

FOURTEENTH ANNUAL REPORT

OF THE

METEOROLOGICAL COMMITTEE

TO THE

LORDS COMMISSIONERS OF HIS MAJESTY'S
TREASURY.

For the Year ended 31st March, 1919

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

Presented to Parliament by Command of His Majesty.



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ANNUAL REPORT.

THE METEOROLOGICAL COMMITTEE, 1918-19.

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

Appointed till.

March 31st, 1920 ... Sir NAPIER SHAW, Sc.D., F.R.S. Director,
Chairman.

Sept. 1st, 1919 ... Rear-Admiral J. F. PARRY, R.N., C.B.,
Hydrographer to the Navy.

March 31st, 1920 ... Captain J. M. HARVEY, Principal
Examiner of Masters and Mates, Board
of Trade. Nominated by the Board of
Trade.

Dec. 2nd, 1921 ... Sir THOMAS MIDDLETON, K.B.E., C.B.,
Assistant Secretary of the Board of
Agriculture and Fisheries. Nominated
by the Board of Agriculture and
Fisheries.

March 31st, 1920 ... Professor ARTHUR SCHUSTER, F.R.S.
Nominated by the Royal Society.

Feb. 26th, 1923 ... Colonel H. G. LYONS, Sc.D., F.R.S.
Nominated by the Royal Society.

March 31st, 1920 ... Mr. G. L. BARSTOW, C.B. Nominated by
the Treasury.

Resigned. 1919 ... Colonel R. W. GLENNIE. Nominated by
the Air Ministry.

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, 1919.

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*).

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

The Astronomer Royal.

Dr. C. Chree.

Mr. W. H. Dines.

Sir Archibald Geikie, K.C.B.

Sir Richard Glazebrook, C.B.

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 (*deceased. March, 1919*).

Mr. C. T. R. Wilson.

ADVISORY COMMITTEE ON ATMOSPHERIC POLLUTION, 1919.

Appointed by the Meteorological Committee, 12th March 1919, 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*, (*Chairman*).

Professor H. B. Baker, C.B.E., F.R.S.

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

Mr. J. G. Clark, F.I.C.

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*).

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

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

Bailie W. Smith (*Member of Departmental Committee on Smoke Abatement*).

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
Meteorological
Committee.

Dr. John Robertson, nominated by the Corporation of Birmingham.

Dr. W. Hanna, nominated by the Corporation of Liverpool.

Dr. W. J. Howarth, nominated by the Corporation of the City of London.

Mr. Henry Mills, J.P., nominated by the London County Council.

Mr. W. Osborn Thorp, nominated by the Corporation of Malvern.

Professor W. Haldane Gee, nominated by the Corporation of Manchester.

Mr. C. T. Stableforth, J.P., nominated by the Corporation of Newcastle-on-Tyne.

Dr. J. B. Wilkinson, nominated by the Corporation of Oldham.

Dr. J. R. Ashworth, nominated by the Corporation of Rochdale.

Dr. Cates, nominated by the Corporation of St. Helens.

Mr. John Fyfe, nominated by the Corporation of Stirling.

Appointed by the
Municipal
Authorities con-
tributing Obser-
vations.

Mr. W. S. Curphey (*Chief Alkali Inspector of the Local Government Board*).

Appointed by the
Advisory Council
for Scientific and
Industrial
Research.

THE STAFF OF THE METEOROLOGICAL OFFICE AND OF THE OBSERVATORIES OF THE METEOROLOGICAL COMMITTEE, MARCH, 1919

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.

Acting-Director (May 23, 1918, to April 28, 1919), Colonel H. G. Lyons, R.E., D.Sc., F.R.S.

METEOROLOGICAL OFFICE.

Secretarial Staff.

<i>Chief Clerk</i> ...	...	T. D. Bell. <i>Acting Cashier</i> :— J. A. Curtis.
<i>Professional Assistants</i> ...	...	H. Jeffreys, D.Sc.; Misses E. F. Walker, E. E. Austin.
<i>Clerical Assistants</i> ...	...	E. J. Hood; Misses R. E. Smith, D. G. Chambers, M. Coleman, H. G. Chivers, I. Cook, H. W. Newsholme, E. Cottrill, A. J. Clapham; Mrs. E. Stocks; [E. L. Ardley]; [E. L. Clinch].
<i>Probationers and Boy and Girl Clerks.</i>		Misses E. G. Picknett, E. R. Andrews, V. Potts, W. G. Palmer; [C. S. Herbert].
<i>Office Keepers</i> ...	...	C. E. Goad; W. R. Chillman; J. L. Evans.
<i>Store Keeper</i> ...	...	[A. G. Goad].

Marine Division.

<i>Superintendent</i> ...	...	(Office vacant since the death of Captain M. W. Campbell Hepworth, C.B., R.D., R.N.R., on 25th February, 1919).
<i>Acting Superintendent</i> ...	...	H. Harries
<i>Clerical and Technical Assistants</i>		C. Harding; W. G. James; J. T. Williams; A. G. W. Howard; J. E. Belasco; H. T. Smith; A. J. Tabor; [A. A. Lovie].
<i>Boy Assistant</i> ...	...	A. H. French.

Forecast Division.

<i>Superintendent</i> ...	...	R. G. K. Lempfert, C.B.E., M.A.
<i>Professional Assistants</i> ...	...	J. S. Dines; E. G. Bilham; C. E. P. Brooks; M. A. Giblett; W. C. Kaye; E. V. Newnham; Miss L. F. Lewis; Mrs. Newnham; Miss L. D. Sawyer; Miss G. L. Thorman; [F. Entwistle]; [M. T. Spence].
<i>Clerical and Technical Assistants.</i>		F. J. Brodie; R. Sargeant; H. L. B. Tarrant; A. T. Bench; W. Hayes; H. Keeton; Miss N. L. Despicht; F. C. Warmington; Misses R. M. Chambers, D. G. Lee; [R. Pyser]; [C. F. J. Jestico]; [C. C. Newman]; [R. M. Poulter].
<i>Probationers and Boy and Girl Clerks.</i>		Miss E. V. Freeman; W. R. Penfold; Miss M. L. Taylor; W. A. Kimber; P. Powell; S. R. Rozier.

Statistical Division.

<i>Superintendent</i> ...	F. J. W. Whipple, M.A.
<i>Professional Assistants</i> ...	S. N. Sen; C. W. Lamb; H. W. Braby.
<i>Clerical and Technical Assistants.</i>	J. Sheerman; A. H. Bell; C. A. Bracey; L. H. Powers; A. R. Simpkins; A. E. Pycock; H. Fahmy; W. J. Tomkins; Misses M. Bigelstone, R. M. Figgins, W. A. Quennell, F. A. Shields.
<i>Probationers and Girl Clerks.</i>	Misses E. G. Johnson, M. Enderby, A. W. C. Fitch, T. M. Hunt.

Instruments Division.

<i>Superintendent</i> ...	R. Corless, O.B.E., M.A.
<i>Professional Assistant</i> ...	Miss E. H. Geake.
<i>Clerical and Technical Assistants.</i>	R. F. Wallace; J. H. James; E. P. Pearce; F. W. Snell; C. W. Heinemann; Misses D. Taylor, W. Bulgin, G. K. Herbert, A. Sanford; [A. E. Gendle]; [C. V. Ockenden].
<i>Probationer</i> ...	H. J. Bigelstone.
<i>Boy Assistant</i> ...	J. C. Woods.

MEMBERS OF THE OFFICE STAFF EMPLOYED IN METEOROLOGICAL SECTION, R.E.

<i>Lieut-Colonel</i> ...	Lieutenant-Colonel E. Gold, D.S.O., R.E., F.R.S.
<i>Major</i> ...	A. H. R. Goldie.
<i>Captains</i> ...	H. W. Absalom; D. Brunt; J. Durward; F. Entwistle; E. Kidson.
<i>Lieutenants</i> ...	R. P. Batty; G. R. Hay; W. H. Pick; R. S. Read.
<i>N.C.Os.</i> ...	E. L. Clinch; W. J. Fowler; A. G. Goad; A. H. Lupton; C. V. Ockenden; R. M. Poulter; R. Pyser; C. F. J. Jestico.

METEOROLOGICAL OFFICE, EDINBURGH.

<i>Superintendent</i> ...	Andrew Watt, M.A.
<i>Assistants</i> ...	Misses M. Crawford; W. Hume.

METEOROLOGICAL OFFICE, SOUTH FARNBOROUGH.

<i>Meteorologist-in-Charge</i> ...	R. A. Watson Watt, B.Sc.
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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; N. H. Smith.
<i>Clerical and Technical Assistants.</i>			E. Boxall; B. Francis; L. G. Hemens; [A. H. Lupton]; [F. Levin].
<i>Boy Clerks</i>	...	...	L. E. Fletcher; A. C. Lloyd.
<i>Observer and Caretaker</i>	...		W. R. Corrin.
<i>Mechanical Assistant</i>	...		T. J. Kinton.

MAGNETIC OBSERVATORY.

Eskdalemuir, Langholm, Dumfries-shire.

<i>Superintendent</i>	...	...	A. Crichton Mitchell, D.Sc., F.R.S.E.
<i>Clerical and Technical Assistants.</i>			P. N. Skelton; B. G. Brame; [H. G. Harris]; Misses E. M. Anderson, M. Ure.
<i>Boy Clerks</i>	...	...	J. B. Beck; [J. Graham].

WESTERN OBSERVATORY.

Valencia Observatory, Cahirciveen, co. Kerry.

<i>Superintendent</i>	...	...	L. H. G. Dines, M.A., A.M.I.C.E.
<i>Professional Assistant</i>	...		P. I. Mulholland.
<i>Clerical Assistant</i>	...		M. Sugrue.
<i>Boy Clerks</i>	...	...	M. J. Morley; J. B. Morley.

AEROLOGICAL OBSERVATORY.

Benson, near Wallingford.

<i>Director of Aerological Investigations.</i>			W. H. Dines, F.R.S.
<i>In charge of experiments in computation of sequence of weather by numerical process.</i>			L. F. Richardson.
<i>Clerical Assistant</i>	...	...	H. W. Baker.

WEATHER STATION, FALMOUTH OBSERVATORY.

<i>Assistant-in-Charge</i>	...		J. B. Phillips.
<i>Boy Clerks</i>	...	...	W. A. Toms; [W. J. Fowler].

NORTHERN OBSERVATORY

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

<i>Assistant</i>	...	...	G. A. Clarke.
<i>Boy Assistant</i>	...	...	C. McRae.

FOURTEENTH ANNUAL REPORT
OF THE
METEOROLOGICAL COMMITTEE

TO
THE LORDS COMMISSIONERS OF HIS
MAJESTY'S TREASURY.

For the Year ended 31st March, 1919 (the Sixty-fourth
Year of the Meteorological Office).

MAY IT PLEASE YOUR LORDSHIPS,

The financial year which closed with 31st March, 1919, witnessed the signing of the Armistice, on November 11, 1918, which brought to a conclusion the War which was declared on August 4, 1914; it is the first duty of the Committee to place on record their recognition of the devoted work of the staff, which has enabled them to carry on efficiently the work of the Office during that momentous time.

The changes which have taken place during that period may be briefly indicated by the fact that whereas the total of the sums brought to account in the year 1913-14 was £29,380, of which £3,396 represented the cost of instruments obtained for the Navy, the Air Services, the Office establishments, establishments of the Crown Colonies, private observers, &c., the corresponding total in 1918-19 was £66,371, of which £28,199 was spent on instruments. The grant-in-aid for 1914-15 was £20,000, and that provided for 1919-20 is £47,500. The number of names on the pay list in March, 1914, was 180, of which 90 were included in the list of the regular staff on full time at the Office and observatories, whereas the corresponding number of names on the pay list in March, 1919, was 204, of which 102 represented the regular staff.

The principal changes of practice were in the Forecast Division, where continuous service was ultimately established to meet the vastly increased demands for weather reports, requiring a staff of 27 persons, as compared with 11 in 1914; and in the Instruments Division, where a staff of 13 is employed, in place of 6 in 1914. In the Marine Division, on the other hand, there was a great falling off in the number of documents received from observers at sea, from 1,905 in 1913 to 39 in 1918.

In the Statistical Division there was no material change, except that the demand for statistical information in various

parts of the world was largely increased: the voluntary stations were maintained with little loss. And at the observatories the principal change was the general demand for reports at 1 a.m., and for observations with pilot-balloons.

The large increase in work of the Forecast Division and the Instruments Division entailed an expansion of the accommodation. For the Forecast Division and general administration, six rooms on the top floor of the building were borrowed from the Board of Education, through the good offices of Major F. G. Ogilvie, C.B., Director of the Science Museum; and in September, 1918, accommodation for the Instruments Division was provided by H.M. Office of Works in No. 15, Cromwell Road.

Thirty members of the Office staff of 1914 joined the forces. The names of four of them are on the Roll of Honour as having lost their lives on service—**H. BILLET**, B.Sc., of the establishment at South Farnborough, **N. C. BRADNOCK** of the Forecast Division, **G. J. BARKER** of the Statistical Division, and **W. B. GREENING** of the Marine Division.

A number of men with qualifications in science joined the staff for voluntary duty in connexion with the Office or with the Meteorological Section of the Royal Engineers.

A. H. R. Goldie, Senior Professional Assistant at Eskdalemuir Observatory, became Major in the Meteorological Section; and the following became Captains:—

C. J. P. Cave, M.A., J.P., of Ditcham Park, past President of the Royal Meteorological Society; A. E. M. Geddes, M.A., of the University of Aberdeen; E. Kidson, M.A., New Zealand, of the Magnetic Department of the Carnegie Institution of Washington; D. Brunt, M.A., Isaac Newton Student of the University of Cambridge; J. W. Bispham, M.A., of the Education Department of the London County Council; also H. W. L. Absalom, B.Sc.; E. H. Chapman, M.A., B.Sc.; J. Durward; F. Entwistle, B.Sc.; J. G. Lamb; W. H. Pick, B.Sc.; E. M. Wedderburn, D.Sc., of the Scottish Meteorological Society. T. Harris, M.A., B.Sc., of the East London College, became lieutenant, as did also J. Duffin, M.A., who joined the Office staff after being discharged from the Army invalided, R. P. Batty and G. R. Hay.

Three of the members of the Office staff, Messrs. A. E. Gendle, H. G. Harris, and M. T. Spence, received commissions in the Naval Air Service; and of these Messrs. Gendle and Harris now occupy important positions as Major and Captain in the Meteorological Service of the Air Ministry.

Many of the gentlemen selected for the Naval Air Service attended at the Office for a brief period of training, and in May, 1918, arrangements were made with Professor McAdie, of Blue Hill Observatory, Harvard University, Lieutenant-Commander in the United States Navy, for a course of instruction of the meteorological officers who were to take charge of the meteorological service organised for the Navy of the United States in this country.

As evidence of the immense development of the study of the upper air, it may be mentioned that, whereas in 1914 observations with pilot balloons were confined to South Farnborough, Upavon, Aberdeen, and a few other stations which required an insignificant number of balloons, the issue of balloons for this purpose

in 1918 reached the enormous number of 13,176 per month. For use with these balloons, with the assistance of the Northampton Institute, two new models of theodolite have been designed, and large numbers have been constructed and issued after testing in the Office, besides slide rules, balance-fillers, books of instructions and other accessories.

The efficiency of the work of the Office staff during the war has been recognised in various ways. Mr. Gold, Superintendent of the Statistical Division, who as captain was placed in charge of the meteorological work in France, obtained the D.S.O., and was promoted major in 1915. He was promoted lieutenant-colonel in 1918. Mr. R. G. K. Lempfert, who has been in charge of the work of the Forecast Division at home, received the C.B.E. in 1917, and Mr. Corless, who has been in charge of the Instruments Division, obtained the O.B.E. in 1919. The same order was also conferred upon Capt. A. E. M. Geddes, Capt. E. M. Wedderburn, Capt. E. Kidson and Capt. Bispham.

The following were mentioned in despatches: Lieut.-Col. E. Gold, Capt. J. W. Bispham, Capt. D. Brunt, Capt. E. H. Chapman, Capt. F. Entwistle, Capt. A. E. M. Geddes, Capt. A. H. R. Goldie, Capt. E. M. Wedderburn, Lieut. J. G. Lamb, Sergt.-Maj. R. Pyser, Sergt. E. L. Clinch, Sergt. L. G. H. Lee (Observer at Raunds), Sergt. F. J. Parsons (Observer at Ross-on-Wye), Corp. J. Chaytow, Corp. C. V. Ockenden, Corp. R. M. Poulter.

RECOGNITION OF ASSISTANCE.

During the war the Office received much valuable assistance in its work from many sides. Mention has already been made of the devotion of the members of the staff of the Office and its Observatories who were called upon to undertake exceptional duties, sometimes in very arduous conditions, in London or elsewhere, and who met the demands made upon them without demur, until, in not a few cases, they were obliged under direction of medical authority to desist. The Committee desires here to make acknowledgement of assistance from others.

In the first place, they wish to record their obligation to the Army Council for lending the services of Colonel Lyons, one of the representatives of the Royal Society on the Committee. Colonel Lyons was at first responsible for the meteorological work of the Mediterranean, subsequently for the command of the Meteorological Section of the Royal Engineers, for the origin and success of which, as well as for the supply of instruments and the training of personnel, the Office was responsible; and, finally, for the administration of the Office. Without the assistance thus rendered, particularly in the direction of selecting the large numbers of persons qualified to replace the absent members of the staff and to take their share in the extension of the activity of the Office, it might have been impossible to accomplish the work.

The Committee desire also to express their thanks to Capt. C. J. P. Cave, who in 1915 undertook the duty of Special Inspector of the establishment at South Farnborough, and subsequently took charge of that establishment; to Prof. W. Peddie

Report of the Meteorological Committee.

of Dundee, who took charge of the Observatory at Eskdalemuir during the absence of the Superintendent, and to Mr. R. Nahon, who for nearly two years assisted voluntarily in the work of the Statistical Division, and especially in compiling the data used in the publication of "The Weather of the British Coasts"; and they wish also to make acknowledgement to the Royal Meteorological Society for their assistance in lending various books and periodicals from the Society's library.

Climatological Stations.—To the observers who, with very few exceptions, managed to carry on the work of the climatological stations, though under great difficulties, a special note of thanks is due, and particularly to Mrs. Edith Purchas of Ross-on-Wye, who carried on the work of that station while the observer, Sergt. Parsons, was with the Colours and other available help was withdrawn, and to Mr. G. Lee of Raunds, who acted as deputy for his son, who joined the Meteorological Section, R.E.

Telegraphic Reporting Stations.—Many notable contributions were made by the observers at the telegraphic reporting stations. At many of them the addition of daily observations at 1h. was accepted as a voluntary extension of duty, until the unexpected prolongation of the strain made special provision necessary.

Special mention should be made of the following:—

Hartland Quay.—Mr. Harold Notley, for his services as a volunteer. For some time he was engaged on special cloud work at Kew Observatory. This work had to be relinquished for reasons of health, but in the summer of 1917 Mr. Notley was able to undertake to supply observations from a telegraphic reporting station at Hartland Quay, and his work was carried on until after the signing of the Armistice.

Deerness.—Mr. Magnus Spence supplied telegraphic observations at 7h., 13h. and 18h. These were in addition to the regular observations of the climatological station and the care of the sun recorder and anemometer, for which Mr. Spence has been responsible for twenty-nine years. The attendance upon the instruments so many times in the day, in all weathers, at a point which is selected as being one of the most exposed of the British coasts, deserves the warmest acknowledgement. After the death of his wife at the close of the war, Mr. Spence retired from his post as schoolmaster at Deerness, and in consequence gave up the duty of observing. The long series of excellent observations associated with his name is a notable item in the great collection which the Office possesses.

Stornoway.—In connection with the 1 a.m. service regular observations have been supplied by Messrs. Grant and Miller. For a long time this additional work was undertaken as voluntary war-work.

Oban.—Mr. J. Culbert, Sanitary Inspector, has supplied regular telegraphic reports at 7h., 13h. and 18h. These observations were asked for by the Office as a precaution in the event of interruption of telegraphic communication with the Hebrides, and were made in peculiarly difficult circumstances.

Valencia Wireless Station.—Observations at 1h. daily and 13h. on Sundays in addition, have been supplied by the officers in charge.

Holyhead.—The 1 a.m. service has been carried out almost single-handed by Mr. Davies. For a long time the additional work was accepted as a voluntary contribution to national requirements. Special reports at other than the regular hours have also been sent by Mr. Davies to units of the Royal Air Force.

Clacton-on-Sea.—Mr. A. Shadick has supplied observations regularly at 7h., 13h. and 18h.

Farøe.—Upon the discontinuance of the international weather reports from Iceland and Farøe, Mr. A. Coates, His Majesty's representative at Thorshavn, took special observations and reported to the Office daily at 7h. and 13h.

Iceland.—Upon the discontinuance of the international reports arrangements were made through the Foreign Office for Mr. Cable, the British representative at Reykjavik, to obtain copies of the observations made at the official stations in Iceland and to cable the information once a day.

Supply of Instruments.—With regard to the supply of instruments, special assistance has been received from the Northampton Institute in the design of theodolites for observing pilot balloons; from the City and Guilds Engineering College in respect of Lightning Recorders; from the Royal Aircraft Establishment in respect of baro-thermographs; and from the Science Museum at South Kensington in respect of the supply of thermometer screens and the repairs of instruments. The Science Museum also rendered valuable service by making good the deficiencies of the Office in respect of photographic reproductions of diagrams.

The Committee desire also to acknowledge the special efforts made by many firms of instrument makers in the supply of the large number of instruments which were required for the Office. The names are given in the following list:—

Francis Barker & Son, Ltd.—Fineman nephoscopes.

Bassett & Findley.—Screens.

British Oxygen Co., Ltd.—Hydrogen.

S. & A. Calderara.—Barometers and thermometers.

Cary Porter, Ltd.—Theodolites.

Chance Bros. & Co., Ltd.—Sunshine spheres.

H. Chappell & Co.—Miscellaneous tools and materials.

Cowey Engineering Co., Ltd.—Cup anemometers.

T. Dowler & Co., Ltd.—Balloons.

Henry Harvey & Co.—Paper lanterns.

J. J. Hicks.—Miscellaneous instruments.

Adam Hilger, Ltd.—Lenses and prisms.

George Kent, Ltd.—Fan anemometers.

Kodak, Ltd.—Photographic paper.

C. Macintosh & Co., Ltd.—Balloons.

Negretti & Zambra.—Miscellaneous instruments.

Pastorelli & Rapkin, Ltd.—Aneroids and barographs.

A. W. Piggott & Co., Ltd. (formerly A. W. Gamage, Ltd.)—

Balloon-balances, fillers and lanterns.

Price's Patent Candle Co., Ltd.—Candles

Raphael's, Ltd.—Goggles for cloud observing.

Reichenberg & Co.—Stop watches.

W. Rollason & Co.—Rain-gauges.

Rubber Novelties Co., Ltd.—Balloons.

Short & Mason, Ltd.—Aneroids, barographs and thermographs.

T. Wheeler.—Aneroids.

Wilson Warden & Co.—Aneroids, barographs and hygrometers.

F. & J. Wright.—Packing cases.

One of the most noteworthy features of the work of the Office during the war has been the issue of information about the average pressure, temperature and density at different levels in the upper air, prepared by Mr. W. H. Dines, F.R.S., from the observations which he himself obtained at Pyrton Hill or, subsequently, at Benson Observatory, and from the comparison of the observations with those of similar character in various parts of the world. The information was originally asked for by those who were interested in the working of engines at different levels, but it was found also to be indispensable for questions of ballistics and for many purposes of aviation.

Much of the information is collected in a memoir by Mr. Dines on "*The Characteristics of the Free Atmosphere*," which is now passing through the press. It includes tables of coefficients of correlation between the variations of pressure and temperature in the atmosphere, from which it appears that between the levels of two kilometres and nine kilometres the coefficient of correlation exceeds .75, and for some levels reaches .9. When it is understood that these relations refer to observations taken at random and grouped only according to season, and that all incidental errors of observation would operate to depress the coefficient, the immediate conclusion from the result is that in the levels of the atmosphere referred to, changes of pressure are proportional to changes of temperature in the direct sense. This is a generalisation of the highest importance in meteorology, perhaps the most important that has been reached since the enunciation of the relation of wind to the distribution of barometric pressure propounded by Buys Ballot.

Within the financial year 1918-19 nine meetings of the Committee have been held on 22nd May, 29th May, 26th June, 21st August, 23rd October, 4th December, 1918, 29th January, 12th March and 26th March, 1919, respectively.

Colonel R. W. Glennie, Director of the Meteorological Service of the Air Ministry was appointed an additional member of the Committee in August, 1918, to represent the Air Ministry. He withdrew from the Committee on resigning his appointment at the Air Ministry. No further nomination has yet been made. In other respects the membership of the Committee has remained unchanged.

Obituary.—The Committee have to record with regret the death, after a long illness, on February 25th, 1919, of Captain Melville Willis Campbell Hepworth, C.B., R.D., R.N.R., one of the Younger Brethren of Trinity House and a member of the Challenger Society. He had been Superintendent of the Marine Division since 1899. He had devoted himself with unflinching ardour to the development of the Office work for the use of seamen. It was upon his initiative that the preparation and issue of Monthly Meteorological Charts of the North Atlantic and Mediterranean and subsequently of the East Indian Seas were undertaken. At the time of his death the Office was engaged upon corresponding charts for the South Atlantic Ocean. He was assiduous in promoting the development of meteorological work at sea in every way, by the arrangements for wireless reports, by the issue of improved books of instructions, and the preparation of the charts above mentioned, and by his personal influence with seamen. He was largely instrumental in bringing the careful study of ice, both in the Northern and Southern seas, within the range of the activity of the marine meteorologist. The Seaman's Handbook of Meteorology, of which he prepared three editions, has found general acceptance. He was also interested, in co-operation with the oceanographers of various corporations and societies in compiling information about the salinity of various parts of the sea, and he brought the collected information together on the backs of the monthly charts, which he made a sort of magazine of meteorology and oceanography.

The Committee are of opinion that the association of the physical side of oceanography with the meteorology of the sea which Captain Hepworth fostered should be continued and recognised as an established part of the marine work of the Office.

A few weeks before the death of Captain Hepworth the Office suffered the loss of the principal assistant in the Marine Division through the sudden death on his way to the Office of William Allingham, who had been a sailor before he joined the Office staff in 1875. He was a facile writer on nautical matters and well known as an author, as editor of Lecky's "*Wrinkles*" and as a contributor to various nautical periodicals. By the almost simultaneous removal of these two members of the staff the Office has lost temporarily its direct nautical connection.

Organisation of the Office and Staff.—The proposals referred to on page 10 of the report of last year whereby provision was to be made for the compilation of a comprehensive Manual of Meteorology for the use of the professional staffs of the Meteorological Services were carried into effect when Your Lordships, by letter of 22nd May 1918, approved an arrangement whereby the Director was relieved of administrative duties and was appointed Scientific Adviser in Meteorology to the Government for the period of the war, retaining the duties of Chairman of the Committee, and Colonel Lyons was appointed Acting-Director for the same period. An arrangement was made with the Cambridge University Press for assistance in the preparation of the work, and for its publication. In view of immediate requirements regarding the study of the winds in the upper air it was decided

to proceed at once with the last of the four parts into which the book is to be divided, and to issue it at once with the title of "*The Relation of the Wind to the Distribution of Atmospheric Pressure.*". Proofs were issued to the officers of various establishments interested in the work as the sheets came through the press, but the final manuscript was not in the printers' hands until December, 1918. A number of advance copies of Part IV for confidential issue were received in January, 1919. When these copies were exhausted it was decided to have the part published without waiting for the preliminary parts. For these a considerable number of diagrams have been prepared.

In the meantime the administrative work of the Office had increased very largely, particularly in regard to maintaining sufficient staff at the Office and Observatories to carry on the greatly increased work, while it was necessary to provide trained staff for the development of the Meteorological Section of the Royal Engineers and to set free any one whom it was thought might possibly be spared for work elsewhere. To secure these objects the work of various sections of the Office, the Forecast Division, the Statistical Division and the Instruments Division was reorganised, and a considerable number of women with the necessary qualifications of degrees in Mathematics and Physical Science were appointed professional assistants.

One of the principal results of these changes has been the re-modelling of the Daily Weather Report after consultation with the representatives of the Meteorological Section, R.E., the Meteorological Services of the Air Ministry and Admiralty and the French Meteorological Services in Paris and London.

The Daily Weather Report, as prepared for issue in the coming year, consists of ten lithographed pages and is divided into three sections. First, the British Section, which includes observations of various meteorological elements at a number of stations four times a day, viz., 1h., 7h., 13h., 18h. G.M.T., with a map and forecasts. To this the Office stations and those of the Air Service contribute. The second section is one devoted to observations of wind velocity and temperature in the upper air, to which the Air Service is the largest contributor. The third is the International Section, which gives maps of Western Europe and the Eastern Atlantic for 7h. and 18h. G.M.T., with inset maps of the British Isles and France for 1h. and 13h. G.M.T.

In all sections, in accordance with the principle adopted for the Daily Reports since 1867, the actual data are given as well as the maps unless the full data are themselves included in the maps.

The number of appointments on the staff has been exceptionally large in consequence of the additional responsibilities in connection with the supply of information to the services.

A visitation of the Office by a Military-Service-Committee, consisting of Lord Charnwood and Mr. H. Evans Austin, representing the Ministry of National Service, was held on 1st August, 1918.

Co-operation with the Advisory Committee for Aeronautics.—During the year two special committees formed by the Advisory Committee for Aeronautics, which was originally

appointed as an independent committee by the Prime Minister and is now attached to the Air Ministry, have been in operation. One of these committees has reference to the Electrification of Balloons and seeks the protection of aircraft from lightning, and the other is on Meteorology in general as applied in aeronautics. Of these Committees the Adviser has been Chairman, and the Office has been the place of meeting, not only on account of its general convenience but also on account of the facilities for reference. The discussion of the various points raised has been found of considerable interest from the meteorological point of view.

British Rainfall Organization.—Since 1915 negotiations have been in progress for the incorporation of the British Rainfall Organization with the Office. The work of that organization was begun in 1860 by the late Mr. G. J. Symons, F.R.S., and developed by him with remarkable success until his death in 1900. It was then taken over by Dr. H. R. Mill, and further developed, until it now represents the combined efforts of some 5,000 observers of rainfall in all parts of the British Isles, supervised and arranged with marked success for scientific and economic purposes. Its collection of statistics, represented partly by the annual volume of "*British Rainfall*," and much more effectively by its collection of original records and monthly summaries, is unrivalled in any country, and is the essential body of material of reference for all questions of water supply in this country, which is unique in being able to depend upon private enterprise for the satisfaction of so fundamental a necessity.

The occasion of the present negotiations is Dr. Mill's desire to make adequate provision for the continuance of the work upon his retirement from the Directorship of the Organization, which is, unfortunately, brought about by the impairment of his eyesight.

The Committee have made careful inquiry as to the terms upon which the Organization should be taken over. They have presented to Your Lordships a proposal, and trust that the Government may see their way to approving it.

RECONSTRUCTION.

In reply to a request from the Ministry of Reconstruction a memorandum on the organisation of the Meteorological Services was presented on November 20, 1918, to the Ministry. It embodied, amongst other things, a representation in favour of the establishment of centres for the collection and distribution of meteorological information in Scotland, Ireland and elsewhere, which had previously been the subject of communication to Your Lordships. Memoranda setting out the necessary arrangements of a similar character for the supply of information to airmen had also been contributed to Lord Northcliffe's Committee on Commercial Aviation.

Proposed transfer of the Office to the Air Ministry.—In the early part of 1918 a proposal was put forward on the part of the

newly-formed Air Ministry that the Office should be transferred to that Ministry on account of the importance of meteorology to aviation and the reciprocal importance of aviation to meteorology. At the request of Your Lordships' representative the Director prepared a memorandum setting out the alternative of proceeding on the same lines as heretofore and adding the interests of Aviation to those of the Navy, the Mercantile Marine, Agriculture and other aspects of general economics of the Empire for which the Office is intended to provide. It was pointed out that by regarding the Meteorological Office as a scientific enterprise drawing its information from wherever it was obtainable, from land, or sea, or air, of our own or other countries, and supplementing it by its own observations only in so far as additional facilities were necessary for the adequate supervision and control of the observations, and for the scientific development of the study of them, its primary obligation was to supply the requirements, as far as possible in the present state of the science, of all the various departments of State and of the general public and to obtain whatever information was necessary for that purpose. There remained a residual obligation, with the assistance of the scientific organisations of the country, to use all available means to obtain a greater scientific insight into the atmospheric processes, in order to utilise to the greatest advantage the information which the several departments found it necessary to obtain for their own immediate purposes. The fulfilment of this residual obligation depended mainly upon the ingenuity with which the organisation of the Office could utilise the various opportunities afforded sometimes by one department and sometimes by another. If the Office were attached to one department and there were no definite scientific obligation, residual or other, the ultimate objects of the Office in the improvement of the service on the scientific side might be disregarded.

A conference of the representatives of the various departments was held at the Treasury on 31st May, 1918. It was decided that it was desirable that the organisation of the Office should continue to be independent of the several departments interested in its work, so that its activity might not be restricted by a controlling influence on one side.

Since the close of the year the question has been raised again by the Air Ministry with a different result.

Proposal for Transfer to the Department of Scientific and Industrial Research.—On 4th December, 1918, the Committee were notified that, subject to certain conditions, the Committee for Home Affairs of the War Cabinet had approved a resolution that the Meteorological Office be attached to the Government through the Committee of the Privy Council which controls the grant for Scientific and Industrial Research, instead of being in direct connection with the Treasury.

The Committee made careful inquiries of the Department as to the possible effects of the proposed transfer upon the various activities of the Office and the facilities which it enjoys under Your Lordships for dealing with the many miscellaneous questions which are associated in practice with meteorology.

They received re-assuring replies, and ultimately they felt themselves justified in informing your Lordships that they saw no ground for raising any objection on principle to the proposed transfer if the continuance of the present direct dependence upon Your Lordships was considered to be irregular on general grounds.

Meanwhile, the Committee have themselves raised by letter to Your Lordships the important question of the co-ordination of the various meteorological services in this country to which reference was made on p. 8 of the 13th report. The necessity for this step was made prominent by the transfer of a considerable part of the Naval Meteorological Service, with its Director, to form a separate Meteorological Service of the Air Ministry. In the absence of proper co-ordination, overlapping, and to some extent, unnecessary rivalry are likely to occur. The Committee have received from the War Cabinet a report of the Research Committee of the Cabinet, in which, at the instance of Your Lordships, the principles of co-ordination are laid down for the guidance of the various services. As this document becomes the instrument upon which the services depend it will be published in due course.

Advisory Committee on Atmospheric Pollution.—The Advisory Committee appointed in the previous year have presented a report of their proceedings during the year 1918, and have requested the Committee to apply for a renewal of the grant from the Department of Scientific and Industrial Research. In the report it is noted that an account of the work done in 1917-18 has been presented to the Department in accordance with the terms of the grant and has been published in the *Lancet*. The account of the work in 1918-19 is to be dealt with in like manner. In compliance with the request of the Advisory Committee an application for the renewal of the grant has been forwarded to the Department. The Advisory Committee has been re-appointed with the addition of Professor H. B. Baker, O.B.E., F.R.S., of the Imperial College of Science and Technology. The Committee have reason to be well satisfied with the investigations of the Advisory Committee; they recognise that the design and construction of a continuously running gauge for recording the amount of pollution in the atmosphere is a remarkable achievement. It would, however, seem that if the expenses of the central establishment forming the connecting link of an enterprise in which many local authorities co-operate, are to be defrayed out of Government funds, it would be desirable that the Meteorological Office should take the financial as well as the administrative responsibility. Accordingly, in the various schemes for reconstruction that have been before the Committee, the Committee have included provision for incorporating the investigation of atmospheric pollution with the work of the Meteorological Office. The financial arrangements have not yet been considered, but they will come up for consideration in the proposals which must precede the settlement of the new relations of the Office.

Accommodation.—The question of the accommodation for the work of the Office is a very serious one. The Office has already overflowed the accommodation which it rents from the Office of Works. It has borrowed accommodation for the Forecast Division from the Board of Education on the top floor of the building which, as set out in the correspondence respecting the arrangement with the Office of Works in 1910, was definitely assigned for the extension of the Office premises, and was only to be allocated temporarily for other purposes, with the concurrence of the Meteorological Committee. In the mean time, additional accommodation was necessary for the Instruments Division, and a house in Cromwell Road was obtained by the Office of Works for that purpose. If the work of the Office is to be co-ordinated with the meteorological work of the Air Ministry, and adequate provision is to be made for the meteorological staffs of other departments, for the library and collection of records, for the new developments of the activity of the Office and for the printing of its reports, accommodation is required which is represented by the basement and five other floors of the same size as one of the Office floors, so that the accommodation of the present building outside the limits of the Post Office is not large enough. At the same time, it must be remarked that the present building was especially designed for meteorological work, and so far no other available building offers the necessary accommodation.

Meteorological Work for the Army.—Officers and men of the Meteorological Section R.E., in charge of Colonel Lyons as Commandant of Army Meteorological Services, are still employed for the meteorological work of the Armies of Occupation. The Army Council, however, has asked the Meteorological Committee to take over the meteorological work at Artillery Ranges and to provide civilian staff for the purpose. The staff required for this purpose is estimated as 5 professional assistants and 22 technical assistants. The Committee have undertaken to supply the staff for this purpose, and in the estimate for 1919-20 they have included provision for 5 professional assistants and 13 technical assistants.

International Meteorology.—Meetings have been held in Paris and in London between representatives of the various services of the two countries in order to arrange a code for the transmission of weather messages under the new conditions.

Notice has been received from M. Lacroix, one of the permanent secretaries of the French Academy of Sciences and President of the Comité d'Action, a body appointed to co-ordinate the Meteorological Services of France, that it is intended to call a meeting of Meteorologists of the Allied countries in the course of the summer. The Committee have thought it desirable to use the opportunity to take up again the proposal for a conference between the meteorologists of the various Dominions of the Empire, and they have accordingly taken steps to secure that object.

As a sequel to correspondence with the Colonial Office respecting the reports of hurricanes received from the West Indies the Office has undertaken to prepare a memorandum on hurricanes for general use.

PUBLICATIONS.

The following Libraries and Institutions have been added to the lists of recipients of presentation copies of official publications:—

University of Minnesota, Minneapolis; University College, London (Geophysical Memoirs).

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

PERIODICAL.—**The Daily Weather Report** [to date].
The B Daily Weather Report [to date].
Monthly Meteorological Charts of the North Atlantic Ocean [to date].
Monthly Meteorological Charts of the East Indian Seas [to date].
Monthly Meteorological Charts of the Mediterranean Basin (reprint of the second edition) [to date].

PERIODICAL.—**The British Meteorological and Magnetic Year Book**, comprising—

Part I.—**The Weekly Weather Report** with Quarterly and Annual Summaries [up to date], with the exception of the maps, which have not been issued since August, 1914.

Part II.—**The Monthly Weather Report**, with a summary for the year.

Part III. (1).—**Daily Readings** at meteorological stations of the first and second orders [to December, 1918].

Part III. (2).—**Geophysical Journal**. Daily Readings in meteorology, solar radiation, seismology, atmospheric electricity and terrestrial magnetism, and the results of observations in the upper air [to March, 1918].

Part IV. (1).—**Hourly Values from Autographic Records, Meteorological Section**. [The publication of this series has been discontinued. The last volume is that for 1913, but the subsequent hourly readings have been prepared and are available in manuscript form.]

Part IV. (2).—**Hourly Values from Autographic Records, Geophysical Section**. Hourly values for terrestrial magnetism, atmospheric electricity and meteorology for five Observatories. [Volume 1915 issued.]

Part V.—**Réseau Mondial**. Monthly and Annual Summaries of pressure, temperature and precipitation at land stations, generally two for each 10-degree square of latitude and longitude. [Volumes of tables for 1913 issued without charts.]

Observer's Handbook, 1918 edition.

Calendar, with notes and diary of operations for the use of observers, for 1919.

OCCASIONAL.—**Geophysical Memoirs, Volume 2.**

No. 12. The travel of circular depressions and tornadoes and the relation of pressure to wind for circular isobars. By Sir Napier Shaw, F.R.S.

Professional Notes.

No. 1. On the inter-relation of wind direction and cloud amount at Richmond (Kew Observatory). By David Brunt, Lt. R.E.

No. 2. Note on examples of katabatic wind in the valley of the Upper Thames at the Aerological Observatory of the Meteorological Office at Benson, Oxon., by E. V. Newnham, B.Sc.

No. 3. Incidence of fog in London on January 31st, 1918. By C. E. P. Brooks, M.Sc.

Cloud Forms according to the International Classification.

Weather of the British Coasts.

Weather Map, 4th issue.

Seaman's Handbook of Meteorology, 1917 edition.

Marine Observer's Handbook, second edition.

Other publications for which authority has been given and which are in preparation are as follows:—

Professional Notes.

No. 4. Upper air temperatures at Martlesham Heath. By W. F. Stacey.

No. 5. On the use of the normal curve of errors in classifying observations in meteorology. By E. H. Chapman, M.A., B.Sc.

No. 6. The variation of wind with height. By E. H. Chapman, M.A., B.Sc.

No. 7. Climate of North West Russia.

Geophysical Memoirs, Volume 2.

No. 13. The characteristics of the free atmosphere. By W. H. Dines, F.R.S.

The Barometer Manual, ninth edition.

Computer's Handbook, Section 5. Tables of Coefficients of Correlation compiled from various sources. By E. H. Chapman, M.A., B.Sc.

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

By Sir Napier Shaw, F.R.S., Director—

Memorandum on atmospheric visibility. London, 1918, Naval Meteorological Service, 8vo., p. 16.

Manual of Meteorology, Part 4. The relation of the wind to the distribution of barometric pressure. Cambridge, 1919, 8vo., pp. 16, 160.

By Colonel H. G. Lyons, F.R.S.—

Meteorological resources of the British Empire. London, Q.J.R. Meteor. Soc., 44, 1918, pp. 69-89.

Meteorology during and after the War. London, J.R. Soc. Arts, 57, 1919, pp. 167-177.

By Mr. F. J. W. Whipple, M.A., Superintendent of Statistics—

Seasonal variation in the audibility of distant gunfire. London, Q.J.R. Meteor. Soc., 44, 1918, pp. 285-289.

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

The magnetic storm of December 16-17, 1917, as recorded at Kew and Eskdalemuir Observatories. Proc. R. Soc., London, 94, 1918, pp. 525-547.

Electric potential gradient and atmospheric opacity at Kew Observatory. Proc. R. Soc., London, 95A, 1919, p. 210-234.

Terrestrial magnetism in relation to mine surveying. Trans. Inst. Min. Engin., London, 55, Part 4, 1918, 8vo., pp. 223-263.

The diurnal variation of barometric pressure at seven British Observatories 1871-82. A correction and some additions. London, Q.J.R. Meteor. Soc., 44, 1918, pp. 99-111.

By W. H. Dines, F.R.S., Benson Observatory—

The daily variation of temperature in the lower strata of the atmosphere. London, Q.J.R. Meteor. Soc., 45, 1919, p. 41.

The water contents of the atmosphere in relation to heavy rainfalls. Symons's Meteor. Mag., London, 53, 1918, pp. 95-97.

By J. S. Dines, M.A.—

The rate of ascent of pilot balloons. London, Q.J.R. Meteor. Soc., 44, 1918, pp. 131-133.

By H. Jeffreys, D.Sc.—

On travelling atmospheric disturbances. London, Phil. Mag., 37, 1919, pp. 1-8.

One number of the second volume of the Series of *Geophysical Memoirs* has been published during the year and one is now in the press. A new series of professional papers has been started in royal octavo with the general title of *Professional Notes*. As noted in the above list, the first three numbers have already been published and four others are now in the press.

In response to a request from the Hydrographer of the Navy for information about the weather of the British Coasts in a form suitable for the general reader, the *Weather of the British Coasts* was written by Sir Napier Shaw for a series of illustrations and tables prepared in the Office, and was issued in 1918. Although intended primarily for the seamen who navigate the coasts, it contains much information of general interest. The tables and diagrams deal chiefly with winds, but there are also statistics of fog, snow, thunderstorms, rainfall, temperature and sunshine. The later chapters of the book deal with the methods of co-ordinating observations, a general sketch of modern meteorology being illustrated by the discussion of particular records.

As the International Cloud Atlas is out of print a provisional atlas has been issued in *Cloud Forms according to the International Classification*. This contains reproductions of a number of cloud photographs by Mr. G. A. Clarke of Aberdeen, with an introduction giving a revised translation of the international definitions and additional notes on cloud types.

The 1918 edition of the *Observer's Handbook* was issued towards the end of 1918. It contains a few changes; the section on clouds has been somewhat modified, there are additional articles on the Green Ray and Mirage and on the Air Meter and the Swinging Plate Anemometer. A plate illustrating the Zodiacal Light has been included.

INQUIRIES.

The inquiries dealt with during the year were 740, of which 526 were answered by letter and the rest personal inquiries. The following table gives a classification of the inquiries for the years since the beginning of the war:—

		For Scientific or Commercial purposes.	For Evidence in Legal Proceedings.	From Newspaper Correspondents for Special In- formation.	Miscellaneous.	Answered by Letter.	Answered Personally.	Total.
1914-15	...	639	92	56	34	468	353	821
1915-16	...	498	133	21	27	431	248	679
1916-17	...	414	115	19	16	397	167	564
1917-18	...	400	127	15	28	400	170	570
1918-19	...	542	175	17	12	526	220	740

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

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 and is now being kept up to date. Some progress has also been made in preparing cards for the subject card catalogue for the books received before 1905. The additions to the library received during the past year include about 400 books and pamphlets. The total number of books in the library is now about 26,000.

The revision of the original catalogue and the authors' and subject cards, necessitated by the re-arrangement of the library on the removal of the Office in 1910, has been completed.

A Register of books and pamphlets in the library has been started and is being kept up to date. The work of registering books received in the library since December 31st, 1900, is also being carried out. Books received before this date are entered in the original author catalogue.

In the Report of the Tenth Meeting of the International Meteorological Committee at Rome, 1913 (M.O. 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:—

Das Mittelmeergebiet, seine geographische und kulturelle Eigenart, by Alfred Philippson.

La temperature en Chine et à quelques stations voisines d'après des observations quotidiennes. Tome I, II, III, by H. Gauthier.

Sobre els vents estivals de conveccio a la costa catalana, by E. Fontseré.

Introductory meteorology, by the National Research Council, Washington.

Among those acquired by purchase have been:—

Temperaturschwankungen des Nord-atlantischen Ozeans und in der Atmosphäre, by Bjorn Helland-Hansen and Fridtjof Nansen.

Mémoires originaux sur la circulation générale de l'atmosphère, by M. Brillouin.

A treatise on the sun's radiation and other solar phenomena, by Frank H. Bigelow.

Aerodynamics, by F. W. Lanchester.

A selection of the volumes of the International Catalogue of Scientific Literature.

FINANCE.

A statement of receipts and payments during the year ended 31st March, 1919, is given on page 26.

The amount of the Parliamentary Grant-in-Aid for Meteorology, which was paid direct to the Committee by the Treasury, was £29,750 or £7,250 in excess of the Grant for the previous year.

This increase in the Grant was in part intended to cover the increases in the Salary List of the Office directly due to the emergency of the War, and partly to meet the telegraphic charges of services rendered to H.M. Government in connection with the supply of weather information to the Admiralty, War Office and Air Ministry, charges which were formerly recovered from the Departments concerned but which by arrangement with the Treasury are to be borne in future by this Office without repayment.

The sum total of subventions from other votes and from the Royal Society, as enumerated last year, was £1,818 17s. 6d. which together with the Parliamentary Grant of £29,750 provided £31,568 17s. 6d. as the revenue available for the work of the year. Repayments and other miscellaneous receipts totalled £34,753 8s. 2d., making a grand total of £66,222 10s. 10d.

Of the total receipts £30,672 14s. 11d. were for instruments etc., mainly for supplies to the Admiralty, War Office and Air Ministry.

Expenditure, including the recoverable items, amounted to £65,041 3s. 11d., so that the deficit of £1,121 17s. 3d. with which the year began was changed into a net cash book balance of £59 9s. 8d. as the year closed.

The balance at the commencement of the year included £96 0s. 8d. held to the credit of H.M. Stationery Office and £13 on account of National War Bond Subscriptions deducted from Salaries during March, 1918.

These amounts have been discharged during the year, but there have been larger sales of Government Publications and the amount held to the credit of H.M. Stationery Office on March 31st, 1919, was £146 0s. 10d.

The statement of Receipts and Expenditure of the Edinburgh Office for year ending 31st March, 1919, is as follows:—

<i>Receipts.</i>			<i>Expenditure.</i>		
	£	s. d.		£	s. d.
Balance carried forward	15	0 1	Salaries	545	0 0
From the Meteorological Committee—			Telephone, telegrams, postage, petty outlays ...	12	6 4
Grant { Normal £350 }	410	0 0	Binding	4	4 9
War Suppl. £60 }			Balance carried forward ...	16	3 2
Further War Bonus	52	14 2			
	462	14 2			
On account of Reports supplied to the Registrar-General for Scotland ...	100	0 0			
	£577	14 3		£577	14 3

ACCOUNT of RECEIPTS and PAYMENTS for the year ended 31st March, 1919, subject to alteration upon audit by the Comptroller and Auditor General.

RECEIPTS.			PAYMENTS.		
	£ s. d.	1918-19. £ s. d.		£ s. d.	1918-19. £ s. d.
Balance from year 1917-18	—	99 14 10	Adviser	—	1,000 0 0
Parliamentary vote ..	22,500 0 0		Acting Director— Col. H. G. Lyons ..	—	147 16 8
Vote of Credit (Treas. 43850/17)	7,250 0 0	29,750 0 0	OFFICE SALARIES (in- cluding Insurance):		
DEPARTMENTAL EX- PENSES REPAID:			Monthly	15,015 5 8	
Forecasts, &c.	42 11 11		Weekly	3,285 7 8	18,300 13 0
Marine, Statistical, and Administrative	99 6 0		EXPENSES OF OFFICE:		
Instruments	1,624 7 7	1,766 5 6	Rent, Heating, and Lighting	702 16 10	
INCIDENTAL EXPENSES REPAID:			Furniture and Equip- ment	44 7 9	
D.W. Report	486 12 7		Library	14 10 4	
Divisional	256 9 8		Insurances and Repairs	57 5 8	
Advertising Account ..	22 13 2	765 15 5	Incidental Expenses and Consumable Stores	480 12 9	
S. O. PUBLICATIONS AND FORMS	—	145 17 4	Advertising Account ..	7 10 0	1,307 8 2
TELEGRAPH CHARGES REPAID	—	134 3 0	POST OFFICE:		
TELEPHONE CHARGES REPAID	—	117 4 0	Postage	1,349 12 4	
INSPECTIONS	—	57 12 1	Telephones	265 4 7	
INSTRUMENTS:			Telegrams	3,277 4 0	4,892 0 11
Royal Navy	608 11 4		STATIONERY OFFICE	—	96 0 8
By Sales from Stock ..	30,064 3 7	30,072 14 11	TRAVELLING EXPENSES	—	234 0 11
SUPERANNUATION ACCOUNT:			SUPERANNUATION:		
Annuities	540 0 0		Pensions not charge- able on Fund	25 0 0	
Interest on Investments	50 2 8	590 2 8	Pensions chargeable on Fund	132 2 0	
OBSERVATORIES, BRAN- CHES, AND STATIONS:			Annuities	532 10 0	
Richmond	456 7 7		Contribution to fund ..	—	689 12 0
Eskdalemuir	1,023 12 1		COST OF INSTRUMENTS:		
Cahiriveen	27 11 6		Royal Navy	1,776 9 4	
Farnborough	27 2 11		For Stock	26,422 18 1	28,199 7 6
Falmouth	11 4 0		OBSERVATORIES, BRAN- CHES, AND STATIONS:		
Benson	—		Richmond	2,540 3 8	
Edinburgh	—		Eskdalemuir	2,086 3 11	
Investigation of Atmos- pheric Pollution	476 4 8		Cahiriveen	1,068 2 1	
Miscellaneous	192 19 6	2,215 2 3	Farnborough	776 2 8	
NATIONAL WAR BONDS..	—	3 0 0	Falmouth	617 1 9	
Salaries refunded	—	4 13 8	Benson	547 13 6	
BALANCE DUE TO BANK	—	49 0 4	Edinburgh	478 1 5	
			Investigation of Atmos- pheric Pollution	340 11 0	
			Miscellaneous	1,720 9 7	10,174 9 7
			Balance due to Bank on April 1st, 1918 ..	—	1,221 13 1
			BALANCE:		
			Cash at Bank	—	108 10 0
			„ at Office	—	—
		£66,371 6 0			£66,371 6 0

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

The following abstract shows approximately the net payments for this year and the preceding year, together with the increase or decrease in 1918-19 as compared with 1917-18:—

NET CHARGES.	1917-18.	1918-19.	Increase.	Decrease.
SALARIES :	£	£	£	£
Adviser	1,000	1,000	—	—
Acting Director	—	148	148	—
Office and Observatories ...	18,089	22,860	4,771	—
GENERAL ADMINISTRATION OF CENTRAL OFFICE :				
Rent, Heating, and Lighting	693	703	10	—
Furniture and Equipment	45	44	—	1
Library	23	15	—	8
Insurances and Repairs ...	65	57	39	—
Incidental Expenses, Con- sumable Stores, and Ad- vertising Account.		47		
STATIONERY OFFICE (see below).				
POSTAGE	704	1,025	321	—
TELEGRAMS	1,829	3,143	1,314	—
TELEPHONES	163	148	—	15
TRAVELLING EXPENSES ...	27	177	150	—
INSTRUMENTS (see also below)	2,082	—	—	2,082
SUPERANNUATION	223	99	—	124
OBSERVATORIES, &c. (exclu- sive of Salaries) :—				
Richmond	226	257	31	—
Eskdalemuir	436	559	123	—
Cahiriveen	135	135	—	—
Farnborough	195	103	—	92
Falmouth	107	143	36	—
Benson	99	65	—	34
Edinburgh	365	478	113	—
Committee for Atmospheric Pollution.	140	177	37	—
Other Observatories, Sta- tions, &c.	1,214	1,528	314	—
LECTURES AND EXPERI- MENTS.	*	*	—	—
Total Expenditure ...	27,860	32,911	5,051	—
NET CREDITS.				
SALE OF PUBLICATIONS, &c.	32	50	18	—
INSTRUMENTS	—	2,473	2,473	—
Total Net Expenditure £	27,828	30,388	2,560	—
NET INCOME.				
PARLIAMENTARY GRANTS :				
M.O. Vote	22,500	29,750	7,250	—
Royal Society Vote ...	1,000	1,000	—	—
" " Advisory Com- mittee.	250	—	—	250
Advisory Committee At- mospheric Pollution.	500	476	—	24
ROYAL SOCIETY :				
Gassiot Trust	405	339	—	66
Rosse Trust	6	4	—	2
SCOTT ANTARCTIC FUND ...	82	—	—	82
	24,743	31,569	6,826	—

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

The Reports of the several divisions of the Office and of the Observatories which it maintains are as follows:—

I.—MARINE DIVISION.

Report by H. Harries, Acting Superintendent.

Throughout the period of the Great War the work of the Marine Division suffered severely through (1) the absence of as many as five members of the staff—all who were within the prescribed age limits—who had volunteered for active service; and (2) the inevitable great falling off in the amount of meteorological information which it was possible to obtain from ships, there being wide areas of the oceans within which log-keeping was prohibited; and in addition to this a number of the vessels which had been provided with Office instruments and logs were lost through enemy action.

The War Services of the members of the Division were as follows:—

Naval.

A.B. WALTER BENJAMIN GREENING.—Killed at the Dardanelles.

Military—Foreign Service.

Lieut. Joseph Leslie Gray.—Egypt and Palestine.

Pte. Alfred Anderson Lovie—India and Mesopotamia.

Pte. Hugh Thomas Smith.—France and Belgium.

Home Service.

Gunner Albert John Tabor.—Garrison duty at Plymouth.

Lieutenant Gray is still serving with his regiment. As soon as demobilised Messrs. Lovie, Smith and Tabor returned to their posts in the Marine Division.

The work of the Division suffered also from the sudden death in January of the Nautical Assistant, Mr. Allingham; and in the following month from that of the Superintendent, Captain Hepworth, after an illness which had incapacitated him for several months.

Collection of Information.—The reckless “frightfulness” which characterised the practices of the enemy at sea, and the precautions rendered necessary to counteract this, resulted eventually in an almost entire paralysis of the work of obtaining meteorological observations from ships of the Royal Navy and of the Mercantile Marine. Compared with the various classes of documents received during the pre-war year ending March 31st, 1914, the following table exhibits the extent of the falling off in the subsequent years. The several columns show the number of full 4-hourly meteorological logs kept with the tested instruments lent for the purpose by the Office; the number of Short Logs, with untested instruments; Forms 121 and 122 containing observations for use in connection with the preparation of the North

Atlantic and the East Indian Seas, respectively; and Form 138, from ships reporting to the Office by Radio-telegraphy:—

Year ending March 31.	Full Log.	Short Log.	Form 121.	Form 122.	Form 138.	Total.
1914	279	4	1,427	170	858	2,738
1915	224	2	974	90	410	1,700
1916	147	—	790	92	20	1,049
1917	115	1	546	124	—	786
1918	59	—	111	33	—	203
1919	22	—	17	4	—	43

Meteorological Logs.—Submitted to careful examination, the 22 full logs received during the past year were all awarded the character of “Excellent” or “Very Good,” the number so classed in the previous year having been 57, out of the total 59 received.

Supplementary Information.—The arrangements for obtaining meteorological information 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 four-hourly 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. The set observations for this class of information are taken at 8 a.m. and 8 p.m., ship’s time, but all casual occurrences, such as ice, derelicts, waterspouts, &c., and special observations on visibility are noted, as in the more complete log. Immediately upon receipt the returns are closely examined for any information that can add to the interest of the Monthly Meteorological Charts of the North Atlantic and of the East Indian Seas. In this connection co-operation is not confined to the personnel of British ships. A list of observers given in Circular No. 001 (J.) contains the names of Belgian, Dutch and Japanese captains.

A number of barograms and thermograms have been received from some of the ships of the Royal Navy, which give continuous records of pressure and temperature 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.

North Atlantic	{ United States	2
	{ West Indies	1
Africa, S.E. and E. coasts... ..		1
China, coasting		1
Japan, <i>viâ</i> Cape of Good Hope		1
Australia	{ Out, <i>viâ</i> Cape of Good Hope; Home,	
	{ <i>viâ</i> Panama	2
	{ <i>viâ</i> Suez	1
Australia and Natal, <i>viâ</i> Panama		1

Four-hourly Logs—continued.

Trans-Pacific	...	...	...	...	...	2
South America, E. coast	...	...	...	...	...	2
Indian Ocean	...	...	...	...	...	2
India and China Ports	...	...	...	...	...	1
River Thames	...	...	...	...	...	1
Orkney	...	...	...	...	...	3
Murmansk	...	...	...	...	...	1

North Atlantic Registers (Form No. 121) and East Indian Seas Registers (Form No. 122).

Routes.	Form No. 121.	Form No. 122.
South America, West Coast to New York, <i>via</i> Panama.	1	—
Africa, West Coast	5	—
South America, East Coast	11	—
East Indies } <i>via</i> Cape of Good Hope...	—	1
„ } <i>via</i> Suez	—	1
Indian Ocean	—	2
Totals	17	4

“ **Excellent** ” Observers.—In Circular No. 001 (J.) is given a complete list of the ships from which the four-hourly logs were received, the names of their captains, and of the officers who shared between them the duties of observing the elements recorded in the logs. Several of these observers have maintained their connection with the Office, as observers, through many years, and some of them have contributed numbers of logs which have been awarded an “ **Excellent** ” character. Among these should be mentioned Captain G. H. Harris, Lieut. R.N.R., who has had placed to his credit as many as 50 logs; Captain J. W. Millican, who has supplied 35 logs; and Captain C. J. Higgins, whose total to date is 31 logs. Those captains whose names appear in the list of “ **Excellent** ” observers for the first time are Captain P. W. Glennie, R.N., and Captain H. Trowbridge, of the S.S. “ **Sunkiang**.”

As a mark of recognition and appreciation of valuable co-operation, the practice of former years has been maintained of presenting various publications of the Office to the captains and officers 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; single and bound copies of the Monthly Meteorological Charts of the North Atlantic, and also of the East Indian Seas; The Barometer Manual; The Seaman’s Handbook of Meteorology; The Marine Observer’s Handbook; Geophysical Memoirs, Vol. I, Nos. I and II.

Obituary.—The Committee have noted, with regret the deaths of five of their old Observers in the course of the past year:—Captain E. B. Hatfield, of the S.S. "Barrowmore"; Captain J. W. Millican, of the S.S. "Keyingham"; Captain F. M. Passow, of the S.S. "St. Paul"; and Lieut. G. Spencer, R.N.R., D.S.C., formerly an observing officer on the S.S. "Arabic." Towards the end of last March there passed away at Stirling, and at the ripe age of 84, the last of the famous whaling captains of a bye-gone generation. Captain Alexander Simpson, of Peterhead, spent the greater part of his active life in Arctic waters. As a young man, in 1857-9, he served in the expedition which endeavoured to determine the fate of Sir John Franklin. On being appointed master of the three-masted schooner "Traveller" of 195 tons, in 1870, he undertook to keep a meteorological log on his voyages to the Davis Strait region. When, in 1899, he retired from the command, upon being appointed Harbour Master of his native town, Peterhead, he had contributed to our knowledge of the meteorology of the Arctic regions as many as 28 logs, all of which had been awarded an "Excellent" character.

Use of Information received.—Every opportunity was taken to utilise such information as was contained in the various documents received, but owing to the very small numbers of returns it became necessary to suspend the work of obtaining the weekly and monthly mean temperature of the air and of the sea surface water over the North Atlantic area, so that for the time being these elements have ceased to appear on the monthly issues of the Charts. It was also decided to suspend the issue of the Charts in the weekly numbers. For the same reasons the preparation and publication of the monthly maps of sea surface salinity of the North Atlantic, the English Channel and the North Sea had to be suspended. In other respects the monthly Meteorological Charts of the Atlantic and the East Indian Seas have undergone no very important modification. The backs of both charts have been utilised for the publication of maps, diagrams and letterpress relating to sea temperature, salinity, the distribution of ice, fog and mist, tracks of typical hurricanes, recent current observations, measurements of ocean rainfall by gauge, and other subjects. For publication on the charts special cables were received monthly from Toronto giving the state of the ice along the Canadian and Newfoundland coasts; and, during the summer, from Simla relating to the South-west Monsoon, its appearance and its character, and also noting the occurrence of cyclones about the Arabian Sea and the Bay of Bengal.

The subject of visibility at sea has engaged a good deal of attention. Observations made on ships of H.M. Navy in the North Sea area from 1912 to 1914 have been discussed and monthly and annual results obtained showing the relationship between Visibility and (a) Pressure Distribution; (b) Wind Distribution; and (c) the Time of Day. These results have been utilised in the development of a Visibility Scale which

has been adopted for general use not only by this Office, but also by the Admiralty Meteorological Service, the Royal Air Force Meteorological Service, and the French Army Meteorological Service.

The Meteorological Charts of the Southern Ocean between the Cape of Good Hope and New Zealand (Official Publication No. 123), and Monthly Wind Charts of the South Atlantic (No. 168) have undergone revision for the issue of new editions.

In connection with investigations respecting the disappearance of ships and other maritime casualties, information contained in meteorological logs has been supplied to the legal representatives of the parties concerned.

The supply of observations from the logs of ships navigating the Indian Ocean between the parallels of 10°N and 20°S , and the meridians of 40° and 80°E , to the Director General of Observatories, Simla, was continued as long as possible during the war, and it will be resumed immediately on the receipt of new logs from the region. It has not been possible to supply to the Royal Dutch Meteorological Institute similar data for selected ocean areas.

At the request of the Hydrographer to the Navy the monthly distribution of mist and fog over the North Sea and Baltic areas is being revised and the information brought up to date.

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

The rapid advance already made in the navigation of the upper air, and the prospect that flying over the open oceans will soon become common are inducing aviators and their advisers to seek the latest meteorological information. Every endeavour is made to meet the demands made in this direction.

II. FORECAST AND GALE WARNING DIVISION.

Report by R. G. K. Lempfert, C.B.E., M.A., Superintendent.

Change in Stations.—As a consequence of mobilisation changes were necessary at several of the reporting stations in charge of the coastguard. The work at Blacksod Point was transferred to the War Signal Station on Termon Hill, and that at Donaghadee to the War Signal Station at Orlock Hill. In August, 1915, it became impracticable to carry on the observations at the Coast Defence Station at Great Yarmouth, and the work was accordingly transferred to the Coastguard, Gorleston, who were already in charge of the anemometer. In May, 1918, the work at Lerwick was transferred to the War Signal Station at Ander Hill, on the Island of Bressay. Upon demobilisation the stations at Blacksod Point, Donaghadee and Lerwick were transferred back to the old sites.

The telegraphic network before the war did not include a station in the Orkneys, but in view of the importance of the Orkney Islands from the naval point of view, arrangements

were made for regular telegraphic reports to be supplied by the climatological station in charge of Mr. Magnus Spence at Deerness. In view of the contingency of the breakdown of telegraphic communication with the Outer Hebrides, arrangements were also made with the municipal authorities at Oban for regular reports to be sent at 7h. and 18h. In July, 1917, a telegraphic reporting station was started at Hartland Quay, in charge of Mr. Harold Notley, who volunteered his services. Arrangements have also been made for reports to be supplied from the wireless station on Valencia Island, at hours when there was no telegraphic communication with Valencia Observatory.

In addition to the regular reports received from the telegraphic reporting stations of the Office, regular reports have also been received from many of the meteorological stations established by the Royal Naval Air Service at aerodromes. Reports from these stations are still being supplied, the stations having been transferred to the Meteorological Service of the Air Ministry.

Foreign Reports.—Upon outbreak of hostilities the arrangements for the supply of foreign reports were at first much hampered, but after the first few weeks arrangements were made with the Censors' Department for meteorological telegrams to be passed without interruption. Most neutral and allied countries, from which the Office had received reports before the war, continued to supply the information, but the Great Northern Telegraph Company, of Denmark, found itself unable to continue to supply reports from Iceland under the international arrangements which existed before the war. At the request of the Admiralty arrangements were, therefore, made through the Foreign Office for the British representatives at Reykjavik and Thorshavn to obtain the necessary information and cable it to this country.

The Swedish Meteorological Authorities also found themselves unable to continue the supply of Swedish information except upon terms of reciprocity. Similar arrangements were, therefore, made by the British representative in Stockholm for reports to be supplied. By arrangement with the Danish and Norwegian Meteorological Offices additional and more frequent reports have been obtained from Denmark and Norway.

In April, 1915, a request was received from the Admiralty that the Office would undertake the collection of systematic reports from the Mediterranean in order that meteorological information might be supplied regularly to the Admiral in Command of the Operations on the Dardanelles. Arrangements were therefore made for regular reports to be supplied from Malta, Cyprus, Cairo, Alexandria, Athens, and Crete. Regular reports were also received from a number of stations in Italy through the Italian Meteorological Service. About the same time a request was received from the Russian Meteorological

Department, which since the outbreak of hostilities had been deprived of meteorological information from this country which it had been accustomed to obtain through Germany, for the direct supply of weather reports from this country and after some delay a regular exchange of reports between London and Petrograd was arranged for and continued in operation until the change of the political situation in Russia rendered that impracticable. At a later date arrangements were made for the regular exchange of reports with the Russian Meteorological Department at Archangel.

Upper Air Reports.—The reports on the upper air required by the various units of the Flying Corps necessitated that the surface observations which had formerly been the only ones reported by telegraph should be supplemented by reports giving the result of pilot balloon ascents. Arrangements were, therefore, made for the Observatories connected with the Office, Aberdeen, Eskdalemuir, Valencia, Falmouth, and Benson to make regular pilot balloon ascents and to report the results by telegraph. Numerous reports were also received from the stations of the Meteorological Section, R.E., and of the R.N. Air Service, now Air Ministry Meteorological Service. Reports have thus been received three times a day from a large network of pilot balloon stations. The information has been supplemented by observations of the upper wind obtained by means of shell bursts at various stations in this country and at the meteorological stations established with the Army in France. Reports of upper air temperature obtained in aeroplanes have been received with considerable regularity from the Royal Aircraft Factory at Farnborough and the Experimental Station at Martlesham Heath and at Army stations in France.

Night Service.—In September, 1914, an application was received for special forecasts to be supplied to the military authorities at sunrise and arrangements were accordingly made to meet this request by obtaining reports from selected stations at 3 a.m. Before the purpose for which these forecasts were required had been achieved applications were received from other sources for the supply of forecasts in the early morning and thus a regular night service was inaugurated. It was not possible to arrange for observations at 3 a.m. at all the telegraphic reporting stations, but a sufficiently large number were able to report to make it possible to construct a fairly comprehensive map. The reports made it possible for the forecasts to reach their destination just about sunrise, in time for them to be considered before the day's work was commenced. During the summer months of the year 1915 these early forecasts did not reach their destination sufficiently early, and accordingly the hour of observation was put forward to 1 a.m. G.M.T., and it has remained at that hour ever since. The number of applications for these early morning forecasts steadily increased, and from November, 1917, arrangements were made to keep a full staff on duty during the night and to make the issue of forecasts based on the 1 a.m. reports the principal issue of the 24 hours.

Re-transmission of Data.—The arrangements for the supply of British meteorological data to foreign countries were naturally interrupted upon the outbreak of hostilities, and the supply of information to neutral countries was entirely suspended. Collective reports for a selection of British stations were prepared and transmitted to the French Meteorological Service in cypher. At a later date these telegrams were also sent to the Meteorological Services of Russia and Italy. After the establishment of the Meteorological Section of the Royal Engineers, it became necessary to supply the officers in charge with material for the preparation of weather maps in order that they might be in a position to prepare forecasts for the guidance of the military authorities. The reports supplied to the Meteorological Section with the British Armies in France had become increasingly important as time went on, and ultimately a great part of the information received at the Office, both from British and foreign stations, had to be re-cyphered and transmitted to France. Arrangements were also made for the supply of a selection of reports from Western Europe to the Meteorological Department in Cairo. Suitable reports have also been prepared and transmitted to the meteorological sections attached to the Armies in Salonica and Murmansk. In this country arrangements were made for the circulation of synoptic data for the construction of weather maps to the meteorological forecast centres established in connection with various units of the Royal Naval Air Service, subsequently the Meteorological Service of the Air Ministry.

Supply of Forecasts.—Requests for the supply of forecasts were continually being received from military and naval officers. As far as possible these applicants were arranged in groups according to the district in which they were situated and in order to save time in circulation the addresses for each group were communicated in advance to the Post Office. Even with this sub-division the number of individual forecasts which had to be prepared remained very large: as a rule about 20 different forecasts had to be prepared and cyphered with each set of forecasts issued on each map that was drawn.

Special Reports.—The issue of the Daily Weather Report was continued throughout the war; after the issue to the general public had been discontinued official addresses continued to receive the Report regularly as a confidential document.

The following additional reports were prepared for circulation:—

- (1) A. Report based on the 1 a.m. observations which contained a copy of the map for that hour, forecasts for the various districts of the British Isles with special section referring to the upper air conditions was issued each morning at 6 a.m. for circulation to addresses within the London area. The report was also sent by special arrangement to a number of addresses near London which could be reached at an early hour.

- (2) **B. Report.** This formed the main issue for the day. It was based on the observations taken at 7 a.m. G.M.T., and it gave, in addition to a large scale map for that hour, inset maps showing the direction and velocity of the wind as determined from pilot balloon ascents up to 15,000 feet. Forecasts for districts of the British Isles and a paragraph summarising the upper air conditions and a surmise of a forecast which the enemy might be expected to prepare supposing him deprived of access to information from the area over which the Allies had control. B. Report was issued daily at about noon and was circulated confidentially by railway letter to addresses supplied by the Naval or Military Authorities.
- (3) **Naval Supplement to the Daily Weather Report.** This gave a summary of the weather conditions over the oceans with forecasts of anticipated changes.
- (4) **Military Supplement to the Daily Weather Report.** This gave a summary of the weather conditions on the various fronts with forecasts.

Both these Supplements were circulated at 3.30 p.m. each day.

In addition to these more general reports special reports were prepared daily or upon application for the information of various officers.

Thames Estuary Report.—Special reports on the conditions over the Thames Estuary and surrounding counties, referring particularly to cloud, visibility and upper winds were prepared 3 times a day. Originally asked for by General Headquarters in London in connexion with provisions against air-raids in the London area, the reports were found to meet the special requirements of various other Departments and were circulated to about a dozen centres in and round London.

Gale Warning Service.—The issue of gale warnings to the public was continued for some time after the outbreak of hostilities in view of its importance in the navigation of small craft, but in November, 1915, the public issue of such warnings was discontinued and arrangements were made for the information to be circulated confidentially to naval and military officers.

Harvest Weather Forecasts.—The harvest weather forecast service was continued during the summer of 1914 but the issue of notifications in connexion with spells of settled weather was much hampered by the absence of information from the Atlantic in consequence of the discontinuance of the wireless reports from ships. In the following summers no attempt to issue such notifications was made, but forecasts for the following day were supplied to authorised addresses after inquiry as to the *bonâ fides* of the applicant.

Summer Time.—The introduction of Summer Time has complicated the work of the Division in several respects. It has not been possible to reach an agreement between the Meteorologists

of various countries as to whether the observations should continue to be taken according to Greenwich Time or whether the new standard should be adopted. After consultation with the Meteorological Service of France it was decided that the former course offered fewer disadvantages and the observations have accordingly been made throughout according to Greenwich Time. The arrangements for the distribution of the various reports and forecasts have, therefore, had to be revised for each change in the time standard, from which much inconvenience has resulted in practice.

Resumption of Normal Conditions.—The restrictions upon the circulation of meteorological information were removed after the signing of the Armistice. Notification of the removal of restrictions was received on 16th November, 1918, and the issue of reports to the Newspaper Press was resumed the same day. The full set of press reports as issued before the war was brought into operation on January 1st, 1919.

Arrangements for the circulation of gale warnings took some time to complete, but the service was restarted in April, 1919. The service of special forecasts for agriculturists will be resumed on normal lines during the summer of 1919.

Daily Weather Report.—As a consequence of the changes made during the war and the increase in the information being received, the form of the Daily Weather Report has had to be considerably modified. It is now issued in three sections:—

- | | | | | |
|---------------------------------------|-----|-----|-----|---------|
| I. British Section (B. Report) | ... | ... | ... | (pp 4). |
| II. International Section (I. Report) | ... | ... | ... | (pp 4). |
| III. Upper Air Supplement | ... | ... | ... | (pp 2). |

I. The British Section (B. Report) is issued daily at noon, in time for circulation by midday post. It contains:—

- (a) Statistics for British stations observing four times a day at 1h., 7h., 13h. and 18h.
- (b) Statistics for British stations observing twice a day at 7h. and 18h.
- (c) Particulars of sunshine, &c., reported from health resorts.
- (d) Weather map for North-west Europe for 7h. G.M.T. on the scale 1:10,000,000, with inset maps showing the distribution over the British Isles of upper and lower cloud visibility.
- (e) A summary of the weather over the British Isles by districts at 7h.
- (f) Forecasts for the districts of the British Isles for the 24 hours commencing at 3 p.m., with a "further outlook," if conditions are sufficiently definite.

II. The International Section (I. Report) is issued on the morning of the day following that to which the report refers, in time for circulation with the day's British Section. It contains:—

- (a) Statistical data for foreign stations.

- (b) Weather maps on the scale 1:20,000,000 for 1h., 7h., 13h. and 18h., the maps for 7h. and 18h. covering a wide area.
- (c) Particulars of observations from ships received by wireless telegraphy.
- (d) Notes on the weather.

The issue for Saturday appears on the following Monday; that for Sunday on the following Tuesday.

III. The Upper Air Supplement is issued daily at noon. It contains:—

- (a) Maps showing the direction and velocity of the wind at different levels for 13h. and 18h. of the day preceding that of issue, and for 7h. of the day of issue as deduced by observations of pilot balloons and other methods at the Office Observatories and the Meteorological Stations of the Air Ministry.
- (b) Particulars of upper air temperatures that may have been reported to the Office.
- (c) Notes on the upper air.

WEATHER STATION—FALMOUTH OBSERVATORY.

The Observatory was in charge of Mr. Patrick Y. Alexander up to 12th June, 1918. He was then succeeded by Mr. R. E. Watson, B.Sc., who remained until 28th February, 1919, when he resigned his appointment. Since then the Observatory has been in charge of Mr. J. B. Phillips, the permanent assistant.

The arrangements entered into with the Royal Cornwall Polytechnic Society commencing July, 1913, have been maintained.

Telegraphic reports have been sent regularly to the Meteorological Office at 1h., 7h., 13h. and 18h. The 18h. observation has been usually made by Mr. R. H. Brenton, the Falmouth Corporation Observer. The self-recording instruments have been kept in continuous operation throughout the year. Pilot balloon soundings of the upper air were made by Mr. Watson during November, December, January and February. Analysis and tabulation of the records from the anemometers at Plymouth, Pendennis Castle and Scilly have been made weekly. Several stations in the South-Western Counties were inspected by Mr. Watson.

All external wood and iron work of the observatory buildings have been painted and minor repairs carried out.

BRANCH METEOROLOGICAL OFFICE AT SOUTH FARNBOROUGH.

*Report by R. A. Watson Watt, B.Sc., A.M.I.E.E.,
Meteorologist-in-Charge.*

The routine work of the Branch Office continued on the same lines as in former years; but considerable expansion was necessary to meet the growing demands for special information made by Royal Aircraft Establishment, Royal Air Force, and various establishments of Aldershot Command. In the period 1917-19

the number of forecasts and upper air reports issued was more than doubled, special local forecasts of cloud amount and height, for aircraft work, and of surface wind, for gas operations, were introduced; climatological tables for the Army School of Sanitation and for the U.S. Air Service, rainfall returns for the Officer Commanding Royal Engineer, Camps and Roads, and daily meteorological summaries to several departments, were issued; while numerous inquiries by officers and officials of ministries were answered. Telephonic reports of existing conditions and fitness for flying became a prominent item in the daily programme. Upper air data were exchanged with Meteorological Section, R.E. (Home), while collection of reports of upper air temperatures, for transmission to the Central Office, was also undertaken. M.O. Radio Station supplied daily time signals—taken from Eiffel Tower—to Aldershot Command and to No. 1 (S) ARD, R.A.F.; thanks are due in this connection to Mrs. R. A. Watson Watt, who was responsible for the time signal service, and who rendered much assistance in other parts of the work of the office.

During the year under review 219 pilot balloon ascents were made, in which the balloon was followed above the 1 k. level, the mean height sounded being 3415 m., the maximum 12.6 k., while the longest observed trajectory was 46 k. In addition, 21 ascents were made in which the balloon entered cloud under 1 k., and in six ascents vertical currents obviously vitiated the results.

Experiments on the use of rangefinders in pilot balloon ascents, begun in the previous year, were continued until transferred to another establishment.

Daily observations of cloud height at dusk, using a vertical searchlight beam, kindly made available by General Officer Commanding, London Aircraft Defence Area, and Officer Commanding, Farnborough Gun Position, were made at M.O. Radio Station from May to November.

Two courses of instruction, one on pilot balloon work, to a member of M.O. Staff, and one on general meteorology, to an N.C.O. of the R.A.F. were given.

The principal research work of the year has been the continued development of the radiotelegraphic inquiry into the location of thunderstorms. For the further design and construction of equipment for the stations indicated in last year's report as being necessary for the prosecution of the inquiry, a considerable amount of experimental and constructional work on direction-finders, amplifiers, and accessories was carried out, and designs and estimates for standard equipment prepared.

A modified pattern of coherer lightning-recorder was designed, and trials of the first instrument of this pattern show a great improvement on the earlier form. A quantitative recorder, using valve amplifiers, has also been evolved, and has reached a stage at which reduction to practical form will be easy. The most interesting and important experimental work has been held up by pressure of other work, but progress towards a satisfactory directional recorder is now being made.

The Admiralty continues to give valuable assistance, although war-pressure greatly reduced the number of useful observations obtained in 1918. The most noteworthy observations of the year are, on this account, those of South Farnborough. A thunderstorm of May 17th, 1918, was followed throughout the afternoon, while the observed bearing of the West London storm of June 18th was sufficiently accurate to discriminate between East and West London. On May 19th, in very disturbed weather, a telephonic inquiry was received from an aerodrome as to whether thunderstorms were likely to be encountered on a specified route in south-east England. Radiotelegraphic observations were made, and within a quarter of an hour of the original inquiry a forecast was given of no thunderstorms on the route within three hours. The forecast, based on the observed bearing of disturbances, proved correct.

Some data on the relation of "stray" disturbance to wavelength were supplied to the National Physical Laboratory, and simultaneous observations of strays at N.P.L., and at Farnborough, were made on two occasions.

Throughout the year the difficulty of staffing was acute. Mr. N. Tunstall, of Manchester University, gave temporary assistance for three weeks in the beginning of the year. Mr. E. L. Hawke remained as Professional Assistant until his resignation on February 1st, after protracted sick leave, during which, as in the two months February and March, 1919, the Meteorologist-in-Charge was the only professional member of staff of the two virtually separate establishments, Branch Office and M.O. Radio Station. The thunderstorm inquiry has suffered in consequence.

The Committee wish to record their indebtedness to the wireless services of Admiralty, Army and Air Force, to the National Physical Laboratory and the Marconi Company, for assistance and advice on radiotelegraphic matters.

III.—CLIMATOLOGY AND STATISTICS DIVISION.

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

(1) ORGANIZATION.

The normal work of the Statistics Division has been carried on through the war without serious interruption. The restrictions on the circulation of meteorological information did not affect the issue of statistical publications until they were made more stringent in September, 1918, little more than a month before the Armistice.

(2) 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 returns have been prepared, is issued as a separate Circular (001 J.). An alphabetical list of the stations accompanies the Introduction to the Monthly Weather Report.

The following table gives the distribution by Districts of the stations of different types and also indicates where autographic records are being kept.

	Stations.				Autographic Records.					
	Observatories.	Other Telegraphic Stations.	Climatological Stations.	Additional Rainfall Stations.	Sunshine.	Rainfall.	Wind.	Pressure.	Temperature.	Humidity.
0. Scotland, N. ...	0	4	12	4	7	0	1	5	0	0
1. " E. ...	1	2	29	5	12	1	4	3	3	2
2. England, N.E. ...	0	2	19	7	13	0	2	2	0	0
3. " E. ...	0	2	21	6	15	0	3	2	0	0
4. " Midlands ...	0	2	41	25	14	0	1	3	1	1
5. " S.E. ...	0	2	44	15	30	0	2	4	0	0
London District ...	1	0	9	4	8	3	2	2	1	1
6. Scotland, W., and Isle of Man.	1	1	27	5	13	1	2	4	2	2
7. England, N.W., and N. Wales.	0	2	27	11	28	1	4	3	1	0
8. England, S.W., and S. Wales.	0	3	35	14	18	1	3	2	1	1
9. Ireland, N. ...	0	3	8	2	4	1	1	3	0	0
10. " S. ...	1	2	18	7	8	1	4	7	1	1
11. Scilly and Channel Islands ...	0	3	3	0	4	0	1	3	0	0
Total ...	4	28	293	105	174	9	30	42	10	8

Only such autographic records as are regularly received at the Office are shown. It should be noted that the records from observatories, such as those at Oxford, Glasgow, Southport, are available on occasion, as well as those from the stations of the Royal Air Force.

Changes in Stations Associated with Division III.

Kensington Palace.—Since the transfer of the Meteorological Office to South Kensington a station had been maintained in the grounds of the National History Museum, and the observations were published in the Daily, Weekly and Monthly Weather Reports. The exposure of the instruments was good but the erection of the new buildings of the Science Museum spoiled it. The station has, therefore, been abandoned, and by arrangements with the Office of Works a new station was started in April, 1918, in the Nursery Gardens, Kensington Palace, where the exposure is excellent.

Salisbury Plain.—Two meteorological stations, Porton and Stonehenge, established on Salisbury Plain for military purposes have contributed observations for use in the Monthly Weather Report from June, 1918. Through Stonehenge summaries of the autographic records of the wind at Butler's Cross are received. The recording instrument, an anemobiograph, is situated on open ground about 510 feet above sea level in the middle of Salisbury Plain, about $7\frac{1}{2}$ miles north-west from Stonehenge. There could hardly be a better position for recording the unrestricted flow of the wind over open country.

Keswick.—A new climatological station has been established at Keswick by the Urban District Council.

Dover.—The climatological station at Dover, from which telegraphic reports had been sent for some years, was situated on high ground to the west of the town. This site having been found inconvenient, the station has been moved to the Maison Dieu Gardens, near to the River Dour.

Mallaranny.—At this station, in the west of Ireland, only sunshine records have been taken hitherto. It has now been equipped by the Office as a station of the third order, the observer being the M.G.W. Railway Stationmaster.

Shrewsbury.—The Office of the Ordnance Survey having been moved from Shrewsbury, the meteorological observations have been discontinued. Tenbury has taken the place of Shrewsbury as one of the District Value Stations for District 4 in the Weekly Weather Report. The observations at Birmingham are being utilised in Daily Readings.

Of other stations at which observations have been interrupted by conditions arising out of the war, the following may be mentioned:—Aberdovey, Bude, Folkestone, Hereford, Lowestoft, Rugeley and Walton-on-the-Naze. Observations have also ceased at Ruthin and at Oundle owing to the death of the observers, Dr. G. A. Crace-Calvert and Mr. N. E. Dixon. At Great Billing the Rev. G. H. Mullins formerly of Marlborough College, who has been an observer for the Office for nearly forty years, is giving up the rainfall observations.

For further details concerning these changes reference may be made to the Meteorological Office Circular.

The history of Scottish Stations is given in the report of the Edinburgh Office.

(3) CLIMATOLOGY OF THE GLOBE.

A list of the foreign and colonial stations from which documents are received is given in Circular 001 (J). In most cases these returns have not been interrupted by the war, they have been examined and summarised month by month.

For climatological information with regard to most countries the Office depends on publications received in the library. For many purposes this information has to be worked up, long term averages or frequencies being derived from the daily or monthly values found in the publications.

(4) PUBLICATIONS.

The Year Book.—The Statistical publications of the Office, which represent the public memory of the weather of each year for the purpose of future reference, are grouped together under the general title "The British Meteorological and Magnetic Year Book." Some account of the several parts of the Year Book will be found in Circular 001.

Part I. Weekly Weather Report.—The lapse of the stations at Shrewsbury and Hereford necessitated the selection of new District Value Stations in District 4, Midland Counties: excellent observations from Tenbury and from Ross-on-Wye were fortunately available.

Part II. Monthly Weather Report.—The number of stations was again slightly reduced owing to war conditions. The majority of observers arranged to take their readings at the same hour by true time throughout the year, making due allowance for the effects of the Summer Time Act. Only observations conforming with this condition are now accepted for Table IV, which refers to fixed hours. For such measurements as total rainfall and maximum temperature, consistency in the standard of time is not of the first importance, and they are accepted from stations where "summer time" is adopted.

Part III. (1). Daily Readings at Meteorological Stations of the First and Second Orders.—The break in the observations at Shrewsbury has led to the substitution of Birmingham in this publication from July, 1918.

Part III. (2). Geophysical Journal.—The monthly parts of the Journal for 1916 were issued during 1917-18, and were in the same form as in previous years, except that the table of soundings with pilot balloons had been recast in a more compact form. In the Annual Supplement an analysis of the cloud observation at Aberdeen Observatory was incorporated. With the Annual Supplement a special Supplement was published, containing the meteorological observations at St. Louis Observatory, Jersey, during the years 1914-1916. This Observatory was organised by the Rev. Marc Dechevrens, of the Society of Jesus, in 1893 and 1894, and is still under the same direction. It is a station of the First Order and its association with the Meteorological Office is welcomed.

The monthly issues of the Geophysical Journal now include the St. Louis observations, and from the beginning of 1917 an additional table showing the stations at which aurora was reported during the month has also appeared.

Part IV. Hourly Values from Autographic Records.—For the years 1911 to 1913 "Hourly Values from Autographic Records" appeared in two sections. The issue of the first section, which contained hourly values of the meteorological elements, is now discontinued, so that meteorology is only represented by the averages for the months for the several hours. The magnetic tables are still published in full. Special features of the 1915 volume, which was issued during the year under review, are the tables showing for Eskdalemuir the average diurnal variation of magnetic force on disturbed days and its harmonic analysis, and a discussion by Dr. Mitchell of the magnetic results for the five years 1911-1915 at that Observatory.

Part V. Réseau Mondial—The first four parts of the Year Book are devoted to British meteorology. In the fifth part observations from selected stations covering the whole globe in a "Réseau Mondial" are tabulated, material from the library being supplemented where necessary by manuscript returns. The volume for the year 1913 was issued in 1918, and, as data for 1914 are not available at present, the preparation of the material for 1910 has been proceeded with.

The Meteorological Office Circular.—This Circular is issued monthly; it contains official notices, a section devoted to Notes and Queries and, under the heading "The Library Table," occasional reviews of books.

The Monthly Flysheet is issued on the first day of each month; it contains a summary of the observations reported during the preceding month at certain telegraphic stations, together with general notes. The Flysheet, which has been typed, not printed, hitherto, dates from the beginning of 1917. It may be regarded as a preliminary notice of the contents of the Monthly Weather Report. Mr. F. J. Brodie has been in charge of its preparation.

Returns for Registrar-General.—A weekly summary of the weather at certain large towns has been prepared for the report of the Registrar-General for England and Wales. Quarterly and Annual Summaries are also published by the same authority. A Quarterly Summary of the Weather in Ireland is furnished in like form for the report of the Irish Registrar-General.

Admiralty Pilots.—The handbooks issued by the Admiralty for the use of navigators are provided with climatological tables prepared in the Meteorological Office. The tables for the following volumes were completed during the year:—

Mediterranean Pilot, Vol. III.

Pacific Pilot, Vol. I.

New Zealand Pilot.

West Coast of India Pilot.

West Indies Pilot (Part 2).

Special Reports.—Memoranda dealing with the climate of various regions were prepared to meet the demands of the services. One of these, on the climate of North-West Russia, is being published as Professional Notes, No. 7.

IV. INSTRUMENTS DIVISION.

Report by R. Corless, M.A., Superintendent.

Supply to the Navy.—At the beginning of the year under review a new system was introduced regulating the supply of meteorological instruments to H.M. Ships and Dockyards. Under this system the Office purchases the instruments estimated to be required by the Navy during 12 months, and supplies them on requisition of the Director of Stores, Admiralty, at rates which are fixed every six months. These rates include departmental expenses and costs of packing, insurance, and transmission to the ultimate destination, unless that destination be abroad, when delivery is effected to a London dock.

Instruments received for repair (chiefly mercurial and aneroid barometers) are valued by the Office on receipt under a schedule, and credit is given to the Admiralty for their estimated value, so that they become again the property of the Office.

Formerly the Office arranged for the purchase, and stored and issued for the Admiralty both new and repairable instruments,

the bills being paid and the books being inspected periodically by the Admiralty. This entailed separate stocks and books for Admiralty instruments.

The new system has worked well, the simplification produced by the elimination of separate stocks and books being very marked.

Comparisons made between the expenses incurred for this service and the amounts subsequently recovered from the Admiralty show satisfactory agreement.

The demands have been extremely heavy, and difficulty was found in meeting the requirements in respect of aneroid barometers until after November.

Supply to the Meteorological Section, R.E.—The heavy demands of the various units of the Meteorological Section were generally met, as in previous years, the cost of the stores being recovered from the War Office. Store accounts of the instruments on charge with each unit were kept for reference purposes.

At the close of hostilities many of the stores were returned to the Office. These were examined, and valued, and a statement of their value was prepared for the Commandant, Army Meteorological Services. Many of these instruments require repairs before they can be placed in commission again.

Supplies to the Royal Air Force.—Considerable quantities of instruments and stores have continued to be supplied to the Air Ministry for the Meteorological Stations of that department. The cost of these is recovered from the Air Ministry.

Supplies to Observatories and Official Stations.—The equipment at these stations has been kept in serviceable condition, so far as was possible, and in certain cases it was augmented where it was found to be necessary, but no general changes of importance were undertaken.

The supply of photographic paper to observatories is now undertaken by the Instruments Division.

Supplies to the Dominions and Crown Colonies.—Requisitions continued to be received under this heading, and it was usually found possible to comply with them, although in several instances prolonged delays occurred before supply could be made.

The total number of requisitions received during the year from all sources was 1,391.

Store accounts and stocktaking.—The store accounts of instruments, the property of the Committee, on charge at the Office, at the observatories and telegraphic reporting stations, at the official climatological, and sea-temperature stations, on board ships of the mercantile marine and at fishery barometer stations, as well as the lists of instruments lent to the Science Museum and other museums, have been forwarded to the respective custodians for their acceptance and return. A considerable number of ships' outfits have been written off owing to enemy action.

At the close of the financial year the annual stocktaking of stores in this division was carried out. Authority for the adjustment of a few discrepancies from the store ledger, which were thereby revealed, was given by the Director.

Exhibitions.—Exhibits illustrating methods and some results of the investigation of the upper air by means of pilot balloons and balloons carrying meteorographs were forwarded to the two British Scientific Products Exhibitions which were held at King's College, London, and at the College of Technology, Manchester.

New instruments.—The following new instruments may be mentioned as being designed or obtained during the year:—

Alligraph.—An instrument with a special form of clock designed at Benson Observatory for use on aeroplanes for recording "height" (using the R.A.F. conventional scale) up to 25,000 feet against time.

Wind direction recorder.—A modification of Mr. W. H. Dines's twin pen recorder in which slides are eliminated and levers substituted to reduce the tendency to stick shown by the original design. The essential features of the original remain unchanged.

Theodolite, balloon, Mark B.—In this instrument (*a*) the reflecting prism is pentagonal instead of triangular; (*b*) the rack and pinion for focussing the telescope is omitted, the focus being fixed for infinity; (*c*) the tangent screws have micrometer heads, which are used instead of verniers for reading the scales; (*d*) the gear for throwing the tangent screws in and out of action is redesigned and placed on the side of the instrument remote from the observer.

Theodolite, Mark C.—This is the Mark A model with an additional adjustment to secure perpendicularity of the trunnion axis and the main vertical axis.

Nephoscope, Fineman, Mark II.—The adjustable pointer is capable of rotation about the centre of the dial without rotating the dial itself. The periphery of the dial is graduated in 5° . A long narrow window is provided over the end of the magnetic needle so that the instrument can be properly set in accordance with true bearings. In use the dial is not rotated, and the direction of motion of the cloud is read off directly on the scale engraved on the periphery of the dial.

Aeroplane psychrometer.—This consists of a pair of ordinary mercurial thermometers, suitably mounted for reading at a distance of 5 or 6 feet through a pair of lenses which are arranged on a slide which is attached to the instrument and operated by the observer.

An apparatus for testing balloon-theodolites, consisting of a horizontal and a vertical collimator with suitable scales in their focal planes has been erected in the workshop.

A Roots' blower with electric motor was also installed for testing pilot balloons.

Owing to the increased accommodation necessary for the work of the division due to war requirements, the Instruments Division was moved from the Office in Exhibition Road to temporary premises secured by H.M. Office of Works at 15, Cromwell Road, in September, 1918.

At the conclusion of hostilities, steps were taken as far as possible to cancel orders for instruments and stores which had been placed with makers in August, 1918, to cover the estimated requirements of the ensuing twelve months, on the assumption that the current rate of demand would be maintained. Surplus stores are now being disposed of as opportunity offers.

V. METEOROLOGICAL OFFICE, EDINBURGH.

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

No change in the staff, which consists of the Superintendent and two lady assistants, has occurred during the year, but there has been considerable interruption to work on account of illness. As in former years, a temporary assistant was employed during the summer (for eleven weeks); but it is desirable that funds should be made available to provide at least one additional permanent assistant. Progress has been made with the tabulation of rainfall statistics, but much remains to be done in that direction. Some valuable long-period temperature tables have been compiled with the view of readily placing the temperature record of each month in its proper historical perspective.

The routine work of the Office has proceeded on the usual lines. The Registrar-General for Scotland has been supplied with a Monthly Report each month, and also with a comprehensive Annual Report. The descriptive matter of these reports is based not merely on the material available from the ordinary climatological stations, but also on a consideration of returns from the Northern Lighthouses and numerous additional rainfall records. The restrictions of the Censorship, which became more rigorous in what proved the closing months of the war, resulted, fortunately, in the temporary suppression of only one Monthly Report, that for September, 1918, which was published along with the report for the following month.

As in former years, statistical summaries of observations at Scottish stations have been regularly prepared and forwarded to the Meteorological Office, London, for publication in the Monthly Weather Report. In addition a general descriptive note of the weather from month to month has been supplied. Returns of Daily Readings in absolute units for two stations were supplied.

The Observing Stations.—Various notes regarding the Scottish observing stations have appeared in *The Meteorological Office Circular*. The deaths occurred of three old and experienced observers—Mr. D. Macalister, M.Inst.C.E., of Greenock, The Reverend J. A. Macdonald, of Buchlyvie, and Dr. W. de Watteville, of Kingussie. No arrangements have yet been made at Buchlyvie, but observations have been uninterrupted at Greenock and Kingussie. The station at Hamilton has been discontinued; but on the other hand, a new station has been started at Strathpeffer, and observations at Turnberry have been resumed after a considerable break. The retirement of Mr. Magnus Spence, The School House, Deerness, Orkney, after long service as an observer, is to be noted.

The general distribution and state of efficiency of the voluntary stations in Scotland should presently be reviewed. Many of them have stood the strain of war conditions in a remarkable manner, but at some weakness has developed. It would be easier to handle the situation and secure adequate representation if (1) a few instruments, not necessarily new, were available on

loan for old-established stations where renewals prove a difficulty, and (2) it was possible to equip and maintain a few stations with paid observers in sparsely populated districts.

Inspections.—During the year the Superintendent inspected the stations at Cargen, Castlebay, Drumlanrig, Dumfries, Kirkcaldy, Oban, Perth, Stornoway, Strathpeffer, Ruthwell, and West Linton.

Mr. Whipple, of the London Office, supervised the temporary transfer of the Lerwick telegraphic station from Fort Charlotte to Ander Hill, and visited the stations at Aberdeen, Balmakewan, Deerness, Dunrobin, Edinburgh (Royal Observatory), Glasgow (Observatory), Glasgow (Springburn Park), Inverness, Leith, Lerwick, Nairn and Paisley.

Inquiries.—Numerous inquiries continue to be dealt with either by correspondence or at an interview. In eight cases, most of them in connection with marine insurance risks, fees were charged for information supplied, the total fees amounting to £6 10s.

The Superintendent attended at the London Office for about a week in April, 1918. As for some years past, he delivered a course of lectures in elementary meteorology at the Edinburgh and East of Scotland College of Agriculture.

OBSERVATORIES.

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

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

Staff.—Mr. R. E. Watson, who had entered on his duties as professional assistant in March, 1918, was transferred to Falmouth in June, and Mr. C. D. Stewart became professional assistant in August. Mr. Hemens resumed his duties in February, 1919, after demobilisation.

Self-recording Instruments and Eye Observations.—A new arrangement devised at the Office for recording wind direction by means of the pressure-tube was on trial from July to December, 1918. Since it was dismantled the instrument has recorded only velocity.

Some of the woodwork in the box containing the drum of the water-dropping electrograph has been cut away because it obstructed the light near the margin of the photographic paper; but it is not yet possible to utilise the full width of the sheet, owing to the insufficient length of the hemi-cylindrical lens.

The wireless receiver for recording "atmospherics," which had been out of action for some time, has been removed from the Observatory.

All the meteorological records obtained except those from the pressure-tube anemograph, the float barograph, the micro-barograph and the Callendar thermograph, 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 February. The table of hourly values of potential gradient for the year 1918, from ten selected quiet days a month, has been prepared up to the end of May.

Tables of two-hourly mean values of magnetic declination have been prepared and sent weekly to the Institution of Mining Engineers and to two mining journals. Information is also supplied as to the magnetic "character" of the day, as based on declination only, and as to specially disturbed hours. At the end of each month particulars are got out of the mean diurnal inequality from all days with the exception of those of character 2 (*i.e.*, highly disturbed days), and the most recent information on this point, with corresponding information for the previous year, appears on the weekly sheet issued.

All the declination and horizontal force curves for the international quiet days for the first six months of 1918 have been measured. The list of selected quiet days for the later months of the year has not yet been received from the Director of the Netherlands Institute, De Bilt, who acts for the International Commission for Terrestrial Magnetism.

Magnetic "character" figures, according to the international standard, have been got out up to the end of 1918, and have been transmitted to De Bilt.

The seismograms have been studied up to the end of May, 1918. A list of earthquakes has been transmitted monthly to the Office, and particulars have also been sent to the Seismological Institute of the British Association at Shide.

The water-level curves from the "Nilometer" in the basement have been studied up to the end of February and the results have been sent monthly to the Office.

Regular cloud observations have been made with the Fineman nephoscope in connection with the investigation of the upper air. On days of bright sunshine observations of the intensity of solar radiation have been made with the Angström pyrheliometer within half an hour of noon.

Observations of the air-earth vertical electrical current have been made with the Wilson apparatus, and observations of the positive and negative charges per cubic centimetre associated with the more mobile ions in the atmosphere have been taken with the Ebert apparatus. These electrical observations have been taken on most fine afternoons between 14½h. and 15½h. All the regular observations made 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 observational and 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, as well as observations in accordance with the general scheme recently adopted at the Office.

Antarctic Magnetic Observations.—The measurement of the magnetic curves obtained in 1911-2 by the second Antarctic Expedition under Captain Scott has been completed by Mr. Foster. The discussion of the observations has been written out, and the MS. sent to the Committee of the Scott Antarctic Fund. Considerable progress has been made with the deduction of diurnal inequalities from the tabulated hourly values, received from New Zealand, derived from the magnetic curves of the Australasian Antarctic Expedition of 1912-13.

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, level of underground water, values of the electric potential gradient at four fixed hours, and the electric and magnetic "character." The results are also given of the absolute magnetic observations, the observations of solar radiation with the Angström pyrheliometer, the electrical observations made near 15h. with the Ebert and the Wilson apparatus and the seismic movements.

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 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.

The following papers by the Superintendent relating to the work of the Observatory have appeared during the year:—

"Terrestrial Magnetism in relation to Mine Surveying." *Institution of Mining Engineers, Trans. Vol. LV, Part 4, p. 223.*

"The Magnetic Storm of December 16-17, 1917, as recorded at Kew and Eskdalemuir Observatories." *Royal Society Proc. A., Vol. 94, p. 525.*

"Electric Potential Gradient and Atmospheric Opacity at Kew Observatory." *Royal Society, Proc. A., Vol. 95, p. 210.*

Verification Work.—Owing to the war this has been practically suspended. A collimator magnet for Lukiapang, China, was tested, and a number of horizontal force observations were made with it by the special request of the Rev. J. de Moidrey, S.J.

Three dip circles which had been tested in 1914 for the Russian Government but had remained at the Observatory, were re-tested on being taken over by the Office.

Carpenter's Shop.—Twelve thermometer screens of the largest size and two of the ordinary size Stevenson screens have been completed, and considerable progress has been made with a number of Marine screens.

Instruction to Meteorological Observers.—It has been arranged that a 2 or 3 months' course of meteorological instruction, including observations on pilot balloons, shall be given at the Observatory to selected men sent by the Office. The first observer under the new scheme began work in March, 1919.

Requisitions.—The supply of photographic paper has been transferred to the Office. In the early part of the year, prior to the transfer, paper was supplied on requisition to the other observatories of the Meteorological Office and to the Radcliffe Observatory, Oxford.

Library.—The arrangement and classification of the books has been continued, but no very great progress has been made.

Special Work in connection with the War.—A variety of confidential information has been given on magnetic and electrical matters to various committees and individuals. Unifilar magnetometer No. 140 was lent for special work in France, and some observations were made with it after its return, to provide against possible change. Two old declinometers (with magnets) were lent to the Admiralty, one of which has not yet been returned.

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

To Whom Lent.	Articles.	Date of Loan.
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
Board of Education, Science Museum, South Kensington.	Articles specified in the list given in the Annual Report of the Kew Committee for 1893.	1876
" "	Report specified on p. 52 of the 10th Annual Report of the Meteorological Committee to the Lords Commissioners of His Majesty's Treasury for the year ended 31st March, 1915.	1914 and 1915
Admiralty ...	Old declinometer.	1918

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

Report by A. Crichton Mitchell, D.Sc., Superintendent.

The Committee have to note with much regret the death of Professor Watson, who lent the magnetograph still in use at Eskdalemuir for recording changes in the vertical component

of the earth's magnetic field. (See Annual Report, 1913-14, p. 55.)

Staff.—The only changes in the staff during the year were as follows:—

J. Burns, Mechanic,	} resigned.
Mrs. Burns, Housekeeper,	
Miss M. A. Kerr, Temporary Clerk,	
R. Leggat, Mechanic,	} appointed.
Mrs. Leggat, Housekeeper,	
Miss M. Ure, Temporary Clerk,	
J. B. Beck rejoined the staff on demobilisation.	

On the one hand, the staff was below the establishment strength to the extent of one Professional Assistant during the whole of the year. On the other, the total volume of work which had to be put through increased considerably. The want of skilled assistants capable of undertaking or assisting in special investigations was very keenly felt, and in consequence several lines of enquiry which might have been prosecuted could not be attempted.

Buildings, &c.—Repairs to the buildings during the year were cut down to the lowest possible minimum by the Office of Works, owing to the difficulty in obtaining labour and material.

A portion of the eastern room, upper floor, in the main building was partitioned off for photographic recording work.

The Underground Magnet House has, during the past year, given less trouble on account of damp than in any year since its erection. This is attributable to the removal of lath and plaster from interior walls and to the location and confinement within narrower limits of a leak through the asphalt layer in the foundation. Damp only shows now in the warmer summer months in the form of a thin film of moisture on certain parts of the interior face of the outer walls, and this should be removed as soon as the new ventilating arrangements are completed. The floors of the two rooms have shown no indications of damp for some considerable time.

The question of the diurnal variation of temperature in the Magnet House is an important one, and in order to determine it with accuracy arrangements were made and completed for a continuous record of temperature being obtained. The record has not been started as yet, as the only galvanometer suitable for such work is being employed otherwise. It is expected that the record will be started in about two months from now.

Water supply and drainage have worked satisfactorily during the year. The gas supply has failed on one of the branch pipes on one or two occasions owing to condensation in times of low temperature.

Magnetic Work.—The general plan of recording continuously the north, west, and vertical components of terrestrial magnetic force has continued throughout the year. Base line values for the magnetograms are obtained from separate absolute observations, made weekly or oftener, of declination, horizontal force,

and inclination. Scale values are determined fortnightly. The orientation of the magnets recording the horizontal components, and the inclination of the vertical force magnet, are tested annually on 1st January.

The reduction of the magnetic observations has for its object the publication in the *British Meteorological and Magnetic Year Book* of tables giving the following data:—(I) Hourly values of the three components N, W, and V. (II) Daily maximum and minimum values of N, W, V, with the time of occurrence. (III) Diurnal inequalities for each month and season,* and of declination, horizontal force, and inclination, for all days, international quiet days, and selected disturbed days. (IV) Tables of non-cyclic change and inequality ranges for each month. (V) Harmonic coefficients of the diurnal inequalities for each month and season, and for the year, of the N, W, and V components and also H, D, and I, (a) on all days, and (b) selected disturbed days. (V) Mean Monthly Values of N, W, V, H, D, I, and Total Intensity. (VI) Magnetic Notes for each month. (VII) The reproduction of the magnetograms on certain days of large disturbance.

For the 1915 *Year Book*, which finally passed through the press during the year under report, a Review of the principal magnetic results of 1915 was prepared, and a comparison made with those of previous years since 1911, when the present system of observation was instituted. A corresponding review for 1916 was also prepared.

It has to be noted that the separate tabulation and reduction of disturbed-day-records is new.

In accordance with the scheme of international co-operation, information was forwarded to the Magnetic Commission as to the magnetic character of each day in the year. In order to provide, if possible, some numerical basis for this information, and thereby make it more exact, a trial was made during the year of Dr. Chree's suggestion to use the sum of the squares of the absolute daily ranges of the three components as a measure of magnetic activity. The method promises well and is being continued. The data referred to are sent to De Bilt Observatory, from which institution we receive in return similar information.

An examination of 400 hours' records was made during the year in order to test Biddlingmaier's method of measuring magnetic "activity." The results were not sufficiently regular to justify the use of the method, even if the initial objection to it—the necessity for much laborious computation—were overcome.

In addition to the above annual tabulation and reduction, other matters connected with the reduction of past years' magnetic records received a good deal of attention. In anticipation of the time when there must be some general discussion of the Eskdalemuir results, the data for all the years since 1911 have been brought in a comparable form, with a view of getting them as nearly as practicable up-to-date in this form and maintaining them so. Only the main features so far have been dealt with. A certain amount of the work so done appears in the Reviews for 1915 and 1916, referred to above.

* And for the year of the N, W and V components.

During the year under report, arrangements were made for the observation and measurement of small or rapid pulsations in the vertical component of terrestrial magnetic force. This was carried out by recording the currents induced in a coil of wire laid in a horizontal plane, and for this purpose an insulated cable was laid over the moor, in the vicinity of the Observatory, so as to enclose an area of about 800,000 square metres. The cable was laid along a contour line, 1,000 feet above sea level, the accurate marking out of the line being done by an Ordnance Survey party directed by Mr. Mathieson. The preliminary observations establish the fact that, far beyond the region which is observable by ordinary magnetographs, there are numerous pulsations in vertical force of an extremely varied character. This opens up a promising field of inquiry.

Taken all round, the magnetic work at the Observatory increased very considerably during the year.

Meteorology.—The system of meteorological observation consists of autographic continuous records, of eye observations made at seven fixed hours in the twenty-four, and of a close watch on the weather except for the interval between 1 a.m. and 7 a.m.. The autographic records were added to during the year by the establishment of two recording thermographs at levels 400 feet vertically apart, in connection with observations on valley fogs. Eye observations of visibility and fog density were added. Special attention was paid to the watch on the weather, and it is believed that few, if any, changes of importance, no matter the time of their occurrence, have escaped notice or have not been acted upon when necessary.

The information thus collected was used in the first instance in the compilation of weather telegrams despatched at 1h., 7h., 13h., 18h., and at other times when weather conditions required. The number so despatched during the year was 1,643, as compared with 1,505 in the preceding year. The number of pilot balloon ascents made during the year was 201, a considerable increase over the average of previous years.

Considerable annoyance was caused on several occasions, not merely by interruptions due to breaks in the telephone wire to Langholm, but owing to the delay in getting breaks repaired.

The continuous records of pressure, temperature, humidity, rainfall, wind, and sunshine were tabulated in the usual manner on weekly sheets, which were forwarded to the Meteorological Office. The practice has been to prepare hourly values of these quantities, with monthly means, inequalities, maxima and minima, and to prepare other statistical deductions therefrom, at the Meteorological Office. This tends to make the Observatory merely a means of collecting information which, transmitted elsewhere at once, is not studied on the spot, and has disadvantages if anyone on the Observatory staff wishes to examine or work on the data up to a recent date. To improve matters, the monthly sheets of hourly values, &c., are now prepared here soon after the end of the month to which they relate. The same process is being applied to annual data.

In addition to the ordinary meteorological work referred to, special observations, with a view to obtaining a definite visibility scale, were made during the year by a method devised by Professor Peddie. In order to complete these, a set of observations is still required, and, it is hoped, will soon be made, on intensity of illumination of an exposed surface under different conditions.

The revised code for weather telegrams came into operation on 17th February. In connection therewith, scales for visibility and fog intensity suitable to local conditions had to be prepared.

Continuous records of atmospheric electric potential gradient were obtained as hitherto, and the observed values tabulated and reduced.

Observations with the Angström Pyrheliometer were made on a few occasions during the year. But the number of days annually on which these are possible at Eskdalemuir is comparatively small.

Seismology.—The three Galitzin seismographs have been in operation throughout the year, except on a few occasions when the clockwork of the recording drum (a weak part of the design) has given trouble. The monthly earthquake bulletin has been prepared as usual, but owing to pressure of other work is now slightly in arrear. The bulletin gives particulars of the amplitude and period of microseismal displacements in the N-S direction measured four times daily.

I regret it was not possible, owing to other demands, to do more in this interesting branch of the Observatory work. The difficulty is that work on Galitzin seismograms requires uninterrupted attention on the part of those engaged on it, and this could not be given in the conditions which prevailed during the year.

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

Report by L. H. G. Dines, M.A., A.M.I.C.E., Superintendent.

Mr. P. I. Mulholland, B.Sc., joined the staff as Professional Assistant at the Observatory in August, 1918.

As there is no accommodation for assistants near the Observatory, the Superintendent has, as before, acted as Resident Observer and has been responsible for most of the evening and early morning observational work; the Sunday work is now shared by several of the staff in rotation.

One member of the office staff is being trained in carpentry and mechanical work and is now able to supply to some extent a deficiency which has always been felt.

In order to provide more space in the computing room, an adjoining room in the dwelling-house has been connected with the observatory by a doorway and taken into regular use for observatory purposes.

The outside of the observatory has been painted during the year.

About three acres of the observatory property, previously noted as being under cultivation, are still let for that purpose.

The observatory has been maintained as a first order meteorological station keeping a continuous record of the weather, with notes on any interesting or abnormal phenomena which may be observed. Cloud observations with the Fineman nephoscope have been made on the prescribed days whenever the conditions were suitable, in connexion with the international investigation of the upper air. There have been no additions to the self-recording equipment during the year. All the existing instruments have been kept in continuous operation, with the exception of the Fernley rain-gauge which has been returned to the owners, Messrs. Negretti and Zambra, for alteration and repairs.

All the meteorological records obtained have been tabulated for each hour and the work checked at the observatory, with the exception of the micro-barograph, hair hygograph and the pen thermograph and barograph. C.G.S. units are almost entirely employed. Copies of the tabulated hourly values of all the meteorological elements are now kept at the observatory.

The systematic comparison between the records of the two anemometers is still being kept up, and the peculiarities often noticed before in the behaviour of the Robinson instrument are well shown by it. Good progress has been made with the comparison between the records of the Pressure Tube anemometer and the geostrophic wind, and an interesting feature of the local exposure has been discovered; within a certain range of direction the geostrophic wind systematically backs from the surface direction; it seems probable that this is caused by the configuration of the neighbouring hills.

Telegraphic reports to the Forecast Division of the Central Office have been made at regular hours three times daily, and at any other hours at which they were specially required; in addition, information has been sent at the regular hours to the Air Station at Pembroke Dock throughout the year, and for the three months September to November to the U.S.A. Air Authorities at Queenstown. The staff of the Valencia Wireless Station have rendered assistance with the telegraphic reports at certain hours as in former years.

Pilot balloon ascents have been made regularly throughout the year. The results of each ascent have been telegraphed immediately to the Central Office, and since September, 1918, have been duplicated to the Admiralty also. In all cases in which 500 metres has been reached, data of the ascent have been prepared for subsequent publication in the *Geophysical Journal*.

An ascent has been made for inclusion in the second special weather report on practically every occasion that the weather conditions allowed of 2,000 feet being reached, and up to November, 1918, one or more extra ascents were made daily on suitable days; in most cases one theodolite only has been employed. A few tailed balloons have been sent up from time to time and some interesting results obtained from them.

A welcome addition to the library has been made by the executors of the late Dr. R. H. Scott, who presented the observatory with some 700 volumes, being part of Dr. Scott's private library.

Absolute observations of magnetic declination, inclination and horizontal force have been made at fixed hours at least twice in each month. As before, only such results will be published as have been taken at times of reasonably quiet magnetic conditions.

The time standard for all purposes has been G.M.T. throughout

IX.—ABERDEEN OBSERVATORY.

The ordinary work of the Observatory, which includes observations of pilot balloons in addition to the routine of a first-order station with telegraphic reporting, has been carried on as usual. An analysis of cloud distribution at Aberdeen during 1916 to 1918 with special reference to aerial navigation has been prepared by Mr. G. A. Clarke, Assistant, and is being printed as a Professional Note.

A boy clerk has been appointed to assist in the routine work, in the absence, during the war, of laboratory students of the University.

X.—AEROLOGICAL OBSERVATORY AT BENSON.

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

The ordinary work of the station was carried on throughout the year, the telegraphic reports being sent up twice daily and the self-recording instruments kept in action practically without a break.

With regard to the investigation of the upper air, which is the primary work of the Observatory, great difficulty was experienced, though matters improved somewhat in comparison with the previous year. Balloons of a satisfactory quality could not be obtained, in several cases the balloons burst while they were being filled, and the maximum height reached during the year was only 14·8 k. In all, 10 balloons were sent up and 6 meteorographs were returned, the proportion of 6 out of 10 is lower than usual, especially in view of the fact that the ascents only took place on days when it seemed likely that the balloons would not be carried to the sea.

XI.—ARMAGH.

Regular observations have been made at the Observatory at Armagh since 1833 and less systematic records are available from 1793. Observations have been published by the Office since 1869. A Robinson anemograph and an autographic rain gauge are now maintained in addition to the equipment of a station of the Second Order.

**XII.—STATIONS IN CONNEXION WITH THE OFFICE: INSPECTIONS
IN 1918.**

The inspection of the stations in connexion with the Office had to be much curtailed during the war, and with each successive year the number of stations visited was reduced. So long as the publication in the newspapers of reports of the duration of bright sunshine was continued, the stations at the contributing health resorts were regularly visited. Inspections of these stations were, therefore, carried out in 1915, 1916 and 1917. Beyond this, inspection was limited to the telegraphic reporting stations which contribute information to the daily weather service, and to the anemograph stations where regular inspection of the instruments is necessary to maintain them in an efficient state. A few climatological stations were also visited in cases where it was possible to combine the inspection with that of a neighbouring telegraphic reporting or anemograph station.

NAPIER SHAW,
Chairman.

Meteorological Office,
London.

15th October, 1919.

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