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M.O. 428



ANNUAL REPORT

of the Director of the

METEOROLOGICAL OFFICE

presented by the Meteorological Committee
to the Air Council

For the Year ended
March 31
1938

The Eighty Third Year of the Meteorological Office

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LONDON

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METEOROLOGICAL COMMITTEE

1937-8.

 Appointed by the Air Council.

Chairman :—The Under-Secretary of State for Air.

Vice-Chairman :—Colonel Sir HENRY LYONS, F.R.S. Nominated by the Royal Society.

Mr. J. B. ABRAHAM, C.B., Principal Establishment Officer, Air Ministry. Nominated by the Air Ministry.

Professor S. CHAPMAN, F.R.S. Nominated by the Royal Society.

Rear-Admiral J. A. EDGELL, C.B., O.B.E. Hydrographer of the Navy. Nominated by the Admiralty.

Captain W. ELLERY. Nominated by the Board of Trade.

Mr. J. E. W. FLOOD, C.M.G. Nominated by the Colonial Office (To December 31, 1937.)

Mr. W. J. BIGG. Nominated by the Colonial Office. (From January 1, 1938.)

Sir THOMAS MIDDLETON, K.C.I.E., K.B.E., C.B., F.R.S., Development Commission. Nominated by the Ministry of Agriculture and Fisheries.

Mr. F. G. NUTT, C.B.E. Assistant Secretary, Air Ministry. Nominated by the Air Ministry.

Mr. P. J. G. ROSE, C.B. Assistant Under-Secretary of State for Scotland. Nominated by the Scottish Office.

Colonel F. N. C. ROSSITER, M.B.E., M.C., Superintendent of Experiments, Shoeburyness. Nominated by the War Office.

Sir GEORGE C. SIMPSON, K.C.B., C.B.E., F.R.S., Director, Meteorological Office.

Sir D'ARCY W. THOMPSON, C.B., LL.D., F.R.S. Nominated by the Royal Society of Edinburgh.

Secretary :—Miss D. G. CHAMBERS.

The Committee met on July 7 and November 9, 1937.

COMMITTEE OF THE METEOROLOGICAL OFFICE
EDINBURGH, 1937-8

Chairman :—The Director of the Meteorological Office.

Vice-Chairman :—Professor R. A. SAMPSON, D.Sc., F.R.S. Nominated by the Royal Society . (To November 7, 1937.)

Professor E. T. WHITTAKER, Sc.D., LL.D., F.R.S. Nominated by the Royal Society. (From November 8, 1937.)

Commander LESLIE FISHER, D.S.O., R.N. Nominated by the Fishery Board for Scotland.

Mr. DAVID RONALD, M.Inst.C.E., F.R.S.E. Nominated by the Department of Health for Scotland.

Mr. J. M. RAMSAY, O.B.E. Nominated by the Department of Agriculture for Scotland.

Dr. E. M. WEDDERBURN, M.A., Deputy Keeper of the Signet. Nominated by the Royal Society of Edinburgh.

Mr. W. DUNBAR, M.Inst.M.E., M.Inst.W.E. Nominated by the Royal Meteorological Society.

Dr. FREDERICK WALKER. Nominated by the University of St. Andrews.

Mr. A. STEVENS, M.A., B.Sc. Nominated by the University of Glasgow.

Secretary : Dr. A. H. R. GOLDIE, F.R.S.E.

The Committee met on June 18, 1937.

THE GASSIOT COMMITTEE, 1937

Appointed by the Royal Society in accordance with Treasury Letter of February 26, 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.

The President of the Royal Society (Sir WILLIAM H. BRAGG).

Sir HENRY LYONS (*Chairman*).

The Astronomer Royal (Dr. H. SPENCER JONES).

The President of the Royal Astronomical Society (Dr. H. SPENCER JONES).

The Director of the Meteorological Office (Sir GEORGE C. SIMPSON).

Sir GERALD LENOX-CONYNGHAM.

Sir GILBERT WALKER.

Professor S. CHAPMAN.

Dr. G. M. B. DOBSON.

Professor G. I. TAYLOR.

Sir FRANK DYSON.

The Committee met on July 27, 1937.

A list of the staff and of the divisions and establishments of the Office will be found on pp. 50 to 57.

ANNUAL REPORT of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the year ending March 31, 1938 (the eighty-third year of the Meteorological Office).

In the Meteorological Office the year 1937-8 has been one of steady progress towards supplying the additional meteorological services required in connexion with the expansion of aviation, both Service and Civil. In the *Annual Report* for the previous year the nature of these increased services, both for the Royal Air Force in this country and for Civil Aviation along the main air routes in connexion with the Empire Air Mail Scheme, was set out, and there has been no material change. The progress made during the year has not consisted only in recruiting and training more staff and opening new stations as the men became available, but improvements have been carried out in the communications between the observing stations and Headquarters and between Headquarters and the stations where the information is required, and there has been development in the number of observations taken and the methods of taking them.

The Divisions of the Office not dealing primarily with aviation have not been unaffected by the increased activity due to aviation, and there has also been the normal expansion of work due to the increasing realization, amongst business people and the general public, of the use which can be made of the vast accumulation of weather information in the Meteorological Office.

The chief change in the organization of the Office during the year has been the transfer to the Admiralty of the administration of meteorological work in the Fleet as described on p. 29. This transfer was necessitated by the rapid development of the use of meteorology in the Royal Navy, involving many questions of detailed administration which could not conveniently be separated from other naval questions. Responsibility for the development of the scientific side of naval meteorology remains with the Meteorological Office.

MARINE DIVISION

The work of the Marine Division has continued with little change.

Considerable progress has been made in extracting information from the logs which have accumulated since 1855. During the year about 500,000 sets of observations were extracted so that now only 230,000 sets still remain. The work of extraction should be completed in the course of the year 1938-9, when it will be possible to commence analysing the data preparatory to the preparation of the proposed meteorological atlases of the oceans.

The "selected ship" service for supplying meteorological information from the sea by means of W/T has worked satisfactorily throughout the year and the arrangement by which supplementary reporting ships supply information in those regions where there are not sufficient "selected ships" to provide the required density of observations has been developed and is successfully fulfilling its purpose.

A full description of the work of the Marine Division will be found in the *Marine Observer* for July, 1938.

GENERAL CLIMATOLOGY DIVISION

Meteorological Returns from British Colonies—Many of the British Colonies and Protectorates which have no organized meteorological service nevertheless maintain one or more meteorological stations, and publish the observations in their annual blue-books. The Meteorological Office collects reprints of these summaries and circulates them in sets to nearly 200 recipients in all parts of the world. During the year 1937-8 reprints from 35 Colonies were issued in this way, containing data for 629 stations.

In several small Colonies, mostly on oceanic islands, climatological stations are maintained directly by the Meteorological Office. Summaries of the observations at six of these stations—Amman (Trans-Jordan), Ascension Is., Fanning Is., Funafuti (Ellis Is.), Ocean Is., and St. Helena for the year 1935 were printed for the first time and included with the summaries for other Colonies for distribution.

Climatological returns were received in manuscript from a number of other stations both in the Colonies and in foreign countries where no regular meteorological service exists; summaries for some of these stations are included in the *Réseau Mondial*. Two new stations were established during the year at Mukalla and Seiyun in the Aden Protectorate, the instruments being supplied by the Meteorological Office. The total number of stations for which MS. returns were received in 1937 was 86.

Réseau Mondial.—The annual volume of data known as the *Réseau Mondial*, which includes as far as possible summaries of pressure, temperature and precipitation for the whole world, was published for the year 1930. The preparation of the volumes for 1931 and subsequent years has been delayed because data for large areas, notably U.S.S.R. and Brazil, have not yet been published by the authorities in those countries, and it has not proved possible to obtain advance summaries in manuscript.

The International Meteorological Conference at Warsaw in 1935 recommended that the standard period for normal values of meteorological elements should be 1901 to 1930. This differs from the practice adopted in the *Réseau Mondial*, which aims at a standard period of 35 years for normals. As continuity of practice from one volume to another of the *Réseau Mondial* is highly desirable, it was

not considered desirable to change the normals in the volumes now under preparation, but a subsidiary series of normal values for the years 1901-30 is being prepared for *Réseau Mondial* stations, and it is proposed to issue these in a separate publication.

Broadcasting of Climatological Data.—The international organization for the regular broadcasting of short summaries of world-wide climatological data about the 5th of the following month, which was begun in 1936, is now working smoothly. Data are received each month for stations over the whole of Europe, the greater part of Asia, Australia, New Zealand and the Pacific Islands, North America, the Arctic and Greenland. These data and their differences from normal are plotted on charts which are described in detail in the *Meteorological Magazine* for the following month. They are also available for inspection at the Meteorological Office, and have already been employed in various investigations.

Admiralty Pilots.—The periodical revision of the meteorological sections of the Pilots issued by the Admiralty was continued, and the texts of six Pilots were revised.

Naval Handbooks.—Closely allied to the work of revising the Admiralty Pilots is the preparation of special handbooks on the meteorology of certain areas on a very detailed basis, for the use of the Royal Navy. This work was taken over by the General Climatology Division on the transfer of the Naval Division to the Admiralty.

Special Investigations.—Considerable progress has been made with an investigation of the climatic conditions in Africa during the years 1925 to 1936. During this period there were a number of serious outbreaks of locust swarms, and the investigation is being carried out on behalf of the Committee on Locust Control of the Economic Advisory Council. Monthly data of temperature, humidity and rainfall have been collected for a large number of stations. A great deal of the material has kindly been supplied in manuscript by the various meteorological services in Africa, and this assistance is gratefully acknowledged. Arrangements are now being made for the information to be plotted on special charts.

Inquiries.—During the year 228 general or scientific inquiries and 321 personal inquiries were dealt with. Among these may be mentioned, several requests from the Ministry of Agriculture and Fisheries for information as to pressure gradients over the English Channel and North Sea, in connexion with the migrations of fish; a request from the Rothamsted Experimental Station for details of weather changes in relation to flights of moths; and an inquiry from the Governor of St. Helena about a suspected decrease in the rainfall of that island. On many occasions advice and information

on library and other matters were given to the recently formed Meteorological Service of Eire.

A copy of the original records made at the Ice Cap Station of the British Arctic Air Route Expedition of 1930-1 was made for Dr. J. Georgii of the Deutsche Seewarte.

Library—The unprecedented meteorological activity in all parts of the world has led to a continued growth of the Library of the Meteorological Office during the past year. The additions numbered 838 new books and pamphlets, 4,289 periodicals and 12,501 daily weather reports. The rapid increase in the staff of the Office has also resulted in much greater use of the Library; 1,931 books, etc. were issued on loan during the year, in addition to a large number consulted in the Library itself.

The Library took a pioneer part in introducing the revised decimal classification for meteorology, and has given information and advice to many other meteorological institutions on the use of the classification, which is now adopted in many of the largest meteorological libraries in all parts of the world.

The Meteorological Office also prepared a classified catalogue of all known meteorological books and pamphlets published in the British Empire during 1936, with abstracts where possible, and forwarded it to the Office National Météorologique of France for inclusion in an international bibliography of meteorology for that year.

It has not proved practicable to re-classify the great mass of publications received in the library prior to 1936, but a selection of some 2,000 of the more important books and papers published during 1901-35 has been re-classified in the form of a selected subject bibliography which is available for consultation.

The collection of lantern slides has also been re-arranged according to the decimal classification, and a revised catalogue prepared and issued. Additions to the collection during the year numbered 81. To facilitate rapid selection of slides, photographic reproductions of the majority have been arranged in a special album.

Six films showing the development and transformations of cloud systems were purchased from the Reichsstelle für den Unterrichtsfilm, Germany. The accompanying explanations of five of these were translated into English, and the films were shown to the staff in the lecture theatre of the Science Museum on February 28. Thanks are due to the Director of the Science Museum for his courtesy in allowing the use of the theatre on this occasion, and also for the staff discussion on March 21. The remaining fortnightly discussions were held in the Meteorological Office Library as formerly. They were attended by greatly increased numbers, and some re-arrangement of the furniture in the library was necessary to accommodate them.

The continued growth of the Library again caused the problem of space to become acute, and it was necessary to find accommodation outside London for a number of books which are rarely consulted. The seismological part of the Library was transferred to Kew Observatory. Co-operation with the National Central Library was continued as in former years.

The exchange of publications was extended to the following institutions :—

Instituto Geofísico e Geodética della R. Università, Messina.

Service Météorologique, Tananarive.

Observatorio Astronómico de la Universidad Nacional, La Plata.

Station Séismique de l'Institut Géophysique, Tiflis.

Seismological Observatory, Weston College, Mass., U.S.A.

Pilar Geophysical Observatory, Argentina.

Seismological Station, Brisbane.

Erdphysikalische Warte b.d. Sternwarte, Munich.

Meteorological Service, Jerusalem.

Observatoire Météorologique, Michelson, Moscow.

BRITISH CLIMATOLOGY DIVISION

Organization.—The Division collects and indexes climatological and rainfall records from all stations in the British Isles which report to the Office. Summaries of the results of the observations at the stations are published in one or more of the publications entitled *Weekly Weather Report*, *Monthly Weather Report* and *British Rainfall*. The Division is also responsible for the passage through the press of the annual volumes of the *Observatories' Year Book*, of which the "copy" is prepared at the several observatories.

Other activities of the Division include the preparation of replies to inquiries relating to past weather or British climatology, including the assessment of mean rainfall on specified areas in connexion with water schemes, and the computation of climatological averages for publication and official use.

Distribution of Stations.—The stations vary greatly in equipment and personnel and may be roughly divided into six classes—

(a) Observatories (*see pp. 33-6*) where continuous records of all meteorological elements are obtained.

(b) Distributive stations, which are established to distribute information for civil aviation, the Royal Air Force and the Army, at which—with but few exceptions—synoptic charts are prepared daily.

(c) Telegraphic reporting stations. These stations have been established to take observations and report them immediately by

telegraph. The observers are not members of the Meteorological Office staff, being frequently coastguards, lighthouse keepers or others with permanent posts giving them facilities for taking meteorological observations at all hours.

(d) Crop Weather stations are maintained at certain agricultural colleges and research institutions in connexion with the study of the relations between the weather and growing crops. They report partly to the Meteorological Office and partly to the Ministry of Agriculture and the Department of Agriculture for Scotland, and the arrangements for the observations are under the general control of a committee on which the Office is represented.

(e) and (f) Climatological and Rainfall stations. These are maintained by private observers, or by municipal or other local authorities without payment by the Office. Great public spirit is shown by those who maintain these stations, and forward their records and observations for incorporation in the official weather reports, and for preservation in the Office, where they are available for the benefit of the community.

The number of stations of each of the above types in each of the 16 divisions into which the British Isles is divided for meteorological purposes is shown in Appendix I (p. 47). In that table also is given the number of stations which maintain instruments for the continuous record of certain specified meteorological elements. Only such autographic records as are regularly received in the Office are included in the table.

Presentations to Observers of Long Standing.—As a mark of appreciation of long service to the public, the names of the following rainfall observers have been added to the free issue list of *British Rainfall* :—

Miss A. T. Gardiner, 40 years' observations at Weybridge (Heath Field).

Mr. J. Corbett, 42 years' observations at Whitby (Mulgrave Castle).

Rev. Eustace Malden, 41 years' observations at Frant (Henley Lodge).

Mr. Alfred Downs, 42 years' observations at Bolton Abbey.

The services of the following observers at climatological stations, whose observations have extended over unusually long periods, have been acknowledged by the presentation of appropriately inscribed aneroid barometers :—

Mr. Joseph Baxendell, 50 years' observations under his direction at Southport.

Mr. Charles Webster, 45 years' observations at Gordon Castle, Morayshire.

Dr. T. Edmonton Saxby, 33 years' observations at Baltasound, Shetland.

Publications.—*The Monthly Weather Report* has appeared regularly in the same form as in recent years.

The Weekly Weather Report, 1936-7 was published on August 30, 1937.

British Rainfall, 1936.—The volume was signed for press on June 25, and published on September 7, 1937.

Observatories' Year Book.—The volume for 1935 was published on July 27, 1937. The "copy" for the 1936 volume had all been sent to the printer by the end of September, 1937, and the volume was published on March 17, 1938.

Returns for Registrar-General.—Weekly summaries of the weather at certain large towns are prepared for the Registrar-General for England and Wales. Quarterly and annual summaries are also prepared. Similar information is supplied quarterly to the Governments of Northern Ireland and Eire.

The report for Scotland published by the Registrar-General for Scotland is prepared at the Meteorological Office, Edinburgh.

Inquiries.—During the year 3,037 inquiries were received and dealt with, including 256 legal inquiries. These figures represent a slight increase on the total dealt with last year, though legal inquiries show an increase of 46 per cent.

Whilst the majority of the inquiries refer to climatological data for specified places for insurance, residential or health purposes, the proportion of inquiries for data in connexion with industry and research has continued to increase. Inquiries of this type are very varied in character, and it may be of interest to mention one from an important electricity undertaking relating to the deposition of snow on overhead power lines and the possibility of dislodging the snow by increasing the current transmitted by the lines.

The establishment of Catchment Boards under the Land Drainage Act of 1930 has led to a large increase in the amount of work involved in rainfall inquiries.

Investigations and Special Work.—*Averages of Humidity*.—The new volume of averages of humidity referred to in last year's *Annual Report* was prepared and was passed for press on March 26.

Climatological Atlas.—Work has proceeded on the preparation of pressure normals for the period 1901-30 and is nearing completion.

Rainfall.—Monthly and annual averages of rainfall at selected stations for the period 1901-30 were computed as a first step in the construction of rainfall maps for this period. The changes of distribution as compared with the present standard period 1881-1915 are discussed in an article to be published in *British Rainfall*, 1937.

Rainfall Survey.—Further progress was made with the survey of Scotland, and the work on the counties of Lanarkshire and Perthshire was completed, whilst that on Dumbartonshire, Stirlingshire and Buteshire is well advanced. In addition, survey work on repayment has been carried out in respect to various catchment areas.

Committees.—The Superintendent continued to represent the Meteorological Office on the Agricultural-Meteorological Committee (Ministry of Agriculture and Fisheries) and as Assessor on the Inland Water Survey Committee (Ministry of Health). The Superintendent and Dr. J. Glasspoole served on a joint committee of the Meteorological Office, the Royal Meteorological Society and the Institution of Water Engineers which presented an important report on the determination of general rainfall over any area at the meeting of the Institution of Water Engineers in December, 1937. The Superintendent also assisted a sub-committee of the Building Research Committee (Department of Scientific and Industrial Research) and prepared a report on the incidence of extreme winds in the British Isles, to March 1938.

SYNOPTIC DIVISION

General.—The work of the Division in London is divided broadly into five parts :—

(1) A Headquarters service for the co-ordination of the activities of the Division.

(2) A daily weather service of weather reports and forecasts which are issued to the general public, the newspaper press, Government Departments, the British Broadcasting Corporation etc. This section supplies weather information also to the Royal Air Force and for civil aviation, partly directly and partly through a number of meteorological stations established on aerodromes.

(3) Supervision and control of a number (at present 30) of meteorological stations established at stations and other establishments of the Royal Air Force which are situated in Great Britain and Northern Ireland.

(4) Supervision and control of a number (at present 4) of meteorological stations situated at civil airports or aerodromes in Great Britain.

(5) Supervision or general control of the meteorological instruction which is given to civil pilots and to pilots of the Royal Air Force; arrangements for oral and written examination of these pilots; replies to meteorological inquiries concerning new aerodrome sites, and other matters connected with aviation.

The year has been one of marked activity in every direction, consequent upon the expansion of the Royal Air Force, and the

development of civil aviation. Weather forecasting has become more exacting, especially as regards aviation, for the present requirement is that aircraft should be able to fly in nearly every kind of weather, although the pilot has to be prepared for the conditions which are actually experienced.

Headquarters Service.—Before the close of the period under review, consideration and preparations were made for the removal of the Headquarters service from Adastral House, Kingsway, to new and greatly extended quarters in Victory House, Kingsway. The move was actually carried out on April 2 and 3, 1938. Prior to this move a third senior technical officer was allocated to the division for duties in connexion with the forecast service. The new organization and accommodation have already proved beneficial; they will be severely tested in the months to come, owing to the rapid developments which are taking place.

A new system of communication with meteorological stations well distributed over the country was initiated during the year by the installation of direct teleprinter connexions between these stations and Headquarters. Plans have been made and approved for a large extension of this method of communication, and the work is proceeding.

During the year, considerable developments have taken place in the hourly service of broadcasting of current weather reports by radiotelephony from the transmitting station at Borough Hill, Northamptonshire. At the beginning of the year only a very few stations observed every hour, but at the end of the year no fewer than 87 stations sent hourly reports from 0700 to 1800 G.M.T. for broadcasting, and 47 from 1900 to midnight. The full service is in operation only for five days a week; on Saturdays and Sundays the service after 1800 G.M.T. is suspended, while the number of reports broadcast before 1800 is reduced, especially on Sunday. To the above numbers should be added a number of stations which report at intervals less frequent than one hour. For the most part these are telegraphic reporting stations which are not included in the hourly service but report regularly at some or all of the hours 0700, 1000, 1300, 1600, 1800 and 2200 G.M.T. full "synoptic" observations which are used for the construction of daily weather charts for the purposes of weather forecasting.

The broadcasts, which are made on a frequency of 245 Kc./sec. (wave-length 1224 m.), are audible on ordinary broadcast wireless receivers at loudspeaker strength in most parts of the country. The broadcasting of the weather reports which are compiled from observations made at each hour commences at 15 minutes past the hour, and a full set of hourly observations takes about 30 minutes to broadcast. The "studio" is in Victory House, and the teleprinter system to which reference has been made is a necessary link in the chain for the rapid collection of the information. The order

of announcement of stations proceeds by belts lying across the country in a direction approximately west-south-west to east-north-east. The first reports are derived from the southernmost belt, and reports from the more northern belts follow in order of geographical distribution of the belts. Ten of the stations which render hourly reports by day are situated in mountainous districts of the British Isles. Pads of forms for taking down the messages are essential for easy recording. They can be purchased from H.M. Stationery Office at the usual addresses, price 6s. per set of four pads.

Preceding the announcement of each hour's reports, meteorological warnings of gales, thunderstorms, squalls and information regarding the likelihood of ice accretion in or below clouds, are broadcast; while at 0845, 1145, 1445, 1545, 1945 G.M.T. general aviation forecasts together with any navigational warnings, are broadcast for Great Britain and Northern Ireland.

Synoptic reports which are immediately forwarded to Headquarters are now made at about 45 stations in the British Isles, at some or all of the following hours each day:—0100, 0400, 0700, 1000, 1300, 1600, 1800 and 2200 G.M.T. After receipt they are forwarded to the Air Ministry Wireless Station (GFA.) and broadcast in morse both on long and short waves at pre-arranged times, for the benefit of meteorological stations on aerodromes. These reports also fulfil an international obligation, for they are used by meteorological services on the continent. *Per contra*, synoptic reports for the same hours are received by wireless telegraphy from the continent, and are also used for the construction of the weather charts at Headquarters. Only a part of the information received from abroad is re-transmitted to outstations. The Marine Division has maintained the arrangements for the reception of corresponding synoptic reports from ships on the high seas. These reports are regarded as essential for the preparation of a complete weather chart, and on many occasions they are vital for successful forecasting. The hours of observation on board ships are, in general, midnight, 0600, 1200 and 1800 G.M.T. Observations made at these hours are plotted respectively on the weather charts upon which land observations at 0100, 0700, 1300 and 1800 G.M.T. are shown.

At Headquarters three kinds of synoptic charts are regularly drawn.

(1) Charts on the scale of 1 : 5 million upon which the synoptic observations are plotted practically in their entirety, in accordance with the procedure laid down by the International Meteorological Organization. These charts are drawn for each of the eight hours a day for which land observations are made, and their primary purpose is to enable the forecaster to prepare the detailed forecasts (usually for not more than 10 hours ahead, and often much less) which are required for aviation purposes. This type of chart is also drawn at outstations.

(2) Charts on the scale of 1 : 10 million covering most of Europe and the North Atlantic, upon which only a selection of the observations can be shown, and those only incompletely. In conjunction with the charts previously described these charts are used primarily for press forecasts, and for other forecasts for 24 to 36 hours ahead. They are prepared for the four principal hours of observation, viz.:— 0100, 0700, 1300 and 1800.

(3) Two charts a day, for 0100 and 1300 G.M.T. (except at sea where the hours of observation are midnight and noon, and in the U.S.S.R. where the hours of observation are 0100 and 1300 local mean time, and in a few other places where different hours of observation are used) for the greater part of the Northern Hemisphere, on a nominal scale of 1:30 million. These charts are specially useful for giving a broad conspectus of the meteorological situation, and of the changes which are taking place.

All charts are "analysed" according to the method now generally accepted, so as to show the different kinds of air masses which are present at the surface, as well as surface isobars. It is only by maintaining the series of charts unbroken that the movements of "fronts" which separate different kinds of air masses can be correctly and accurately traced.

The issue of gale warnings both visual and by wireless broadcast has continued. The result of the checking of the warnings for 1937 is shown in Appendix II.

Special attention has been given to the necessity of lowering gale-warning cones (which are displayed at stations around the coast on receipt of telegraphic instructions from Headquarters that a gale is expected) as soon as it has become evident that the gale will subside. Telegraphic instruction for lowering cones may therefore be issued even when the gale is still blowing. From January 1, 1938, gale warnings have been issued by radiotelephony from eight coast stations of the G.P.O. in addition to the issue by radiotelegraphy from six stations.

Much attention has been devoted during the year to the question of ice accretion on aircraft, and instructions in the matter have been issued to forecasters (see also Publications, p. 59).

From January 1, 1938, the weather map of the northern hemisphere which is published on page 3 of the British section of the *Daily Weather Report* has been prepared as far as possible from observations at 0100 G.M.T. (midnight at sea). The principal exception is that the observations in the U.S.S.R. are made according to 0100 local mean time. Previously the hours of observation for this chart were 0100 G.M.T. in America and midnight on the Atlantic west of 40° W., while on the Atlantic east of 40° W. the observations shown on the chart were for 0600 G.M.T., in western Europe for 0700 G.M.T. and in the U.S.S.R. for 0700 local mean time. The advantage of the change is that there is not more than one hour in discontinuity of time from America to western Europe; this is

important for forecasting, since most of the weather experienced in the British Isles travels from the west. The former discontinuity of 6 hours at longitude 40° W. was not infrequently troublesome in tracing the eastward movement of "fronts" across the Atlantic.

From the same date the publication, in the Upper Air Supplement to the *Daily Weather Report*, of wind speed and direction as determined from observations of pilot balloons has been in stages of 500 metres or whole kilometres of height, while the unit of wind speed has been changed to the kilometre per hour. If marked changes of wind occur at any height intermediate between the stated heights, they are shown at the feet of the relative columns.

The regular service of forecasts and reports to the press has been continued without change.

Forecasts for broadcasting by the British Broadcasting Corporation have also been issued daily without material change from last year. These include special forecasts of wind and visibility for shipping in the waters around the British Isles, and forecasts for fishing fleets.

Forecasts for shipping in home waters have also been issued twice daily by wireless telegraphy, both from the Air Ministry, from the long-wave G.P.O. station at Rugby, and also on a wave-length of 600 metres from four coastal wireless-telegraph stations of the Post Office.

The long daily programme of issues by morse from the Air Ministry Wireless Station, of weather reports from stations and ships, has been continued without material change. Full particulars are published by H.M. Stationery Office in Meteorological Office publication 252.

Slight changes have taken place in the Fleet synoptic messages, issued through the Admiralty twice each day. These are also described in the publication just referred to.

Meteorological officers at outstations were asked some years ago to collect in special manuscript books information regarding the local weather at their stations, so that the information would be of service to their successors who would normally be unacquainted with the local conditions. During the year these books have been collected, and the information contained in them has been collated and issued to every station, for it was felt that the local information at any station was of interest to all other stations also, in view of the amount of cross-country flying which is carried out.

"Cloud searchlights" which project beams of light vertically upwards have been installed at 15 aerodromes, and arrangements have been made for the installation of many further instruments of this type. It is a simple matter to determine accurately the height of the base of low cloud during darkness with the aid of one of these instruments. By means of an alidade set up at the meteorological station or elsewhere the angular altitude of the patch of light which the searchlight throws upon the under surface of the cloud is measured, and the actual height of the cloud is then readily computed from a table.

Services for the Royal Air Force.—In March, 1937 the Royal Air Force Meteorological Policy Committee was established to ensure that the meteorological services are adequate to meet the needs of the R.A.F. Much of the business of this committee has directly affected the work of the Synoptic Division and of its outstations. Among the matters which have been dealt with are :—

- (1) the establishment and staffing of meteorological offices of different types at stations and other establishments of the Royal Air Force.
- (2) the siting of meteorological offices on Royal Air Force stations etc., and the planning of suitable accommodation for offices of different types.
- (3) the arrangements for making and communicating to Headquarters hourly reports of weather from numerous stations of the R.A.F. These reports form a considerable part of the hourly weather reports which are broadcast from Borough Hill.
- (4) the general question of communications to and from aerodromes.

In May, 1937, ten new stations were opened on R.A.F. stations or establishments.

Owing to the greatly increased speed of modern aircraft and to the fact that they are designed to be flown in practically every kind of weather, it has been arranged that R.A.F. pilots proceeding on long flights should be provided with a card setting out the latest weather reports at stations on the route, and an aviation forecast.

The number of R.A.F. exercises has been markedly increased during the year, and it has been found necessary that staff at outstations should be kept on night duty more frequently than in the past.

The "meteorological flights" by R.A.F. aircraft for making observations of the temperature and humidity of the upper atmosphere have been continued during the year at Mildenhall and Aldergrove. The remarkable and extremely creditable standard of regularity established in previous years has been maintained.

The Meteorological Officer at South Farnborough worked in close liaison with the R.A.F. officers who were responsible for creating the world record for the maximum altitude attained in an aeroplane.

Assistance is being rendered as necessary to the officers of the Long-Range Development Unit.

There were a considerable number of Army co-operation trials during the summer at camps in various parts of the country. As a general rule the aircraft were able to operate from stations where meteorological staff were already available, but in one case it was necessary to post a meteorological officer to a temporary R.A.F. camp which had been set up for the purpose.

Meteorological officers at several stations provided upper wind data to Army units in connexion with the firing of heavy guns.

Fourteen meteorological offices on R.A.F. stations were open to the public for inspection on Empire Air Day, May 29.

Services for Civil Aviation.—Meteorological services were provided as previously at the London Airport, Croydon, continuously day and night. Whereas, some years ago, scheduled flights were normally made only to relatively near destinations, *e.g.* Paris, Brussels, Amsterdam, it is now common for some of these flights to be continued to greater distances, or for longer flights to be made without stop. Thus, services to Amsterdam are often continued to Berlin, and there is a direct London-Zürich service. If, in the first case, weather conditions at Amsterdam are unfavourable for landing, the flight is made non-stop to Berlin. It is therefore now necessary to receive at Croydon by wireless telegraphy, from a much wider area than previously, the special regional reports which have been arranged for Europe; this has led to increased demands upon the wireless staff, and to a greatly increased amount of work in the Meteorological Office at Croydon.

Mr. R. S. Read, the Officer-in-Charge of the Meteorological Office at Croydon has recently paid visits, through the courtesy of the local authorities, to the continental airports at Paris, Zürich, Brussels, Amsterdam, Berlin, Cologne and Hamburg, in order to familiarize himself with the methods of working at the meteorological offices on those airports. These visits have proved to be of great value.

Several improvements in the equipment of the Croydon Meteorological Office have been effected: for example, red lights are switched on in the Office by the Control Officer whenever Q.B.I. conditions prevail at Croydon (*i.e.* whenever aircraft are only permitted to enter the Croydon Controlled Zone one at a time owing to stress of weather or other cause).

At Manchester the amount of work has greatly increased in consequence of the establishment at the airport of control arrangements similar to those at Croydon. It is now part of the duty of the Meteorological Office regularly to pass local weather reports by tube to the Control Office, the Wireless Office and the Teleprinter Office.

A new meteorological office on a civil aerodrome has been opened at Bristol, mainly in connexion with the daily services between Croydon and Dublin.

Action has been taken in conjunction with the Department of Civil Aviation, to work out a scheme for implementing the report of the committee which considered the internal air lines of this country, whose Chairman was Sir Henry Maybury. Under this scheme consideration has also been given to the lay-out of buildings which would suitably house the control, signals and meteorological staffs at airports in this country.

A report was prepared for the consideration of the Cadman Committee giving the outlines of the meteorological organization for civil aviation in this country. The report is printed as an appendix to the Report of the Cadman committee.

Arrangements were made for the supply of weather reports and forecasts, at various points of the course, to competitors in the King's Cup Air Race on September 10 and 11, 1937.

Meteorological arrangements were made for the protection of aircraft on the new route Woollington (Newcastle) and Stavanger (Norway) which was operated during the autumn of the year.

A service was operated during the summer between Amsterdam and Liverpool by the Royal Dutch Air Lines (K.L.M.), and the necessary weather reports and forecasts were supplied for the use of the pilots.

Advice was given to the Southern Railway on the taking of requisite meteorological observations at their proposed aerodrome site at Lullingstone, Swanley Junction, Kent, in order to ascertain whether the site is meteorologically a good one for the purpose. The observations are being continued.

The Superintendent is a member of the Meteorological Commission of the International Aeronautical Conference and also of the International Commission for Aeronautical Meteorology (see p. 38).

Meteorological Instruction to Pilots—Inquiries, etc.—The matter of instruction in meteorology to the R.A.F. has been under review. In consequence of the large increase in instruction which is needed, it is being arranged that the elementary meteorology which is required to be taught to pilots at flying training schools should be dealt with by the education officers at the schools. At a later stage in their training, R.A.F. pilots will all attend, either the Navigation School, Manston or the School of General Reconnaissance, Thorney Island, where Meteorological Office lecturers are now available to give meteorological instruction. A lecturer was posted to the latter school at the end of the year under review. The former school has had a lecturer for many years.

Lectures have been given regularly during the year to flying training schools, and to the Central Flying School, while a large number of lectures has been given to service squadrons at many other stations by the meteorological officers at the stations.

Lectures have been delivered to naval personnel at Calshot, Leuchars and in London.

Reports on the general meteorological conditions prevailing over 40 proposed aerodrome sites in Great Britain and Northern Ireland were prepared and supplied on request. Many other special inquiries were dealt with at Headquarters. A very large increase in the number of inquiries for weather reports and weather forecasts for aviation has occurred both at Headquarters and at outstations, in spite of the ease with which this kind of information can now be obtained by wireless telephony.

OVERSEAS DIVISION

The outstanding features of the period under review have been, activities associated with the provision of a meteorological organization for the survey flights across the North Atlantic Ocean carried out during the summer by Imperial Airways Ltd. in conjunction with Pan American Airways Inc., and the completion in February of the fourth overseas tour by the Superintendent of the Division. The primary object of this tour was to attend a conference convened at Wellington, towards the end of November, by the Director of the New Zealand Meteorological Service, which was concerned with the development of meteorology in the south-west Pacific, and at which the United Kingdom, Australia, New Zealand, the United States of America and Fiji were represented. The journey to Australia was made by air, and opportunity was taken to make contacts with representatives of the various meteorological services along the route. On the return journey visits were paid to the Meteorological Offices at Melbourne, Toronto and Washington.

The Empire Airways.—Close liaison has been maintained with the different meteorological authorities responsible for the provision of facilities along the Empire Airways; and assistance has been given in the selection and training of staff, the purchase of equipment and the general development of meteorological services.

Details of the more important developments during the year are given below.

The Empire Air Base at Hythe (Southampton).—A meteorological station was opened at Hythe, in May, in order to provide facilities for furnishing direct to the Commanders of the Imperial Airways flying boats, meteorological information for the first section (from England to the Mediterranean) of the Empire Airway. Previous to February, information had been supplied by telephone from the Meteorological Office at the Royal Air Force Base, Calshot.

Owing to the lack of suitable accommodation at Hythe, a brake van, hired from the Southern Railway Company and stationed on a siding in the Hythe Goods Yard in close proximity to the air base, has served as a meteorological office. Complete wireless facilities have not yet been provided, but since August a teleprinter circuit, established between Hythe and Calshot, has been used for the transmission from the latter station of the synoptic messages necessary for the construction of weather charts. Regional meteorological messages from French stations are received direct at Hythe. A combined meteorological and wireless hut is now being built overlooking Southampton Water; it will be occupied shortly.

Weather reports and forecasts covering the route over France have been issued for each outgoing service. Information is furnished to incoming aircraft in flight via Southampton and Portsmouth airports.

Malta.—Arrangements have been completed for the supply of meteorological information at Tai Kali aerodrome for the Imperial Airways landplane service between England and India which is expected to commence during 1938. An observer has already been posted to the aerodrome, and regular observations are being made there.

Egypt.—In pursuance of the policy for the gradual transfer, over a period of years, of the aviation meteorological service in Egypt from the Air Ministry to the Egyptian Ministry of Communications, three Egyptian graduates have been selected for meteorological duties—they commenced a post-graduate course in meteorology at the Imperial College of Science, London University, in October. Egyptian computing staff have received preliminary training under the Director of the Meteorological Service of the Egyptian Physical Department.

Arrangements are in hand for the establishment of a subsidiary forecast centre at Alexandria to supply meteorological information to the Imperial Airways' flying-boat service.

Palestine.—The Meteorological service of the Government of Palestine under the Department of Civil Aviation has developed, but has not yet assumed responsibility for the supply of forecasts and data for the air routes through Palestine. Assistance has been given to the Service during the year in connexion with the purchase of meteorological equipment and other matters.

Iraq.—The Iraqi Meteorological Service assumed responsibility, as from December 28, for the collection of observations from all stations in Iraq; and from January 1, 1938, the Iraq synoptic messages have been broadcast from Baghdad instead of by the Royal Air Force wireless station at Hinaidi as previously. From March 13, Baghdad civil wireless station also took over from the Royal Air Force the broadcasting of the regional aviation forecast, prepared each evening in the Air Ministry meteorological office at Habbaniya.

From January 1, 1938, the station of the Iraqi Meteorological Service at Basra assumed responsibility for all forecasts for aircraft leaving Basra for Baghdad or Habbaniya; from March 1 by arrangement with the India Meteorological Department, this station also assumed responsibility for the Persian Gulf area west of a line Sharjah—Jask.

The transfer of meteorological stations in Iraq to the Iraqi service, other than those maintained at Royal Air Force stations, is now nearly complete.

British West Africa.—The administrations of the four West African Dependencies agreed to the establishment of a joint British West African Meteorological Service, on the lines recommended to them by the Superintendent of the Division during the tour

referred to in last year's *Annual Report*. Mr. D. E. Smith, an officer of the Survey Department in Nigeria who was formerly on the staff of the Meteorological Office, has been appointed to take charge of the service. Assistance has been rendered to the Colonial Office in the recruitment of staff. Three members of the staff of the Meteorological Office have been appointed to assistant posts in Nigeria, the Gold Coast and Sierra Leone respectively.

New Zealand.—At the meteorological conference held in Wellington towards the end of November, to which reference has already been made, agreement was reached, on methods of improving the existing meteorological organizations in Australia and New Zealand, on the issue of additional weather reports from south-west Pacific Islands and from ships at sea, and on arrangements for a series of national, continental and inter-continental broadcasts of observations. Particular attention was directed to the provision of adequate meteorological organizations to meet the requirements of projected trans-Tasman and trans-Pacific routes.

Trans-Atlantic Air Routes.—(a) *Meteorological Investigations*.—A detailed investigation into the times of passage of aircraft from east to west across the North Atlantic Ocean from Ireland to New York on the northern, direct and southern routes was completed, and copies were distributed to Government departments and operating companies concerned.

The analysis of synoptic weather charts of the Atlantic, including the classification of depression tracks and developments, has been actively pursued throughout the year.

The special programme of observations and investigation carried out by a technical officer of the Overseas Division in the course of eight round voyages in the *Manchester Port* between England and Canada was completed in November. A report has been prepared.

A statistical analysis of upper winds over the North Atlantic has been carried out.

Following the survey flights between Southampton and New York which are referred to below, an investigation was made into the relation between the weather conditions during the flights, as revealed by the aircraft logs, and the existing synoptic situations.

(b) *Provision of Meteorological Organization for North Atlantic Survey Flights*.—The meteorological station at the Shannon Airport, which, as reported last year, is operated by the Meteorological Office on behalf of the Government of Eire on an agency basis, was in operation from April 14 until October, when the forecasting staff were withdrawn. During the preliminary period prior to the first survey flight, attention was directed to developing the routine working of the station, and to collaboration with the aeronautical radio station and between the meteorological services at the Shannon airport and Botwood, the Newfoundland base.

A detailed meteorological organization was drawn up for the exchange of meteorological information between the Shannon airport and Botwood, and for the supply of information both prior to and during flight. In this organization, the respective functions of the meteorological services at the Shannon airport and Botwood were carefully co-ordinated.

The full organization was brought into operation on the occasion of the double flight in July of the Imperial Airways' "C" class flying boat *Caledonia* and the Pan American Airways' flying boat *Clipper III*. The complete series of survey flights included three double crossings by the *Caledonia*, two double crossings by the *Cambria*, and two double crossings by the Pan American *Clipper III*.

It may be stated that the meteorological organization worked smoothly, both operating companies expressing satisfaction with the arrangements made. A tribute must be paid in this connexion to the close and cordial co-operation received from the Meteorological Service of Canada, which is responsible for supplying the organization at Botwood on behalf of the Government of Newfoundland.

A conference was held in Dublin in July after the conclusion of the first double crossing, at which the operational control and the radio and meteorological organizations were reviewed, and minor modifications were introduced.

During the tour referred to earlier, the Superintendent of the Division visited the Meteorological Service of Canada at Toronto in January; the opportunity was taken to review the working of the meteorological arrangements during the previous summer, especially in so far as co-operation between the two meteorological services was affected. Representatives of Pan American Airways were present, and provisional agreement was reached regarding details of organization for future flights, both across the Atlantic and between Botwood, Montreal and New York.

A further conference was held in Dublin in March, and attended by representatives of the Government departments concerned from Eire, London and the United States of America as well as the two operating companies. As regards meteorology, the arrangements previously agreed in Toronto were confirmed, and complete organizations were drawn up for future trans-Atlantic flights between Southampton, Montreal and New York.

After the conclusion of the 1937 survey flights, the forecasting staff were withdrawn from the Shannon airport, and the investigation programme was continued in London. A skeleton staff was retained at the Shannon airport for the purpose of maintaining an observational routine and plotting current synoptic charts which will be used later for investigational work. The full programme of reception of meteorological broadcasts is being maintained, so that the forecasting organization can be brought into operation at short notice when further trans-Atlantic flights are arranged.

(c) *Bermuda-New York Route*.—Arrangements were made, in conjunction with the Colonial Office, for increased meteorological facilities at Bermuda, in view of the inauguration by Imperial Airways Ltd. and Pan American Airways Inc. of the Bermuda-New York air service in June.

Two additional officers were appointed to the staff of the Bermuda Meteorological Service, and after a six months' course of training, part of which was carried out at the Shannon airport, they proceeded to Bermuda in August. Additional observing and radio staff have been engaged locally, and arrangements made for improved communications in Bermuda between the meteorological station, the radio station and the airport.

Overseas Stations.—The work of the overseas stations maintained by the Meteorological Office has continued on the lines described in previous *Annual Reports*. With the transfer of the civil aviation work in Iraq to the Iraqi Meteorological Service and the impending transfer of civil aviation work in Egypt to the Egyptian Ministry of Communications, the functions of the Meteorological Office stations are now tending more and more to become confined to those for which the stations were originally established viz. the supply of meteorological information to the Services. The meteorological sections in Middle East area and Iraq exist primarily to meet the meteorological requirements of the Royal Air Force, while at Malta the Royal Navy and the Army account for a considerable part of the activities of the office. At Gibraltar, where the meteorological station has now been placed on a permanent basis, the work is confined almost entirely to meeting the needs of the Royal Navy and the Army.

A brief account of the work of the different stations during the period under review is given below.

Gibraltar.—The main development in the forecasting service was the inauguration on March 15 of a regular broadcast issue of Mediterranean Fleet synoptic messages at 1030 G.M.T. daily. In addition to a suitable selection of synoptic observations and to information about the pressure distribution, the messages include forecasts for definite areas of the Mediterranean west of longitude 5° E. and the Atlantic approaches to the Straits of Gibraltar. It is anticipated that similar issues at 1600 and 2130 G.M.T. will be commenced as soon as sufficient forecasting staff are available.

Synoptic charts have been prepared at 0700, 1300 and 1800 G.M.T. daily except at week ends, when the 0700 G.M.T. charts only have been drawn. Forecasts for the Gibraltar area have been issued morning and evening to the various naval and military authorities, and evening forecasts have been supplied to H.M. Ships in eastern Spanish waters. For a considerable period, forecasts for the route Gibraltar—Oran—Algiers were issued twice daily to R.A.F. squadrons on Mediterranean anti-piracy patrol. Local forecasts have been

supplied regularly to the civil port authorities and to the local broadcasting station; special route forecasts have been issued from time to time in connexion with long-distance cruises by R.A.F. aircraft.

During the "Defence of the Rock" exercises and gunnery trials, "meteor" telegrams and calibration reports have been supplied to the Commander, Royal Artillery.

Arrangements were made during the spring cruises of the Home and Mediterranean Fleets for ascents for taking upper air temperatures to be carried out as often as possible by the Fleet Requirements Flight.

A monthly summary, and daily continental weather data have been supplied regularly for publication in the *Gibraltar Chronicle*.

Malta.—Auxiliary reporting stations were established at Hal Far and Kalafrana in October and at Gozo in December. Reports from the R.A.F. stations are made by R.A.F. personnel, whilst those at Gozo are the responsibility of the chief lighthouse keeper, who completed a short training course at the Meteorological Office prior to commencing observations.

As in previous years, full synoptic observations made at 0700, 1300, and 1800 G.M.T. were broadcast daily by the Malta W/T station, together with upper winds obtained from pilot-balloon ascents made twice daily. Two to three times a week upper air temperatures (from Hal Far) were included in the broadcast.

The forecast routine was maintained from 0430 G.M.T. to 2100 G.M.T. on weekdays, and from 0700 to 2100 G.M.T. on Sundays. During the period of R.A.F. participation in the Nyon anti-piracy patrols, and also on many occasions of stormy conditions during the winter months, the full routine was maintained on Sundays as well as on weekdays.

The system of warnings of gregales, gales and squalls continued in force, and its value to naval and port authorities in particular remained undiminished.

On March 15 alterations were made in the form of the Fleet synoptic messages, in order to avoid overlapping with Gibraltar forecast routine and to render the messages of greater value to ships not requiring the synoptic portions. The morning and evening messages included forecasts for the Malta vicinity, and for areas where H.M. or British merchant ships were known to be either cruising or on passage.

In addition to the normal routine distribution of reports and forecasts, 113 special forecasts were supplied to naval units.

Close liaison was maintained with the meteorological and navigating officers of reporting ships. During the year all ships of the Fleet carrying meteorological officers, and most other observing ships were visited.

The year was outstanding for the large number of special forecasts supplied in connexion with flying-boat operations. The majority of these were concerned with the Nyon anti-piracy patrols in the western Mediterranean.

The number of special forecasts supplied in connexion with Mediterranean flights and training cruises totalled 223.

Assistance was rendered in connexion with experimental work, to the Air Defence Experimental Establishment, the Royal Artillery, the Royal Army Medical Corps and the Royal Army Ordnance Corps.

The number of "meteor" reports supplied for artillery practices and calibrations totalled 80.

The main work in connexion with civil aviation was performed on behalf of the Italian company operating the Syracuse—Malta—Tripoli air route. The number of reports sent to Tripoli, Syracuse and to aircraft in flight totalled 761, of which 148 were additional to normal routine requirements. The total number of signals handled in connexion with this service was 3,886.

Middle East Area.—During the year requests for weather forecasts and meteorological data have steadily increased, necessitating the inauguration of routine synoptic reports at 0900 G.M.T. and of upper wind observations with the "dawn," 0600, and 0900 or 1200 G.M.T. reports. Routine synoptic observations have been made at Aboukir, Heliopolis, Ismailia, Ramleh, and Amman throughout the year at "dawn," 0600, 0900, 1200 and 1800 G.M.T.; and thrice daily at Mirabella and Gaza (by arrangement with Imperial Airways, Ltd.), and at H.4 (by arrangement with Iraq Petroleum Co.); while abbreviated weather reports have been received from Bair, Mudawara, Ma'an and Akaba (by arrangement with the Arab Legion, Trans-Jordan). An effort to obtain routine synoptic reports from Akaba has not proved successful, as the frequent changes of native personnel there made it impossible to ensure the adequacy of trained staff and the care of instruments.

Over 6,300 route forecasts have been issued to the Royal Air Force, to the Egyptian Army Air Force, and to civil aviation, an increase of 26 per cent. on the preceding year.

The increase in the number of messages passed from Heliopolis Meteorological Office to Almaza Airport by telephone caused frequent congestion and delay owing to language difficulties with Egyptian telephonists at Almaza. Some alleviation resulted from the employment of figure code for as many forecasts as possible from September, 1937, but congestion still occurs, and the Egyptian State Telegraphs have agreed to the establishment at the Meteorological Office of a telegraph office staffed by Egyptian personnel.

Iraq.—The meteorological office at Hinaidi was closed on December 29, 1937; the staff, equipment and stores were transferred on the 30th–31st to the new Royal Air Force cantonment at

Habbaniya, where a reporting and distributive station had been in operation since October, 1936.

Regional aviation forecasts have been issued each morning and evening for all areas in Iraq; tabular statements of upper winds and weather at stations in Iraq and copies of pressure charts have been prepared and distributed each morning to Air Headquarters and the three squadrons at Habbaniya: a local daily weather map is also prepared at Shaibah each day for the guidance of the squadron there.

During the year 1,144 forecasts for specific cross-country and long-distance flights, and 2,857 weather reports and upper wind information have been issued to the Royal Air Force units in Iraq. In addition, information was supplied in reply to 1417 inquiries, mainly by telephone.

Until November 1937, the Hinaidi office was responsible for supplying forecasts to the Baghdad airport for all scheduled movements of civil aircraft through Iraq: over 700 such forecasts were supplied. In December the forecasting staff of the Iraqi Meteorological Service took over this work.

Weather reports and upper winds were supplied to the airports at Baghdad and Basra from Hinaidi, Habbaniya and Shaibah on 371 occasions.

Summarized means of the meteorological elements at Habbaniya, Shaibah and Diwaniyah have been supplied monthly to the Iraqi Service in a form immediately suitable for inclusion in the monthly weather report published by that service.

During the year inquiries have been made into: (i) thunderstorm phenomena in Iraq; (ii) the conditions leading to duststorms; (iii) Temperature variation in the lowest 10,000 ft. in the atmosphere over Iraq, with particular reference to the typical air masses which affect weather in Iraq; (iv) improved methods of reducing barometer readings at high-level stations; (v) normals of pressure tendencies at the three standard observation hours at key stations in Iraq; and (vi) the characteristics of the diurnal variation of the main meteorological elements at Hinaidi. The results of these investigations have been filed for guidance in forecasting in Iraq.

General.—Standard meteorological instructions for flights from the United Kingdom to and from the Mediterranean were prepared for use in connexion with cruises by Royal Air Force aircraft. Special organizations for flights beyond the Mediterranean were prepared as required.

Considerable time was devoted to the meteorological arrangements for operations of the Royal Air Force Long-Range Development Unit.

Meteorological sections of Aircraft Route Books covering several routes have been prepared for the Air Staff.

During the year 114 inquiries relating to meteorological conditions affecting aviation overseas were dealt with on behalf of the Air Staff and the Department of Civil Aviation. Many of these inquiries were associated with the development of flying-boat routes to Australia, Cape Town and South America.

Assistance has been rendered in the preparation of an instructional film on "Fog," to be used for training purposes by the Royal Air Force. The script for a second film on "Ice Accretion" has been prepared.

Several representatives from Dominion and Colonial meteorological services visited the Division during the year. Two officers of the South African Meteorological Service spent some months in this country studying the work of the different divisions of the Meteorological Office.

The Superintendent of the Overseas Division attended the meetings of the International Commission for Aeronautical Meteorology, of which he was elected Secretary, and of the Atlantic Committee appointed by that Commission (see p. 38); he was also present at meetings, of the European Conference of Meteorological Experts for Aeronautics at Paris in June, and of the International Commissions, for Synoptic Weather Information, for Climatology and for Projections for Meteorological Charts at Salzburg in September (see pp. 38-40). He also visited Brussels in September, in company with the Director of the British East African Meteorological Service, in order to confer with the Belgian Government regarding the establishment of a meteorological organization in the Belgian Congo.

NAVAL DIVISION

Organization of Fleet Meteorology.—It was mentioned in the *Annual Report* for the Year 1936-7, that discussion was then proceeding between the Air Ministry and the Admiralty regarding the transfer to the Admiralty of certain sections of the work performed by the Naval Division, Meteorological Office. These discussions were continued during the year under review, and a scheme was approved whereby a new branch of the Hydrographic Department of the Admiralty, known as the Naval Meteorological Branch, was formed, this Branch being responsible for the administration of meteorological work in the Fleet.

Captain L. G. Garbett, R.N. (Retd.), who hitherto had been Superintendent of the Naval Division of the Meteorological Office, was appointed Chief Superintendent of Naval Meteorology, and transferred to the Admiralty in charge of the Naval Meteorological Branch of the Hydrographic Department with effect from August 1, 1937.

Fleet Synoptic Messages.—Considerable attention was devoted to the question of Fleet synoptic messages, and a scheme was prepared for instituting such a message from Gibraltar, and standardising and extending the messages issued from Cleethorpes and Malta.

Meteorological Reports from H.M. Ships.—Up to July 31, H.M. Ships made 1,069 weather reports to the Meteorological Office, London, and a considerable number to the meteorological services of the Dominions and British possessions overseas. In addition, 241 pilot-balloon observations and 7 observations of upper air temperatures were received from H.M. Ships, and 15 meteorological logs were forwarded for retention.

Training of Naval Personnel.—The arrangements for training naval officers were continued, the total number of officers attending up to July 31 being 10.

Meteorological Equipment for H.M. Ships.—The Division continued to advise the Admiralty regarding the installation of meteorological instruments in H.M. Ships, and representatives of the Division visited a number of ships in connexion with the fitting of instruments, the provision of space for pilot-balloon shelter, etc.

Charting of the Upper Air over the Sea.—The preparation for publication of the results of all pilot-balloon ascents made by H.M. Ships during the years 1925-36 was completed, and these results are now in the process of printing.

In the *Annual Report* for 1936-7 reference was made to discussions then proceeding regarding the issue of pilot-balloon equipment to H.M. Ships. Agreement was reached with the Admiralty that, with effect from April 1, 1938, such equipment should be issued by the Admiralty, the necessary stores being obtained by the Admiralty on repayment from the Meteorological Office. Hitherto such equipment has been issued by the Meteorological Office on loan to the Admiralty.

Investigations.—The investigation into the forecasting of visibility at sea to which reference was made in the *Annual Report* for 1936-7 was continued. Unfortunately owing to unavoidable staff changes, work on the problem has been somewhat delayed.

ARMY DIVISION

The re-armament of the country has affected the work of the Army Division and it has been found necessary to post additional staff to Headquarters to deal with the problems which have arisen for solution. The pressure has also been felt at outstations, and at Larkhill, where a station is maintained for co-operation with the School of Artillery, an additional technical officer and two assistants have been posted for the research work required by the Army. The station at Shoeburyness is located on the New Ranges; in addition to supplying the meteorological reports required by the Superintendent of Experiments, this station has the responsibility of manning artillery practice camps in different parts of the country during the summer months. This arrangement

provides rather more flexibility in man-power than is the case at some other stations, and it has not been found necessary up to the present to augment the staff, but the strain at times has been heavy, and has necessitated working long hours on days when demands for meteorological information at the station have been particularly severe.

An innovation during the year was the giving of lectures on meteorology to Army units. Two lectures were given by the Superintendent to courses at the Staff College, Camberley, and a more extended programme of lectures covering units in different parts of the country was arranged for the coming financial year.

INSTRUMENTS DIVISION

The expansion of the Meteorological Office to meet the increasing demands of the Royal Air Force has necessarily led to a large increase in the work of the Instruments Division, so that the number of demands for instruments and equipment received and dealt with during the twelve months exceeded by more than 30 per cent that of the preceding twelve months. It has further been necessary to place greatly increased orders for new instruments to meet anticipated demands in the future, and this also has added to the work. Although there has been some increase of personnel the strain on the staff has at times been considerable, and much credit is due to all concerned for the way in which the work has been accomplished. During the year equipment has been issued to ten new stations on Royal Air Force aerodromes, to one on a civil aerodrome, and also to a new telegraphic reporting station at Hartland Point on the north coast of Devon.

The pressure of work has prevented as much time as usual from being devoted to the development side of instrument work, but, nevertheless, some progress has been made in the design of new instruments and in the improvement of existing designs. One of the most important of the new developments has been the work on measurement of upper-air conditions by radio instruments carried on free balloons. As noted in the last *Annual Report*, the National Physical Laboratory are collaborating in this work; during the year the development proceeded to a point at which it became possible for the Meteorological Office to draw up plans and provide the facilities for routine daily observations. The work may be divided under two heads—

(a) The determination of pressure and temperature in the upper atmosphere.

(b) The measurement of wind.

The observations of pressure and temperature will be carried out at Kew Observatory. The necessary equipment has been ordered,

and preparations for the commencement of the work were almost complete at the end of the financial year. For the measurement of wind it is necessary to locate the balloon by radio-direction bearings from two stations at the ends of a base line. The conditions to be fulfilled are very exacting, as it is necessary to locate the stations in the centre of an open level area which is free from obstruction for a distance of at least a quarter of a mile. Considerable difficulty was found in securing suitable sites, but two were finally obtained in the neighbourhood of Salisbury Plain, and erection of the huts and assembly of the equipment are proceeding. In the initial stages of the work it is proposed that the balloon shall be followed by two theodolites in addition to the radio bearings, so that a check on the accuracy of the latter may be obtained. The necessary staff have been provided and are being trained for the work.

The use of a searchlight of special design, for obtaining the height of the base of a cloud sheet at night by reading from a distance the angular elevation of the light spot thrown by a vertical beam from the searchlight, has been developed during the year, and numerous meteorological stations and aerodromes have been equipped. The effectiveness of the beam thrown by the searchlight is dependent in large measure upon the concentration of the light source. The ideal to be aimed at is a point light source which would throw an almost truly parallel beam. Such a source is closely approached by an arc light, but this source of light is not suitable for use in a searchlight which is required to run for considerable periods without attention, the filament type of lamp has therefore to be adopted. Discussion has taken place with the representatives of several firms with a view to obtaining a more concentrated source of light, and some measure of success has been achieved.

A new type of pilot-balloon theodolite, designed in the Instruments Division, has been under test for some time and has proved entirely satisfactory, the only modifications found necessary have been of a very minor character. An order for a large number of these theodolites has been placed, and they will shortly come into general use. A new type of mounting adjustable for height has also been developed for use with pilot-balloon theodolites, so that the inconvenience formerly experienced by observers of different heights, when using an instrument mounted on a fixed "wall-head," will be obviated. The need having been felt for a pilot-balloon capable of ascending at a rate greater than that of 500 ft. per minute, which has been the standard used in the Meteorological Office for many years, experiments have been made with different types of balloon. It has been found that the rate of ascent increases more rapidly with increasing diameter than would be expected from the formula generally used for small balloons, and that a rate of ascent of 1,000 or even 1,200 ft. per minute can be achieved by the use of balloons, the price of which is not prohibitive. Attention has also been devoted to the development of an improved type of tail for

attachment below balloons, for use when the distance of the balloon from the observation point is measured by reading the angle subtended by the balloon tail on a graticule in the theodolite.

For some time past the need has been felt for a small portable manometer for use in testing pressure-tube anemometers at meteorological stations. No entirely suitable instrument being available on the market, it was accordingly decided to devote attention to the design of one in the Meteorological Office. A very compact design has been evolved capable of giving readings accurate to 0.1 mm. of water, and the first instrument, which was made up in the workshop attached to the Instruments Division, was shown at the Physical Society's Annual Exhibition of Scientific Instruments in January. For many years past two types of rain-gauge of different diameter have been in regular use for the measurement of rainfall at Meteorological Office stations, the policy being to use 8-inch gauges at stations reporting for the *Daily Weather Report* by telegraph, and 5-inch gauges at other stations. Prolonged experiments have shown that the larger gauge gives no increase in accuracy, and during the year it was decided to cease issuing gauges of this size, and to adopt the 5-inch pattern as standard for all Meteorological Office stations in future. The distant-reading anemometer, which was referred to in the *Annual Report* for 1936-7, has been brought into use at several stations during the year, and one of these instruments has been installed at the Meteorological Office at South Kensington. The erection of high buildings in the neighbourhood had rendered the record of wind, which has been maintained for many years past in the entrance lobby to the Meteorological Office, unsatisfactory; advantage has therefore been taken of the facilities afforded for transmitting the record to a distance by placing one of the new recorders in the entrance lobby, the vane which actuates it being mounted above the roof of the Science Museum near by. Although the record is necessarily of the urban type showing considerable gustiness, it now provides a true representation of the wind in inner London, which was not formerly the case.

OBSERVATORIES

KEW

Atmospheric Electricity.—The exploration of the electric field in thunderstorms by means of alti-electrographs carried on small free balloons was continued during the year in continuation of the work described in the paper "The distribution of electricity in thunderclouds" by Sir George Simpson and F. J. Scrase published by the Royal Society (see p.59). Thirty-six soundings were made, 20 yielding useful results.

Systematic observations of potential gradient, electricity of rain, and conductivity of the atmosphere have been made. Mr. Hogg of the Solar Physics Observatory, Canberra, has carried on during the year a special investigation into the nature of intermediate ions.

Seismology.—All the seismographs have now been erected in the new underground seismological house. The instruments have worked satisfactorily throughout the year, and the records have been analysed and discussed as usual.

Exploration of the Upper Air.—Further work has been done on the attempt to obtain samples of air from the atmosphere at heights above 20 Km., in order that Professor Paneth might determine the helium content. This work, however, has not been successful as only one sample was obtained. Considerable difficulty is being experienced with the mechanism which opens and closes the sample vessel at the required height.

The investigation of the water-vapour content of the upper atmosphere has been put into abeyance, pending further research work in the laboratory to solve the very difficult problem of measuring the small quantities of water vapour involved.

Ordinary soundings in which the temperature, pressure and humidity of the upper atmosphere are recorded have been made in accordance with the international programme. The heights reached by the balloons carrying meteorographs were as follows :—

Above 20 Km.	...	...	...	6
Between 15 and 20 Km.	...	...	...	12
Between 10 and 15 Km.	...	...	...	7
Less than 10 Km.	...	...	...	0

Specimens of British instruments used in upper air research, which had for the most part been constructed in the workshop at Kew Observatory, with photographs and diagrams, were exhibited in the Pavillon de l'Air of the Paris Exhibition, 1937. The exhibit was awarded a gold medal.

ESKDALEMUIR.

Terrestrial Magnetism.—The standard la Cour magnetographs recorded with little interruption during the year, and supplementary records were obtained from the old instruments. The instruments, giving declination (D), horizontal force (H) and vertical component (V), were standardized by regular observations with the Kew magnetometer, the Schuster-Smith coil and the Schulze dip inductor, and also by regular scale tests. Measurements of H with the Kew magnetometer were made twice per month.

In order to reduce the number of full observations of declination a permanently suspended magnet (tungsten suspension) was installed in the west hut. Comparison observations will be completed shortly, and the magnet will then be put into use for two out of three regular observations per week.

The condition of the underground chambers was maintained generally satisfactory by the electrical heaters, water seepage being negligible except in the middle and late summer.

Hourly values of magnetic declination continued to be tabulated, and supplied for publication weekly in *The Colliery Guardian* and *The Iron and Coal Trades Review* alongside similar data for Abinger. Copies of original records and other information were supplied to various engineers and mining authorities.

Details of disturbances were sent to the National Physical Laboratory as required, and numerous inquiries regarding magnetic disturbances were dealt with, particularly that of January 24-25, 1938, when the ranges were : D , $3^{\circ} 4' 2''$; H , 1480γ ; V , 1057γ .

Quarterly character figures of disturbance were furnished to Edinburgh as usual.

The Observatory co-operated in an investigation of giant pulsations being carried out by Dr. la Cour.

A great deal of time was spent during the first six months in investigating the abnormal temperature coefficient of the suspended system used with the Smith portable coil. The fault was traced to the presence of magnetic material in the arresting bar. A modified arrangement was designed, and the work of construction put in hand.

Meteorology.—Routine meteorological work was carried out. Some increase occurred in connexion with the aviation broadcasts from Borough Hill.

Observations of solar radiation were suspended for the greater part of the year, pending repair of the milliammeter. They were resumed in February.

Atmospheric Electricity.—As in recent years, the work has been confined to maintaining autographic records and making absolute observations of atmospheric electrical potential gradient.

LERWICK

Terrestrial Magnetism.—*Recording Instruments.*—Apart from a few occasions of minor mechanical defect, the instruments have recorded without interruption. All breaks in the standard traces are recovered by the supplementary records.

Absolute Observations.—In July the number of absolute observations was halved on account of the steadiness of the base-line values, making a minimum of three D and I and one H observations a week. Since February, however, a return has been made to the former number of H observations, two a week, as there had been a slight change in the base-line value of the la Cour H variometer.

Observations have also been made with the BM vertical force magnetometer about four times weekly. The average departure for the year of the computed base-line values from the mean is only 3.0γ , compared with 4.2γ for the earth inductor.

Aurora.—The usual watch has been maintained. Aurora has been observed relatively frequently and there have been several active displays. No photography has been attempted.

Atmospheric Electricity.—The Benndorf electrograph has functioned satisfactorily, and the customary scale and insulation tests and absolute observations have been carried out.

Meteorology.—The usual 0900 observations have been made, and autographic records have been maintained. Frequent reports of wind speed and direction have been supplied to Sumburgh Airport.

ABERDEEN

Work during the past year proceeded on the usual lines, but there has been considerable increase in the number of observations which have been supplied for aviation purposes.

The north wall screen of the Observatory has been completely overhauled and repaired.

VALENTIA

The Observatory at Valentia was transferred to the Meteorological Service of Eire on October 1, 1937.

BRANCH METEOROLOGICAL OFFICE, EDINBURGH.

The Edinburgh Office has continued to act as a centre for the organization of climatological and rainfall stations in Scotland, and for the administration of the three observatories at Eskdalemuir, Lerwick and Aberdeen. In addition, during the year under review, the telegraphic reporting stations and such auxiliary reporting stations as are not attached to aerodromes have been brought within the administration of the Edinburgh Office.

Climatological, Rainfall and Telegraphic Stations.—The numbers of stations of various types in different districts of the British Isles are shown in Appendix I. The Edinburgh Office receives the monthly registers and autographic records from the stations in the Scottish districts, and carries out the systematic examination and checking of these, and the extraction of data in form ready for publication. During the year action was taken to augment and improve the observations of snow and to encourage the setting up of rain-gauges in areas which hitherto have been inadequately represented.

Inquiries.—Regular inquiries are made daily, and sometimes additionally at week ends, by three newspaper offices, numbering altogether about 980. The number of other inquiries received was 275 of which 135 were dealt with by correspondence. The gross number was thus 1,255. About 50 were in connexion with legal cases or insurance claims; generally in such cases written statements sufficed; but in two instances attendance in court was required and in one case expert evidence was called.

Reports for the Registrar-General for Scotland.—A monthly summary of the weather in Scotland, together with statistics for certain large towns, has been prepared, as well as the annual report, as usual, for the Registrar-General. The general form of the various tables in the annual reports is similar to that followed by the Registrar-General for England and Wales. The monthly reports include data for eleven principal towns.

Services for Aviation.—Meteorological reports were prepared on 17 proposed aerodrome sites in all parts of Scotland and the islands. The number of auxiliary reporting stations has been increased to thirteen.

INTERNATIONAL CO-OPERATION

The work of the three main organizations, through which the Meteorological Office participates in international work, during the past year is summarized in the following paragraphs.

1. **The International Meteorological Organization.** — (a) *The International Meteorological Committee* met at Salzburg in September, 1937, under the Presidency of Dr. Th. Hesselberg.

The main work at this meeting was the consideration of the recommendations made by the commissions which had held meetings in the two years following the last meeting of the Committee at Warsaw in 1935: the Commission for Aeronautical Meteorology, the Commission for Synoptic Weather Information, the Climatological Commission, the Commission for Agricultural Meteorology, the Commission on the Projection of Meteorological Charts and the Commission for Solar Radiation; and the Regional Commissions of Lusaka (African Conference), Hong Kong (Far East Conference) and Lima (South American Conference).

Nearly 100 resolutions were adopted. These are largely concerned with the technical details of the international machine. Among them may be mentioned:—

- (i) The statement of the general principles which should govern the international arrangements for the meteorological protection of aviation.

Submitted by the Commission for Aeronautical Meteorology. The development of a world-wide system on these principles is making rapid progress.

- (ii) The recommendation for the establishment of a network of stations at which daily or twice-daily observations of the conditions in the upper atmosphere are made by means of radio-sondes;
- (iii) The adoption of new rules for the levels to which barometer observations should be reduced.

Submitted by the Commission for Synoptic Weather Information.

- (iv) The appointment of a Regional Commission for North and Central America.

(b) *The Commission for Aeronautical Meteorology.*—This Commission was appointed by the Conference of Warsaw with a view to the co-ordination of the work of the meetings of experts who found themselves confronted with problems in the application of meteorology to aviation, which necessitated international action sometimes additional to, sometimes not in conformity with, existing international resolutions.

This Commission met at Paris in June 1937, under the Presidency of Dr. R. Bureau, Assistant Director of the Office National Météorologique de France. This meeting was attended by Lieut.-Colonel E. Gold, President of the Commission for Synoptic Weather Information and Chairman of the Meteorological Sub-Committee of the International Commission for Air Navigation, Mr. R. Corless, Meteorological Expert of the Air Ministry on the European Aeronautical Conference for western and central Europe, and Mr. F. Entwistle, Superintendent of the Overseas Division of the Meteorological Office and Secretary of the Commission.

The Commission formulated a statement of the principles on which the meteorological protection of aviation should be based, emphasising the need for uniformity and for differentiation between the arrangements before the start of the flight and the arrangements during the flight. For the former, the necessity for consultation between the pilot and the meteorologist is emphasised, in order that there may be no misunderstanding on the pilot's part as to the significance for the flight of the existing synoptic situation.

The Commission also emphasised the importance for aviation, of observations of upper air temperature, of an increase in the number of reports from ships, and of the value for flights across the North Atlantic of stationary meteorological ships such as the one already established by France.

An important decision taken by the Commission at Paris in June was to appoint an Atlantic Committee, limited as to membership to countries interested in the operation of trans-Atlantic air lines and having as its object the development of meteorological facilities over the oceans for trans-ocean flights. The Committee held its first meeting during the meeting of the International Meteorological Committee at Salzburg in September.

(c) *The Commission for Synoptic Weather Information.*—This Commission met at Salzburg in September 1937 under the Presidency of Lieut.-Colonel E. Gold. The meeting was attended by Mr. F. Entwistle, Secretary of the Commission for Aeronautical Meteorology.

The principal resolutions concern :

- (i) The exploration of the upper atmosphere by means of radio-sondes.

“ Radio-sondes ” is the name applied to free balloons carrying specially designed instruments which transmit messages by radio-telegraphy. These messages give the values of pressure and temperature in the atmosphere in the position which the balloon occupies at the time the message is transmitted. The outstanding importance of this method is that it enables the values of temperature and pressure at different heights in the atmosphere to be obtained in all conditions of weather, and at altitudes far greater than can be normally reached by other methods. The normal height to which it is possible to obtain information by radio-sondes is about 50,000 ft., and in favourable conditions values can be obtained up to 80,000 ft. The Commission recommended the establishment of a network of fifty stations in Europe, and networks of corresponding density in North America and in other parts of the temperate zone.

- (ii) The code for reports of upper wind observations.

The code for upper wind observations was materially altered. Previously the height had been represented by one figure according to a conventional specification, and the speed given in miles per hour or kilometres per hour by two figures. In the new code the height is given by two figures (in hectometres) and the speed is given by one figure according to a conventional specification.

- (iii) The specification of the symbolic forms of message by the letter F and a number.

This specification prevents confusion between the “ forms of message ” and the “ specifications ” which are both usually called “ codes.”

- (iv) Rules for the reduction of atmospheric pressure to a standard level.
- (v) The code for the collective transmission of monthly mean values of pressure over the ocean.
- (vi) The revision of the code for reporting rainfall.
- (vii) Modifications in the arrangements for the broadcast issues of reports by wireless telegraphy.
- (viii) Methods of indicating areas of precipitation on synoptic charts.

(d) *The Climatological Commission* met at Salzburg in September 1937, under the Presidency of Professor H. von Ficker. The principal recommendations concern :

- (i) The preparation and publication of mean values of upper air observations.

- (ii) The desirability of ensuring that meteorological observations made and published in connexion with health and holiday resorts should be obtained from approved instruments by approved methods.
- (iii) The classification or definition of the terms used to describe the different types of precipitation, solid and liquid.

(e) *The Commission for Agricultural Meteorology* met at Salzburg in September under the Presidency of Dr. C. Braak. The principal recommendations concern :

- (i) The study of hail both from the point of view of meteorology and in liaison with the International Committee of Insurance against Hail.
- (ii) The collection of information on the role played by dew and other secondary sources of deposition of water, in agricultural production.

(f) *The Commission on the Projection of Meteorological Charts* met at Salzburg in September, 1937, under the Presidency of Dr. W. R. Gregg. The principal recommendations concern the projections which should be used for charts for synoptic meteorology and the scales which should be adopted for these charts. New scales were added to those which have been previously approved as standard scales. The new scales are

1 : 7,500,000
1 : 10,000,000
1 : 15,000,000

Mercator's projection was approved as the standard projection for the equatorial regions ; the conformal conic projection for middle latitudes and the stereographic projection for polar regions.

(g) *Regional Commission III (South America)*.—The Regional Commission for South America held a meeting at Lima in September, 1937. The principal recommendations concern :

- (i) The development in the different countries of South America of a better understanding of the importance of meteorology for aerial navigation and the necessity for unifying the different services which now exist in each country.
- (ii) The lack of specialised meteorological technical personnel and the necessity for creating special schools in South America for training meteorological personnel.
- (iii) The establishment of an inter-continental collective message for South America to be called AMERSUD and to be transmitted from Rio de Janeiro. (This issue will be of the same character as the messages issued from Rugby for Europe and northern Asia, and from Arlington for North America.)

(h) *Regional Commission IV (South-west Pacific)*.—A Conference of Directors of Services in the south-west Pacific (Australasia) was held at Wellington under the Presidency of Dr. E. Kidson, Director of the Meteorological Service of New Zealand. Mr. F. Entwistle, Superintendent of the Overseas Division of the Meteorological Office, attended the meeting.

The principal recommendations concern :

- (i) The arrangements for the issue of broadcast reports in the south-west Pacific region. The Conference recommended that there should be 5 issues of the "continental" type from the following centres—a station in the Netherlands East Indies, a station in Australia, a station in New Zealand, a station in Fiji and a station in Samoa; and that there should be one inter-continental collective issue from a station in Australia.
- (ii) The establishment of a system of exchange by radio between adjacent forecasting centres of analysis and forecast messages for the relevant sections of air routes between the two centres.
- (iii) The establishment of a detailed organization for ocean flights, supplementary to the general arrangements outlined by the International Commission for Aeronautical Meteorology.

2. *International Union of Geodesy and Geophysics*.—There has been no meeting of the Union this year.

3. (a) *International Commission for Air Navigation*.—A meeting of the Meteorological Sub-Commission of the International Commission for Air Navigation was held in Paris in November, 1937, under the Presidency of Lieut.-Colonel E. Gold. The questions considered at this meeting related mainly to modifications of the Meteorological Annex (Annex G) of the International Air Convention, taking into account the changes relating to synoptic reports approved by the International Meteorological Committee at its meeting at Salzburg in September, 1937.

The Sub-Commission had also under consideration the meteorological questions involved in :

- (i) Proposals to give to chief officers of aerodromes the power to prohibit aircraft from departing from an aerodrome.
- (ii) Proposals for the revision of the standard atmosphere to be taken as a basis for the graduation of altimeters.

In connexion with (ii) the Sub-Commission reported to the Commission that the idea that a well-chosen standard atmosphere would permit altimeters to be so graduated as to give exact altitudes was erroneous, on account of the large variations of the temperature

of the actual atmosphere. Moreover the conditions in the existing standard atmosphere differ from the average for the world by amounts which are insignificant compared with the differences of the actual conditions on individual occasions from the average conditions, so that no substantial advantage could be expected from a revision.

3. (b) *International Aeronautical Conference.*—The 38th meeting of the International Aeronautical Conference was held in Paris in May, 1937. Mr. R. Corless, Meteorological Expert of the Air Ministry, attended the meeting of the Meteorological Commission.

Thirty resolutions were adopted. The principal recommendations concern :

- (i) The introduction of a code for reporting air temperature and the depression of the wet-bulb when humidity exceeds 85 per cent.
- (ii) The hourly transmission by wireless telegraphy of atmospheric pressure at aerodrome level for certain airports.
- (iii) The transmission of meteorological reports to aircraft in flight.

4. *International Telecommunications Conference.*—The International Meteorological Organization appointed a delegation consisting of :

Lieut.-Colonel E. Gold, representative of the Synoptic Commission.

Dr. R. Bureau, representative of the Aeronautical Commission.

Mr. L. J. Sutton, Director of the Meteorological Service of Egypt,

to represent it at the International Telecommunications Conference at Cairo.

The principal objects of the delegation were :

- (i) To make certain that no action was taken by the Conference at Cairo which would prevent the carrying out of the investigations by means of radio-sondes which were recommended by the International Meteorological Committee at the meeting at Salzburg.

It was immediately apparent from the proposals which had been submitted to the Telecommunications Conference for the allocation of frequencies (wave-lengths) that the only practical means of securing this was to obtain the allocation of certain frequencies (wave-lengths) definitely for radio-sondages.

- (ii) To secure either a wider band or another frequency (wave-length) in addition to the two which were allocated by previous Radio-Telegraphic Conferences for broadcasting meteorological reports in Europe.

- (iii) To maintain or improve the arrangements in the Telegraphic Convention and Regulations in regard to meteorological reports.

The Telecommunications Conference includes the Conferences of Telegraphy, Telephony and Radio-Telegraphy. Up to the present there have been no specific meteorological regulations in regard to telephony and there is at present no obvious need for such regulations. The delegation was consequently concerned only with the arrangements in the Telegraphic and Radio-Telegraphic Sections.

With regard to the Telegraphic Section, there were no proposals of substantial importance relating to the meteorological arrangements in the telegraphic regulations, although there were minor proposals for certain re-arrangements. In regard to these, the Delegation contented itself with seeing that the *status quo* was maintained or at least not made worse, and that object was successfully achieved.

With regard to frequencies (wave-lengths) for radio-sondages, it appeared from the information available to the delegation that the best frequency (wave-length) would be in the neighbourhood of 30 megacycles (10 m.). In view, however, of the rapid developments which have taken place in the use of still higher frequencies (shorter wave-lengths) and as proposals were being made to the Conference for the allocation of the whole band of frequencies up to 300 megacycles (1 m.), it was obviously desirable to make provision for future developments in radio-sondages in the direction of the use of higher frequencies.

The demands made at the Conference for the allocation of frequencies were naturally much in excess of the number of frequencies available, but owing to the assistance largely of the British and French delegations, the meteorological delegation was successful in obtaining the allocation of a band of half a megacycle for radio-sondages, viz. 27·5 to 28 megacycles.

The American delegation explained that there were already some stations in this band in use in America and they could not agree to its exclusive allocation to radio-sondages, but they agreed to include radio-sondages as one of the services to which this band was allocated in America.

In addition to this fundamental frequency, a further band of one megacycle (from 94·5 to 95·5) was allocated for radio-sondages thus providing scope for future developments. Further in the bands of 60-64 megacycles, 120-150 megacycles and 162-170 megacycles, the Conference agreed that only stations of small power should be allowed to operate in these bands of frequencies. This should permit the use of frequencies within these bands for purposes of radio-sondages if it is found in future that such frequencies are well suited for the purpose.

In addition to the needs already mentioned for frequencies for use in ordinary radio-sondages, from which observations of pressure and temperature and possibly humidity at different altitudes are to be derived, it appeared that there was also need for the allocation of a specific wave-length for use by radio-sondes whose position at different times has to be determined by radio-goniometric methods. Such observations provide one method of determining the upper wind when direct visual observations are impossible owing to cloud or fog. It appeared that a frequency in the neighbourhood of 2,000 kc/s would be suitable for this purpose and the delegation were successful in obtaining the allocation for such radio-sondages of a frequency band of 20 Kc/sec, namely from 2,050-2,070 Kc/sec. (143.3-147.9 m.)

With regard to the second main object, the improvement of the allocation of long waves in the European region for broadcasting continental collective messages, for which two waves had been allocated at the previous Conferences of Washington and Madrid, the delegation was successful in obtaining the allocation of two additional long waves for this purpose. The waves allocated have the frequencies 41.6 Kc/sec. (7,210 m.); 42.25 Kc/sec. (7,100 m.); 89.5 Kc/sec. (3,352 m.) and 99.85 Kc/sec. (3,005 m.).

The remaining articles of the Conference relating to priority, charges and the general arrangements for meteorology as one of the special services, were maintained without any substantial change.

STAFF

As is inevitable in a period of rapid expansion the difficulties of staff organization have again been considerable. The total numbers have gone up from 456 to 586, an increase of over 25 per cent., but these figures give an inadequate impression of the degree of staff dilution that has had to be faced. The rapid growth of the Office has coincided with a period of expansion in other departments, and there has been a considerable number of resignations to take up appointments elsewhere. These losses, which have totalled 29, have been mainly from the junior grades, but three officers who had many years of meteorological service to their credit have resigned, one to take up an appointment under the War Office and two to join the meteorological services being started abroad, primarily to meet the needs of Empire air mail services.

Another factor that led to disturbance of routine and delayed the commencement of new work was the need for detaching officers for special training to qualify them to undertake more advanced and responsible work on promotion. In addition to the new entrants, 47 officers have attended special courses varying in length from 6 weeks to 6 months. Nor does the matter stop there, for the training has involved the detachment of other officers from their normal duties to supervise the instruction.

Further recruitments of technical officers, assistants III and observers are also in hand.

The Coronation Honours award of O.B.E. was conferred on Dr. J. M. Stagg in recognition of his work while in charge of the British expedition to Fort Rae during the Second Polar Year 1932-3. The following university degrees have been awarded to members of the staff :—

Mr. R. Frith, B.A., the degrees of M.A., Ph.D.(Cambridge).

Mr. W. R. Galloway, B.Sc., the degree of M.Sc. (University of Wales).

Mr. F. E. Lumb, B.Sc., the degree of M.Sc. (Sheffield University).

Mr. A. W. Brewer, B.Sc., the degree of M.Sc. (London).

Mr. D. W. Rhead, the degree of B.Sc. (London).

Mr. A. M. Young, the degree of B.Sc. (London).

PUBLICATIONS

A list of publications issued during the year is given in Appendix V. It includes a volume of averages of humidity for stations in the British Isles, an element which has been but inadequately dealt with in earlier statistical publications issued by the Office. Such averages of humidity as had been previously published, referred, as a rule, to the hour of morning observation, generally 0900 when the diurnal variation of relative humidity approximates to the mean value. The figures gave very little useful information. In this new publication, averages are included for the early afternoon, 1300, which is approximately the hour of lowest relative humidity at most stations. The publication also contains small-scale maps showing the average distribution of relative and absolute humidity at this hour for each month.

Four *Geophysical Memoirs* have appeared during the year. No. 72 entitled "Kinematical features of depressions," of which Dr. A. H. R. Goldie is the author, is a very detailed study of two depressions which passed respectively north and south of Scotland. In this investigation the records from anemometers at Lerwick, Tiree, Butt of Lewis and Bell Rock, erected at the instance of the Advisory Committee for the Edinburgh Meteorological Office, have been extensively used. Some conclusions of general application are reached.

Memoir No. 74, by Dr. A. W. Lee, examines the travel of the seismic waves from the Baffin Bay earthquake of November 20, 1933, with the help of records borrowed for the purpose from a large number of seismic observatories in all parts of the world. Records from 99 observatories were examined.

Memoir No. 75, by F. J. Scrase, discusses records of the electrification of rain made at Kew Observatory.

Among the unofficial publications by members of the staff, attention should be drawn to a paper by the Director and F. J. Scrase in the *Proceedings of the Royal Society* on the distribution of electricity in thunderclouds. The list also includes Volume I of the results of the British Polar Year Expedition to Fort Rae containing contributions by J. M. Stagg, W. R. Morgans and P. A. Sheppard, dealing respectively with the observations of magnetism and aurora, meteorology and atmospheric electricity made by the expedition. Messrs. Macmillan have published a text book by E. G. Bilham entitled "The Climate of the British Isles, being an introductory study of the official records for students and general readers." As the title implies, official records, particularly those compiled in the British Rainfall Organization, have been freely used. The book supplies a long felt want; it should prove of great assistance in the proper exploitation of the records accumulated over many years through the co-operation of an enormous number of voluntary observers in all walks of life.

APPENDIX I

CLASSIFICATION OF STATIONS WHICH REPORT TO THE BRITISH CLIMATOLOGY DIVISION (see p. 10 for explanation).

DISTRICTS		STATIONS						AUTOGRAPHIC RECORDS					
		Observatories	Distributive	Telegraphic	Crop Weather	Climatological	Rainfall only	Sunshine	Rainfall	Wind	Pressure	Temperature	Humidity
0	Scotland, N. ...	1	0	4	0	12	127	11	1	3	5	0	0
1	„ E. ...	1	1	1	2	35	341	23	7	2	3	1	1
6A	„ W. ...	1	1	1	1	25	397	20	7	3	3	3	1
2	England, N.E. ...	0	2	2	2	18	291	23	4	6	4	2	2
3	„ E. ...	0	3	1	8	19	494	25	15	7	9	6	2
4	„ Midlands	0	1	2	6	40	1095	34	23	2	3	2	1
5	„ S.E. ...	0	7	3	4	39	912	39	15	10	9	10	8
	London District...	2	0	0	0	11	49	10	3	2	2	3	2
8B	England, S.W. ...	0	1	2	5	31	638	32	6	4	5	4	3
7A	„ N.W. ...	0	1	0	1	22	479	23	8	4	3	1	1
7B	Wales, N. ...	0	2	0	1	6	200	6	4	3	1	2	2
8A	„ S. ...	0	0	1	2	9	225	14	4	2	2	1	0
9	Ireland, N. ...	0	1	2	0	7	130	7	2	3	5	1	1
10	„ S. ...	1	0	2	0	12	127	8	2	3	4	0	0
6B	Isle of Man ...	0	0	1	0	1	7	2	0	1	1	1	1
11	Scilly and Channel Isles ...	0	0	2	0	1	25	3	0	1	2	1	0
	TOTAL ...	6	20	24	32	288	5537	280	101	56	61	38	25
	Corresponding number for last year ...	6	21	25	32	286	5522	278	93	54	64	38	25

APPENDIX II

GALE WARNINGS ISSUED DURING THE YEAR 1937.

DISTRICTS	Summary of occasions of gales		Summary of warnings issued			
	Total number of occasions when warnings were necessary	Percentage of occasions of gales effectively warned	Total number issued	Issues justified by gales, force 8 and above	Issues justified by strong winds, forces 6 and 7	Percentage justified by gales and strong winds
Scotland, N.E.	9	55	49	5	24	59
Scotland, E.	9	90	32	8	19	84
Scotland, N.W.	12	100	57	12	26	67
Scotland, W. and North Channel	12	92	41	11	18	71
Ireland, N.	11	100	63	11	32	68
Ireland, S.	9	100	47	9	25	72
Irish Sea	12	100	37	12	21	89
St. George's Channel	14	86	37	12	18	81
Bristol Channel	21	95	49	20	16	73
England, S.W.	25	88	43	22	14	84
England, S.	12	100	37	12	22	92
England, S.E.	6	83	27	5	17	82
England, N.E.	8	88	25	7	13	80
England, E.	12	92	32	11	13	75
TOTAL	172	91	576	157	278	75

APPENDIX III

FINANCIAL STATEMENT.

The year under review, 1937-8, is the seventeenth in which the cost of the Meteorological Office has been borne on Air Ministry Votes. The accounts are not yet closed, but the following tables give the approximate figures for the expenses and receipts of the Meteorological Office :—

APPROXIMATE STATEMENT OF EXPENDITURE AND RECEIPTS IN RESPECT OF METEOROLOGICAL SERVICES DURING THE YEAR 1937-8.

<i>Expenditure.</i>		<i>Amount.</i>	
		£	£
Salaries and Wages—H.Q. Establishments	... ..	61,765	
" " —Out-station Establishments	... ..	85,235	
		<hr/>	147,000
Fuel and Light	... ..		690
Transport of Personnel and Equipment	... ..		8,549
Instruments, Equipment and Stores	... ..		20,594
Research	... ..		2,648
Minor Works Services, Rents, Repairs and Maintenance of Buildings	... ..		4,910
Telegrams, Telephones	... ..	
Subventions to reporting stations and miscellaneous charges	}		24,249
Grants towards Meteorological Services for Empire			
Air Routes	... ..		4,289
Superannuation	... ..		573
	Total	... ..	<hr/><hr/>213,502
 <i>Receipts</i>			
Receipts from War Office and Admiralty	... ..		775
Sale of Instruments, Carriage, etc.	... ..		7,094
Daily Weather Reports, Forecasts, etc.	... ..		2,650
Receipts from Royal Society	... ..		534
	Total	... ..	<hr/><hr/>11,053

APPENDIX IV

THE STAFF OF THE METEOROLOGICAL OFFICE, ITS
OBSERVATORIES AND BRANCHES, MARCH 31, 1938

THE STAFF AT HEADQUARTERS

DIRECTOR :

Sir George C. Simpson, K.C.B., C.B.E., D.Sc., LL.D., F.R.S.

<i>Assistant Directors</i>	R. G. K. Lempfert, C.B.E., M.A. E. Gold, D.S.O., F.R.S.
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GENERAL SERVICES DIVISION

<i>Chief Clerk</i>	H. L. B. Tarrant, M.B.E.
<i>Assistant I</i>	Miss D. G. Chambers.
<i>Assistants</i>	...	...	6
<i>Typists</i>	...	...	2

MARINE DIVISION

<i>Superintendent</i>	...	...	L. A. Brooke Smith, Capt., R.N.R. (retd.) R.D.
<i>Technical Officer</i>	...	...	J. Hennessy, Cdr., R.N.R., (retd.), R.D.
<i>Senior Professional Assistant</i>			E. W. Barlow, B.Sc.
<i>Assistant I</i>	...	...	H. Keeton
<i>Assistants</i>	...	...	20

BRITISH CLIMATOLOGY DIVISION

<i>Principal Technical Officer</i>	...	...	E. G. Bilham, B.Sc., A.R.C.S., D.I.C.
<i>Technical Officers</i>	...	...	J. Glasspoole, M.Sc., Ph.D.; G. R. Benwell, B.A.
<i>Senior Professional Assistant</i>			Miss L. F. Lewis, B.Sc.
<i>Assistant I</i>	...	...	A. G. W. Howard.
<i>Assistants</i>	...	...	19
<i>Draughtsman and Draughts-</i> <i>women</i>	...	...	3
<i>Telephone Operator</i>	...	...	1
<i>Typists</i>	...	...	2

GENERAL CLIMATOLOGY DIVISION

<i>Superintendent</i>	...	...	C. E. P. Brooks, D.Sc.
<i>Technical Officers</i>	...	...	Miss E. E. Austin, M.A.; Miss E. H. Geake, M.Sc.
<i>Senior Professional Assistants</i>			Miss L. D. Sawyer, B.A.; Miss G. L. Thorman, B.Sc., A.K.C.
<i>Retired Naval Officers</i>	...	...	E. W. Woodruff, Cdr., R.N. (retd.). J. Pontifex, Cdr., R.N. (retd.).
<i>Assistant I</i>	...	...	A. T. Bench.
<i>Assistants</i>	...	...	15
<i>Draughtswomen</i>	...	...	2
<i>Presskeeper</i>	...	...	1
<i>Typist</i>	...	...	1

APPENDIX IV—continued

SYNOPTIC DIVISION

<i>Principal Technical Officer</i> ...	R. Corless, O.B.E., M.A.
<i>Senior Technical Officers</i> ...	H. W. L. Absalom, B.Sc., A.R.C.S., D.I.C.; M. T. Spence, B.Sc.
<i>Technical Officers</i> ...	J. Crichton, M.A., B.Sc., F.R.S.E.; R. A. Watson, B.A.; S. F. Witcombe, B.Sc.; C. S. Durst, B.A.; R. G. Veryard, B.Sc.; M. J. Thomas, B.Sc.; F. H. Dight, B.Sc.; W. H. Bigg, B.Sc.
<i>Assistants I</i> ...	F. M. Dean; W. Hayes; E. S. Tunstall; J. E. Belasco, M.Sc.; T. F. Twist; W. A. L. Marshall.
<i>Assistants</i> ...	40
<i>Draughtswomen</i> ...	8
<i>Telephone Typists</i> ...	12

OVERSEAS DIVISION

<i>Principal Technical Officer</i> ...	F. Entwistle, B.Sc.
<i>Senior Technical Officer</i> ...	S. P. Peters, B.Sc., A.Inst.P.
<i>Technical Officers</i> ...	J. S. Farquharson, M.A.; D. A. Davies, B.Sc.; J. Harding, B.A., B.Sc.
<i>Assistant I</i> ...	R. Pyser.
<i>Assistants</i> ...	5

NAVAL DIVISION

<i>Technical Officers</i> ...	T. W. V. Jones, B.Sc.; A. G. Forsdyke, Ph.D., A.R.C.S., D.I.C.
<i>Assistants</i> ...	2

ARMY AND INSTRUMENTS DIVISION

<i>Principal Technical Officer</i> ...	J. S. Dines, M.A.
<i>Senior Technical Officer</i> ...	E. V. Newnham, B.Sc.
<i>Technical Officers</i> ...	D. N. Harrison, D.Phil.; R. Cranna, M.A., B.Sc.
<i>Assistant I</i> ...	P. N. Skelton
<i>Assistants</i> ...	12
<i>Draughtsman</i> ...	1
<i>Instrument Maker</i> ...	1
<i>Photographic Assistant</i> ...	1
<i>Storeman, Packers and Porter</i> ...	4
<i>Typist</i> ...	1

POOL FOR TRAINING, EXPANSION AND SPECIAL INVESTIGATIONS

<i>Senior Technical Officer</i> ...	C. K. M. Douglas, B.A.
<i>Technical Officers</i> ...	A. F. Crossley, M.A. } <i>Instructors.</i> C. J. Boyden, B.A. }
	H. L. Wright, M.A.; W. R. Galloway, M.Sc.; L. P. Smith, B.A.; J. S. Sawyer, B.A.; A. W. Brewer, M.Sc.; P. F. Illsley, B.Sc.; W. S. Garriock, M.A., B.Sc.; N. Bradbury, B.Sc.; S. L. Portass, B.A.; E. T. Eady, B.A.
<i>Assistant I</i> ...	A. E. Mayers, B.Sc.
<i>Assistants & Observers</i> ...	44

APPENDIX IV—continued

THE STAFF AT OBSERVATORIES AND BRANCH ESTABLISHMENTS

KEW OBSERVATORY, Old Deer Park, Richmond, Surrey

<i>Assistant Director</i>	...	...	F. J. W. Whipple, Sc.D., F.Inst.P.
<i>Technical Officers</i>	...	...	L. H. G. Dines, M.A.; A. W. Lee, D.Sc., A.R.C.S., D.I.C.; G. D. Robinson, B.Sc., Ph.D.
<i>Assistant I</i>	...	...	E. Boxall.
<i>Assistants & Observer</i>	...	...	6
<i>Instrument Maker</i>	...	...	1
<i>Mechanics and Carpenter</i>	...	...	3
<i>Caretaker & Handyman</i>	...	...	2
<i>Housekeeper</i>	...	...	1

METEOROLOGICAL OFFICE, 6, Drumsheugh Gardens, EDINBURGH, 3

<i>Principal Technical Officer</i>	...	...	A. H. R. Goldie, M.A., D.Sc., F.R.S.E.
<i>Technical Officer</i>	...	...	F. E. Dixon, B.A.
<i>Assistant I</i>	...	...	H. E. Carter.
<i>Assistants and Clerk Typist</i>	...	...	7

THE OBSERVATORY, ESKDALEMUIR, Langholm, Dumfriesshire

<i>Senior Technical Officer</i>	...	...	W. A. Harwood, D.Sc.
<i>Technical Officer</i>	...	...	R. F. M. Hay, B.A.
<i>Assistants</i>	...	...	3
<i>Mechanic & Handyman</i>	...	...	2
<i>Housekeeper and Domestic Servant</i>	...	...	2

THE OBSERVATORY, King's College, ABERDEEN

<i>Assistant I</i>	...	...	G. A. Clarke.
<i>Assistant & Observer</i>	...	...	2

THE OBSERVATORY, LERWICK, Shetlands

<i>Technical Officer</i>	...	...	O. M. Ashford, B.Sc.
<i>Assistant & Observers</i>	...	...	3
<i>Caretaker</i>	...	...	1

PORT METEOROLOGICAL OFFICE, LIVERPOOL

<i>Senior Professional Assistant</i>	...	...	M. Cresswell, Cdr., R.N.R. (retd.).
<i>Clerk</i>	...	...	1

PORT METEOROLOGICAL OFFICE, LONDON

<i>Senior Professional Assistant</i>	...	...	C. H. Williams, Cdr., R.N.R. (retd.).
<i>Clerk</i>	...	...	1

APPENDIX IV—continued

HOME AVIATION SERVICES

ABBOTSINCH			
<i>Technical Officer</i>	...	...	W. J. Grassick, M.A., B.Sc.
<i>Assistants & Observers</i>	...	...	6
ABINGDON			
<i>Senior Technical Officer</i>	...	...	R. E. Watson, B.Sc., Ph.D.
<i>Technical Officers</i>	...	...	A. H. Gordon, M.S. (Pasadena); V. R. Coles, B.Sc.; J. H. Brazell, M.Sc.
<i>Assistant I</i>	...	...	W. L. Andrew.
<i>Assistants & Observers</i>	...	...	5
ALDERGROVE			
<i>Technical Officer</i>	...	...	D. Dewar, B.Sc.
<i>Assistants & Observers</i>	...	...	5
ANDOVER			
<i>Senior Technical Officer</i>	...	...	W. H. Pick, B.Sc., F.Inst.P., F.C.P.
<i>Assistant</i>	...	...	1
BIGGIN HILL			
<i>Assistant & Observers</i>	...	...	5
BIRCHAM NEWTON			
<i>Technical Officer</i>	...	...	F. E. Lumb, M.Sc.
<i>Assistant</i>	...	...	1
BOSCOMBE DOWN			
<i>Technical Officer</i>	...	...	C. V. Ockenden, B.Sc.
<i>Assistants & Observers</i>	...	...	5
BRISTOL			
<i>Assistant I</i>	...	...	P. I. Mulholland, B.Sc.
<i>Assistant & Observers</i>	...	...	3
CALSHOT			
<i>Technical Officer</i>	...	...	E. A. Cope, B.Sc., A.R.C.S.
<i>Assistants & Observers</i>	...	...	5
CATTERICK			
<i>Technical Officer</i>	...	...	W. R. Morgans, M.Sc.
<i>Assistants</i>	...	...	4
CRANWELL			
<i>Technical Officer</i>	...	...	F. E. Coles, B.Sc., A.R.C.S., D.I.C.
<i>Assistant</i>	...	...	1
CROYDON			
<i>Senior Technical Officer</i>	...	...	R. S. Read, M.A., B.Sc., A.R.C.S., F.Inst.P.
<i>Technical Officer</i>	...	...	C. J. M. Aanensen, M.Sc.
<i>Assistants I</i>	...	...	D. F. Bowering; A. A. Lovie.
<i>Assistants & Observers</i>	...	...	14
<i>Telephone-Typists</i>	...	...	3

APPENDIX IV—continued

DISHFORTH			
<i>Technical Officer</i>	...	...	T. H. Kirk, B.Sc.
<i>Assistant</i>	...	...	1
DRIFFIELD			
<i>Assistant & Observer</i>	...	...	2
FELIXSTOWE			
<i>Technical Officer</i>	...	...	G. A. Bull, B.Sc.
<i>Assistant & Observer</i>	...	...	2
FINNINGLEY			
<i>Technical Officer</i>	...	...	C. P. Drake, B.A.
<i>Assistant</i>	...	...	1
GRANTHAM			
<i>Senior Technical Officer</i>	...	...	R. H. Mathews, B.A.
<i>Assistant I</i>	...	...	C. F. J. Jestico
HEMSWELL			
<i>Technical Officer</i>	...	...	R. Frith, M.A., Ph.D.
<i>Assistant</i>	...	...	1
HOLYHEAD			
<i>Assistants & Observer</i>	...	...	3
HUCKNALL			
<i>Technical Officer</i>	...	...	G. Thornton Smith, B.A.
<i>Assistant</i>	...	...	1
LEE-ON-SOLENT			
<i>Technical Officer</i>	...	...	J. Pepper, Ph.D., M.A., B.Sc.
<i>Assistant</i>	...	...	1
LEUCHARS			
<i>Technical Officer</i>	...	...	S. T. A. Mirtlees, M.A.
<i>Assistants & Observer</i>	...	...	4
LYMPNE			
<i>Assistant & Observers</i>	...	...	5
MANCHESTER			
<i>Technical Officer</i>	...	...	C. W. G. Daking, B.Sc.
<i>Assistants & Observers</i>	...	...	8
MANSTON			
<i>Technical Officer</i>	...	...	H. F. Jackson.
<i>Assistants & Observers</i>	...	...	6

APPENDIX IV—continued

MILDENHALL

<i>Senior Technical Officer</i>	...	G. R. Hay, M.A.
<i>Technical Officers</i>	...	R. F. Budden, M.A.; A. L. Maidens, B.Sc.
<i>Assistants & Observer</i>	...	5

MONTROSE

<i>Technical Officer</i>	...	H. H. Lamb, B.A.
<i>Assistants</i>	...	2

MOUNT BATTEN

<i>Technical Officer</i>	...	A. Walters.
<i>Assistants & Observers</i>	...	5

PEMBROKE DOCK

<i>Technical Officer</i>	...	G. W. Hurst, B.Sc., A.R.C.S., D.I.C.
<i>Observer</i>	...	1

SEALAND

<i>Technical Officer</i>	...	D. W. Johnston, B.Sc.
<i>Assistants & Observers</i>	...	4

SOUTH FARNBOROUGH

<i>Technical Officer</i>	...	R. M. Poulter
<i>Assistants & Observer</i>	...	3

THORNABY

<i>Technical Officer</i>	...	T. N. S. Harrower, M.A., B.Sc.
<i>Assistant</i>	...	1

THORNEY ISLAND

<i>Technical Officer</i>	...	R. C. Sutcliffe, Ph.D., B.Sc.
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UPPER HEYFORD

<i>Technical Officer</i>	...	J. C. Cumming, M.A.
<i>Assistants</i>	...	3

UPWOOD

<i>Technical Officer</i>	...	L. Jacobs, M.A., M.Sc.
<i>Assistant</i>	...	1

UXBRIDGE

<i>Assistant I</i>	...	J. D. Ashton.
<i>Assistant</i>	...	1

APPENDIX IV—continued

OVERSEAS AVIATION SERVICES

HYTHE (SOUTHAMPTON)

<i>Technical Officers</i>	...	...	G. J. W. Oddie, B.Sc.; P. J. Meade, B.Sc. ; S. Proud, B.A.
<i>Assistants</i>	...	...	3

GIBRALTAR

<i>Senior Technical Officer</i>	...	F. J. Scrase, M.A., B.Sc.
<i>Assistant I</i>	...	H. E. Forster.
<i>Clerks (locally entered)</i>	...	4
<i>W/T operators (locally entered)</i>	...	2

MALTA

<i>Senior Technical Officer</i>	...	N. H. Smith, B.Sc.
<i>Technical Officers</i>	...	A. C. Best, B.Sc.; L. Dods, B.Sc.
<i>Assistants I</i>	...	E. L. Clinch; C. C. Newman.
<i>Assistant</i>	...	1
<i>Clerks (locally entered)</i>	...	9

HELIOPOLIS

<i>Senior Technical Officer</i>	...	R. P. Batty, B.A.
<i>Technical Officers</i>	...	C. W. Lamb, M.C., B.Sc.; R. E. Farms, B.Sc.
<i>Assistant I</i>	...	W. J. R. Pook.
<i>Assistant & Observers</i>	...	7

ABOUKIR, AMMAN, ISMAILIA AND RAMLEH

<i>Observers</i>	9
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HABBANIYA

<i>Senior Technical Officer</i>	...	J. M. Stagg, O.B.E., M.A., D.Sc.
<i>Technical Officers</i>	...	R. Frost, B.A.; G. G. Macdonald, M.A.
<i>Observer</i>	...	1
<i>Clerks (locally entered)</i>	...	7

SHAIBAH AND DIWANIYAH

<i>Assistant</i>	...	...	1
<i>Clerks (locally entered)</i>	...	...	3

ARMY SERVICES

LARKHILL

<i>Technical Officers</i>	...	L. G. Hemens, B.Sc.; J. Briggs, B.A.
<i>Assistants & Observers</i>	...	6

PORTON

<i>Assistants</i>	6
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SHOEBURYNNESS

<i>Technical Officer</i>	...	C. E. Britton, B.Sc.
<i>Assistants & Observers</i>	...	12

APPENDIX IV—*continued*

SECONDED FOR DUTY WITH OTHER SERVICES

<i>Senior Technical Officer</i>	...	J. Durward, M.A.	}	Meteorological Service of Iraq.
<i>Technical Officers</i>	... ..	J. L. Galloway, M.A., B.Sc.	
		E. L. Davies, M.Sc.	}	(War Office Experi- mental Station, Porton).
		H. Garnett, M.Sc.		
		P. A. Sheppard, B.Sc.		
		K. L. Calder, B.Sc., A.R.C.S.		
		F. Pasquill, B.Sc.		
		O. G. Sutton, B.Sc.	(War Office, Research Department).	
		B. C. V. Oddie, B.Sc.	(Chemical Defence Research Department, India).	
		L. H. Starr, M.Sc.	(Royal Air Force, India).	
<i>Assistants</i>	... ..	2	(British West African Meteorological Ser- vice).
<i>Assistants and Observers</i>	... ..	4	(Meteorological Service of Eire).

APPENDIX V

PUBLICATIONS

The publications prepared by the Office are generally issued by His Majesty's Stationery Office as official publications. A complete list, with the prices at which they can be purchased through any of the Sale Offices or usual agents of the Stationery Office is sent free to any applicant.

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

PERIODICAL :—

The Daily Weather Report issued in three sections (to March 31) :—

1. The British Section.
2. The International Section.
3. The Upper Air Section.

The Monthly Weather Report with a summary for the year (to February, 1938).

Weekly Weather Report for the period March 1, 1936, to February 27, 1937. Particulars of temperature, rainfall and bright sunshine for each week. *7s. 6d.*

The Marine Observer (to March, 1938).

The Meteorological Magazine (to March, 1938).

Monthly Frequency Tables, being summaries of observations of horizontal visibility, height of base of low cloud and speed and direction of surface and upper winds in the form approved by the International Commission for Air Navigation (to January, 1938). *Not on sale.*

Seismological Bulletin. A diary of seismological disturbances recorded on the Galitzin Aperiodic Seismographs at Kew Observatory, Richmond (to February, 1938). *Not on sale.*

Observatories' Year Book, 1935 and 1936. Comprising the meteorological and geophysical results obtained from autographic records and eye observations at the observatories at Lerwick, Aberdeen, Eskdalemuir, Valentia and Kew, and the results of soundings of the upper atmosphere by means of registering balloons. *42s. each.*

Réseau Mondial, 1930. Monthly and annual summaries of pressure, temperature, and precipitation based on a world-wide network of observing stations. *15s.*

British Rainfall, 1936. A report on the distribution of rain in space and time over the British Isles as recorded by over 5,500 observers. *15s.*

Southport Auxiliary Observatory. Annual Report and results of meteorological observations, 1936. By J. Baxendell. *Not on sale.*

OCCASIONAL :—

Averages of Humidity for the British Isles. *9d.*

Decode for use with the International Code for Wireless Weather Messages from Ships adopted by the International Meteorological Conferences, Copenhagen 1929 and 1935. 5th edition, revised to December, 1937.

Gazetteer of British Meteorological Stations used in the preparation of Synoptic Reports. Amendment No. 2. *2s.*

APPENDIX V—*continued*

Wireless Weather Messages. Particulars of Meteorological Reports issued by Wireless Telegraphy and Wireless Telephony in Great Britain, Gibraltar, Malta, Middle East and Iraq. 11th edition, 1938. *1s. 3d.*

Geophysical Memoirs :—

Vol. VIII :—

72. Kinematical features of depressions. By A. H. R. Goldie, D.Sc., F.R.S.E. *3s.*

Vol. IX :—

73. Meteorological observations in the South Atlantic, at Ocean Island and in British Somaliland during the second International Polar Year, 1932–3. *4s. 6d.*
74. On the travel of seismic waves from the Baffin Bay earthquake of November 20, 1933. By A. W. Lee, D.Sc. *2s.*
75. Electricity on rain. A discussion of records obtained at Kew Observatory 1935–6. By F. J. Scrase, M.A., B.Sc.

Professional Notes :—

Vol. V :—

75. Temperature and relative humidity in the atmosphere over lower Egypt. By W. D. Flower, B.Sc., A.Inst.P. *2d.*
76. The effects of obstacles on sunshine records. By E. G. Bilham, B.Sc., D.I.C. *4d.*
77. Variations of temperature at Oxford, 1815–1934. By Lilian F. Lewis, B.Sc. *3d.*
78. Upper winds at Kingston, Jamaica. By S. Proud, B.A. *9d.*
79. Upper winds measured at M/Y Imperia, Mirabella Bay, Crete. By J. Durward, M.A. *6d.*
80. A height computer for use in aerological work. By E. G. Bilham, B.Sc., D.I.C. *3d.*

Vol. VI :—

81. Ice formation in clouds in Great Britain. By W. H. Bigg, B.Sc. *6d.*
82. Ice accretion on aircraft, Notes for Pilots. By G. C. Simpson, K.C.B., F.R.S. *3d.*

The publication of the following books or papers by members of the Staff may also be mentioned :—

By SIR GEORGE SIMPSON, K.C.B., C.B.E., F.R.S. :—

Snow crystal or snow flake. *Nature, London, 140, 1937, pp. 729–30.*

Ice ages. (Friday evening discourse delivered at the Royal Institution on December 10, 1937). *Nature, London, 140, 1938, pp. 591–8.*

By SIR GEORGE SIMPSON, K.C.B., C.B.E., F.R.S., with F. J. SCRASE, M.A., B.Sc. :—

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