

ANNUAL REPORT
of the Director of the
METEOROLOGICAL OFFICE

presented by the Meteorological Committee
to the Air Council

For the Year ended
31st March
1929

*The Seventy-fourth Year of the
Meteorological Office*



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METEOROLOGICAL COMMITTEE

1928-9

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

Lieut.-Colonel E. L. BOND, D.S.O., R.A. Superintendent of Experiments, Shoeburyness. Nominated by the War Office.

Rear-Admiral H. P. DOUGLAS, C.B., C.M.G., R.N. Hydrographer of the Navy. Nominated by the Admiralty.

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

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

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Mr. H. W. W. McANALLY, C.B. Principal Assistant Secretary, Air Ministry. Nominated by the Air Ministry.

Mr. L. V. MEADOWCROFT, Assistant Secretary, Air Ministry. Nominated by the Air Ministry.

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

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

Dr. G. C. SIMPSON, C.B., F.R.S., Director, Meteorological Office.

Secretary :—Mr. D. BRUNT, M.A.

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**COMMITTEE OF THE METEOROLOGICAL OFFICE,
EDINBURGH**

Chairman :—The Director of the Meteorological Office.

Vice-Chairman :—Professor R. A. SAMPSON, F.R.S. Nominated by
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Sir W. L. MACKENZIE, M.D., LL.D. (until January, 1929).
Nominated by the Department of Health for Scotland.

Dr. J. PARLANE KINLOCH (from January, 1929). Nominated by
the Department of Health for Scotland.

Dr. A. CRICHTON-MITCHELL, F.R.S.E. Nominated by the Royal
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Professor W. PEDDIE, D.Sc. Nominated by the Royal Society of
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Mr. J. M. RAMSAY, O.B.E. Nominated by the Board of Agriculture
for Scotland.

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

ANNUAL REPORT of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the year ending 31st March, 1929 (the seventy-fourth year of the Meteorological Office).

The **Meteorological Committee** met twice during the year, on the 14th November, 1928, and the 13th March, 1929. There were no changes in the membership of the Committee during the year.

The **Edinburgh Meteorological Committee** met on the 12th June and 29th October, 1928, and 14th January, 1929. Dr. J. E. Crombie, representing the University of Aberdeen, ceased to be a member of the Committee at the termination of a period of two years, his place being taken by Professor H. Stanley Allen, representing the University of St. Andrews. At the beginning of 1929 Sir Leslie Mackenzie, who has represented the Department of Health for Scotland since 1921, retired from the Committee, and was succeeded by Dr. J. Parlane Kinloch.

CLIMATOLOGY

British Climatology.—There has been the normal number of changes in the voluntary stations which co-operate with the Office in the collection of climatological data for the British Isles. Reports have ceased to be received from six stations, while five new climatological stations have been established. Observations have been received for the first time from Cannington and Elbridge, two stations co-operating in the "crop weather scheme" of the Ministry of Agriculture and Fisheries. Of the 4,500 rainfall stations reporting to the Office, about 300 changes occur each year and the year under review has been one of average change.

The examination, discussion and publication of the large mass of data collected have progressed in the normal way, and the *Monthly Weather Report*, *British Rainfall* and the *Observatories' Year Book* have appeared as usual. The only publication which has not appeared as in previous years is the *Weekly Weather Report*, as it has been decided to make fundamental changes in this publication. The *Weekly Weather Report* contains averages of various climatological elements for periods of the calendar weeks, and for many years the *Report* has been published weekly. Experience has shown that whereas data for weeks are essential for many problems, it is not convenient to have them published in 52 separate issues throughout the year, but that it would be much more practicable to use the data if they were published for the whole year in a

single volume. The reasons for this change were given in the last *Annual Report*. The weekly issues terminated at the end of February, 1928, and the first volume of collected data has been in preparation during the whole of the year under review. The re-arrangement of the data and improved methods of giving departures from normal have necessitated a considerable amount of work in the re-calculation of normal values, especially with the data for temperature and accumulated temperature. Accumulated temperature, which is a numerical value proportional to the amount of heat received when temperatures are above or below 42°, is of great importance in agricultural investigations. The whole basis of calculation of accumulated temperature has been reviewed and new methods have been employed which have necessitated a re-calculation of the normal values. It is hoped that as a result of this work the data in the future will be more homogeneous and more useful. The data have been worked upon as they have arrived weekly throughout the year and there will be little delay in the publication of the annual volume after the year's data have all been received.

The data used for the climatology of the British Isles are mainly derived from voluntary stations, but observations from a large number of official stations maintained by the Office on aerodromes, together with the observations made at the observatories are also used. Practically all the official stations are equipped with self-recording instruments, the records of which are of great value for investigating the actual changes which take place at any station and the method on which changes are propagated across the country. The British records are extremely complete, and many requests have been received from investigators, especially in Germany and Norway, for the loan of records for use in the intense detailed study of meteorological phenomena which is now being carried out. The needs of these continental workers have been met and records have been lent on many occasions without the loss of a single record. The facilities thus placed at the disposal of continental workers have been much appreciated and have been a valuable contribution to the advance of meteorological science.

Further progress has been made with the preparation of the map of average annual rainfall of the British Isles on the scale of 2 miles to the inch. The map was extended during the year to cover the counties of Hereford, Dorset, Cheshire, Stafford and Worcester, and substantial progress has been made with data for Somerset, Wiltshire and Warwick.

A section of the "Book of Normals" dealing with humidity was published and the preparation of a section on wind is in hand.

Close co-operation has continued with the Ministry of Agriculture and Fisheries in connexion with the "crop weather scheme." A second conference for the discussion of subjects connected with agriculture and meteorology was held at the Meteorological Office,

South Kensington, on September 27th and 28th, with Sir Thomas Middleton in the chair. A course of instructions for observers at "crop weather" and other stations was held at Kew Observatory during September, when 24 persons attended the course.

World Climatology.—The collection of meteorological data from all parts of the world outside the British Isles, especially from British Colonies and Protectorates, has continued throughout the year. The work on the preparation of the *Réseau Mondial*, an annual publication summarising the meteorological records obtained at representative stations in all parts of the world, has progressed steadily; the volume for 1921 has been issued, that for 1922 sent to the press, and the preparation of the tables for 1923 is well advanced. The volume for 1921 includes for the first time the data from ocean regions based on observations taken on board ship. The collection of these ships' observations is being undertaken by international co-operation, at present Great Britain, Holland, Brazil and Norway have made themselves responsible for collecting the data for specified regions of the ocean.

A valuable set of meteorological observations taken by Mr. Francis Rodd during his journeys of exploration in the Sahara in 1922 and 1927, which were accompanied by a number of autographic records of pressure and temperature were received. The importance of these data from an area of which the meteorological conditions are little known, was so great that they have been the subject of special examination and discussion and a monograph dealing with them has been prepared for publication.

For many purposes it is desirable to know the variations of temperature which may be expected in any part of the world. Many data exist based on the average values of the maximum and minimum temperatures, but these are not satisfactory for all purposes. An investigation was therefore carried out during the year with the object of determining the maximum and minimum temperatures which will be reached or exceeded one year in two. These values for the period 1910 to 1921 were calculated for a number of places distributed over the globe and represented on charts. The charts and tables have been published as a *Geophysical Memoir*.

The additions to the library during the past year include 438 new books and pamphlets, 12,528 daily weather reports, and about 4,000 periodicals. The author and subject catalogues have been kept up to date and considerable progress has been made with the bibliography of meteorological literature.

OCEAN METEOROLOGY

The collection of meteorological data from ships at sea has been one of the chief functions of the Meteorological Office since its foundation. The observations collected in this way have been used for determining

the average conditions in all parts of the world and meteorological charts have been prepared and published setting out these average conditions for practical use. Although average charts are indispensable, the actual conditions often depart so much from the average that they are of little use for most day-to-day purposes.

On land meteorology has developed along the lines of the synoptic chart, the essence of which is the rapid collection of observations taken over a wide area, so that they can be plotted on charts to give the conditions so soon after their occurrence that the charts may be considered to be representative of the actual weather existing at the time they are prepared. With charts of this nature forecasts can be made. The use of synoptic methods was impossible at sea before the introduction of wireless telegraphy, owing to the impossibility of collecting the necessary information. On the introduction of wireless telegraphy, there was nothing to prevent a ship collecting wireless information with almost the same ease as it can be collected on land. It was only a question of an organisation which would provide for the taking of the observations and the supply of them to ships desiring to prepare a synoptic chart. The use of synoptic charts at sea, however, was a new idea to the seaman, and it has taken a considerable time for him to realise the advantages which can be derived from the preparation of such charts on board ship. For several years the Meteorological Office has been steadily working towards this application of modern meteorology, and the *Marine Observer*, a monthly magazine published by the Meteorological Office, has been one of the most efficient means of instructing seamen regarding the possibilities of synoptic meteorology as applied to navigation.

So long as meteorological work at sea was confined to taking observations and entering them in the log little organisation was required beyond enlisting the help of seamen in making the observations. As soon, however, as these observations are to be transmitted for the immediate use of other ships other questions become important, especially the time of observation, the corrections to be applied to the barometer, the method in which the messages containing the observations are to be prepared, and the limitation of the number of ships in certain areas which issue messages in order to prevent undue interference with the normal wireless traffic. These problems have received very great attention in the Marine Division, and a scheme has been worked out which will, it is hoped, be satisfactory in application and be welcomed by seamen. The scheme is based on what is called the "selected ship." From the total number of ships making meteorological observations in co-operation with the Meteorological Office, a certain number will be selected for making wireless weather reports. In choosing these ships consideration will be taken of the instrumental equipment, and the interest shown by the observers in

meteorological work. Consideration will also be given to the routes followed by the ships in order that selected ships will at any time be well distributed over the world. Instructions will then be issued to these selected ships regarding the time of observation, the method of preparing the messages for issue and the times at which they should be broadcast. In this way reliable meteorological data will become available in all parts of the world. It is hoped that the same scheme will be adopted by other countries and a definite proposal was made to the International Meteorological Organisation that all countries should organise a number of selected ships along these lines, the number being in proportion to the total tonnage of each country and the total number of selected ships being 1,000. If this scheme is adopted, the British Empire (including Dominions) would provide 350 of the total number of selected ships, while at present 289 of the ships co-operating with the Meteorological Office are already undertaking this work.

The number of staff in the Marine Division is not sufficient to deal with all the meteorological information which could be obtained from British ships. It is, therefore, the policy of the Office to limit the number of ships co-operating to approximately 500. On the 31st March, 1929, 487 ships were co-operating. Of these 116 were equipped with sets of instruments by the Office; they take observations every four hours, which are entered into special meteorological logs which are forwarded to the Office at the end of each voyage. 323 ships used their own instruments and provided a less elaborate record. 32 North-Atlantic liners were equipped with instruments, especially for making reports to London by W/T in connexion with the forecasting service. In addition, seven H.M. ships kept full logs and 9 cross-channel ships contributed reports of observations made at mid-channel positions.

During the year 275 full logs were received from ships equipped by the Office and 2,290 minor reports from ships using their own instruments.

The reports received from the North-Atlantic liners are of special importance in the work of the Meteorological Office. The information conveyed from the Atlantic is absolutely indispensable for accurate weather forecasting, and the Office is very grateful to the officers who carry out this voluntary service with such regularity and accuracy. The observations from ships compare very favourably with observations made by professional meteorologists and errors of observation are almost non-existent. The accuracy with which the ships' observations are transmitted is surprising when it is considered that the messages are all in figure code and frequently are sent during the busiest periods of the Atlantic wireless traffic. During the year 4,476 reports were received, each consisting of 8 groups of five figures each. In this large number of messages only 347 errors of transmission occurred, i.e., only 2 mistakes in every

1,000 figures telegraphed. Such accuracy was not expected with wireless telegraphy when the messages from ships were first organised. These North-Atlantic liners are asked to report when they are westward of longitude 40°W. to the United States Weather Bureau instead of to London. The United States Weather Bureau collects these messages and then transmits them at its own expense to Europe. In this way the observations made by the ships are put to valuable use by the forecast services of Europe and North America. The Meteorological Office is grateful to the United States Weather Bureau for its co-operation in obtaining these messages from the other side of the Atlantic.

As the Atlantic liners travel only along definite routes, arrangements have been made for H.M. Ships, when in other parts of the North Atlantic, especially off the coast of Spain, to send W/T reports direct to London. These observations have also proved of the greatest value.

The *Marine Observer* has been published regularly throughout the year and continues to serve as the channel of communication between the Meteorological Office and the voluntary marine observers. "The Marine Observer's Log," which contains contributions made by mariners and selections from the remarks made in the logs, continues to be a popular feature of the publication, and the Marine Division is grateful to those who provide these valuable contributions.

FORECASTING

The issue of weather forecasts for general purposes has continued uninterrupted throughout the year, and no changes of major importance have occurred. Two minor changes may, however, be recorded. Each forecast issued in the press refers to a definite specified period. On June 1st these periods were revised with the object of making the forecasts which appear in any newspaper apply to a period of some 15-20 hours from the time when the paper normally comes into the hands of the reader; thus, the forecasts prepared for the evening newspapers, which commence to be published soon after midday, refer to the 24 hours commencing at noon on the day of issue, while the forecasts prepared for the morning newspapers extend from 6 a.m. to midnight of the day of issue.

In December the weather reports broadcast by the British Broadcasting Corporation were amplified by the addition of forecasts for the various sea passages to Ireland and the Continent. This change was made in response to requests which had been received by the B.B.C. for this information.

Owing to the difficulty of picking up the weather reports issued by Russia at the Air Ministry wireless station in London, arrangements were made to attempt to take these important messages at a station remote from London. The wireless station at Cardington has been

successful in this effort, and the Russian observations are now received there regularly and transmitted to London by telephone each morning in time to be of use in the preparation of the chart of the northern hemisphere.

Thames Floods.—Reference was made in the *Report* for last year to the responsibility placed on the Meteorological Office for giving warnings of Thames floods after the disastrous flood of January, 1928. Arrangements were made to issue warnings to the public in conjunction with the Port of London Authority whenever the meteorological conditions were similar to those which are known to have produced floods in the past. These arrangements were, however, provisional to cover the interval necessary for a detailed inquiry to be carried out regarding the origin of disastrous floods. This inquiry has now been completed and shows that while it is quite practicable to forecast the meteorological conditions which may lead to floods, yet unless there is exact synchronisation between the meteorological conditions and the time of high water no flood would result. The investigation showed that the dangerous meteorological conditions would occur 20 times with only one coincidence with the time of high water which would lead to a dangerous flood. It was, therefore, obviously undesirable that the public should be informed whenever these meteorological conditions occur. From November, therefore, the system of warning was modified and now the Meteorological Office notifies Scotland Yard whenever the specified meteorological conditions occur without issuing any warning to the general public.

Gale Warnings.—The service of gale warning has been carried on throughout the year, new stations having been established at Workington, Bridlington and Isle of May, while the station at Lundy Island was closed. The gale warnings issued have as usual been checked against the actual occurrence of high winds, and the results are shown in Appendix II, from which it will be seen that effective warnings were issued for 92 per cent. of the gales which occurred, while 78 per cent. of the warnings issued were justified by the occurrence of either gales or strong winds.

AVIATION

Increasing demands have been made on the Office in connexion with aviation, both service and civil. A new distributive station was opened in August at Manston in continuation of the policy laid down in 1925 to meet the requirements of the Home Defence Expansion Scheme of the Royal Air Force.

Considerable changes have been made in the meteorological organisation on the regular air routes operating from Croydon. This development was the outcome of the deliberations during the past four years of the Meteorological Sub-Commission of the International

Aeronautical Conference, which meets periodically to discuss the details of the organisation of the air routes of north-west Europe, and consisted of a complete reorganisation of the weather reporting system on these routes. Hitherto all meteorological stations observing in connexion with civil aviation had reported regularly during the period that flying was in progress, and although the organisation admitted of certain additional reports and warnings in the case of bad weather, no decrease in the amount of observational work was possible when good conditions for aviation were established. Further, the wave length of 1,680 metres which was reserved for the wireless transmission of aviation weather reports was rapidly becoming overloaded, chiefly as a consequence of the extension of existing routes and the creation of new routes. The new scheme which was adopted finally at the 27th Aeronautical Conference at The Hague in September, 1928, and brought into operation on an experimental basis in November in certain of the countries participating in the Conference, was rendered possible by the allotment, under the provisions of the International Radiotelegraphic Conference held at Washington the previous autumn, of three wave-lengths for aviation meteorology.

In the new scheme of reports Europe is divided into regions within any one of which the same wave-length is employed for the transmission of aviation weather reports. Three wave-lengths are provided for this service, and they are distributed in such a way that two regions employing the same wave-length are never adjacent. Each region is divided into six sub-regions which transmit reports successively according to a fixed time-table, the latter being identical for all regions. The air routes from London to Paris, Brussels, Cologne and Amsterdam lie in one region.

In the transmission of reports differentiation is made between the hours following the times at which general synoptic observations are made at meteorological stations, viz., 7 a.m., 10 a.m., 1 p.m., 4 p.m., and 6 p.m. G.M.T. and the intermediate hours. During the former, full observations are transmitted from all meteorological stations on air routes, together with upper-air information, the transmission of reports from the different sub-regions occupying nearly a full hour. During the intermediate hours each sub-region transmits a report every half-hour. The half-hourly messages contain, normally, an observation from the terminal aerodrome in the sub-region, made just before the transmission of the message, and also, once an hour, observations from certain stations which are particularly important from the point of view of aviation, together with reports of any important changes in the meteorological conditions, as regards either deterioration or improvement that may have occurred since the last report transmitted. Thus, messages of the first type are invariably of the same form and length, while the nature of the second type of message depends on the weather conditions prevailing, the messages being fuller in bad weather than in fine settled weather.

The main advantages of the system are—that it is more elastic than the system of hourly reports, in that it permits of more adequate reports in bad weather; that all the meteorological information for aviation is concentrated in one system of reports; and that, from the nature of the distribution of the three wave-lengths, the system is capable of geographical extension indefinitely.

In addition to the revised system of weather reporting, a new form was drawn up for the transmission of meteorological information to pilots or aircraft in flight. Agreement was also reached regarding a code for the international exchange of forecasts by radiotelegraphy.

It was mentioned in the last *Annual Report* that it had been found necessary to establish additional auxiliary reporting stations on alternative air routes between Croydon and the Channel, which could be followed by aircraft when bad weather prevails on the normal route. For the same reason further stations have been established at Penshurst, Caterham and Horley. The additional stations have proved of great value in connexion with the operation of air services in bad weather.

Owing to the earlier commencement of flying from Croydon it has been found necessary to extend still further the period during which meteorological observations are made. During the year under review observations commenced at 0600 G.M.T. on week-days in the winter, at 0300 G.M.T. from the 3rd May to 27th September and from 0400 G.M.T. during the remaining months.

During the period under review 4,651 requests for reports or forecasts were received by the terminal aerodrome at Croydon, while 4,380 reports were passed by radiotelephony from Croydon and Lymington to pilots of aircraft in flight.

Experimental Flying-boat Service between Liverpool and Belfast.—Special meteorological arrangements were made for an experimental flying-boat service operated daily by the Imperial Airways Limited between Liverpool and Belfast from the 22nd September to the 6th October. Weather reports were obtained from Liverpool, Southport, Douglas, Donaghadee and Belfast, the reports from each half of the route being collected at the Royal Air Force stations at Sealand and Aldergrove respectively, and interchanged between these stations by wireless. The meteorological officers at the two stations supplied reports for the complete route, including reports of upper winds, together with forecasts, further information being transmitted to the aircraft as required.

Supply of Weather Reports and Forecasts for private Aviation.—The Automobile Association has recently created an Aviation Section for the benefit of its members who have taken up aviation. At the request of this Section weather reports from a number of stations, together with short-period forecasts are supplied to the

Association twice daily and the Association is arranging to exhibit this information on maps at selected centres throughout the country. Up to the present the only map exhibited regularly by the Association has been at its own Headquarters in London, but special maps have been exhibited on the occasion of air meetings. The maps conform to the scheme recommended by the International Commission for Air Navigation, which has already been adopted at Croydon for the display of weather reports along the London-Continental air routes.

Meteorological Arrangements for long-distance Flights.—For the third year in succession the Meteorological Office has been called upon to supply meteorological information including forecasts for trans-Atlantic flights. In all, information was supplied for six flights or projected flights, chief amongst which was the first successful flight across the Atlantic from east to west which was carried out in the *Bremen*, which started from Baldonnell on April 12th, 1928. A special forecast was supplied on the evening prior to the commencement of the flight and the probable conditions were discussed by telephone with Commander FitzMaurice.

An increasing number of requests for information are being made for private long-distance flights, and during the year information was given regarding flights to such places as Nice, Lucerne, Nuremberg, Malta, Naples, Venice, Budapest and Constantinople.

Meteorological Arrangements for trans-Atlantic Flights.—Advantage was taken of the presence in London during May of the Chief of the United States Weather Bureau and the Director of the Canadian Meteorological Service to discuss the necessary co-operation between the meteorological services in Europe and America in connexion with Atlantic flights either by aeroplane or airship. It was decided that all the meteorological arrangements connected with these flights should be made by the national meteorological service of the country from which the cross-Atlantic flight was to commence, and that the meteorological services of either Canada or the United States would be responsible for collecting information from the other side and transmitting it with forecasts to the meteorological service responsible in Europe, Canada or America undertaking the service according as to whether the aircraft intended to land in Canada or America respectively. These arrangements have been carried out in subsequent flights and have worked successfully.

Supply of Meteorological Information to the Royal Air Force.—Meteorological information required by the Royal Air Force is largely supplied by the small meteorological stations called "distributive stations" established on the chief aerodromes. There are now 12 such distributive stations attached to the Royal Air Force, and these have continued to do satisfactory work throughout the year. Arrangements were made in February for the issue from the Air Ministry by W/T of more complete synoptic information for the

benefit of these distributive stations. At the same time improved working charts were provided so that the information available on the aerodromes of the Royal Air Force is much more complete than formerly. At several of the distributive stations the meteorological officer gives elementary courses in meteorology to the Royal Air Force personnel.

In addition to the normal issue of routine weather reports specially designed for the needs of the Royal Air Force, special information was given on 1,023 occasions in response to individual requests, mainly in connexion with cross-country flights.

The nature of the information supplied from distributive stations to the units to which they are attached, and the duties of the meteorological staff, depend on the nature of the flying training carried out by the particular units. Most stations, however, have supplied, in addition, information for purposes outside the requirements of the services for which they primarily exist. Thus, five distributive stations have supplied meteorological reports for artillery practice. At Aldergrove frost warnings have been supplied to the Ministry of Agriculture for Northern Ireland in connexion with the "smudging" of apple orchards. The staff at Biggin Hill and Lympne have co-operated in the work of the Acoustic Section of the Air Defence Experimental Establishment in supplying meteorological data. At Renfrew a large amount of information has been supplied to civilian organisations, particularly in connexion with shipping.

Air Defence Staff and Tactical Exercises.—In August, 1928, the Royal Air Force carried out an elaborate programme in connexion with the Air Defence Command Exercises, based on a scheme for the defence of London when attacked from the air. These exercises involved close co-operation on the part of the Meteorological Office. The Superintendent of the Aviation Service Division was attached to the Directing Staff and advised the Air Officer Commanding with regard to meteorological conditions throughout the operations. Meteorological officers were also attached for similar duties to Fighting Area Headquarters, and Wessex Bombing Area Headquarters, and also to the various squadrons participating in the exercises. A special organisation of reports and forecasts was drawn up in connexion with the operations. The exercises were of very great value in giving experience as to the meteorological organisation which would be necessary in the event of aerial attacks on England.

Observations of Upper Wind.—The total number of pilot-balloon ascents made at outstations during the year to determine the velocity and direction of the upper winds was 12,416, and in addition 6,097 nephoscope observations of the movements of upper clouds have been made.

Airships.—In view of the approaching completion of the construction of the two new airships the Division of the Meteorological Office charged with the duty of supplying meteorological information to the airships has been brought up to sanctioned strength, and arrangements for commencing active operations have been completed at Cardington. The new meteorological building at the Royal Airship Works, Cardington, has been completed and equipped. It was occupied early in the period now under review and a complete forecasting service was brought into operation, thus providing an opportunity for the whole of the operational staff to obtain practice in working as a unit on the lines required for airship operations. Considerable attention has been given to the equipment of meteorological instruments and to erecting them so that their records can be kept under observation in the new forecasting room. Above the new meteorological building a pressure tube anemometer has been erected with its head 150 feet above the ground, which records both wind velocity and direction on a drum within the forecast room. Also an instrument has been installed in the same room which records the air temperature near the summit of the anemometer tower (150 feet), and also temperatures of the dry and wet bulbs at 4 feet above the ground level in an open exposure on the aerodrome.

Telephone installation has been provided giving direct connexion from the forecast room to the airship operation control room, also to the airship itself when the latter is moored at the tower. The telephone is also connected to the main exchange of the Royal Airship Works. Provision has also been made so that the forecaster in the forecast room may converse directly by radiotelephony with the airship when in flight. The telephone apparatus in the forecast room is so arranged that the weather charts and any of the meteorological recording instruments may be consulted during speech. The wireless receiving station in the meteorological building which will be used for taking in meteorological data has been equipped with two long-wave receivers and one short-wave receiver.

In addition to organising the main service which will be brought into operation when the airships commence their flights, work has been continued on a detailed investigation of the weather on the England-India airship route, daily weather charts for the whole area having been prepared for representative periods of time. The investigation of the structure of the wind by the aid of four special anemometers has continued and has given valuable information regarding the wind stresses which an airship is likely to experience in all winds.

Arrangements for the provision of a temporary observing and forecasting centre at Howden to operate in connexion with the first flight of the airship R.100 from Howden to Cardington have been completed. A hut has been reconditioned to accommodate the

meteorological and wireless staffs who will be detailed for the reception of meteorological data. A Dines pressure tube anemometer has been installed and an instrument enclosure prepared.

The mooring tower in Egypt has been established at Ismailia, and arrangements have been made for providing the meteorological observations required when the airship is at this mast. At present only temporary and provisional arrangements can be made, as no permanent meteorological staff can yet be assigned to this airship base. The meteorological station at Ismailia is located in a hut reconditioned for the purpose; this hut also provides accommodation, on a temporary basis for the wireless reception of meteorological data and for forecasting during periods when airships are operating on the route to Egypt and India. A special meteorological mast 200 feet high has been erected on a site about half a mile from both the meteorological hut and the airship mooring tower, and platinum resistance thermometers at levels of 4, 50, 150 and 200 feet above the ground have been installed on this mast to record electrically on an instrument situated in the forecast room. These instruments have been provided because there can be very great temperature variation with height over the heated desert surface in the conditions which prevail at Ismailia, and the temperature conditions are of great importance to an airship when moored at the mast.

A Dines pressure tube anemometer with vane 50 feet above the ground and a cup anemometer installed on the summit of the 200-foot mast will also record in the forecast room. At Ismailia arrangements have been made for direct telephone communication between the forecast room and the airship mooring tower, including the airship when moored, and for speech with the airship in flight by radio-telephony from the forecast room.

The Government of India is providing the meteorological organisation for the airship base at Karachi, which is to be placed in charge of Dr. B. N. Banerji, under the direction of the Director-General of Observatories, India. Dr. Banerji spent eight months in England studying the special problems of airship meteorology and returned to India in July, 1928. Very close relations are maintained between India and the Meteorological Office, London, and monthly progress reports are exchanged in each direction. Meteorological services at the airship bases at Cardington, Ismailia and Karachi, together with the existing meteorological services at Malta and Baghdad are accordingly now available to supply the necessary meteorological facilities required for the initial airship flights to Egypt and India. The arrangements yet to be made are, by comparison, matters of detail.

The work of the Airship Missions which visited the Dominions and certain Colonies in 1927 and dealt, among other things, with the meteorological facilities required, has been carried further in correspondence, particularly in the case of Canada and South Africa. In

Ceylon also a number of first-order observing stations, equipped with pressure tube anemometers and other recording instruments are being erected by the meteorological service of that Colony to obtain data for later use when the question of selecting an airship base arises. A similarly equipped station has been provided at Mombasa, Kenya Colony, in this case with instruments lent by the Air Ministry. The station for observing upper winds at Kamaran Island, Southern Red Sea, which is in charge of a voluntary observer Captain G. V. Wickham, Civil Administrator, has been maintained by the Air Ministry, with a break during the observer's absence on leave. A station for observing upper winds has been opened by the Air Ministry at St. Helena, the records dating from July 17th, 1928.

Meteor Flight, Duxford.—The meteorological flying carried out by the Royal Air Force at Duxford, which has been of material assistance in the forecast work for some years past, has suffered unavoidable setbacks during the year. In December a regrettable accident in the air led to the death of Sergeant Pilot Tostevin, who for a year had acted as second pilot in the Flight, carrying out the work with great enthusiasm. Flying Officer Fielden, who had been responsible for much of the flying for the past two years, left the Flight in December, and this, coupled with the death of Sergeant Pilot Tostevin, led to a break in the regularity of the observations for some time. The regular work of the Flight was, however, resumed before the end of the financial year. Some experiments were carried out with an apparatus to lead air from the outerpart of the wing to thermometers placed alongside the pilot's seat, readings in this position being taken more easily than those from thermometers on the wing strut. The trial had not passed the experimental stage when flying on the type of aeroplane in use had to be abandoned, and it has not been possible to resume the experiments up to the present.

METEOROLOGY FOR THE ARMY

The meteorological stations at Shoeburyness and Larkhill have been maintained as in the past, to provide meteorological data required by the artillery units at these stations. The officers-in-charge at both stations have from time to time delivered lectures to artillery officers and other ranks on the applications of meteorology in gunnery. At Shoeburyness a considerable amount of work has been done in computing weighting factors for wind and temperature for different trajectories. The officer-in-charge at Shoeburyness has continued to be responsible for the issue of forecasts of the probable effects at Southend and elsewhere of the concussion due to the firing of large guns. Experience has shown that it is possible to forecast these effects with reasonable accuracy.

During the summer of 1928, temporary stations were maintained at five artillery practice camps, for the purpose of supplying upper

air data to the artillery units posted to these camps. In addition, similar information was issued from Larkhill to the summer camps on Salisbury Plain, and from Shoeburyness to the Coast Artillery School.

Information has been given to visiting officers from various Dominions, with regard to the equipment and maintenance of meteorological stations at artillery practice camps and elsewhere.

The Meteorological Section of the Royal Air Force Reserve was called up for a period of training during the last fortnight in June. A very high standard of efficiency was attained, and the section showed that it is capable of acting efficiently as a unit. The section now consists of six officers and twenty-three other ranks.

METEOROLOGY FOR THE ROYAL NAVY

During the year there have been further developments of the application of meteorology in the fleet and the work of the Navy Services Division of the Meteorological Office has continued to expand. The assistance which can be rendered by the Meteorological Office is now fully realised by the Navy, and the number of requests for information or advice received from the Admiralty and other naval sources steadily increases. As in previous years close liaison has been maintained with the Admiralty and frequent discussions on meteorological matters concerning the Navy have taken place with the Hydrographer and other naval authorities. The policy of the Superintendent of the Division of keeping in close personal touch with the meteorological and navigating officers of the Fleet by personal visits to H.M. ships whenever opportunity offers has resulted in a considerable increase in the interest shown in meteorology throughout the Fleet.

The Fleet Meteorological Committee appointed by the Admiralty met three times during the year, and a number of memoranda were prepared for the information of the Committee.

Owing to the increase of the work a professional assistant was appointed to the Navy Services Division at the beginning of the year.

In connexion with the scheme mentioned in last year's *Report* for observing the upper air currents in all parts of the world from H.M. Ships, 227 pilot-balloon ascents were made; 54 of these exceeded 10,000 feet, the maximum height being 35,000 feet, while 8 ascents were made at night. Arrangements were made for H.M.A.S. Canberra to make a series of observations during the return voyage to Australia and also for the H.M.S. Durban to make observations on a passage from England to Bermuda via Cape Horn and the Panama Canal.

Arrangements have been made for H.M. Ships when in certain regions which are off the main shipping routes to make meteorological

observations, and to report them to London or Malta. An average of two reports per day have been received in the London Meteorological Office and a much larger number at Malta. These reports from H.M. Ships have been of great value to the forecasters both in London and at Malta.

The great advances which have recently been made in weather forecasting have largely resulted from the extended use of synoptic charts combined with developments of meteorological theory, especially regarding the structure of the atmosphere. Occasions may arise, especially during war, when owing to lack of sufficient data the construction of synoptic charts in a ship will not be possible. Attention is therefore being given to the problem of forecasting for a ship from the observations and autographic records actually available in the ship itself. The solution of this problem is being greatly facilitated by the new knowledge of the structure of the atmosphere, and several naval officers who have studied recent meteorological theory have made valuable suggestions. The Admiralty have decided to depute an officer to make a special study of this subject in the Meteorological Office, and Lieut.-Commander T. R. Beatty, R.N., is now working on this problem at the Air Ministry.

Courses of Instruction for Naval Officers.—Arrangements were made during the year for all meteorological courses for naval officers to be held at the London Meteorological Office. Three courses of instruction for naval officers have now been arranged at the request of the Admiralty:—

- (i) Three months' course for selected naval observers (previously held at Calshot).
- (ii) One month's "refresher" course, for naval observers who have undertaken meteorological duties in aircraft carriers for about two years.
- (iii) One week's meteorological course for surveying officers and officers on the staff of the Navigation School.

During 1928-9 two observers took course (i), one observer took course (ii), and two officers took course (iii). In a normal year about four officers will take courses (i) and (ii), and about eight officers will take course (iii).

OBSERVATORIES

The Meteorological Office maintains five first-order observatories, namely Kew, Eskdalemuir, Aberdeen, Lerwick and Valentia, at which meteorological and geophysical observations are made. These observatories are well spread over the country, being situated in south-east England, southern Scotland, northern Scotland, the Shetland Islands and south-west Ireland, respectively.

At all these observatories self-recording instruments are installed which give continuous records of all meteorological elements which it is possible to record automatically ; eye observations are taken at regular intervals to control the recording instruments and to keep a record of such elements as cannot be automatically recorded. All observatories except Lerwick send observations by telegram to London at the standard hours of 7h, 13h, and 18h.

In addition to meteorological observations, self-recording instruments are installed at Eskdalemuir and Lerwick for giving a continuous record of terrestrial magnetism ; atmospheric electricity is recorded at Kew, Eskdalemuir and Lerwick ; while the seismographs at Kew give a complete record of earthquake activity.

Since 1922 the results obtained at the observatories have been published in a special publication entitled the *Observatories' Year Book*, of which the volume for 1925 was issued during the year under review.

Kew

The ordinary routine work of the Observatory has continued satisfactorily throughout the year without any material change in the methods used.

Seismology.—The Galitzin seismographs have been in operation without interruption. Considerable difficulty has been experienced in the past owing to the changes of zero of the vertical seismograph, due to the effect of changing temperature on the steel spring supplied with the instruments. It was, therefore, decided to see whether this trouble could not be removed by replacing the spring made of ordinary steel by one made of Elinvar steel. The change was effected on May 21st, and the new spring proved entirely successful, the instrument being no longer liable to be put out of action by small temperature changes.

In order to fix with any accuracy the origin of an earthquake recorded by a seismograph, it is necessary to compare the results obtained at a number of stations. Normally the work of locating the origin of earthquakes is deferred until records from the various seismological observatories have been published. There is, however, considerable need for the early determination of the origin of the more important earthquakes. In order to meet this need international co-operation has been arranged in accordance with which certain seismological stations broadcast by wireless telegraphy at the earliest possible moment details of any earthquake recorded by them. An important and welcome addition to this international co-operation commenced on January 1st, 1929, when the Director of the Coast and Geodetic Survey of the United States, in collaboration with the Chief of the Weather Bureau, commenced to broadcast, as part of the synoptic meteorological reports issued from Arlington, information with regard to large earthquakes. The information

given in these American messages is very full, and refers to a number of seismological stations in the western hemisphere, and is not limited to those of the United States. In the first three months of the year 1929, 11 such reports were successfully received at the Air Ministry and transmitted to Kew Observatory. On 36 occasions during the year under review messages of the same nature were prepared at Kew and included by the Air Ministry in the synoptic meteorological reports issued by wireless telegraphy. In addition, communications regarding earthquakes recorded at Kew were issued to the newspapers on 22 occasions.

Atmospheric Electricity.—Some improvements have been made with the apparatus used in connexion with the Kelvin water-dropper electrograph, chief amongst which is an arrangement whereby insulation tests can be recorded photographically in addition to being observed visually. During the severe frosts the electrograph was out of action for an exceptionally long period, but measurements of potential gradient were obtained by the aid of a radio-active collector, so that little loss of record resulted.

Further progress has been made in the development of apparatus for obtaining a continuous record of earth-air current. Good records have been obtained, and it is hoped that a satisfactory method of recording this important element of atmospheric electricity will result.

A series of experiments with the Ebert instrument has thrown much light on the significance of the observations with this apparatus, which have been part of the observatory routine for many years. The apparatus has been designed to give the number of "small" ions in the atmosphere, but it has been known that "large" ions were being caught also. The experiments indicate that on some occasions the large ions are in the majority. This work is being continued.

For many experiments connected with atmospheric electricity it is desirable to make observations immediately above a level surface far removed from any obstacle rising above the general level of the ground. As the presence of an observer and instruments is necessary in these observations, difficulties are experienced owing to the disturbance caused by their presence. A method of removing this difficulty is to instal the observer and instruments underground, in such a way that the observations can be made at the point required. It has, therefore, been decided to construct an underground laboratory in the middle of the large field attached to the observatory and work has been started on its construction.

Radiation.—Considerable attention is given at Kew to the measurement of radiation, both that received from the sun and from the atmosphere. A pyrheliometer of the type designed by Professor Gorczynski, after certain improvements have been carried out, is now in regular use, and gives instantaneous values of the intensity of the direct sunshine during the day.

The radiometer designed by Mr. W. H. Dines and used by him at Benson for observations of radiation received from the sky, has been transferred to Kew Observatory. It has been installed in a room specially constructed under the steps leading to the main entrance to the Observatory, from which an uninterrupted view of the sky to the northward can be obtained.

The Propagation of Air Waves to great Distances.—In the last *Annual Report* (pp. 17, 18) an account was given of an investigation which is being carried out to determine the zones of audibility surrounding the seat of an explosion. This investigation has been continued with interesting and important results. The air waves which are studied are those produced by the firing of a 16-inch gun at Yantlett, Isle of Grain, at the mouth of the Thames. Receiving stations supplied with instruments by the War Office have been established at Bristol, Birmingham, Sheffield, Nottingham, Exeter and Cardiff. Two microphones were in operation at Bristol and three at Birmingham, and at both stations it has been found possible to estimate the angle at which the air waves descend after being reflected from the upper atmosphere. At the other stations it has been possible to determine the intensity of the waves received and the time of their arrival. A striking feature of the observations is that the time of passage of the air waves undergoes slight variations, the cause of which is under investigation.

Investigation of the Upper Atmosphere.—The systematic investigation of the upper atmosphere by means of registering balloons has continued, the work being carried out by the Upper Air Section at Kew Observatory. The total number of registering balloons sent up was 29, of which 10 were lost, this being an unusually large percentage of losses. Of the 19 records recovered, 17 were completely successful.

The instrument used for obtaining records of the upper air is that designed by the late W. H. Dines. The instrument is very successful and cheap. Many other investigators have desired to use this form of instrument, and there has always been difficulty in getting instrument makers to manufacture satisfactory instruments. Arrangements have, however, now been made by which, for a small fee, instruments can be submitted by instrument makers to Kew Observatory for test. Certificates are issued for satisfactory instruments, an arrangement welcomed by the instrument firms as it will put them in a position to supply satisfactory instruments to foreign meteorological services.

ESKDALEMUIR

There are no changes to report in the routine work of the Eskdalemuir Observatory.

A new Fortin barometer, with a tube of diameter 0.7 inch, was brought into use in November. It was adopted as the standard

instrument as from 1st January, 1929, comparative readings of this instrument and the former standard—a Kew pattern barometer—are being continued in order that any change in the pressure records due to the change in the barometers may be completely investigated.

In connexion with the magnetic re-survey of the British Isles, which is being carried out by the Ordnance Survey, Mr. H. L. P. Jolly has been in touch with the Observatory, and information has been supplied to him as to the character of the magnetic conditions at the time of his observations. Mr. Jolly, employing a portable form of the Schuster-Smith coil magnetometer, made observations of declination and horizontal force at Eskdalemuir on May 24th. Values of the magnetic elements at Eskdalemuir at the times of Mr. Jolly's observations in Wales and northern England during May and June, 1928, have been supplied to him.

The condition of the underground magnetic house in respect of condensation of water on the walls and floors continues to cause anxiety. During the first half of the year some improvement was effected by the use of calcium chloride exposed on trays of perforated zinc, but it became apparent that the corridors could not be kept dry by the use of reasonable quantities of this drying agent. Examinations made during the year showed that the greater part of the lath and strapping of the wall plaster is rotten, and that dry rot is affecting the timbers of the ceiling of the west chamber.

ABERDEEN

The Observatory at Aberdeen records only meteorological data. It has maintained a continuous record of barometric pressure, temperature, wind and rainfall for sixty years, and other meteorological observations at specified hours have been made without interruption. The work has continued throughout the year as usual.

Owing to the extension of the University buildings, which encroach seriously on the site where the instruments for recording temperature and rainfall have been exposed, it was necessary to remove the instruments to a new site. The work of fencing in and preparing the new enclosure and installing the instruments was begun in April and observations were commenced at the new site on June 1st. Throughout the month duplicate sets of observations of temperature and relative humidity were made with the thermometers at the old site, and a comparison with the corresponding observations made on the new site showed an agreement between the readings which was much better than had been expected. There should, therefore, be no material break in the continuity of the records as the result of the change.

LERWICK

The Lerwick Observatory was established mainly for observations of terrestrial magnetism, atmospheric electricity and the aurora. Meteorological observations are taken only in so far as they are

necessary for the main purpose of the Observatory, but self-recording instruments for wind, pressure, temperature and sunshine are maintained.

All instruments have been kept in good order, and the complete programme of observations has been carried out. Subsidiary magnetographs recording declination and horizontal force have been installed in a spare non-magnetic hut and have been used to cover lacunæ in the standard traces and for special investigations.

In October, 1928, a Krogness auroral camera was brought into use, and since then every possible opportunity has been taken to obtain photographs of the aurora. This work is being carried out in co-operation with Professor Størmer, of Oslo, who has done very important work in connexion with the investigation of the aurora.

VALENTIA

Valentia Observatory was established chiefly with the object of obtaining complete meteorological records for south-west Ireland. This work has been continued without a break since 1867, but during recent years the work of the Observatory has developed largely as a reporting station for the Forecast Division. The geographical position of Valentia makes it the most important reporting station in Europe, and all meteorological services depend on the accuracy of its observations for the success of their forecasts. In addition to the meteorological work, absolute observations of magnetic declination, horizontal and vertical force, are made weekly.

BRANCH METEOROLOGICAL OFFICES

Edinburgh.—The Edinburgh Meteorological Office acts as a local centre for the organisation of climatological and rainfall stations in Scotland, and for the administration of the three observatories at Eskdalemuir, Lerwick and Aberdeen. The number of climatological stations in Scotland is now 65 and the number of rainfall stations about 840. The Edinburgh Office also receives the monthly registers and autographic records from Scottish telegraphic stations before they are forwarded to London.

A monthly summary of the weather in Scotland, together with statistics for certain large towns has been prepared as usual for the Registrar-General, the tabular matter being in the usual form, while the text was arranged on the lines adopted for the report of the previous year.

Owing to shortage of staff, due to several causes, little progress could be made with the scientific investigations, the whole time of the staff being fully occupied in carrying on the routine work of the Office. Progress was, however, made in formulating a scheme of research which is to be undertaken under the guidance of the

Edinburgh Meteorological Committee. The research has received the approval of the Air Ministry, and it is hoped that considerable progress will be made in the near future.

The MS. volumes of meteorological observations made by the late Arthur Forbes at Culloden from 1841-1880 inclusive were presented to the library in February, 1929, by Major G. D. Warrand, a cousin of the observer. These records form a valuable addition to the library and the Office is grateful to Major Warrand for his welcome gift.

Malta.—The principal work of the Malta Meteorological Office continued to be for the Navy and was carried on along the lines described in the last *Annual Report*. The Army and the Royal Air Force requirements remained much smaller than those of the Navy, but showed some increase. Next in importance to the work for the Navy was that for trans-Mediterranean aviation. This increased considerably. There was an increase also in the number of reports issued to small craft for deep sea passages. A new demand arose as a result of the local authorities and local shipping firms beginning to recognise that the reports were sufficiently reliable to be of use to them.

The amount of information available for the daily forecasts was increased to an important degree by the regular transmission of data from Turkey and the amplification of Greek issues. Very much remains to be done, however, before the information for the Mediterranean region begins to approach that for northern Europe in amount and accuracy. Mention need only be made of two areas—the Sahara, from which unheralded disturbances may come, upsetting the forecast, at any time of year, but especially in winter and spring; and the large expanse of sea, from which there are very few observations, and which occupies all the centre of the synoptic chart prepared in Malta.

There was a large increase in the number of aeroplanes flying across the Mediterranean, all of which required meteorological reports, and in addition special reports for extended flights by Royal Air Force machines based on Malta were supplied on fourteen occasions.

The difficulty of weather forecasting in the Mediterranean is greatly increased owing to two factors: (a) the want of sufficient observations from large areas as already described, and (b) difficulties in the meteorological situation itself due to the distribution of land and water and the large differences of temperature occasioned thereby. Whereas in recent years a considerable amount of special investigation has been directed to solving the problems connected with weather forecasting, especially in northern Europe, no such investigation had been made for the Mediterranean. The Air Ministry, therefore, decided to invite Dr. Thor Bergeron, of the Norwegian Meteorological Service, who has played a very prominent

part in the development of meteorological practice which is associated with the name of Bjerknes, to visit Malta for six months to study the meteorological conditions there and to see how far it is possible to apply the methods developed by Bjerknes and his co-workers to the special problems of the Mediterranean. Dr. Bergeron arrived in Malta in October and remained there for six months, during which period very great energy was displayed both by Dr. Bergeron and the staff of the Meteorological Office in carrying out the special investigation. As was expected, great difficulties were experienced, largely due to the want of reliable observations, but there is no doubt that Dr. Bergeron's visit will lead to considerable additions to the science of weather forecasting, and will be of particular and lasting value to the staff of the Meteorological Office, who co-operated with him in the investigation.

Full use was made by the meteorological officers attached to the Fleet of Dr. Bergeron's stay to receive instruction in the new methods of forecasting, and Dr. Bergeron gave a series of special lectures, which were well attended by officers of the Navy and of the Royal Air Force.

Meteorological Section, Middle East.—In last year's *Annual Report* the establishment of a civil meteorological service in the Middle East Area, to provide the meteorological services required by the Royal Air Force, was recorded. The second year's work of this organisation has mainly consisted in completing the details and training the new staff in its work. The organisation continues along the lines described last year, and no material changes have been made.

Iraq.—The arrangements have continued in Iraq by which the meteorological work is undertaken by R.A.F. personnel. The headquarters are in Baghdad in charge of a flight-lieutenant, who has received special training in meteorology, and who is assisted by a number of airmen who act as clerks and observers.

SPECIAL INVESTIGATIONS

A list of papers published by members of the staff during the year is given on pp. 43-46. Five *Geophysical Memoirs* have been issued. Two of these deal with the connexion between magnetic phenomena and sunspots. One by the late Dr. Chree is mentioned on page 30; the other by J. M. Stagg examines the question of the time interval elapsing between the change in sunspot area and the occurrence of terrestrial magnetic changes. J. M. Stagg was also associated with Professor S. Chapman in a paper on magnetics which appeared in the *Proceedings of the Royal Society of London*. Dr. C. E. P. Brooks appears as the author of two *Memoirs*. In *Memoir No. 41*, in the preparation of which he was associated with

Miss Winifred Quennell, he examines the influence of arctic ice on the subsequent pressure distribution over Europe by the method of correlation, and arrives at a measure of the magnitude of the effect. Dr. Brooks and Miss Quennell tackle another section of the problem of correlating conditions in different parts of the world, which may be held to aim at the ultimate development of a practicable system of seasonal forecasting, in a paper appearing in the *Quarterly Journal of the Royal Meteorological Society*. In that case the Nile Flood, which may be regarded as integrating the rainfall, and hence the general meteorological conditions over a considerable area on the African continent, is brought into relation with European conditions.

In his other *Memoir*, in which Miss G. L. Thorman's name appears as joint author, statistics regarding the mean and extreme annual maxima and minima of temperature for the stations appearing in the *Réseau Mondial* are put together in a form very convenient for ready reference (see page 7). The fifth *Memoir*, which is by Dr. R. E. Watson, deals with measurements of atmospheric electricity carried on at Kew Observatory.

Atmospheric Electricity is also the subject of a paper by Dr. F. J. W. Whipple in the *Quarterly Journal of the Royal Meteorological Society*. In this paper Dr. Whipple considers the diurnal variation of electric potential and refers it to universal time instead of to local time, as is more usually done. He notes a remarkable agreement in phase between the time of maximum potential and the time of maximum thunderstorm activity for the globe as a whole, also considered according to universal time, and makes some interesting suggestions regarding the connexion between the two classes of phenomena.

In the newly established series of *Memoirs of the Royal Meteorological Society* the Office is also well represented. The Director contributes a paper on radiation, in which the problem of the outgoing of radiation for the earth as a whole is considered in the light of the observed temperature data, and some very important and far-reaching conclusions are drawn. Starting from the observed temperatures at the earth's surface and from the temperatures prevailing in the stratosphere, which are also known to us, at any rate in outline, by direct observation and allowing for the absorption of water vapour and carbon dioxide, approximate values are deduced for the outgoing radiation for the earth and its atmosphere. Values are found for the horizontal transfer of heat across circles of latitude necessary to obtain radiation equilibrium for the atmosphere as a whole. The consequences of a possible change in the intensity of solar radiation are considered and the conclusion is drawn that a change in the amount of cloud would be the chief agency by which the balance of the radiation equilibrium would be restored. The somewhat startling, and, at first sight, paradoxical possibility is put forward that an increase in the amount of radiation from the sun might lead to an ice age on the earth.

A *Memoir*, of which D. Brunt and C. K. M. Douglas are joint authors, entitled "The modification of the strophic balance for changing pressure distribution, and its effect on rainfall," breaks new ground in another direction. In the mathematical section Mr. Brunt deals with the mathematical relation between wind and pressure distribution, and shows how certain corrections which are generally dismissed as being of the second order and, therefore, negligible in the practical application of the theory may be brought into account by using the map of isallobars which appears in the *Daily Weather Report* as a small inset alongside the map showing the conditions at 7 a.m. In the second section of the paper Captain Douglas deals with the application of the theory to selected weather maps and the distribution of rain shown on them. In another *Memoir* L. H. G. Dines discusses the variation of temperature in the stratosphere as disclosed by the ascents of registering balloons, approximately 350 in number, made in the British Isles in the years from 1909 to 1925, thus carrying on the work which was commenced by his father, the late W. H. Dines, F.R.S., and described by him in a classical paper first published in the *Philosophical Transactions of the Royal Society* and subsequently incorporated in the comprehensive review of the state of upper air research in Great Britain, which was issued by the Office in 1911 as the second number in the series of *Geophysical Memoirs* under the title "The free atmosphere in the region of the British Isles."

STAFF

Details of the staff and its distribution will be found on pp. 37-41. No changes in the establishment have been made during the year, but the Office has lost the services of two officers in the grade of assistant superintendent by reason of their secondment to other departments for special duty and the professional staff has been further depleted by one resignation and one death. These losses of experienced officers have hampered the work considerably. Three vacancies on the clerical staff have been filled by established officers recruited through the Civil Service Commission's examination for the general clerical class; other vacancies on the clerical side have again been filled on a temporary basis.

News of the death, on August 12th, of Dr. Charles Chree, F.R.S., was received with extreme regret. Dr. Chree had directed the work of Kew Observatory from 1893 until his retirement under the age limit in 1925. At the time of his retirement there was every reason for hoping that Dr. Chree had many years of useful work still before him and that he would be able to continue to act as President of the International Commission for Terrestrial Magnetism and Atmospheric Electricity and of the Magnetic Section of the International Union of Geodesy and Geophysics, for which the unique position which he had won for himself as a magnetician so eminently qualified him. Unfortunately the hope has not been realised, and his death after a few months' illness is a great loss to magnetic science. Dr.

Chree continued at work almost to the end, and during the last few months of his life was engaged in an important investigation on the dependence of the diurnal magnetic variation on the sunspot cycle, the results of which are set out in a *Geophysical Memoir* issued in November last. The work on this was done entirely by Dr. Chree, but the final correction of the proof sheets had to be carried out by other hands.

The death of Mr. Andrew Watt, F.R.S.E., on January 9th of this year, came as a great shock to members of the staff. Mr. Watt entered the service of the Office in 1920, when the Office took over from the Scottish Meteorological Society the responsibility for climatological work in Scotland. He had previously acted as Secretary of the Society as successor to the late Dr. Alexander Buchan, F.R.S. Mr. Watt was within a few months of his retirement under the age limit, but his end was quite unexpected, and he had actually been at work as usual on the day of his death.

News was also received of the death, on May 31st, 1928, at the age of 80 of Mr. J. A. Curtis, formerly Chief Clerk and Cashier.

It is a pleasure to record that the Simms Gold Medal of the Royal Aeronautical Society has been awarded to Captain F. Entwistle, Superintendent of the Aviation Services Division, in recognition of his paper on "Fog," read before the Society in December, 1927.

INTERNATIONAL MEETINGS

International Commission for Synoptic Weather Information.—A meeting of the International Commission for Synoptic Weather Information, of which Lieut.-Colonel E. Gold is President, was held in London during the week May 29th to June 2nd.

Nearly all the European members of the Commission attended the meeting, as well as Dr. Marvin, Chief of the United States Weather Bureau, and Mr. E. B. Calvert, Chief of the Forecast Service of the Weather Bureau. The last meeting of the International Meteorological Organisation, at which representatives of the United States attended, was the meeting of the Commission for Weather Telegraphy in London in 1909.

At the previous meeting of the Commission in Zurich in 1926 a Sub-Commission had been appointed conjointly by the Commissions for Synoptic Weather Information and Maritime Meteorology to consider the method of collecting and distributing the reports from ships at sea. The Sub-Commission met in Paris during May, under the chairmanship of General Delcambre, the Director of the Meteorological Office of France, and prepared a scheme for the consideration of the Commission at its meeting in London. The scheme which,

after some slight modification, received the approval of the Commission, envisages the collection of reports from all ships at selected wireless stations and provides for the repetition of the reports for the benefit of all countries. It provides also for the reports to be made in a universal code and for the observations to be made at standard hours of Greenwich time in all the oceans. Before executive action is taken generally by the different services concerned to give effect to the scheme, the scheme requires also the approval of the International Commission for Maritime Meteorology, which was jointly responsible for the appointment of the Sub-Commission.

In the last *Report* mention was made of the reservation of two wave-lengths for meteorological synoptic messages in the European region by the International Radio-Telegraphic Convention at Washington. The Commission for Synoptic Weather Information at its meeting in London considered the best method of securing the improvement of synoptic exchange which it was the intention of the reservation of wave-lengths to achieve. The Commission decided that the best method would be to have one station in France using one of the two wave-lengths and another station in Germany using the other wave-length. At these two stations reports from different countries would be collected as they were issued by the national services and re-issued without delay for the use of all meteorological services. The reports re-issued from the station in France would be those of the countries of western Europe, while those re-issued from the station in Germany would be for the countries of the rest of Europe, excluding Russia and the Balkans. The reports from Russia are already issued in collective form, while the organisation of the Balkans is not yet sufficiently complete to enable a collective method to be applied at once. The two wave-lengths to be used for these collective meteorological messages have been notified by France and Germany to the International Telegraphic Bureau at Berne and the arrangements for giving effect to the scheme prepared by the Commission are being made by a Sub-Commission appointed at the meeting in London.

The third important matter dealt with at the meeting of the Commission in London related to the international code for the exchange of meteorological reports. At the meeting of the Commission held in London in 1920 a new international code was adopted for use in telegraphic meteorological reports, and this was approved by the International Meteorological Committee in 1921. The code marked a great advance on the pre-war codes, but at the time of its introduction neither the Norwegian ideas of the polar front nor the French ideas of the systems of cloud had been much developed; these ideas profoundly affect modern forecasting; they must, therefore, affect the conception of a code for telegraphic reports. Moreover, as the meteorological map extends in area, the necessity of a world-wide code becomes increasingly obvious. The revision of the code prepared in 1920, which applies primarily to the temperate

zone, is therefore inevitable if it is to become universal and in conformity with the recent advances in meteorological science. The first steps towards its revision were taken at the meeting at Utrecht in 1923; further advance was made at Zurich in 1926; and at the meeting in London in 1928 a new code was prepared which is designed to meet requirements in all countries: polar, temperate and tropical, and to give an adequate description of those skies which are found to be characteristic of different "air." This new code also is to be communicated to meteorological services in all countries for their consideration, preliminary to a decision being taken at the meetings of the Conference and Committee in September, 1929.

Ever since the establishment of international weather telegraphy, the difference in the units employed has been a continued source of difficulty. Broadly, the English-speaking countries have used the inch for rainfall, the degree Fahrenheit for temperature and the mercury inch for pressure, while the majority of other countries have used the millimetre for rainfall, the degree Centigrade for temperature, and the mercury millimetre for pressure. In Europe uniformity in regard to rainfall was achieved in 1914, since when the millimetre has been used for all international reports by telegraphy and wireless telegraphy. For temperature the degree Fahrenheit and the degree Centigrade continue to be used and no bridge has been found to surmount the difficulty. The introduction of the millibar as a practical unit of pressure on the C.G.S. system offered a solution of the difficulty in regard to the mercury inch and the mercury millimetre, and it is satisfactory to record that the Commission at its meeting in June, 1928, resolved by 15 votes to 2 that in synoptic messages issued by W/T for international exchange the pressure should be expressed in millibars. It is perhaps worthy of mention that the dissentients were not two of the English-speaking countries, but were Denmark and Russia. The representative of Russia expressed himself as favourable to the proposal, but unable to vote for it because of the practical difficulties of introducing it into the Russian service at present.

International Commission for Air Navigation.—A meeting of the Meteorological Sub-Commission of the International Commission for Air Navigation was held in Paris, November, 1928. At this meeting the representatives of the meteorological services reached agreement on the difficult question of an international code for the exchange of short-period forecasts for aviation and the code recommended by the Sub-Commission was adopted subsequently at the meeting of the Commission which was held in Brussels in March, 1929.

Lieut.-Colonel Gold represented the Meteorological Office at Paris at the meeting of the Sub-Commission, when he was elected Chairman for the ensuing year, and at Brussels at the meeting of the Commission.

APPENDIX I
CLASSIFICATION OF STATIONS WHICH REPORT TO THE
BRITISH CLIMATOLOGY DIVISION

DISTRICTS	STATIONS						AUTOGRAPHIC RECORDS					
	Observatories	Distributive	Telegraphic	Crop Weather	Climatological	Rainfall only	Sunshine	Rainfall	Wind	Pressure	Temperature	Humidity
0 Scotland, N. ...	1	0	3	0	9	129	9	0	2	6	0	0
1 " E. ...	1	1	2	2	27	342	17	2	2	3	3	3
6A " W. ...	1	1	1	0	20	315	15	2	2	3	2	1
2 England, N.E. ...	0	1	2	3	18	257	16	2	5	4	1	0
3 " E. ...	0	3	2	3	17	408	20	1	4	4	2	1
4 " Midlands ...	0	2	3	4	35	971	28	13	1	4	2	2
5 " S.E. ...	0	7	3	3	40	840	39	7	11	9	10	3
London District ...	2	0	0	0	8	58	8	6	1	1	2	1
8B England, S.W. ...	0	1	2	5	31	434	28	2	4	4	3	2
7A " N.W. ...	0	0	1	1	19	448	19	0	3	1	0	0
7B N. Wales ...	0	2	0	1	5	161	6	2	3	4	2	2
8A S. " ...	0	0	1	2	7	213	10	0	1	1	1	0
9 Ireland, N. ...	0	1	3	0	6	110	4	3	3	5	1	1
10 " S. ...	1	0	2	0	15	135	6	1	2	6	0	0
6B Isle of Man ...	0	0	0	0	1	8	1	0	0	0	0	0
11 Scilly and Channel Isles ...	0	0	2	0	2	25	3	0	2	2	1	0
TOTAL ...	6	19	27	24	267	4970	229	41	46	57	30	21
Corresponding number for last year ...	6	17	28	24	267	4873	219	64	40	42	26	17

The observatories and distributive stations which are classified in the table are operated by the staff of the Office. Reports on the work of the observatories will be found on pages 20-25. The distributive stations are administered by the Army, Aviation, and Airship Services and particulars of their work will be found on pages 11-19. The telegraphic stations are, as a rule, maintained at coastguard stations or lighthouses by arrangement with the respective authorities. The meteorological observations at these stations are made expressly for the purposes of the daily weather service and form part of the regular work of the station staff, for which payment is made from the Office. Further particulars will be found on pages 5-6. The "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 Board of Agriculture for Scotland, and the arrangements for the observations are under the general control of a committee on which the Office is represented.

APPENDIX II

GALE WARNINGS ISSUED DURING THE YEAR 1928

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
1. Scotland N.E. { A	15	93	40	14	14	70
{ B	6	100	36	6	18	67
2. Scotland, E. ...	11	82	32	9	12	66
3. Scotland, N.W. ...	20	95	47	19	19	81
4. Scotland W. and North Channel ...	17	94	47	16	24	85
5. Ireland, N. ...	15	93	49	14	24	78
6. Ireland, S. ...	13	100	53	13	29	79
7. Irish Sea ...	13	100	41	13	21	83
8. St. George's Channel	17	88	44	15	18	75
9. Bristol Channel ...	28	86	46	24	10	74
10. England, S.W. ...	24	96	51	23	19	82
11. England, S....	14	100	39	14	16	77
12. England, S.E. ...	16	100	35	16	13	83
13. England, N.E. ...	8	88	28	7	17	86
14. England, E....	15	73	29	11	15	90
TOTALS ...	232	92	617	214	269	78

APPENDIX III

FINANCIAL STATEMENT

The year under review, 1928-9, is the ninth in which the cost of the Meteorological Office has been borne on Air Ministry Votes. The accounts are not yet closed, it is therefore impossible to give the exact amounts for the expenses and receipts of the Meteorological Office, but the following tables give the approximate figures:—

APPROXIMATE STATEMENT OF EXPENDITURE AND RECEIPTS IN RESPECT
OF METEOROLOGICAL SERVICES DURING THE YEAR 1928-9.

<i>Expenditure.</i>		<i>Amount.</i>	
		£	£
Salaries and Wages—H.Q. Establishments	... ..	49,234	
" " —Out-station Establishments	... ..	55,605	
			104,839
Fuel and Light	... ..		538
Transport of Personnel and Equipment	... ..		3,350
Instruments, Equipment and Stores	... ..		8,359
Minor Works Services, Rents, Repairs and Maintenance of Buildings	... ..		5,364
Research	... ..		619
Telegrams, Cables and Telephones	... ..	
Subventions and Reporting Stations	... ..		11,410
Miscellaneous	... ..	
Superannuation	... ..		1,829
			<hr/>
	Total ...		£136,308
			<hr/> <hr/>
<i>Receipts.</i>			
Receipts from Royal Society	... ..		685
" " National Debt Commissioners (Annuities)	... ..		180
Sale of Instruments, Carriage, etc.	... ..		3,699
Daily Weather Reports, Forecasts, etc.	... ..		2,237
Receipts from War Office	... ..		6,078
			<hr/>
	Total ...		£12,879
			<hr/> <hr/>

APPENDIX IV

THE GASSIOT COMMITTEE, 1928

Appointed by the Royal Society in accordance with Treasury Letter of 26th February, 1910, to administer the Gassiot Trust, and to promote the scientific study of the branches of science to which the Trust relates, viz :— Meteorology, Terrestrial Magnetism, Atmospheric Electricity, Seismology and the cognate subjects.

Sir ERNEST RUTHERFORD, O.M., D.Sc., G.B.E. (*President of the Royal Society*).

Colonel Sir HENRY LYONS (*Chairman*).

The Astronomer Royal.

Professor S. CHAPMAN.

Dr. C. CHREE (deceased August, 1928).

Sir JAMES JEANS.

Sir NAPIER SHAW.

Dr. G. C. SIMPSON.

Professor G. I. TAYLOR.

APPENDIX V

THE STAFF OF THE METEOROLOGICAL OFFICE, ITS
OBSERVATORIES AND BRANCHES, 31ST MARCH, 1929

THE STAFF AT HEADQUARTERS

DIRECTOR :

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

Assistant Directors R. G. K. Lempfert, C.B.E., M.A., F.Inst.P.
E. Gold, D.S.O., F.R.S.
Senior Professional Assistant Miss E. E. Austin, M.A.

GENERAL SERVICES DIVISION.

Chief Clerk H. L. B. Tarrant.
Clerk, Grade I R. M. Poulter.
Clerks, Grades II & III ... 9
Officekeeper 1

MARINE DIVISION.

Superintendent L. A. Brooke Smith, Captain R.N.R. (retd.),
R.D.
Senior Professional Assistants E. W. Barlow, B.Sc.; J. Hennessy, Cdr
R.N.R. (retd.), R.D.
Clerk, Grade I H. Keeton.
Clerks, Grades II & III ... 10

BRITISH CLIMATOLOGY DIVISION.

Superintendent R. Corless, O.B.E., M.A.
Assistant Superintendent ... E. V. Newnham, B.Sc.
Senior Professional Assistants J. Glasspoole, M.Sc.; Ph.D., P. I. Mulholland,
B.Sc.
Clerk, Grade I A. G. W. Howard.
Clerks, Grades II & III ... 16
Draughtsman 1

GENERAL CLIMATOLOGY DIVISION.

Superintendent C. E. P. Brooks, D.Sc.
Senior Professional Assistants Miss E. H. Geake, M.Sc.; S. T. A. Mirrlees,
M.A.; Miss L. D. Sawyer, B.A.
Junior Professional Assistant Miss G. L. Thorman, B.Sc.
Clerk, Grade I A. T. Bench.
Clerks, Grades II & III ... 7

FORECAST DIVISION.

Superintendent J. S. Dines, M.A.
Assistant Superintendents ... J. Crichton, M.A., B.Sc.; C. K. M. Douglas,
B.A.; W. H. Pick, B.Sc.
Senior Professional Assistants F. H. Dight, B.Sc.; L. Dods, B.Sc.; Miss
L. F. Lewis, B.Sc.; S. C. Russell, LL.B.
Junior Professional Assistants F. E. Coles, B.Sc., A.R.C.S., D.I.C.; E. A.
Cope, B.Sc., A.R.C.S.; A. G. Forsdyke,
Ph.D., A.R.C.S., D.I.C.; H. Garnett, M.Sc.
Clerk, Grade I W. Hayes.
Clerks, Grades II & III ... 20
Telephone-Typists 8

APPENDIX V—continued.

AVIATION SERVICES DIVISION.

<i>Superintendent</i>	...	...	F. Entwistle, B.Sc.
<i>Assistant Superintendent</i>	...	...	R. S. Read, M.A., B.Sc., A.R.C.S., F.Inst.P.
<i>Senior Professional Assistants</i>	...	...	C. H. Kellett, B.Sc.; C. W. Lamb, M.C., B.Sc.; E. Taylor, M.A., B.Sc.; M. J. Thomas, B.Sc.; S. F. Witcombe, B.Sc.;
<i>Clerk, Grade I</i>	...	...	F. M. Dean.
<i>Clerks, Grades II & III</i>	...	...	4

AIRSHIP SERVICES DIVISION.

<i>Superintendent</i>	...	...	M. A. Giblett, M.Sc.
<i>Clerks, Grade III</i>	...	...	2 (and one research post)

NAVY SERVICES DIVISION.

<i>Superintendent</i>	...	...	L. G. Garbett, Commander, R.N. (retd.).
<i>Senior Professional Assistant</i>	A. H. Nagle, B.Sc., A.R.C.S., D.I.C.

ARMY SERVICES DIVISION.

<i>Superintendent</i>	D. Brunt, M.A., B.Sc.
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INSTRUMENTS DIVISION.

<i>Superintendent</i>	E. G. Bilham, B.Sc., A.R.C.S., D.I.C.
<i>Senior Professional Assistant</i>	J. E. Belasco, B.Sc.
<i>Junior Professional Assistant</i>	...	...	D. W. Johnston, B.Sc.
<i>Clerk, Grade I</i>	...	...	P. N. Skelton.
<i>Clerks, Grade III</i>	...	...	7
<i>Draughtsman</i>	...	...	1
<i>Instrument Designer</i>	...	...	1
<i>Storeman, Packer and Porter</i>	...	...	3

THE STAFF AT OBSERVATORIES AND BRANCH ESTABLISHMENTS

METEOROLOGICAL OFFICE, 6, Drumsheugh Gardens, EDINBURGH.

<i>Superintendent</i>	...	...	A. H. R. Goldie, M.A., F.R.S.E.
<i>Assistant Superintendent</i>	...	...	Vacancy
<i>Senior Professional Assistant</i>	...	...	D. N. Harrison, D.Ph.
<i>Clerks, Grade III</i>	...	...	5 (one vacancy)

METEOROLOGICAL OFFICE, MALTA.

<i>Superintendent</i>	...	...	W. A. Harwood, D.Sc.
<i>Senior Professional Assistants</i>	...	...	G. A. Bull, B.Sc.; R. C. Sutcliffe, Ph.D.
<i>Clerk, Grade II</i>	...	...	1
<i>Clerks (locally entered)</i>	...	...	4

METEOROLOGICAL OFFICE, MIDDLE EAST.

HELIOPOLIS.

<i>Superintendent</i>	...	...	J. Durward, M.A.
<i>Senior Professional Assistant</i>	...	...	W. D. Flower, B.Sc.
<i>Clerk, Grade I</i>	...	...	R. Pyser.
<i>Clerks (locally entered)</i>	...	...	4

APPENDIX V—continued.

ABOUKIR, AMMAN, ISMAILIA AND RAMLEH.

Clerks, Grade II 4
Clerks (locally entered) 4

KEW OBSERVATORY, Old Deer Park, Richmond, Surrey.

Assistant Director F. J. W. Whipple, Sc.D., F.Inst.P.
Senior Professional Assistants F. J. Scrase, M.A., B.Sc., A.I.C.; R. E. Watson, Ph.D.
Junior Professional Assistant H. L. Wright, M.A.
Clerk, Grade I E. Boxall.
Clerks, Grades II & III ... 5 (one vacancy)
Caretaker and Handyman ... 2

KEW OBSERVATORY (Upper Air Section), Richmond, Surrey.

Assistant Superintendent ... L. H. G. Dines, M.A., A.M.I.C.E.
Instrument Maker 1
Mechanic and Carpenter ... 2

VALENTIA OBSERVATORY, Cahirciveen, Co. Kerry.

Assistant Superintendent ... M. T. Spence, B.Sc.
Clerks, Grade III 4
Messenger 1

THE OBSERVATORY, ESKDALEMUIR, Langholm, Dumfriesshire.

Assistant Superintendent ... H. W. L. Absalom, B.Sc., A.R.C.S., D.I.C.
Senior Professional Assistant J. M. Stagg, M.A., B.Sc.
Clerks, Grade III 3
Housekeeper, Mechanic and Handyman 3

THE OBSERVATORY, King's College, ABERDEEN.

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

THE OBSERVATORY, LERWICK, Shetlands.

Senior Professional Assistant A. W. Lee, M.Sc., A.R.C.S., D.I.C., A.Inst P.
Clerks, Grade III 3
Caretaker 1

PORT METEOROLOGICAL OFFICE, Liverpool.

Senior Professional Assistant M. Cresswell, Lt.-Cdr. R.N.R.
Clerk, Grade II (Temp.) ... 1

AVIATION SERVICES STATIONS

ALDERGROVE.

Senior Professional Assistant W. Gillon, M.A., B.Sc.
Clerks, Grades II & III ... 3

BIGGIN HILL.

Clerks, Grades II & III ... 3

APPENDIX V—continued.

CALSHOT.

<i>Assistant Superintendent</i> ...	H. F. Jackson, M.S.E.
<i>Junior Professional Assistant</i>	C. W. G. Daking, B.Sc.
<i>Clerks, Grades II & III</i> ...	4 (one vacancy).

CATTEWATER.

<i>Clerks, Grades II & III</i> ...	2
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CRANWELL.

<i>Assistant Superintendent</i> ...	Vacancy.
<i>Junior Professional Assistant*</i>	G. J. W. Oddie, B.Sc.
<i>Clerks, Grades II & III</i> ...	4

CROYDON.

<i>Assistant Superintendent</i> ...	G. R. Hay, M.A.
<i>Senior Professional Assistants</i>	J. S. Farquharson, M.A.; A. Walters.
<i>Clerks, Grades II & III</i> ...	8
<i>Telephone-Typists</i> ...	2

FELIXSTOWE.

<i>Senior Professional Assistant</i>	T. W. V. Jones, B.Sc.
<i>Clerks, Grades II & III</i> ...	3 (one vacancy).

HOLYHEAD.

<i>Clerks, Grades II & III</i> ...	3
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LEUCHARS.

<i>Senior Professional Assistant</i>	R. H. Mathews, B.A.
<i>Clerks, Grade II & III</i> ...	3 (one vacancy).

LYMPNE.

<i>Senior Professional Assistant</i>	R. M. Stanhope, B.A.
<i>Clerks, Grades II & III</i> ...	6

MANSTON.

<i>Senior Professional Assistant</i>	H. St. G. Dyke-Marsh, B.A.
<i>Clerks, Grade II & III</i> ...	3

RENFREW.

<i>Senior Professional Assistant</i>	W. J. Grassick, M.A., B.Sc.
<i>Clerks, Grade III</i> ...	2

SEALAND.

<i>Senior Professional Assistant</i>	J. J. Somerville, B.A., B.L.
<i>Clerks, Grades II & III</i> ...	3

SOUTH FARNBOROUGH.

<i>Senior Professional Assistant</i>	W. H. Bigg, B.Sc.
<i>Clerks, Grades II & III</i> ...	3

* Held against vacancy for Senior Professional Assistant.

APPENDIX V—continued.

UPPER HEYFORD.

Senior Professional Assistant N. H. Smith, B.Sc.
Clerks, Grade II & III ... 3.

WORTHY DOWN.

Senior Professional Assistant C. V. Ockenden, B.Sc.
Clerks, Grades II & III ... 3

AIRSHIP SERVICES STATIONS

CARDINGTON.

Assistant Superintendent ... W. C. Kaye, B.Sc.
Senior Professional Assistants C. S. Durst, B.A. ; B. C. V. Oddie, B.Sc. ;
 S. P. Peters, B.Sc., A.Inst.P.
*Junior Professional Assistants** A. F. Crossley, B.A. ; D. E. Smith, M.A.
Clerks, Grades II & III ... 5
Draughtsman ... 1
Telephone-Typist ... 1

ARMY SERVICES STATIONS

METEOROLOGICAL OFFICE, SHOEBURYNNESS.

Assistant Superintendent ... E. E. Britton, B.Sc.
Junior Professional Assistant O. G. Sutton, B.Sc.
Clerks, Grades II & III ... 12

METEOROLOGICAL OFFICE, LARKHILL.

Senior Professional Assistant J. Wadsworth, M.A.
Clerks, Grades II & III ... 4

METEOROLOGICAL OFFICE, PORTON.

Clerks, Grades II & III ... 5

SECONDED FOR DUTY WITH OTHER BODIES

Assistant Superintendents ... N. K. Johnson, M.Sc., A.R.C.S. (War Office,
 Porton Experimental Station).
 C. D. Stewart, B.Sc. (Colonial Office, Malaya).
Senior Professional Assistants R. P. Batty, B.A. (R.A.F., India).
 E. L. Davies, M.Sc. } (War Office, Porton
 A. C. Best, B.Sc. } Experimental Station).
 R. F. Budden, M.A. }
 R. G. Veryard, B.Sc. (R.A.F., India).
 L. G. Hemens, B.Sc. (Indian Government).
 R. A. Watson (Mauritius).

* Held against vacancies for Senior Professional Assistants.

APPENDIX VI

PUBLICATIONS

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

PERIODICAL :—

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

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

The Monthly Weather Report with a summary for the year (to February, 1929).

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 of upper winds in the form approved by the International Commission for Air Navigation (to February, 1928).

Seismological Bulletin. A diary of seismological disturbances recorded on the Galitzin Aperiodic Seismographs at Kew Observatory, Richmond (to February, 1929).

The British Meteorological and Magnetic Year Book :—

Part V. **Réseau Mondial**. Monthly and annual summaries of pressure, temperature and precipitation at land stations, generally two for each 10-degree square of latitude and longitude. Volume for 1921.

The Observatories' Year Book. Comprising the meteorological and geophysical results obtained from autographic records and eye observations at the observatories at Lerwick, Aberdeen, Eskdalemuir, Cahir-civeen (Valentia Observatory), and Richmond (Kew Observatory), and the results of soundings of the upper atmosphere by means of registering balloons. Volume for 1926.

British Rainfall, 1927. A report on the distribution of rain in space and time over the British Isles as recorded by about 5,000 observers.

Southport Auxiliary Observatory. Annual Report and results of meteorological observations. By J. Baxendell. Report for the year 1927.

OCCASIONAL :—

Meteorological Reports issued by Wireless Telegraphy in Great Britain and the countries of Europe and North Africa. 6th edition, 1928.

Wireless and Weather : An Aid to Navigation. By Captain L. A. Brooke Smith, R.D., R.N.R. Reprinted from the *Marine Observer*, Vol. IV, with three appendices giving particulars of Ships' Wireless Weather Signals, British Wireless "Weather Shipping" Bulletin and Decode Tables of the International Weather Telegraphy Code.

Book of Normals of Meteorological Elements for the British Isles :—
Section VI. Normals of Relative Humidity.

OCCASIONAL.—*continued.*

Geophysical Memoirs :—

Vol. V :—

41. Influence of Arctic Ice on the Subsequent Distribution of Pressure over the Eastern North Atlantic and Western Europe. By C. E. P. Brooks, D.Sc., and Winifred A. Quennell.
42. Time Interval between Magnetic Disturbance and Associated Sunspot Changes. By J. M. Stagg, M.A., B.Sc.
43. The Regular Diurnal Variation of Magnetic Declination at Kew Observatory, from selected years of many and few sunspots, 1859–1894. By C. Chree, Sc.D., LL.D., F.R.S.
44. The Distribution of Mean Annual Maxima and Minima of Temperature over the Globe. By C. E. P. Brooks, D.Sc., and Miss G. L. Thorman, B.Sc.
45. Measurements of the Effective Electrical Conductivity of the Air and the Earth's Electric Field at and near Ground Level by means of the Wilson Universal Electrometer. By R. E. Watson, Ph.D.
46. A Study of the Vertical Gradient of Temperature in the Atmosphere near the Ground. By N. K. Johnson, M.Sc., A.R.C.S.

Professional Notes :—

Vol. IV :—

49. Sunspots and the Distribution of Pressure over Western Europe. By C. E. P. Brooks, D.Sc.
50. Some Regions of Formation of Depressions in the North Atlantic. By L. Doris Sawyer, B.A.
51. Changes of Zero in Spirit Thermometers. By W. F. Higgins, M.Sc., Physics Department, National Physical Laboratory, and E. G. Bilham, B.Sc., A.R.C.Sc., D.I.C., Superintendent of Instruments, Meteorological Office.

Report of the Seventh Meeting of the International Commission for Synoptic Weather Information. London, 1928.

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

By G. C. SIMPSON, C.B., D.Sc., F.R.S.—

Further studies in terrestrial radiation. *London, R. Meteor. Soc., Mem.* 3, No. 21, 1928, pp. 1–26.

Summary of above in *Washington, D.C. Monthly Weather Review*, 56, 1928, pp. 322–323.

Die Theorie der Gewitter. *Meteorologische Zeitschrift, Braunschweig*, 45, 1928, pp. 321–326.

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

On the association of the diurnal variation of electric potential gradient in fine weather and the distribution of thunderstorms over the globe. *London, Q. J. R. Meteor. Soc.*, 55, 1929, pp. 1–13.

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