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30 SEP 1931

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ANNUAL REPORT

of the Director of the
METEOROLOGICAL OFFICE

presented by the Meteorological Committee
to the Air Council

For the Year ended
March 31
1931

*The Seventy-sixth Year of the
Meteorological Office*

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1931

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METEOROLOGICAL COMMITTEE
1930-31

Appointed by the Air Council.

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

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

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.

Colonel Sir HENRY LYONS, F.R.S. Nominated by the Royal Society.

<p>Sir HENRY McANALLY, C.B. (To November 30, 1930.)</p> <p>J. A. WEBSTER, C.B., D.S.O. (From December 1, 1930.)</p>	}	<p>Principal Assistant Secretary, Air Ministry. Nominated by the Air Ministry.</p>
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<p>Mr. L. V. MEADOWCROFT, (To September 21, 1930.)</p> <p>Mr. C. N. KNIGHT, O.B.E. (From September 22, 1930.)</p>	}	<p>Assistant Secretary, Air Ministry. Nominated by the Air Ministry.</p>
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Sir THOMAS MIDDLETON, K.B.E., K.C.I.E., C.B., Development Commission. Nominated by the Ministry of Agriculture and Fisheries.

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

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

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

Secretary :—Mr. D. BRUNT, M.A.

**COMMITTEE OF THE METEOROLOGICAL OFFICE,
EDINBURGH, 1930-31.**

Chairman :—The Director of the Meteorological Office.

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

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

Dr. J. PARLANE KINLOCH. Nominated by the Department of Health for Scotland.

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

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

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

Dr. J. E. CROMBIE, M.A., LL.D. Nominated by the University of Aberdeen.

Professor J. R. CURRIE, M.A., M.D., D.Ph. Nominated by the University of Glasgow.

A list of the staff and of the divisions and establishments of the Office will be found on pp. 43 to 47.

ANNUAL REPORT of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the year ending March 31, 1931 (the seventy-sixth year of the Meteorological Office).

The Meteorological Committee met three times during the year, on July 30 and November 12, 1930, and March 11, 1931. Sir Henry McAnally, C.B., who retired from the staff of the Air Ministry at the end of November, 1930, was succeeded by Mr. J. A. Webster, C.B., D.S.O. Mr. L. V. Meadowcroft, who retired from the Committee in September, 1930, was succeeded by Mr. C. N. Knight, O.B.E. Sir Henry McAnally had served on the Meteorological Committee since its re-organisation in October, 1919, on the transfer of the Meteorological Office to the Air Ministry; and Mr. Meadowcroft had served since December, 1919. The valuable assistance which they had given during their long period of membership was highly appreciated by the Committee.

The Edinburgh Meteorological Committee met on January 21, April 1, June 17, and October 28, 1930, and February 10, 1931. Dr. J. E. Crombie, M.A., LL.D., was nominated as representative of the University of Aberdeen.

Staff.—The staff has suffered a grievous loss through the death of M. A. Giblett in the disaster to the Airship R.101. Giblett joined the staff of the Office in March 1919, as a senior professional assistant. He was commissioned in the Meteorological Section of the Royal Engineers in the following August, and served as Meteorological Officer with the British Expeditionary Force in North Russia. On his return he was attached to the Forecast Service and soon attracted notice by his scientific ability and keen power of application. He became one of the principal exponents in this country of the new ideas regarding the structure of depressions which had been developed in Norway and published a number of papers on the subject, some in collaboration with his friend, J. Bjerknæs. In 1924 he attended the Meeting of the British Association in Toronto as meteorological secretary of Section A. On the return journey he and Bjerknæs arranged for the ship's wireless station to pick up the synoptic data from America and Europe, and also the weather reports from other ships. From the data collected they drew synoptic charts thus demonstrating the practicability of synoptic forecasting at sea. When in 1924 it became necessary to have a special division of the Office for dealing with the many problems arising from the applications of meteorology in airship work, Giblett was selected as its Superintendent. He threw himself into his new task with

characteristic energy, and soon won the confidence of all with whom he came in contact. He became the trusted colleague of Richmond, Scott, Colmore and the other members of the devoted band who worked together in the great enterprise.

Details of the staff and its distribution will be found on pp. 43-7. On the professional side three new posts have been added to the establishment. One of these is at Headquarters in the Navy Services Division to enable more attention to be given to the courses of instruction in meteorology for naval officers. The other two are at Catterick and Mount Batten respectively, where the requirements of the Royal Air Force have made it necessary to establish normal distributive stations. The establishment of a Port meteorological office in the London Docks in charge of a master mariner, graded as professional assistant, has added another senior post.

Mr. J. Wadsworth, M.A. resigned from the staff in May, 1930, to take up the Directorship of the Apia Observatory, Samoa, under the Government of New Zealand.

Mr. M. G. Bennett, M.Sc., has joined the staff to take charge of the special investigation of visibility to which reference is made on page 32.

The clerical establishment shows an increase of eleven posts. Two of these are in the Marine Division to cope with the arrears of data extraction (p. 11), one is in the British Climatology Division, which now undertakes the preparation of summaries of the observations of stations taking part in the Ministry of Agriculture's Crop Weather Scheme, and one is in the Navy Services Division. The remaining seven posts are at out-stations, and arise from the establishment of distributive stations at Mount Batten and Catterick and from the increased night flying on civil air routes which has made it necessary to provide for hourly observations throughout the 24 hours at Croydon, Lympne and Biggin Hill. Five clerks were assigned to the Office in the course of the year by the Civil Service Commission, and the system of recruitment through the Commission's examination for the general clerical class may now be regarded as working satisfactorily, apart from the slowness in filling vacancies when they arise. At the end of the year no less than 12 authorised posts showed vacancies.

It was stated in the last *Annual Report* that during the year 1929-30 three important conferences had been held, namely :

- (a) The International Conference on Safety of Life at Sea ;
- (b) The Conference of Empire Meteorologists ; and
- (c) The International Conference of Directors of Meteorological Services.

The work in the Meteorological Office during the year under review has been largely affected by the endeavour to carry out the decisions

reached at these conferences and in several Divisions, chiefly in the Marine Division and the Forecast Division, the carrying out of the decisions has led to considerable strain which it is hoped will be relieved as the new procedures become definitely established. Otherwise the work of the Meteorological Office has continued along normal lines with no major changes to be recorded. There is, however, in every Division a natural growth of work resulting from the greater use being made of meteorology in many different spheres. To meet this increasing demand without a corresponding increase of staff a constant revision of methods of work is necessary, and the routine work has to be constantly examined in order to reduce it to the absolute minimum to carry on the work of the Office. The report which follows deals only with the chief activities of the Office and changes which have taken place during the year, arranged under the various types of work for which the Office is responsible.

CLIMATOLOGY

British Climatology.—The collection and publication of climatological data for the British Isles has continued along the customary lines. Observations are taken at a large number of stations in all parts of the country. These stations vary greatly in equipment and personnel. On the one hand there are the observatories maintained by the Meteorological Office where continuous records of all meteorological elements are obtained, and on the other hand the 5,000 rainfall stations, where the equipment is restricted to a rain-gauge which is read once a day. In Appendix I the particulars are given of the number of stations of the various types in each district into which the British Isles are divided. From this table it will be seen that 347 stations provide climatological data, while rainfall records are received from 5,180 rainfall stations. It is important to notice that practically all the rainfall stations and the stations classified as climatological stations in Appendix I are maintained by local authorities or private persons, who supply information without charge to the Meteorological Office. The observers at these stations carry out at considerable personal inconvenience a real public service.

The data collected are published for general use in the following publications :—

The Weekly Weather Report.—This publication contains data from a certain number of selected stations, arranged according to weeks, and is designed for special use in agricultural problems for which the week is a useful unit of time. The data are, however, chiefly used in investigations connected with the relationship between weather and crops or weather and other subjects some time after the actual occurrence. For this reason it has been found most convenient to publish these weekly values in an annual volume issued at the end of each year.

The Monthly Weather Report contains data from all stations at which observations are taken, arranged according to months. The numbers are issued monthly.

The British Rainfall.—This annual publication contains data supplied by the large number of rainfall stations with a description of the distribution of rainfall, and articles on interesting features connected with the rainfall of the year.

The Observatories' Year Book contains data from the five observatories, hourly values being given for most of the elements. The data are not confined to those of climatology, but data of terrestrial magnetism, atmospheric electricity and seismology are also contained in the *Year Book*. A section is devoted to observations made in the upper air.

All these publications have been kept up to date throughout the year.

The number of inquiries for meteorological information has continued to increase, and during the year 1,417 general or scientific inquiries for particulars of past weather in the British Isles were dealt with. These figures represent an increase of 11 per cent upon those for 1929-30, and 47 per cent on the figures for 1920-1.

The mere tabulation of the meteorological statistics from any station has little value unless the results can be compared with normal values. The usual practice is to wait until observations for at least ten years are available at a station, when provisional normals are calculated from these observations. Owing to the unavoidable changes of stations it has hitherto only been possible to obtain the normals for about half of the stations appearing in Table III of the *Monthly Weather Report*. The normal value of temperature does not vary rapidly from place to place in neighbouring parts of the country, and during the year under review advantage has been taken of this fact to attempt to obtain normals for stations by preparing charts of normal values for surrounding stations. In this way normals have been evaluated for nearly all the stations for which temperature normals were not previously available. The results of the investigation are still under discussion, but they appear so satisfactory that it is hoped to introduce normals obtained in this way in the *Monthly Weather Report* in the near future.

A course of instruction for observers at stations maintained by the authorities at health resorts and at agricultural meteorological stations was held on September 23 and 24. Twenty-five persons attended the course, which was held this year at the Office at South Kensington instead of at Kew Observatory as previously, owing to lack of accommodation at Kew.

The Office has also continued to co-operate with the Ministry of Agriculture and Fisheries in the "Crop-Weather Scheme," which has for its object the tracing of the connexion between weather and

the yield and quality of crops. As a result of resolutions adopted by the Agricultural Section of the Conference of Empire Meteorologists held in London in 1929, it has been decided that the week should be adopted instead of the month as the unit of time for summarising the meteorological data collected at the co-operating stations. The change was introduced at the end of January, 1931. It has involved some increase in the work of the British Climatology Division of the Office, which has become responsible for the preparation of the summaries for the use of the Ministry of Agriculture.

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 1923 has been issued, that for 1924 is in the press, and the preparation of the "Tables" for 1924 is well advanced. The volume for 1923 includes data for seven "five-degree squares" over the ocean based on observations taken on board ship, and that for 1924, data for fourteen such squares. The collection of the ships' observations is being carried out with the co-operation of Holland, Norway, Germany, United States of America and Brazil.

The collection of data for "World Weather Records" from stations in Africa, Australasia and Oceanic Islands is continuing. The tables for 17 stations are being prepared in the Meteorological Office, while 27 tables have been received from other meteorological services.

Several investigations dealing with climate in different parts of the world have been undertaken during the year, amongst which may be mentioned the following:—

(a) An inquiry into the existence of more or less regular warm and cold spells in the annual variation of temperature near London. It was found that the well-known Buchan cold spells do not occur regularly in London.

(b) An investigation into the average distribution of rainfall over land and sea in the different zones of latitude.

(c) An investigation into the climate of Ascension Island, based on the valuable observations made there for a number of years by the officials of the Eastern Telegraph Company, Ltd.

Library.—The additions to the library during the past year included 620 new books and pamphlets, and 13,391 daily weather reports. The number of periodicals received was 3,811. Books issued on loan during the year numbered 1,662.

It was mentioned in last year's *Annual Report* that the question of revising the subject classification used in the library was brought before the International Conference of Directors at their meeting at Copenhagen in September, 1929, when a small sub-commission

was appointed to consider it. For the use of this sub-commission a draft classification on the decimal system based on that employed at the International Institution of Bibliography at Brussels has been constructed in collaboration with the Science Library, and copies have been circulated to the members of the sub-commission for consideration.

OCEAN METEOROLOGY

Services for the Merchant Navy.—As a result of the three conferences to which reference has been made above, it has been necessary to carry through certain changes in connexion with the collection of meteorological data at sea. These changes were not fundamental because the conferences accepted in the main the practices which had been developed by the British Meteorological Office in framing their resolutions. Considerable alteration in detail, however, was involved, and this has been carried out during the year under review. It therefore appears suitable to give here a short description of the organization now developed in the Meteorological Office in connexion with the collection of meteorological data at sea.

The study of the weather has a great attraction for the seaman, and accurate observing and recording comes naturally to him. Most sailors are desirous of studying the weather along scientific lines, and the Meteorological Office has always found the greatest willingness on the part of seamen to co-operate in the collection of meteorological data. The Office can, however, only deal with a certain amount of data for marine meteorology does not consist simply in the collection of records, but every record received requires scrutiny, tabulation and discussion. Experience has shown that observations taken in 500 ships are the maximum with which the Office can deal with its present staff. It has, therefore, for some years been the policy to limit the ships observing for the Office to this number.

The observing ships are divided into two main classes :—

- (a) log-keeping ships ; and
- (b) form-keeping ships.

Each log-keeping ship, of which there are 101, takes a very full set of observations at the end of every watch, that is every four hours ship's time. These observations are entered into special meteorological logs which are supplied to the ship and returned to the Office at the end of each voyage. Each one of these log-keeping ships is supplied with a complete set of standardized meteorological instruments by the Meteorological Office. It is impossible to praise sufficiently highly the quality of the observations taken in these ships. All logs received are scrutinised in the Marine Division

and the best 40 per cent classified as "excellent." Awards are made to the officers of ships whose logs are classed as "excellent", and as there is great competition to secure this distinction a high standard of observing and log-keeping is maintained.

The information contained in these logs is the raw material for the preparation of meteorological charts giving normal values of the meteorological elements in all parts of the world. On receipt each log is carefully scrutinised, and the observations made available for statistical investigation by punching them on to cards for sorting and tabulation by the Hollerith calculating machine. Up to 1927-28 between 60 and 70 per cent of the logs received were completely extracted each year, but owing to the press of work in the Marine Division during the last three years in connexion with the conferences already mentioned and the re-organization consequent on these conferences, extraction of data is much in arrears, and only 17 per cent of the logs received during the year under review were extracted. To meet the difficulty the staff of the Marine Division is being strengthened by the addition of two clerks, and it is hoped that with the completion of re-organization, arrears of extracting will be overtaken and a higher percentage of extraction will become normal in the future.

The form-keeping ships are so called because they enter their observations on "Form 1911." These ruled forms were originally introduced for use in any ship which did not keep a complete meteorological log, but was willing to send meteorological observations to the Office.

The development of wireless telegraphy which has led to the preparation of synoptic charts based on ocean observations has resulted in a divergence in purpose between the observations taken in a log-keeping ship and those taken in a form-keeping ship. For synoptic meteorology observations must be synchronous and by resolution of the International Meteorological Conference observations at sea which are taken for synoptic meteorology should be made at the standard hours 0h., 6h., 12h. and 18h. G.M.T. It has been mentioned above that the log-keeping ships take their observations at the end of each watch. The times of the watches are, however, based on local apparent time, and seldom agree with the Greenwich times chosen for synoptic observations. Ships which do not maintain logs but enter their observations on Form 1911 are instructed to observe at the standard synoptic hours. Thus the chief difference between the two kinds of observing ships is that while the log-keeping ship takes observations every four hours according to local time, form-keeping ships need only take observations at one or more of four observing hours fixed by Greenwich time. The majority of ships using Form 1911 only observe during the daylight hours.

There are at present 386 form-keeping ships, 103 of which have instruments provided by the Meteorological Office, the other ships

using their own instruments. On receipt in the Office Forms 1911 are examined and classified in the same way as the logs. The data from them, however, are not extracted but the forms themselves are filed in such a way that observations taken in any part of the world at any time can easily be obtained. The information contained on these forms is of the utmost importance, and is constantly being used for scientific inquiries. Also the forms are frequently used to supply information in connexion with investigations into marine casualties, and for general inquiries connected with shipping. These ships supplied during the year under review 2,686 forms.

In addition to the 101 log-keeping ships and the 386 form-keeping ships mentioned above there are 10 stationary training ships and lighthouses which make returns in the same way as ships, thus bringing the total number of co-operating ships or lighthouses to practically the 500 which is set as the limit.

By Article 35, paragraph (c), of the International Convention for Safety of Life at Sea each contracting Government undertakes "to arrange for certain selected ships to take meteorological observations at specified hours and to transmit such observations by wireless telegraphy for the benefit of other ships and of the various official meteorological services." This obligation is being carried out in full by the British Merchant Navy. At the International Meteorological Conference held in Copenhagen in 1929, in order to control the number of ships broadcasting observations and avoid congestion of the wireless services at sea, it was decided to limit the total number of the selected ships to 1,000 for the world as a whole, and that each country should maintain the proportion of this number corresponding to its share of the world's total tonnage.

Under this arrangement Great Britain should maintain 312 selected ships, that is ships which broadcast by wireless telegraphy the observations taken by them at one of the four hours adopted for synoptic observations at sea.

On November 26, 1930, the British complement of selected ships was completed for the first time and no difficulty whatever is anticipated in being able to obtain the voluntary work of the ships' officers in maintaining this number of selected ships in the future. The 312 selected ships are drawn from the log-keeping ships and form-keeping ships mentioned above. It is clear from what has been said that in the case of a form-keeping ship which takes observations at one of the standard synoptic hours no additional work is involved by becoming a selected ship beyond the coding and despatch by W/T of observations already taken. In the case of a log-keeping ship which volunteers to be also a selected ship, another complete set of meteorological observations have to be taken because the observations taken for the logs are not taken at the standard synoptic hours. The keenness of the seamen to help forward this work is shown by the fact that with very few exceptions—and those

on account of the small number of officers available—practically all log-keeping ships are also selected ships, many of them taking and broadcasting observations at the four synoptic hours in addition to the complete set of observations taken for the log every four hours, thus making ten sets of observations to be taken each day and entered in various registers.

The selected ships are sub-divided into two classes : A selected ships and B selected ships.

The A selected ships are ships which have powerful long-range wireless installations, while B selected ships are ships which have the ordinary ship's wireless installation which has a much more restricted range. According to the Convention for Safety of Life at Sea selected ships provide information for two purposes :—

(a) For the benefit of other ships ; and

(b) for the benefit of the various official meteorological services.

It has been found convenient to employ the two types of selected ships for these separate purposes, A selected ships supplying information for the official meteorological services and the B selected ships providing information for the benefit of other ships. The distinction is, however, not complete because all ships can pick up, if they wish, the messages despatched from A selected ships and in certain cases messages broadcast by the B selected ships intended primarily for surrounding ships are picked up by coast stations and forwarded to official meteorological services.

When the Meteorological Office first organised observations from ships on the Atlantic Ocean to send messages for the official meteorological services a number of ships were invited to send these messages during their voyages to and from America. These ships naturally became A selected ships on the introduction of the new scheme. Sufficient ships were chosen to supply the total number of messages in each year for which financial sanction had been given. Each of these ships then when at sea sent messages at the specified hours quite irrespective of what other ships were doing. In consequence it was found that a large number of observations would be sent from ships very near together while from other parts of the Atlantic no observations would be received because no observing ships were there. A new scheme has therefore been introduced for the supply of information from the Atlantic. A large-scale chart of the North Atlantic Ocean is maintained in the Marine Division, and on it the position of every A selected ship is indicated by a flag each morning. All these ships are under instruction not to transmit observations to England without definite instructions. Each morning a choice is made from the ships in the east of the Atlantic from which observations are required and this list is transmitted to Portishead wireless station. This list is then issued by wireless and picked up by each A selected ship and according as to whether its name appears in the list or not, so it sends its observations at the standard hours. In this

way wireless communication is cut down to a minimum by preventing ships whose observations are not required on account of the proximity to other ships from broadcasting them, so making it possible to get observations from other areas at a minimum of cost for telegrams. This scheme was introduced on May 1, 1930, and has worked extremely well in practice. B selected ships are not affected by this scheme but continue to broadcast their observations for the benefit of surrounding ships.

It was mentioned in last year's *Annual Report* that at the Copenhagen Conference new codes for ships' observations were adopted. These codes are flexible and allow of the ships telegraphing the information they are in a position to supply according to the needs of the shore stations. As these codes have been almost universally adopted by ships of all nations, the very satisfactory position has been reached that the observations transmitted from selected ships of all nations can be decoded by all other ships, quite independently of the language of the ship's own country.

So far the method of obtaining information from ships only has been described. The reciprocal service by which information collected on shore is transmitted to ships is also well developed. The Meteorological Office issues two messages each day from a high-power wireless station, this station was the Air Ministry station until the end of the year and the Rugby station from April 1 onwards. These messages, called "Weather Shipping" messages, contain a general statement of the meteorological situation and the position of the centres of high and low pressure are stated; a set of actual data from ten stations in the British Isles and two foreign stations is given, with forecasts for the weather to be expected in the seas around the British Isles. These messages are issued twice a day, based on observations taken at 7h. and 18h. G.M.T. With these special weather shipping messages and observations picked up from surrounding ships—to say nothing of the frequent issues of meteorological messages not specially issued for ships, which can be picked up when desired—it is possible for ships approaching the British Isles to draw complete synoptic charts of the existing meteorological conditions. Similar but less complete information is available in other parts of the world, and it is very gratifying to find that the preparation of synoptic charts on board ship is rapidly increasing, and it is the general practice on quite a large number of ships for the navigating officer to prepare a synoptic chart to be used as an aid to navigation.

To introduce these changes has necessitated a very large amount of work in the Marine Division, but the work of instructing the various ships' officers has been much facilitated by the monthly publication of the *Marine Observer*. As already stated, the ordinary work of the Marine Division has somewhat suffered in consequence, but it is hoped that this will soon be rectified.

Services for the Royal Navy.—It was explained in the *Annual Report* for last year that in consequence of a request received from the Admiralty the Superintendent of Navy Services Division visited the Navy on the China and East Indies Stations in order to arrange a close liaison between the Navy and the local meteorological services, particularly those of Hong-kong, Zi-ka-Wei, Malaya, Ceylon, India and the Middle East, and to organise meteorological work of the Navy on those stations. The success of this visit was so marked that the Admiralty asked that the Superintendent should visit the Fleet on the America and West Indies station for a similar purpose. This visit was carried out and opportunity was taken of conferring with the Director of the Canadian Meteorological Service and the Chief of the United States Weather Bureau. During his tour the Superintendent visited Bermuda and attended a conference at which there were representatives of the Government of Bermuda and the Admiralty; the Director of the Canadian Meteorological Service also attended. As the result of the Conference the Government of Bermuda decided to institute a fully equipped meteorological service in Bermuda, and it is hoped that this service will be in operation before the end of 1931.

One of the chief developments of the Navy Services Division is the training of naval officers in meteorology. Courses have been arranged as follows: the numbers on the right show the number of officers who have taken the various courses during the year:—

12 weeks' course for naval observers	...	...	4
12 ,, ,, ,, surveying officers	...	...	*
4 ,, advanced course for naval observers	...	...	2
4 ,, course for surveying officers	...	...	4
1 ,, ,, ,, navigating officers	...	...	15
1 ,, ,, ,, surveying officers	...	...	*

During the year officers of the Royal Australian Navy, of the Royal Canadian Navy and of the Royal Indian Marine have also attended one or other of these courses, and at the request of the Commonwealth Naval Department arrangements have been made for all navigating officers of the Royal Australian Navy to take the one week's course for navigating officers.

The increase of work associated with these instructional courses has made it necessary to appoint another senior professional assistant to the staff of the Navy Services Division.

Ships of the Royal Navy have continued to transmit weather reports to the Meteorological Office when at sea, and 676 reports were received in London during the year, and a considerable number were made also to the Meteorological Office in Malta.

* Not commenced before March 31, 1931.

Meteorological work on the aircraft carriers continued to develop during the year, special meteorological officers having been provided in certain carriers ; a definite meteorological routine is carried on in all carriers, which it is hoped will shortly be adopted in other ships carrying aircraft.

The Admiralty have introduced a new meteorological log to be kept by flagships, ships carrying aircraft and surveying ships on foreign service. The completed logs will be forwarded to the Meteorological Office. All meteorological logs received from H.M. Ships are examined in the Navy Services Division, and reports made to the Admiralty as necessary.

The investigation of the problem of making satisfactory forecasts in a ship without the aid of meteorological information beyond that which can be obtained in the ship itself, has been continued throughout the year, Lieut.-Commander T. R. Beatty, R.N., continuing his work on this subject in the Division. During the year the draft report prepared by him has been considered by a committee of Admiralty and Meteorological Office representatives.

Upper-air investigation from H.M. ships has continued. 557 observations of wind in the upper air and 41 observations of upper temperatures were received during the year. These numbers are more than twice the corresponding figures for last year, but are still far from those aimed at, namely, 2,000 wind observations per annum. Increased activity in upper-air work is, however, anticipated as a result of the recent conferences on Fleet meteorology.

A chart showing the distribution of all existing observations of wind and temperature in the upper air over the sea was prepared in the Navy Services Division and published by the Hydrographer of the Navy (obtainable from the Admiralty Chart Establishment, price 3s.).

Throughout the year the Navy Services Division has continued to advise the Admiralty with regard to the meteorological equipment of H.M. ships. A large number of recommendations regarding the improvement of meteorological equipment of H.M. ships has received the approval of the Admiralty and action upon these recommendations is now being taken in the Meteorological Office.

In order to keep the officers of the Navy who are engaged on meteorological work in touch with developments in Fleet meteorology, it is hoped that arrangements may be made for a periodical letter to be prepared in the Navy Services Division for circulation to them.

FORECASTING

It is generally known that all modern weather forecasting is based on synoptic weather charts. On these charts information regarding the weather, wind, cloud, barometric pressure, temperature, past

weather, visibility and rainfall is plotted for a number of stations distributed over the whole area. From the observations made each station prepares its weather message in one of the figure codes adopted by the International Meteorological Conference held in Copenhagen in September, 1929. These codes are now used by all the countries of Europe, (except Iceland and Turkey) and North Africa, and by all ships. As each country of Europe requires the information obtained at the stations and ships of other countries as well as the information received from its own stations and ships, a system of broadcasting weather information by wireless telegraphy at pre-arranged times on pre-arranged wave-lengths was brought into operation soon after the war, each country having one or more broadcasting stations. The intention was that each country would broadcast information from its own stations (previously collected by telegraphy or otherwise) and all the countries would listen for the broadcasting of every other country so that in a very short time all countries would be in possession of the whole of the desired information. It is clear that for this system to work every broadcasting station used must be sufficiently powerful to reach all parts of Europe.

Owing to the increased length of the messages and the growing requirements of aviation for more frequent observations, the system has tended to become unworkable because of interference and the difficulty of fitting all the messages into a time-table. To overcome this the International Conference at Copenhagen proposed a somewhat different scheme. According to this scheme Europe, with Russia, is divided into three main areas, namely western Europe, central Europe and Russia. The Meteorological Services of France, Germany and Russia were invited to undertake the duty of collecting the meteorological messages issued by each country within these three areas respectively, and to re-broadcast them from a wireless station of sufficient power to be heard all over Europe. As soon as this scheme comes into use each country will be able to use for its own issues much less powerful wireless stations as it will only be necessary to reach Paris, Berlin or Moscow, according to the area in which it is situated. Moreover any country instead of having to listen to the separate issues of well over 20 national issues will listen only for the three main issues made by Paris, Berlin and Moscow. In this way not only will there be a considerable decrease in the amount of interference between the meteorological messages issued by the various countries, but the task of receiving the information will be much reduced.

In this way the dissemination of meteorological messages within Europe is simplified, but modern meteorology requires information from a much larger area and it is necessary now to make provision for a selected number of observations taken in North America to be transmitted to Europe, and for a selection of the European data

to be transmitted to North America. The International Meteorological Conference suggested that these duties might be undertaken by the United States Weather Bureau for North America, and the British Meteorological Office for Europe. After formulating this scheme the Conference invited the five Meteorological Services mentioned to undertake these services in the interests of the meteorology of the northern hemisphere. It is gratifying to know that the invitation has been accepted by all five countries and that active steps were taken during the year under review to carry out the plan outlined. All preparations were made by the end of the year and America and Russia were already carrying out their share of the work, and France and England had concluded their preliminary arrangements sufficiently far to commence their new issues on April 1, 1931. Although the actual date on which the issues commenced falls just outside the year under review, it may be stated that both issues have been successfully inaugurated and are giving great satisfaction. The arrangements for the issue by Germany of the collective message for central Europe has not progressed quite so far owing to technical difficulties, but it is anticipated that the whole scheme will be in successful operation before the next *Annual Report* is written.

No change of importance has been made during the year in the issue of the *Daily Weather Report* or in the issues of forecasts by the British Broadcasting Corporation. As the statement given in the last *Annual Report* of the programme of issues from the B.B.C. has proved of considerable use it is reprinted with the necessary changes as Appendix VII to this Report.

There have been several changes in the telegraphic reporting stations which are of sufficient interest to demand mention here.

Stornoway.—The observations and instruments at Stornoway have been moved to the care of the coast-guard. The station was established in 1872 and since 1907 has been in charge of Mr. W. Grant. Although Mr. Grant is engaged in business he has succeeded in arranging for observations daily at 0100, 0700, 1000, 1300, 1800 and 2100 since and during the war. The thanks of the Meteorological Committee have been communicated to Mr. Grant for his valuable co-operation in successfully meeting the exacting demands which it was necessary to make upon him on account of the unique position of this station in the extreme north-west of Scotland.

Nairn.—The Committee has also taken the opportunity of the resignation of Miss Penny from the office of observer at Nairn to express its thanks to her for her past services. This station was founded so long ago as 1867 and for some time was carried on by Miss Penny's father. Since his death many years ago three of his daughters have successfully maintained the record intact. With the resignation of Miss Penny it has been found necessary to close

the station as a telegraphic reporting station but the Town Council of Nairn, who have for many years been interested in meteorological work, have now provided a health-resort station on the golf course so that the record will not cease but be carried on in another form.

Clacton-on-Sea.—This station, which has had a long though rather shorter life than Stornoway or Nairn, ceased to be a station for the daily weather service at the end of December. The observer and the station are still continuing however and health-resort messages are being regularly despatched.

Dalwhinnie.—On the closing of the station at Nairn a new station was established at Dalwhinnie in the Highlands of Scotland at a height of 1,176 feet above mean sea level. Telegrams containing reports for 7h., 13h. and 18h. G.M.T. are regularly received. As representing one of the most severe winter climates to be found in any part of the British Isles, this station has a unique value for the daily weather service.

Gale Warnings.—No meeting of the Gale Warning Board was held during the year.

Arrangements have been made for cones to be exhibited at the coast-guard stations at Dunkilm and Abersoch.

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 taking the country as a whole, effective warnings were issued for 92 per cent of the gales experienced. Of the warnings issued, 75 per cent were justified by the occurrence of gales and strong winds.

AVIATION

The supply of meteorological information to the Royal Air Force and for civil aviation is carried out by the Aviation Services Division, which consists of two sections, one at Headquarters in London and the second at distributive stations spread over the country. A list of these stations will be found in Appendix V. Each distributive station is attached to an aerodrome and its function is to supply all meteorological data required in connexion with flying to and from that aerodrome.

Meteorological Arrangements for Civil Aviation.—Regular civil-aviation services are confined in this country to the route from Croydon to the Continent. During the course of the year the collection and issue of weather messages along this line and the preparation of forecasts was transferred from Headquarters in London to Croydon. In this way a considerable saving of time has been effected. The introduction of a regular night air service

between Croydon and the Continent has necessitated the introduction of 24-hour routine at Biggin Hill and Lympne, and this has led to an increase of staff.

The international character of the main air routes necessitates close co-operation between the various countries of western Europe. This co-operation is effected by means of the International Air Conference at which representatives of the following countries attend: Great Britain, France, Belgium, Holland, Germany, Switzerland and Czechoslovakia. Meetings of this Conference were held at Prague in April, the Hague in September, and in London in March. During the last Conference in London regulations for the international meteorological service for aviation were completed and approved. These regulations, which will be issued in two volumes, set out in detail the nature of the observations to be made, the times of transmission of reports, the issue of meteorological information to pilots both at aerodromes and in flight and the regulations governing the relations between meteorological services and aviation organizations. The preparation of these regulations has formed the main work of the Conference during the last two years. Many other subjects, however, have been discussed, and it may be stated that, thanks largely to the spirit of co-operation and goodwill which dominates the Conference, the meteorological arrangements on the international air routes of western Europe have worked efficiently and smoothly.

The Conference strongly advocated the desirability of the officers in charge of the various meteorological stations visiting one another to become familiar with the methods followed in the various countries. Under these arrangements the Officer in Charge, Meteorological Office, Croydon, visited the Meteorological Offices at the terminal aerodromes at Le Bourget, Brussels, Cologne and Amsterdam.

Arrangements were made for the supply of weather reports and forecasts for an experimental air service operated by the Imperial Airways Ltd. between Croydon and Liverpool from June to September.

In addition to the supply of information on the regular air routes the Aviation Services Division gives a considerable amount of information to civil pilots engaged on special flights, in particular long-distance flights. It has become the usual practice now for any aviator who contemplates making a long flight to visit the Meteorological Office and to discuss his plans with the Superintendent of the Aviation Services Division.

During the year 3,047 requests for information for civil aviation were dealt with by the Aviation Services Division at Headquarters, an increase of 1,362 on the corresponding figures for last year. There was a noticeable increase in the requests for forecasts for flights to distant parts of the Continent.

Services for the Royal Air Force.—In order to keep the Meteorological Office in touch with the practical needs of the Royal Air Force a committee has been set up, called the Royal Air Force Meteorological Committee, at which officers of the Royal Air Force who are actively engaged in flying meet representatives of the Meteorological Office and discuss the meteorological requirements of the Royal Air Force in considerable detail.

The regular issue of forecasts for Great Britain and Northern Ireland for the use of the Royal Air Force was revised and a scheme brought into operation whereby units must obtain special forecasts from the Meteorological Office (either from the local distributive station or from the London Office by wireless) before undertaking cross-country flights. Arrangements were made in London for attending to such inquiries without loss of time.

In addition to the issue of routine forecasts 3,030 requests for information were received in London from Royal Air Force units, an increase of 1,399 over the corresponding figure for last year. This large increase is mainly due to the introduction of the scheme just mentioned.

In connexion with the defence exercises carried out by the Royal Air Force in July special arrangements were made for the supply of the extra meteorological information required. In addition to special information being issued to the various units, members of the staff of the Meteorological Office were attached to the Headquarters of the Air Officers Commanding in the various areas.

As in the case of civil aviation the Royal Air Force obtains advice regarding the weather conditions which are likely to be encountered before undertaking any extended flights outside the British Isles. In the instructions prepared for every long-distance flight by Royal Air Force units sections are introduced dealing with the meteorological organization.

Regular courses of instruction to Royal Air Force officers were given during the year at Calshot, Cranwell, Sealand, and Leuchars. During the refresher courses to Royal Air Force Flight Commanders at Northolt a series of lectures on meteorology was given.

Combining the inquiries connected with both civil and service aviation, the total number received at outstations during the year was 29,367, an increase of nearly 10,000 over last year. At Headquarters 6,077 inquiries were received for forecasts and 92 inquiries for data regarding weather conditions affecting aviation. The former figure represents an increase of 2,761 over the corresponding number for the previous year. The total number of inquiries was 35,536, against a corresponding figure for last year of 22,796.

Observations of Upper Wind.—The total number of pilot-balloon ascents made in Great Britain and Northern Ireland during the year

to determine the velocity of the upper winds was 14,662, and in addition 5,653 nephoscope observations of the movements of upper cloud have been made.

Airships.—In previous *Annual Reports* the establishment and growth of the Airship Division has been described, and in last year's *Annual Report* the final stages in the development of this Division were described.

For nearly six years the Division had been preparing for the operation of the two large airships R.100 and R.101, and at the beginning of the year under review both these airships had had their preliminary trials and everything was in train for the long-distance trials of R.100 to Canada and R.101 to India. The staff of the Airship Division was brought up to full strength, consisting of the Superintendent, Mr. M. A. Giblett, an assistant superintendent, 5 senior professional assistants and 7 clerical assistants. The work of investigation was largely in abeyance, and the whole attention of the staff was given to organizing and practising the forecasting routine which was to be employed during the voyages of the airships. During this period information and forecasts were supplied to the airship staff on the home trials in accordance with the procedure already laid down. Conferences were held daily in the forecast room at 9.30 G.M.T. and 15.30 G.M.T., and at other times as necessary between the Director of Airship Development, the Assistant Director in charge of Flying, and the Superintendent, Airship Services Division, when the meteorological situation in relation to the airship operations in progress was discussed. R.100 made her successful flight to Canada and back in the summer, Mr. Giblett being on board. The meteorological organization functioned well throughout this flight and gave promise of a similar success in the more difficult voyage of R.101 to India.

On October 4 R.101 set out on her flight to India, Mr. Giblett being on board as meteorological officer. In the disaster which ended this flight Mr. Giblett lost his life. Reference to the serious loss suffered by the Meteorological Office by the death of Mr. Giblett is made elsewhere in this Report.

As the result of the disaster all operations with airships were suspended pending the formulation of future airship policy by Government. The Airship Meteorology Division, however, was not disbanded, but was employed in preparing the data required for the inquiry into the disaster held by Sir John Simon, at which the Director gave evidence. Since the inquiry the staff have been employed in completing the investigational and scientific work on which they had been engaged before it was necessary to give their whole attention to the operation of the airships. This investigational work consisted mainly in investigating the meteorological conditions in many parts of the world which had previously not been considered

in detail. Also an important investigation into the structure of the wind had been completed, but time had not been found to write the report. This was taken in hand and completed before the end of the year.

Meteorological Flight, Duxford. — The Meteorological Flight, R.A.F., Duxford, Cambridgeshire, has maintained a regular service of week-day reports of temperature and humidity at different heights, obtained by readings of strut-psychrometers installed on aeroplanes. Flights are normally made twice each week-day (once on Wednesdays and Saturdays) when conditions permit. The reports are of great value in forecasting, since they not only indicate whether and to what degree the atmosphere is in a stable or unstable condition, but in conjunction with ascents by pilot balloons they often give definite information as to the origin of air currents at different levels.

Further experiments have been made on the air-duct apparatus described in the *Annual Report* for last year, but unexpected difficulties have been found and the apparatus has not yet been successfully developed.

METEOROLOGY FOR THE ARMY

There has been no marked change in the work of the Division during the year. The stations at Shoeburyness and Larkhill have been maintained on the same footing as in previous years. At these stations the work consists in supplying the meteorological requirements of artillery units, the officers-in-charge being called upon from time to time to deliver lectures on various aspects of meteorology to officers and non-commissioned officers following certain courses of training. Further assistance has been given by the staff at Shoeburyness in connection with the investigation of the audibility of gunfire referred to on page 26.

As in previous years temporary stations were maintained during the summer at five artillery practice camps. Meteorological information was supplied to practice camps on Larkhill and Westdown by the station at Larkhill, and to the Coast Artillery School and other artillery units in its neighbourhood by the station at Shoeburyness.

The system whereby the meteorologist at Shoeburyness issues a forecast of the probable effects at Southend of heavy gunfire has been continued. In consequence of the use of such forecasts the complaints of the shattering effects of heavy gunfire which were so frequently made a few years ago, have practically ceased.

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 1928 was issued during the year under review.

KEW

Meteorology.—As from January 1, 1931, the new anemograph with the vane over the dome was brought into use for all weather reports. The height of the vane is 75 ft. above the ground and the exposure is excellent.

Four cup anemometers have been under trial; two of these are of the new pattern introduced by Mr. J. Patterson, Director of the Canadian Meteorological Service. These anemometers have three cups 5 in. in diameter, whilst the older cup anemometers of the Meteorological Office have four cups 3 in. in diameter. The new anemometers are found to be more sensitive in light winds.

A special analysis of the autographic records of rainfall for the year 1930 was undertaken with a view to the comparison of the duration of rain with various intensities. The rule of the Meteorological Office is to estimate the duration of rainfall as the time during which the rate of fall is 0·1 mm./hr. or more. It was found that if the critical rate was changed to 0·2 mm./hr. the duration would be reduced by nearly 10 per cent.

Atmospheric Pollution.—During the year a pair of deposit gauges of exactly the same pattern has been under observation. It is found that the discrepancies between the amounts of deposit in these two gauges are nearly as great as those recorded previously when the

gauges in use were of slightly different types. For example, in the case of "total solids" the discrepancy between the monthly amounts is as likely as not to exceed 9 per cent.

Radiation.—In accordance with a resolution of the International Commission for Solar Radiation arrangements have been made for observations of radiation made in western Europe to be collected by M. Volochine at Trappes and published by the French Meteorological Service. Readings made at Kew with the Ångström pyrheliometer (standard measurements of solar radiation), the Gorczyński radiometer (continuous measurements of solar radiation) and the Benson radiometer (measurements of radiation from the sky at night) have been sent to Trappes together with the readings from the Callendar recorders (sunshine and skyshine) at South Kensington and Rothamsted and from the Ångström pyrheliometer at Eskdalemuir.

Atmospheric Electricity.—After a large number of comparisons of measurements of conductivity with the Wilson apparatus on a tripod and with similar apparatus at ground level the routine observations with the former apparatus were discontinued in favour of corresponding observations with the latter apparatus for which the underground laboratory is utilised.

The apparatus designed for giving continuous records of the air-earth current has been in operation during the greater part of the year, various difficulties having been overcome. The results, from which the annual and diurnal variation of the air-earth current and of conductivity can be deduced are under discussion.

It has been realised for a long while that the observations with the Ebert apparatus, designed to measure the number of ions in the atmosphere, are ambiguous. As a result of a series of experiments it was decided to discontinue the routine observations, which have been published regularly since 1911. Apparatus which will yield continuous records of the conductivity of the air and of the number of small ions present has now been constructed. In this apparatus air is aspirated simultaneously through three condensers, the inner rods of which are connected to three Dolezalek electrometers, whilst the outer cylinders are maintained at known potentials. The deflections of the electrometers will be recorded photographically. It is anticipated that reliable estimates of the ionization will be obtained.

Polonium collectors prepared for the Meteorological Office by the Government Chemist have been brought into use and have been found more sensitive than the radium and ionium collectors with which they have been compared. The polonium collectors are returned for re-coating after six months' use.

Measurements of the quantity of electricity discharged from a point at the top of a mast have been made by means of a Wormell

voltmeter since February, 1931. The current which passes through the voltmeter also passes through a sensitive galvanometer, the deflections of which can be recorded photographically. It is proposed to study simultaneous records of the discharge current and of potential gradient.

Seismology.—The Galitzin seismographs have been in operation without interruption. Arrangements have been made for the display at the Science Museum, South Kensington of records of important earthquakes. The *Seismological Bulletin* has been issued monthly.

The arrangements for the addition of data regarding earthquakes to the ordinary meteorological broadcast messages have continued. During the year ending March 31, 1931 particulars regarding earthquakes were added to the synoptic messages issued by the Air Ministry on 27 occasions and during the same period 14 reports of earthquakes were received in the meteorological messages issued by the Weather Bureau, Washington.

Comparisons of microseismic activity at the seismological observatories in Great Britain have been undertaken. All the available seismograms for January, 1930 have been measured.

Methods by which earthquakes with abnormal focal depth can be identified in the records of a single station have been developed by Mr. F. J. Scrase. The first application of these methods was made in the case of an earthquake on February 20, 1931, which was judged to have originated at a depth of 250 miles in the neighbourhood of Korea.

The Propagation of Air Waves to Great Distances.—The study of the propagation of air waves to great distances has continued. On nine occasions the firing at Woolwich was utilised and on one occasion that at Shoeburyness. The most successful of the recording stations was a new one organised by Dr. Shaxby at Cefn Mably, near Cardiff. The series of experiments in which the source of the air waves was at Woolwich served to demonstrate a gradual increase from mid-July to September in the time of passage of the waves.

Investigation of the Upper Atmosphere.—Sixty-nine soundings of the upper air by means of registering ballons were made during the year. The instruments were recovered in 56 cases, from which 55 good records were obtained. The remaining 13 instruments were not found. Fourteen of the successful soundings were made from Kew Observatory, the remainder from Sealand. The heights reached were as follows :

20 kilometres and upwards	...	...	...	4
15 to 20 kilometres	...	...	...	30
10 to 15 kilometres	...	...	...	14
Below 10 kilometres	...	...	...	7

Of the seven soundings which failed to reach 10 kilometres, five were deliberately curtailed by the automatic release of the instruments. In the other two soundings the balloon failed prematurely. The mean height of the 55 successful soundings was 15·3 kilometres, the maximum 22·3 kilometres. In six of the successful soundings two meteorographs were employed and the records worked up independently in order to check the working of the instruments.

The Dines meteorograph has continued to be employed throughout the year. A number of experiments have been made to improve the instrument in detail, but generally speaking these have not been successful and the instrument has remained unchanged.

Observations were made throughout the winter with the small captive balloon in order to determine the vertical thickness of fogs. On each occasion the information was supplied immediately to the Aviation Services Division.

ESKDALEMUIR

As in previous years continuous photographic records of the north, west and vertical components of the earth's magnetic field were maintained. These records were standardized by absolute observations of horizontal force, declination and inclination made twice weekly.

In addition to the standard autographic records, auxiliary records of declination, horizontal force and vertical force have also been maintained on the magnetographs formerly at Kew Observatory. The sensitivity of the auxiliary records of horizontal and vertical force is about half that of the corresponding standard records and although these former are not tabulated regularly, they have proved of great value when the more sensitive record has exceeded the limits of registration during large magnetic disturbances or when records have been defective for other reasons.

Hourly values of magnetic declination have been tabulated and supplied weekly for publication in the *Colliery Guardian* and the *Iron and Coal Trades Review*, alongside simultaneous data from Abinger. Arising out of this weekly publication of declination data copies of the original records and other information have been supplied on request to several firms of mining engineers and surveyors.

Particulars of the larger magnetic disturbances have been forwarded to the Radio Research Board. Details of five large magnetic storms occurring in the last quarter of 1930 were extracted for the Department of Scientific and Industrial Research.

In continuance of his magnetic survey of the south of Scotland, Mr. H. L. P. Jolly, Ordnance Survey Department, kept in touch with the Observatory and made absolute observations of horizontal force, dip and declination with his field instrument at the Observatory

in May and June. Subsequently values of the horizontal force, dip and declination from the Observatory records were supplied to Mr. Jolly for the times of his field observations.

A Schuster-Smith coil for rapid measurements of horizontal magnetic force has been set up in the east hut, but observations cannot be commenced until the new batteries for supplying the electrical current required have been installed.

An Ångström pyrheliometer was set up in June and observations of solar radiation have been made regularly since then.

On May 1, owing to reconditioning of the building the Kelvin water-dropper electrograph was discontinued and records of the earth's electrical potential gradient were obtained from an auxiliary electrograph installed at the opposite end of the building. On the completion of the building operations in November the electrograph was re-erected in its old position but the opportunity was taken to improve the housing of the electrometer itself. The instrument is now fitted along with a hot-water radiator in a cupboard adjoining the water-tank cupboard, and difficulty with the insulation has now almost entirely ceased.

The reconditioning of the fabric of the buildings to eradicate dry rot was completed in October. It was found necessary to renew the floor in the ground-floor laboratory of the observatory and in one of the bedrooms in Schuster House. The steps taken to prevent the ingress of water into the buildings seem to have been effective. Central heating apparatus has now been installed in Rayleigh and Schuster Houses, and this should keep the interior of the houses in such a condition as to prevent a recurrence of the dry rot.

ABERDEEN

On the foundation of the Aberdeen Observatory a Beckley anemometer was erected on a tower of King's College, Aberdeen. In 1925 it was thought desirable to replace this instrument, which was then giving trouble owing to its worn condition, by one of the new-pattern pressure-tube anemometers. As the exposure on the roof of the College was not all that could be desired it was decided to erect the new pressure tube in an open space about half a mile to the east of the Observatory. Simultaneous observations were taken with the old and the new instruments and in 1926 the records from the new anemometer were used for all purposes. The old anemometer however was not dismantled and records were still obtained from it but were not worked up. A year or two ago the Aberdeen Town council commenced a building scheme in the neighbourhood of the Observatory and during the year work on the new houses has approached the site of the pressure-tube anemometer. The records of the instrument began to show a falling off of velocity in July and an accentuated decrease in November. The second decrease coincided with the erection of a block of houses directly

north of the anemograph and at a relatively small distance away compared with their height. The whole area of buildings now covers the sector from about 290° through 360° to about 70° and forms a very effective barrier to winds from these directions. On analysis, however, the falling off of velocity in the records does not seem to be confined to north-westerly and north-easterly winds, but occurs with southerly winds as well. This interference with the exposure of a standard instrument is very regrettable but fortunately the old anemometer is still in use and the records obtained are now being tabulated for the period subsequent to the encroachment of the new council houses on the pressure-tube anemometer. It is hoped in this way to be able to preserve continuity although it is desirable to find a new site for the pressure-tube anemometer.

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.

The work has continued satisfactorily throughout the year. The two sets of magnetic instruments have on the whole worked well but the new V instrument still continues to show a drift which necessitates occasional re-adjustment.

Observations have been maintained on the aurora every night up to 22h. G.M.T., except during the period of the year when daylight is continued until this hour. Many photographs of the aurora have been obtained.

A new pressure-tube anemometer has been erected over the Office building so that the recorder is contained in one of the Office rooms.

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 organization 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 73 and the number of rainfall stations about 900. The Edinburgh Office also receives the monthly registers and autographic records from 8 telegraphic stations in Scotland before they are forwarded to London.

A monthly summary of the weather in Scotland, together with statistics for certain large towns has been prepared as usual for the Registrar-General.

A large number of inquiries continues to be received, and advice on meteorological subjects has been given to several Government Departments and to private inquirers. Amongst these may be mentioned an inquiry dealing with the alleged spread of noxious fumes from the fish meal works in Aberdeen; an investigation of the weather in connexion with a local outbreak of typhoid fever; and the effect of rainfall on potato disease.

The research on the physics of barometric depressions and the structure of the wind in them has been continued steadily throughout the year, the records from the new anemometer stations at Tiree, the Butt of Lewis and Bell Rock Lighthouse proving particularly useful.

MALTA

The normal observation work of the Office, including full observations of surface conditions three times daily, and pilot-balloon ascents twice daily, remained unchanged while the other routine work continued to develop along the lines of previous years, and, as before, reports for the Services continued to be the most important feature of the work.

Forecasting for the Navy again made the greatest demands on the office staff, and the methods of frontal analysis, which are now almost exclusively employed in forecasting, have led to definite improvements. Reports for the Army, the Air Force, civil aviation, merchant shipping, and local authorities have developed normally, and there has been a growing demand for reports and forecasts for publication in the local press.

There has been little change, apart from minor improvements, in the receipt of synoptic reports, but the increasing use of transmission on short wave has improved wireless reception. Lack of reliable data from certain African districts, particularly the Sahara, has again been a severe handicap in local forecasting, while the scarcity of reports from ships at sea has continued to be badly felt in forecasting for the Mediterranean generally.

On the occasions when early morning reports and forecasts were required for special flights, the absence of early reports from Mediterranean countries proved a serious drawback. If aviation in the Mediterranean continues to develop, observations at 0100 G.M.T. sufficient to enable at least a skeleton chart to be drawn, will soon become essential.

METEOROLOGICAL SECTION, MIDDLE EAST

The supply of meteorological reports and forecasts has been carried on throughout the year to meet the requirements of—

- (a) The Royal Air Force both in Middle East Area and for long distance flights.
- (b) Imperial Airways, Ltd., for the three air routes Salonika to Alexandria, Cairo to Baghdad, Cairo to Khartoum and in addition for a temporary service in September and October 1930 between Alexandria and Cyprus.
- (c) The K.L.M. Dutch Air Service flying between Athens and Alexandria and Cairo and Baghdad.
- (d) Civilian pilots passing through Cairo outward and homeward.

Systematic examination is made of flight reports submitted by Imperial Airways pilots on all routes. Particulars of exceptional or interesting weather phenomena are extracted and together with the appropriate synoptic chart are filed in a suitable manner for easy reference.

In continuance of the scheme adopted in previous years from November 1 to March 31, arrangements were made for hourly reports to be available at Amman during the period of the flights of Imperial Airways between Gaza and Rutbah. Special arrangements were also made for the urgent transmission to aircraft of any reports of dangerous phenomena issued during the period of these flights.

Arrangements have been made for Imperial Airways pilots on the North African route to make meteorological observations when passing over selected points along the route, and to forward them to Meteor, Heliopolis. These reports are in the same form as those sent by W/T by pilots on the Athens to Alexandria route.

The records of the vertical temperature-gradient recorder at the airship base at Ismailia have been maintained throughout the year, and calibration tests and necessary adjustments to the instrument have been made periodically by a senior professional assistant from Heliopolis. Difficulties have, however, been experienced, and the results obtained are not commensurate with the amount of work which has been devoted to this instrument. It is clear that if the data for which the tower is designed are to be obtained it will be necessary to employ the whole time of a professional assistant on this work. A considerable amount of meteorological training continued to be given to the personnel of the Royal Air Force at Abu Sueir.

Close co-operation has continued to exist between the Meteorological Section, Middle East, and the Meteorological Service, Physical Department, Cairo, to the advantage of both services.

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 Investigation on Visibility.—Many departments of Government are interested in questions affecting visibility, particularly in connexion with aviation, naval operations, search-light and lighthouse problems, and lighting conditions. A departmental committee to consider the question was called in July, 1929, at which it was decided to co-ordinate so far as possible these inquiries, and to make special investigations under the direction of the Meteorological Office. As the chief departments interested the Air Ministry and the War Office agreed to share the cost, and a committee was formed at first of representatives of these two Government Departments but with power to add to their number. A special investigation officer, Mr. M. G. Bennett, has also been added temporarily to the Meteorological Office staff to organise the investigations and he has been allotted accommodation at Kew Observatory, but he will supervise and direct actual observations and experiments being made in several different localities.

Air Currents around the Rock of Gibraltar.—Mr. J. H. Field continued his work in the investigation referred to in last year's *Annual Report* (p. 12) on the air currents around the Rock of Gibraltar. In June, 1930, Mr. Field submitted an extremely valuable report which shows clearly that the disturbances actually set up by the Rock in natural winds are closely reproduced on the model in the wind tunnel. With winds from due E. two large eddies having vertical axes are formed, making with the ridge of the Rock a roughly symmetrical arrangement. With winds from 30° N. or S. of E. one eddy is formed having a horizontal axis, and this eddy can be traced right across the Bay. Some of the eddies observed by Mr. Field had diameters of 6,000 feet, and exceeded 2,000 feet in height, and in all cases he observed strong downward currents to the leeward of the main eddies. Valuable observations were made by the use of kites carrying a specially designed light instrument which gave readings of wind direction in pitch and yaw and of velocity on a recording disk. The report has been considered by the Aeronautical Research Committee of the Air Ministry and the Admiralty,

and the Admiralty and the Air Ministry have issued instructions to aircraft regarding the areas to be avoided in winds from various directions. Further action on the report is still under consideration.

International Polar Year 1932-3.—An account of the origin of the proposal to hold a second Polar Year during 1932-3 was given in last year's *Annual Report* (p. 11). During the year a despatch was received in the Foreign Office from the Netherlands Legation inviting this country to take part. The despatch was forwarded by the Foreign Office to the Royal Society and the Royal Society of Edinburgh, both of whom appointed representatives to a committee to advise whether this country should co-operate. The committee strongly supported the proposal, and recommended that Great Britain should establish two observing stations in Canada: one at Fort Rae where a station was maintained by Great Britain and Canada during the previous Polar Year, and another at some suitable place near the north magnetic pole. This proposal is now under consideration by the Government, but in view of the short time available for preparation sanction was given for the Meteorological Office to employ one of its assistants, Mr. J. M. Stagg, to draw up preliminary plans for the work, and to visit the magnetic observatory at Sodankyla in the north of Finland in order to get experience of magnetic work in Arctic conditions, thus saving much valuable time if Government decides that this country should co-operate.

British Arctic Air Route Expedition.—In connexion with the meteorological work to be undertaken by the British Arctic Air Route Expedition which set out for Greenland in July 1930, under Mr. H. G. Watkins, the Meteorological Office gave advice on the instruments to be used and arranged that a number of them should be lent for use on the expedition. In addition Mr. Q. Riley, a member of the party, received a course of training at Kew Observatory.

INTERNATIONAL CO-OPERATION

International Conference on Load Line.—In May, 1930, an international conference met in London to consider the draft of a convention to regulate the use of load lines on ships. In addition to a large number of technical problems connected with the position and use of load lines the question arose of the areas of the world and the seasons of the year in which the various standard load lines should be enforced. These depend largely on the weather to be expected at different places and at different seasons, the problem is therefore largely meteorological. A special committee of the conference was appointed to consider this aspect, and the Director of the Meteorological Office was a member. He also acted as Chairman of the Technical Sub-Committee which drafted the proposals considered by the Conference. The Conference resulted

in a convention signed by thirty nations, and it is anticipated that the convention will be ratified in the near future by all countries concerned.

International Union of Geodesy and Geophysics.—The General Assembly of the International Union of Geodesy and Geophysics was held in Stockholm in August, and was attended by the Director and Dr. F. J. W. Whipple. Many questions of importance in meteorology, especially on the scientific side, were discussed and resolutions adopted. The chief amongst these were resolutions approving the project of a second Polar Year to be held in 1932-33, and certain resolutions regarding the measurements of solar radiation and terrestrial magnetism.

International Commission for the Polar Year 1932-33.—Immediately following the conference at Stockholm mentioned above a meeting was held in Leningrad of the International Commission for the Polar Year 1932-33, which was also attended by the Director. The progress made towards carrying out this project was reviewed and the programme still further developed. The promises of co-operation from practically all countries which have any interest whatever in polar regions and general geophysical problems are very gratifying and in spite of the difficult financial conditions which are affecting the whole world, the promises already give every hope of the successful accomplishment of the scheme.

International Commission for Synoptic Weather Information.—There has been no meeting of the International Commission for Synoptic Weather Information during the year, but further progress has been made with putting into operation the arrangements which the Commission recommended to the Conference at Copenhagen in 1929. The codes for reports from land stations have now been adopted throughout Europe (with the exception of Iceland and Turkey) and in Egypt, Iraq, India, Algeria, Morocco, Tunisia and Syria. The code for reports from ships at sea has been generally adopted.

Reference has already been made above to the advances made towards carrying out the plan of concentrating the main wireless transmissions in the hands of five countries, which had its origin with this Commission (see pp. 17 and 18).

The Commission appointed at Copenhagen in 1929 a sub-commission to consider the best method of representation on synoptic charts of the information contained in the new codes. The sub-commission has prepared a report, which is at present under consideration by the members of the Commission to whom it has been circulated. The need for a uniform method of representation of information on charts is of special importance in connexion with

aviation, because the synoptic chart is an essential auxiliary for conveying meteorological information to pilots on international airways.

The Commission, in conjunction with the Commission for the Study of Clouds, also appointed at Copenhagen in 1929 a sub-commission to prepare a cloud atlas for the guidance of observers at stations from which reports in the new code have to be made. This "International Atlas of Clouds and of States of the Sky" has been prepared and published in Paris under the direction of the Director of the French Meteorological Office (General Delcambre); it contains an excellent series of coloured plates illustrating the different types of sky and a set of instructions for the guidance of observers. The original edition was printed in French, but an edition in English was also printed for the use of observers in English-speaking countries.

In order to prevent confusion and to facilitate the use of international codes for reports from land stations a system of index numbers was introduced in Europe in 1928. One number (of 3 figures) is allotted to each synoptic station. During the past year the system has been extended and agreement reached with the Directors of the different services in Asia, Australia, New Zealand, North America on the allocation of numbers in these regions. The index numbers are for use whenever reports are issued by wireless telegraphy in the international code.

International Commission for Air Navigation.—A meeting of the Meteorological Sub-Commission of the International Commission for Air Navigation was held in Paris under the Chairmanship of Lieut.-Col. Gold in January, 1931. At this meeting the Sub-Commission completed the revision of Annex G of the International Air Convention begun at the meeting in February, 1930. The section of the Annex which deals with the meteorological organisation of international airways has been completely revised and the importance of forecasts as distinct from reports of existing weather is clearly enunciated in the revised section.

The Annex recommends that all contracting states should publish guides giving all available climatological information in a form suitable for use by airmen, and a plan has been prepared for guidance in their preparation.

The changes in the Annex rendered necessary by the resolutions of the International Conference at Copenhagen in 1929 have been completed and further changes have also been made as a result of trials in regard to warnings of dangerous phenomena and improvements of weather, initiated by the International Air Conference (see p. 20).

Lieut.-Col. Gold has continued to act as President of this important international commission.

International Commission for the Investigation of the Upper Atmosphere, and the International Commission for the Investigation of Waves from Explosions.—Meetings of these two commissions were held in Madrid in March 1931. Mr. R. G. K. Lempfert and Dr. F. J. W. Whipple attended as representatives of the Meteorological Office. The Commissions were concerned almost entirely with technical details involved in international co-operation.

PUBLICATIONS

A list of the publications by the Office or by members of the staff which have appeared during the year will be found on pp. 48-52. Among the official publications may be mentioned a new and much revised edition of the Meteorological Glossary. Most of the articles in it have been re-written, the work being assigned to different members of the staff. An appendix gives the equivalent in nine foreign languages, Danish, Dutch, French, German, Italian, Norwegian, Portuguese, Spanish and Swedish of the technical terms. This list has been prepared in response to a request formulated by the International Meteorological Committee at its meeting in London in 1921. The individual lists have been drawn up by the courtesy of the Directors of the different services concerned, whose co-operation in preparing this authoritative list of equivalents is much appreciated. Another publication which owes its origin to an international demand is the "Gazetteer of British Meteorological Stations." This gives for all stations included in the British synoptic reports particulars of the site and of the instrumental equipment and also a description of the conditions of exposure accompanied by photographs and plans, information which is of great value when using the observations in forecasting. Publications on similar lines have appeared in Germany, France, Holland, Norway and Finland, and it may be hoped that in due course information of this kind will be readily accessible for all the stations included in international synoptic issues.

Three *Geophysical Memoirs* have appeared during the year. In *Memoir 50*, Dr. J. Bjerknes, who was attached to the Office for six months during 1925-26, doing work on polar-front analysis, sets out in detail the results of a number of such analyses. In the course of the work many theoretical points are dealt with and elucidated. *Memoir 52* is a detailed study of the conditions of visibility and fog in Malta by J. Wadsworth, based on systematic observations extending over the five years 1919-24. *Memoir 53* describes experiments made on Salisbury Plain in 1926 by F. J. Scrase on eddy motion in the atmosphere, in which use was made of the principle of the cinematograph for recording the behaviour of wind vanes in gusty winds.

The Office is again well represented by papers contributed by members of the staff to outside bodies. In an address on the Climate of the Pleistocene Period, delivered before the Royal Society of Edinburgh by the Director the theory was propounded that the glaciation of northern Europe during the great Ice Age was due to a shift of the pole relative to the continents associated with appreciable variations of solar radiation. The shift of the pole brought Europe into sufficiently high latitudes to permit of the formation of an ice sheet; but the large variations of climate, during the Ice Age, as shown by the inter-glacial periods were due to oscillations of solar energy. The Director also delivered the 32nd Robert Boyle Lecture before the Oxford University Junior Scientific Club, choosing for his subject "Thunder and Lightning."

In the *Proceedings of the Royal Society*, there is a paper by D. Brunt on "Some phenomena connected with the transfer of heat by radiation and turbulence in the lower atmosphere," in continuation of a paper of similar title that appeared in the *Proceedings* of the preceding year, in which the question of surface inversions of temperature and of the high lapse-rates observed under suitable conditions near the surface are critically examined from the mathematical side. In the *Memoirs of the Royal Meteorological Society* C. K. M. Douglas examines by the methods of correlation the relation between temperature and pressure in the troposphere.

The Office is also well represented among the papers contributed to the *Quarterly Journal of the Royal Meteorological Society*. Some curious oscillations of pressure observed at stations in this country so long ago as June 1908, were discussed in a paper read before the British Association in Dublin in 1908 by Sir Napier Shaw. Microbarographs had then been recently introduced and the chief interest of Sir Napier's paper was in showing the curious and inexplicable oscillations that occasionally occur in the atmosphere. Now after the lapse of 22 years an explanation of the origin of the phenomena is at last forthcoming. Mr. C. J. P. Cave, who had supplied one of the records discussed by Sir Napier, happened to come across a reference to a great disturbance in Siberia associated with the fall of a meteorite that occurred in June, 1908. Verification of dates soon showed that the origin of the oscillations recorded on microbarographs in this country was undoubtedly the disturbance caused by the meteorite in Siberia. In a paper appearing in the *Quarterly Journal* F. J. W. Whipple examines the available information critically, and works out the rate of propagation of the disturbance. In the course of the discussion which followed the interesting fact came out that the night glow of the sky which attracted so much attention during the summer of 1908 must also have been caused by the meteorite. In another paper read before the Society, C. E. P. Brooks and S. T. A. Mirrlees examine critically the irregularities in the annual variation of temperature in London

over a long period with a view to testing whether the generalisation made by Buchan in 1869 regarding the incidence of cold and warm spells at regular periods held for London. They reach the conclusion that the regularity claimed for these spells is not in accordance with the observed facts.

The *Quarterly Journal* also contains a full abstract of a paper communicated to the British Association by C. E. P. Brooks on "Changes of climate in the Old World during historic times."

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	5	0	8	133	11	1	4	5	0	0
1 " E. ...	1	1	2	2	27	344	18	4	3	2	2	2
6A " W. ...	1	1	0	0	20	320	14	3	3	2	2	1
2 England, N.E. ...	0	1	2	3	21	267	14	3	2	1	0	0
3 " E. ...	0	2	1	5	22	477	26	4	5	5	4	2
4 " Midlands	0	2	3	4	44	1007	31	10	1	3	2	2
5 " S.E. ...	0	7	3	5	38	837	40	11	8	7	6	5
London District ...	2	0	0	0	6	58	7	8	1	0	2	0
8B England, S.W. ...	0	1	2	3	29	599	22	6	3	3	4	2
7A " N.W. ...	0	0	1	0	21	451	22	7	2	1	0	0
7B N. Wales ...	0	1	0	1	6	166	6	3	3	2	2	2
8A S. " ...	0	0	1	1	6	220	9	3	1	1	1	0
9 Ireland, N. ...	0	1	3	0	7	133	6	3	4	4	1	1
10 " S. ...	1	0	2	0	16	132	6	2	2	6	0	0
6B Isle of Man ...	0	0	0	0	1	10	1	0	0	0	0	0
11 Scilly and Channel Isles ...	0	0	2	0	1	26	3	0	2	2	1	0
TOTAL ...	6	17	27	24	273	5180	236	68	44	44	27	17
Corresponding number for last year ...	6	17	28	23	270	5068	230	64	43	43	26	17

APPENDIX II

GALE WARNINGS ISSUED DURING THE YEAR 1930

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	17	94	48	16	21	77
{ B	5	80	43	4	22	65
2. Scotland, E. ...	20	95	39	19	9	72
3. Scotland, N.W. ...	17	100	53	17	21	72
4. Scotland W. and North Channel ...	11	91	46	10	24	74
5. Ireland, N. ...	11	100	52	11	21	63
6. Ireland, S. ...	16	94	47	15	18	70
7. Irish Sea ...	9	100	40	9	23	80
8. St. George's Channel	18	100	40	18	19	93
9. Bristol Channel ...	16	100	40	16	21	93
10. England, S.W. ...	27	85	51	23	19	82
11. England, S....	17	82	45	14	16	67
12. England, S.E. ...	11	100	41	11	22	80
13. England, N.E. ...	5	80	31	4	16	65
14. England, E....	15	73	33	11	15	79
TOTALS ...	215	92	649	198	287	75

APPENDIX III

FINANCIAL STATEMENT

The year under review, 1930-31, is the tenth in which the cost of the Meteorological Office has been borne on Air Ministry Votes. The accounts are not yet closed, but the following tables give the approximate figures for the expenses and receipts of the Meteorological Office:—

APPROXIMATE STATEMENT OF EXPENDITURE AND RECEIPTS IN RESPECT OF METEOROLOGICAL SERVICES DURING THE YEAR 1930-31.

<i>Expenditure.</i>		<i>Amount.</i>	
		£	£
Salaries and Wages—H.Q. Establishments	... ..	52,233	
" " —Out-station Establishments	... ..	59,094	
		111,327	
Fuel and Light	... ..		482
Transport of Personnel and Equipment	... ..		3,878
Instruments, Equipment and Stores	... ..		8,214
Research	... ..		569
Minor Works Services, Rents, Repairs and Maintenance of Buildings	... ..		7,925
Telegrams, Telephones	.. ..	
Subventions to Reporting Stations and miscellaneous charges	... ..		12,494
Superannuation	... ..		1,749
		Total	£146,638
			£146,638
 <i>Receipts.</i>			
Receipts from Royal Society	... ..		580
" " National Debt Commissioners (Annuities)	... ..		101
Sale of Instruments, Carriage, etc.	... ..		3,696
Daily Weather Reports, Forecasts, etc.	... ..		2,788
Receipts from War Office	... ..		6,147
		Total	£13,312
			£13,312

APPENDIX IV

THE GASSIOT COMMITTEE, 1930

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

LORD RUTHERFORD, O.M. (*President of the Royal Society*).
Colonel Sir HENRY LYONS (*Chairman*).
The Astronomer Royal.
Professor S. CHAPMAN.
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, MARCH 31, 1931

THE STAFF AT HEADQUARTERS

DIRECTOR :

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

<i>Assistant Directors</i>	R. G. K. Lempfert, C.B.E., M.A., F.Inst.P. E. Gold, D.S.O., F.R.S.
<i>Senior Professional Assistants</i>	Miss E. E. Austin, M.A. ; J. M. Stagg, M.A., B.Sc.
<i>Junior Professional Assistants</i>	C. J. Boyden, B.A. ; R. Frost, B.A. ; A. E. Mayers, B.Sc. ; W. R. Morgans, M.Sc. ; (one vacancy).

GENERAL SERVICES DIVISION.

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

MARINE DIVISION.

<i>Superintendent</i>	L. A. Brooke Smith, Captain R.N.R. (retd.), R.D.
<i>Senior Professional Assistants</i>	E. W. Barlow, B.Sc. ; J. Hennessy, Cdr. R.N.R. (retd.), R.D.
<i>Clerk, Grade I</i>	H. Keeton.
<i>Clerks, Grades II & III</i>	11 (two vacancies)

BRITISH CLIMATOLOGY DIVISION.

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

GENERAL CLIMATOLOGY DIVISION.

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

FORECAST DIVISION.

<i>Superintendent</i>	R. Corless, O.B.E., M.A.
<i>Assistant Superintendents</i>	H. W. L. Absalom, B.Sc. A.R.C.S., D.I.C. ; C. K. M. Douglas, B.A. ; W. H. Pick, B.Sc., A.Inst.P., F.C.P.
<i>Senior Professional Assistants</i>	F. H. Dight, B.Sc. ; C. H. Kellett, B.Sc. ; Miss L. F. Lewis, B.Sc. ; S. C. Russell, LL.B.
<i>Junior Professional Assistants</i>	D. Dewar, B.Sc. ; A. L. Maidens, B.Sc. ; (one vacancy).
<i>Clerk, Grade I</i>	W. Hayes.
<i>Clerks, Grades II & III</i>	20
<i>Telephone-Typists</i>	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>	...	...	R. F. Budden, M.A.; C. W. G. Daking, B.Sc.; G. J. W. Oddie, B.Sc.; E. Taylor, M.A., B.Sc.; M. J. Thomas, B.Sc.
<i>Clerk, Grade I</i>	...	...	F. M. Dean.
<i>Clerks, Grade III</i>	...	...	4

AIRSHIP SERVICES DIVISION.

<i>Superintendent</i>	...	...	(vacancy).
<i>Clerk, Grade III</i>	...	...	1

NAVY SERVICES DIVISION.

<i>Superintendent</i>	...	...	L. G. Garbett, Commander, R.N. (retd.).
<i>Senior Professional Assistants</i>	H. St. G. Dyke Marsh, B.A.; A. H. Nagle, B.Sc., A.R.C.S., D.I.C.
<i>Clerk, Grade III</i>	1

ARMY SERVICES DIVISION.

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

<i>Superintendent</i>	J. S. Dines, M.A.
<i>Senior Professional Assistant</i>	J. E. Belasco, B.Sc.
<i>Junior Professional Assistant</i>	...	...	J. C. Cumming, M.A.
<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>	...	...	J. Crichton, M.A., B.Sc., F.R.S.E.
<i>Senior Professional Assistant</i>	...	...	D. N. Harrison, D.Ph.
<i>Clerks, Grade III</i>	...	...	5

(and one research post).

METEOROLOGICAL OFFICE, MALTA.

<i>Superintendent</i>	...	...	G. R. Hay, M.A.
<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., A. Inst. P.; W. J. Grassick, M.A., 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 A. W. Lee, M.Sc., A.R.C.S., D.I.C., A.Inst P.;
 F. J. Scrase, M.A., B.Sc., A.I.C.
Junior Professional Assistant P. A. Sheppard, B.Sc.
Clerk, Grade I E. Boxall.
Clerks, Grades II & III 5
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 R. E. Watson, B.Sc., Ph.D.
Senior Professional Assistant H. L. Wright, M.A.
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 B. C. V. Oddie, B.Sc.
Clerks, Grade III 3
Caretaker 1

PORT METEOROLOGICAL OFFICE, LIVERPOOL.

Senior Professional Assistant M. Cresswell, Lt.-Cdr. R.N.R.
Clerk, Grade III 1

PORT METEOROLOGICAL OFFICE, LONDON.

Senior Professional Assistant C. H. Williams, Lt. R.N.R.
Clerk, Grade III 1

AVIATION SERVICES STATIONS

ALDERGROVE.

*Junior Professional Assistant** F. E. Coles, B.Sc., A.R.C.S., D.I.C.
Clerks, Grades II & III 3

BIGGIN HILL.

Clerks, Grades II & III 5 (one vacancy)

APPENDIX V—continued.

BOSCOMBE DOWN.	
<i>Senior Professional Assistant</i>	C. W. Lamb, M.C., B.Sc.
<i>Clerks, Grades II & III</i> ...	3
CALSHOT.	
<i>Assistant Superintendent</i> ...	H. F. Jackson, M.S.E.
<i>Junior Professional Assistant</i>	L. H. Starr, M.Sc.
<i>Clerks, Grades II & III</i> ...	4
CATTERICK.	
<i>Senior Professional Assistant</i>	W. Gillon, M.A., B.Sc.
<i>Clerks, Grades II & III</i> ...	3 (three vacancies).
CRANWELL.	
<i>Assistant Superintendent</i> ...	W. A. Harwood, D.Sc.
<i>Senior Professional Assistant</i>	R. M. Stanhope, B.A.
<i>Clerks, Grades II & III</i> ...	4
CROYDON.	
<i>Assistant Superintendent</i> ...	S. F. Witcombe, B.Sc.
<i>Senior Professional Assistants</i>	J. S. Farquharson, M.A. ; T.W.V. Jones, B.Sc.
<i>Clerks, Grades II & III</i> ...	8
<i>Telephone-Typists</i> ...	2
FELIXSTOWE.	
<i>Senior Professional Assistant</i>	A. Walters.
<i>Clerks, Grades II & III</i> ...	3
HOLYHEAD.	
<i>Clerks, Grades II & III</i> ...	3
LEUCHARS.	
<i>Senior Professional Assistant</i>	R. H. Mathews, B.A.
<i>Clerks, Grades II & III</i> ...	3
LYMPNE.	
<i>Assistant Superintendent*</i> ...	R. A. Watson, B.A.
<i>Clerks, Grades II & III</i> ...	7 (two vacancies).
MOUNT BATTEN.	
<i>Junior Professional Assistant*</i>	E. A. Cope, B.Sc., A.R.C.S.
<i>Clerks, Grades II & III</i> ...	3 (one vacancy).
RENFREW.	
<i>Junior Professional Assistant*</i>	A. G. Forsdyke, Ph.D., A.R.C.S., D.I.C.
<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, Grades II & III ... 3

WORTHY DOWN.

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

AIRSHIP SERVICES STATION

CARDINGTON.

Assistant Superintendent ... W. C. Kaye, B.Sc.
Senior Professional Assistants A. F. Crossley, B.A.; C. S. Durst, B.A.;
 L. Dods, B.Sc.; S. P. Peters, B.Sc., A.Inst.P.
 (one vacancy).
Clerks, Grades II & III ... 6 (one vacancy).
Draughtsman ... 1
Telephone-Typist ... 1

ARMY SERVICES STATIONS

METEOROLOGICAL OFFICE, SHOEBURYNESS.

Assistant Superintendent ... C. E. Britton, B.Sc.
Junior Professional Assistant J. Pepper, M.A., B.Sc.
Clerks, Grades II & III ... 12 (one vacancy).

METEOROLOGICAL OFFICE, LARKHILL.

Senior Professional Assistant D. W. Johnston, B.Sc.
Clerks, Grades II & III ... 4

METEOROLOGICAL OFFICE, PORTON.

Clerks, Grades II & III ... 5

SECONDED FOR DUTY WITH OTHER BODIES

Assistant Superintendent ... C. D. Stewart, B.Sc. (Colonial Office, Malaya).
Senior Professional Assistants R. P. Batty, B.A. } (R.A.F., India).
 R. G. Veryard, B.Sc. }
 A. C. Best, B.Sc. } (War Office, Porton
 E. L. Davies, M.Sc. } Experimental Station).
 H. Garnett, M.Sc. }
 O. G. Sutton, B.Sc. }
 L. G. Hemens, B.Sc. (Indian Government).

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, 1931).

The Marine Observer (to date).

The Meteorological Magazine (to date).

Monthly Frequency Tables, being summaries of observations of horizontal visibility, height of base of low cloud and speed and direction of surface and upper winds in the form approved by the International Commission for Air Navigation (to December, 1930).

Seismological Bulletin. A diary of seismological disturbances recorded on the Galitzin Aperiodic Seismographs at Kew Observatory, Richmond (to February, 1931).

British Rainfall, 1929. A report on the distribution of rain in space and time over the British Isles as recorded by over 5,000 observers.

Observatories' Year Book, 1928. Comprising the meteorological and geophysical results obtained from autographic records and eye observations at the observatories at Lerwick, Aberdeen, Eskdalemuir, Cahirciveen (Valentia Observatory) and Richmond (Kew Observatory), and the results of soundings of the upper atmosphere by means of registering balloons.

Réseau Mondial, 1923. Monthly and annual summaries of pressure, temperature, and precipitation based on a world-wide network of observing stations.

Southport Auxiliary Observatory. Annual Report and results of meteorological observations, 1929. By J. Baxendell.

Weekly Weather Report for the period March 3, 1929 to March 1, 1930. Particulars of temperature, rainfall and bright sunshine for each week.

OCCASIONAL :—

Decode for use with the International Code for Wireless Weather Messages from Ships adopted by the International Meteorological Conference, Copenhagen, September, 1929. 2nd edition, 1931.

Examples of Weather Maps showing Typical Distributions of Pressure. Reproduced from "The Weather Map."

APPENDIX VI—*continued.*OCCASIONAL :—*continued.*

Fishery Barograph. A note on the use of the barograph in anticipating gales and instructions for the care and maintenance of barographs lent to fishing communities.

Gazetteer of British Meteorological Stations used in the preparation of synoptic reports.

Meteorological Glossary. In continuation of "The Weather Map." 2nd edition, 1930.

Meteorological Observer's Handbook. Supplement No. 1. Instructions for Meteorological Telegraphy. 2nd edition, 1930.

Meteorological Reports issued by Wireless Telegraphy in Great Britain and the countries of Europe and North Africa. 8th edition, 1931.

Observer's Primer, being short instructions in the method of taking and reporting readings of temperature and rainfall, specially prepared for meteorological observers in the British colonies. 2nd edition, 1930.

Report of the Conference of Empire Meteorologists, London, August 20–September 3, 1929.

Short Course in Elementary Meteorology. By W. H. Pick, B.Sc., F.C.P. 3rd edition, 1930.

Geophysical Memoirs :—

Vol. V :—

50. Practical examples of polar-front analysis over the British Isles in 1925–26. By J. Bjerknes, D.Ph., Director, Vaervarslingen pa Vestlandet, Bergen, Norway.

Vol. VI :—

51. A study of visibility and fog at Malta. By J. Wadsworth, M.A.
52. Some characteristics of eddy motion in the atmosphere. By F. J. Scrace, M.A., B.Sc.

Professional Notes :—

Vol. IV :—

56. Auroral observations at Lerwick Observatory 1924–9. By A. W. Lee, M.Sc.
57. Effect of variation in relative wind force on the readings of wet and dry bulb thermometers in a portable screen on board ship. By E. G. Bilham, B.Sc., D.I.C. and J. E. Belasco, B.Sc.
58. A new relation between atmospheric electricity and terrestrial magnetism. By A. W. Lee, M.Sc., D.I.C.
59. Some observations of upper air temperature in Iraq. By S. P. Peters, B.Sc.
60. Weather conditions over the central and western Mediterranean during the period February 10–14, 1929. By G. A. Bull, B.Sc.

Vol. V :—

61. A comparison of temperatures inside and outside the meteorological enclosure at the airship base Ismailia, Egypt. By J. Durward, M.A.

APPENDIX VI—continued.

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.—

Dynamische Meter. *Meteor. Zs., Braunschewig*, **47**, 1930, pp. 125-126.

See also *Beitr. Physik Atmosph., Leipzig*, **17**, 1930, pp. 85-87.

Mr. M. A. Giblett.† *Nature*, **126**, 1930, pp. 610, 619.

Thunder and lightning, being the thirty-second Robert Boyle Lecture, delivered before the Oxford University Junior Scientific Club on 7 June, 1930. Oxford, 1930, pp. 15.

The climate during the pleistocene period. *Edinburgh, Proc. R. Soc.*, **50**, 1930, pp. 262-296. Summary in *Nature*, **125**, 1930, p. 992.

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

Discussion on geological climates. *London, Proc. R. Soc.*, **106** (B), 1930, pp. 299-317.

By E. GOLD, D.S.O., F.R.S.—

Prof. Dr. F. M. Exner.† *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 194-196, portr.

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

The great Siberian meteor and the waves, seismic and aerial, which it produced. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 287-301, disc. pp. 301-304.

Exploring the atmosphere by air-waves. *Discovery, London*, **11**, 1930, pp. 343-346.

By F. J. W. WHIPPLE, M.A., Sc.D., F.Inst.P., with A. W. LEE, M.Sc., A.R.C.S., D.I.C., A.Inst.P.—

Studies in microseisms. (a) The question of diurnal variation.

(b) The variation of amplitude with period. *London, Mon. Not. R. Astr. Soc., Geophys. Supp.*, **2**, 1931, pp. 363-373.

By C. E. P. BROOKS, D.Sc.—

The rôle of the oceans in the weather of western Europe. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 131-140.

The climate of the first half of the eighteenth century. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 389-402, disc. p. 402.

Changes of climate in the Old World during historic times. *London, Q.J.R., Meteor. Soc.*, **57**, 1931, pp. 13-26.

The climate of Ascension Island. *London, Q.J.R. Meteor. Soc.*, **57**, 1931, pp. 85-89.

By C. E. P. BROOKS, D.Sc. with S. T. A. MIRRLEES, M.A.—

Irregularities in the annual variation of the temperature of London. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 375-384, disc. pp. 384-388.

See also *Nature*, **126**, 1930, pp. 61-63.

By C. E. P. BROOKS, D.Sc. with THERESA M. HUNT.—

The zonal distribution of rainfall over the earth. *London, R. Meteor. Soc., Mem.*, **3**, No. 28, 1930, pp. 139-158.

By D. BRUNT, M.A., B.Sc.—

Some problems of modern meteorology. I. The present position of theories of the origin of cyclonic depressions. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 345-350, also in *Washington, D.C., U.S. Dept. Agric., Monthly Weather Rev.*, **58**, 1930, pp. 419-422.

Some phenomena connected with the transfer of heat by radiation and turbulence in the lower atmosphere. *London, Proc. R. Soc.*, **130** (A), 1930, pp. 98-104.

Weather as a factor in history. *State Service, London*, **10**, 1930, pp. 4-7.

† Obituary notice.

APPENDIX VI—continued.

By R. CORLESS, O.B.E., M.A.—

The gale of the 12th of January, 1930. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 184–186.

By J. S. DINES, M.A.—

Meteorological instruments [at the Twenty-First Annual Exhibition of the Physical and Optical Societies]. *London, Inst. Physics, J. Sci. Instr.* **8**, 1931, pp. 75–77.

By J. DURWARD, M.A.—

Squalls at Amman—Transjordan. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 175–178.

By F. ENTWISTLE, B.Sc.—

La formation du brouillard. *Météorologie, Paris*, **5**, 1929, pp. 505–519.

Mr. M. A. Giblett.† His life and work. *London, Q.J.R. Meteor. Soc.*, **57**, 1931, pp. 106–110, portr.

By the late M.A. GIBLETT, M.Sc.—

Observations du vent en altitude à l'île de Kamaran (Sud de la Mer Rouge) en novembre, décembre 1927 et janvier 1928. *Météorologie, Paris*, **5**, 1929, pp. 519–528.

By C. K. M. DOUGLAS, B.A.—

The cyclonic depressions of November 16 and 23, 1928. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 121–129.

On the relation between temperature and pressure in the troposphere. *London, R. Meteor. Soc., Mem.*, **3**, No. 29, 1930, pp. 159–168.

Movements of cirrus cloud in relation to fronts. *London, Q.J.R. Meteor. Soc.*, **57**, 1931, pp. 90–92.

Le processus physique de la formation des nuages. *Météorologie, Paris*, **6**, 1930, pp. 399–406.

By W. H. PICK, B.Sc.—

A note on the inter-relation between visibility and relative humidity. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 183–184.

The change in pressure distribution in 48 hours over the British Isles in winter. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 336–338.

The significance of a green sky. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 350–352.

Further note on fogs during winter with unsaturated air. *London, Q.J.R. Meteor. Soc.*, **57**, 1931, pp. 103–104.

By W. H. PICK, B.Sc. with F. E. COLES, B.Sc.—

The value of observations of sea disturbance at stations on our western coasts in forecasting depressions advancing from the Atlantic. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 129–130.

By W. H. PICK, B.Sc. with A. G. FORSDYKE, Ph.D., A.R.C.S., D.I.C.—

A further note on fogs during winter with unsaturated air. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 339–341.

By M. T. SPENCE, B.Sc.—

The factors affecting visibility at Valentia Observatory. *London, Q.J.R. Meteor. Soc.*, **57**, 1931, pp. 71–78, disc. pp. 78–80.

By R. A. WATSON, B.A. with N. R. MCCURDY, B.Sc.—

Pilot balloon observations at Mauritius. *Mauritius, Royal Alfred Observatory, Misc. Publ.*, No. 11, 1930, pp. 17, pls. 3.

By E. W. BARLOW, B.Sc.—

Some problems of modern meteorology. No. 2. The present position of theories of the circulation of the atmosphere. *London, Q.J.R. Meteor. Soc.*, **57**, 1931, pp. 3–12.

APPENDIX VI—*continued.*

- By A. C. BEST, B.Sc.—
Instruments for obtaining dry and wet bulb temperatures. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 365-371, pl., disc. pp. 371-373.
- By A. F. CROSSLEY, B.A. and C. W. G. DAKING, B.Sc.—
A double occluded front at Cardington. *London, Q.J.R. Meteor. Soc.*, **57**, 1931, pp. 94-97.
- By F. H. DIGHT, B.Sc.—
The thunderstorms of November 2, 1930. *London, Q.J.R. Meteor. Soc.*, **57**, 1931, pp. 101-103.
- By H. GARNETT, M.Sc. and G. S. P. HEYWOOD.—
Notes on a cold front on the 23rd of May, 1929. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 186-191.
- By J. GLASSPOOLE, M.Sc., Ph.D.—
The reliability of rainfall over the British Isles. *London, Trans. Inst. Water Engin.*, **35**, 1930, pp. 174-199. See also *Water and Water Engineering, London*, **32**, 1930, pp. 555-562.
Heavy falls of rain in short periods (two hours or less). *London, Q.J.R. Meteor. Soc.*, **57**, 1931, pp. 57-64, disc. pp. 64-70.
- By S.C. RUSSELL, LL.B.—
Arab weather prognostics. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 338-339.
- By F. J. SCRASE, M.A., B.Sc., A.I.C.—
Deep focus earthquakes. *Nature*, **127**, 1931, p. 486.
- By J. M. STAGG, M.A., B.Sc.—
Atmospheric pressure and the state of the earth's magnetism. *Nature*, **127**, 1931, p. 402.
- By J. M. STAGG, M.A., B.Sc. with S. CHAPMAN, D.Sc., F.R.S.—
On the variability of the quiet-day diurnal magnetic variation. Part II. *London, Proc. R. Soc.*, **130**, (A), 1931, pp. 668-697.

APPENDIX VII

BROADCAST ISSUES.

ISSUES BY BRITISH BROADCASTING CORPORATION.
National Programme.

<i>Normal hour of issue.</i>	
10.30 a.m.	(a) Forecasts for farmers prepared at 10 a.m. (b) Forecasts for shipping prepared at 10 a.m.
6.15 p.m.	General forecasts for the British Isles prepared at 5.45 p.m. (week-days only).
9.0 p.m. (week-days), 8.50 p.m. (Sundays).	} General forecasts for British Isles prepared at 8.30 p.m.
9.15 p.m. (week-days), 9.0 p.m. (Sundays).	

Regional Programmes.

6.15 p.m.	As National Programme (week-days only).
8.50 p.m. (Sundays), 10.15 p.m. (week-days).	} General forecasts for British Isles prepared at 8.30 p.m.
<i>Belfast</i> (in addition to the items' shown above under "National Programme") :—	
9.15 p.m. (week-days), 9.0 p.m. (Sundays).	} Forecasts for farmers in Northern Ireland prepared at 8.30 p.m.

Gale warnings.—Warnings of approaching gales are telephoned to the London Office of the British Broadcasting Corporation and issued as part of the National Programme.

- (a) with the next forecast for shipping ;
- (b) with the time signals at 1 p.m., 4.45 p.m. and 6.30 p.m. of the day of issue.

"*Spell*" forecasts.—Forecasts of "spells" of settled fine weather of at least three days' duration are broadcast by the B.B.C., as required, with all the general forecasts and forecasts for farmers.

ISSUES BY STATIONS AT DUBLIN AND CORK, IRISH FREE STATE.

<i>Normal hour of issue.</i>	
1.30 p.m. (week-days) only.	General forecasts for Ireland prepared at 12 noon.
10.30 p.m. (week-days), 11 p.m. (Sundays).	} General forecasts for Ireland prepared at 8.30 p.m.