M.O. 258.

ANNUAL REPORT

OF THE

METEOROLOGICAL COMMITTEE

TO

THE AIR COUNCIL.

For the Year ended 31st March, 1923

(The Sixty-eighth Year of the Meteorological Office).

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1923

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METEOROLOGICAL COMMITTEE.

1922-23.

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Vice-Chairman :—Sir ARTHUR SCHUSTER, F.R.S. Nominated by the Royal Society.

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Mr. J. E. W. FLOOD. Nominated by the Colonial Office.

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Captain R. C. WARDEN., C.B.E. Nominated by the Board of Trade.

Professor E. M. WEDDERBURN, M.A., D.Sc., W.S. Nominated by the Royal Society of Edinburgh.

Secretary :—Captain D. BRUNT, M.A.

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Professor E. M. WEDDERBURN, M.A., D.Sc., W.S. Nominated by the Royal Meteorological Society.

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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.

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

The Astronomer Royal.

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Dr. C. CHREE.

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Sir ARTHUR SCHUSTER.

Sir NAPIER SHAW.

Dr. G. C. SIMPSON.

Mr. G. I. TAYLOR.

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Dr. J. S. OWENS (*Honorary Secretary*).
Dr. T. L. BAILEY (*Chief Alkali Inspector, Ministry of Health*).
Professor H. B. BAKER, C.B.E., F.R.S. (*Royal College of Science*).
Dr. JOSEPH CATES, (*Medical Officer of Health to the Surrey County Council*).
Captain C. J. P. CAVE (*Past President of the Royal Meteorological Society*).
Mr. J. G. CLARK, F.I.C. (*Chemist, Gas, Light & Coke Co.*)
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*).
Lieut.-Colonel E. GOLD (*Assistant Director, Meteorological Office*).
Sir JOHN RUSSELL (*Director of the Rothamsted Experimental Station, Harpenden*).
Mr. W. B. SMITH (*Member of Departmental Committee on Smoke Abatement*).
Mr. F. J. W. WHIPPLE (*Superintendent Climatology Division, Meteorological Office*).

} Nominated by the Meteorological Committee.

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Mr. A. R. TANKARD, nominated by the Corporation of Hull.
Dr. W. HANNA, nominated by the Corporation of Liverpool.
Dr. W. T. HOWARTH, nominated by the Corporation of the City of London.
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Professor W. HALDANE GEE, nominated by the Corporation of Manchester.
Dr. R. W. SIMPSON, nominated by the Corporation of Newcastle-on Tyne.
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Mr. J. BAXENDELL, nominated by the Corporation of Southport.
Mr. JOHN FYFE, nominated by the Corporation of Stirling.

} Nominated by the Municipal Authorities contributing observations.

Dr. MARGARET FISHENDEN, nominated by the Department of Scientific and Industrial Research.

THE STAFF OF THE METEOROLOGICAL OFFICE, ITS OBSERVATORIES AND BRANCHES, MARCH, 1923.

THE STAFF AT HEADQUARTERS.

DIRECTOR:

G. C. Simpson, C.B.E., D.Sc., F.R.S.

DIRECTORATE AND GENERAL SERVICES DIVISION.

Assistant Directors ..	R. G. K. Lempfert, C.B.E., M.A., E. Gold, D.S.O., F.R.S.
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Clerks, Grades II & III ..	11
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Senior Professional Assistants	C. S. Durst, B.A., J. Hennessey, Lt. Cdr. R.N.R.
Clerk, Grade I	H. Keeton.
Clerks, Grades II & III ..	10

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Senior Professional Assistants	G. Harris, W. C. Kaye, B.Sc., Miss L. F. Lewis, B.Sc., S. C. Russell, LL.B., Miss L. D. Sawyer, B.A., R. A. Watson, B.A., S. F. Witcombe, B.Sc.
Junior Professional Assistants	J. E. Belasco, B.Sc., W. J. Grassick, M.A., Miss G. L. Thorman, B.Sc.
Clerk, Grade I	W. Hayes.
Clerks, Grades II & III ..	20
Telephone-Typists ..	8

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Assistant Superintendent ..	C. E. P. Brooks, M.Sc.
Senior Professional Assistants	E. W. Barlow, B.Sc., Miss E. H. Geake, M.Sc., P. I. Mulholland, B.Sc.
Junior Professional Assistant	N. H. Smith, B.Sc.
Clerk, Grade I	A. G. W. Howard
Clerks, Grades II & III ..	16

INSTRUMENTS DIVISION.

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Junior Professional Assistant	C. W. Lamb, B.Sc.
Clerk, Grade I	P. N. Skelton.
Clerks, Grades II and III ..	7
Instrument Designer ..	1
Storemen and Packers ..	3

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Superintendent	D. Brunt, M.A., B.Sc.
Clerks Grade III	*2

*Attached for temporary duty.

LOCAL CENTRES DIVISION.

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Assistant Superintendent ..	F. Entwistle, B Sc.
Junior Professional Assistant	R. H. Mathews, B.A.
Clerks, Grades II and III ..	2

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Superintendent	M. de C. S. Salter.
Senior Professional Assistant	J. Glasspoole, M.Sc., A.I.C.
Clerk, Grade I	A. T. Bench.
Clerks, Grades II and III ..	4

ADVISORY COMMITTEE ON ATMOSPHERIC POLLUTION, 47, Victoria St., S.W.1.

Superintendent	J S. Owens, M.D., A.M.I.C.E., F.G.S., F.R.S.I.
Junior Professional Assistant	G. M. Watson, B.Sc., A.R.C.S., A.I.C.

NAVY SERVICES DIVISION.

Superintendent	L. G. Garbett, Commander R.N.

THE STAFF AT OBSERVATORIES AND BRANCH ESTABLISHMENTS.

METEOROLOGICAL OFFICE, EDINBURGH.

Superintendent	A. Crichton Mitchell, D.Sc., F.R.S.E.
Assistant Superintendent ..	A. Watt, M.A., F.R.S.E.
Senior Professional Assistant	C. K. M. Douglas, B.A..
Clerks, Grade III	5
Housekeeper	1

KEW OBSERVATORY, Old Deer Park, Richmond, Surrey.

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Senior Professional Assistants	S. T. A. Mirrlees, M.A., R. E. Watson, B.Sc
Junior Professional Assistant	C. H. Kellett, B.Sc.
Clerk, Grade I	E. Boxall.
Clerks, Grades II and III ..	5
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THE OBSERVATORY, Eskdalemuir, Langholm, Dumfries-shire.

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Senior Professional Assistant	E. Taylor, M.A., B.Sc.,
Clerks, Grade III	3
Housekeeper, Mechanic and Handyman	3

VALENCIA OBSERVATORY, Cahirciveen, Co. Kerry.

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Senior Professional Assistant	One vacancy.
Clerks, Grade III	3
Messenger	1

THE OBSERVATORY, BENSON, Wallingford.

Assistant Superintendent .. L. H. G. Dines, M.A., A.M.I.C.E.
Instrument Maker .. 1
Mechanic 1

THE OBSERVATORY, King's College, Aberdeen.

Clerk, Grade I .. .. G. A. Clarke.
Clerks, Grade III 2

THE OBSERVATORY, LERWICK, Shetlands.

Senior Professional Assistant J. Crichton, M.A., B.Sc.
Clerks, Grade III 2
Caretaker 1

PORT METEOROLOGICAL OFFICE, Liverpool.

Senior Professional Assistant G. ff. H. Lloyd, Commander R.D., R.N.R.
Clerk, Grade III 1

METEOROLOGICAL OFFICE, Malta.

Superintendent .. .. W. A. Harwood, D.Sc.
Senior Professional Assistant J. Wadsworth, M.A.
Clerks, Grades II & III .. 4 (one vacancy).

ARMY SERVICE STATIONS.

METEOROLOGICAL OFFICE, Shoeburyness.

Senior Professional Assistant C. E. Britton, B.Sc.
Junior Professional Assistant One vacancy.
Clerks Grades II & III .. 12

METEOROLOGICAL OFFICE, LARKHILL.

Senior Professional Assistant R. P. Batty, B.A.
Clerks Grades II & III .. 3

METEOROLOGICAL OFFICE, Porton.

Clerks Grade III 3

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ANDOVER.

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Clerks, Grade III 2

BIGGIN HILL.

Clerks, Grades II & III .. 3

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Junior Professional Assistant One Vacancy.
Clerks, Grade II & III .. 5

CASTLE BROMWICH.

Clerk, Grade III 1

CATTEWATER.

Clerks, Grade III 2

CRANWELL.

Assistant Superintendent .. W. H. Pick, B.Sc.
Junior Professional Assistant One vacancy.
Clerks, Grades II & III .. 5

CROYDON.

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Clerks, Grades II & III .. 7
Telephone-Typists .. .. 2 (one vacancy).

GRAIN.

Senior Professional Assistant H. St. G. Dyke-Marsh, B.A.
Clerks, Grade III 2

HOLYHEAD.

Clerks, Grades II & III .. 3

LEUCHARS.

Senior Professional Assistant W. Gillon, M.A., B.Sc.
Clerks, Grade III 2

LYMPNE.

Senior Professional Assistant R. S. Read, M.A., B.Sc., A.R.C.S.
Clerks, Grades II & III .. 5

MANCHESTER.

Clerks, Grade III .. .. 2 (one vacancy)

RENFREW.

Senior Professional Assistant J. J. Somerville.
Clerks, Grade III 2

SHOTWICK.

Senior Professional Assistant H. F. Jackson, M.S.E.
Clerks, Grades II & III .. 3

SOUTH FARNBOROUGH.

Senior Professional Assistant R. M. Stanhope, B.A.
Clerks, Grade III 3

SECONDED FOR DUTY WITH OTHER BODIES.

Assistant Superintendent .. R. A. W. Watt, B.Sc., A.M.I.C.E. (Department of Scientific and Industrial Research).

Senior Professional Assistants Miss E. E. Austin. Maths. & Nat. Sci. Tripos. (Imperial College of Science).
F. J. Herd, A.M.I.Radio E. (Department of Scientific and Industrial Research).
N. K. Johnson, B.Sc., (War Office, Porton Experimental Station).

Junior Professional Assistants O. F. T. Roberts, B.A. (War Office, Porton Experimental Station).
F. J. Serase, B.Sc. (War Office, Porton Experimental Station).

ANNUAL REPORT

OF THE

METEOROLOGICAL COMMITTEE

TO

THE AIR COUNCIL,

For the Year ended 31st March, 1923 (the Sixty-eighth Year of the Meteorological Office).

THE METEOROLOGICAL COMMITTEE met four times during the year: on 24th May, 25th October, 22nd November, 1922, and 21st March, 1923.

On the reorganization of the Department of Civil Aviation, when the post of Controller-General of Civil Aviation was discontinued, the Air Council decided that the Under-Secretary of State for Air should act as Chairman of the Meteorological Committee in place of the Controller-General; while the Director should report to the Secretary of the Air Ministry on questions of administration.

A few days before the commencement of the year under review Captain D. Fulton, the representative of the Board of Trade on the Committee, died suddenly. Captain Fulton was very much interested in meteorology, and he gave much help to the Meteorological Office. The Committee desire to record their appreciation of his services and their regret at his early death. Captain R. C. Warden was nominated by the Board of Trade to succeed Captain Fulton.

In view of the continued need for national economy the attention of the Meteorological Office during the year has been directed mainly to improving the efficiency of the work already undertaken. With the exception of the establishment of the branch office in Malta, referred to below, there has, therefore, been no important extension of the activities of the Office.

Considerable progress has been made in the reorganization of the administration of the Office, and except in a few details the procedure of the Meteorological Office is now the same as that of other departments of the Air Ministry.

Wireless Telegraphy.—The importance of wireless telegraphy as an aid to the rapid collection of meteorological data and dissemination of forecasts and warnings becomes more apparent every year. It has now been adopted to such an extent by the official meteorological services of all countries that the use of wires has practically ceased in the international exchange of weather messages, the few remaining exchanges by cable being limited to a small number of messages retained for safety or because a suitable wireless service does not exist.

In order to arrange the wireless issues from the large number of countries involved so that the issues follow one another without overlapping, a large amount of international co-operation has been necessary, but this has been successfully accomplished and a time-table adopted which is working well in practice, although there is still some interference with the weather messages due to other stations emitting on wave-lengths which are too near those used for the meteorological reports.

In the British national service it has been possible to extend the use of wireless, and many messages which were formerly sent by wire are now transmitted by this means. The Committee would like to take this opportunity of acknowledging the cordial co-operation of the Controller of Communications, which alone has made it possible to organize the national and international exchange of wireless messages so successfully.

Wireless Messages to and from Ships.—Ever since forecasting was commenced the need for meteorological information from the Atlantic has been acutely felt by all European meteorological services but particularly by the British service, which is the first affected by disturbances approaching from the west. The introduction of wireless telegraphy made the collection of such information possible and a service of weather messages from ships was organized in 1909. On the outbreak of war this service was stopped and it was not until 1921, that it could be re-organized. Profiting by the earlier experience it was decided to limit the number of ships sending reports and to arrange for regular observations made with instruments provided by the Office from only so many ships as would supply the number of messages required. During the year under review the observing fleet has been increased to 25, which is considered to be sufficient for present needs, and the supply of information from the North Atlantic is now extremely efficient, the observations being regularly and carefully taken and the telegrams accurately and rapidly transmitted. The whole of this work on the ships is voluntarily undertaken by the officers, and no " ship's charges " are made by the Marconi Company for the messages despatched. The Committee is grateful for this very welcome help.

A step was taken last year in the direction of making some return to the Mercantile Marine for all the help they have given and are giving to the meteorological service of the country. Twice a day a message specially prepared for the shipping approaching our western coasts was broadcasted from the high power station at Poldhu, to which was added a section giving the actual observations of pressure, wind and visibility at five coast stations in the British Isles. With this information ships' officers could construct a rough weather map showing the weather they were likely to experience on approaching their ports. A small pamphlet (M.O. 246) was also issued explaining the use of these messages.

Sailors were beginning to appreciate and make use of these messages when the Marconi station at Clifden in Ireland (to which the issue had been transferred when the Poldhu station was re-organized) was destroyed on July 27th, 1922. This was the only high power station in Great Britain issuing messages on " spark," which is the only emission most ships are able to intercept. It became necessary then to employ two low power spark stations at Malin Head and Land's End, but as the range of these stations is very restricted much of the value of the messages is lost. It is hoped that a new high power spark station will shortly become available for these messages.

Observations from America.—The Director of the United States Weather Bureau has made arrangements for a high power wireless station in America to send out once a day a message giving meteorological data for 29 stations in North America. These messages are

received in France and then re-issued from the Eiffel Tower. This is an important advance, for now, with the aid of these messages and the messages from ships, it is possible to construct daily a synoptic chart for the north temperate zone extending from the west of America to the east of Europe. This brings the dream of meteorologists for a daily chart of the whole northern hemisphere considerably nearer, and it is legitimate to hope that when conditions become more normal in Russia the dream may become a reality.

Aviation.—The dependency of aviation—especially civil aviation—on rapid and accurate meteorological reports becomes more marked every year. The meteorological station at Croydon has grown into a large establishment where 11 assistants are employed, the service being practically continuous day and night during the summer months. Every hour observations are despatched to, and collected from, the aerodromes along each of the aerial lines radiating from that station. The information thus obtained is given to the pilots by reports exhibited on the aerodromes and by special "ground signals" laid out in such a way that they can be read from the air. In addition the machines carry wireless telephones and pilots make frequent calls during flight for weather information. The provision of accurate up-to-date replies to these calls has necessitated considerable organization and close co-operation between the meteorological and wireless staffs on the aerodromes.

Climatology.—Much attention has been given to the method of presenting climatological data for the British Isles in the publications of the Office. After considerable discussion it was decided to make several changes in the *Monthly Weather Report*, and these were introduced in the number for January, 1923. It has also been decided to collect into one volume, to be published annually, the hourly values and other data obtained at the observatories at Kew, Eskdalemuir, Valencia, Aberdeen and Lerwick. The data for the calendar year, 1922, will be the first to be published in this way.

British Rainfall Organization.—The transfer of the British Rainfall Organization to the Air Ministry involved questions which did not arise so long as the Organization was in private hands. The former Directors of the Oganization acted as experts on rainfall questions and as such charged the usual professional fees. In cases of dispute and litigation the Director was retained by either side to give evidence on their behalf, and in a few cases important water undertakings retained a kind of lien on their services so that the resources of the Organization could not be employed against them. It was not clear how far a government servant should give "expert advice," which would normally be the function of a private professional expert, and and what charges should be made for any advice given. It appeared obvious that in any case a government servant could not be employed exclusively by any one party to a dispute, and this involves the corollary that he cannot advise on secret data. The Air Council on the advice of the Meteorological Committee, therefore, appointed a small committee to advise them, on which the chief interests concerned were represented. The Committee consisted of:—

Dr. G. C. Simpson, F.R.S. (*Chairman*), Director of the Meteorological Office.

Mr. W. J. E. Binnie, B.A., M. Inst. C.E. F.G.S., Representative of the Institution of Water Engineers.
Mr. Ernest P. Hill, M. Inst. C.E., Representative of the Institution of Civil Engineers.
Mr. Walter Sedgwick, M.A., F.R. Met. Soc., Representative of the Society of Parliamentary Agents.
Mr. S. T. Blackwell, Representative of the Finance Division of the Air Ministry.

The terms of reference were :—

1. To draft a scheme to govern the conditions under which the services of the Superintendent or other officials of the British Rainfall Organization may be made available for the public and to define the duties which they may be called upon to perform in this way.
2. To draw up a scale of fees payable to the Ministry for the services rendered, and to define the method of payment and the allocation of fees in cases when more than one party is advised on the same matter.
3. To draft a form of Agreement which shall be entered into in each specific inquiry.

Two meetings were held on March 13th and April 20th, 1922, at which a draft scheme and a draft form of agreement—embodying the scale of fees— were drawn up for submission to the Air Council. With slight alterations these were accepted by the Air Council and approved by the Treasury. The scheme and agreement as finally approved are printed as an appendix to this report.

Malta.—It was realised when the future of the Meteorological Office was under consideration after the war that if aviation develops and regular communication by aeroplane or airship is established with the East, an organization will be necessary for supplying to the pilots detailed information of the meteorological conditions prevailing over the Mediterranean Basin and forecasts of weather changes. It was therefore decided to establish a small meteorological office in Malta at which daily weather charts for the whole of the Mediterranean area can be prepared and studied and where suitable observations of upper air currents may be made.

Mr. W. A. Harwood, late of the Indian Meteorological Service was appointed Superintendent and, with a senior professional assistant and staff assistant from England and local help, established the new office on June 14th, 1922.

The work of the new office consists at present of collecting from surrounding countries meteorological information, mainly by wireless telegraphy, and plotting and studying the information received. Reports and forecasts are then issued to the local authorities requiring them. Observations of the upper air are regularly taken so that information for the use of aviation is available as required. The observational work is carried out under Professor Agius by the staff of the University Observatory ; the Committee wishes to acknowledge the help given by Professor Agius in organizing close co-operation between the University and the new office ; it is convinced that the arrangements made will be of value to the University, to the Meteorological Office and to meteorology in general.

International Union of Geodesy and Geophysics.—The first meeting of this Union was held in Rome in May, 1922, and was attended by the Director and Dr. C. Chree. The sections of the Union of most interest to the Meteorological Committee are those of Terrestrial Magnetism and Atmospheric Electricity, Meteorology, and Seismology. Dr. Chree was the acting president of the former section in the absence of Professor Tanakadate (Dr. Chree was subsequently elected president), while Sir Napier Shaw and Professor H. H. Turner were respectively the presidents of the two latter. Much useful work was done at the meetings, but the formation of this new international organization dealing with many subjects which have previously been the concern of the International Meteorological Committee raises many difficult questions. If serious overlapping of interests is to be averted there must be close co-operation between the Union and the Committee and it is hoped that some working arrangement will be reached at the International Meteorological Conference— of which the Committee is the executive body— to be held in Holland in September next. The present position of international relations will make this work particularly difficult.

International Commission for Air Navigation.—The International Convention for the Regulation of Aerial Navigation having been ratified by Great Britain, France, Belgium and Japan in June, 1921, the permanent International Commission for Air Navigation was instituted in accordance with Article 34 of the Convention. At its first meeting in Paris in July, 1922, this Commission appointed a meteorological sub-commission to deal with questions arising out of Annex G. of the Convention. Lieut-Colonel E. Gold, Assistant Director, was nominated as the British Representative on the meteorological sub-commission of which he was elected Chairman at its first meeting.

The sub-commission has had four meetings, in Paris (2), Brussels and London, and has drafted a revision of Annex G in the light of the experience gained since the Annex was originally drafted in 1919, and to bring it into accord on common points with the decisions of the International Meteorological Committee at its meeting in September, 1921.

Anglo-Franco-Belgian Conference.—At the periodical conferences on questions relating to civil aviation between England, France and Belgium held in Paris, London and Brussels, a uniform system of exchange of meteorological reports was adopted in conjunction with the meteorological services of France and Belgium in 1921. The working of the system has been examined at conferences during the past year and such additions or alterations effected as were required for the efficiency of the service and for the extension of the London-Brussels route to Cologne. Colonel Gold has represented the Meteorological Office at all the meetings.

Staff.—The Committee records with regret the retirement on June 30th, 1922, of Mr. W. H. Dines, F.R.S., from the direction of Upper Air Investigations. Mr. Dines's connexion with the Office is of very old standing. Much of his work on anemometry, done during the eighties and nineties, was undertaken in association with the Office, and the same applies to the early stages of the investigation of the upper atmosphere with kites carried out at Oxshott and Crinan. In 1905, the Meteorological Committee were able for the first time to

make definite financial provision for the investigation of the upper air by assigning a yearly sum of £500 for the provision of apparatus. The work was placed in charge of Mr. Dines, and thus began that intimate co-operation of Mr. Dines in the work of the Office which has proved of such far-reaching importance in the development of the investigation of the free atmosphere in Britain. In 1906, Mr. Dines removed from Oxshott to Pyrton Hill in order to be able to prosecute the investigation to better advantage and in 1914, when his lease of the house at Pyrton Hill expired, he transferred the work to its present site at Benson.

The Committee desires to place on record its high appreciation of the services which Mr. Dines has rendered to the Office and to British Meteorology during the years when he acted as Director of Aerological Investigations and of the generous manner in which he has placed at its disposal the facilities for carrying on the work which his house offered.

The investigation of the Upper Air is being continued at Benson with Mr. L. H. G. Dines in charge as Assistant Superintendent, and the Committee has to acknowledge its further debt to Mr. W. H. Dines in that he is allowing the workshop and office to remain on his premises. It trusts also that it may continue to have the benefit of his advice and long experience on matters affecting the conduct of the work.

The Committee also records with regret the death at the early age of 46 years, of Mr. J. H. James, Mr. James joined the staff in 1908, and upon the transfer of the Office to South Kensington in 1910, he was made instrument expert and placed in charge of the workshop. His skill as a mechanic and his ability in designing instruments were great assets to the Office and his loss will be much felt.

The retirement upon pension for reasons of health of Mr. C. W. Heinemann after 42 years of service mostly in the Climatology Division has also to be recorded. In him the Office has lost a conscientious and steady worker. Captain R. M. B. Mackenzie, Senior Professional Assistant, Messrs. J. E. Cowper and H. W. Braby, Junior Professional Assistants, have left the service of the Office in order to take up appointments elsewhere. There have also been five resignations from among the clerical staff, four in order to take up other appointments, and one by reason of marriage.

The vacancy in the grade of Assistant Superintendent caused by the resignation of Mr. R. Sargeant, to which reference was made in last year's report, has been filled by the promotion of Mr. M. A. Giblett. The reorganization of the work in Scotland has involved the promotion of Captain H. W. L. Absalom to the same grade, upon his taking charge of the Observatory at Eskdalemuir. The Assistant Superintendentships originally contemplated at Calshot and Cranwell have been filled by the promotion of Captain J. Durward and Captain W. H. Pick. Mr. J. Wadsworth has been promoted to the grade of Senior Professional Assistant upon taking up duty at Malta. Mr. A. G. W. Howard has been promoted to the vacancy in the grade of Principal Assistant (Grade I Clerk) caused by the retirement of Mr. A. H. Bell, of which mention was made in the Report for last year.

The conditions of appointment of the clerical staff have been under discussion since the Office came under the Air Ministry, and in the course of the year a scheme for their regrading has been approved.

The staff are divided into 3 grades, to which the following salaries are applicable :—

Grade I ..	£300–£15–£400	men.
	£230–£10–£300	women.
Grade II ..	£200–£10–£250	men.
	£170–£10–£220	women.
Grade III ..	£75–£5–£90–£10–£180 ..	men.
	£75–£5–£120–£7 10s.–£150 ..	women.

There is in addition one post of Chief Clerk on the scale £400–£15–£500. The application of the new salary scales has been made retrospective as from November 1st, 1921, and all salaries carry cost of living bonus at Civil Service rates in addition. Members of the former pensionable grades of the Office down to and including the grade of clerk computer, who were employed on these grades before April 1st, 1920, have been given the option between (*a*) nomination to the Civil Service Commissioners for establishment under Clause 7 of the Order in Council of January 10th, 1910, with the right of reckoning service for pension as from April 1st, 1920, and (*b*) continuation of their pension rights under the Superannuation Scheme adopted by the Meteorological Council in 1900. Members appointed after March 31st, 1920, are required to pass a qualifying examination before the issue of a certificate of establishment, but in view of the fact that the Civil Service Commissioners have consented to recognise the Matriculation Examination of the University of London and various other public examinations of similar standing for the purpose of these appointments, only a small proportion of the staff will be required actually to undergo examination. The new arrangements were brought into operation and certificates issued in the case of the majority of the staff before the close of the financial year.

The Meteorological Committee desires to express its appreciation of the services of the staff of the office, and of the assistance given to the Director in the preparation of the *Annual Report*, by the Superintendents of Divisions.

Finance.—The year under review, 1922–23, is the third in which the cost of the Meteorological Office has been borne on Air Ministry Votes. The accounts are not yet closed, it is therefore impossible to give the exact amounts for the expenses and receipts of the Meteorological Office, but the following tables give the approximate figures :—

APPROXIMATE STATEMENT OF DIRECT EXPENDITURE AND RECEIPTS ON METEOROLOGICAL SERVICES DURING THE YEAR, 1922–23.

Expenditure.

	£	£ s. d.
Salaries and Wages—		
Headquarters Establishments ..	46,500	
Outstation Establishments ..	34,700	
		81,200 0 0
Fuel and Light		600 0 0
Transport of Personnel and Equipment ..		2,600 0 0
Instruments, Equipment and Stores ..		5,300 0 0
Minor Works Services, &c.		2,400 0 0
Telegrams, Cables and Wireless Reports ..		4,850 0 0
Subventions to Reporting Stations ..		1,250 0 0
Miscellaneous		100 0 0
Superannuation Charges		3,700 0 0
Total		£102,000 0 0

Receipts.

	£	*s.*	*d.*
Receipts from Royal Society	582	0	0
,, ,, National Debt Office (Annuities)	500	0	0
Sale of Instruments, Carriage, &c. ..	3,000	0	0
Daily Weather Reports, Forecasts, &c. ..	2,100	0	0
Received from War Office	4,592	0	0
Total	£10,774	0	0

MARINE DIVISION.

The year has been one of steady progress in the application of meteorological work at sea to safe and economical navigation; though, in the eastern North Atlantic, results have been retarded by the absence in the British Isles of a long range spark wireless telegraphy station since 27th July, 1922, by which to give navigators the necessary data from the coast at sufficient range. Many complaints have been made with regard to this.

Addresses by the Marine Superintendent have been continued at important ports, and the discussion promoted has given much valuable information as to improvements still considered necessary in the interest of meteorology in general, and sea-borne commerce in particular.

With the development of the practical application desired by seamen there have been considerable improvements in the contribution of data by marine observers; and there is every indication that as the Meteorological Office improves its service to mariners, so they will respond.

The report outlining a scheme for the better fulfilment of the modern requirements of shipping and seamen, together with the advancement of the requirements of land services as affected by the sea, mentioned in last year's report, is being considered, and the Sub-Committee of Marine Meteorology, at a meeting on March 14th, recommended the adoption of the proposals regarding the publication of a monthly journal and future ocean charts in atlases.

Voluntary Observing Fleet and Observers.—The number of ships whose officers regularly make returns has been steadily maintained at about 500. The number of ships foreshadowed in last year's report (25) undertaking the wireless telegraphy coded report service to the Office was reached in September, 1922. The proportionate numbers of ships undertaking the various functions has remained practically the same as that given at the end of last year. A tabular statement for the past eleven years is given on page 22.

The senior cadets of H.M.S. *Conway* and H.M.S. *Worcester* were examined; and the Marine Superintendent has visited both these establishments during the year.

The collection of water samples on behalf of the Ministry of Agriculture and Fisheries by steamers on the Liverpool to West Indies and Liverpool to South America routes has been continued.

Obituary.—The following deaths of former marine observers and marine agent are noted with regret.

Commander R. Reynolds, R.D.., R.N.R., late Marine Superintendent, Union Castle Line.
Commander R. L. Haddock, R.N.R., late Commodore of Peninsular and Oriental Steam Navigation Co.
Captain H. L. Waite, s.s. *Melita.*
Captain L. W. Bolland, s.s. *Deseado.*
Captain W. Davidson, s.s. *Scotian.*
Captain R. Moodie Heddle, s.s. *Hobson's Bay.*
Captain E. Vooght, late ship *Sierra Lucena.*
Captain J. F. Simpson, s.s. *Verentia.*
Lieut.-Commander R. Gregory, R.N., late Marine Agent at Hong Kong.

Excellent Observers.—A list is appended on pages 23 and 24 of captains and officers who have been granted awards for "excellent" meteorological logs and wireless telegraphy weather report registers.

Classification of Meteorological Logs.—Generally the standard of the logs shows an improvement. The percentage of the number classed excellent is higher than last year. There have been a number of logs not classed, where officers in their zeal to contribute data have overlooked the necessity for using officially tested instruments for the special purpose for which the data in these logs are intended. The knowledge that high class data contained in these logs are being systematically and methodically prepared stimulates observation. 272 logs were received which have been classed as follows:—

Excellent	83
Very Good	170
Good	11

Classification of Wireless Telegraphy Weather Report Registers.—This is the first year during which these registers have been systematically classed.

228 registers were received, of which
73 were classed Excellent.
150 „ „ Very Good.
3 „ „ Good.

Ships' Meteorological Reports, Form 911, using Ships' Instruments.—1,741 of these reports have been received from ships on all routes, and much useful information has been collected by this means. As an inexpensive and popular means of obtaining a network of observation over all oceans, which cannot be completed with full logs, these forms have proved most valuable.

Port Meteorological Office and Marine Agencies.—The Port Meteorological Office, Liverpool, has done consistent good work for the betterment of the service to Liverpool shipping, and for the collection of data through Liverpool Marine Observers. There has been a very marked improvement in the care of official instruments lent to Liverpool ships, breakages of thermometers having decreased by no less than 42% since last year.

Due to frequent absences from their ports owing to the new arrangements for Board of Trade examinations, the following changes have taken place :—

Captain W. K. Stewart of the Technical College, Dundee, Marine Agent *vice* Captain J. A. S. Chalmers, Board of Trade Examiner, resigned.

Captain W. H. Hunter, Marine Surveyor, Board of Trade, has joined with Captain J. Weir in the work of the Marine Agency at Cardiff.

By arrangement with the Director of Navigation, Commonwealth of Australia, through the Commonwealth Meteorologist, the Deputy Directors of Navigation have undertaken the duties of Marine sub-agents as follows :—

Captain G. D. Williams, D.S.O., ...Sydney, N.S.W.
Captain L. G. Bolger .....Melbourne.
Captain J. J. Airey .....Fremantle.

Lieut.-Commr. P. W. S. Henderson, R.N., Superintendent, Admiralty Chart and Chronometer Depôt, Hong Kong, took over the agency vacant through the death of Lieut.-Commr. R. Gregory, R.N.

The Meteorological Office is indebted to the marine agents for much useful work. These gentlemen spend a considerable amount of time in obtaining the interest of marine observers, shipowners, and others, necessary for the success of a voluntary system of co-operation.

Data Extraction and Research.—The new system of extracting data from logs from all parts of the world, as received, has been continued.

The use of the Hollerith system has made the exchange of data with foreign meteorological services possible at very small cost ; and has provided a means of supplying yearly averages for selected areas to the Réseau Mondial. In 1920—21, 51 sets of observation per man per day, including Sundays and holidays, were averaged. During the latter 10 months of the year 1921—1922, with the use of the Hollerith machine, this average was 55. In the past year it has been 55. The total number of sets of observations extracted and punched on cards during the year was 97,533 ; 73 per cent. of meteorological logs received, which reached the high standard required, have been prepared for extraction. There is now established in the Marine Division a working system of data extraction and of indexing special phenomena, which will become more and more valuable as time goes on. There is a great need for logs received prior to April, 1920, to be dealt with similarly. Ships' meteorological reports (Form 911) have been indexed.

The following researches have been continued :—

Tropical Cyclones, with reference to which the supposed cessation of the diurnal range of the barometer, long taught as an indication

at sea, has been found to be misleading; steps have been taken to bring this to the notice of seamen, also the importance of comparing the observed pressure with the normal, in cyclone regions.

Fog and other weather at sea.

Conditions during the South West Monsoon, along the route homeward, Colombo to Perim, including the district adjacent to Cape Guardafui.

Current and its relation to Wind and Sea Temperature.

Exchange of Data.—Information regarding ice and derelicts in the North Atlantic, together with a summary of Atlantic wireless telegraphy weather reports have been forwarded regularly to Lloyd's.

All information received regarding ice in the North has been forwarded monthly to the Danish Meteorological Institute. Observations for the months of May and June, 1922, in the North Atlantic from the meteorological logs of 55 ships were copied and sent to the Oceanographical Institute, Bergen, Norway. 6,785 sets of observations, in selected squares in the tropics, for all months of the year 1921, were sent to the Dutch Meteorological Institute by means of Hollerith cards. Only 6 " man hours " extra time was expended, and the Dutch Office returned the cards within one month, having meanwhile computed the averages they desired, using our cards.

Mean values of barometric pressure, air and sea temperature for two selected squares in the North Atlantic for all months in 1921, have been computed by the Hollerith system for the Réseau Mondial.

Extracted observations of current in the North Atlantic, 1909 to 1921, for the months March to September, for the area Lat. 47° to 53°N., Long. 10° to 30°W.; and for all months of 1920 for the area Lat. 40° to 50°N., Long. 10° to 50°W., with generalized direction and force of wind, were sent to the Fishery Board for Scotland.

Publication of Information for Seamen.—*The Marine Observer's Handbook,* 3rd Edition, corrected to September, 1922, was published. The articles on applied marine meteorology on the backs of the Monthly Meteorological Charts were continued, amongst which were:

Steamship Route from Colombo and the East to Perim during the South West Monsoon.
Work of the Year. Note to Marine Observers.
Atlantic Hurricanes, September, 1921.
Barometer, Weather, and Wireless Telegraphy.
Arabian Sea Cyclone, April 18th to 25th, 1922, and the use of Wireless Telegraphy.
—Commander L. A. Brooke Smith, R.D., R.N.R. (Retd.).
Surface Ocean Currents.
Notes on the Weather of the New Zealand-Panama Route.
The Barometer.
—Mr. C. S. Durst.
Atmospheric Obscurity at Thames Estuary and Approaches (duration of fog signals).
Heavy Storm in Western North Atlantic, December, 1921.
Notes on Cyclones of the South Indian Ocean.
—Lieut.-Cmmr. J. Hennessy, R.D., R.N.R.,
Fog.
Swell.
—Mr. H. Keeton.
Clouds and Weather Charts.
Ice in the Northern Hemisphere.
Clouds.
—Mr. A G. W. Howard.

Information required in connection with the Investigation of Missing Ships, and other Maritime Casualties.—It was found that this work could be more suitably handled by being placed entirely in the hands of the Marine Superintendent: other Divisions supplying information of the weather conditions for coast stations when necessary. All regular forms of returns made by ships and coast stations have been used to provide the necessary information. The work has been very heavy.

Wireless Telegraphy, Reports from North Atlantic Liners.—The high state of efficiency reached at the end of last year has been maintained. During the year 2,807 weather reports have been received, and checked in the Marine Division on receipt of registers. Of these 561 were received within 1 hour of observation, 699 were received within 1 to 2 hours of observation, 513 were received in from 2 to 4 hours of observation. The remainder, 1,034, were over 4 hours in transmission. 535 errors, corrected by the check system, were substantiated on receipt of registers, while the check failed in 41 cases.

The Application of Wireless Telegraphy to Weather Work at Sea.—For the reason already stated, progress in the eastern North Atlantic has been retarded; and the following is an example of the loss of utility of these reports, due to inadequate wireless range of Land's End and Malin Head Stations. The Bibby Line s.s. *Oxfordshire*, Captain Adamson, homeward bound, was unable to intercept the report until after passing Ushant on 29th October, 1922, by which time the ship had run into a N.E. gale, and was 14 hours late on arrival. Had she been able to obtain the reports of the 26th, 27th and 28th, it is probable that Captain Adamson would have increased speed earlier; or have made up his mind that he would not attempt to arrive in accordance with schedule, and so expense, wear and tear, and discomfort to passengers would have been reduced.

It is evident that the practice of exchanging reports is steadily growing, and that these reports are being made on more uniform lines. The most striking examples which have been investigated during the year were:—

At 8 a.m. on September 8th, 1921, Captain Shadforth, of s.s. *Dundrennan*, broadcasted a report which was intercepted by H.M.S. *Valerian* and other ships; and the information enabled Commander England, R.N., of H.M.S. *Valerian*, near Barbados, to locate the centre of a hurricane, and so take the correct action in assisting the schooner *Lillian J. Barnes*, with 200 native emigrants on board, who was dragging her anchors in Carlisle Bay, Barbados.

In April, 1922, there was a cyclone in the Arabian Sea, and a great number of steamers on the Colombo-Perim route exchanged W/T reports. All avoided the centre with the exception of one steamer.

General Improvement in Observation.—Marked improvement has been made in barometric observation, current observation has improved, and special attention is now being focussed on temperature observation. Experiments are being conducted by marine observers themselves, in order that improved methods may be adopted which are convenient and practicable under the conditions of the service in which observations are made.

DETAILS OF VOLUNTARY OBSERVING FLEET AND COAST STATIONS.

	At 31st March.										
	1923	1922	1921	1920	1919	1918	1917	1916	1915	1914	1913
No. of Ships equipped with sets of instruments keeping full Logs ...	123	125	133	104	—	—	—	—	192	209	192
No. of H.M. Ships keeping full Logs ...	9	9	9	2	2	—	—	1	3	4	6
No. of Ships contributing ship's Meteorological Reports, using ship's own Instruments ...	332	341	216	117	7	—	—	—	—	—	—
No. of Ships equipped especially for W/T Weather Reports ...	24	17	1	—	—	—	—	—	9	11	12
No. of Coast Stations equipped with Instruments for Form 129A....	38	40	42	53	52	49	49	58	59	62	61
No. of Ships equipped with Instrumentsfor Home Waters Telegraphic Reports ...	8	8	24	—	—	—	—	—	—	—	—
No. of Ships with Instruments on board, logs overdue	0	0	2	19	—	—	—	—	—	—	—
No of Barometer Errors ascertained or checked ...	1355	1025	365	—	—	—	—	—	—	—	—

	Receipts for the year ended 31st March.										
	1923	1922	1921	1920	1919	1918	1917	1916	1915	1914	1913
Meteorological Logs... ...	272	264	204	67	22	59	115	147	224	279	290
Ships' Meteorological Rpts.	1741	1717	1068	503	21	144	670	882	1064	1597	1628
Forms 129A...	423	460	437	381	334	324	340	351	510	682	680
Lighthouse Registers ...	13	16	16	12	16	15	14	15	14	15	17
Ocean W/T Report Registers	228	98	—	—	—	—	—	20	410	858	783
Home Waters Telegraphic Reports ...	752	1066	1808	—	—	—	—	—	—	—	—
Cadets Meteorological Logs...	9	9	6	—	—	—	—	—	—	—	—
New Data extraction.											
Logs extracted	204	155	169	—	—	—	—	—	—	—	—

LIST OF CAPTAINS AND OFFICERS WHO HAVE BEEN AWARDED "EXCELLENT."

Captain.	Chief Observing Officer.	Ship.
*Ashley, H.	Maddrell, G. D.	*Hypatia*
Beadnell, F.E., Commr., R.N.R.	Weller, A. E.	*Baltic* / *Adriatic*
*Black, J.	Brownlee, A.	*Saturnia*
Bradshaw, J.	Bowyer, S.	*Lapland*
Byers, G.	Hunter,	*Changchow*
Campos, V., O.B.E., Lt.-Commr., R.N.R.	Muir, A. S.	C.S. *Colonia*
Carlton, G. F., O.B.E., Commr., R.N.R.	Hegarty, L. J.	C.S. *Stephan*
Charles, Sir J. T. W., K.B.E., C.B., Com., R.N.R., R.D.	Croasdaile, J. F.	*Aquitania*
Cornish, N.P.	Barker, G. W.	*Matheran*
Cottell, S. C.	Keating, R. S.	*Port Victor*
David, H. F., Capt., R.N.R., R.D.	Crowley, E. E. A.	*Adriatic*
*Davies, J.	Pellas, I.	*Highland Heather*
Davies, J. Burton	Anderson, M. J. / Robertson, E. G.	*Whakatane*
Diggle, E. G., Capt., R.N.R., R.D.	Thelwell, R. G.	*Caronia*
*Douglas, H. P., C.M.G., Capt. R.N.	Tennent, H. P. L., Lieut., R.N.	H.M.S. *Mutine*
*Evans, T. R.	Jones, A. C. H.	*Elpenor*
Fishwick, A. T.	Brufton, S. V. / Harvey, F. G.	*Port Albany*
*Fitz Roy, F. H., Capt., R.N.R., R.D.	Holland, S. J.	*Nyanza*
Griffiths, J. N.	—	*Dunbridge*
Hamilton, W. Y.	Rowlands, A. L.	*Arracan*
*Hannam, F. S.	Lancaster, H. H.	*Nariva*
Hayes, Sir B. F., K.C.M.G., D.S.O., Com., R.N.R., R.D.	Butcher, A. F.	*Majestic*
Hearn, G. W.	Coate, C. F.	*Port Augusta*
Higgins, C. J.	Young, G. T.	*Clan Malcolm*
Higgs, W. G.	Hudson, J.	*Port Stephens*
*Hill, R.	Jones, A. C. H.	*Elpenor*
Hill, S, A. Geary, D.S.O., Commr. R.N.	Turner, H. E., Lieut. R.N.	H.M.S. *Endeavour*
Hoad, A. C.	Pinckney, H.G.B.	*Port Caroline*
Howarth, F. B., Commr. R.N.R.	Hill, W.	*Homeric*
Hughes, E. G.	Richards, C. M.	*Bratton Castle*
*Kettlewell, C. R.	Neagle, H.	*Surrey*
Lainson, W. H.	Carr, J. W.	*Orduna*
Lea, W. H.	Lovegrove, F. A.	*Port Sydney*
Lear, A. W. H.	Cole, A. F. / Lawrence, H.	C.S. *Britannia*
*Macdonald, K., O.B.E.	McIntyre, W.	*City of Chester*
Mackay, A. S.	McNickle, A. J. S. / Boumphrey, G. S.	*Conway*
McKellar, A. W., Capt., R.N.R., R.D.	Freeman, H. W.	*Ruapehu*
Randall, H. W., Capt., R.N.R., R.D.	Edwards, L. J. / Munford, T. H.	*Nore*
Reilly, J. V.	Graham. L. D.	*Woodarra*
Roberts, J., C.B.E., D.S.O., Capt., R.N.R., R.D.	Walker, R. S.	*Celtic*
Robinson, C. A.	Townshend, C. R.	*Port Augusta*
Rolls, J. T.	Ditcham, K.	*Niagara*

*Those marked with an asterisk appear in the list of "excellent" observers for the first time.

LIST OF CAPTAINS AND OFFICERS WHO HAVE BEEN AWARDED "EXCELLENT"—*cont.*

Captain.	Chief Observing Officer.	Ship.
Rostron, A. H., C.B.E., Capt., R.N.R., R.D.	Stainsby, P. A.	*Mauretania*
Rowe, S. N.	Ellwood, D. A. C.	*Carpentaria*
Shelford, W. S., Lt.-Commr., R.N.R.	O'Bryen, A. O. H.	*Orvieto*
Sibbons, H.	Meikle, A. R.	*Minnedosa*
*Simner, G. L., Commr. R.N.R., R.D.	Savage, N.	*Omar*
Stanley, W.	Hawkins, P.	*Herefordshire*
Staunton, H. G., C.B.E., Commr. R.N.R., R.D.	Smithard, E. G.	*Ormonde*
Taylor, A., O.B.E., Lt. R.N.R.,	Allingham, J. W.	*Frankenfels*
Turnbull, J., C.B.E., Capt., R.N.R., R.D.	Lane, J.	*Empress of Britain*
Waite, H. L. (The Late)	Mories, H. G.	*Melita*
Wigger, W.	Cave, L. J.	*Hatarana*
*Willis, M.	Rowlands, A. L.	*Arracan*
*Wilson, W. W.	Wells, F.	*Hatarana*
*Woodhouse, A. F. B., Lieut.-Commr., R.N.	Cowan, D. L., Lieut., R.N.	H.M.S. *Fitzroy*
*Wyles, W. S.	Norris, H. W. Turner, J. E.	*Bambra*
*Young, G. J.	Rowlands, A. L.	*Arracan*

*Those marked with an asterisk appear in the list of "excellent" observers for the first time.

FORECAST DIVISION.

The work of the Division has been carried on throughout the year on the same lines as previously, but many developments have taken place, some of a far-reaching character.

General—The charges for the Daily Weather Reports and for forecasts supplied by telegram and telephone were revised at the beginning of February, 1923.

Arrangements were made, at the end of 1922, to have a printed post-card attached to each pilot balloon sent up in the British Isles before release. The card bears the name of the station with the date and time of ascent, and the finder is asked to post it to the Meteorological Office. Many cards have been received in the Forecast Division and a number of interesting cases noted, in which the balloon travelled an unusually long distance, or showed an upper wind materially different in direction or force from that prevailing at lower levels.

A pamphlet entitled *The Wireless Weather Manual* (M.O. 255) was prepared and issued in July. This gives a complete account of the various synoptic reports and weather forecasts issued by the Air Ministry together with full explanations, codes and instructions in the method of plotting the observations.

Nine supplements to M.O. 252 *Particulars of Meteorological Reports issued by Wireless Telegraphy in Great Britain and the countries of Europe and North Africa* have been prepared and published. These give alterations and additions to the pamphlet as necessary from time to time. After the issue of the first two supplements, special arrangements were made for rapid printing so that changes taking place in foreign reports are notified to those interested in this country within a few days of the receipt of information in the Meteorological Office.

During March a sunshine recorder and a hyetograph were installed on the roof of the Air Ministry, and records are now regularly taken and filed in the Forecast Division.

Some re-organization has taken place in the temporary staff, and a new grade of telephone-typist has taken the place of the temporary telephone staff previously employed. All telephone work in connection with the London-Continental Air Routes, hitherto carried out in the Forecast Division was transferred to the Local Centres Division in December, one telephone operator being loaned to that Division in order to provide adequate staff.

Observations Received.—(a) *British Reports.*—Considerable changes have taken place in the telegraphic reporting stations and observers during the year. For the greater part of the period, reports from the western Irish stations have been very irregular owing to interruption in telegraphic communications. This has been a great hindrance to the forecast work throughout the year. With the evacuation of Ireland by the British Forces, the coastguards were withdrawn from Blacksod Point and Malin Head, but arrangements were made locally for carrying on the work. Communication with the Scilly Isles was interrupted during July and August and again in October and November; in the last named month communication with Castlebay was broken for 14 days.

Early in the present year notification was received of the transfer of many coastguard stations from the Admiralty to the Board of Trade as from April 1st, 1923. Eight telegraphic reporting stations were affected, but with the exception of Scilly and Pendennis, the observing work was not hindered. In the case of these two stations the interruption which occurred was of brief duration.

A new station at the Post Office Wireless Station at Leafield was set up in October. At present the observations are not being telegraphed. They will ultimately replace those from Benson, when the latter station is closed.

Observations from the R.A.F. aerodrome near Dublin (first Baldonnel and later Collinstown) ceased after 23rd October, when the aerodrome was closed.

During the year Andover and Leuchars were added to the list of telegraphic reporting stations and the following health resorts were added to those from which observations are received for issue to the press:—

Cromer	North Berwick
Guernsey	Lerwick
Ilkley	

Observations from Banff ceased in November.

It has not yet been possible to arrange for a telegraphic reporting station in the northern Midlands to replace Howden. Negotiations are still in progress.

Observations from Atlantic Liners were received by wireless telegraphy throughout the year. Many of the reports were transmitted in a very short time and all have proved a most valuable addition to the information received from land stations. The number of ships' reports received from foreign countries has shown some increase during the year and these now frequently form a useful supplement to the reports from British ships.

Upper wind observations have been received from local centres and observatories and upper air temperatures have been taken by means of aeroplanes when conditions permitted at Andover, South Farnborough, Grain and Leuchars.

(b) *Foreign Reports.*—More continental countries have adopted the new international code in the course of the year and 19 now use the code against 12 at the end of the previous year.

The complete list is as follows :—

Azores (modified)
Belgium
Czecho-Slovakia
Denmark
Egypt
Finland
France (in general European issues)
Gibraltar
Greece
Holland
Iceland (modified)
Jugo-Slavia
Malta
Norway
Poland
Portugal
Roumania (Bucharest only)
Sweden
Switzerland

With the increase in the use of wireless telegraphy as a means of exchanging weather information the transmission of reports by cable has still further diminished. Regular reports are still received from Rome each morning, and from Christiania three times a day, while one cabled report is received daily from Holland and Portugal. Reports are also received by cable from a few other foreign stations with which no exchange of observations is in operation.

By mutual agreement between Belgium, Denmark, France, Holland, Norway, Sweden and this country, arrangements have been made whereby a selection of observations is issued by cable on the rare occasions when the normal issue by wireless fails.

During June the method of disseminating the Iceland weather reports was altered. The reports are now sent direct to London by cable and issued by wireless from the Air Ministry to continental countries.

Rainfall reports from Thorshavn have been received in the morning and evening messages since 20th January, and from Reykjavik since 1st February.

Since the 26th June a daily wireless synoptic message containing reports from 29 stations in the United States has been received from France. The reports are sent by wireless telegraphy from the United States to France, and re-issued from the Eiffel Tower for the benefit of European countries.

On the 28th October, the first weather report was received from Greenland, being included in the Christiania wireless synoptic A Norwegian expedition is wintering at Mygbugten, Lat. 73° 30'N,

Long. 21° 30'W, and sending observations by wireless to Norway. These reports form a very useful addition in that part of the observational area which is very sparsely covered with meteorological stations.

Occasional observations have been received from the steam-ship *Maud* of the Norwegian Polar Expedition in Lat. 72°N, Long. 175°W.

Distribution of Information.—The British Synoptic reports issued by wireless telegraphy have remained practically unchanged throughout the year. The reports continue to be issued five times each day from the Air Ministry, the 0200 issue being repeated at 0600.

In response to a request from the Norwegian Meteorological Service all British ships' reports which cannot be included in the regular wireless issues at 0800, 1400, 1900 and 0200 are now added to the supplementary issue at 0600.

Since the 3rd July, a wireless synoptic report giving data from about 20 foreign stations has been issued daily at 0850 and 1450 G.M.T.

The issue of the "Western Seaboard" reports and forecasts was transferred from Poldhu to Clifden in May, and when the Clifden station was destroyed in July the reports were issued from Land's End and Valencia. Subsequently, in August, Malin Head took the place of Valencia.

The number of daily synoptic reports sent by cable has been greatly reduced during the year. Reports to Denmark ceased on 12th May; to France and Switzerland on 31st May; and to Stockholm on 31st December. Reports to Holland have consisted of observations from one station only since 1st April.

In June the "Fleet Weather" telegraphic forecast, which is prepared daily for a number of naval recipients, was modified. Instead of one report including all British coasts being issued to all addresses three separate reports are drawn up for the North Sea, English Channel and Western Coasts respectively. All three reports are supplied to certain Naval Officers and one or two reports only to others, according to their stated requirements.

Special weather forecasts in response to requests received from naval ports have been sent on many occasions during the year.

On the 14th November, a new method of issuing weather forecasts came into operation. On that date forecasts for the London district were first sent to the British Broadcasting Company for issue with their evening news bulletin. Forecasts were later supplied for issue from the broadcasting centres at Birmingham, Manchester, Newcastle, Cardiff and Glasgow as these stations were opened.

A demonstration of the application of wireless telegraphy to Meteorology was given at the Royal Agricultural Show at Cambridge from July 4th to 8th, when charts were prepared from the synoptic reports picked up and forecasts were issued.

A similar exhibition was given at the Hull meeting of the British Association in September, and at the Fisheries Exhibition at the Royal Agricultural Hall, London, from July 24th to August 5th.

Lithographed and Duplicated Reports.—The *Daily Weather Report* has been published in three sections, British, International and Upper Air, throughout the year, and no modification has taken place in form or arrangement.

A chart of weather covering North America, the North Atlantic and Europe has been duplicated and issued each day since 15th February.

The Monthly Supplement to the *Daily Weather Report* has been prepared and issued on the 1st day of each month. A short summary of the weather of the year 1922 was issued to the press on the evening of December 31st. Correction and addition sheets to the British and Upper Air Sections of the *Daily Weather Report* for each month have been prepared and published ; that for the International section ceased with the August issue.

Gale Warnings.—The gale warning service has been maintained throughout, though there has been some decrease in the number of stations. Several Irish stations were shut down in 1922 owing to withdrawal of the Coastguard force from Ireland, and at the end of the financial year a number of English stations were closed owing to the re-organization of the Coastguard Service and reduction in the number of watching posts.

Examination of the returns from the signal stations showed that the percentage of messages delivered within two hours varied from 98 in September to 92 in November and December during the day time. At night the percentage varied from 37 in September to 22 in October and March.

The distribution of gale warnings to aerodromes has been modified. Those in the south-east of England now only receive warnings when the southern or eastern parts of the country are threatened, while those in other districts continue to receive all warnings.

The warnings issued during 1922 have been checked and the table on page 29 gives the results.

It is noteworthy that no general gale was reported during the year on the east coast of Scotland and only one on the north-east coast of England.

Harvest Forecasts.—During the season June to November, 67 subscribers received notifications of spells of settled weather and 17 received Daily Forecasts. Of the 67 subscribers about half received notifications over periods exceeding two months in duration of from two to five months. Notifications of spells of settled weather were issued on 19 occasions.

Supply of information to the Press and Public.—Forecasts for issue to the Press have been prepared three times each day except on Sundays and Bank Holidays, when no morning forecasts are issued.

Remarks on the weather of the day over north-west Europe, together with a tabular statement of weather experienced at a number of Health Resorts have been issued each evening, while during the summer months these have been supplemented by a midday issue of the last named report.

Special week-end forecasts are prepared each Thursday and Friday. This service was commenced at the request of certain provincial newspapers in the eastern counties.

Regular meteorological press correspondents have been supplied with current information each evening of the week except Saturday.

Inquiries were received by telegram or telephone on 1,753 occasions, and there were 584 personal inquiries at the Press Room. In addition to these a marked feature has been the large increase in the number of applications for weather forecasts received by wireless telegraphy from ships. There was an exceptional number during the stormy period about Christmastide.

Gale Warnings Issued During the Year, 1922.

DISTRICTS.	Summary of occasions of gales.		Summary of Warnings issued.			
	Total number of occasions upon which warnings were necessary.	Percentage of occasions of gales effectively warned.	Total number issued.	Issues justified by subsequent gales (forces 8 and above).	Issues justified by subsequent strong winds (forces 6 and 7).	Percentage justified by gales or strong winds.
1. Scotland N.E. A	8	88	35	7	16	66
1. Scotland N.E. B	6	100	30	6	10	53
2. Scotland E.	—	—	26	—	14	55
3. Scotland N.W.	3	67	38	2	19	55
4. Scotland W. and North Channel.	6	33	32	2	17	59
5. Ireland N.	15	80	38	12	16	74
6. Ireland S.	7	71	32	5	22	84
7. Irish Sea.	8	88	31	7	19	84
8. St. George's Channel.	11	82	31	9	13	71
9. Bristol Channel.	21	67	29	14	9	79
10. England S.W.	19	74	34	14	13	79
11. England S.	9	89	36	8	24	89
12. England S.E.	13	92	35	12	15	77
13. England N.E.	1	100	27	1	17	67
14. England E.	2	100	27	2	23	93
All districts	129	78	481	101	247	72

INQUIRIES.

Month	1920–21		1921–22		1922–23	
	By Telephone or Telegram	Personal	By Telephone or Telegram	Personal	By Telephone or Telegram	Personal
April	37	8	76	21	14	32
May	83	32	54	21	131	59
June	73	17	82	39	150	50
July	166	36	197	65	303	72
Aug.	86	20	124	38	111	47
Sept.	54	13	110	32	103	40
Oct.	53	23	145	60	102	36
Nov.	72	23	119	56	136	41
Dec.	87	42	82	40	125	53
Jan.	85	32	147	67	193	51
Feb.	66	23	86	31	147	59
Mar.	67	30	163	59	158	44
TOTAL ..	929	299	1,385	529	1,753	584
GRAND TOTAL	1,228		1,914		2,337	

CLIMATOLOGY DIVISION.

Organization.—The normal work of the Climatology Division is the collection of meteorological observations and of autographic records, the preparation of summaries of the observations for publication, and the discussion of all information bearing on climate. The Library, which had been incorporated in this Division since 1920, was transferred to the General Services Division on 18th December, 1922.

Climatology of the British Isles, Distribution of Stations.—The following table gives the distribution by districts of the stations of different types, and also indicates where autographic records are being kept. The list refers to March, 1923.

	Stations.				Autographic Records.					
	Observatories.	Distributive.	Telegraphic.	Climatological.	Sunshine.	Rainfall.	Wind.	Pressure.	Temperature.	Humidity.
0. Scotland, N...	1	0	4	10	6	0	2	7	0	0
1. ,, E...	1	1	2	29	14	1	4	2	2	2
6*a*. ,, W...	1	1	0	20	12	1	1	2	1	1
6*b*. Isle of Man ..	0	0	0	1	1	0	0	0	0	0
2. England, N.E.	0	1	2	16	13	1	3	3	1	1
3. ,, E...	0	1	2	18	17	1	2	3	1	0
4. ,, Midlands	2	0	3	35	24	0	1	3	0	1
5. ,, S.E.	0	8	1	38	33	7	9	9	8	7
London District	2	0	0	7	6	3	1	1	1	1
7*a*. England, N.W.	0	0	1	21	18	1	2	1	0	0
7*b*. N. Wales ..	0	2	0	5	5	2	1	3	2	2
8*a*. S. ,, ..	0	0	1	6	7	0	0	1	0	0
8*b*. England, S.W.	0	1	2	29	23	1	4	3	2	2
9. Ireland, N. ..	0	0	3	5	5	1	1	3	0	0
10. ,, S. ..	1	0	2	14	6	0	3	6	0	0
11. Scilly and Channel Isles	0	0	2	1	3	0	1	3	0	0
	8	15	25	255	196	19	35	50	18	17

Only such autographic records as are regularly received at this Office are shown. It should be noted that the records from observatories such as those at Oxford, Paisley and Southport, are available on occasions. The records from distributive stations* at aerodromes are now examined at South Kensington month by month and returned for preservation locally.

The records of rainfall in possession of the British Rainfall Organization are not shown in the table.

Changes of Stations associated with the Climatology Division.—New stations have been started at Ascot (July, 1922), Earls Colne (December, 1922), Hounslow (July, 1922), Ilkley (July, 1922), Rendcomb College, Cirencester (January, 1923). Reports from Midhurst were resumed as from February, 1923.

The following stations have been given up during the year :—

Alnwick Castle (August, 1922) ; Carrigoran (August, 1922) ; Guildford (April, 1922) ; Gwernyfed Park (November, 1922) ; Hemel Hempstead (July, 1922) ; Little Massingham (December, 1922) ; Ranelagh (June, 1922) ; Ridgewell (July, 1922) ; Sevenoaks, The Old House (August, 1922) ; Baldonnel (April, 1922) ; Basingstoke (December, 1922) ; Glencarron (April, 1922).

Climatology of the Globe.—Returns from a number of foreign and colonial stations have been examined and summarised month by month. Returns have been received for the first time from the Begoro (Gold Coast) and Livingstone (Rhodesia). Manuscript returns have also been received regularly from Lagos (Nigeria). Returns from 16 stations in Nigeria (Northern Provinces) have been discontinued, adequate arrangements being in force for publication locally.

The bibliography of climatological data of some thousands of entries, in manuscript, is being kept up to date, as is also a bibliography of upper air data.

Publications.—This division is responsible for the preparation of the climatological publications of the Office.

The *Weekly* and *Monthly Weather Reports* have been published regularly throughout the year. Important changes were made in the *Monthly Weather Report* as from January, 1923, the object of the changes being to increase the amount of information given for certain stations so as to bring out the differences between cloudiness, visibility and wind at different hours of the day.

The last of the monthly parts of the *Geophysical Journal* to complete the year 1921 was issued, also the volumes for 1918 and 1919 of *Hourly Values from Autographic Records.* The tables for the *Observatory Yearbook,* which is to take the place of the *Geophysical Journal,* and *Hourly Values,* as from 1922, are being prepared at the Observatories.

The tables of the *Réseau Mondial* for 1915 were completed and sent to press, those for 1916 are approaching completion. In accordance with a resolution of the International Meteorological Committee, arrangements are being made to include in the *Réseau Mondial* data based on observations made on ships in certain selected oceanic regions.

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* The stations of the Army Meteorological Service, Shoeburyness and Larkhill, are counted with the Distributive Stations in the Table.

A list of the occasional publications passed through the press during the year is given on page 58.

Returns for Registrars-General.—A weekly summary of the weather at certain large towns has been prepared for the reports of the Registrar General for England and Wales. Quarterly and annual summaries are also supplied.

Similar information is furnished quarterly to the Governments of Northern Ireland and of the Irish Free State.

Admiralty Pilots.—These handbooks issued by the Admiralty for the use of navigators are provided with climatological tables prepared in the Meteorological Office.

The text of the meteorological portion of 5 *Pilots* was revised during the year. Meteorological tables for 35 stations were worked up in the Division for insertion in the *Pilots*. Tables for 29 stations were received from Meteorological Services abroad.

Special Investigations.—The normal values of vapour pressure month by month for some 80 stations in the British Isles have been computed with a view to the construction of charts.

The normal values of atmospheric pressure at assigned hours, usually 7 h., have been computed for the period 1881-1915 for use in the new Table IV of the *Monthly Weather Report*.

The relations between estimates of maximum and minimum temperatures recorded by thermometers read and set at various times in the day have been investigated with special reference to the routine at climatological stations.

Charts showing the frequency of thunderstorms in all parts of the world have been prepared, primarily on on account of the importance of the subject in connection with wireless telegraphy. It is hoped that the charts will be published shortly.

A memoir on the variation in the level of the Central African Lakes and its relation to meteorological and cosmical conditions, was prepared by Mr. C. E. P. Brooks and is in the press.

A book by Mr. Brooks, *The Evolution of Climate*, has been published by Benn Brothers, Ltd.

Inquiries.—The inquiries dealt with during the year were 559 (exclusive of those dealt with by other divisions of the Office). These figures compare with a total of 1,041 for the previous year. Those requiring information for legal purposes numbered 98 as against 140 in 1921-22.

INSTRUMENTS DIVISION.

General.—The work of this division has been continued on the general lines of the preceding year.

Store Accounts.—The number of Store Accounts now kept, each of which details the equipment on charge and accounted for by the Office at a single station or on board ship, is 707. Each store account has been verified on inspection or by correspondence with the custodian during the course of the year, and all discrepancies revealed have been investigated and disposed of in consultation with the relative accounts branch of the Air Ministry when necessary.

Store Audit and Stocktaking.—Air Ministry auditors visited the Division from 13th to 28th June, 1922, and from 5th to 9th March, 1923, to audit the Store Accounts from October, 1921, to December, 1922. Stock was taken of the instruments, etc., held at the central store at South Kensington as on 30th September, 1922, and 31st March, 1923, and compared with the ledgers.

Demands.—The total number of demands dealt with during the year was 1,866.

Supply of Equipment to Official Stations.—The equipment at Official Stations has been maintained in serviceable condition. Among the more noteworthy new issues may be mentioned the following :—

Anemometers.—The erection of standard Dines tube anemometers at Croydon and Lympne aerodromes in connexion with the London-Paris Air Route was completed. Similar anemometers were erected (1) at Aberdeen, on a new site which is more suitable for records of wind than that hitherto used ; (2) at the Geophysical Observatory at Lerwick. A similar installation has been provided for Kew Observatory, the existing instrument having proved to be unsatisfactory so far as records of wind direction are concerned. New instructions for the care and setting of these instruments have been prepared and issued.

" *Wall heads.*"—Concrete pillars with fittings for pilot balloon theodolites have been erected at all stations requiring them, to replace wooden tripods.

An electrical generating set for charging accumulators, and a large clock and drum for use with the Galitzin seismograph, were provided for use at Eskdalemuir.

The Adie pattern magnetographs formerly at Falmouth were reconditioned and issued to Lerwick. Other instruments obtained for this Observatory included a new Kew pattern unifilar magnetometer and a " string " electrometer.

A simple wireless set for receiving Eiffel Tower time signals and a power-driven Geryk vacuum pump for use in calibrating balloon meteorographs, were issued to Benson.

Instruments were issued to new " local centres " at Manchester and Castle Bromwich aerodromes in connexion with the new civil air route from London to Birmingham and Manchester.

Instruments were supplied for new telegraphic reporting stations at Leafield and Guernsey.

Instruments were supplied for temporary use at four artillery practice camps.

A wind speed indicator was erected on H.M.S. *Argus.*

Establishments.—Standard maximum rates of supply were arranged in respect of pilot balloons, and domestic stores to local centres.

It has been decided to maintain two gale-warning cones at each of 78 less accessible gale warning stations, the normal establishment at each of the remaining 57 stations being one cone. Supplies have been made accordingly.

Paper for recording instruments.—In co-operation with H.M. Stationery Office a new type of paper has been selected for use as record charts on self-recording instruments which use pens and glycerine ink. A new " board " for Sunshine Cards is being selected, the existing board having proved unsuitable because its thickness

was insufficient to cause the recording cards to be retained in position in the instruments in windy weather.

Investigations.—Attention has been given to the theory of the temperature corrections of the Kew pattern barometer, and to the relation between the "falling-time" of the marine barometer and the dimensions of the various parts of the tube.

The best shape and size of the cistern of a portable barometer have been determined.

A new type of portable mercurial Kew pattern barometer incorporating certain features of the Fuess portable instrument and also of the Newman barometer has been designed and a specimen obtained.

Apparatus to determine the effect of wind on readings of mercurial barometers has been obtained and will shortly be put into use.

A report of the National Physical Laboratory indicates that the large leaden counterweight placed near the opening of the pressure pipe on the vane of the tube anemometer produces no appreciable effect upon the pressure excess produced by the wind inside the pipe.

Instruments for use in making aerial surveys in connexion with sites for gliding flights are being supplied.

Apparatus has been obtained to investigate the suitability of the existing method of ascertaining earth temperatures which uses a combination of lagged thermometer in a vertical iron tube.

At the request of the International Meteorological Committee arrangements have been made for a comparison of three sunshine recorders at Kew Observatory, one being an instrument forwarded by the Director of the Swiss Meteorological Service.

Considerable attention is being devoted to the supply of suitable material for registering balloon ascents, so that the British method may be available for more extended use.

Attention is also being given to the question of pilot balloon ascents on board ship. Equipment has been lent to Captain H. P. Douglas, R.N., H.M.S. *Mutine* for trial.

Tests of Rain-Gauges and Rain Measures.—During the year 43 rain-gauges and 558 rain measures, received in the Office for tests, were approved. Fees are charged for these tests.

Exhibitions.—Publications and diagrams were displayed at the Royal Agricultural Show which was held at Cambridge in June, 1922, and a complete climatological station was set up temporarily and maintained throughout the show. Representatives of the Office attended to take the observations and to answer inquiries.

An exhibition of instruments was contributed to the Deep Sea Fisheries Exhibition held at the Royal Agricultural Hall in July-August, 1922.

Charts, diagrams and instruments were exhibited at the Royal Institution on March 2nd in connexion with a lecture delivered by the Director on that occasion.

ARMY SERVICES DIVISION.

The work of the stations at Shoeburyness and Larkhill has been continued on the lines of preceding years. At Shoeburyness a new kite balloon was received from South Farnborough at the beginning

of April, but was only in use for a short time on account of the damage done to the hangar by a gale. The repaired hangar cover has been received at Shoeburyness and after its erection the balloon will again be put into use.

Lectures have been delivered to Artillery Officers at Larkhill and Shoeburyness by the Meteorologists-in-Charge at the respective stations.

During the summer of 1922 one technical assistant was posted to each of four Artillery practice Camps at Okehampton, Trawsfynydd, Redesdale, and Buddon Ness, for the purpose of supplying upper air data to the Artillery Units posted there.

The Superintendent has attended a number of meetings of the Chemical Warfare Committee, and has continued to act as Chairman of the Meteorology Sub-Committee of the Chemical Warfare Committee.

Two temporary clerks have been engaged since the end of October upon a periodogram analysis of twelve sets of meteorological observations each extending over 100 years. The work has proceeded slowly on account of errors in the additions carried out by the Hollerith machine.

LOCAL CENTRES DIVISION.

General.—Stations have been in operation at the following places :—

Civil Aviation Aerodromes.

Croydon	throughout the year.
Lympne	,, ,, ,,
Renfrew	,, ,, ,,
Manchester	since 25th Oct., 1922.
Castle Bromwich	since 16th Feb., 1923.

Royal Air Force Establishments.

Cadet College, Cranwell	throughout the year.
School of Aerial Navigation and Naval Co-operation, Calshot	,, ,, ,,
Royal Aircraft Establishment, South Farnborough	,, ,, ,,
Instrument Design Establishment, Biggin Hill	,, ,, ,,
Seaplane Station, Cattewater	,, ,, ,,
Marine and Armament Experimental Station, Isle of Grain	,, ,, ,,
No. 5 Flying Training School, Shotwick	,, ,, ,,
Royal Air Force Base, Leuchars ..	,, ,, ,,
Royal Air Force, Andover	,, ,, ,,
No. 11 (Irish Group) Baldonnell (later Collinstown)	to 25th Oct., 1922.

Unattached.

Experimental Anemometrical Station, Holyhead	throughout the year.

Auxiliary Reporting Stations.

Beachy Head	throughout the year.
Hythe..	„ „ „
Dungeness	„ „ „
North Foreland	since 17th Nov., 1922.
Deal	since 14th Dec., 1922.

Eleven of the stations in the first two lists, being largely concerned with work of a distributive or advisory nature, have been in charge of a professional meteorologist, assisted by technical staff. The other four and the "Unattached" station at Holyhead have been manned by technical staff only during the greater part of the year. Those in the last list have no Meteorological Office staff. Beachy Head, Hythe and Deal are Coastguard Stations, Dungeness a Lighthouse, and North Foreland a Post Office Wireless Station. In these cases arrangements have been made with the Admiralty, Trinity House and the Post Office respectively for abbreviated weather reports to be supplied either as a regular routine or on demand. Further accounts of the nature and work of individual stations are given below.

Services for Civil Aviation.—The organization covers the civil air routes in or emanating from the British Isles, and it will be seen that it has to a great extent to be made to fit in with similar organizations in other countries. Briefly, it aims at providing information regarding weather, visibility, amount and height of cloud and wind at surface and at various levels in the upper air at selected stations lying on or near the routes, together with forecasts of probable developments. An Assistant Superintendent stationed at Headquarters has been directly responsible for the preparation and issue of the necessary reports and forecasts. The following special arrangements have been in operation in connection with the routes leading from London to Paris, Brussels, Cologne and Amsterdam.

(1) *Hourly Route Meteor Messages.*—(*a*) These are prepared for issue daily by wireless telegraphy from the Air Ministry, at 35 minutes past the hour, each hour from 03·35 to 16·35 inclusive during the summer months, and from 07·35 to 16·35 inclusive during the remainder of the year. They are collective messages containing the weather observations made at the hour at Croydon, Biggin Hill, Lympne, Beachy Head, Hythe and Dungeness, and under certain conditions (see (3) below), also at Grain, North Foreland and Deal. In addition, since April 1st, 1922, a group has been added to each message giving the last moment weather conditions at the terminal aerodrome.

(*b*) Other countries undertake the issue of similar collective messages, the transmissions taking place as follows:—

Brussels	24 minutes after the hour.
Paris (Le Bourget)	28 „ „ „
Soesterberg ..	45 „ „ „
Cologne	13 „ „ „

(*c*) Particulars as to the codes, &c., employed are given in the publication M.O. 252. Since 15th June, 1922, the forecasts in the British reports have been given in the forecast code of M.O. 244.

(*d*) The whole of the information contained in the above messages has been decoded and written up or charted as received and made available for consultation by pilots and others at the meteorological stations at Croydon and Lympne as well as at the Air Ministry. Since 12th July, 1922, the French forecasts as well as the British have been exhibited at Croydon Aerodrome.

(2) *Weather Reports by Radio-Telephony for Machines in Flight.*—The Radio-Telephonic stations at Croydon and Lympne have been kept supplied with the latest weather information for communication to pilots of aircraft in flight. These reports are drawn up in a set form designed to give the vital information in the briefest way. Particulars are given in Notice to Airmen No. 80 of 1922. In this connection it was later on (28th December) arranged that whenever the distance of visibility is below 1,000 yards it should be given to the nearest 100 yards to pilots of incoming machines.

(3) *Weather Reports on Alternative Route.*—During the year arrangements have been instituted whereby when bad weather conditions prevail on the normal air route between Croydon and the Channel, supplementary reporting on an alternative (North Kent) route is brought into operation. The additional places for which information is then available are Isle of Grain, North Foreland and Deal.

(4) *Ground Signals at Lympne Aerodrome.*—The system of ground signals at Lympne Aerodrome has continued in operation. The signals are described in Notices to Airmen Nos. 57 of 1921 and 18 of 1922 ; they indicate to airmen the height of the lowest cloud, the visibility and the weather at Croydon, Biggin Hill and St. Inglevert respectively Signals of a somewhat similar type are now in operation at at Ostend and Flushing.

The Air Route from London to Manchester differs from the others in that the whole arrangements are internal to this country.

(*a*) During the period since flying on this route commenced weather reports (relating to Croydon) and forecasts for the route have been forwarded from Headquarters to Manchester and Castle Bromwich at 08·05, 09·05, and 10·05. Observations have been made at Manchester at 8, 9, 11, 12, and 13 h., and at Castle Bromwich at 8, 9, 10, 12 and 13 h. and forwarded to Croydon.

(*b*) On occasions when the weather at Croydon is bad or when fog is reported from the north-west of London, weather reports are supplied, by the kindness of the De Havilland Aircraft Company, from Stag Lane Aerodrome on request. They are forwarded for information to Manchester and Castle Bromwich.

Civil Aviation has made few demands on the station at Renfrew, but its staff have been fully occupied in other local distributive work. The *Local Daily Weather Report* (M.O. 2375) issued by this station has a circulation of 40 copies daily in Glasgow and neighbourhood, being distributed to the principal public libraries, railway stations and engineering departments, Harbour, University, &c.

Miscellaneous.—Special arrangements were made on the occasion of the King's Cup Race round Britain on September 8th and 9th involving the supply of reports and forecasts at various points along the route.

During the year, special arrangements have been made from time to time in connection with night flying, chiefly of an experimental nature, between London and Paris, and also, on one occasion, between Strasbourg and London.

In particular, reference may be made to the Air Ministry experimental night flights which took place on the London-Paris route between 5th February and the 8th March.

Pilots' Licences: Examination in Meteorology.—During the year this examination (the syllabus for which is given in Notice to Airmen No. 55 of 1921) became compulsory for all applicants for renewal of Class "B" Licences. 46 examinations were conducted by this Division It very soon became evident that the majority of the candidates had too little knowledge of meteorology to obtain even the minimum standard for a pass. In order to assist them, a free course of lectures was given by the Meteorologist-in-charge at Croydon Aerodrome in August and September, 1922.

Services for Royal Air Force.—At Cranwell regular courses in Meteorology at the Cadet College have been continued by the Meteorologist-in-charge, who has also acted as examiner. It may be mentioned that he has been awarded the Diploma of Fellow of the College of Preceptors for a thesis on *The teaching of Meteorology in Secondary Schools* considered in conjunction with his *Short Course in Elementary Meteorology* (M.O. 247). Many additional open lectures have been given in the College and at schools and institutions in the county.

At Calshot lectures by the Meteorologist-in-Charge have been continued to officers attending the courses in Aerial Navigation, Air Pilotage and Naval Co-operation; the necessary examinations have also been conducted. As far as possible, also, airmen applying for classification as meteorologist-airmen have been tested at this station.

At Calshot and Cranwell 8 airmen have been specially trained as observers with a view to their proceeding to the Near East. One officer also received training with the same object in view.

The meteorological station at Baldonnell was removed to Collinstown on 28th April, 1922, and continued in operation there till 25th October, 1922, when it was finally closed. During the greater part of this time, in addition to work done for the Royal Air Force weather information was supplied to the Irish Free State authorities at Baldonnell Aerodrome.

Following on the reduction to a Care and Maintenance Party of the Royal Air Force unit stationed at Cattewater, the distributive work of the meteorological station was no longer required and it had been decided to reduce the staff to such dimensions as would just enable it to perform such contributive work as was required by the Office. The final reduction took place at the end of June, 1922. Tabulation of the records of the anemographs at Scilly and Plymouth has, however, continued to be done at Cattewater.

In the work of the stations at Andover, Farnborough, Isle of Grain, Leuchars and Shotwick there has been little change. At the last

named a considerable amount of instruction in meteorology has been given by the Meteorologist-in-Charge to pilots in training.

In conjunction with the Royal Aircraft Establishment some work has been done at Farnborough on a suggested method of facilitating the following of a pilot balloon to great heights by having the balloon released from an aeroplane in a suitable position at a height of some 15,000 feet. The initial problem was to design an apparatus to effect the safe release of the balloon and to protect it till the moment of release. This presented considerable difficulties which seem now to have been mostly overcome as a result of experiments conducted in a wind channel.

On the occasion of the Royal Aero Club Gliding Contest at Itford Hill (15th to 21st October) two members of the staff were detailed to observe and to make such upper wind measurements as the means available permitted. A report was prepared containing the information obtained. A further investigation on the same subject was commenced at Upavon in March in conjunction with experiments which are being carried out by the Royal Air Force.

In connexion with the delivery of machines special reports for various routes have been supplied periodically to the Director of Equipment or to manufacturing firms.

Experimental Anemometrical Station.—In May, 1922, the Professional Assistant was withdrawn from Holyhead and since then the station has been in charge of a Staff Assistant. The comparison of the old and new sites (in respect of the observations of pressure, temperature and rainfall) was continued throughout 1922. The effect of the more open exposure is appreciable, particularly in the case of the two last elements. The mean daily range of temperature is less and less rainfall is recorded. The data are still under discussion. Pilot balloon ascents have been made as far as possible twice daily; all the anemometers have been maintained in operation and the records analysed and tabulated at the station.

Upper Air Observations.—The total number of single theodolite pilot balloon ascents made at the stations during the year was 8,133. Concrete stands for the theodolites have been erected at nearly all stations.

The number of flights made by pilots of the Royal Air Force for the determination of upper air temperature and humidity was 239, mostly to heights of 10,000 to 16,000 feet.

At Farnborough, as described above, investigations have continued on a suggested method of obtaining pilot balloon ascents into the stratosphere.

Miscellaneous.—During 1922, the International Commission for the Investigation of the Upper Air had decided that it would be desirable to make an experimental study of the propagation of the sound of great explosions in relation to meteorological conditions and had applied to various Ministries of War with a view to obtaining their collaboration in the case of obligatory destruction of explosives. The first favourable reply came from the Dutch Ministry of War and it was finally arranged that at 17h. G.M.T. on 28th October, 1922, 5 tons of ammonium perchlorate should be exploded on the Oldebroek Artillery Drill Ground. In conjunction with the Superintendent of the Naval Services Division arrangements were made

for all meteorological observers and coastguards in this country to listen for the sound and to make notes regarding the meteorological conditions at the time. Where possible, observations of wind and temperature in the upper air were also made. In addition, through the medium of the Press, the public were invited to forward to the Meteorological Office notes of any observations made. As a result about 140 reports were received from observers in the British Isles. Two valuable records were also obtained on the Hot Wire Microphones by the officers of the Signals Experimental Establishment at Woolwich and at Biggin Hill respectively. The results were summarised and forwarded to the Dutch Meteorological Service for collation with Continental reports. Short articles on the subject appeared in *Nature* of 4th November, 1922, and of 6th January, 1923.

Inquiries.—A very large number of inquiries in person or by telephone, was received. The total for headquarters and the outstations amounted to some 6,000. In the great majority of these cases the advice was wanted in connection with aviation; in addition some 1,650 replies were passed by radio telephony to pilots of aircraft in flight.

Investigations.—The following papers by members of the staff of the Division have been completed and official publication authorised, in some cases in summarised form.

The Diurnal and Seasonal Variations of Fog at certain stations in England. —F. Entwistle.

Appendix to same (relative to Manchester and Shotwick)—H. F. Jackson.

Visibility and Wind Velocity at six representative Stations—Discussion initiated by W. H. Pick.

Relations between Visibility and Wind Speed, Wind Direction and Pressure Change at Calshot, Hants.—H. W. L. Absalom.

Visibility and Wind Direction and Speed at Cranwell, Lincs., April, 1920 to March, 1922—W. H. Pick.

Visibility in Relation to Type of Pressure Distribution; Cranwell, April, 1920 to December, 1922—W. H. Pick.

Buildings.—The Meteorological Office at Lympne has now been partitioned to accommodate also the radio-telephony station. This was done to facilitate the communication of weather information to pilots of machines in flight.

The erection of the pressure tube anemograph at Lympne was completed in July. The head of the instrument is 60 feet above ground level.

A scheme for the provision of satisfactory office accommodation and for the erection of an anemograph at Shotwick is under consideration.

Staff.—Changes of staff between different stations have tended to become less frequent; the total staff has fallen in number during the year from 68 to 61.

BRITISH RAINFALL ORGANIZATION.

Administration.—The year ended March 31st, 1923, was the first complete year during which the work of the Division was carried out at South Kensington. The change was effected without serious interference with the routine work. The transfer of the work of collecting and checking rainfall returns for stations in Scotland to

the Meteorological Office, Edinburgh, was put into effective operation in January, 1923. Assistance in the checking of the 1922 rainfall returns has been given by the staff of the Local Centres Division. This has largely overcome a difficulty which had become increasingly great during the last few years.

Permanent Files.—A start has been made in the work of re-arranging the collected rainfall records, dating back to 1677, in charge of the Division, with a view to making the order uniform throughout. This work has been planned to be carried on as opportunity offers without interference with the general work. The records so far dealt with include those for Ireland back to the year 1880, and those for Scotland since 1900. The number of annual rainfall returns at present filed exceeds 200,000 : reference should be greatly facilitated. Opportunity is being taken to improve the map-index showing the positions of the stations.

Rainfall Stations.—The number of stations from which rainfall records are being received continues to expand. The "General Table" of *British Rainfall, 1921*, contains 125 more records than the corresponding table for 1920, the largest increase since 1912. This was no doubt partly a result of the interest provoked by the remarkable drought of 1921.

Whilst the more thickly populated areas in the British Isles are on the whole well represented, special efforts are necessary to establish new stations in remote districts, and especially in mountain areas. Every effort is, therefore, being made to urge the commencement of new records in such districts, and in cases where this proves impossible by voluntary effort rain-gauges are being lent for the purpose. During the year 8 gauges have been issued, chiefly to the north of Scotland. Effective work in the same connection has been done in co-operation with municipal water authorities.

During the year 225 rainfall stations were inspected by the staff of the Division, in addition to 62 sites. The most important improvements in the exposure and distribution of gauges were effected as the result of inspections in the following localities: the Berwyn Mountains (Denbighshire) ; Dartmoor ; the Southern Pennines ; the Peak District and Derwent Valley ; the West Highlands. On Ben More, Isle of Mull, West Highlands a gauge had been set up in 1921 at 2,900 feet above sea-level. It was found that the exposure of this gauge was not entirely satisfactory and it was moved to a more suitable position at 2,800 feet. This is the highest gauge in the British Isles, the next at Crib Goch on Snowdon being at 2,340 feet.

In the work of inspection, assistance was rendered by the Metropolitan Water Board, the Derwent Valley Water Board, the Corporations of Barnsley, Bradford (Yorks), Morley, Oldham, Plymouth, Rochdale, Rotherham, Sheffield, Wakefield and Warrington and by Mr. J. W. Melles of Gruline, Mull.

An index map showing the sites of rainfall stations inspected since 1910, has been prepared.

The meteorological observations at Camden Square, N.W.1, have been supervised throughout the year on behalf of the Royal Meteorological Society.

Publications.—*British Rainfall, 1921,* was published on December 22nd, 1922, the latest date at which the annual volume has ever appeared.

Steps are being taken in conjunction with H. M. Stationery Office to expedite publication in future.

The statistical data published included :—

Records of Percolation	at	11	stations
,, ,, Evaporation	,,	13	,,
Detailed Analysis of Daily Rainfall ..	,,	100	,,
Duration of Rainfall	,,	54	,,
Records of Monthly Rainfall	,,	394	,,
,, ,, Annual ,, ...	,,	5,078	,,

The 5,078 records in the General Table were made up as follows :—

	England.	*Wales and Islands.*	*Scotland.*	*Ireland.*	*British Isles.*
1921	3,577	446	784	271	5,078
Change from 1920	+117	—8	+26	—10	+125

The interest of the volume was largely centred in the unprecedented drought of 1921. A special article on the subject was included.

The Obituary list contained the names of 121 observers and was the longest ever published in *British Rainfall.* The death was announced of Mr. R. Lamport, assistant on the staff of the British Rainfall Organization from 1885 to 1919.

The Meteorological Magazine.—The issue of *The Meteorological Magazine* was continued. In February, 1923, the size was reduced to 24 pages. At the same time the rainfall tables were re-arranged and enlarged, the number of records included being 228.

Special Work.—The Superintendent and Mr. Glasspoole have devoted a good deal of the time to a general investigation of the variations of rainfall in the British Isles during the last fifty years. A paper by Mr. Glasspoole on the mean and extreme range of annual rainfall was published in *British Rainfall, 1921,* and a preliminary paper on the fluctuations in amount and distribution of annual rainfall from 1868 to 1921 was contributed to the Royal Meteorological Society. An investigation on similar lines into the variations of the 35 years' average of annual rainfall has been commenced as a preliminary to the extension of the large scale rainfall survey map of the British Isles, about one half of which is now drawn. The survey map has been extended or revised during the year in parts of the counties of Ross and Cromarty, Perthshire, Westmorland, Durham, Yorkshire, Lancashire, Denbighshire and Devonshire.

The standard rainfall normals for the period 1881—1915 were revised and extended. A complete series was prepared for publication.

An investigation has been made into the desirability of modifying the present method of computing rainfall frequency. The old and new methods will be used concurrently for the present.

Experimental observations with the Nipher rain-gauge shield were continued at Eskdalemuir. A modification in the design of the shield was made in November, 1922.

Professional Work.—A special committee met twice during the year to consider the conditions under which professional advice on rainfall could be given. A scheme was drawn up and has been put into operation, under which the exclusive retention of the services of the Superintendent by any one party is discontinued. During the year advice has been given to the following : the Corporations of Barnsley,

Birmingham, Chester, Darlington, Morley, Oldham, Plymouth, Rochdale, Wakefield, and Warrington; the Metropolitan Water Board, the Chester Water Works Company, and the promoters of four water power schemes. Copies of the reports submitted have been sent, when desired, to the Ministry of Health and to the Ministry of Agriculture and Fisheries.

The Superintendent attended one meeting of the Inter-departmental Water Committee of the Ministry of Health.

Inquiries.—The number of inquiries dealt with during the year was 369, an increase of 64 over the previous year. In addition to professional reports, information was supplied to the following:—

The Admiralty, the Ministry of Health, the Forestry Commission, the Engineering Department of the Houses of Parliament, the Ministry of Agriculture of Northern Ireland, the Boroughs of Swansea and Mansfield, the Universities of Liverpool and Leeds, the Huddersfield Technical College, the Midland Agricultural College, the Manchester Ship Canal, the Mersey Ship Canal, the Glamorgan Agricultural Committee, the Aspatria and District Joint Water Board, The Tyne Conservancy Board, the Metropolitan Railway Company and a large number of professional and private persons.

ADVISORY COMMITTEE ON ATMOSPHERIC POLLUTION.

The investigation of atmospheric pollution has been continued under the direction of the Advisory Committee on Atmospheric Pollution, of which Sir Napier Shaw is Chairman and Dr. J. S. Owens Honorary Secretary. During the year the Committee has been unfortunate in losing two members by the death of Mr. W. S. Curphey and of Mr. C. T. Stableforth. New Members have been elected, and the Committee at the end of the year was as shown on page 5.

Routine work has consisted mainly of the collection and classification of monthly analysis of rain and impurities deposited in 38 standard gauges in different parts of the country, several of which are of the new form with glazed stoneware collecting vessel. Eight new gauges have been put into operation during the year, three old gauges have been replaced by the new pattern and one station has discontinued observations.

From the tabulated results of records of four of the automatic instruments in operation at different stations for the continuous estimation of suspended impurity in the air, curves have been prepared showing hourly and daily variations in the impurity, with a view to determining the origin of the pollution.

One automatic instrument is in continuous operation ot the office of the Committee, Westminster.

The Eighth Annual Report of the Committee has been prepared for publication.

Research work has been carried out in the laboratory acquired at the beginning of the year. Microscopic investigation of suspended matter in the air has been continued by means of the dust counter previously described. Various possible means of increasing the efficiency of the method have been followed up and a very high efficiency in the

collecting instrument has been attained. Careful attention has been paid to details of the necessary microscopy with a view to shortening the process of counting the dust particles as far as is compatible with accuracy.

A large number of records taken in England and abroad under varied conditions have been examined microscopically and much information obtained, particularly with regard to the nature of the particles. Photomicrographs of typical records have been taken.

Preliminary experiments have been carried out in connection with the evolution of a new portable instrument for the measurement of the amount of water in the air :—

(*a*) In the form of drops, independent of vapour.

(*b*) In the form of vapour, independent of drops.

Measurement of the obstruction of light by suspended matter in the air has been commenced using two distinct photometric methods, one of which is adapted for use in daylight. It is intended to correlate the amount and nature of impurity with the degree of obstruction, the impurity being measured by two distinct methods, one of which involves a microscopic examination of the particles.

This research has involved the design and construction of special apparatus and the erection of a hut at the Imperial College of Science, South Kensington.

A paper was read by Dr. Owens before the British Association in September and exhibits have been shown at several functions, including conversaziones at the Royal Society, Royal Institution, and Institution of Civil Engineers.

NAVAL SERVICES DIVISION.

Close co-operation with the Admiralty has been maintained. The Superintendent visited the Commander-in-Chief, Atlantic Fleet, to discuss the Meteorological requirements of the Fleet, and the possibility of providing a training in Meteorology for officers of the Royal Navy. The question of the co-operation of the Navy in obtaining observations in the upper air has been raised and it is hoped that active help will be given along these lines in the near future.

The Fleet Weather Forecasts for Home Waters issued to the Fleet have been revised and are now issued for three separate areas. These forecasts are broadcasted from Admiralty Wireless Stations to H.M. Ships and Naval Establishments.

Numerous enquiries, some of a confidential nature, have been received from Naval sources and dealt with.

Thirteen Gale Warning Stations on the north-west coast of England have been visited and their positions fixed for insertion on the Admiralty Charts.

The amount of work dealt with has shewn considerable increase during the year.

LIBRARY.

On December 18th, the library ceased to form part of the Climatology Division and was attached to the General Services Division.

The library was in charge of Captain H. W. L. Absalom until April 26th, when Captain M. T. Spence took over the duties of librarian.

An exchange of publications has been established with.—

1. The International Hydrographic Bureau at Monaco.
2. The Meteorological Service of the Colombia Government.
3. The Astronomical Observatory of the University of Vilna.
4. Institut Scientifique Chérifien, Rabat, Morocco.

The additions to the library during the past year include 233 new books and pamphlets. The number of periodicals received was about 290. 3,379 books were lent during the year.

The Author Card Catalogue has been kept up-to-date. The Subject Card Catalogue has been kept up-to-date so far as books added to the library during the year are concerned.

The preparation of the shelf catalogue has been continued, 208 shelves have been numbered and catalogued.

572 volumes have been bound during the year.

186 requisitions for publications were dealt with.

The following important works were presented to the library during the year. The names of the donors are given as well as the titles of the publications :—

Royal Society, Edinburgh. *Collected Scientific Papers of John Aitken, F.R.S.*

Professor H. H. Turner. *Miscellaneous Papers published by the Oxford University Observatory.*

Amsterdam K. Nederlandsch Aardrijkskundig Genootschap, *De Zeeën van Nederlandsch Oost-Indie.*

Mathias, E. *Rapport sur l'état actuel de l'électricité atmosphérique.*

Peppler, A. *Die Badische Landeswetterwarte Karlsruhe. Ihre Einrichtungen und Arbeiten.*

London Physical Society. *Report of a Discussion on Hygrometry.*

Society of Friends. *Some remarks on unusual occurrences which seemed remarkable beginning at December, 1739.* [Oustwick] By J. Saanderson.

London Board of Education and Science Museum. *Catalogue of collections in Science Museum, South Kensington—Meteorology.*

Committee of the Captain Scott Antarctic Fund, British Antarctic Expedition, 1910-13. *Observations on the Aurora,* by C. S. Wright.

Determinations of Gravity, by C. S. Wright.

Among those acquired by purchase are :—

Times Gazetteer.

Humphreys, W. J. *Physics of the Air.*

Defant, A. *Wetter und Wettervorhersage.*

Nodon, A. *Essai d' astrométéorologie et ses applications à la prévision du temps.*

METEOROLOGICAL OFFICE, EDINBURGH.

Staff.—The arrangement made in June, 1920, whereby the Superintendent, Eskdalemuir Observatory, was placed in charge of the Office was terminated in June, 1922. While still retaining charge of Eskdalemuir Observatory, the Superintendent now has his headquarters at Edinburgh.

General.—Details have been given in previous Annual Reports of the organization of the general work of the Office and, with the addition of the Scottish rainfall work, these were adhered to during the year.

The Office carries out all the reductions of Eskdalemuir magnetic data, and this work was kept well forward during the year.

The climatological work of the office comprises the examination and tabulation of returns from 55 reporting stations throughout Scotland, and the preparation of tables and summaries for the *Monthly Weather Report* and for the Registrar-General for Scotland.

The number of inquiries received during the year was 59—considerably fewer than in the previous year. Most of these inquiries deal with marine insurance risks, and their number rises or falls with the frequency of gales or bad weather on the north-east coast of Scotland.

The transfer to the Office of the work of collecting rainfall statistics for Scotland was effected in January, 1922, but only began to be felt as a real addition to the volume of work in January, 1923, when the annual returns for the previous year began to arrive. It would seem possible to effect some improvement in the handling of this mass of statistics by obtaining them monthly, instead of annually, from the observers, and it is intended that an attempt in this direction should be made during the current year.

Forecasts received by telegraph from London were communicated to the local press.

In connexion with an examination of the barometric pressure data from Eskdalemuir for the period 1911-1921, a tabulation has been completed and graphs prepared of atmospheric "surges." A comparison with the corresponding data for Christiania has yielded some interesting results. It is hoped that these will be completed for publication during the current year.

Another piece of work, begun but not completed during the year, is an examination of the pressure inequalities at Spitzbergen.

The number of observing stations in Scotland at work during the year is shewn below :—

	Observatories.	Climatological Stations*	Telegraphic Reporting Stations
No. at beginning of year ..	3	57	8
No. closed during year	—	5	—
No. opened during year	—	3	—
No. at end of year	3	55	8

* Including Health Resort Stations.

Advisory Committee.—This committee met on 5th December, 1922, the Director being present as Chairman.

Observatories:—

ESKDALEMUIR OBSERVATORY.

Buildings, etc.—A certain amount of minor repair and constructional work was carried out under the direction of the Works and Buildings Department. The general state of the underground magnet house was rather more satisfactory than in recent years. No deficiency in water supply was experienced, presumably because the summer rainfall was in excess of the average.

Terrestrial Magnetism.—This branch of the work, which is regarded as the prime function of the Observatory, proceeded in all essential details as in recent years. The photographic registration of the three geographical components of terrestrial magnetic force was maintained with scarcely an intermission. The practice, initiated at the beginning of 1922, of making in each week two absolute determinations of declination, horizontal intensity and inclination was continued. The absolute values of the elements so obtained are employed for the standardization of the readings of the curves obtained photographically, and from these corrected curve readings hourly values, diurnal inequalities, mean values, absolute daily ranges, and hourly ranges are derived. As in recent years, the reading of the curves and the assigning of base and scale values was done at the Observatory, while the bulk of the ensuing work of computation was carried out in the Edinburgh Office. The re-reading of the 1911 magnetograms was completed and the tabulation of hourly ranges for that year has been commenced. Magnetic character figures and values of the squares of daily range were forwarded quarterly to De Bilt. A direct comparison between the Eskdalemuir magnetometer and dip-inductor and the Carnegie Institution of Washington Instrument No. 27 was made in August, 1922. Magnetic conditions during the comparison were rather disturbed and the results obtained are not yet in final form.

In connection with the solar eclipse of 21st September, 1922, eye observations, at one-minute intervals, of the reading of the north and west magnetographs and of the direct reading declination instrument were made between 1h. 30m. and 8h. on 20th, 21st and 22nd September.

Meteorology.—The system of meteorological observation was, in all respects, the same as detailed in the *Report* for last year. Telegraphic weather reports were despatched daily at 7h., 13h., and 18h. to Headquarters, and, on a few occasions, special reports were sent to certain aerodromes, in connection with aerial flights.

In the early part of the year the twin-pen direction recorder of the pressure-tube anemometer was replaced by a Munro-Rooker single pen recorder, but for some time afterwards the direction record showed a disquieting lack of detail. Eventually, it was found possible to tighten the connexion between two sections of the direction-rod and, subsequently, the character of the direction record was more satisfactory, although there is still evidence of undue "sticking."

Toward the end of December, 1922, the photographic barometer was damaged and had to be sent away for repair. From that date until the present, the records of the float-barograph have been used in the tabulation of hourly values of pressure.

Reference may be made to difficulties which have arisen in assigning hourly values of relative humidity. Ordinarily, the values are derived from the readings of the photographic records of the screened dry and wet bulb thermometers by use of Glaisher's tables, but on occasions when the wet bulb reading is below freezing it is undesirable to follow this method and recourse to the hair hygrograph record is necessary. Unfortunately, the hair hygrograph appears frequently to be inconsistent in behaviour, and, as the wet bulb temperature is often less than freezing for many hours in succession, there is very great uncertainty about the value of the relative humidity. It is hoped that, in the near future, a second hair hygrograph will be available, and it is proposed then to use each instrument in turn as standard, the one not in use being cleaned and adjusted to give consistent readings.

Early in the year a certain amount of minor investigational work upon the behaviour of the Assman psychrometer was undertaken, but the results are somewhat inconclusive.

The number of pilot balloon ascents was rather smaller than usual, owing to unfavourable weather conditions during the greater part of the summer. The observation of balloons has been somewhat facilitated by the provision of a concrete pillar for the theodolite.

Throughout the year a record has been maintained of the amounts of rain received by two gauges (one unshielded, the other provided with a Nipher shield) situated in an exposed position to the north of the Observatory enclosure.

The entire work of tabulation and reduction of the meteorological records has been performed at the Observatory and the usual data for inclusion in the *Weekly* and *Monthly Weather Reports* were supplied.

Atmospheric Electricity.—The photographic records from a Dolazalek electrometer connected to a water dropper were maintained with very few interruptions, which were occasioned chiefly by the occurrence of defective insulation of the connections between the water jet and the electrometer. To convert the curve readings into potential gradient in volts per metre above ground level in the open, factors based upon the results of absolute observations (made at least four times per month) were used. Values of the potential gradient for 3h., 9h., 15h. and 21h. on each day and for each hour on certain selected quiet days were tabulated.

Seismology.—The Galitzin instruments, with galvanometric registration, recording disturbance in north, east, and vertical directions, continued in operation.. Frequent and sometimes prolonged interruptions of the records were caused by the failure of the clockwork mechanisms of the recording drums. Endeavours are being made to rectify the defects in order that the records of this very excellent Galitzin instrument, the only installation in the kingdom, may be utilised for more effective contributions to observational seismology.

The earthquake bulletin for 1921 was completed for publication, and copies of the provisional bulletin for 1922 were supplied to the B.A. Seismological Committee and to the International Bureau at Strasbourg. Details of individual earthquakes have been sent to the B.A. Committee from time to time. The measurement of microseismal amplitude and period was continued as heretofore.

Aberdeen Observatory.

The staff was increased by the appointment of a Technical Assistant.

Buildings.—During the summer of 1922 a fenced enclosure, measuring 60 feet × 50 feet was erected in a field belonging to the University of Aberdeen and situated about a quarter of a mile east of the Observatory. Within this enclosure there has been installed a standard pattern Dines' Pressure-tube Anemograph, fitted with the new National Physical Laboratory pattern vane and the twin-pen direction recording mechanism. The height of the vane is about 42 feet above the ground. The fitting up of the instrument was completed on 19th September, 1921, since which date records have been regularly obtained.

A concrete pillar has also been built in the north-eastern angle of the enclosure to carry a wall-head for the Watts' Mark B. Theodolite.

In addition to the routine work of telegraphic reporting, continuous records of pressure, temperature, humidity, wind direction and force, have been obtained and reduced. The preparation of hourly values for *The Observatories Year Book* for 1922 was well in hand by the end of the year.

In addition, comparisons are being made between the records of the Robinson cup-anemograph, mounted on the Observatory tower, and those of the new Dines' pressure-tube instrument erected in the field, in order to establish the relationship between them. The records obtained by the Hair Hygrograph are likewise being compared with the Humidity values as calculated from the readings of the dry and wet bulb thermometers in the Stevenson screen.

During the year five observers have undergone a course of training in observational work for climatological or health resort stations. These stations are as follows:—North Berwick, Inverness, Achnashellach, Berwick-on-Tweed, and Banff.

Owing to pressure of work, fewer pilot balloon ascents were possible during the year.

Lerwick Observatory.

The work of the year was mainly concerned with preparations for regular recording being begun on 1st January, 1923. By that date, the magnetographs had been installed in the new concrete house erected for the purpose, and were brought into operation. The arrangements for recording atmospheric potential gradient proved unsatisfactory and will require modification. A pressure tube anemometer was erected and began work on 1st January, 1923.

The magnetic instruments in use record declination, horizontal force, and vertical force. The first two have been running satisfactorily since 1st January, 1923, but the vertical force record has been affected by moisture depositing on the pivoted magnet system. Arrangements to prevent this were under preparation at the end of the year. Scale tests are made weekly, and absolute observations of declination, horizontal force, and dip are taken twice weekly. Eye observations of the details of all visible auroral displays are also made. A number of observations were made for Lord Rayleigh on the auroral spectrum.

The year's work at Lerwick has been of a particularly arduous kind and the staff deserve special credit for the manner in which it has been carried out.

Climatological Stations.—The number of climatological stations (including "health-resort" stations) suffered a net decrease of 3, owing to the closing of those at Glen, Lednathie and Dumbarton. New stations under trained observers were opened at Achnashellach (in place of Glencarron), North Berwick and Inverness. The first is managed by the Forestry Commission (Scotland), the two latter by the local Town Councils. Steps were also taken towards the establishment of new stations at Banff, Glasgow, Onich, and Berwick-on-Tweed, but had not been completed by the end of the year.

In addition to the general question as to the better distribution of these climatological stations, two points are regarded as of importance. The first is the transfer of management to local authorities or public bodies or departments. This has received continued attention during the year, and there are now 27 out of the 55 stations which are so managed. The second is the training of the observers. It is only at 9 of the 55 stations, that we have observers who have received any training in observational duties under the Meteorological Office, and it is extremely desirable that this low proportion should be considerably increased. The matter will receive special attention during the current year.

Rainfall Stations.—The number of stations for which rainfall statistics are now being received is 782, practically the same as in the previous year. Efforts were made to secure observations of rainfall in those areas for which data are still incomplete, and five additional stations were opened in the area lying to the north of the Dingwall and Skye railway.

CENTRAL OBSERVATORY, KEW OBSERVATORY, RICHMOND, SURREY.

Instruments and Instrumental Comparisons.—The Dines' pressure tube anemometer was dismantled and replaced by a new one.

A new "static" head anemometer has recently been erected on the roof, with a view to an inter-comparison between it and the Dines' pressure tube. A Glaisher screen, long in use at 62, Camden Square, in connexion with the British Rainfall Organization, has been erected on the lawn in immediate proximity to the large Stevenson screen, and regular observations with a view to its comparison with the Stevenson and north-wall screens commenced in June.

A new ordinary pattern Stevenson screen has been erected on a stand in the garden, at such a height as to put the contained thermometers at the level of those in the north screen, and regular observations have been begun with a view to the intercomparisons of the various screens. To make the comparison of screens and thermometric methods more complete, regular daily readings have been taken with Assmann ventilated thermometers.

The earth thermometer, nominally at 1-foot depth, having been found to be at a slightly greater depth, a new earth thermometer of the same pattern recording the temperature exactly at 1-foot depth has been brought into use, the observations with the old instrument being also continued.

During the winter additional grass minimum thermometers were exposed on the lawn within two wire cages differently supported, with a view to ascertaining the effect, if any, exerted by the wires on the temperatures recorded.

A sunshine recorder of the Swiss pattern and a new recorder of the ordinary British pattern have been erected on the roof near the old Observatory instrument, and a regular comparison has been commenced.

Several series of inter-comparisons have been made between the Abbot disc and Ångström pyrheliometers.

Two old Wilson radio-integrators have been exposed on the lawn, with a view to comparison with a pyrheliometer and other investigations.

The sulphuric acid arrangements in the electrograph have been altered in a way devised at the Ebro Observatory, Tortosa, with a view to avoiding creep in the zero. The arrangement has worked satisfactorily.

The old Falmouth magnetographs for recording declination and horizontal force, after repairs by Mr. Adie, were subjected to prolonged trial before being despatched to Lerwick, where they are now in use.

The moment of inertia of the Jones collimator magnet has been re-determined, in terms of the moments of inertia of the two old inertia bars (made by Dover and Elliott respectively), and the new value was brought into use on January 1st, 1923. An appreciable fall in moment was found to have occurred since the last determination in 1915.

At the request of the Survey of India, the moment of inertia of the standard Indian inertia bar was determined by comparison with the Dover and Elliott bars.

Three inertia bars, purchased from the executor of the late Prof. W. Watson, F.R.S., which had been serving at several continental stations, were received from de Bilt.

An inertia bar belonging to a magnetometer under test having given results inconsistent with those obtained from the Dover and Elliott bars, was, with the permission of the makers, cut into a number of pieces. The specific gravity of the pieces was found to vary in a way which fully accounted for the observed inconsistencies.

A question having arisen as to the magnetic meridian at the Royal Dockyard, Woolwich, the Superintendent visited the Dockyard and arranged for the comparison of certain compasses at Kew Observatory, an official from the Dockyard taking the necessary readings.

A further comparison was made with the new coil magnetometer at the National Physical Laboratory, observations being taken by the Superintendent and Mr. E. Taylor at Teddington with the Dover unifilar No. 140. To standardize the Dover unifilar, some 20 complete observations of the horizontal force were made with it at Kew, half before and half after the observations at Teddington. The final results were communicated to Mr. F. E. Smith, who took the observations with the coil magnetometer.

Facilities for taking magnetic observations were afforded in June and October to Mr. J. de Graaf Hunter, of the Indian Survey, and in September to Mr. W. C. Parkinson, of the Carnegie Institution, Washington. On the several occasions a number of special

simultaneous observations were taken by the Observatory Staff. The results of curve measurements corresponding with Mr. Hunter's and Mr. Parkinson's observations were supplied to the Indian Survey and to the Carnegie Institution respectively.

In connexion with the eclipse of the sun on September 21st, a number of special curve measurements were taken at the request of the Carnegie Institution of Washington and sent to that Institution.

Eye Observations and Observational data.—The ordinary eye readings of the meteorological instruments have been made at the usual hours.

On days of bright sunshine the Ångström pyrheliometer has been used to measure the intensity of solar radiation within half an hour of noon.

Absolute observations have been made of potential gradient in the garden on most fine days to standardise the electograph.

Observations have been made of the air-earth electrical current with the Wilson apparatus, and of the ionic charges of the atmosphere with the two Ebert instruments ; both sets of observations have been taken regularly in the afternoon, weather permitting, between 14 h. 30 m. and 15 h. 30 m. G.M.T.

The magnetic elements horizontal force, declination and inclination have been observed regularly, usually once a week, with the Jones magnetometer, and the Barrow dip circle. On many occasions, especially during the latter part of the year, simultaneous observations of the horizontal force have been taken with the Dover Magnetometer No. 140.

The reduction of the records from the various self-recording instruments is well in hand.

Tables of two-hourly mean values of magnetic declination have been prepared. These are now sent weekly to the Geographical Section of the War Office, the Survey Department, Southampton, the Institution of Mining Engineers, the Secretary of the Institute of Mine Surveyors of Great Britain and two mining journals. Information is supplied at the same time 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 diurnal inequality derived from all days with the exception of those of " character " 2. The most recent information on this point with the corresponding information for the previous year appears in the weekly sheet issued.

Magnetic " character " figures after the international scale are assigned every three months to de Bilt. The list for the first quarter of 1923 has been sent in.

Diurnal inequalities for magnetic declination and horizontal force from the international quiet days have been prepared up to the end of September, 1922.

Publications.—A paper by the Superintendent on the 27-day interval in magnetic phenomena has appeared in the Royal Society's Proceedings, and a second paper by the Superintendent on the alleged 11-year period in atmospheric electricity has been read to the Physical Society. A paper by Mr. R. E. Watson on the comparison of pyrheliometers belonging to the Observatory is being printed as a Geophysical Memoir. The Superintendent has contributed short notes to *Terrestrial Magnetism* and to *The Meteorological Magazine.*

Verification Work.—In addition to the instruments intended for use at the new Observatory in Shetland, there have been tested 2 unifilar magnetometers, 2 dip circles, 15 dip needles and a special magnet.

Instruction to Observers.—Special courses of instruction have been given to Captain Kilner, R.G.A., and to Mr. Ashby of the Gold Coast Medical Service.

Captain Absalom also spent a short time at the Observatory before taking up his duties at Eskdalemuir.

Miscellaneous.—The Superintendent attended the meeting of the International Union of Geodesy and Geophysics held at Rome in May and acted as President of the Section of Terrestrial Magnetism and Electricity. He was selected to succeed Prof. Tanakadate as new president of the section.

Thanks to the assistance of Mr, Thomas G. Bocking, M.I.M.E. of Birmingham, arrangements have been made for taking continuous magnetic observations underground in the Sandwell Park Colliery, near Birmingham. The necessary instruments have been installed by Mr. R. E. Watson, who receives every assistance from Mr. H. W. Hughes, the Managing Director and the Colliery Staff.

VALENCIA OBSERVATORY, CAHIRCIVEEN, CO. KERRY.

Mr. L. H. G. Dines, for seven years superintendent of the Observatory, was succeeded at the beginning of July by Mr. C. D. Stewart, the change taking place just about the time that the dispute in Ireland developed into active warfare. The interval between this time and the end of the twelve months under review has been, in all probability, the most eventful time in the history of the Observatory. The activities of the irregular forces produced a complete suspension of trains and of mail and telegraph services from the beginning of August. The town of Cahirciveen was captured by the troops of the Irish Free State before the end of August, the Observatory becoming involved indirectly in the operations leading to the capture ; but as the surrounding district was a refuge for irregular forces for several months after this, the state of isolation remained more or less unchanged to the end of March. The nearest station to which a train came was 24 miles distant. Ordinary telegraphic communication was not restored, but the Post Office, after the middle of November, was able to accept messages for the Air Ministry, sending them by the Valencia Island radio station. Mails were most irregular for the whole of the period, one interval of six weeks and two of four weeks, without mails in or out, being experienced. For several weeks it was unsafe, on account of shooting, to be out of doors after dark in the vicinity of the Observatory ; observations at night became extremely unpleasant at this time.

The work of the Observatory, apart from the sending of the usual telegraphic messages and returns to Headquarters, continued uninterrupted throughout the year.

Meteorological Routine.—The Observatory has been maintained as a first order meteorological station, keeping as far as possible a continuous record of the weather. Regular eye observations, including

weather and sky, have been made eight times daily between 7h. and 21h. Telegraphic reports have been made five times daily to the Forecast Division on weekdays and four times on Sundays, with exceptions due to conditions noted in the first paragraph of this report. Cloud observations with the Besson Comb Nephoscope have been made regularly throughout the year.

The records of the mountain raingauge at the Cahirciveen Waterworks have been obtained without interruption, which is a matter for congratulation, as for some weeks this part of the country was entirely in the hands of irregular forces, rear as it is to the town.

The self-recording equipment has been maintained in full operation save for a few unimportant stoppages which did not affect the obtaining of the usual information for returns and summaries. The Robinson Cup Anemometer lost two cups in the gale of February 26th, and up to the end of March it had not been possible to arrange for the carriage of new ones from London.

The extraordinary conditions made it necessary for the superintendent to carry out all early and late observations during the six winter months.

Tabulation has been kept up to date, and the hourly values of temperature, humidity, pressure, wind (two anemometers), rain and sunshine have been computed and checked. All tabulations and original curves are now retained at the Observatory.

Instruments and Instrumental Investigations.—Measurements of rainfall with differently exposed raingauges continue. The evaporation tank appears to maintain itself free from leaks. The results obtained from this instrument for the year 1922 go to confirm the opinion expressed in last year's report, namely, that the records are of no value during periods in which rain is falling. Observations are also being continued with the Piche evaporimeter with a view to investigating the relation between the evaporations as measured by the two instruments.

Pilot Balloons.—Regular pilot balloon work was more or less suspended from August to November on account of the difficulty in getting supplies of balloons and the impossibility of telegraphing the results to Headquarters. 175 ascents were carried out during the year.

Terrestrial Magnetism.—Absolute observations of declination, horizontal force and inclination were taken about two or three times per month up to September, since which time observations of all three elements have been made weekly.

AEROLOGICAL OBSERVATORY AT BENSON.

During the year 41 registering balloons were sent up, of which 30 were found and the instruments returned. In only one case was no record obtained, when the balloon failed almost immediately and fell less than half a mile away. The heights reached were better than in recent years owing to the better quality of the balloons, but there has been, and still is trouble from this cause. The matter has been looked into systematically and the reasons for the premature bursting of balloons are becoming clearer.

The recording instruments have been employed in their old form, but systematic work has proceeded in the direction of detail improvements and the elimination of minor errors of various kinds, both in the instruments themselves and in the process of calibrating them. The graphical method of working up the records has been overhauled and has now reached a high degree of accuracy.

Heretofore the supply of the Dines balloon meteorographs has been almost entirely dependent on the skill of Mr. H. W. Baker. With a view to getting them made by independent firms a very detailed specification has been prepared, covering both mechanical details and methods of manufacture.

The observations of radiation from the sky have been continued and published in *The Meteorological Magazine.*

The ordinary meteorological routine work of the Observatory, the sending of the daily weather telegrams, and the obtaining of continuous automatic meteorological records has gone on without interruption. A number of special early morning observations were made during the winter with the object of comparing a grass minimum thermometer, normally exposed, with an aspiration psychrometer placed close to it.

A good deal of time was spent in the winter months in the evolution of a suitable light meteorograph for determining the upper limit of ground fogs, and the resources of the workshop were directed to that end for a considerable time. A scarcity of fogs prevented adequate test of the apparatus, which was however apparently satisfactory.

METEOROLOGICAL OFFICE, MALTA.

The work of this office began with the arrival of the staff from England on the 8th May, and the transference of duties from Professor Agius of the Valletta University took place formally on the 14th June. With some difficulty quarters which combined satisfactorily the requirements of the office and of the observational work were found, and these were occupied on the 10th July. In the meantime, by the courtesy of the University authorities and of Professor Agius, the work was carried on at the University. The initial arrangements were greatly facilitated by the very helpful attitude of the Royal Air Force authorities and of the Superintending Civil Engineer, H. M. Dockyard. His Excellency the Governor took considerable interest in the progress of the arrangements with the University authorities for coordinating the work of the new office and that of the University Observatory.

Reception of Information.—The first part of the work requiring attention was the development of communications in order to increase the amount of meteorological information received and to reduce the interval between the time of observation and that of issuing the reports and forecasts. The ready assistance of the Royal Air Force enabled good progress to be made during the year and it is now possible to issue fairly regularly about noon reports based on the 0700 observations while at the same time the information has been much amplified. There is still room for improvement and it is hoped

that it will be possible to obtain this in the course of the next year's work. A summarised analysis of the present state of the reception of information by W/T is given in the table below.

	No. of Messages			
	completely received.	incompletely received	Maximum possible.	% received completely
Gt. Britain	54	29	124	38
North Africa	105	7	124	85
Italy	20	1	62	32
Ajaccio	25	—	31	81
France	118	18	186	64
Spain	62	6	93	67
Gibraltar	41	—	62	66
Greece	29	—	31	94
Germany	37	13	124	30
Bulgaria	38	—	62	61
Serbia	61	6	93	66
Roumania	8	—	93	9

The University Observatory has regularly supplied observations thrice daily, and from time to time Professor Agius has courteously placed the observatory records at the disposal of the office.

Some inconvenience has been experienced in the daily charting work through the multiplicity of codes and units employed in the various messages. Decoding work has become more involved as the year advanced.

Distribution of Information.—In the early part of the year the Navy and the Royal Air Force were consulted as to their special meteorological requirements, and these have been kept in view in organising the work. Reports and forecasts by telephone and by hand have been made twice daily to the two Services during the year. Special reports have been supplied on several occasions in compliance with specific requests, and meteorological data have been furnished regularly to the Sandfly Commission sent to Malta by the Royal Air Force. The observations at Malta have also been broadcast morning and evening by the Naval W/T station at Rinella.

Preparations for the issue of a Daily Weather Report are in hand, and the possibility is being tested of the supply of forecasts to the Navy for sections of the Mediterranean other than that immediately surrounding Malta.

Some cabled reports which involved cash payments have been discontinued and W/T is now relied on almost exclusively for both the reception and the transmission of messages.

Investigations.—The principal investigational work which has been carried on has been the day to day study of weather conditions from charts of the observations made at 0700, 1300 and 1800. In addition a formal examination of the diurnal variation of the winds has been completed, and some progress has been made towards discussing the local pilot balloon data, Rainfall maps have been drawn to settle queries in relation to local variations of rainfall in the island which possesses some thirty rainfall stations in an unusually small area.

Library.—The office has received the publications of the London Meteorological Office, a small collection of books from the late library of the British Rainfall Organization, and publications courteously presented by meteorological organizations at home and abroad and by private individuals.

Instruments and Observations.—At the beginning of the year some questions were still outstanding relative to wartime instruments collected at Malta after the armistice from various areas of operations in the Mediterranean, and in connection with instruments loaned to the University Observatory. These have been settled, and the excess stores and instruments returned to London or otherwise disposed of under instructions from Headquarters. Instruments have been lent to the Royal Air Force Sandfly Commission and to the Superintending Civil Engineer, H. M. Dockyard for special purposes. Skeleton surface observations have been made twice daily to supplement the University observations, and Pilot Balloons have been sent up morning and evening.

Staff.—The staff sent out from England has been supplemented by the local appointment of a clerk and a messenger, and since October two airmen of No. 267 Squadron, Royal Air Force, have been attached to the office for training in pilot balloon work.

PUBLICATIONS.

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

PERIODICAL.—**The Daily Weather Report** issued in three sections (to date).
1. The British Section.
2. The International Section.
3. The Upper Air Section.

The Weekly Weather Report (to date).

The Monthly Weather Report with a summary for the year (to December, 1922).

Monthly Meteorological Charts of the North Atlantic Ocean (to date).

Monthly Meteorological Charts of the East Indian Seas (to date).

The Meteorological Magazine (to date).

The British Meteorological and Magnetic Year Book:—

Parts I and II issued as separate publications from commencement of 1922 (*see* Weekly and Monthly Weather Reports).

Part III (1) **Daily Readings** at meteorological stations of the first and second orders (publication ceased with vol. for 1921).

Part III (2) **Geophysical Journal.** Daily Readings in meteorology and terrestrial magnetism and the results of observations in the upper air (to December, 1921).

Part IV **Hourly Values from Autographic Records.** Hourly Values for terrestrial magnetism, atmospheric electricity and meteorology for five observatories. Volumes for 1918 and 1919 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 (none issued).

British Rainfall, 1921. A report on the distribution of rain in space and time over the British Isles during the year 1921, as recorded by more than 5,000 observers.

Eighth Report of the Committee for the Investigation of Atmospheric Pollution. Report on observations for year ending 31st March, 1922 (in the press).

Southport Auxiliary Observatory. Annual Report and results of meteorological observations for the year 1921. By Joseph Baxendell.

OCCASIONAL.—**The Wireless Weather Manual** being a guide to the reception and interpretation of weather reports and forecasts distributed by wireless telegraphy in Great Britain.

Particulars of Meteorological Reports issued by Wireless Telegraphy in Great Britain and by the Countries of Europe and North Africa (also Supplements Nos. 1 to 9).

The New International Code for Meteorological Messages.

Report on the Eleventh Ordinary Meeting of the International Meteorological Committee, London 1921.

Report of the Fourth Meeting of the Commission for Weather Telegraphy, London, 1921.

Professional Notes :—

No. 28. A Comparison of the Anemometer Records for Shoeburyness and the Maplin Lighthouse. By N. K. Johnson, B. Sc. and S. N. Sen, M.Sc.

No. 29. On the Formation of Thunderstorms over the British Isles in Winter. By E. V. Newnham, B.Sc.

No. 30. Diurnal Variation of Temperature as affected by Wind Velocity and Cloudiness. A discussion of observations on the Eiffel Tower. By J. Durward, M.A.

Geophysical Memoirs :—

No. 19. Hurricanes and Tropical Revolving Storms. By Mrs. E. V. Newnham, M.Sc., with an introduction on the Birth and Death of Cyclones by Sir Napier Shaw, Sc.D., F.R.S.

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

The British Observatories Meteorological and Geophysical Year Book from 1922 (in continuation of the Geophysical Journal, and Hourly Values at Meteorological Stations).

The Book of Normals of Meteorological Elements for the British Isles.

Section IV (*a*). The Range of Variation of Temperature and Rainfall. (*b*). Frequency Tables for Hail, Thunder, Snow, Snow Lying, and Ground Frost.

Professional Notes :—

Vol. III :—

No. 31. The Relation between the Height Reached by a Pilot Balloon and its Ascending Velocity. By J. Wadsworth, M.A.

No. 32. A Note on the Upper Air Observations taken in North Russia in 1919. By W. H. Pick, B.Sc.

No. 33. The Diurnal and Seasonal Variations of Fog at Certain Stations in England. By F. Entwistle, B.Sc.

Geophysical Memoirs :—

Vol. II :—

No. 20. Variations in the Levels of the Central African Lakes, Victoria and Albert. By C. E. P. Brooks, M.Sc.

Vol. III :—

No. 21. Pyrheliometer Comparisons at Kew Observatory, Richmond, and their bearing on data published in the Geophysical Journal. By R. E. Watson, B.Sc.

No. 22. Absolute Daily Range of Magnetic Declination at Kew Observatory, 1858-1900. By Dr. C. Chree, F.R.S.

The publication of the following papers, etc., may also be mentioned :

By Dr. G. C. Simpson, F.R.S.—

The Water in the Atmosphere, pp. V-XII. Supplement to *Nature* No. 2789. Vol. III.

By Dr. Charles Chree, F.R.S.—

The 27-day Period (interval) in Terrestrial Magnetism, *Proc. R. Soc.* Vol. 101, 1922, pp. 368-391.

By F. J. W. Whipple, M.A., F. Inst. P.—

The Horizontal Range of Vision as a Meteorological Observation. *Q. J. R. Met. Soc.* 48, 1922, pp. 99-113.

By J. S. Dines, M.A.—

Note on the Effect of a Coast Line on Precipitation. *Q. J. R. Met. Soc.* 48, 1922, pp. 357-360.

By A. H. R. Goldie, M.A.—

Circumstances Determining the Distribution of Temperature in the Upper Air under Conditions of High and Low Barometric Pressure. *Q. J. R. Met. Soc.* 49, 1923, pp. 6-20.

By D. Brunt, M.A.—

A Double-Vertical-Reflection Mirage at Cape Wrath. *Nature*, Vol. III, 1923, p. 222.

By Dr. J. S. Owens, M.D., A.M.I.C.E.

Suspended Impurity in the Air. London. *Proc. R. Soc.*, Vol. 101, 1922, pp. 18-37.

By C. E. P. Brooks, M. Sc.—

The Evolution of Climate. London. Benn Brothers.

By C. E. P. Brooks, M.Sc., and J. Glasspoole, M.Sc.—

The Drought of 1921. *Q. J. R. Met. Soc.* 48, 1922, pp. 166-8.

By C. K. M. Douglas, B.A.—

Observations of Upper Cloud Drift as an Aid to Research and to Weather Forecasting. *Q. J. R. Met. Soc.* 48, 1922, pp. 342-356.

By G. R. Hay, M.A.—

Arrangements for Supplying Information to Pilots Flying on the London-Continental Air Routes. *Q. J. R. Met. Soc.* 48, 1922, pp. 365-370.

APPENDIX.

SUPPLY OF RAINFALL INFORMATION BY THE METEOROLOGICAL OFFICE.

I. The whole of the rainfall records in the possession of the Meteorological Office (in which the British Rainfall Organization is now incorporated) are public property and may be consulted during office hours by any member of the public without charge. Facilities for making investigations and copying records will be given on application to the Director.

II. **General Inquiries.**—Except in cases which are within Section III, inquiries regarding rainfall will be treated in the same way as inquiries regarding any other meteorological element, and the general rules and charges of the Meteorological Office for the supply of meteorological information will be applied.

III. **Professional Advice.**—When the British Rainfall Organization was in private hands, the Director acted as professional adviser to public and private bodies in matters relating to rainfall. The opinions and advice required involved more than mere meteorological knowledge, being rather of the nature of the opinions given by experts in engineering, mining, chemical and many other applications of scientific knowledge to commercial, industrial or legal ends.

In view of the facts that practically the whole of the accumulated records of British Rainfall are now in the possession of the Meteorological Office, and that there is no one outside that Office who has the same knowledge and experience to supply the technical advice required, Government has decided that it is to the public interest that the Superintendent of the British Rainfall Organization, although he is now in the service of Government, should continue to give professional advice and expert opinions when required and to support such opinions in evidence before a court of law, a Parliamentary Committee or other tribunal, if necessary.

The conditions under which the Superintendent of the British Rainfall Organization will give professional opinion and advice are the following:—

(1) On the receipt of an inquiry which in the opinion of the Director of the Meteorological Office involves the expert advice of the Superintendent of the British Rainfall Organization, the inquirer will be requested to complete a form of agreement specifying the nature of the inquiry and setting out the conditions and the rate of the charges which will be made.

(2) The services of the Superintendent, British Rainfall Organization, will be given to any party who is willing to enter into the above-mentioned agreement. The fact that advice is already being given to one party in a case will not prevent any other party from employing the Superintendent to advise that party also.

(3) The Superintendent will give opinions and advice based only on information in the possession of the Meteorological Office, and any data supplied to the Superintendent for use in an inquiry become *ipso facto* part of the general records of the British Rainfall Organization and, therefore, available for general use. This precludes the Superintendent from examining or considering data in the possession of any party which it is desired to keep secret. The services of the Superintendent will not, however, be refused on the ground that information is being withheld from him.

(4) The Superintendent will limit his opinions and advice strictly to consideration of rainfall. Evaporation, percolation, run-off or other cognate questions will not be discussed by him.

(5) *Fees.*—The time spent by the Superintendent on the professional side of an inquiry will be charged for at the rate of £2 2*s*. per hour. The time spent by other members of the staff of the Meteorological Office will be charged for at the usual average rate of 3*s*. 6*d*. an hour. Travelling and out-of pocket expenses will be charged in addition.

(6) If more than one party requires opinions and advice on the same subject, the total costs of the investigation will be divided between the parties concerned, in the proportion decided on by the Air Ministry. This will apply to all requests made within six months of the supply of the first Report, and if necessary, a refund will be made to any applicant if the amount he has paid proves ultimately to be in excess of his share.

(7) A deposit may be demanded before an investigation is undertaken.

METEOROLOGICAL OFFICE,
AIR MINISTRY,
Kingsway, London, W.C.2.
December 14th, 1922.

AGREEMENT.

APPLICATION FOR THE OPINION AND ADVICE OF THE SUPERINTENDENT OF THE BRITISH RAINFALL ORGANIZATION METEOROLOGICAL OFFICE.

To The Air Council.

I request that the opinion and advice of the Superintendent, British Rainfall Organization, Meteorological Office, Air Ministry (hereinafter called the "Superintendent") on the following matter may be furnished to me :—

I hereby undertake to pay the charges mentioned in paragraph 5 hereof and I agree to the following terms and conditions :—

(1) The Superintendent will undertake such examination of records or statistics, investigation or enquiries as he may deem necessary, and will give his opinion and advice on the matter submitted, but neither the Air Council nor the Superintendent shall be liable for any loss or damage sustained or incurred by the applicant as a result of the giving of such opinion and advice or be subject to any legal liability whatsoever in respect of any communication made to the applicant or to any other person as a result of or in connection with this application or any matter arising out of it.

(2) The Superintendent is at liberty to give opinion and advice to any other person or persons on this or any other matter or matters, and the fact that any opinion or advice has been or is being given to the applicant in connection with Parliamentary, legal or other proceedings, shall not debar the Superintendent from giving his opinion or advice on the same or any similar matter or matters to any other person or persons, whether a party to such Parliamentary, legal or other proceedings or otherwise.

(3) The opinion and advice shall be limited to consideration of rainfall, and shall not extend to such matters as evaporation, percolation, run-off, or other cognate questions.

(4) Rainfall records furnished by an applicant in connection with a request for opinion or advice, and accepted by the Superintendent will be treated as having been furnished for inclusion in the general records of the British Rainfall Organization, Meteorological Office, Air Ministry, for the general use and information of the Air Ministry and the public, and will be dealt with accordingly. The Superintendent will, therefore, not accept, criticise or consider records which the applicant requires to be kept secret, or which are furnished on any other footing than that above stated.

(5) The charges for furnishing the opinion and advice shall be payable on demand and shall be calculated as follows:—

A fee at the rate of 2*l.* 2*s.* 0*d.* per hour (and *pro rata* for part of an hour) for the time spent by the Superintendent in the examination of records or statistics, investigation or enquiry or otherwise in connection with the work of furnishing the opinion and advice requested by the applicant, and a fee of 3*s.* 6*d.* per hour (and *pro rata* for part of an hour) for the time similarly spent by each subordinate official. Travelling and out-of-pocket expenses will be charged in addition. The certificate of the Superintendent as to the time charged for and the expenses incurred shall be final, conclusive and binding on the applicant.

(6) The charges referred to in the foregoing paragraph will however, in the event of more than one application being received for similar opinion and advice within a period of six months from the date the opinion and advice are given to the first applicant, be apportioned between the applicants in such manner as the Air Council may decide, and their decision in this respect shall be final, conclusive and binding upon the applicant.

Note.—The applicant must affix and sign over a sixpenny adhesive stamp.

Signature of Applicant..... | 6*d.* Adhesive Stamp. | .....

Address .....

.....

.....

Date.....

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