

ANNUAL REPORT
of the Director of the
METEOROLOGICAL OFFICE

presented by the Meteorological Committee
to the Air Council

For the Year ended
March 31
1937

The Eighty Second Year of the Meteorological Office



LONDON

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METEOROLOGICAL COMMITTEE

1936-7.

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.

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.

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

Colonel A. E. MACRAE, O.B.E., R.A. Superintendent of Experiments, Shoeburyness. Nominated by the War Office. (To December 11, 1936.)

Colonel F. N. C. ROSSITER, M.B.E., M.C., Superintendent of Experiments, Shoeburyness. Nominated by the War Office. (From December 12, 1936.)

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

Professor R. A. SAMPSON, F.R.S., Astronomer Royal for Scotland. Nominated by the Royal Society of Edinburgh.

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

Mr. J. A. WEBSTER, C.B., D.S.O. Principal Assistant Secretary, Air Ministry. Nominated by the Air Ministry. (To December, 1936.)

Mr. J. B. ABRAHAM, C.B. Principal Assistant Secretary, Air Ministry. Nominated by the Air Ministry. (From January, 1937.)

Secretary :—Miss D. G. CHAMBERS.

The Committee met on July 8 and November 11, 1936.

COMMITTEE OF THE METEOROLOGICAL OFFICE
EDINBURGH, 1936-7

Chairman :—The Director of the Meteorological Office.

Vice-Chairman :—Professor R. A. SAMPSON, D.Sc., F.R.S. Nominated by the Royal Society.

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.

Dr. A. CRICHTON MITCHELL, F.R.S.E. Nominated by the Royal Meteorological Society.

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

Professor A. G. OGILVIE, O.B.E., M.A., B.Sc. Nominated by the University of Edinburgh.

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

The Committee met on June 25, 1936.

THE GASSIOT COMMITTEE, 1936

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 (Mr. J. H. REYNOLDS).

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 October 26, 1936.

A list of the staff and of the divisions and establishments of the Office will be found on pp. 46 to 52.

ANNUAL REPORT of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the year ending March 31, 1937 (the eighty-second year of the Meteorological Office).

The year 1936-7 has been one of planning and preparation in the Meteorological Office. The great extension of the Royal Air Force involving the establishment of a large number of additional aerodromes spread widely over the country necessitates an extension of the work of the Meteorological Office. To establish a complete meteorological service on each of the new aerodromes would be extremely expensive. On the other hand a great increase in the amount of instrumental flying carried out by the Royal Air Force both during the night and in clouds demands more information regarding the existing weather and the anticipated changes. The best way for supplying this information is to have available a synoptic chart which can be explained to the pilots by an experienced meteorologist. This information is required at many stations throughout the day and night. To meet these requirements a scheme has been prepared based on an arrangement of meteorological stations in groups, consisting of main stations and dependent stations. At the main stations there will be a staff of forecasters large enough to maintain a day and night service. On the surrounding aerodromes there will be small meteorological stations without independent forecasting staff but with meteorological personnel capable of preparing synoptic charts. These will be connected with the main station from which they will obtain the latest reports and forecasts as required for flying operations. Groups of stations based on this plan will be established partly on a geographical arrangement and partly on the group arrangement adopted by the Royal Air Force. No distinction will be made in this scheme between civil and military aerodromes as the group arrangement will apply independently of the purposes for which the forecasts are required.

The scheme will involve a large increase in the Meteorological Office staff both of highly trained forecasters and less-skilled assistants who will be in charge of the dependent stations. Throughout the year steps have been taken to recruit and train the necessary personnel for this expansion (see notes on staff on p. 41).

The Empire Air Mail Scheme will depend on an efficient meteorological service along every Empire air route. Although the Meteorological Office is not responsible for meteorology outside the British Isles, except where units of the Royal Air Force are stationed, the duty has devolved on the Office of advising the Governments of the territories traversed by the air routes on the meteorological

organization which will be required. In consequence a new division was established in the Meteorological Office in 1935, to organise the meteorological services of the trans-Atlantic and Empire air routes. Throughout the year this division has been engaged in preparing for the opening of the new Empire Air Mail service in 1937. A full description of the activities of the division is given on pp. 19 to 28 from which it will be seen that this development involves increased responsibility for the Meteorological Office and an enlargement of the staff.

The greater demands being made have resulted in increased activity throughout the Office which has thrown a considerable strain on the staff. Details of the work carried out by the various divisions are now described.

MARINE DIVISION

The work of the Marine Division has continued with little change. The number of ships, on which observations are taken at the end of each watch and entered into a "meteorological log", was reduced during the year from 41 to 29 in conformity with the policy of confining the collection of climatological data to those regions of the ocean for which little information has been collected in the past. There has been a corresponding increase in the number of ships taking observations at the standard times for synoptic meteorology, the results of which are entered on special forms instead of into logs, the total number of observing ships and lighthouses being maintained at 357, practically the same as in the previous four years.

By international agreement, 281 of the observing ships have been selected to issue their observations by wireless telegraphy, ships undertaking this extra duty being termed "selected ships."

During the year 88 meteorological logs were received and 2,544 records from the form-keeping ships. The selected ships make their reports direct to 14 meteorological services in different parts of the world through 52 wireless stations which have been selected to receive weather messages from ships.

Owing to the congestion of wireless telegraphy in the neighbourhood of the British Isles it has been the policy in the past only to receive messages from ships in the North Atlantic fitted with continuous wave wireless transmitting sets communicating with the large Post Office station at Portishead. The demand for more ships' observations from the North Atlantic has made it necessary to revise this practice and to arrange for ships fitted with less powerful wireless installations to communicate their observations also. Since July 1, 1936, these additional messages have been received through the wireless stations at Valentia and Malin Head. The total number of observations received daily from the North Atlantic is in consequence considerably increased.

The scheme of selected ships adopted internationally, by which each country selects a limited number of its observing ships in

proportion to the tonnage of its Merchant Navy to issue weather reports by wireless, was inaugurated to restrict the amount of wireless communication occupied by weather reports. It has been found, however, that the scheme fails in certain parts of the world owing to the small number of selected ships which are at any one time in touch with the land. This is particularly so in the neighbourhood of New Zealand and off the China coast. It has therefore been decided that a number of ships shall be asked to issue meteorological observations as though they were selected ships when they come into regions where the number of selected ships is too small to provide sufficient observations, but only in these regions. Since October, 1936, when this extension was introduced, 143 masters of British ships have agreed to supply meteorological reports by telegraphy in these regions.

In 1931 it was decided to prepare atlases of the meteorological conditions over the oceans based on the large amount of information contained in meteorological logs which have been preserved in the Marine Division during the last sixty years. It was necessary, however, that the information contained in the logs should be extracted on to Hollerith cards for statistical treatment. This work has been proceeding slowly since January, 1933, when there were 1,340,000 sets of observations to be extracted. In the three years ending March, 1936, 347,000 sets of observations were extracted. In order that the work should not be indefinitely prolonged special staff have been appointed during the present year so that the rate of extraction has been more than doubled, the number of observations extracted this year being 280,696 against 137,320 last year. There now remain about 737,000 to be extracted before the preparation of atlases can be commenced.

For further details regarding the work performed by the Marine Division reference should be made to the *Marine Observer* for July, 1937.

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. 31-5) 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. 43). 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.

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

The Weekly Weather Report, 1935-6, was published on November 3, 1936.

British Rainfall, 1935.—The volume was signed for press on September 1, 1936, and published on October 20, 1936.

Observatories' Year Book.—The volume for 1934 was published on August 19, 1936.

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 the Irish Free State. The returns were in the same form as in recent years. The report for Scotland published by the Registrar-General for Scotland is prepared at the Meteorological Office, Edinburgh.

Inquiries.—During the year 2,919 general inquiries have been received and dealt with, including 175 legal inquiries. These figures represent an increase of 11 per cent and a decrease of 18 per cent respectively on last year's figures. The majority of the inquiries refer to rainfall data or general climatological data for specified places.

Investigations and Special Work.—*Gorczynski Solarigraph.*—A Gorczynski Solarigraph giving records of the vertical component of total radiation from the sun and sky at 1-minute intervals was brought into use at South Kensington.

Health Resorts Association—Handbook Sub-Committee.—The Superintendent served on this committee as meteorological adviser.

Averages of Temperature and Sunshine.—In accordance with the policy adopted in 1933, work was completed in November on the computation of averages of temperature and sunshine for the period 1906 to 1935. These were published in January, 1937, and the values were used for official purposes as from January 1, 1937. Averages of temperature at fixed hours (0700, 1300, and 1800 G.M.T.) for 40 stations used in the international exchange of synoptic weather information were included in the volume of "Averages of temperature."

New Averages—Humidity.—Work was begun on a book of averages of humidity. The volume will include averages of temperature, relative humidity, vapour pressure and moisture content at 0700, 1300 and 1800 for synoptic stations, hourly average of humidity for nine stations and monthly charts of relative humidity and vapour pressure at 1300.

Rainfall.—Arrangements were made for copies of the annual average rainfall map of the British Isles on a scale of 19 miles to the inch to be available for supply on repayment.

Rainfall Survey of Great Britain.—Further work on the Survey of the River Nene Catchment area was carried out and surveys of the Hastings area and River Stour areas were completed. The Survey of Scotland was put in hand and work on Orkney, Shetland, Midlothian, Renfrew, West Lothian and Kinross was completed. Some progress was made with the remaining counties.

GENERAL CLIMATOLOGY DIVISION

The General Climatology Division deals with the climate of the world excluding the British Isles. It collects data from many sources, the chief being the publications of the various meteorological

services of the world. In addition, manuscript copies of data are obtained from a number of stations which do not normally publish their data.

Meteorological Returns from British Colonies.—The Meteorological Office acts as a collector and disseminator of meteorological observations from the Colonies. For a number of Colonies, Protectorates and Mandated Territories, the authorities send monthly manuscript returns of daily observations; returns for 70 stations were received in this way, including 52 from various parts of Africa, 4 from the West Indies, and 12 from islands in the Atlantic and Pacific Oceans. In addition returns were received from 15 stations maintained by the Meteorological Office in Egypt, Palestine and Iraq, and from certain stations in foreign countries where no regular meteorological service is in operation, including Abadan on the Persian Gulf, Geah ba Zondo in Liberia, and El Peru, Venezuela.

A number of other Colonies publish climatological summaries in their annual Blue Books. Under an arrangement made with the Colonial Office in 1910 reprints of these summaries are sent to the Meteorological Office for redistribution to a number of Institutions at home and abroad; 35 Colonies and Protectorates supplied reprints in this way, containing data for 621 stations.

Réseau Mondial.—The General Climatology Division compiles the *Réseau Mondial*, which is an annual volume containing data of pressure, temperature and rainfall from all parts of the world. The scheme on which this publication is based divides the globe into "squares" bounded by lines of latitude and longitude at 10° intervals. Data are published, if available, for two stations in each "square." For a few "squares" entirely in the sea, observations taken on ships are used as a basis. The volumes are published by the Meteorological Office on behalf of a commission of the International Meteorological Organization, the *Réseau Mondial* Commission, of which the Director is President. During the year under review the volume for 1929 was issued. It includes 460 land stations and two marine 5-degree squares. Of the land stations 52 are between 80° and 60° N, 149 between 60° and 30° N, 214 between 30° N and 30° S and 45 south of 35° S. The data are in part extracted from official publications of the various meteorological services and in part supplied in manuscript by these services specially for the *Réseau Mondial*, but it is not always possible to obtain the information quickly and an interval of several years must necessarily elapse between the year dealt with and the year of publication.

Broadcasting of Climatological Data.—The publication of the *Réseau Mondial* is inevitably subject to a lag of several years. The need for a more immediate supply of information is now being met by the broadcasting on the 5th of each month of means of pressure and temperature and totals of precipitation for

the preceding month. These broadcasts are received in the Meteorological Office for a large number of places in Europe, Siberia, and North America. The figures are plotted on charts which are described in detail in the June, 1937, issue of the *Meteorological Magazine* and are also available for consultation.

Admiralty Pilots.—The periodical revision of the meteorological sections of the Pilots issued by the Admiralty for the use of navigators was continued as opportunity offered, but suffered some delay from the pressure of other work, and especially from the preparation of the new Naval Handbook of the Mediterranean. The texts of six Pilots were revised, in two of which the Meteorological Services of India and Australia co-operated, and tables were revised for six Pilots, involving the compilation in the Office of data for six stations in addition to revised tables for 42 stations contributed by Meteorological Services abroad.

Special Investigations.—Arrangements were made for the General Climatology Division to undertake, on behalf of the Committee on Locust Control of the Economic Advisory Council, a large-scale investigation of climatic conditions in Africa during the period 1925 to 1936, during which there were several outbreaks of locust swarms. The details of the proposed investigation have been discussed, and it is hoped to put the work in hand during the coming year.

Inquiries.—During the year 213 general or scientific inquiries and 287 personal inquiries were dealt with. A number of these were from commercial or manufacturing firms or scientific institutions engaged in research. Among them may be mentioned several from the Ministry of Agriculture and Fisheries for variations of resultant winds over the seas round Great Britain, in connexion with variations in the yield of fisheries from year to year.

Library.—The additions to the Library during the past year include 682 new books and pamphlets and 13,811 daily weather reports. The number of periodicals received was 4,008 ; 1,563 books, etc., were issued on loan during the year.

The card catalogue of authors has been kept up to date. All new receipts have been classified according to the Universal Decimal Classification in Meteorology described in last year's Annual Report (pp. 12-3). Each month a list of the more important receipts has been prepared and circulated throughout the Office and, in co-operation with the Royal Meteorological Society, a bibliography of meteorological books and papers has been prepared and published at six-monthly intervals.

FORECAST AND AVIATION DIVISION

The work of this division may be summarised under three heads:—

(a) The collection of information of current weather from observing stations situated in nearly all parts of the northern hemisphere.

(b) The preparation of synoptic charts from these observations for the purpose of making forecasts.

(c) The distribution of information regarding current weather and forecasts of future weather for all purposes, including weather reports for the newspapers, the British Broadcasting Corporation, gale warnings for shipping and, in particular, reports and forecasts for aviation.

The division is responsible for maintaining the observing stations in all parts of the British Isles and the stations established on aerodromes for the supply of information for aviation, both civil and military. It also arranges for meteorological instruction to be given to the personnel of the Royal Air Force and for conducting the examinations in meteorology for civil air pilots.

As already mentioned in the introductory paragraphs of this report, there is proceeding a rapid expansion of the meteorological services required both by the Royal Air Force and civil aviation, necessitating the training of a large number of meteorological personnel. Concurrent with the increase in the services demanded a change in the character of the information required is taking place. The amount of flying in and through clouds is increasing both by civil pilots—who now rapidly climb through the clouds and if possible fly above them—and by pilots of the Royal Air Force. This has raised new meteorological problems since it is impossible to navigate in and above clouds without detailed information of the winds likely to be met with above clouds, as these winds may be very different from those near the surface. Aerial navigation without this knowledge is impossible. Moreover, the probability of meeting ice-forming conditions within the clouds themselves has to be estimated and warnings issued. All this demands a much higher degree of skill on the part of the meteorological personnel.

Observations and Reports.—In order to meet the increased amount of night flying it has been found necessary to extend the hours of observation throughout the night. A plan has been drawn up for observations to be taken at many stations at 2200, 0100 and 0400 G.M.T. Part of the scheme is now in operation and it is hoped to bring the full scheme into operation at an early date.

To meet the demands of the Royal Navy and of stations from which night flying is carried out, a collective message is now broadcast daily at 1940 containing synoptic information of the conditions at a number of selected stations on the continent of Europe at 1800.

Prior to May 26, 1936, a "Fleet Synoptic Message" was issued daily at 1000 for the use of the Fleet. From that date this message has been replaced by two, a morning and an evening message broadcast from the Admiralty at 0600 and 1720 respectively. These messages contain reports from coastal stations in west Europe and from ships on the Atlantic, together with a coded report describing the position of any outstanding fronts over the Atlantic. The morning message contains observations made at midnight and 0100,

while the evening message contains observations made at noon and 1300.

By arrangement with the Admiralty a new telegraphic reporting station was opened at St. Abb's Head in December, 1936, on the site of the auxiliary station formerly maintained there. This station is in a position to take observations at synoptic hours during the night (namely 2200, 0100 and 0400) as well as during the day. It will eventually replace the station on the island of Inchkeith which has been in operation for some years by the courtesy of the Northern Lighthouse Board.

Meteorological Broadcasts by Wireless Telephony.—An account was given in last year's annual report (p. 15) of the service of weather reports issued by wireless telephony for aviation from the wireless station at Borough Hill, Northamptonshire. This service has been considerably developed during the year; the number of stations from which reports are given has been increased, and twelve stations (called key stations) well distributed over the British Isles have been chosen to make reports every hour for immediate broadcast. The reports from the key stations are amplified by values of barometric pressure reduced to mean sea level. Arrangements have been made for the pilots of aircraft to report immediately when they experience accretion of ice when flying through clouds and for these reports to be broadcast immediately from Borough Hill.

Further developments of this service, which has proved its great value, are under consideration.

Meteorological Flights.—The Meteorological Flight which has been stationed at Duxford for many years was moved to Mildenhall in November and has continued to provide information regarding upper air conditions in all types of weather, which is invaluable for forecasting purposes. Heights reached by this Flight are consistently good and frequently exceed 23,000 ft. The great value of the information provided by the meteorological flight at Duxford has justified the establishment of another similar Flight. In order that conditions as far west as possible should be available this new Flight was established in January, 1937, at Aldergrove in Northern Ireland.

Civil Aviation.—The work in connexion with the supply of weather reports and forecasts to pilots of aircraft flying on organized air routes has been continued. Croydon remains the centre of this organization, but a meteorological office at Barton Airport, Manchester, caters mainly for the requirements of civil aviation in the north of England, while the meteorological stations at the Royal Air Force aerodromes at Abbotsinch, Aldergrove, Mount Batten and Calshot supply a considerable amount of information for civil aviation.

The work at Croydon has increased considerably during the course of the year. The aerodrome at Gatwick was opened and the meteorological reports required there were supplied regularly from Croydon, while in return hourly reports of weather at

Gatwick from 0800 to 1800 were transmitted daily from Gatwick to Croydon by teleprinter. Frequent reports of weather at Heston, another important aerodrome serving the London district, were also received and forecasts issued for regular air services operating from that airport.

Special meteorological arrangements were made as usual for the King's Cup Air Race on July 10 and 11, 1936.

Royal Air Force.—As flying at night has become general in the Royal Air Force, not only among the regular squadrons but also among auxiliary squadrons and training units, the meteorological staff at out-stations as well as at headquarters have had to devote much attention to the issue of forecasts for night flying.

Night flying has set the meteorologist a number of problems; chiefly the exact time of the incidence of the low cloud and fog which develop at certain stations during the night or just about sunrise. These problems have been the subject of serious study at many stations.

The experiment is being tried of providing R.A.F. pilots who are setting out on long distance flights with a written statement of the latest weather reports from stations near the route and a written forecast of the weather to be expected. A similar procedure has been satisfactorily followed on civil air lines.

Special meteorological staff were provided as usual for air exercises, and meteorological demonstrations were given at a number of the aerodromes thrown open to the public on May 23, in celebration of Empire Air Day. A full meteorological forecasting organization was established at Hendon from June 24 to 27 for the Royal Air Force Display.

The programme of lectures on meteorology to Flying Training Schools of the Royal Air Force has been extended in consequence of the opening of additional schools. Lectures have also been delivered to the Navigation School, Manston, and the Cadet College, Cranwell. A course of lectures on meteorology was also given to No. 500 Auxiliary (City of London) Squadron.

British Broadcasting Corporation.—When the British Broadcasting Corporation extended the number of their news bulletins they desired that the number of weather forecasts should be increased so that a weather report should be available at the beginning of each news bulletin. In consequence weather forecasts are now broadcast either from National or Regional transmitters of the British Broadcasting Corporation at the following times on weekdays :—

10.30 a.m., 6.0, 7.0, 9.0, 10.0 and 11.30 p.m.

Bulletins for shipping are issued with the forecast at 10.30 a.m. and at 9 p.m., while a bulletin for farmers is included with the 10.30 a.m. issue, as previously. On Sundays the service of forecasts for land areas is confined to issues at 10.30 a.m. and 8.50 p.m. Forecasts for shipping are issued on Sundays at 10.30 a.m. and 11 p.m.

An experiment was made between November 2 and 28 of issuing weather charts by the television process and accompanying them by a spoken description of the chart and a short forecast. This experiment was made at the Alexandra Park Television Station of the British Broadcasting Corporation, and as the radius of the transmission is limited the forecast referred to London only. The experiments indicated that there were possibilities in this method which might have to be reviewed later when television becomes one of the amenities in the lives of the majority of the inhabitants of the country.

Warnings of probable air temperatures below 30° F. at a height of 4 ft. above the ground were issued with the broadcast forecasts during April and May for the benefit of horticulturists. The two very severe frosts which were encountered during the period were both successfully forecast.

Forecasts for the Herring Fishing Fleet in the area of the Minch were telegraphed to Edinburgh for broadcasting in Scotland from January 6, 1937, while similar forecasts for the Herring Fishing Fleet operating in the southern North Sea were issued from English stations from October 1, 1936, to February 13, 1937.

Forecasts for Broadcasting by the Irish Free State.—In addition to the two previous daily services an additional forecast is telegraphed to Dublin for issue from the Athlone Transmitting Station at 6.45 p.m. Forecasts for Ireland are now issued from Athlone at 12.15 p.m., 6.45 p.m., and 10.30 p.m.

Forecasts of Ice Accretion.—The increased amount of flying within clouds both by civil and R.A.F. aircraft has raised in an acute form the problem of issuing warnings of ice accretion on aircraft. The physical processes connected with the deposit of ice on aircraft are now well understood. It is known that ice accretion may occur in clouds whenever the temperature is between the limits of 35° F. and 0° F. and that really dangerous conditions are almost entirely confined to temperatures round about freezing point. Experience shows, however, that ice accretion often does not occur when temperatures are between these limits, the density of the cloud and the state of the cloud particles being other factors which have an important influence on whether or no appreciable deposition of ice will occur. It is clear therefore that forecasters would not be justified in issuing warnings whenever the temperature conditions appear favourable. On the other hand some information regarding the possibility of ice accretion must be given to the pilots. The problem is being given close attention by the staff of the Meteorological Office, and in the meantime arrangements are being made for forecasts to contain information regarding the height at which the conditions are most favourable for ice formation, and the two heights above and below which danger does not exist. Arrangements have also been made for pilots of aircraft to report formation

of ice whenever it is met with. These reports are immediately broadcast, stating the height and locality in which ice accretion has been encountered.

Gale Warnings.—A table setting out the results of checking the gale warnings issued will be found in Appendix II, p. 44.

ARMY SERVICES DIVISION

The work of the Army Services Division has been continued as in previous years, a highly trained staff being maintained at Shoeburyness to meet the needs of the War Office Experimental Establishment for meteorological information and reports. A second station at Larkhill supplies the needs of the School of Artillery. Men have been posted to Artillery Practice Camps during the summer months to provide the meteorological reports required for firing practice. Many new problems have arisen during the year which have required the attention of the headquarters staff.

NAVAL DIVISION

Organization of Fleet Meteorology.—During the year 1936-7 the work of the division has been devoted largely to establishing in the Fleet the Meteorological Organization approved by the Board of Admiralty in 1934-5 and set out in the annual report for that year. The continuation of the abnormal international situation, particularly during the earlier part of the year under review, gave rise to many difficulties in the organization of Fleet Meteorology, but nevertheless marked progress has been made. The increase in the number of ships in which meteorological organizations have been instituted has added considerably to the work of the division, and in order to cope with the increased pressure of work it has been found necessary to obtain the assistance of Naval Officers who have been lent to the division by the Admiralty.

It is satisfactory to be able to report that continued and increasing interest in meteorology is being taken in the Fleet, and as an instance of this interest it may be noted that the Board of Admiralty have during the year approved of meteorology being included in the list of subjects for choice for individual study by acting Sub-Lieutenants during their course at the Royal Naval College, Greenwich.

The continued expansion of meteorological work in the Fleet has accentuated certain administrative difficulties due to the Naval Meteorological organization being centred at the Air Ministry. As a result of discussion between the Air Ministry and the Admiralty the two departments have agreed that in the best interests of Fleet Meteorology it is desirable that a Naval Meteorological Branch under the Hydrographer of the Navy should be formed to take over certain sections of the work now performed by the Naval

Division, Meteorological Office. Discussion on the matter is still proceeding.

The value of the Fleet Synoptic Messages has been further emphasised during 1936-7, and arrangements were made to amend the Home Fleet synoptic message transmissions so that two issues are now made each day from Cleethorpes, one at 0600 G.M.T., and one at 1720. Both these issues are repeated by Gibraltar twenty minutes later.

At the request of the Admiralty the question of issuing a new collective synoptic message from the Air Ministry in the evening, giving a selection of reports from foreign stations for the use of the Home Fleet, was taken up, and it was arranged for the regular issue of such a message to commence on January 15.

Owing to the cessation of meteorological reports from land stations in Spain during the internal troubles in that country, the Admiralty gave instructions that as a temporary measure H.M. Ships stationed at ports on the east coast of Spain were to furnish weather reports twice or more daily to the Meteorological Offices at London, Malta and Gibraltar. These reports have been of great assistance to the forecast services of this and other countries.

During the year, in accordance with the policy recommended by the Naval Meteorological Conference held at Malta in 1934, the hours of operation of the forecast service at that station were considerably extended. This was made possible by staff increases at the Meteorological Office, Malta, and the provision of this more extended service has proved of very great value to the Mediterranean Fleet. Valuable assistance has also been given to the Mediterranean Fleet by the forecasting service which was opened by the Meteorological Office at Gibraltar during the year 1935-6.

Meteorological Work in H.M. Ships.—During the year H.M. Ships made 1,686 weather reports to the Meteorological Office, London, and a considerable number to the meteorological services of the Dominions and British possessions overseas. In addition, 619 pilot balloon observations and 37 observations of upper air temperatures were received from H.M. Ships, and 51 meteorological logs were forwarded for retention in the division. The total number of weather reports made shows an increase of over 150 per cent on the number made during 1935-6.

Training of Naval Personnel.—The meteorological training of naval officers was continued during the year, the total number of officers attending being 30, 19 of whom took the full 12 weeks' course and qualified in meteorology.

This brings the total number of officers who have qualified in meteorology since the inception of the scheme to 73, of whom 63 are available, if they can be spared, to undertake ships' meteorological duties.

During the year one R.N.V.R. officer attended the 12 weeks' meteorological course in accordance with the arrangements referred to in the report for 1935-6. One three weeks' course for training N.C.O.s and men of the Royal Marines was held at Calshot.

Meteorological Equipment for H.M. Ships.—The division has continued to advise the Admiralty regarding the installation of meteorological instruments in H.M. Ships, and representatives of the division have visited a number of ships in the course of the year in connexion with the fitting of instruments, the provision of space for pilot balloon shelters, etc.

Charting of the Upper Air over the Sea.—Work on the preparation of the results of pilot balloon ascents from H.M. Ships for publication was recommenced during the latter part of the year and it is hoped to publish the results of pilot balloon observations for the years 1925-36 inclusive during the forthcoming year.

Investigations.—The revision of the first report on Single Observer Forecasting was completed by Lt. Cdr. T. R. Beatty, R.N., during the year and the publication of this revised report is being undertaken by the Admiralty. It is also proposed to include this report as an appendix to the "Admiralty Weather Manual" when this volume is published.

Supply of Meteorological Information to Naval Authorities.—A considerable number of miscellaneous inquiries from naval authorities were dealt with during the year and the usual two issues of the Naval Division Periodical Letter (Nos. 11/36 and 12/36) were prepared and issued to H.M. Ships and Naval Authorities.

In view of the probable early publication of the "Admiralty Weather Manual," and the continued issue of naval handbooks of meteorology for the various stations the number of new memoranda issued to H.M. Ships has been radically reduced during the year as it is hoped that the manual and handbooks will replace nearly all other publications at present issued to the Fleet.

In co-operation with the Marine and General Climatology Divisions the meteorological texts of six Admiralty Pilots were revised.

In co-operation with the General Climatology Division the publication of the Mediterranean Handbook was completed during the year and further progress was made in the preparation of the China Handbook. The work on the "Admiralty Weather Manual" referred to in last year's annual report has been continued. The manuscript is now nearing completion and publication will take place shortly.

OVERSEAS DIVISION

The Overseas Division was formed in October, 1935, to deal with meteorological questions connected with Empire Air Routes, including the projected trans-Atlantic routes. The division is also

responsible for the administration of Meteorological Office establishments overseas and for matters connected with Empire and foreign meteorological services which are not assigned specifically to other divisions.

In view of the anticipated further development of British air services to British West Africa, the Superintendent of the division visited the West African Colonies in February and March to discuss with the respective Administrations the development of meteorological services in those territories. The tour, which commenced on December 26, included Gibraltar, Malta, Egypt, Khartoum and British East Africa. Opportunity was taken to inspect the Meteorological Office stations at Gibraltar, Malta and Heliopolis, and to inquire into the meteorological requirements of the services and local authorities, while the further development of local meteorological services formed the subject of discussions with the Governments of Egypt, the Sudan and Kenya.

Empire Air Routes.—Close liaison has been maintained with the meteorological services responsible for supplying information along different sections of the Empire Air Routes. Details of the developments which have occurred during the past year are given below, under the respective countries.

Iraq.—Since the War the Air Ministry has provided a meteorological unit with the Royal Air Force in Iraq. As this unit was the only meteorological service in Iraq it has supplied the meteorological information required for all purposes, including information required by the Iraqi Government and by civil aviation. As the result of the Air Ministry mission which visited Iraq in May, 1935, it was decided that the Iraqi Government would establish its own meteorological service. Action was taken and on April 1, 1936, an Iraqi Meteorological Service was established under the Ministry of Defence. The Air Ministry continued to maintain a meteorological service attached to the Royal Air Force.

Mr. J. Durward, Senior Technical Officer in the Meteorological Office, was seconded to the Iraqi Government for three years in order to take up the post of Director of the new service, and arrived in Baghdad on November 10. Prior to that date the Officer-in-Charge of the Air Ministry Meteorological Service at Hinaidi, acted temporarily as Director of the Iraqi Service in addition to carrying out his normal duties. Mr. J. L. Galloway, Technical Officer in the Meteorological Office, was seconded to the Iraqi Government for three years in order to take charge of a subsidiary forecast centre at Basrah, to serve the Persian Gulf area. He took up his new duties on September 29.

Mr. Towfiq Fattah, a candidate for appointment in the Iraqi Meteorological Service, received a course of instruction in the Meteorological Office from May to November, at the conclusion of which he returned to Iraq to work under Mr. Durward.

Close liaison has been maintained between the Director of the Iraqi service and the Officer-in-Charge of the Air Ministry Service at Hinaidi. Mr. Durward is at present engaged in organising his service, but he will, eventually, assume responsibility for the supply of all meteorological information required for civil aviation, the work of the Air Ministry service being limited to meeting the requirements of the Royal Air Force and supplying such meteorological reports as may be necessary to complete the network in Iraq.

Palestine.—Two meteorologists have been appointed by the Government of Palestine but the meteorological service is not yet fully organised.

Egypt.—During the tour mentioned above a meeting was held in Cairo with the Minister of Communications at which a procedure was worked out for transferring the Aviation Meteorological Service in Egypt from the Air Ministry to the Egyptian Government.

Anglo-Egyptian Sudan.—The Sudan Government established a Meteorological Service with effect from October 9, 1936. Mr. W. D. Flower and Mr. J. Carmichael were appointed Government Meteorologist and Assistant Meteorologist respectively, resigning their appointments as Technical Officers in the Meteorological Office to take up their new duties.

Prior to Mr. Flower's arrival in Khartoum, some progress had been made with the establishment of new meteorological stations on the lines agreed during the visit of the Air Ministry Mission in 1935, by the Officer-in-Charge of the Air Ministry station in Khartoum, acting in consultation with the Sudan Government. Further progress has now been made and there is already an efficient meteorological service in the Sudan.

British East Africa.—Steps have already been taken to give effect to the proposals for the expansion of the Meteorological Service in order to provide an adequate network of meteorological stations along the main Empire Air Route to Cape Town. The proposed arrangements were discussed in detail during the visit to Nairobi in January, in addition to further proposals based on a scheme prepared by the Director of the Meteorological Office for a more general expansion of the British East African Meteorological Service in order that it might be in a position to fulfil all requirements.

Trans-India Route.—The question of the meteorological organization along this section of the Empire Air Routes was discussed in July with the Director of Civil Aviation, India, and representatives of the Department of Civil Aviation, Air Ministry, and Imperial Airways Limited.

The Empire Air Base at Hythe (Southampton).—Early in February Imperial Airways, Ltd. commenced operations with their new Empire Flying Boats along the first section of the Empire Air Route between England and Egypt, flying via Marseilles and Rome. Pending the establishment of a permanent Empire Air Base the services are

operating from Hythe, near Southampton. As a temporary measure, arrangements have been made for the necessary meteorological information for these services to be supplied from the Meteorological Office at the Royal Air Force Base at Calshot, a Technical Officer of the Overseas Division having been attached to Calshot for this purpose. Steps are being taken, however, to establish a meteorological station at Hythe which will be responsible for the supply of the special information required for the Empire Air Route.

British West Africa.—The meteorological organization in the West African Colonies has been confined mainly to the collection and tabulation of data from climatological and rainfall stations. The establishment of the Khartoum-Kano air route in 1936 and its subsequent extension to Lagos, necessitated the provision of a skeleton meteorological organization between Maiduguri and Lagos, and following discussions at the Conference of Empire Meteorologists held in London in August, 1935, the necessary meteorological organization was provided by the Government of Nigeria under the aegis of the Commissioner of Lands and Surveyor General. In the Gold Coast, two recording anemometers were purchased and erected near the sites selected for the aerodromes at Accra and Takoradi. Pilot balloon equipment was also purchased and regular observations of upper winds and analysis of the records from the two anemometers have been undertaken by the Surveyor General.

As a result of the discussions which took place during the visit of the Superintendent of the Overseas Division in February and March, the Administrations of Nigeria, the Gold Coast, Sierra Leone and the Gambia agreed in principle to the establishment of a combined British West African Meteorological Service with headquarters and main forecast centre at Lagos, subsidiary headquarters at Accra, Freetown and Bathurst, and a secondary forecast centre at Kano, Northern Nigeria.

On March 3 an air service operated by a French Company, Aeromaritime, a subsidiary of the Compagnie des Chargeurs Réunis Limited, was inaugurated between Dakar (Senegal) and Cotonou (Dahomey). Following correspondence between the Department of Civil Aviation, Air Ministry and the French Minister for Air, the help which was expected from British West African Colonies in accordance with normal international practice had been discussed in Paris in October, and advantage was taken of the visit mentioned in the preceding paragraph to hold discussions with representatives of the company in West Africa. A skeleton organization for the provision of the necessary weather reports and upper wind observations in the Gambia, Sierra Leone and the Gold Coast and also in Nigeria for a later stage when the route will be extended to Duala (Cameroons), was drawn up and submitted to the respective administrations. The proposals were accepted; a skeleton point-to-point meteorological organization for aviation along the West African Coast was immediately brought into operation.

Trans-Atlantic Air Routes.—(a) *North Atlantic Route.*—Close liaison has been maintained with the Controller of the Meteorological Service, Canada, regarding the meteorological organization in Newfoundland for the North Atlantic route and the arrangements for the projected air service. Monthly summaries of meteorological observations at stations in Newfoundland have been received from Canada commencing January, 1937.

Meteorological flights for the purpose of obtaining upper air temperature observations were commenced in Newfoundland in July, an aircraft purchased by the Air Ministry and operated by Imperial Airways Limited, being used for the purpose. The observations are supervised by a member of the staff of the Meteorological Service of Canada. The sequence of flights was interrupted owing to the difficulty of operating during the freeze-up period but was resumed towards the end of the winter.

A new working chart of the North Atlantic, for use at the Irish and Newfoundland bases, is being printed in Canada, details having been settled with the Controller of the Meteorological Service.

Attention has been directed to increasing the number of merchant ships which send regular weather reports by wireless to England and to the question of the reception of ships' reports in Canada. Consideration has also been given to the method of interchange of synoptic reports between Europe and North America.

Arrangements were made for a Technical Officer in the Overseas Division to be attached to the "Manchester Port," one of the ships of Manchester Liners Limited, for a period of one year in order to carry out a special programme of meteorological observations and investigation over the North Atlantic. The first voyage commenced on November 20, and it is expected that eight round voyages between England and Canada will be made.

(b) *Bermuda—New York Route.*—Lieutenant Commander H. B. Moorhead, Director of the Meteorological Service of Bermuda, visited London in May and June in order to discuss the meteorological organization for the air service between Bermuda and New York which is due to commence in 1937. Arrangements have now been made for additional staff to be appointed to the Bermuda service, and for the two officers selected in March to receive a course of training in the Meteorological Office before leaving England. Additional ancillary staff are to be appointed locally.

(c) *Meteorological Service in the Irish Free State.*—The participation of the Irish Free State in the trans-Atlantic air service and the necessity of providing a meteorological forecasting service at the air base on the Shannon has raised the question of the responsibility for meteorological services generally in Ireland. The Free State Government decided early in 1936 to take over the whole of the meteorological service in their territory and negotiations have since been in progress regarding the terms on which the transfer should be effected. The negotiations were brought to a successful

conclusion in December when it was agreed that the meteorological service should be transferred with effect from April 1, 1937, and that the Free State Government should take over all existing meteorological stations. An exception was made in the case of Valentia Observatory which will continue to be operated by the Meteorological Office, London, on behalf of the Irish Free State Meteorological Service on an agency basis, pending the appointment of a full complement of Irish Free State staff.

The Irish Free State Government appointed Mr. A. H. Nagle, a Technical Officer in the Meteorological Office, to be the first Director of the new Service. Mr. Nagle took up his duties early in December, 1936.

With regard to the trans-Atlantic air base, it was agreed that, pending full assumption of control by the Irish Free State Meteorological Service, the Meteorological Office, London, would provide the staff and operate the meteorological service on an agency basis, the Irish Free State Government providing accommodation and all necessary equipment.

The meteorological station at Foynes, Shannon, the provisional air base, was in operation temporarily from February 15 to March 7, in connexion with trial flights, including a flight round Great Britain and Ireland and local operations from Foynes of the aircraft *Cambria*, one of the two Empire Flying Boats destined for experimental flights across the North Atlantic.

Investigation and Training Section.—At the beginning of the year under review, 10 Technical Officers and two Technical Assistants, Grade I, were under training, the course being directed particularly to synoptic meteorology with special reference to the North Atlantic. As the officers gained experience they were able to assist in the Atlantic investigation work, but in the course of the year it was necessary to transfer some of these officers to other divisions to meet urgent requirements for staff.

The main investigation was a comparison of the times of passage of aircraft of different air speeds across the North Atlantic by various routes, which involved computing times of flight along different sections of the routes from the daily synoptic charts. A preliminary report has been issued.

A second investigation involved the examination and analysis of all meteorological data available for Newfoundland. This was completed and a report issued in March. A further report, dealing with the meteorology of the Bermuda-New York route was issued at the same time.

Another phase of the investigation work consisted in plotting a series of charts of the North Atlantic covering a period of one year. For this purpose, all available ships' observations were utilised so that the charts should be as complete as possible. These charts will be used for further investigation of Atlantic meteorological problems.

Apart from the main investigations, the technical officers under training have been encouraged to undertake independent investigations. Among the latter may be mentioned the study of upper wind conditions over the West Indies in relation to tropical revolving storms and an investigation of the meteorology of Greenland. As a prelude to the former, an analysis was carried out of pilot balloon observations over a period of ten years at Kingston, Jamaica. This piece of work has been completed and will be published shortly.

A technical officer appointed to the Meteorological Service of Canada was attached for training in September for six months. Officers appointed to the Malayan and British East African Meteorological Services also received short courses of training prior to proceeding overseas to take up their new posts. Mr. B. R. Schulze, an officer in the Meteorological Service of the Union of South Africa, spent six months in the Office studying British methods.

Inquiries.—During the year 142 inquiries were dealt with relating to meteorological conditions affecting aviation overseas. Many of these inquiries were concerned with the development of the new flying boat routes to Australia and South Africa.

A considerable amount of time has been devoted to the preparation of meteorological sections of Aircraft Route Books for the use of the Royal Air Force.

Meteorological Organization for Royal Air Force cruises.—Schedules setting out the arrangements for the supply of meteorological information for aviation along different overseas routes have been prepared as required for the use of the crews of Royal Air Force aircraft carrying out long-distance cruises. Standard instructions were prepared in February for flights between England and Malta.

Air Races.—A considerable amount of time was devoted to the meteorological arrangements for the England–Johannesburg air race which started from Portsmouth on September 29, 1936. A preliminary memorandum on the average meteorological conditions along the route was prepared and circulated in July. Arrangements were made for the supply of information by meteorological services along the route; a schedule setting out these arrangements was issued early in September. A special organization was brought into operation at Portsmouth, forecasts and other information covering the section of the route from Portsmouth to Cairo being supplied to the organising officials and competitors prior to the commencement of the race.

In connexion with the air race from Paris to Saigon, organised by the French Air Ministry in the autumn, arrangements were made for the supply of information to competitors at Cairo and Baghdad and for the issue of special messages by wireless from Ismailia.

Overseas Stations.—The station which had been established at Aden towards the end of 1935 was closed in November and the personnel withdrawn. The station at Khartoum was also closed

early in November but, owing to the establishment of the Sudan Government Meteorological Service, the meteorological work continued without a break.

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

Malta.—Important developments in the routine work of the office took place early in the year. On April 21 full synoptic observations at 0400 and 1000 G.M.T., and additional synoptic charts for those hours (Sundays excepted) were commenced. These changes enabled the office to provide regular forecasts to the Royal Air Force just before the commencement of each day's flying.

Synoptic reports continued to improve in quantity, and reception was usually satisfactory. The lack of information from Spain since the commencement of the civil war was partially compensated by the organization of reports from H.M. ships.

The predominant part of the office routine deals with work for the Services. During the year the office was called upon to advise and co-operate in a number of experiments carried out or projected by Army units. Contacts were maintained with the civil departments of H.M. Dockyard, including the Victualling Yard and Armament Depot, and also with the Port Authorities and other local institutions. Forecasts and summaries of local conditions were issued as usual for publication in the local press.

Middle East Area.—Routine synoptic and upper wind observations have been made throughout the year at Heliopolis, Aboukir, Ismailia, Ramleh and Amman. The station at Mersa Matruh was closed on September 10, arrangements being made for weather and upper wind reports to be supplied by the Egyptian Meteorological Department station established there. Observations have been made at 0900 G.M.T. at all stations during the months October-May and transmitted by wireless to Heliopolis. The following broadcasts have been issued daily: all routine synoptic reports, an international collective message of 0600 G.M.T. reports, forecasts for Egypt, Palestine and Trans-Jordan, normally at 0410 and 0945 G.M.T.

Liaison has been maintained with other services supplying meteorological reports from stations manned by their own personnel, the equipment being supplied and maintained by the Air Ministry:—Arab Legion, Trans-Jordan, (Bair, Mudawara, Ma'an, Akaba); Imperial Airways, (Gaza, Wadi Halfa, M/Y Imperia); Iraq Petroleum Company, (Landing Ground H.4); Director of Public Works, (Cyprus); while details of rainfall values at stations in Trans-Jordan were supplied by the British Resident, Amman.

An improvement has been noted in the reception of meteorological data from other countries but some vital broadcasts, e.g. Libya, upper wind reports from Greece, Sudan, etc., are not satisfactory and action has been taken to improve the transmissions. Experimental receptions were made of meteorological broadcasts from Nairobi and Khartoum.

Reports have been received from ships in the Mediterranean and Red Sea and also from Imperial Airways aircraft whilst flying over selected positions on the routes Cairo-Brindisi; Alexandria-Karachi; and Cairo-Kisumu.

Mainly due to the increase in flying by Imperial Airways, Dutch and Italian Civil Air Lines, and to the establishment of Egyptian Misr Airwork Services, the number of inquiries has more than doubled during the last two years and now totals over 3,000 with over 5,000 forecasts annually.

Iraq.—The meteorological station at Mosul was transferred to the Iraqi Meteorological Service on October 31, 1936: the observational reports from that station however continue to be included in the collective messages broadcast thrice daily from Hinaidi.

The station at Kirkuk was taken over by the Iraq Petroleum Company on behalf of the Iraqi Government on September 15, but its equipment remains the property of the Air Ministry, as does also that at Rutbah where the observational duties have been carried out by an employee of the Iraqi Meteorological Service since April 5 instead of the Posts and Telegraphs Department. Since the observations at these stations are also incorporated in the collective broadcasts from Hinaidi, all matters regarding the maintenance of equipment and the observational efficiency there continue to be the concern of the Meteorological Office, Hinaidi. The stations at Shaibah and Diwaniyah as also the station at Ramadi (which was transferred to Dhibban in October, 1936) have continued to be controlled from Hinaidi both as regards staff and equipment.

At all these stations normal observations are made each day at 0200, 0600 and 1300 G.M.T. Upper wind observations are made at Hinaidi, Shaibah, Dhibban, Diwaniyah and Rutbah, and at the Iraqi Meteorological Service station at Mosul.

Forecasts covering all Iraq continue to be issued from Hinaidi each morning and evening; the evening forecast is broadcast by the Royal Air Force, Hinaidi.

At the request of the Royal Air Force Area Headquarters the office at Hinaidi has remained open throughout the 24 hours each day from July, 1936.

During the year 1,039 forecasts were issued for civil aircraft and 1,367 reports of upper wind and weather information supplied.

Gibraltar.—Work for the services formed the greater part of the Office routine, and owing to a request from Air Ministry and subsequent requests from the Naval authorities at Gibraltar for evening forecasts for transmission to H.M. Ships in Spanish waters it has been necessary for the 1800 chart to be drawn nightly including Saturdays and Sundays since September 21.

Special route forecasts have been issued from time to time in connexion with long distance cruises by Royal Air Force aircraft.

A close liaison has been maintained with the Royal Navy, the Military authorities (particularly the Royal Artillery), the Royal Air Force, the Civil and Service departments of H.M. Dockyard, the Port authorities, the Colonial Secretary's Office and the Shipping Agencies. Owing to the numerous requests for weather information, it was necessary for a systematic issue of regular forecasts to be made. This routine issue of forecasts, together with the forecasts issued twice daily to the Radio Distribution Company, has resulted in a considerable reduction in the number of inquiries received by telephone.

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

A system of promulgating gale warnings by visual methods to ships entering Gibraltar Harbour was brought into operation by the King's Harbour Master on March 10.

Khartoum.—The distributive station at Khartoum, opened in November, 1935, to meet additional requirements of the Royal Air Force in the Sudan, was closed early in November, when the Government Meteorologist, Sudan Government, Khartoum, assumed full responsibility for the supply of all meteorological information in the Sudan. The subsidiary meteorological station at Port Sudan, opened in January, 1936, was closed on August 3, 1936. At these two stations a total of 315 upper air temperature and 740 pilot balloon observations were made.

The meteorological needs of the Royal Air Force were fully met by a scheme involving the routine daily issue by wireless to all units of comprehensive forecasts covering all routes in the Sudan. In addition, a service of warnings of impending haboobs and thunderstorms was in operation, and pilots could also obtain special forecasts and reports at any time, on request.

The Empire Air Mail Scheme involved the establishment in the Sudan of numerous observing stations for the purpose of keeping pilots informed concerning upper winds and changes in weather generally. Sixteen native observers were trained and were employed at Kareima, Khartoum, El Obeid, Malakal and Geneina. It was thus possible for pilots on the Empire Air Route to Cape Town and on the air route to Lagos to obtain information from these stations as required.

In August, 1936, arrangements were made for broadcasting from Khartoum the synoptic reports for the Sudan, so that by October, 1936, when the Sudan Government Meteorologist assumed control, a full meteorological service was in operation, though on a small scale, involving the collection and dissemination of synoptic reports, and the supply of weather reports and forecasts.

INSTRUMENTS DIVISION

Considerable attention has been given during the past year to the design of new instruments and the improvement of existing designs. During recent years much work has been done on the problem of designing a self-recording anemometer with the recording part at a considerable distance from the exposed part of the instrument. This problem is of great importance because it is necessary to have a record of wind, both force and direction, at the meteorological office on an aerodrome. The office is generally situated amongst buildings which so disturb the normal flow of the wind that an anemometer cannot be used unless the head is at a great height above the buildings where it would form a flying obstruction. A suitable site for the exposure of the anemometer head cannot always be found within a distance of many hundred yards. It is clear that in these circumstances the only means of conveying the movement of the wind vane and the variations in pressure produced by the wind at the anemometer head is by some form of electrical transmission. Reference was made in last year's report to a partial solution of this problem and the installation of an instrument of experimental design at Cranwell in 1935. While the record of wind direction given by this instrument was entirely satisfactory, the record of velocity did not fully meet the requirements at an aerodrome, and it became necessary to give renewed attention to the subject. During the past twelve months an improved design has been worked out and the first instrument of the new pattern was installed at Abingdon aerodrome at the end of the financial year. This instrument shows the full detail of the wind structure in the same manner as the standard pressure tube anemometer which has been in use at aerodromes for many years past, and there is every reason to believe that it will afford a satisfactory solution to the problem.

Attention has also been given to the design of a new type of pilot balloon theodolite. All theodolites used in this country have, in the past, been broadly similar to that designed by Professor de Quervain, the Swiss Meteorologist, in 1905, though detailed improvements have been introduced from time to time. In this pattern the altitude of the balloon is read on a vertical circle and the azimuth on a horizontal circle so that it is necessary to move the eye when taking the two readings. The improved design permits the use of two horizontal circles, one immediately above the other, for the readings of altitude and azimuth. An experimental instrument to the new design was under construction and was almost ready for test at the end of the year.

Work on radio-meteorographs has been actively pursued in many countries during the past few years. These instruments are designed to indicate the pressure and temperature in the upper atmosphere by the emission of radio signals from a light instrument sent up on an unmanned balloon. The readings are received at a ground station and transmitted at once to the central office where they are of the

highest value in the preparation of weather forecasts. In this country the development work has been entrusted to the National Physical Laboratory who are working in close collaboration with the Meteorological Office. Although the experimental stage has not been passed, very satisfactory progress towards the design of a suitable instrument has been made during the year.

A searchlight throwing a beam of light vertically into the sky is an extremely useful adjunct to an aerodrome for obtaining the height of cloud-sheets at night. The angular elevation of the light spot on the base of the cloud-sheet is measured by a simple alidade placed at a short distance from the searchlight and this permits the height of the cloud-sheet to be deduced immediately. The searchlights which have been already installed have proved so valuable that a considerable increase in number is anticipated in the near future and improvements in the equipment have been worked out.

Experiments have been in progress for some years past to obtain an improved spirit for filling minimum thermometers. These thermometers frequently develop errors through the evaporation of spirit from the main column and condensation up the tube. The ethyl alcohol filling has been replaced by glycol ether in some experimental thermometers and the results obtained have been so far satisfactory that it has been decided to place an order for 100 glycol ether thermometers to provide an opportunity for extended experience of their working.

Much experimental work has been carried out during the year on the behaviour of bi-metallic thermographs. The design of this instrument is of an extremely simple and straightforward nature with a minimum of working parts but the records in the past have not shown the required degree of accuracy and the cause has proved very elusive. The research has suggested that certain small modifications in the design will lead to a material improvement in operation and instruments of the modified pattern will be obtained for trial.

The equipment of the test room in the Instruments Division has been improved by the installation of a temperature and humidity chamber in which temperature and humidity can be varied and maintained at any desired value. The testing of thermographs and hygrographs and research work on these instruments will be greatly facilitated by the provision of this apparatus.

During the year the Robinson Cup anemometer, which has been installed on the Island of St. Helena since 1892, has been replaced by a pressure tube instrument which was kindly presented for the purpose by Captain C. J. P. Cave. Arrangements were made for its overhaul and the provision of a suitable mast and hut by the Meteorological Office and the instrument was erected on the island under the superintendence of the Meteorological Officer of one of H.M. Ships.

The Meteorological Office advises the purchasers of meteorological instruments regarding the types of instruments which will

most satisfactorily meet their requirements and much use of this assistance is made by the Dominions and Colonial Meteorological Services. The increasing attention which is being devoted to meteorology in all parts of the world owing to the growth in aviation has led to a marked increase in the number of these inquiries.

OBSERVATORIES

KEW

Buildings.—The building of the underground seismograph house, the extension of the workshop, a house for the motor-mower and a greenhouse, referred to in last year's report, were completed. The seismograph house contains two rooms, 20 ft. x 15 ft. and 15 ft. x 9 ft., the concrete floor of which is about 5 ft. below ground-level. The concrete roof is covered by 2 ft. of soil, the upper surface being about 5 ft. above ground level.

In order to provide additional electrical power, transformers were installed at both ends of the cable connecting the Observatory with the town electrical supply mains.

Two lightning conductors running from the anemometer mast to the ground have been installed and the lead of the roofing connected to them.

Atmospheric Electricity.—In 1934 a simple method, suggested by the Director, of recording the sign of potential gradient by an instrument carried by an unmanned balloon was developed, and a large number of successful ascents were made during the year. The greatest height, at which a gradient strong enough to be recorded was found, was nearly 13 Km.

An account of this investigation incorporating all the results obtained to the end of 1936 has been prepared for publication by the Royal Society. The chief conclusion is that there are two principal modes of production of electrification in clouds; one, involving the collision of ice crystals, being effective at high levels; the other, involving the breaking of drops, at low levels.

Systematic observations of the electric charges on rain began with 1935. The results for two years have been prepared for publication. The records of the second year are more complete than those of the first and indicate an excess of positive charge. The excess was very marked in January and February, 1937, the ratio positive to negative being 11 to 1.

For several years records have been obtained of the current passing through a wire mounted on a mast. A second recorder with a discharging point $\frac{1}{2}$ mile away was installed in May, 1936. The connexion between point and recorder is made through the Post Office telephone cable. The records obtained during storms by the two point discharge recorders can be compared. It is found that there is little agreement in the fine detail but if the direction

only of the current is considered there is obvious similarity. The difference in the time of occurrence of field changes at the two points can be correlated very roughly with cloud movements.

It has been mentioned in previous reports that with light NE. winds at night potential gradient at Kew Observatory has in recent years frequently been negative. It was suspected that the phenomenon might be due to the emission of steam from Brentford Gas Works during the operation of quenching coke. However, observations of potential gradient made below the steam clouds at a point on the towpath at Kew about 200 yards from the source gave no indication of the gradient becoming negative when the clouds passed over. The anomaly is still unexplained.

An analysis of the observations of thunderstorms at Kew during the period 1900-35 has been completed. It is found that the diurnal variation in the frequency of thunder is as well marked in winter as in summer. In either season the number of days on which thunder is heard between 1400 and 1600 is about 35 per cent of the number of days on which thunder is heard at any time.

Seismology.—The Wood-Anderson seismographs were transferred to the new seismograph house in February, 1937. The Galitzin seismographs are to follow.

There were no earthquakes of outstanding importance. In December the total number of disturbances was only 8, the smallest number recorded in any month since January, 1926, when the Galitzin seismographs came into regular operation at Kew.

During the calendar year 1936 the number of earthquakes recorded at Kew was 256, of these 8 were large enough to give waves with an amplitude exceeding 0.1 mm. Details of 11 of the records were broadcast in the International Seismological Code. In six cases the azimuth could be determined from the Kew records alone.

Airwaves from Gunfire.—The series of observations of airwaves from gunfire was terminated at the end of April. The last trial was on April 27, 1936. The collected observations made during the investigation are being prepared for publication.

Investigation of the Upper Atmosphere.—The greater part of the activity of the Upper Air Section of the Observatory has been directed to the problem of determining the amount of water vapour in different levels of the upper atmosphere. This amount is of great importance in many meteorological problems, especially those connected with the heat balance of the atmosphere, but practically nothing is known of the distribution of the water above the lower four or five kilometres.

The want of knowledge is due to the difficulty of measuring the amount of water vapour present when the temperature is very low. Ordinary methods of measuring the humidity of the atmosphere, for example the hair hygrometer or the wet and dry

bulb thermometers, fail when the temperature falls appreciably below the freezing point.

The only method appears to be to take a sample of the air and to measure the amount of water contained in it. This method is being adopted in an investigation which is being carried out in co-operation with the Imperial College of Science. The Upper Air Section is undertaking the collection of the samples by means of apparatus carried on free balloons and the Imperial College of Science is making the analyses of the samples provided. The investigation is, however, proving by no means easy because the amount of water vapour is so extremely small. Professor Paneth and his colleague, Dr. Glückauf, have devised a method for separating the water from the air, but two serious difficulties have to be overcome before the actual measurement of the amount can be made: the collecting vessel must be freed from water before the sample is taken and when the sample has been taken the water must be detached from the walls of the vessel by which it tends to be absorbed.

The method used is to send up an evacuated vessel on a balloon. At a predetermined height the vessel is opened and closed automatically. When the balloon bursts the apparatus falls on a parachute.

During the course of the year much time has been spent on evolving the most suitable form of collecting vessel and the method of opening it and closing it without contaminating the sample of air. Seventy trial ascents have been made and these have yielded about 40 samples of air for analysis. The method is still in the experimental stage but there is every indication that the remaining difficulties will soon be overcome and valuable information collected. The ultimate aim is to measure the amount of water in the stratosphere.

The investigation carried out on behalf of Professor Paneth of the amount of helium contained in samples of air recovered from the upper atmosphere has continued. Six soundings were made which gave five samples of air from heights between 17 Km. and 23 Km. These samples have been successfully analysed by Professor Paneth, yielding important results regarding the distribution of helium in the upper atmosphere.

Twenty-two ordinary soundings were made during the year. This is a much smaller number than usual owing to time occupied in the special soundings referred to above. The heights reached by the balloons carrying the helium apparatus and the ordinary meteorographs were as follows:—

Above 20 Km.	...	...	...	13
Between 15 and 20 Km.	...	...	...	9
Between 10 and 15 Km.	...	...	...	4
Less than 10 Km.	...	...	...	2

The best sounding of the year reached a height of $25\frac{1}{2}$ Km., obtained in an ordinary sounding with a small balloon.

ESKDALEMUIR

Terrestrial Magnetism.—The standard la Cour magnetographs recording declination, D, the horizontal component, H, and the vertical component, V, of the earth's magnetic field, have recorded almost without interruption throughout the year. To provide for occasions on which the record from the standard instruments might be lost, supplementary records have been obtained with the less sensitive standard set formerly in use. The magnetograph records have been standardised by almost daily observations of both declination and horizontal force and by dip observations made twice weekly, declination observations being made with the Kew magnetometer, horizontal force with the Schuster Smith Coil and dip with the Schulze Inductor. Determinations of H with the Kew magnetometer continue to be made regularly two or three times per month.

In addition to these instruments, the la Cour quick-run recorder, installed to record rapid changes in D, H and V has been in operation, apart from minor interruptions, throughout the year. Difficulty continues to be experienced in maintaining the time operating relay system used in time marking the la Cour records.

Since the installation of the electrical tubular heaters, with thermostatic control, the condition of the underground chambers as regards dampness has become much more satisfactory.

Hourly values of magnetic declination have 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 have been supplied to various engineers and mining authorities.

To ensure that the Field Coil apparatus for measuring changes in the earth's vertical magnetic field of force remains in working order, one test run was made.

Comparison tests were carried out as circumstances permitted upon Dover Dip Circle No. 238 and with a B.M. magnetometer which was subsequently forwarded to Lerwick. The tests of Fort Rae and Lerwick portable Smith Coils were continued.

Mr. Jolly of the Ordnance Survey carried out tests on one day in July upon two magnet-theodolites belonging to the Survey Department.

Meteorology.—The routine meteorological work was carried out as in previous years. Observations of solar radiation have been made with an Ångström pyrheliometer, when conditions were favourable and returns of observations forwarded quarterly to Kew Observatory.

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

The polonium collector which replaced the water dropper at the end of January 1936 has been in use throughout the year. The insulation of the system has sometimes been difficult to maintain.

Electrical Supply.—Work was commenced upon connecting the Observatory to the public electrical supply in September, 1936, and was completed, apart from some minor fittings, by the end of November. The installation has worked satisfactorily, apart from one or two interruptions associated with snow storms and the blowing of fuses. The arrangement for transferring the recording instruments to the local 8 volt supply on occasions of breakdown of the grid supply proved effective.

ABERDEEN

Work during the past year has proceeded on the usual lines, and no important changes have taken place.

A ciné-camera has been brought into use for the study of cloud formation. Exposures are made at the rate of about one per second and when the film is run through the projector at the ordinary rate the development of the cloud can be readily appreciated.

LERWICK

Terrestrial Magnetism.—*Recording Instruments.*—The standard, quick-run and supplementary sets have all worked satisfactorily throughout the year.

Absolute Observations.—The routine has been: H observations with Kew magnetometer, 2 per week; Declination 6, and Dip, with the Inductor on loan from the Astronomer Royal, 6 per week.

A "BM" vertical force magnetometer was received in December, 1936, and observations have been made with it regularly.

The azimuth of the Fixed Mark has been under investigation.

Aurora.—The usual watch has been kept. Conditions have been very quiet. No photographs have been taken.

Atmospheric Electricity.—No change has been made in the Benndorf electrograph; routine scale and insulation tests and absolute observations have been regularly made.

Meteorology.—The usual 0900 observations have been made and autographic records have been maintained.

VALENTIA

There has been no change during the year in the work of the Valentia Observatory. Regular telegrams have been sent to headquarters in connexion with the forecast work and observations of magnetic declination, horizontal force and dip have been made weekly.

BRANCH METEOROLOGICAL OFFICE, EDINBURGH

The Edinburgh Meteorological Office acts as a local centre for the organization of climatological and rainfall stations in Scotland, and for the administration of the three observatories at Eskdalemuir, Lerwick and Aberdeen.

Climatological, Rainfall and Telegraphic Stations.—The number of climatological stations in Scotland is now 84 and the number of rainfall stations about 900. The Edinburgh Office also receives the monthly registers and autographic records from 8 telegraphic stations in Scotland before they are forwarded to London. The systematic examination and checking of all returns and the extraction of data in form ready for publication have been carried out in the usual way.

Reports for the Registrar-General for Scotland.—A monthly summary of the weather in Scotland, together with statistics for eleven large towns, has been prepared as usual, as well as the annual report, for the Registrar-General.

Inquiries.—The number of inquiries, other than those received daily from newspapers, was 307, about 70 of which were in connexion with legal cases or insurance claims.

Services for Aviation.—Reports were prepared on proposed aerodrome sites near Stirling and at Longniddry.

An investigation was made into East Coast "haars" and the seasonal and local distribution of fog and low cloud in Scotland generally.

A report on the rainfall, sunshine and temperature of the Outer Hebrides was prepared in connexion with proposed air services to and from the mainland.

INTERNATIONAL CO-OPERATION

Broadly speaking there are three main channels through which the Meteorological Office participates in international work :

1. **The International Meteorological Organization**—This organization is concerned primarily with the administrative and technical arrangements necessary for the routine work of the official meteorological services. The Organization includes :

- (i) Conferences of Directors which meet every 6 years.
- (ii) A permanent Committee — the International Meteorological Committee—which sees to the execution of the decisions of the Conferences, and takes decisions on questions which arise between the Conferences.
- (iii) Commissions : these Commissions deal with different Branches of Meteorology and make recommendations to the Committee and Conferences.

There are also Commissions for different regions : two of these, the Regional Commission for Africa and the Regional Commission for the Far East, were mentioned in last year's report, and a third, the Regional Commission for South America, has subsequently been instituted.

2. The Meteorological Association of the International Union of Geodesy and Geophysics—This Association deals with international co-operation in questions of research or of theoretical meteorology which are not appropriate to the functions of the International Meteorological Organization. The Union comprises Associations of Geodesy, Hydrology, Meteorology, Oceanography, Seismology and Vulcanology and its meetings thereby enable problems to be considered which affect more than one branch of Geophysics, and contacts to be made with experts in allied subjects.

3. The Meteorological Sub-Commissions of the International Commission for Air Navigation and of the International Aeronautical Conference.—(a) The International Commission for Air Navigation, instituted in accordance with Article 34 of the International Convention for Air Navigation, 1919, is charged under the Convention with the duty “of collecting and communicating to the Contracting States information relating to . . . meteorology which may be of interest to air navigation”. The Commission appointed a Meteorological Sub-Commission which was charged with the duty of preparing regulations for the collection and dissemination of meteorological information as required by the Convention and amending and adding to these regulations as required by the progress and development of international civil aviation. Technically the Regulations are applicable only in those countries which are parties to the 1919 Convention, but broadly they form the basis of the regulations in force in the greater part of the world.

(b) The International Aeronautical Conference, which originally began with three members—England, France and Belgium, now includes also Czechoslovakia, Holland, Germany, Switzerland, Austria, Denmark and Poland. Its object is to enable the technical services of the countries mentioned to come to agreement upon the details of the arrangements which are necessary for the operation of international air lines connecting these countries. The meteorological arrangements form an important part of this provision. The problems which arise concern primarily the application of the general rules and regulations of international meteorology to the actual day to day flying on these lines.

In the following paragraphs the work of these three Organizations during the past year will be summarised.

1. The International Meteorological Organization. — INTERNATIONAL METEOROLOGICAL COMMISSIONS: *Regional Commission No. 1* met at Lusaka, Northern Rhodesia, in August, 1936. It was a notable meeting, not only because it was the first meeting of a regional commission of the International Meteorological Organization, but also because it was the first African Conference held on African soil, which brought together representatives of all nationalities engaged in the work of developing the African continent. The meeting was held under the Presidency of Mr.

A. Walter, Director of the Meteorological Service of East Africa and was attended by Mr. J. Durward, Superintendent of the Meteorological Office at Heliopolis, and by the meteorological representatives of the British, French, Italian, Belgian and Portuguese Colonies in Africa, and by the Director of the Meteorological Service of the Union of South Africa. The Commission adopted 45 Resolutions. These Resolutions concern :

- (i) the application in Africa of the recommendations of the Warsaw Conference ;
- (ii) the modifications which it appears desirable to make in certain international regulations to facilitate their application in Africa ;
- (iii) the investigation of the diurnal variation of the upper wind in the tropical region ;
- (iv) the further development of meteorological services and of the broadcast issues of meteorological information to meet the increasing needs of aviation in Africa.

Regional Commission No. 2 met at Hong Kong from January 13 to 21, 1937, under the Presidency of M. E. Bruzon, Director of the Meteorological Service of French Indo-China. The meeting was attended by representatives of India, Ceylon, Dutch East Indies, Siam, Philippines, China, Australia, the Malay States and Hong Kong. Lt.-Col. Gold, President of the Commission for Synoptic Weather Information, attended the meeting at the request of the President, M. Bruzon, to assist in the deliberations of the Commission by his knowledge and great experience of international meetings. The meeting was also attended by representatives of the Royal Navy, Imperial Airways, the United States Navy and Pan-American Airways. The Commission adopted 54 Resolutions. These Resolutions deal broadly with :—

- (i) the application in the Far East of the Resolutions of the Warsaw Conference ;
- (ii) the institution of a collective broadcast issue for the whole of the Far East area, similar to the broadcast issue made from Rugby. The Commission recommended that this issue should be made from the United States Radio Station at Cavite in the Philippine Islands.
- (iii) the extension in the meteorological services of the Far East of the arrangements for obtaining information as to wind, temperature and humidity in the upper air.
- (iv) the improvement of the network of reporting stations and of the information reported for use on international air routes.

The Commission considered that in view of the difficulties in the way of using universal time for the hours of observation in the

Far East the standard hours of synoptic observations there should be 1 a.m., 7 a.m., 1 p.m. and 7 p.m. local time.

Commission for Solar Radiation.—A meeting of the Commission on Solar Radiation under the presidency of Dr. A. Ångström was held in Oxford from September 12 to 15, 1936. The programme was mostly devoted to technical questions with regard to standardization of instruments and observations. Investigations of the exchange of heat between the sea and the atmosphere were discussed, however, and the recommendation was adopted that measurements of the radiant energy transferred to the sea and its heating effects in the water should be carried out by the co-operation of oceanographers and meteorologists, preferably in waters where complications through horizontal currents are reduced to a minimum, as in the Baltic. Dr. F. J. W. Whipple represented the Office at the meeting.

There have been no meetings of the other Commissions of the International Organizations during the past year; but the "Manual of Codes" which was approved by the Conference at Warsaw in 1935, has been published by the Secretariat of the Organization for the guidance of all meteorological services in preparing their own instructions to Observers and in interpreting the reports received by them from other services.

2. International Union of Geodesy and Geophysics—The general Assembly of the Union was held in Edinburgh from September 14 to 25, 1936. The Director, Lt.-Col. E. Gold and Dr. F. J. W. Whipple attended. Lt.-Col. Gold was Chairman of the Hydrology Sub-Committee, and Dr. Whipple was Chairman of the Seismology Sub-Committee of the British National Committee. Dr. A. H. R. Goldie acted as local Secretary of the Association of Meteorology and Dr. J. M. Stagg as local Secretary of the Association of Terrestrial Magnetism.

The attendance at this meeting of the Union was greater than that of any previous meeting.

In addition to the scientific discussions in the various associations of the Union, arrangements were made by the Association of Terrestrial Magnetism and Atmospheric Electricity for a visit to Eskdalemuir Observatory. There was a special exhibition of scientific instruments at the Royal Scottish Museum, and assistance was given by the staff of the Edinburgh Meteorological Office in the arrangement and description of the meteorological and magnetic instruments. A number of instruments selected by the Instruments Division and the Upper Air Section were lent for the Exhibition.

At the conclusion of the meeting Dr. A. H. R. Goldie was appointed Secretary of the Association of Terrestrial Magnetism in succession to Dr. la Cour, the new President of the Union.

3. (a) International Commission for Air Navigation.—The meeting of the Meteorological Sub-Commission of this Commission was held in Paris on November 6 and 7, 1936, under the Presidency of

Lt.-Col. E. Gold. The questions considered at the meeting related to amendments to the Meteorological Annex of the International Air Convention. Under the Convention certain monthly summaries of meteorological information of special interest to aviation, prepared according to the Regulations of Annex G of the Convention, are exchanged between contracting States through the Secretary General of the Commission. The Sub-Commission at its meeting made proposals with a view to the extension of this exchange to non-contracting States. The Sub-Commission also made a preliminary examination of a proposal of the Italian Delegate for the extension and rearrangement of the Meteorological Annex to the Convention.

3. (b) **The International Aeronautical Conference.**—The 37th Meeting of the International Aeronautical Conference was held at Vienna from May 6 to 9, 1936. Mr. Corless and Mr. Absalom attended the meetings of the Meteorological Commission. Representatives of Austria, Belgium, Czecho-Slovakia, France, Germany, Holland and Switzerland took part in the meetings of the Commission. About 20 Resolutions were adopted: these dealt mainly with details of procedure in the application of meteorology to civil aviation between the different countries represented.

CONFERENCE ON ATMOSPHERIC OZONE

An International Conference organized by Dr. G. M. B. Dobson and devoted to Atmospheric Ozone was held at Oxford, September 9 to 11, 1936, at which the Office was represented by Dr. F. J. W. Whipple. A similar conference had been held at Paris in 1929 by invitation of Prof. Fabry. Since that date much work has been done on the subject as may be gathered from the facts that the number of papers presented in the three days of the Conference at Oxford was 29 and the number of authors, some of whom collaborated in joint papers, was 28.

Ozone is present in the atmosphere in very small quantities. If all the ozone could be collected and brought down to the ground it would form a layer only 2 or 3 millimetres in thickness. Nevertheless the ozone plays an important part in our lives by intercepting ultraviolet light from the sun.

In 1929 it was believed that the ozone was mostly at heights of the order 40 Km. above the ground, but it is now known that the centre of gravity of the ozone is at about 22 Km., a part of the atmosphere in which meteorologists have long been interested. Moreover it has been demonstrated that the quantity of ozone is intimately related to the distribution of pressure in the lower atmosphere and there is reason to hope that daily observations of the ozone at well distributed stations would be of service in weather forecasting. Dr. Dobson was able to report to the Conference that a programme of observations at fifteen European stations had the

support of the International Meteorological Organization, and that arrangements had already been made for meeting the cost of the necessary instruments at the majority of these stations.

The papers read at the Conference have been published by the Royal Meteorological Society as a supplement to their quarterly journal.

STAFF

From the point of view of staff organization the year has been one of exceptional difficulty as the Office has had to meet heavy demands arising from Air Force expansion and the development of civil flying before it had settled down after the staff re-organization consequent upon the adoption of the Carpenter grades described in the report for last year. The new calls on the staff have been both direct and indirect. Five Technical Officers, three of them men of long experience, have left the Office to take up appointments created in other services to meet the needs of the Empire Air Routes. Twelve new Technical Officers joined the staff during the year and additional new appointments are about to be completed. In the junior grades there has been corresponding activity. Losses have totalled 20 and 64 new appointments have been made but here, also, additional appointments are about to be completed.

In the circumstances a great deal of time and energy has had to be given to training. Not only have the new entrants had to learn their work but courses of training have also had to be arranged for Assistants already in the Office with a view to fitting them to act as forecasters. Apart from the arrangements made for training new entrants, 15 officers were detached from the normal duties in connexion with longer or shorter periods of training.

The Degree of D.Sc. has been conferred on Mr. A. H. R. Goldie by the University of St. Andrews and on Mr. J. M. Stagg by the University of Edinburgh and that of M.Sc. (Meteorology) on Mr. J. E. Belasco by the University of London.

The Buchan Prize for the most important contributions to the Society's proceedings over the last three years has been awarded to Mr. C. S. Durst by the Royal Meteorological Society. Dr. F. J. W. Whipple has again served as the Society's President.

PUBLICATIONS

A list of the publications issued during the year is given in Appendix V. It includes the quinquennial revise of averages of bright sunshine and temperature for the British Isles ending with the year 1935.

Four Geophysical Memoirs have been passed through the press. The first of these, by Dr. F. J. W. Whipple and Mr. F. J. Scrase contains an analysis of the records of point discharge in the electric field of the earth made at Kew Observatory. In the second Dr. A. H. R. Goldie deals with the rainfall at the fronts of depressions

in the investigation of which he was much assisted by the records from a number of anemometers especially set up around the Scottish coasts for the purpose of studying the changes in structure of depressions as they come under the influence of the land mass of the European continent in their passage from the Atlantic Ocean. Memoir No. 70 is by Mr. C. E. Britton. It contains a collection of extracts dealing with weather phenomena in this country culled from various sources from the earliest times up to A.D. 1450. Apart from its historical interest the collection contains much material of importance in connexion with the question whether the climate of the British Isles has changed within historical times. Mr. Britton is to be congratulated on his industry in collecting the material, a task to which he has devoted a great amount of his private time, and on his skill in arranging the material.

The last memoir, which had not been released by the press at the end of the year, contains the results of the most important investigation undertaken by the Office since the completion of that which resulted in the publication in 1932 of Memoir No. 54 on the Structure of Wind over Level Country. It sets out the results of the investigation of the vertical distribution of temperature at Ismailia made with the help of recording thermometers installed on a special tower 62 metres high erected in the desert. The investigation was undertaken in connexion with problems likely to arise during the mooring of an airship at a mooring mast but the diurnal variation of the thermal structure of the air mass up to 61 metres under conditions of intense radiation such as prevail in the Egyptian desert has great theoretical and practical importance, which justified the continuance of the observations after the decision to abandon the construction of airships had been taken by the Air Ministry.

There is again a long list of contributions by members of the staff to the publications of the Royal Meteorological Society and to other scientific journals.

APPENDIX I

CLASSIFICATION OF STATIONS WHICH REPORT TO THE BRITISH CLIMATOLOGY DIVISION (see p. 9 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	11	129	11	1	3	5	0	0
1	„ E. ...	1	1	2	2	34	349	23	6	2	4	2	2
6A	„ W. ...	1	1	1	1	26	391	22	7	3	3	3	1
2	England, N.E. ...	0	2	2	2	15	281	22	4	5	4	2	2
3	„ E. ...	0	4	1	8	19	476	24	11	7	9	6	2
4	„ Midlands	0	1	2	6	41	1092	33	19	2	3	2	1
5	„ S.E. ...	0	7	3	4	38	902	39	16	9	9	10	8
	London District...	2	0	0	0	11	51	10	4	2	2	2	2
8B	England, S.W. ...	0	1	2	5	32	635	30	6	4	5	5	3
7A	„ N.W. ...	0	1	0	1	22	495	22	8	4	3	0	0
7B	Wales, N. ...	0	2	0	1	6	201	7	4	3	1	2	2
8A	„ S. ...	0	0	1	2	9	229	14	3	2	2	1	0
9	Ireland, N. ...	0	1	2	0	7	136	7	2	3	5	1	1
10	„ S. ...	1	0	2	0	13	121	8	2	3	6	0	0
6B	Isle of Man ...	0	0	1	0	1	8	3	0	1	1	1	1
11	Scilly and Channel Isles ...	0	0	2	0	1	26	3	0	1	2	1	0
	TOTAL ...	6	21	25	32	286	5522	278	93	54	64	38	25
	Corresponding number for last year ...	6	20	24	32	283	5461	272	92	54	63	38	25

APPENDIX II

GALE WARNINGS ISSUED DURING THE YEAR 1936.

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.	17	88	49	15	20	71
Scotland, E.	10	100	26	10	13	88
Scotland, N.W.	11	91	47	10	25	74
Scotland, W. and North Channel	15	100	34	15	12	79
Ireland, N.	13	100	45	13	18	69
Ireland, S.	15	93	34	14	10	71
Irish Sea	16	94	30	15	10	83
St. George's Channel	16	94	34	15	11	76
Bristol Channel	15	93	38	14	16	79
England, S.W.	16	81	38	13	14	71
England, S.	13	100	34	13	14	79
England, S.E.	9	100	28	9	13	79
England, N.E.	10	90	23	9	8	74
England, E.	10	90	20	9	8	85
TOTAL	186	94	480	174	192	76

APPENDIX III

FINANCIAL STATEMENT.

The year under review, 1936-7, is the sixteenth 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 1936-7.

<i>Expenditure.</i>		<i>Amount.</i>	
		£	£
Salaries and Wages—H.Q. Establishments	... ..	84,665	
" " —Out-station Establishments	... ..	80,075	
		<hr/>	164,740
Fuel and Light	... ..		581
Transport of Personnel and Equipment	... ..		6,049
Instruments, Equipment and Stores	... ..		11,812
Research	... ..		1,910
Minor Works Services, Rents, Repairs and Maintenance of Buildings	... ..		6,229
Telegrams, Telephones	... ..	
Subventions to reporting Stations	... ..		16,583
and miscellaneous charges	... ..	
Superannuation	... ..		724
	Total	...	<hr/> <hr/> 208,628
 <i>Receipts</i> 			
Receipts from Royal Society	... ..		541
Sale of Instruments, Carriage, etc.	... ..		5,368
Daily Weather Reports, Forecasts, etc.	... ..		3,356
Receipts from War Office and Admiralty	... ..		964
	Total	...	<hr/> <hr/> 10,229

APPENDIX IV

THE STAFF OF THE METEOROLOGICAL OFFICE, ITS
OBSERVATORIES AND BRANCHES, MARCH 31, 1937

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., F.Inst.P. 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>Assistants & Clerks</i>	7

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 & Clerks</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>	...	...	W. C. Kaye, B.Sc., J. Glasspoole, M.Sc., Ph.D.
<i>Senior Professional Assistant</i>			Miss L. F. Lewis, B.Sc.
<i>Assistant I</i>	...	...	A. G. W. Howard.
<i>Assistants & Clerks</i>	...	...	19
<i>Draughtsmen and Draughts-</i> <i>women</i>	...	...	3

GENERAL CLIMATOLOGY DIVISION

<i>Superintendent</i>	...	...	C. E. P. Brooks, D.Sc.
<i>Technical Officer</i>	...	...	Miss E. E. Austin, M.A.
<i>Senior Professional Assistants</i>			Miss E. H. Geake, M.Sc.; Miss L. D. Sawyer, B.A.; Miss G. L. Thorman, B.Sc., A.K.C.
<i>Assistant I</i>	...	...	A. T. Bench.
<i>Assistants & Clerks</i>	...	...	8
<i>Draughtsman</i>	...	...	1
<i>Presskeeper</i>	...	...	1

APPENDIX IV—continued

FORECAST AND AVIATION SERVICES 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.; S. F. Witcombe, B.Sc.; C. S. Durst, B.A.; R. G. Veryard, B.Sc.; F. H. Dight, B.Sc.; L. Dods, B.Sc.; R. C. Sutcliffe, Ph.D., B.Sc.; J. Pepper, Ph.D., M.A., B.Sc.; F. E. Lumb, B.Sc.; G. W. Hurst, B.Sc., A.R.C.S., D.I.C.; J. H. Brazell, M.Sc.; A. H. Gordon, M.S. (Pasadena).
<i>Senior Professional Assistant</i>	J. E. Belasco, M.Sc.
<i>Assistants I</i> ...	W. Hayes; F. M. Dean; P. I. Mulholland, B.Sc.
<i>Assistants & Clerks</i> ...	32
<i>Draughtswomen</i> ...	8
<i>Telephone Typists</i> ...	8

NAVAL DIVISION

<i>Superintendent</i> ...	L. G. Garbett, Capt., R.N., (retd.).
<i>Technical Officers</i> ...	T. W. V. Jones, B.Sc.; A. G. Forsdyke, Ph.D., A.R.C.S., D.I.C.
<i>Assistants & Clerks</i> ...	4
<i>Draughtswomen</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 Officer</i> ...	R. Cranna, M.A., B.Sc.
<i>Assistant I</i>	P. N. Skelton
<i>Assistants and Clerks</i> ...	11
<i>Draughtsman</i> ...	1
<i>Instrument Designer</i> ...	1
<i>Storeman, Packer and Porter</i>	2
<i>Photographic Assistant</i> ...	1

OVERSEAS DIVISION

<i>Principal Technical Officer</i> ...	F. Entwistle, B.Sc.
<i>Technical Officers</i> ...	S. P. Peters, B.Sc., A.Inst.P.; J. S. Farquharson, M.A.; J. Harding, B.A., B.Sc.; D. A. Davies, B.Sc.; S. Proud, M.A.; P. J. Meade, B.Sc., A.R.C.S.
<i>Assistants I</i> ...	R. Pyser; E. S. Tunstall.
<i>Assistants</i> ...	2

POOL FOR TRAINING AND SPECIAL INVESTIGATIONS

<i>Senior Technical Officer</i> ...	C. K. M. Douglas, B.A.
<i>Technical Officers</i> ...	F. J. Scrase, M.A., B.Sc.; C. J. Boyden, B.A.; R. Frith, B.A.; H. H. Lamb, B.A.; G. Thornton Smith, B.A.; T. N. S. Harrower, M.A., B.Sc.; L. Jacobs, M.A., B.Sc.
<i>Assistants</i> ...	17

APPENDIX IV—continued

THE STAFF AT OBSERVATORIES AND BRANCH
ESTABLISHMENTS

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 Clerks</i> ...	5

KEW OBSERVATORY, Old Deer Park, Richmond, Surrey

<i>Assistant Director</i> ...	F. J. W. Whipple, Sc.D., F.Inst.P.
<i>Technical Officers</i> ...	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 & Clerks</i> ...	5
<i>Observer</i> ...	1
<i>Caretaker & Handyman</i> ...	2

KEW OBSERVATORY (Upper Air Section), Richmond, Surrey

<i>Technical Officer</i> ...	L. H. G. Dines, M.A.
<i>Instrument Maker</i> ...	1
<i>Mechanics & Carpenters</i> ...	3

VALENTIA OBSERVATORY, Cahirciveen, Co. Kerry

<i>Technical Officer</i> ...	H. F. Jackson.
<i>Assistants & Clerks</i> ...	2
<i>Observers</i> ...	2
<i>Messenger</i> ...	1

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 and Clerks</i> ...	3
<i>Housekeeper, Mechanic and Handyman</i> ...	3

THE OBSERVATORY, King's College, ABERDEEN

<i>Assistant I</i> ...	G. A. Clarke.
<i>Assistant</i> ...	1
<i>Observer</i> ...	1

THE OBSERVATORY, LERWICK, Shetlands

<i>Technical Officer</i> ...	D. N. Harrison, D.Phil.
<i>Assistant</i> ...	1
<i>Observers</i> ...	2
<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

AVIATION SERVICES STATIONS

ABBOTSINCH

<i>Technical Officer</i>	...	...	W. J. Grassick, M.A., B.Sc.
<i>Assistant</i>	...	...	1
<i>Observers</i>	...	...	3

ABINGDON

<i>Technical Officer</i>	...	...	R. E. Watson, B.Sc., Ph.D.
<i>Observer</i>	...	...	1

ALDERGROVE

<i>Technical Officer</i>	...	...	D. Dewar, B.Sc.
<i>Clerk</i>	...	...	1
<i>Observers</i>	...	...	2

ANDOVER

<i>Assistant Superintendent</i>	...	...	W. H. Pick, B.Sc., F.Inst.P., F.C.P.
<i>Assistant</i>	...	...	1

BIGGIN HILL

<i>Clerk</i>	...	...	1
<i>Observers</i>	...	...	4

BIRCHAM NEWTON

<i>Technical Officer</i>	...	...	W. H. Bigg, B.Sc.
<i>Observer</i>	...	...	1

BOSCOMBE DOWN

<i>Technical Officer</i>	...	...	C. V. Ockenden, B.Sc.
<i>Senior Professional Assistant</i>	...	...	A. E. Mayers, B.Sc.
<i>Observers</i>	...	...	2

CALSHOT

<i>Technical Officer</i>	...	...	R. A. Watson, B.A.
<i>Assistant & Clerk</i>	...	...	2
<i>Observers</i>	...	...	2

CATTERICK

<i>Technical Officer</i>	...	...	W. R. Morgans, M.Sc.
<i>Assistant</i>	...	...	1
<i>Observer</i>	...	...	1

CRANWELL

<i>Technical Officers</i>	...	...	R. H. Mathews, B.A.; F. E. Coles, B.Sc., A.R.C.S., D.I.C.
<i>Clerk</i>	...	...	1
<i>Observers</i>	...	...	3

CROYDON

<i>Senior Technical Officer</i>	...	...	R. S. Read, M.A., B.Sc.
<i>Technical Officers</i>	...	...	A. L. Maidens, B.Sc.; C. J. M. Aanensen, M.Sc.
<i>Assistant I</i>	...	...	D. F. Bowering.
<i>Clerks</i>	...	...	2
<i>Observers</i>	...	...	10
<i>Telephone-Typists</i>	...	...	3

APPENDIX IV—continued

HOLYHEAD

<i>Clerks</i> ... ..	...	...	2
<i>Observer (part time)</i> ...	...	...	1

LEUCHARS

<i>Technical Officer</i> ... ..	...	...	S. T. A. Mirrlees, M.A.
<i>Assistant</i> ... ..	...	...	1
<i>Observer</i> ... ..	...	...	1

LYMPNE

<i>Clerk</i> ... ..	...	...	1
<i>Observers</i> ... ..	...	...	6

MANCHESTER

<i>Technical Officer</i> ... ..	...	...	C. W. G. Daking, B.Sc.
<i>Assistant & Clerk</i> ... ..	...	...	2
<i>Observers</i> ... ..	...	...	2

MANSTON

<i>Technical Officer</i> ... ..	...	...	A. F. Crossley, M.A.
<i>Assistant & Clerk</i> ... ..	...	...	2
<i>Observers</i> ... ..	...	...	5

MILDENHALL

<i>Technical Officer</i> ... ..	...	...	R. F. Budden, M.A.
<i>Clerk</i> ... ..	...	...	1
<i>Observers</i> ... ..	...	...	2

MOUNT BATTEN

<i>Technical Officer</i> ... ..	...	...	A. Walters.
<i>Assistant & Clerk</i> ... ..	...	...	2
<i>Observers</i> ... ..	...	...	2

SEALAND

<i>Technical Officer</i> ... ..	...	...	D. W. Johnston, B.Sc.
<i>Assistants</i> ... ..	...	...	2
<i>Observer</i> ... ..	...	...	1

SOUTH FARNBOROUGH

<i>Assistant I</i> ... ..	...	...	R. M. Poulter
<i>Clerk</i> ... ..	...	...	1
<i>Observers</i> ... ..	...	...	2

UPPER HEYFORD

<i>Technical Officer</i> ... ..	...	...	J. C. Cumming, M.A.
<i>Clerk</i> ... ..	...	...	1
<i>Observers</i> ... ..	...	...	2

APPENDIX IV—continued

ARMY SERVICES STATIONS

SHOEBURYNNESS

<i>Technical Officer</i>	...	...	C. E. Britton, B.Sc.
<i>Assistants & Clerks</i>	...	...	6
<i>Observers</i>	...	...	5

LARKHILL

<i>Technical Officer</i>	L. G. Hemens, B.Sc.
<i>Clerk</i>	1
<i>Observers</i>	4

PORTON

<i>Assistants & Clerks</i>	5
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OVERSEAS STATIONS

MALTA

<i>Senior Technical Officer</i>	...	G. R. Hay, M.A.
<i>Technical Officers</i>	...	N. H. Smith, B.Sc. ; A. C. Best, B.Sc.
<i>Assistants I</i>	...	E. L. Clinch ; C. C. Newman.
<i>Assistant</i>	...	1
<i>Clerks (locally entered)</i>	...	5

MIDDLE EAST

HELIOPOLIS

<i>Senior Technical Officer</i>	...	R. P. Batty, B.A.
<i>Technical Officers</i>	...	C. W. Lamb, M.C., B.Sc. ; G. J. W. Oddie, B.Sc.
<i>Clerk</i>	...	1
<i>Observers</i>	...	5

ABOUKIR, AMMAN, ISMAILIA AND RAMLEH

<i>Clerks</i>	...	...	2
<i>Observers</i>	...	...	6
<i>Clerk (locally entered)</i>	...	...	1

IRAQ

HINAIDI

<i>Senior Technical Officer</i>	...	J. M. Stagg, M.A., D.Sc.
<i>Technical Officers</i>	...	M. J. Thomas, B.Sc. ; H. L. Wright, M.A.
<i>Assistant</i>	...	1
<i>Clerks (locally entered)</i>	...	8

APPENDIX IV—continued

DHIBBAN, DIWANIYAH, SHAIBAH

<i>Clerks</i> ... ..	...	2
<i>Clerks (locally entered)</i>	...	3

GIBRALTAR

<i>Technical Officer</i>	...	...	R. Frost, B.A.
<i>Assistant</i>	...	...	1
<i>Observer</i>	...	...	1

SECONDED FOR DUTY WITH OTHER BODIES

<i>Senior Technical Officer</i>	...	J. Durward, M.A.	}	(Iraqi Government).
<i>Technical Officers</i>	...	J. L. Galloway, M.A., B.Sc.		
		L. H. Starr, M.Sc. (R.A.F., India).	}	(War Office, Porton Experimental Station.)
		E. L. Davies, M.Sc.		
		O. G. Sutton, B.Sc.		
		P. A. Sheppard, B.Sc.		
		K. L. Calder, B.Sc., A.R.C.S.		
		H. Garnett, M.Sc. (Indian Government).		

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 date) :—

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, 1937).

Weekly Weather Report for the period March 3, 1935, to February 29, 1936. Particulars of temperature, rainfall and bright sunshine for each week. *7s. 6d.*

The Marine Observer (to date).

The Meteorological Magazine (to date).

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, 1937). *Not on sale.*

Seismological Bulletin. A diary of seismological disturbances recorded on the Galitzin Aperiodic Seismographs at Kew Observatory, Richmond (to February, 1937). *Not on sale.*

Observatories' Year Book, 1934. 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.*

Réseau Mondial, 1929. Monthly and annual summaries of pressure, temperature, and precipitation based on a world-wide network of observing stations. *15s.*

British Rainfall, 1935. 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, 1935. By J. Baxendell. *Not on sale.*

OCCASIONAL :—

Averages of Bright Sunshine for the British Isles for periods ending 1935. *1s.*

Averages of Temperature for the British Isles for periods ending 1935. *1s. 3d.*

Decode for use with the International Code for Wireless Weather Messages from Ships adopted by the International Meteorological Conferences, Copenhagen 1929 and 1935. 4th edition, revised to October, 1936.

Gazetteer of British Meteorological Stations used in the preparation of Synoptic Reports. Amendment No. 1. *2s.*

Hygrometric Tables for the Computation of Relative Humidity, Vapour Pressure and Dew Point from Readings of Dry and Wet Bulb Thermometers exposed in Stevenson Screens. Amendment No. 1. Additions to the Tables. *2d.*

APPENDIX V—continued

Marine Observers Handbook. 6th edition, 1936. 3s.

Measurement of Upper Winds by means of Pilot Balloons. 1s.

Meteorological Observers Handbook. Supplement No. 1. Instructions for Meteorological Telegraphy. 3rd edition, 1936. 2s.

Monthly Normals of Percentage Frequencies of Surface and Upper Winds over Malta, Egypt, Palestine, Trans-Jordan and Iraq. Mainly between the years 1921 and 1932. 2s.

Report of the Conference of Empire Meteorologists, London, August 12-21, 1935. *Not on sale.*

Wireless Weather Messages. Particulars of Meteorological Reports issued by Wireless Telegraphy and Wireless Telephony in Great Britain, Gibraltar, Malta, Middle East and Iraq. 10th edition, 1937. 1s. 6d.

Geophysical Memoirs :—

Vol. VII :—

68. Point discharge in the electric field of the earth. An analysis of continuous records obtained at Kew Observatory. By F. J. W. Whipple, Sc.D., and F. J. Scrase, M.A., B.Sc. 1s. 6d.
69. Rainfall at front of depressions. By A. H. R. Goldie, M.A., F.R.S.E. 1s.

Vol. VIII :—

70. A meteorological chronology to A.D. 1450. By C. E. Britton, B.Sc. 8s.
71. An investigation into the variation of the lapse rate of temperature in the atmosphere near the ground at Ismailia, Egypt. By W. D. Flower, B.Sc., A.Inst.P. (*In the press.*)

Professional Notes :—

Vol. V :—

70. Observations of the blueness of the sky. By J. S. Farquharson, M.A. 2d.
71. Sand Devils. By W. D. Flower, B.Sc., A.Inst.P. 3d.
72. Upper Winds at Wadi Halfa (Sudan). By J. Durward, M.A. 4d.
73. Notes on the behaviour of the anemograph at Lizard. Compiled from reports by M. J. Thomas, B.Sc. 9d.
74. A comparison of the records of two anemometers at different heights at Southport. By W. C. Kaye, B.Sc. 3d.

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

By E. GOLD, D.S.O., F.R.S. :—

Wind in Britain. The Dines anemometer and some notable records during the last 40 years. (Presidential address delivered before the Royal Meteorological Society, January 15, 1936). *London, Quart. J. R. met. Soc.*, 62, 1936, pp. 167-206.

APPENDIX V—continued

By F. J. W. WHIPPLE, M.A., Sc.D., F.Inst.P. :—

On the theory of the strains in an elastic solid bounded by a plane when there is a nucleus of strain at an internal point, and on the relation of the theory to seismology. *London, Mon. Not. R. astr. Soc., geophys. Suppl.*, **3**, 1936, pp. 380–8.

The influence of urban conditions on the circulation of electricity through the atmosphere. *London, Trans. Faraday Soc.*, **32**, 1936, pp. 1203–9.

A note on the analysis of variation by the use of orthogonal polynomials. *London, Quart. J. R. met. Soc.*, **62**, 1936, pp. 492–8.

The present state of investigations of the transmission of air waves to great distances. *London, Quart. J. R. met. Soc.*, **62**, 1936, Suppl. (Conf. Atm. Ozone), pp. 19–21.

What can submarine canyons tell us about the character of the ice age? *London, Quart. J. R. met. Soc.*, **63**, 1937, p. 69.

By A. H. R. GOLDIE, M.A., D.Sc., F.R.S.E. :—

Ascent of air in cyclones. *Nature, London*, **138**, 1936, pp. 166–7.

By C. E. P. BROOKS, D.Sc. :—

The making of climate. *Encycl. mod. Knowledge, London*, Pt. 4, 1936, pp. 349–60.

The recent floods in the United States. *Nature, London*, **139**, 1937, pp. 400–2.

By J. DURWARD, M.A. :—

Blue colour of the sun and surrounding sky in a dust storm. *London, Quart. J. R. met. Soc.*, **63**, 1937, p. 54.

By C. K. M. DOUGLAS, B.A. :—

Rainfall from above 6,000 ft. in relation to upper winds and fronts. *London, Quart. J. R. met. Soc.*, **62**, 1936, pp. 207–17, disc., p. 217.

By Miss E. E. AUSTIN, M.A. :—

La vie météorologique en Grande-Bretagne. *Météorologie, Paris*, (3. Sér.), **1**, 1936, pp. 72–6, 408–10, 497–9, 570–1.

By C. J. BOYDEN, B.A. :—

The formation of coloured rain. *London, Quart. J. R. met. Soc.*, **63**, 1937, pp. 47–53.

By L. H. G. DINES, M.A. :—

A form of apparatus for obtaining samples of the atmosphere from great heights. *London, Quart. J. R. met. Soc.*, **62**, 1936, pp. 379–86, disc., p. 386.

By C. S. DURST, B.A. :—

The variation of the coefficient of surface resistance. *London, Quart. J. R. met. Soc.*, **62**, 1936, pp. 290–1.

APPENDIX V—continued

- By J. GLASSPOOLE, M.Sc., Ph.D. :—
The distribution over the British Isles of the average duration of bright sunshine. Monthly and annual maps and statistics. *London, Quart. J. R. met. Soc.*, **62**, 1936, pp. 247-58, disc., pp. 258-9.
- By O. G. Sutton, B.Sc. :—
The logarithmic law of wind structure near the ground. *London, Quart. J. R. met. Soc.*, **63**, 1937, pp. 105-7.
- By H. L. Wright, M.A. :—
The size of atmospheric nuclei: some deductions from measurements of the number of charged and uncharged nuclei at Kew Observatory. *London, Proc. phys. Soc.*, **48**, 1936, pp. 675-89.
- By R. M. POULTER :—
The presentation of visibility observations. Visibility characteristic curves and a visibility index. *London, Quart. J. R. met. Soc.*, **63**, 1937, pp. 31-45, disc., pp. 45-6.

