, in London or elsewhere, in accordance with the Director's order.

APPENDIX III.

Circular 202.

DAILY WEATHER REPORT OF THE METEOROLOGICAL OFFICE. CHANGE OF UNITS OF MEASUREMENT.

BAROMETRIC PRESSURE IN PRESSURE UNITS.

In their Eighth Report to the Lords Commissioners of His Majesty's Treasury, the Meteorological Committee intimated their intention to use Absolute Units for pressure in the Daily Weather Report of the Meteorological Office from 1st May, 1914.

The absolute unit of pressure on the Centimetre-Gramme-Second system* is the dyne per square centimetre. As this unit is exceedingly small a practical unit one million times as great has been suggested. This unit, the megadyne per square centimetre, is called a "bar." In the Daily Weather Report the centibar and the millibar, respectively, the hundredth and the thousandth part of the "bar" are adopted as working units. The relation between the millibar and the inch of mercury is given in the tables overleaf.†

* Particulars of the Centimetre-Gramme-Second system are given in the *Observer's Handbook*, 1913 edition.

† Conversion tables are printed in the *Observer's Handbook*.

Reasons for the Change.—One of the principal reasons for this change is that it is a step towards the adoption of a system of units which may become common to all nations.

The system was approved by the Meteorological Council in 1904 and by the Gassiot Committee of the Royal Society in 1910. Upon the initiative of Professor V. Bjerknes, formerly professor at Christiania, and now of the Geophysical Institute at Leipzig, it was used in important publications of the Carnegie Institution of Washington, and was adopted by the International Commission for Scientific Aeronautics for the international publication of the results of the investigation of the upper air. Since 1907 the system has been used in the Meteorological Office for the upper air, and since 1911 for the data from the Observatories where Centimetre-Gramme-Second units have been used for many years in connection with magnetism and electricity. The Weather Bureau of the United States has adopted *millibars* and *absolute temperatures* on the Centigrade Scale for the issue of daily charts of the Northern Hemisphere, which began on 1st January, 1914; the Royal Meteorological Society has decided to use *millibars* for the expression of the series of pressure normals for the British Isles, which it is now preparing; and the Meteorological Office has followed the example of the Weather Bureau in using absolute units for the daily maps in the Weekly Weather Report, but its isobars are figured in centibars as they were in the specimen issued with the Eighth Annual Report.

The Scientific Appeal.—The ground of scientific appeal to all nations to adopt the bar, centibar, and millibar is that these units fall naturally into place as members of the Centimetre-Gramme-Second system of units which has already become universal for Magnetism and Electricity and most branches of Physics. Its principles are therefore well known. The inch and the millimetre are really units of length, and to estimate the effect of a pressure measured in terms of height of a column of mercury, it is necessary to introduce the value of the density of mercury at some particular temperature and the value of the acceleration due to gravity at a particular place. It is well known that the atmospheric pressure at sea level in Britain varies between $13\frac{3}{4}$ and $15\frac{1}{4}$ lbs. weight per square inch. The pound weight per square inch is often used by engineers, but it is not a convenient unit because its value depends upon latitude.

The Upper Air.—The past 15 years have witnessed the collection of extensive meteorological observations in the upper air made by means of kites and balloons, from which important results have already been deduced. The absolute system of units is the most convenient for the discussion of the data so collected, and it is being generally adopted for the purpose. The rapid development of aviation makes it impossible to draw a line between the academic study of the meteorology of the upper air and the practical meteorology of the Daily Weather Report. The use of two systems of units, one for observations made at the surface, and the other for observations taken at higher levels, could only retard progress.

Reasons for the Change.—One of the principal reasons for this change is that it is a step towards the adoption of a system of units which may become common to all nations.

The system was approved by the Meteorological Council in 1904 and by the Gassiot Committee of the Royal Society in 1910. Upon the initiative of Professor V. Bjerknes, formerly professor at Christiania, and now of the Geophysical Institute at Leipzig, it was used in important publications of the Carnegie Institution of Washington, and was adopted by the International Commission for Scientific Aeronautics for the international publication of the results of the investigation of the upper air. Since 1907 the system has been used in the Meteorological Office for the upper air, and since 1911 for the data from the Observatories where Centimetre-Gramme-Second units have been used for many years in connection with magnetism and electricity. The Weather Bureau of the United States has adopted *millibars* and *absolute temperatures* on the Centigrade Scale for the issue of daily charts of the Northern Hemisphere, which began on 1st January, 1914; the Royal Meteorological Society has decided to use *millibars* for the expression of the series of pressure normals for the British Isles, which it is now preparing; and the Meteorological Office has followed the example of the Weather Bureau in using absolute units for the daily maps in the Weekly Weather Report, but its isobars are figured in centibars as they were in the specimen issued with the Eighth Annual Report.

The Scientific Appeal.—The ground of scientific appeal to all nations to adopt the bar, centibar, and millibar is that these units fall naturally into place as members of the Centimetre-Gramme-Second system of units which has already become universal for Magnetism and Electricity and most branches of Physics. Its principles are therefore well known. The inch and the millimetre are really units of length, and to estimate the effect of a pressure measured in terms of height of a column of mercury, it is necessary to introduce the value of the density of mercury at some particular temperature and the value of the acceleration due to gravity at a particular place. It is well known that the atmospheric pressure at sea level in Britain varies between $13\frac{3}{4}$ and $15\frac{1}{4}$ lbs. weight per square inch. The pound weight per square inch is often used by engineers, but it is not a convenient unit because its value depends upon latitude.

The Upper Air.—The past 15 years have witnessed the collection of extensive meteorological observations in the upper air made by means of kites and balloons, from which important results have already been deduced. The absolute system of units is the most convenient for the discussion of the data so collected, and it is being generally adopted for the purpose. The rapid development of aviation makes it impossible to draw a line between the academic study of the meteorology of the upper air and the practical meteorology of the Daily Weather Report. The use of two systems of units, one for observations made at the surface, and the other for observations taken at higher levels, could only retard progress,

Practical Considerations.—It is acknowledged that an accuracy of one-thousandth of an inch is not really attainable in practice. For many years the Inspectors of the Meteorological Office have had to be satisfied with agreement within $\cdot 003$ in., and now the National Physical Laboratory has ceased to certify barometers of the Kew pattern to the thousandth of an inch. Consequently, with an instrument graduated to $\cdot 001$ in., observers are being asked to read to an accuracy which is acknowledged to be unattainable. On the other hand an accuracy of the hundredth of an inch is not good enough for scientific purposes.

The practical degree of precision for a mercury barometer of the Kew type is *one-tenth of a millibar*. Graduation in centibars and millibars, with a simple vernier scale for estimating to tenths of a millibar, thus brings the demand for accuracy made upon the observer into harmony with that actually attainable. The new graduation does away with the complications of the conventional vernier scale in use on barometers graduated in inches, and consequently the risk of errors of observation is reduced.

The Percentage Barometer.—Another advantage is that the Bar, or Centimetre-Gramme-Second atmosphere, differs but little from the standard atmosphere. The equivalent of the adopted normal value at sea level of 29.92 mercury inches is 101.32 centibars, or 1013.2 millibars. The lowest barometer value ever observed for sea level in the British Isles is 925.5 millibars, the equivalent of 27.33 inches. This value was recorded at Ochtertyre on January 26th, 1884. The highest value is 1053.5 millibars, the equivalent of 31.11 mercury inches. It was recorded at Aberdeen on January 31st, 1902.

A reading of 100 centibars, or 1,000 millibars, is equivalent to 29.53 mercury inches. It will be remembered that the word "change" is placed opposite the sea-level reading 29.5 in the conventional descriptions engraved on dial barometers. Thus in a barometer graduated in centibars the reading 100 would occupy the position conventionally marked "change." (See Figs. 1 and 2, pp. 66 and 67.)

Practical Course to be Pursued.—It is evidently impossible at one operation to change all the barometers in use in the various services, and even in the most favourable circumstances there must be for many observers a time when the readings are taken on one scale, and the results quoted or published in another. Tables of equivalents are given herewith for making the necessary conversion. †

The barometers issued by the Meteorological Office will be graduated in both scales.*

* It should be borne in mind that the inch scale is graduated to be correct at 62° F., the millibar scale at the temperature of the freezing point, 32° F. When both scales are at the same temperature the relation between them is that shown in the conversion tables corrected by the subtraction of 0.3 millibar, e.g., the graduation 28.0 inch should agree with the graduation 948.2-3 or 947.9 millibars.

† Conversion tables are printed in the *Observer's Handbook*.

RAINFALL DATA IN MILLIMETRES.

As a further step in the direction of international uniformity all rainfall data will be published in the Daily Weather Report in millimetres instead of inches. The occasion for making the change is that modifications are being introduced into the telegraphic code used for the exchange of meteorological information in Europe.

The reading of rainfall in this country has been carried to hundredths, sometimes to thousandths of an inch, but the readings to the higher degree of accuracy have seldom any practical meaning. The readings on the metric system are carried to 0.1 millimetres, 0.004 inch, which represents satisfactorily the highest degree of accuracy. The range is from .01 to 3, 4, or even more inches in exceptional circumstances, for a day's rain. The telegraphic code hitherto in use has made provision for reporting amounts up to 10 inches, though the large majority of the readings are under 2 inches. The code now to be introduced makes provision for reporting amounts up to 100 millimetres or 4 inches.

As one inch is approximately equivalent to 25 millimetres the conversion from millimetres to inches, or *vice versâ*, may be made with sufficient accuracy for most purposes by multiplying or dividing by 4 and appropriately shifting the decimal point. Tables of conversion are given herewith.*

WIND VELOCITIES IN METRES PER SECOND.

Wind force will be specified on the Beaufort scale. Occasional reports are received from anemometer stations regarding the extreme wind velocities attained in gales. These data are published on the front page of the report. The unit of wind velocity used in such cases will be the *metre per second*. Tables for converting velocities from miles per hour to metres per second, or *vice versâ*, are given below.*

W. N. SHAW,
Director.

Meteorological Office,
London, S.W.,
April, 1914.

* Conversion tables are printed in the *Observer's Handbook*

[To face p. 66.]

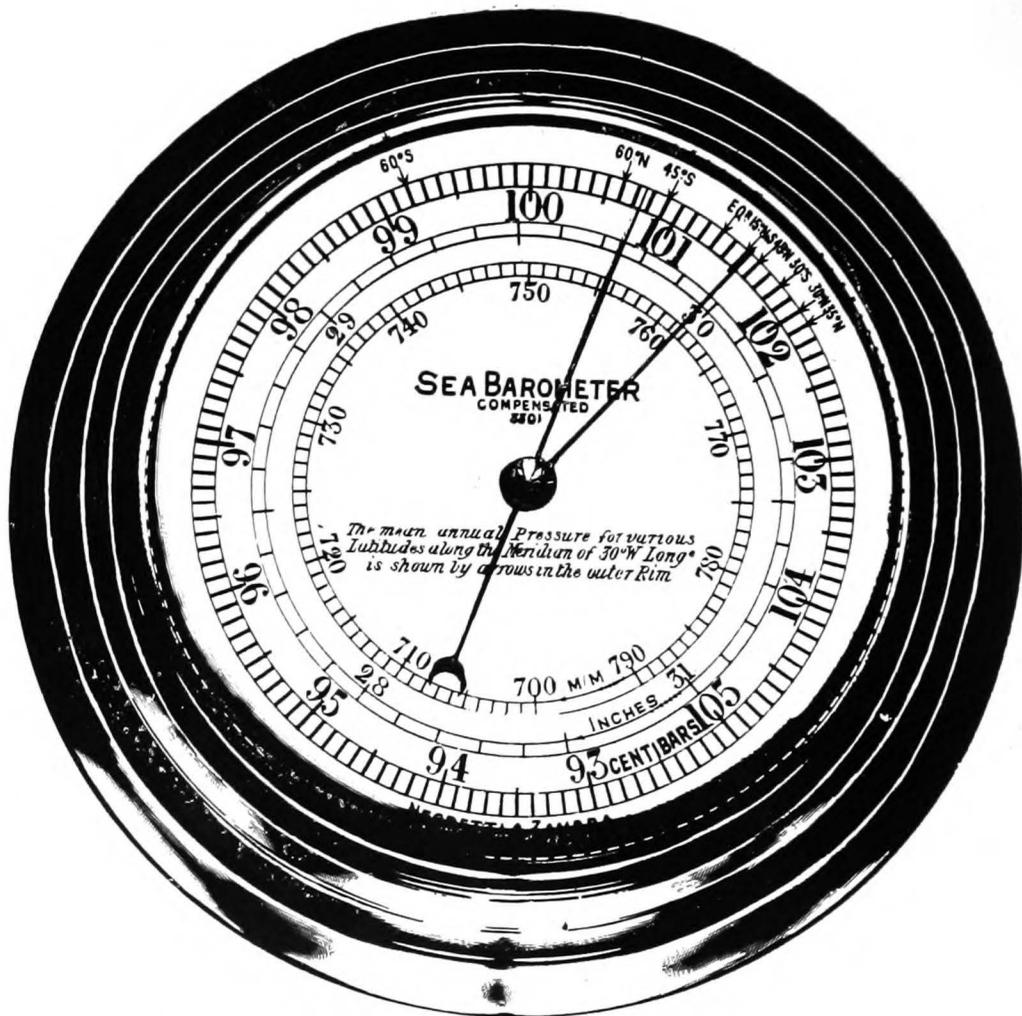
FIG. 1.
LAND BAROMETER.
(See pp. 49, 65.)



The barometer is compensated for temperature and its readings are independent of latitude. It is therefore graduated in centibars and millibars. Scales of mercury inches and millimetres for latitude 45° are added for comparison. A sliding rim which is also graduated in centibars and millibars is provided in order that a reduction to sea level may be made mechanically. In the spaces between the figures of the centibar graduation are given the frequency of occurrence of sea-level pressures for those limits derived from observations at Kew, Valencia and Aberdeen taken together.

To face p. 67.]

FIG. 2.
SEA BAROMETER.
(See pp. 49, 65.)



The barometer is compensated for temperature and its readings are independent of latitude. It is therefore graduated in centibars and millibars. Scales of mercury inches and millimetres for latitude 45° are added for comparison.

On the outer rim are marked the mean annual pressures on the meridian of 30° W at the Equator, and in latitudes 15° N and S, 30° N and S, 45° N and S, and 60° N and S. The highest mean annual reading, that at 35° N, is also marked.

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