THIRTEENTH ANNUAL REPORT

OF THE

METEOROLOGICAL COMMITTEE

TO THE

LORDS COMMISSIONERS OF HIS MAJESTY'S TREASURY.

For the Year ended 31st March, 1918

(the Sixty-third Year of the Meteorological Office).

Presented to Parliament by Command of His Majesty.

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1918.

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THE METEOROLOGICAL COMMITTEE, 1917-18.

Constituted by Minutes of the Lords Commissioners of H.M. Treasury, dated 20th May, 1905, 31st March, 1910, and 31st March, 1915.

Appointed till	
March 31, 1920	... Sir NAPIER SHAW, Sc.D., F.R.S., Director, *Chairman.*
Sept. 1, 1919	...Rear-Admiral JOHN F. PARRY, C.B., Hydrographer of the Navy. Nominated by the Admiralty.
March 31, 1920	... Captain J. M. HARVEY, Principal Examiner of Masters and Mates, Board of Trade. Nominated by the Board of Trade.
Dec. 2, 1921	... Mr. T. H. MIDDLETON, C.B., Assistant Secretary of the Board of Agriculture and Fisheries. Nominated by the Board of Agriculture and Fisheries.
Feb. 26, 1923	... Lt.-Col. H. G. LYONS, D.Sc., F.R.S. Nominated by the Royal Society.
March 31, 1920	... Professor ARTHUR SCHUSTER, F.R.S. Nominated by the Royal Society.
March 31, 1920	... Mr. G. L. BARSTOW, C.B. Nominated by the Treasury.

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

THE GASSIOT COMMITTEE, 1918.

Appointed by the Royal Society in accordance with Treasury Letter of 26th February, 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 Joseph J. Thomson, O.M. (*President of the Royal Society*).
Lt.-Col. H. G. Lyons (*Chairman*).
The Astronomer Royal.
Dr. C. Chree.
Mr. W. H. Dines.
Sir Archibald Geikie, K.C.B.
Sir R. T. Glazebrook, C.B.
Sir A. B. Kempe (*Treasurer of the Royal Society*).
Sir Joseph Larmor, M.P.
Prof. H. F. Newall.
Prof. Arthur Schuster (*Secretary of the Royal Society*).
Sir Napier Shaw.
Mr. G. W. Walker.
Prof. W. Watson.
Mr. C. T. R. Wilson.

(17436—19.) Wt. 6934—105. 950 & 90. 8/18. D & S. G. 17/ 28. A 2

ADVISORY COMMITTEE ON ATMOSPHERIC POLLUTION, 1918.

Appointed by the Meteorological Committee, 28th March, 1917, at the request of the Department of Scientific and Industrial Research, to be an Advisory Committee, for the administration of a grant by the Department, for the investigation of atmospheric pollution.

Sir Napier Shaw, F.R.S. (*Director of the Meteorological Office*), *ex officio.*

Captain C. J. P. Cave (*Past President of the Royal Meteorological Society*).

Mr. J. G. Clark.

Professor J. B. Cohen, B.Sc., Ph.D., F.R.S. (*Professor of Organic Chemistry, Leeds University*).

Dr. H. A. Des Voeux (*Hon. Treasurer, Coal Smoke Abatement Society*).

Mr. J. B. C. Kershaw, F.I.C.

Dr. R. Lessing, F.C.S.

Dr. J. S. Owens (*Coal Smoke Abatement Society*).

Dr. E. J. Russell (*Director of the Rothamsted Experimental Station, Harpenden*).

Baillie W. Smith (*Convener of the Air Purification Sub-Committee of the Glasgow Corporation*).

Mr. S. A. Vasey, F.I.C., F.C.S. (*Director of the Lancet Laboratory*).

Mr. F. J. W. Whipple (*Superintendent of the Statistical Division, Meteorological Office*).

Appointed by the Department of Scientific and Industrial Research—

Mr. W. S. Curphey.

Nominated by the Municipal Authorities co-operating with the Committee—

Dr. John Robertson, Birmingham.

Dr. W. Hanna, Liverpool.

Dr. W. J. Howarth, City of London.

Mr. Henry Mills, J.P., London County Council.

Mr. W. Osborne Thorp, Malvern.

Professor W. Haldane Gee, Manchester.

Mr. C. T. Stableforth, J.P., Newcastle-upon-Tyne.

Dr. J. B. Wilkinson, Oldham.

Dr. J. R. Ashworth, Rochdale.

Dr. Cates, St. Helens.

Mr. John Fyfe, Stirling.

THE STAFF OF THE METEOROLOGICAL OFFICE AND OF THE OBSERVATORIES OF THE METEOROLOGICAL COMMITTEE, APRIL, 1918.

Members of the staff whose names are in brackets are absent by permission on military service or other special duty.

DIRECTOR.

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

METEOROLOGICAL OFFICE.

Secretarial Staff.

Chief Clerk	T. D. Bell. *Acting Cashier:*—J. A. Curtis.
Assistants	H. Jeffreys, D.Sc.; [H. W. Braby, M.A.]; [Lieutenant E. L. Ardley, R.A.F.]; E. J. Hood; Misses R. E. Smith, D. G. Chambers, K. R. Corrin,§ W. A. Quennell;§ Mrs. E. A. Stocks; Misses H. W. Newsholme, M. Pickthall, E. F. Cottrill.
Probationers and Boy and Girl Clerks.	[E. L. Clinch]; Misses H. G. Chivers,§ F. A. Shields,§ V. Potts,§ M. L. Taylor,§ I. Cook,§ E. G. Picknett; [C. S. Herbert]; W. G. Palmer.
Office Keepers	C. E. Goad; W. R. C. Chillman; J. L. Evans.
Store Keeper	[A. G. Goad].

Marine Division.

Marine Superintendent ...	M. W. Campbell Hepworth,† C.B., R.D., Captain, R.N.R.
Assistants	W. Allingham;† C. Harding;† W. G. James;† J. T. Williams; [A. A. Lovie]; J. E. Belasco;§ A. J. Tabor;§ A. G. W. Howard.
Probationers and Boy Clerks.	[2nd Lieutenant J. L. Gray] [H. T. Smith]; W E. King.

Forecast Division.

Superintendent	R. G. K. Lempfert, C.B.E., M.A.
Assistants	J. S. Dines,* M.A.; C. E. P. Brooks, M.Sc.; F. J. Brodie;* H. Harries;† R. Sargeant;* [Lieutenant C. D. Stewart, B.Sc.]; E. V. Newnham, B.Sc.; E. G. Bilham, B.Sc., A.R.C.Sc.; Miss L. D. Sawyer, B.A.; H. L. B. Tarrant;‖ W. Hayes; A. T. Bench; H. Keeton; [Sergt.-Maj. R. Pyser]; Miss N. L. Despicht;§ Miss R. M. Chambers.§
Probationers and Boy Clerks.	[C. F. J. Jestico]; [C. C. Newman]; [R. M. Poulter]; F. W. Beaver;§ F. C. Warmington.§

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* Inspector of Meteorological Stations.
† Retained after reaching the normal age for Superannuation.
§ Member of the corps of observers for the instruments installed at the Office.
‖ Lent from Secretarial Staff.

Statistical Division.

Superintendent	F. J. W. Whipple, M.A.*
Assistants	S. N. Sen, B.Sc.; J. Sheerman; A. H. Bell; A. R. Simpkins; C. A. Bracey; L. H. Powers; C. W. Heinemann; A. E. Pycock; [Sub-Lieutenant M. T. Spence, R.N.V.R.]; [W. J. Tomkins]; H. Fahmy; Miss M. Bigelstone;§ Miss D. R. M. Figgins.
Probationers and Boy and Girl Clerks.	[W. R. Penfold];§ Misses M. Enderby,§ A. W. C. Fitch,§ T. M. Hunt.

Instruments Division.

Superintendent	R. Corless, M.A.
Assistants	Miss E. H. Geake, M.Sc.; R. F. Wallace; F. W. Snell; J. H. James; E. P. Pearce; [Lt.-Commander A. E. Gendle, R.N.V.R.]; [F. Levin]; Misses W. Bulgin,§ D. J. Taylor, A. L. Sanford.
Probationers and Boy and Girl Clerks.	[C. V. Ockenden]; Miss G. K. Herbert.§
Lithographers	Messrs. Wyman & Sons, Ltd.; A. G. King, *Artist.*

METEOROLOGICAL SECTION, R.E.

War Office Representative	Lieutenant-Colonel H. G. Lyons, R.E., D.Sc., F.R.S.
Major	Major E. Gold, R.E., D.S.O., F.R.S.
Captains	Captain C. J. P. Cave, J.P.; Captain E. M. Wedderburn, D.Sc., W.S., F.R.S.E.; Captain A. H. R. Goldie, M.A.; Captain A. E. M. Geddes, M.A., B.Sc.; Captain E. H. Chapman, M.A., B.Sc.; Captain E. Kidson, M.A.; Captain J. W. Bispham, M.A., B.Sc.; Captain F. Entwistle, B.Sc.; Capt. J. Durward.
Subalterns	Lieutenant T. Harris, M.A., A.R.C.Sc.; Lieutenant C. D. Stewart, B.Sc., 2nd Lieutenant J. F. Duffin, M.Sc.
N.C.O.	Sergeant-Major R. Pyser; Sergeant E. L. Clinch; Corporals A. G. Goad, C. V. Ockenden, C. F. J. Jestico, R. M. Poulter.

PROFESSOR OF METEOROLOGY TO THE ROYAL AIR FORCE.

Major	Major G. I. Taylor, R.A.F.

METEOROLOGICAL OFFICE, EDINBURGH.

Superintendent	Andrew Watt, M.A., F.R.S.E.
Assistants	Misses M. Crawford, W. Hume.

METEOROLOGICAL OFFICE, SOUTH FARNBOROUGH.

Meteorologist-in-Charge ...	R. A. W. Watt, B.Sc.
Professional Assistant ...	E. L. Hawke, B.A.

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* Inspector of Meteorological Stations.

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

OBSERVATORIES.

Central Observatory.

Kew Observatory, Old Deer Park, Richmond, Surrey.

Superintendent	C. Chree, Sc.D., LL.D., F.R.S., *Assistant Director of Observatories.*
Assistants	E. Boxall; B. Francis.
Probationers	[L. G. Hemens]; A. C. Lloyd.
Observer and Caretaker ...	W. R. Corrin.
Boy Clerks	[A. H. Lupton]; L. E. Fletcher.

Magnetic Observatory.

Eskdalemuir, Langholm, Dumfries-shire.

Superintendent	A. Crichton Mitchell, D.Sc., F.R.S.E.
Assistants	[Captain A. H. R. Goldie, M.A.]; P. N. Skelton; [Lieutenant H. G. Harris]; B. G. Brame; Misses M. A. Kerr, E. M. Anderson.
Caretaker and Mechanic ...	J. Burns.
Boy Clerks	[J. B. Beck]; [J. Graham].

Western Observatory.

Valencia Observatory, Cahirciveen, co. Kerry

Superintendent	L. H. G. Dines, M.A., A.M.I.C.E.
Assistant	M. Sugrue.
Boy Clerks	M. J. Morley; J. B. Morley.

Aerological Observatory.

Benson, near Wallingford.

Director of Aerological Investigations.	W. H. Dines, F.R.S.
Assistant	H. W. Baker.

Weather Station, Falmouth Observatory.

Meteorologist - in - Charge (Honorary).	P. Y. Alexander.
Clerk Assistant	J. B. Phillips.
Boy Clerk	W. J. Fowler.

Northern Observatory

at King's College, Aberdeen, under the direction of Professor Charles Niven, F.R.S.

Assistant	G. A. Clarke.

Advisory Committee on Atmospheric Pollution.

Hon. Secretary	Dr. J. S. Owens.

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For the Year ended 31st March, 1918 (the Sixty-third year of the Meteorological Office).

MAY IT PLEASE YOUR LORDSHIPS,

Within the financial year 1917-18 six meetings of the Committee have been held, on 23rd May, 27th June, 24th October, 28th November, 1917, 23rd January and 20th March, 1918, respectively.

No change has taken place in the membership of the Committee. Lieut.-Colonel Lyons, R.E., F.R.S., was reappointed by Your Lordships for a further period of five years from 26th February, 1918, on the nomination of the Royal Society.

The most noteworthy feature of the year is the great development of pressing demands for expert meteorological assistance, and the prospect of still larger demands in the future, as regards the Naval, Military and Air Services. The Committee have to note the establishment of a Naval Meteorological Service under a director attached to the Hydrographic Office, a large extension of the Meteorological Section, R.E., various projects in connection with the Royal Flying Corps arranged in conjunction with the Office by Major G. I. Taylor, R.A.F., and the prospect of a large meteorological organisation in connection with the Royal Air Force.

All these have required increased activity on the part of the Office, particularly in the Forecast Division and the Instruments Division, as well as in correspondence and the supply of information, to which reference will be made later. In order to make the information properly available still further activity will be required, and not only in these divisions, but in the other divisions as well, particularly those which deal with the collection of information from the sea, from the Dominions overseas and from foreign countries, and all parts of the work of the Office and Observatories concerned in the upper air.

It is obvious that there must be distributing centres in charge of competent meteorologists in various centres as well as London, whether they be under the control of the Meteorological Committee or not. And as the various Dominions beyond the seas will themselves require some provision for compiling and utilising meteorological information some co-operative organisation is called for on the part of the Imperial Government in conjunction with the Local Governments. This wide extension of its outlook which must be faced if the Office is to continue to be the central national and imperial establishment for meteorology has been before the Committee on several occasions, in the first place with reference to the development of the organisation within the Office to meet the increased requirements for information of different kinds; and, secondly, with reference to application for the acceleration of the supply of information in distant parts of the Kingdom, which can only be satisfied by local centres of distribution.

In response to a request from the Ministry of Reconstruction for a report on the steps taken by the Committee with reference to post-war problems a memorandum was prepared and submitted setting out the peculiarities of the British meteorological services depending upon the history of the development of meteorological work in this Country and the organisation necessary for completing the service. It was pointed out that as the work of the Office originated in the study of the meteorology of the sea exclusively, the detailed study of rainfall which is obviously a vital part of general meteorology and which is the fundamental study of practically all national meteorological establishments in the Dominions and in foreign countries, is still in this Country, in accordance with tradition, left in charge of a private organisation, and also that the municipal authorities in this Country make no provision as a general rule for recording their experiences of the weather for the guidance of their successors; thus all the information required for climatological questions to supplement what appears in the Daily Weather Report is left almost exclusively to private effort. Now that the weather is recognised to be of primary importance in so many of the affairs of life and the requirements of so many departments of the Navy, the Army and the Air Force include a knowledge of weather conditions, not only at the surface in the various parts of the globe but at elevations which have up to now been of interest to the meteorologist alone, some more comprehensive organisation is necessary.

And it is felt that the steps towards this organisation cannot be postponed until after the war. While on the one hand the war makes the development of the organisation difficult on account of the difficulty of obtaining staff and materials for observatories and experimental work, yet on the other hand the war has shown the special importance of certain meteorological problems the solution of which cannot await the conclusion of hostilities.

One of these immediate requirements is the compilation, in the easily accessible form of a book, of the information that is at present scattered in scientific journals and of which the existence is only known to a few experienced meteorologists.

The Committee have had these requirements under their consideration and have made proposals for dealing with them.

In response to an invitation from the Air Board to nominate a member of Lord Northcliffe's Committee on Civil Aerial Transport the Director's name was submitted. Lieut.-Colonel Lyons, R.E., and Major Taylor, R.A.F., were invited to become members of sub-committees appointed to consider special sections of the provision for Civil Aerial Transport.

On the invitation of the Colonial Office the Director has discussed with a representative of that Office the question of the publication of information about the weather in the official reports of the Colonies and other matters concerning the organisation of the information about the weather and climate of the Colonies.

In response to an invitation from the Admiralty the Director took part in a Conference on a proposal by the Hydrographer of the French Navy for the introduction of time-zones at sea. The change would affect, to some extent, the organisation of meteorological observations at sea, which have been a first charge upon the interest of the Office since its establishment in 1854.

Arrangements have been made for assisting the Censor in regard to the transmission of meteorological publications by post.

The Committee note with pleasure as evidence of the appreciation shown for the work under their control that Mr. R. G. K. Lempfert, Superintendent of the Forecast Division, was appointed C.B.E. in January last, and that the following members of the Meteorological Section of the Royal Engineers have been mentioned in despatches:—Major Gold, D.S.O. (twice), Captain E. M. Wedderburn, Lieutenant (now Captain) J. W. Bispham, Lieutenant (now Captain) E. H. Chapman, Lieutenant J. G. Lamb, and Corporal E. L. Clinch. Major Gold has also been selected for election as a Fellow of the Royal Society.

The Meteorological Section of the Royal Engineers has been gradually enlarged under the charge of Major Lyons, who has recently been promoted Lieut.-Colonel. A Home Unit has now been established to meet the requirements of a number of military services. It has been placed in charge of Captain C. J. P. Cave with headquarters on Salisbury Plain. The selection of men for the Section and their initial training in meteorological work is conducted at the Office.

The work of the Forecast Division has been largely re-organised and is now based on continuous attendance to meet the increased demands for information at various hours of the day and night. In order to provide the additional staff required, all the qualified persons have been transferred from the rest of the Divisions or from the Observatories. Some of the most experienced members of the technical staff have had to be relieved on account of ill-health. It is hoped that with the new organisation the strain will be less.

New forms of report have been brought into use, and much attention has been paid to the vocabulary of the reports in order to avoid any ambiguity. In this matter the Office has had the advantage of consultation with Captain H. P. Douglas, R.N., Director of the Naval Meteorological Service.

The Instruments Division has also been re-organised under the Superintendent, Mr. R. Corless, in order to meet the large increase in the demands for instruments which have risen to the value of £12,000 a year, whereas before the war the figure stood at about £3,000. A change has been made in the arrangements for the supply of instruments to the ships of H.M. Navy, which also was one of the duties of the Office as established in 1854. Hitherto they have heen bought on account of the Admiralty, according to an establishment specified by the Director of Stores or formerly by the Hydrographer. They were kept separate from the Office stock. Under the new arrangement the Office stock will be drawn upon for all purposes, and the instruments required for H.M. ships supplied on requisition and paid for as recoverable expenditure. The stocks of instruments on charge belonging to the Admiralty will be taken over by the Office.

In connection with these and other changes the arrangements for conducting the correspondence of the Office have been revised and a general registry established.

For the purpose of dealing with certain difficult questions concerning the winds in the upper air, Dr. Harold Jeffreys, Fellow of St. John's College, Cambridge, was attached to the Office staff as professional assistant to the Director.

The Committee have again to acknowledge voluntary assistance from Mr. Cecil Broadbent and Mr. Raphael Nahon and M. de Carvalho. They have also to add the name of Mr. Harold Notley, who worked in 1916 for some time at Richmond (Kew Observatory). Unable on account of ill-health to continue that work, he offered his services for any duty in the country, and by request established and still maintains a telegraphic reporting station at Hartland Quay, which has filled one of the two notable gaps in the system of telegraphic reporting stations.

Atmospheric Pollution.—The Advisory Committee appointed at the close of the year 1916-17 for the administration of a grant of £500 made by the Department of Scientific and Industrial Research for the further investigation of atmospheric pollution has been increased by the appointment of eleven members nominated by municipal authorities co-operating in the investigation by maintaining gauges and providing for the analysis of the collected products and by the addition of a representative of the Department. The Committee has held four meetings. Reports of the work accomplished in the years 1915-16 and 1916-17 have been drawn up and published in the "Lancet" newspaper in continuance of a practice already commenced. Separate copies of the reports are supplied by the "Lancet" for the use of the Advisory Committee. Besides continuing the inquiry into the amount of atmospheric pollution collected by means of the standard gauge in different localities and its variations from time to time the reports deal with the question of determining by means of filtration the amount of matter suspended in the atmosphere. Satisfactory progress has been made with that part of the inquiry. An application for a further grant of £500 has been forwarded to the Department in order that a satisfactory method of automatic recording may be developed in a practicable form for general use.

The work of the Marine Division, which deals with observations at sea, and of the Statistical Division, which deals with the compilation of data for climatological purposes from the Observatories, the Official Stations of the Office and from Voluntary Stations in the British Isles, has been maintained.

Observatories.

For the work more particularly of the Observatories at Richmond (Kew Observatory), at Eskdalemuir and at Cahirciveen (Valencia Observatory) the Committee has the advantage of the advice of the Gassiot Committee of the Royal Society appointed primarily to administer the trust fund given by the late J. Peter Gassiot for the maintenance of meteorological and physical observations at Kew Observatory or elsewhere. The Committee has held two meetings. By its advice it has been arranged that the magnetographs which were in operation for many years at Falmouth Observatory under the auspices of the Royal Cornwall Polytechnic Society, until lack of funds caused the surrender of the enterprise, should be transferred for one year's use at Eskdalemuir forming a second set of self-recording instruments at the Observatory arranged somewhat differently from the standard set in operation there. The Gassiot Committee contemplate the use of the instruments from time to time in a portable observatory which might be erected in different localities in succession and thus give very useful additional information about terrestrial magnetic forces in the United Kingdom.

Richmond (Kew Observatory).—It has been arranged that the original records obtained with the magnetographs at Falmouth shall be stored at Richmond.

Towards the close of the year, in consultation with representatives of the Institution of Mining Engineers, it has been arranged that the Office shall supply week by week a schedule of values for every two hours of the magnetic declination at Kew Observatory to be published in the principal mining journals for the information of surveyors in mines, whose work is dependent upon an accurate knowledge of the variation of the magnetic needle. The present issue is provisional both as regards the details of the information given and the particular observatory from which the information has been derived. Corresponding information is available for the Royal Observatory, Greenwich, the Observatory of the Meteorological Office at Eskdalemuir, Dumfriesshire and for the Observatory of the Society of Jesus at Stonyhurst, Lancashire. Not only are some of these nearer the mining localities but they are in a better position as regards disturbance by electric traction. It is, however, thought desirable for the trial of the regular publication to use the central Observatory.

Arrangement has been made for Dr. Chree, Superintendent of Kew Observatory, to undertake the discussion of the magnetic observations obtained by Sir Douglas Mawson's expedition to the Antarctic.

Eskdalemuir.—A good deal of difficulty has been experienced in maintaining the necessary staff and obtaining supplies at Eskdalemuir, but the difficulties have so far been surmounted by the Superintendent, Dr. C. Crichton Mitchell.

Dr. J. R. Milne, of the University of Edinburgh, acted as temporary assistant during the vacation from 8 July to 7 September.

Cahirciveen (Valencia Observatory).—The work has been extended to obtain regular daily observations of the upper air, and to examine the peculiarities of the wind-records which are due to the exposure of the anemometer which has been in operation since the establishment of the Observatory (originally on Valencia Island) in 1867.

Part of the grazing land attached to the Observatory has been brought under tillage in compliance with orders of the Irish Government.

Falmouth.—The ordinary work of the Observatory has been maintained. Mr. P. Y. Alexander has acted in an honorary capacity as meteorologist-in-charge since March, 1917.

Aberdeen.—The work has been continued by Mr. G. A. Clarke under Professor Niven's supervision. Mr. Clarke has again been very successful in producing instructive photographs of special cloud-forms and sketches of a number of noteworthy atmospheric phenomena. Arrangements have been made for reproducing a number of his photographs and sketches in various publications, including a cloud atlas which is necessary in place of the International Cloud Atlas published in Paris and illustrated by coloured prints executed in Switzerland which is no longer obtainable.

Benson.—The work on the investigation of the upper air has been carried on at Benson by Mr. W. H. Dines, F.R.S. Mr. Dines has been called upon on many occasions and by various services for information about the conditions of the upper air. He has been able to supply it in most useful form from the observations which have been obtained at Benson or previously at Pyrton Hill. His services have also been required in connection with the design of instruments.

South Farnborough.—The Branch Office, which was originally planned in 1911 for the Air Service, and was ultimately brought into operation on the premises of the Royal Aircraft Factory in 1914, has also been continued as a fully equipped observatory for the Daily Weather Service of the Office, a centre for the supply of information to various Government establishments at Farnborough and for carrying out experimental meteorological work under the Director of the Office for the Advisory Committee for Aeronautics. The experimental work of the past year has been an inquiry into the localities of thunderstorms, whch was commenced by Captain C. J. P. Cave of the Meteorological Section R.E., when, as reserve officer in England, he took over the charge of the Branch Office at South Farnborough in 1915. In June, 1917, he was transferred to the Central Office at South Kensington in order to bring the results of the inquiry then ascertained, into relation with the Daily Weather Service. The charge of the Branch Office was placed with Mr. R. A. W. Watt, the professional assistant there. Great difficulty has been found in providing the additional

assistance which is necessary to carry on the work of the Branch Office with the activity that is required for the present emergency. Mr. N. Tunstall, an assistant in Sir E. Rutherford's laboratory at Manchester, has taken up work there during his vacations but sufficient permanent assistance, which requires the special experience of a physical laboratory, has not been obtained. The inquiry has been further hampered by the illness of Captain Cave from November, 1917. On his return to duty he was placed in charge of a Unit of the Meteorological Section R.E. and is not available for the Branch Office. The inquiry has been pursued so far as to make it clear that two observatories, one in Scotland and one in Ireland, should co-operate with South Farnborough. Apparatus has been designed and made for these establishments and plans for its erection at one of them have been brought before the Committee. At the present time the difficulty of obtaining suitable assistants is insuperable.

The Branch Office has contributed useful reports on the variation of wind velocity close to the ground and on the comparison of the wind velocities obtained for various heights by different methods. It has also set up an anemometer of special construction on the "Pyestock Chimney" under Major Taylor's guidance in order to test the variation of gustiness at different times of the day.

Weather Stations have been maintained at Deerness (Orkney), Glasgow and Holyhead, Yarmouth and Scilly, an anemometer at Fleetwood; and ordinary stations for telegraphic reports at twenty other points. Information has also been obtained from the Observatory of the Mersey Docks and Harbour Board at Bidston and, as already mentioned, from a station maintained by Mr. H. Notley at Hartland Point.

The information from the Observatories and Stations has been supplemented by observations from the Home Unit of the Meteorological Section R.E. and especially by observations contributed by the stations of the Naval Meteorological Service which have formed the basis of some notable additions to the information distributed daily from the Office.

Voluntary Stations to the number of 80 have been utilised to supplement the official Observatories and Stations for the service of the Weekly Weather Report which is a specially organised contribution of the Office to the study of the climatology of the British Isles, and observations from other voluntary stations have been contributed to the Monthly Weather Report which gives a comprehensive summary of the weather of the whole country on lines similar to those generally adopted in other countries, among which the United States, India, Canada, and Australia may be mentioned because the use of similar forms makes it easy for an inquirer to inform himself rapidly of the weather conditions of any particular period over a large part of the globe.

Summer-time.—Arrangements similar to those of last year were made to provide for the maintenance of the continuity of the hours of observing at the Observatories and Stations during the

assistance which is necessary to carry on the work of the Branch Office with the activity that is required for the present emergency. Mr. N. Tunstall, an assistant in Sir E. Rutherford's laboratory at Manchester, has taken up work there during his vacations but sufficient permanent assistance, which requires the special experience of a physical laboratory, has not been obtained. The inquiry has been further hampered by the illness of Captain Cave from November, 1917. On his return to duty he was placed in charge of a Unit of the Meteorological Section R.E. and is not available for the Branch Office. The inquiry has been pursued so far as to make it clear that two observatories, one in Scotland and one in Ireland, should co-operate with South Farnborough. Apparatus has been designed and made for these establishments and plans for its erection at one of them have been brought before the Committee. At the present time the difficulty of obtaining suitable assistants is insuperable.

The Branch Office has contributed useful reports on the variation of wind velocity close to the ground and on the comparison of the wind velocities obtained for various heights by different methods. It has also set up an anemometer of special construction on the "Pyestock Chimney" under Major Taylor's guidance in order to test the variation of gustiness at different times of the day.

Weather Stations have been maintained at Deerness (Orkney), Glasgow and Holyhead, Yarmouth and Scilly, an anemometer at Fleetwood; and ordinary stations for telegraphic reports at twenty other points. Information has also been obtained from the Observatory of the Mersey Docks and Harbour Board at Bidston and, as already mentioned, from a station maintained by Mr. H. Notley at Hartland Point.

The information from the Observatories and Stations has been supplemented by observations from the Home Unit of the Meteorological Section R.E. and especially by observations contributed by the stations of the Naval Meteorological Service which have formed the basis of some notable additions to the information distributed daily from the Office.

Voluntary Stations to the number of 80 have been utilised to supplement the official Observatories and Stations for the service of the Weekly Weather Report which is a specially organised contribution of the Office to the study of the climatology of the British Isles, and observations from other voluntary stations have been contributed to the Monthly Weather Report which gives a comprehensive summary of the weather of the whole country on lines similar to those generally adopted in other countries, among which the United States, India, Canada, and Australia may be mentioned because the use of similar forms makes it easy for an inquirer to inform himself rapidly of the weather conditions of any particular period over a large part of the globe.

Summer-time.—Arrangements similar to those of last year were made to provide for the maintenance of the continuity of the hours of observing at the Observatories and Stations during the

period when all civil occupations were set one hour earlier by the change of clocks to summer-time.

Meteorological Office, Edinburgh.—The work of the Edinburgh Office on the climatological returns for Scotland has been continued, and is combined in the journal of the Scottish Meteorological Society with very valuable tables of the rainfall at a large number of stations in Scotland. The accounts for the year are included in the section on finance on p. 18. Near the close of the year the Treasurer of the Scottish Society represented that the contribution of £350 made by the Committee under the arrangement of 1912 for the maintenance of the Office in Edinburgh did not allow for any increase of the salaries of the staff, which consists of three persons, by way of war bonus as provided for employées of Government. The Committee accordingly authorised an increase of the grant by £60 a year.

Inspections.—In the course of the year upwards of 50 stations have been inspected for the Office, chiefly telegraphic stations and the stations at health resorts which send a telegraphic report each evening.

Office Staff.

A large number of changes have taken place in the Office staff, the results of which are shown in the lists of the staff on pp. 5 and 6. There have been again a number of cases in which the strain of the work has proved too much for the staff employed, but it is hoped that new arrangements will obviate that. Duty has, in some cases, been taken by officers discharged from the Army, or temporarily by those allowed to undertake light duty during convalescence. Three boys on attaining the age of enlistment have passed into the Meteorological Section, R.E.

Obituary.—The Committee regret to record the death on May 31st, 1917, of Mr. Cecil Broadbent, who, after rejection for military service had been engaged for some time as a volunteer worker at the Office; and also the death on December 1st, 1917, of Mr. W. H. Parsons, who had been for many years Office keeper, and who broke down in health in June.

They also record with regret the death of Mr. J. E. Cullum, who retired only in 1915 from the charge of the Valencia Observatory at Cahirciveen, and who had been associated with that Observatory or with Kew Observatory for more than forty years; also of Mr. J. Fisher, the station-master at St. Aubin's, Jersey, who had been in charge since 1877 of the telegraphic reporting station, which was indeed at the railway station, at St. Aubin's.

Publications.

There has been a great demand for what are technically called in the Office "occasional publications"—that is to say, the handbooks and text-books, far greater than the Office has been able to supply. The publications specially in demand are the "Barometer Manual," the "Seaman's Handbook," and the "Marine Observer's Handbook," which are wanted for the examinations of the Board of Trade; "The Weather Map" and "Glossary,"

new publications which are called for from many directions, a handbook of "The Weather of the British Coasts," which is asked for by the Admiralty, "The Observer's Handbook," various sections of "The Computer's Handbook," and the "International Cloud Atlas," which are required by observers at all new stations. Delay has taken place particularly in the supply of copies of the "Seaman's Handbook," the "Marine Observer's Handbook," "The Weather of the British Coasts," "The Weather Map" and "Glossary." It is due largely to the congestion in the arrangements for producing the lithographic illustrations at the Office Press, which is used for the lithographic work of the Daily, Weekly and Monthly Reports, and for the many different forms used for recording instruments at the Observatories and Stations. In the ordinary course of events the printing of maps and forms for the various units of the Meteorological Section, R.E., came upon it, and with the common difficulties as regards labour, when towards the end of 1917 it was found necessary to lithograph two reports daily, the work of the Press got seriously into arrear, and the publications were held up for want of the illustrations; as the same blocks were used to some extent in different works, one publication waited for the others. Special arrangements have been made; part of the additional work has been taken over by the War Office and the completion of some of the bookwork has been placed elsewhere, but even now there is some delay in bringing the lithographic work and the letterpress together. In the past the Committee had not foreseen the extent of the demand for the books, and in consequence the orders for the successive editions have not been on a sufficiently large scale. The book on "The Weather of the British Coasts" is now completely in proof, and copies ought to be ready very shortly. The stock of copies of "The International Cloud Atlas," which was obtained some years ago from Paris, is exhausted and cannot now be renewed. A set of photographs has, therefore, been selected to illustrate the international definitions, and will form the examples of a cloud-atlas which is now in the Press.

The Charts of the Southern Ocean from the Cape of Good Hope to New Zealand which are being reprinted on the requisition of the Admiralty are also in arrear. The Meteorological Charts of Baffin's Bay and Davis Strait, the preparation of which was undertaken for the Board of Trade in 1913, have been completed and are now on issue. The Monthly Marine Charts of the Atlantic Ocean, the Mediterranean, the East Indian Seas have been regularly issued but somewhat in arrear. The Daily Weather Reports have been published as usual and the different parts of the "British Meteorological and Magnetic Year Book," including the Réseau Mondial, and the Calendar have been continued also with more or less delay. The work on the Réseau Mondial was completed for 1913, and, as the data for 1914, the first year of the war, were not available, at least for the present, the year 1910 has been taken up instead, and, with the completion of that year, it is feared that the further prosecution of that enterprise must be left until after the war.

Recently, from time to time, valuable short notes have been received from the meteorologists of the Royal Engineers, which

are not only of permanent scientific value but are immediately useful to officers in similar positions. The Committee have, therefore, authorised the issue of the contributions as Professional Notes in the form of an octavo publication. The first has already been issued.

In the course of the year a number of other contributions to meteorology have been made by members of the staff. Some of them have not yet been published. The Director contributed a memorandum on Visibility in the Atmosphere for the use of the Naval Meteorological Service, and a paper on "Revolving Fluid in the Atmosphere" to the Proceedings of the Royal Society. He has since extended the consideration of the question of revolving fluid in a memoir on "The Travel of Cyclonic Depressions and Tornadoes," which is in the press as "Geophysical Memoirs, No. 12." Mr. L. F. Richardson, on leaving the Observatory at Eskdalemuir, presented an elaborate paper on "Weather Prediction by Finite Differences" which was forwarded by the Director for the consideration of the Royal Society. The Society offered a grant towards the cost of its publication, and the Cambridge University Press has undertaken the work with the title "Weather Prediction by Arithmetical Process." Dr. Chree has contributed the following papers to the Royal Society: "The Magnetic Storm of August 22nd, 1916," and "Historical Note on a Relation between the Gravitational Attraction exercised, and the Elastic Depression caused by Load on the Plane Surface of an Isotropic Elastic Solid."

Mr. E. V. Newnham has made a useful analysis of the flow of air on calm clear nights in the Upper Thames valley, which has been communicated to the Advisory Committee for Aeronautics, and has also constructed some valuable thermodynamic diagrams. Mr. E. G. Bilham has made a series of papers on the variation of water level in a well at Richmond (Kew Observatory), and Mr. Brooks has contributed a number of useful papers to the Royal Meteorological Society.

On the invitation of the Director, meetings for the discussion of meteorological papers published in colonial or foreign journals were held on alternate Mondays during the winter of 1917-18 and were well attended.

A movement has been set on foot under the auspices of the British Association for monthly meetings for the discussion of geophysical subjects including Geodesics, Seismology, Terrestrial Magnetism, Hydrography in the wider sense and the physical constitution of the atmosphere. A number of meetings were arranged under the chairmanship of the Astronomer Royal and with the hospitality of the Royal Astronomical Society. The movement is of importance to the Office as stimulating general interest in a group of scientific subjects with which the Observatories are, in some cases directly, in all cases indirectly concerned.

Finance.

A statement of the receipts and payments during the year ended 31st March, 1918, is given on page 19. The amount of

the Parliamentary Grant-in-aid for Meteorology, which was paid direct to the Committee by the Treasury, was £22,500, as in the previous year.

The sum total of the subventions from other votes and from the Royal Society as enumerated last year was £2,242 15*s.* 6*d.*, which, together with the Parliamentary grant of £22,500, provided £24,742 15*s.* 6*d.* as the revenue available for the work of the year. Repayments and other miscellaneous receipts totalled £14,215 17*s.* 2*d.*, making a grand total of £38,958 12*s.* 8*d.*

Expenditure, including the recoverable items, amounted to £42,128 3*s.* 4*d.*, so that the cash balance, which, at the commencement of the financial year was £2,047 13*s.* 5*d.*, was absorbed, and there was a net cash book deficit at the close of the year of £1,121 17*s.* 3*d.* The deficit is covered by amounts owing from Government Departments for instruments supplied on recoverable order. The total of the sums chargeable against the Office grant was within the amount provided.

The balance at the commencement of the year included the sum of £97 16*s.* mentioned in last year's report as subscriptions on account of War Loan; the amount has been discharged during the year. Sums of £96 0*s.* 8*d.* held to the credit of H.M. Stationery Office on account of forms and publications sold to the public, and £13 on account of National War Bond subscriptions deducted from salaries during March, were in hand on 31st March, 1918.

The Statement of Receipts and Expenditure of the Edinburgh Office for year ending 31st March, 1918, is as follows:—

Receipts.	£	*s.*	*d.*	Expenditure.	£	*s.*	*d.*
Balance brought forward	68	19	5	Salaries and Insurance	488	1	9
From the Meteorological Committee	350	0	0	Telephone, telegrams, postage and petty outlays	11	10	1
On account of Reports supplied to the Registrar-General for Scotland	100	0	0	Furniture and Fittings	0	5	6
				Binding...	4	2	0
				Balance carried forward	15	0	1
	£518	19	5		£518	19	5

Office Property.—The various inventories of Office property have been duly examined and appropriate insurances against loss by fire have been maintained.

Napier Shaw,
Chairman.

26th June, 1918.

Account of Receipts and Payments for the year ended 31st March, 1918.

Subject to correction upon audit by the Comptroller and Auditor-General:—

Receipts.	£ s. d.	£ s. d.	Payments.	£ s. d.	£ s. d.
Balance from year 1916–17	—	2,047 13 5	Director	—	1,000 0 0
Parliamentary vote ..	—	22,500 0 0	Office Salaries (including Insurance):		
Departmental Expenses Repaid:			Monthly	11,568 19 3	
Forecasts, &c.	1 17 6		Weekly	2,296 10 0	
Marine, Statistical, and Administrative ..	75 12 9				13,865 9 3
Instruments	451 4 8		Expenses of Office:		
		528 14 11	Rent, Heating, and Lighting	693 2 0	
Incidental Expenses Repaid:			Furniture and Equipment	44 17 9	
D.W. Report	335 15 4		Library	22 11 10	
Divisional	93 3 1		Insurances and Repairs	72 0 11	
Advertising Account ..	12 0 5		Incidental Expenses and Consumable Stores	205 5 3	
		440 18 10	Advertising Account ..	7 10 0	
Stationery Office ..	—	96 0 8			1,045 7 9
Telegraph Charges Repaid	—	2,010 4 4	Post Office:		
			Postage	927 15 1	
Telephone Charges Repaid	—	1 14 11	Telephones	165 5 8	
			Telegrams	3,839 5 2	
Inspections .. .	—	114 9 6			4,932 5 11
Instruments:			Stationery Office	—	64 1 4
Royal Navy	2,958 0 3		Travelling Expenses	—	141 1 8
Other Services	7,130 10 2		Superannuation:		
		10,088 10 5	Pensions not chargeable on Fund	25 0 0	
Superannuation Account:			Pensions chargeable on Fund	243 19 4	
Annuities	562 10 0		Annuities	562 10 0	
Interest on Investments	46 5 9		Contribution to fund ..	—	
		608 15 9			831 9 4
Observatories, Branches, and Stations:			Cost of Instruments:		
Richmond (K.O.) ..	638 19 2		Royal Navy	2,959 17 11	
Eskdale	1,017 13 9		For Stock	9,211 3 0	
Valencia	30 3 2				12,171 0 11
Farnborough	326 4 0		Observatories, Branches, and Stations:		
Falmouth	15 12 7		Richmond (K.O.) ..	2,208 16 1	
Benson	0 6 6		Eskdale	1,631 3 6	
Edinburgh	—		Valencia	747 7 7	
Committee for Atmospheric Pollution ..	500 0 0		Farnborough	618 15 1	
Miscellaneous	118 7 8		Falmouth	327 9 5	
		2,647 6 10	Benson	551 18 8	
National War Bonds ..	—	13 0 0	Edinburgh	364 12 3	
Fire Insurance Claim	—	2 12 6	Investigation of Atmospheric Pollution ..	291 4 9	
King George's Fund ..	—	4 0 0	Miscellaneous	1,331 19 10	
		41,104 2 1			8,073 7 2
Less War Loan subscription ..	—	97 16 0	King George's Fund ..	—	4 0 0
		41,006 6 1			42,128 3 4
Balance due to Bank	—	1,221 12 1	Balance:		
			Cash at Bank	—	
			„ at Office .. .	99 14 10	
					99 14 10
		£42,227 18 2			£42,227 18 2

Note.—On 31st March the amount of Government securities held for the provision of Superannuation Annuities was £26 14s. 2*d.* 2½ per cent. Consols, and £989 9s. 6*d.* 5 per cent. War Loan.

The following abstract shows approximately the net payments for this and the preceding years, together with the increase or decrease in 1917-18 as compared with 1916-17:—

Net Charges.	1916–17.	1917–18.	Increase.	Decrease.
Salaries:	£	£	£	£
Director	1,000	1,000	—	—
Office and Observatories ...	14,467	18,089	3,622	—
General Administration of Central Office:				
Rent, Heating, and Lighting	688	693	5	—
Furniture and Equipment	123	45	—	78
Library	25	23	—	2
Insurances, Repairs, Incidental Expenses, Consumable Stores, and Advertising Account.	148	65	—	83
Stationery Office ...	6	—	—	6
Postage	564	704	140	—
Telegrams	2,521	1,829	—	692
Telephones	91	163	72	—
Travelling Expenses ...	55	27	—	28
Instruments	889	2,082	1,193	—
Superannuation	581	223	—	358
Observatories, &c. (exclusive of Salaries):—				
Richmond	334	226	—	108
Eskdalemuir	689	436	—	253
Cahirciveen	152	135	—	17
Farnborough	471	195	—	276
Falmouth	122	107	—	15
Benson	111	99	—	12
Edinburgh	374	365	—	9
Committee for Atmospheric Pollution.	—	140	140	—
Miscellaneous	1,269	1,214	—	55
Lectures and Experiments.	*	*	—	—
Total expenditure ...	24,680	27,860	3,180	—
Net Credits.				
Stationery Office	—	32	32	—
Total Net Expenditure £	24,680	27,828	3,148	—
Net Income.				
Parliamentary Grants:				
M.O. Vote	22,500	22,500	—	—
Royal Society Vote ...	1,000	1,000	—	—
" " *Advisory Committee.*	250	250	—	—
Advisory Committee Atmospheric Pollution.	—	500	500	—
Royal Society:				
Gassiot Trust	497	405	—	92
Rosse Trust	10	6	—	4
Scott Antarctic Fund ...	164	82	—	82
	24,421	24,743	322	—

* £43 15*s*. held to the credit of the Schuster Readership.

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