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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
1930

*The Seventy-fifth Year of the
Meteorological Office*

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METEOROLOGICAL COMMITTEE

1929-30

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.

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

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

Sir THOMAS MIDDLETON, K.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, 1929-30.

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 W. PEDDIE, D.Sc. Nominated by the Royal Society of Edinburgh (until May, 1929).

Professor E. M. WEDDERBURN, M.A., D.Sc., W.S. Nominated by the Royal Society of Edinburgh (from May, 1929).

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

Professor H. STANLEY ALLEN. Nominated by the University of St. Andrews.

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. 45-9.

ANNUAL REPORT of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the year ending March 31, 1930 (the seventy-fifth year of the Meteorological Office).

The Meteorological Committee met three times during the year, on July 10 and November 13, 1929, and March 12, 1930. There were no changes in the membership of the Committee during the year.

The Edinburgh Meteorological Committee met on June 11, and October 29, 1929, and January 21, 1930. Professor Peddie, representing the Royal Society of Edinburgh, resigned his membership of the Committee at the beginning of the year, and was succeeded by Professor Wedderburn, whose term as representative of the University of Edinburgh was completed. Professor J. R. Currie was nominated as representative of the University of Glasgow.

CONFERENCES

The year 1929 will always be remembered in the history of official meteorology as that in which were held three important conferences, which led amongst other things to the recognition of marine meteorology in international treaties, to a radical improvement in the interchange of meteorological data throughout the world, and to a much closer connexion between the meteorological services of the British Empire. It is considered desirable, both on account of the general interest and for a record in convenient form, to summarise here the work of the three conferences.

The International Conference on Safety of Life at Sea.—This International Conference met in London during April and May, 1929, and the Convention prepared contains two Articles which may be said to form the charter for marine meteorology. Article 34 of this Convention states :—

“ The master of every ship which meets with dangerous ice, a dangerous derelict, a dangerous tropical storm or any other direct danger to navigation is bound to communicate the information, by all the means of communication at his disposal, to the ships in the vicinity, and also to the competent authorities at the first point of the coast with which he can communicate. It is desirable that the said information be sent in the manner set out in Regulation XLVI.

“ Each Administration will take all steps which it thinks necessary to ensure that when intelligence of any of the dangers specified in the previous paragraph is received, it will be promptly brought to the knowledge of those concerned and communicated to other Administrations interested.

“ The transmission of messages respecting the dangers specified is free of cost to the ships concerned.”

As soon as the Convention is ratified by any Government—and it is anticipated that it will be ratified in the near future by all Governments taking part in the Conference—it will be obligatory on a captain sailing in a ship registered in that country to report immediately his encounter with a tropical storm, and it becomes obligatory on any Government receiving such a report to take steps to forward the information to everyone concerned. The Convention leaves it to each authority to decide who is concerned, but it will, no doubt, mean in practice that all ports likely to be affected will be informed and broadcast messages issued to shipping. A law of this kind will be a very great help to those countries which have organised a hurricane-warning service, as it ensures their receiving full information of every storm as soon as it has formed.

The second article affecting meteorology (Article 35) is probably the more important of the two, although in this case no direct obligation is laid down. The chief clauses of this Article are the following :—

“ The contracting governments undertake to encourage the collection of meteorological data by ships at sea, and to arrange for their examination, dissemination and exchange in the manner most suitable for the purpose of aiding navigation.

“ In particular, the contracting governments undertake to co-operate in carrying out, as far as practicable, the following meteorological arrangements :—

- (a) to warn ships of gales, storms and tropical storms both by the issue of wireless messages and by the display of appropriate signals at coastal points ;
- (b) to issue daily, by radio, weather bulletins suitable for shipping, containing data of existing weather conditions and forecasts ;
- (c) 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, and to provide coast stations for the reception of the messages transmitted ;
- (d) to encourage all ship-masters to inform surrounding ships whenever they experience wind force of 10 or above on the Beaufort scale (force 8 or above on the decimal scale).

"Forecasts, warnings, synoptic and other meteorological reports intended for ships shall be issued and disseminated by the national service in the best position to serve various zones and areas, in accordance with mutual arrangements made by the countries concerned.

"Every endeavour will be made to obtain a uniform procedure in regard to the international meteorological services specified in this Article, and, as far as is practicable, to conform to the recommendations made by the International Meteorological Organization, to which Organization the contracting governments may refer, for study and advice, any meteorological questions which may arise in carrying out the present Convention."

In this Article each contracting government undertakes to encourage marine meteorology, and certain services are specified as being particularly important. These latter are little more than the objects which have been followed by the Marine Division of the Meteorological Office for some considerable time. Their inclusion in an international agreement is, however, of considerable value as they now become part of a wide scheme of international co-operation instead of a mere departmental aid to national shipping. The moral effect of these Articles in making arrangements with other Governments for co-operation in marine meteorology cannot be overestimated.

The Conference of Empire Meteorologists.—In 1928, the Air Ministry issued invitations to all parts of the British Empire to send official delegates to a conference to be held in London during 1929, at which meteorological matters affecting the Empire as a whole would be discussed. The need for the conference had been felt for several years on account of the increasing co-operation necessary in connexion with Empire shipping and agriculture, and more especially with meteorological services on Imperial air routes. The invitation was accepted by 29 administrations of the Empire and 24 delegates attended the Conference; in addition, Egypt was represented by an unofficial observer. A list of the countries taking part, and the delegates representing them, will be found in Appendix VII.

The Ministry of Agriculture and Fisheries took advantage of the presence in London of so many meteorologists, or officers interested in meteorology, from the various parts of the Empire, to arrange a further conference to consider meteorology in relation to agriculture. All the delegates to the meteorological conference attended this further conference, in addition to other representatives from the Dominions and Colonies and a large number of British agriculturists.

The Conference commenced on August 20 and continued until September 3, 1929. A full report of the Conference is being published; it is therefore only necessary here to refer to the work of the Conference in broad outline.

The plan followed for the Conference was a series of meetings at which the work and methods of the London Meteorological Office were explained, followed by a number of meetings at which the application of these methods to the meteorological needs of the various parts of the Empire was discussed in detail. To focus the discussion a series of memoranda was prepared by the staff of the London Meteorological Office, amongst which were papers on the following subjects : meteorology and aviation in the British Empire ; meteorology and airships in the British Empire ; meteorology and the International Commission for Air Navigation ; marine meteorology ; meteorological requirements of the Army within the British Empire ; fleet meteorology ; the Empire in relation to international meteorology ; and the collection, tabulation and publication of climatological data.

During the course of the Conference, special sub-committees were appointed to consider the following subjects : West African meteorology ; ships' wireless weather telegraphy ; West Indian hurricanes ; meteorological organization on the Cairo-Durban airship route and the Cairo-Capetown air route ; meteorological requirements at Aden ; charts and codes (aviation).

The discussions throughout were very keen and a great deal of useful information was communicated. Very few actual resolutions were passed, but the printed record of the Conference contains a mass of information, which will not only be useful throughout the Empire but will tend to introduce uniform methods in all parts.

While in London, the delegates had an opportunity of visiting the various divisions of the Meteorological Office ; they also inspected the work for airships at Cardington and for civil aviation at Croydon.

International Conference of Directors of Meteorological Services.—The international interests of official meteorology are in charge of an organization which functions through several different bodies. The chief authority of the organization is the Conference of Directors of Services which meets once in six years ; of this Conference the directors of official meteorological services in all parts of the world are members, and the work of the Conference is limited to matters affecting the administration of the various services, no purely scientific subject being discussed. During the intervals between the meetings of the Conference, the work is carried on by the International Meteorological Committee consisting of a President and twenty members appointed by the Conference ; each member of the Committee must also be the director of a meteorological service and each member must be of a different country. A number of commissions are appointed by the Conference or the Committee to examine and report on various subjects, which may in suitable cases be purely scientific subjects, but on the whole, the commissions deal with the organization of meteorological work. It is usual for

commissions to meet in the intervals between the Conferences, but for convenience many commissions hold meetings in the same town as the Conference of Directors, but in the previous week.

A meeting of the Conference of Directors fell due in 1929, and arrangements were made to hold it at Copenhagen in the month of September. The date of the Conference of Empire Meteorologists had been chosen so that the directors of meteorological services who had come from different parts of the Empire to London for that Conference could proceed at once to the International Conference. In consequence, eight directors of meteorological services of the Empire attended the meetings at Copenhagen, a larger number of Empire representatives than has ever attended a similar conference in the past.

Previous to the meeting of the Conference a number of commissions met, the most important of which, from the point of view of the London Meteorological Office, was the Commission for Synoptic Weather Information, of which Lieut.-Col. Gold is the President, and the Commission for Maritime Meteorology at which important questions dealing with marine meteorology were discussed.

The report of the Conference shows that 111 Resolutions were passed during the meetings, many of them of first importance for the administration of official meteorological services. It is impossible to refer here to more than a few of the most important resolutions in general terms.

Marine meteorology.—The Conference adopted a proposal originally made by the London Meteorological Office that the number of ships taking meteorological observations and issuing them at stated times by wireless telegraphy for the information of surrounding ships and shore stations, called "selected ships," should be limited to 1,000 for the world as a whole, and that these ships should be organized by the various countries in proportion to the tonnage of the mercantile marine of each country. According to this standard the British Empire will be responsible for 356 selected ships, and arrangements will be made for distributing this number amongst the various Dominions, but as the shipping of Great Britain and Ireland is so much greater than that of the Dominions, practically the whole number will be organized by the London Meteorological Office.

Ever since the introduction of wireless telegraphy has made it possible for ships to communicate with one another, there has been an interchange of meteorological reports. This interchange at first naturally took the form of plain-language messages, but the need for the introduction of some method of sending weather messages in a suitable code has been increasingly felt. Several countries have introduced codes for the transmission of messages direct to them, but the codes have been different and several attempts which have been made to introduce a code for weather messages from ships

which could be used in all circumstances, both for interchange between ships and between ship and shore, have been unsuccessful. The difficulty has been that the information required between ships is not so full as that required between ships and meteorological services on shore. Moreover, the information required in the tropics is different from that required in temperate regions. The question of a universal code was considered at the Conference of Empire Meteorologists, and a form of code drawn up which seemed to satisfy the needs of shipping in the different parts of the Empire. The solution of the problem of meeting the various needs of ships and shore stations and the tropics and temperate regions, was found in the following way. The meteorological data are to be coded in a series of groups of five figures each. It was found possible to put into the first four groups the information which was required from every ship, for example, its position and time of observation, and also the most important meteorological observations which every ship could be expected to provide and which are required equally in all parts of the world. The message issued from every ship will, therefore, consist of these four groups which may be called the universal groups. Ships willing to give more information can do so by adding other groups, and meteorological services requiring particular ships to send additional information can arrange for additional groups to be added. The difficulty was to find some method by means of which the contents of these additional groups could be made known to the recipients of the message. The solution was found in using the first figure of the fifth group to indicate the meaning of the subsequent groups. In this way it will be possible to have ten different arrangements of groups subsequent to the first four, the meaning of which can be identified by the first figure of the fifth group. This proposal was submitted to the Conference at Copenhagen and met with general approval. Slight alterations in the form of the message originally proposed were made at Copenhagen, but the general scheme was accepted and two sets of subsequent groups were decided upon. It was found that at present the needs of all services in all parts of the world could be met by the four universal groups followed by one or other of the two sets of subsequent groups. It is difficult to exaggerate the importance of this decision, for meteorological information can now be given out by any ship in a simple code which will be understood by any ship which receives it, independent of nationality.

Codes for synoptic messages.—Ever since the war, the advance of meteorological knowledge and the ever-increasing demand made by aviation for fuller and more frequent meteorological reports have pointed to the necessity for occasional revision of the codes used in distributing the information between various countries. There has always been great willingness on the part of national meteorological services to adopt international methods. On the other hand, a change in an existing code causes very great difficulty as it means

instructing all the observers in the use of the new code and the reprinting of books of instructions. As the rate of progress and therefore the changing needs have been different in different countries, it will be readily understood that it is not easy to get agreement for changes in an international code, especially changes which are introduced to meet the more advanced scientific methods of some progressive meteorological services. The scientific advances of weather forecasting and the practical needs of aviation have, for different reasons, led to the demand for the inclusion in weather messages of more information about the state of the sky, that is of the form and distribution of the clouds. Other less important changes were also desired, especially a better arrangement of the sentences which describe the weather at the time of observation, that is whether there is rain, fog, thunderstorm, snow or showers. This question had been discussed at considerable length by the Commission for Synoptic Weather Information under Lieut.-Col. Gold's presidency, and proposals made by that Commission to the Conference were accepted and a largely modified code for the interchange of messages between various countries was adopted. The opportunity was also taken of devising a special code suitable for use in the tropics based on European experience. Up to the present, there has been little need to interchange messages between the tropics and temperate regions, and, therefore, it was possible to use different codes in the two regions. The development of air lines which require information over long stretches of country has made it essential that the exchange of weather messages should be universal, hence the need for similar codes in the tropics and temperate regions. Largely owing to the presence at Copenhagen of so many members of the British Empire from tropical regions, this problem was satisfactorily solved and codes based on similar principles were adopted which it is hoped will replace all other codes in the future.

Polar Year.—Another question of very considerable importance was considered by the Copenhagen Conference. This was a proposal originally made by the President of the Deutsche Seewarte that the 50th anniversary of the international co-operation which took place in the years 1882-3 for the scientific investigation of polar regions should be celebrated in some suitable manner. The work done in 1882-3 has resulted in that year being called, in scientific circles, the 'Polar Year,' and it appeared that the most appropriate method of celebrating the previous work would be to repeat it and make the year 1932-3 a second Polar Year. The proposal was considered by two of the international commissions, and they drew up a scheme which they presented to the Conference for consideration. The Conference adopted the idea of a second Polar Year with enthusiasm and approved the general outlines of the scheme presented by their commissions. The Conference appointed a new commission to be entitled the Commission for the Polar Year 1932-3, to be charged with carrying out the undertaking. The proposals now under

discussion are that a number of small observing stations should be established around and within the Arctic regions, and similarly as far as possible in and around the Antarctic regions. At these stations observations of terrestrial magnetism, aurora, weather, upper air motion and temperature should be carried out during twelve months, according to an international plan. If funds permit it is also suggested that a number of mountain stations near to the base stations already mentioned should be established, so that the conditions in the upper atmosphere may also be studied. It is proposed that each country should undertake the establishment of one or more of these small stations. The plan therefore does not visualize expensive expeditions with specially chartered ships, but the establishment of stations, most of which can easily be reached by normal methods of transport, and in cases of stations in remote districts, inexpensive transport can probably be arranged. The Conference decided to approach all Governments through diplomatic channels inviting their co-operation in the enterprise and it is hoped that Great Britain will take the share which her wide-spread interests, extending to all parts of the world, would demand.

The large amount of work connected with the conferences, particularly the preparation of the memoranda and the carrying out of the decisions reached, especially at Copenhagen, has been the cause of a considerable strain on the staff and of disorganization of the work of the Office. The introduction of the new codes for synoptic meteorology on March 1, and the new procedure in connexion with selected ships has been particularly onerous, as is recorded in other parts of this Report.

Load-line Committee.—At the request of the Board of Trade, the Director attended a number of meetings of the Load-line Committee, during which the question of the zones in which various load-lines should be enforced was under consideration. As the result of these discussions zones were marked out and will form the basis of the recommendations made by the British delegation at the International Conference on Load-line which is to be held in London during June, 1930.

Air Currents around the Rock of Gibraltar.—Owing to a series of accidents to aircraft culminating in a fatal accident to a seaplane in February, 1929, the Meteorological Office was asked to investigate the nature of the air currents around the Rock. As it was impossible at the time to spare a member of the staff of the Meteorological Office, Mr. J. H. Field, C.S.I., late Director-General of Observatories, India, very kindly undertook to make the investigation without remuneration beyond his out-of-pocket expenses. Mr. Field spent

several months on the problem in this country, obtaining considerable help from the Aerodynamical Department of the National Physical Laboratory, and then proceeded to Gibraltar to make actual investigations on the spot. Mr. Field's report had not been received at the end of the year under review, but it is already clear that an important piece of work has been carried out.

Mawson's Antarctic Expedition.—In connexion with Sir Douglas Mawson's expedition to the Antarctic in the *Discovery*, the Office was asked to assist in providing meteorological apparatus and installing it in the ship. Mr. R. G. Simmers of New Zealand, came to England to join the ship and took the opportunity of discussing his work and the necessary equipment with the Director and other members of the staff of the Office.

Meteorological Service, Malaya.—The increasing demand for meteorological information in the neighbourhood of Malaya, especially in connexion with aviation, has led to the establishment of a meteorological branch under the Survey Department of the Straits Settlements and Federated Malay States. The London Meteorological Office was consulted regarding the establishment of this new meteorological service and as to a suitable meteorologist to take charge. Mr. C. D. Stewart, an assistant superintendent on the staff of the Meteorological Office, was recommended for the post and he left England to take up his duties in May, 1929. Mr. Stewart has already commenced to organize the meteorological stations and it is hoped that in the near future he will be able to arrange for the preparation of a daily weather map and the issue of synoptic messages.

Meteorological Service, East Africa.—A new meteorological service for East Africa has now been established with its headquarters at Nairobi, the cost being borne by grants from Egypt, Kenya, Uganda, the Sudan, Northern Rhodesia, Zanzibar and Tanganyika. Mr. A. Walter, the Statistician to the Conference of East African Governors and formerly Director of Mauritius Observatory, has been appointed the first Director. Mr. Walter attended the Conference of Empire Meteorologists and took the opportunity while in London to consult the Meteorological Office in many matters of common interest. The Meteorological Office wishes Mr. Walter all success in his new and important enterprise.

Two members of Mr. Walter's staff, namely Mr. F. T. Riley and Mr. M. Walter, have received training in the Meteorological Office before taking up their duties in East Africa, the former was only able to devote a fortnight for this purpose, but the training of the latter will probably extend over twelve months.

CLIMATOLOGY

British Climatology.—For the first time for a number of years there are no major changes in the work connected with British climatology to record. The *Monthly Weather Report*, the *Weekly Weather Report* and *British Rainfall* have been published according to the normal dates. The *Observatories' Year Book* is still somewhat in arrears, the volume for 1927 having been published in August, 1929, while the volume for 1928 was in an advanced state of preparation at the end of the year. It is hoped that it will soon be possible to publish this valuable record during the twelve months succeeding the calendar year in which the data were collected.

There has been the usual number of changes in the voluntary stations which co-operate with the Meteorological Office in the collection of climatological data for the British Isles. Climatological stations have been established at St. Ives (Cornwall), Rickmansworth and Shrewsbury, while the stations at Oxford (Sandford), Caterham and Sidmouth (Sidmount) have been closed.

The number of inquiries for meteorological information has continued to increase and during the year, 1,278 general or scientific inquiries for particulars of past weather in the British Isles were dealt with. As an indication of the wide scope of the inquiries it may be mentioned that 119 were in connexion with legal questions, a large number in connexion with water-supply schemes, while amongst those of a more specialized character was one for humidity data in connexion with an investigation into the deterioration of pictures on wooden panels in the National Gallery, and another from the Electricity Commissioners for particulars of periods of cold weather during the last twenty years in connexion with an investigation into the effect of cold spells on generating-station loads.

The remarkable network of meteorological stations in the British Isles which maintain self-recording instruments has again resulted in several demands from investigators in different countries for records for use in special investigations. It is the practice of the Office to give every facility for the use of its records in this way and it is gratifying to be able to record that although many hundreds of original records have been lent not a single record has been lost.

Considerable progress was made with the preparation of the map of average annual rainfall of the British Isles on the scale of 2 miles to the inch. The map was extended to cover the counties of Somerset, Wilts, Warwick, Yorks (N. Riding), Durham, Devon, Northumberland, Wigtown, Kirkcudbright, Roxburgh, Selkirk, Berwick, Haddington, Fife, Forfar (Angus), Kincardine, Aberdeen, Banff, Moray, Nairn, Sutherland, Caithness, Ayr and the Islands of Mull, Islay and Arran.

A course of instruction for observers at stations maintained by the authorities at health resorts and at agricultural meteorological stations was held at Kew Observatory on September 23 and 24. Eight persons attended the course.

World Climatology.—The collection of meteorological data from all parts of the world outside the British Isles, especially from British Colonies and Protectorates, has continued throughout the year. The work on the preparation of the *Réseau Mondial*, an annual publication summarising the meteorological records obtained at representative stations in all parts of the world, has progressed steadily; the volume for 1922 has been issued, that for 1923 is in the press, and the preparation of the "Tables" for 1924 is well advanced. The volume for 1922 includes data for six "five-degree squares" over the ocean based on observations taken on board ship, and that for 1923, data for seven such squares. The collection of the ships' observations is being carried out with the co-operation of Holland, Norway and Brazil.

In 1928, the Smithsonian Institution of Washington, published a most valuable volume entitled "World Weather Records," which contains monthly values of a large number of meteorological records which extend for long periods of time. The London Meteorological Office collected the data for stations in Africa, Australia and the Oceanic Islands. At the request of Mr. H. H. Clayton, the editor of the volume, the Meteorological Office is providing further data for the same regions in order to bring the volume up to date.

Several investigations dealing with climate in different parts of the world have been undertaken during the year, amongst which may be mentioned an investigation into the causes of the variations of pressure distribution over the North Atlantic and Western Europe, another investigation into the rôle played by the oceans in the weather of Western Europe, and an investigation into the relations between the duration of bright sunshine and the amount of cloud, so that it may be possible to compute the average cloud amount from results obtained by sunshine recorders.

Library.—The additions to the library during the past year include 478 new books and pamphlets, 12,816 daily weather reports and 3,978 periodicals. Books issued on loan during the year numbered 3,037.

The author and subject catalogues have been kept up to date. The subject classification at present in use was devised in 1895, and the growth of meteorology since that date has rendered it in some respects unsuitable. Consideration has been given to the question of replacing it by a new classification based on the decimal system, conformable to that employed at the International Institute of Bibliography at Brussels. In order that the proposed new classification might have international authority, the subject was brought before the International Conference of Directors at their meeting at Copenhagen in September, 1929, where a small sub-committee was appointed to consider it.

OCEAN METEOROLOGY

The normal work of the Marine Division has been very much interfered with by the labour entailed in preparing for the International Conference on Safety of Life at Sea, the Conference of Empire Meteorologists and the meeting of the International Commission for Maritime Meteorology held at Copenhagen. In consequence the extraction of information from the meteorological logs has been seriously diminished. Whereas during the years 1925-8, 75,000 sets of observations were extracted each year on the average, the number fell below 18,000 in the present year. While this diminution in the normal work of the Division is greatly to be regretted, it is some consolation to know that the agreements reached at the various conferences will be the means of accelerating the work in the future and making it of greater value. The work at sea, however, has continued with no interruption, and the logs and reports received indicate improving work and much greater interest on the part of the ships' officers. This is particularly shown in the increasing number of illustrations which now accompany the reports. During the year, the Office provided an average number of seven H.M. Ships and 115 Merchantmen with tested instruments, and from these ships 286 logs were received, each one containing observations taken at the end of each four-hourly watch. In addition there were on the average 324 ships always making observations with their own instruments and forwarding returns on a simplified form instead of in complete meteorological logs; 2,375 of these forms were received during the year. A certain number of ships in the North Atlantic (an average of 31) supplied the Office with meteorological reports by wireless telegraphy. These are used for forecasting purposes and are invaluable. The standard of accuracy of the observations is all that could be desired, and the number of errors introduced in the messages by the telegraphy is amazingly small.

Several ships have continued to forward ice reports which are of great value, especially those received from the Southern Ocean. Some of these reports were illustrated by sketches and photographs. Eight ships in the Liverpool, South American and West Indian trades have returned water samples through the Port Meteorological Officer for the Fisheries Laboratory at Lowestoft. Nine packet steamers on the Newhaven-Dieppe, Weymouth-Guernsey and Holyhead-Dublin services have contributed reports made at mid-channel positions during the year. In addition to the other purposes which these reports serve, they have been particularly useful for the purpose of aerial navigation, giving as they do, information of wind and visibility over the sea in the vicinity of aeroplane routes.

The demands on the Marine Division for data made by foreign and other services continued to increase. Many of these inquiries referred to conditions over the seas in regions of the ocean where it is proposed to establish air routes, either for aeroplanes or airships.

The application of marine meteorology in the daily work of navigation in ships at sea has steadily progressed during the year, and selected ships have generally performed an increasingly useful service in broadcasting wireless meteorological reports which, not only give information of weather, but information of ocean currents, and also when necessary, information of ice and floating navigational dangers. The preparation at sea of synoptic charts from information received from surrounding ships and coast stations is steadily increasing, and there seems little doubt that, in the course of time, the preparation of a synoptic chart on board ship will be a part of the ordinary navigational routine.

FORECASTING

The outstanding feature of the year's work was the adoption on March 1 of the new international code for the transmission of meteorological observations by telephone or telegraph from telegraphic reporting stations to London, and for their re-issue to foreign meteorological services by wireless telegraphy.

This code is the first form of the two which were approved for universal use at land stations by the International Meteorological Conference of Directors of Meteorological Services, which was held at Copenhagen in September, 1929. The change was fundamental, and had wide ramifications in the Division. A new pocket register had to be prepared and circulated to the observers to facilitate the recording of the necessary observations and the coding of the messages. The register was issued to observers at the beginning of February. Most of the observers made the change without difficulty, although a number of minor points had to be settled subsequently as they came up.

The effect of the change on the work of the Division was more marked. The rosters of duty had to be slightly re-arranged so as to provide extra help in the synoptic work, both on week-days and Sundays. The staff met the emergency excellently, and no serious difficulty was experienced beyond the congestion of work dealing with the messages as they arrived. By the end of the month, the staff had become more intimately acquainted with the code, and conditions had consequently improved. Further improvement should ensue as more countries adopt the new code, but as the new code provides more data than the old one its adoption has permanently added to the work.

The adoption of the new code necessitated a reconsideration of the method of plotting synoptic data on working charts because there was no provision for setting out on the charts, the detailed information regarding the forms of low, medium and high clouds, which

is now available. This question is assuming international importance, in view of the desirability of transmitting completed weather maps by wireless. Arrangements have been made for the three Divisions which prepare synoptic charts—the Forecast Division, the Aviation Division and the Airship Division—to make experiments in the matter for six months when the whole question will be reviewed.

Four sections of the *Daily Weather Report*, viz., the British and International Sections, the Upper Air Supplement, and the "Chart of Weather in the Northern Hemisphere," were regularly issued until February 28. From March 1, the "Chart of Weather in the Northern Hemisphere" was discontinued as a separate publication, and it was incorporated in the British Section of the *Daily Weather Report*, the width of the page being suitably increased. At the same time the form of the British Section was completely recast, and a considerable improvement in the appearance of the *Report* was effected by printing in three colours (brown, buff and black) instead of two colours (blue and black). The addition of a chart of the northern hemisphere to the *Daily Weather Report* has met with much appreciation. The *Report* is now issued at 12 noon instead of 11.30 a.m. (12.30 p.m. in summer instead of 12 noon), the delay being due to the late receipt of the Russian synoptic messages, used for the northern hemisphere chart.

Earlier in the year the possibility was examined of issuing the *Daily Weather Report* in the evening instead of the morning, and basing it upon the observations at 18h. instead of those at 7h. The advantage of this would be that a large number of subscribers would receive the *Report* by first post next morning, i.e., at the same time as at present, but the information would be only 14 hours old instead of 25. Unfortunately it was found that, as the whole of the work of preparation, printing and distribution would be done outside normal working hours, the cost would be prohibitive. Inquiry of the Post Office has shown that the only addresses which can be reached the same day by posting the *Report* at 1 p.m. (the "mid-day" post) are now confined within an area not usually exceeding 20 to 25 miles from the centre of London.

The form of the Monthly Supplement to the *Daily Weather Report* was slightly revised for the issue for March, in order to bring the size of the Supplement into conformity with that of the British Section. Slight changes in form have also been made in the tables of the International Section, in order to accommodate observations received in accordance with the new code.

A very large increase in the number of inquiries received in the Forecast Division by personal call, telephone, telegraph or letter, amounting to 42 per cent on the number for last year, has to be recorded. The total number of inquiries in 1929-30 was 6,064; the largest number in any one month was 664 in July.

As examples of the practical use now being made of the forecast service, the following may be of interest. A statement of the probable weather during the day at Bognor Regis was supplied each day to Buckingham Palace during the period in which His Majesty the King was staying at that resort. Since November, a report has been supplied twice daily to the Royal Automobile Club concerning rain, snow, fog or other elements likely to impede road traffic, and also a forecast of anticipated conditions. Temperature readings at certain hours from the thermograph on the roof of the Air Ministry have been passed to the London General Omnibus Company since August. These are additional to the records of rainfall and sunshine which are also supplied. Several business firms with interests in central and northern Europe have been supplied with reports of weather conditions in these regions at different times during the year, and some now receive reports all the year round. Weather forecasts for pigeon racing were supplied to the National Homing Union during the summer as in previous years. The number required was 168, this figure exceeding that of the previous year by nearly 50 messages. Since October 15, a chart of the weather has been prepared and supplied each evening, except Saturday, to the London office of the *Glasgow Herald*. It is understood that each map is transmitted by telegraph from London to Glasgow for publication next morning.

Gale Warnings.—A meeting of the Gale Warning Board was held on October 22, 1929. At this meeting the Board agreed to new wording of the definitions of the signals of the north cone and the south cone. The revised wording is now adopted in all official publications.

There were no new stations established during the year, but arrangements were made for the hoisting of gale-warning signals by fishery protection vessels in home waters for the benefit of fishing fleets at sea.

The gale warnings issued have as usual been checked against the actual occurrence of high wind 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, 73 per cent were justified by the occurrence of gales and strong winds.

Issues of Weather Forecasts by Wireless Broadcasting.—The arrangements for the broadcasting of weather forecasts by radio-telephony have undergone slight modifications and are now as set out in the following statement.

Before the war it was found impracticable to arrange that weather forecasts should reach any considerable part of the population in the British Isles until at least 8 hours of the 24 hours to which the

forecasts referred, had already been spent. The statement shows how great an improvement over pre-war conditions has been effected by the agency of wireless broadcasting in the rapid and widespread dissemination of weather forecasts.

The following is the programme of daily weather forecasts, etc., supplied by the Meteorological Office, for broadcasting by wireless telephony, to the stations of the British Broadcasting Corporation and the Irish Free State :—

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).	
	} Forecasts for shipping (from Daventry, 5XX only).

Regional Programmes

6.15 p.m.	As National Programme (week-days only).
10.15 p.m. (week-days), 8.50 p.m. (Sundays).	} General forecasts for British Isles prepared at 8.30 p.m.

Scottish stations (in addition to the items shown above under "National Programme") :—

5.57 p.m.	Forecasts for farmers in Scotland prepared at 3.15 p.m.
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Belfast (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.

ISSUES BY STATIONS AT DUBLIN AND CORK, IRISH FREE STATE

*Normal
hour of
issue.*

1.30 p.m. General forecasts for Ireland prepared at 12 noon.
(week-days)
only.

10.30 p.m. }
(week-days), } General forecasts for Ireland prepared at 8.30 p.m.
11 p.m. }
(Sundays). }

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.

AVIATION

The work of the Office in connexion with the Royal Air Force and civil aviation has continued to grow and although there has been no important change of procedure, many minor changes both in the quantity and the kind of information supplied have been carried out. The new international code adopted by the Conference of Directors at Copenhagen was brought into use for synoptic reports at all stations on March 1. Simultaneously the new code was introduced in all reports for aviation while certain special reports have been sent from that date in the form adopted experimentally by the 29th International Air Conference at Zürich in October 1929.

Again a large amount of work has been done in connexion with special long-distance flights both by civilian and service craft. Much meteorological organization was necessitated in connexion with the non-stop flight to India in April of two Royal Air Force officers who left Cranwell on the 24th arriving at Karachi on the 26th. Special weather charts covering Europe, North Africa, Iraq, the Persian Gulf and Baluchistan were prepared as a basis for forecasts, and information was supplied to the pilots based on these charts and on special messages received from the Meteorological Section, Middle East Area and from the India Meteorological Department.

A similar organization for the route from Cranwell to South Africa was undertaken in connexion with the proposed non-stop flight from England to Capetown. For this flight special messages were received daily from Malta, Nigeria and South Africa. The flight commenced on the morning of December 17, but unfortunately ended at Tunis the same evening, when the machine crashed and both pilots were killed.

Forecasts for the northern section of the Atlantic Ocean were supplied to the United States Weather Bureau in June and July in connexion with flights from America to Europe, but there was a considerable falling off in the number of attempts to fly the Atlantic as compared with the previous year.

In the course of the year memoranda have been prepared for the Director of Civil Aviation on the meteorological conditions over specified routes or areas in various parts of the world. Information has also been supplied to private pilots regarding the most suitable time of year, from the point of view of weather, for various long-distance flights and also information regarding the meteorological conditions to be expected along the proposed routes.

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 12,987 and in addition 6,270 nephoscope observations of the movements of upper cloud have been made.

Airships.—During the early part of the year the training of the forecasting and observing staff at Cardington as a working unit continued, in readiness for the home trials of H.M. Airships R.101 and R.100 which were soon due to commence. The routine observations taken were supplied by telephone to the Air Ministry for use by the forecasting services centred there.

In order that the forecasting centre at Cardington might, during periods of airship operation, receive the telegraphic reports from observing stations in the British Isles as early as they are received at the Air Ministry, a special arrangement was made with the General Post Office. By this arrangement an assistant at Cardington can listen-in on the telephone tie-line connecting Cardington with the Air Ministry and take down the telegrams as they are being telephoned to the Air Ministry from the Central Telegraph Office, London.

Further experiments were carried out early in the year in the facsimile transmission by wireless of weather charts and of written messages by the Fultograph process. Arrangements progressed for experimental transmissions to airships in flight.

The close co-operation between the meteorological staff and the airship personnel required during operations of the airship has been

the subject of much study and organization. The meteorological help required in connexion with airship operations may be divided into three classes :—

- (a) Operations in connexion with the removal of the airship to and from the sheds. As this operation can only be carried out when the weather conditions are exactly suitable, the direction and strength of the wind being the most important factors, and arrangements have to be made for the landing party to be on the aerodrome when required, accurate forecasting for some hours ahead is essential.
- (b) The period when the airship is at the mast. During these periods a close watch has to be kept on the weather so that the airship staff may be informed of any sudden change in order that they may be prepared to adjust the ship as necessary.
- (c) The period when the ship is carrying out flights. In this case rapid information regarding existing weather conditions and detailed forecasts for the future must be supplied to the airship in flight.

Details of the procedure to be followed and the methods by which the information is to be supplied have been carefully worked out by the Superintendent of the Airship Division and the Director of Airship Development. Arrangements have also been made for conferences between the Director of Airship Development, the Officer in Charge of flying and the Meteorological Superintendent, to be held at 9.30 and 15.30 G.M.T. daily and at other times as necessary during all periods of airship operation. At these conferences the meteorological situation in relation to airship aviation is discussed in detail to assist the airship staff in taking major decisions, such as the times at which the airship should be taken from her shed or flights should be commenced. The arrangements made were first used during the trials of the mooring mast, in which a kite balloon was employed, in September, on which occasion the forecast centre was put on a full operational basis. In the following month the complete procedure was used for the first trials of H.M. Airship R.101, and then on 58 days between October 12, 1929, and January 30, 1930, when the airships were either at the mast or in flight.

The Superintendent, Airship Services Division, Meteorological Office, was on board in an official capacity, during the first trial flight of each airship and during the endurance flight of each. In the cases of the endurance flights, viz. : R.101 from 1033 G.M.T. on November 17 to 1714 G.M.T. on November 18, and R.100 from 0938 G.M.T. on January 27 to 1530 G.M.T. on January 29, weather charts were prepared on board, from data received by wireless and were discussed with the responsible airship officials in relation to the operation of the airship.

During all periods when the airships were not in operation the staff of the Meteorological Office, Cardington, has been engaged on

studying the problem of forecasting along the various routes to be followed by the airships, in particular the route between England and Canada on which it is expected the first long-distance flights will be carried out, and on other meteorological problems connected with airships.

Close co-operation is being maintained with the airships sections of the meteorological services of Canada and India and the results of all investigations carried out at Cardington and copies of instructions regarding operational organization have been sent to them for information.

Meteorological Flight, Duxford.—The Meteorological Flight, R.A.F., Duxford, Cambridgeshire, has successfully 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. At the end of the year an apparatus called an "air-duct apparatus" was installed on two of the machines; its object is to enable the pilot to obtain more accurate readings of the dry and wet bulb thermometers which together form the psychrometer. The apparatus is in principle merely a tube of which one end is fixed on the wing of the aeroplane so that the opening faces forward, while the other end faces aft behind the pilot's seat, but outside the fuselage. The duct is bent so that it passes through the cock-pit, and a chamber is arranged in the duct just below the instrument board to allow of the insertion into the chamber of the bulbs of two thermometers, one acting as a dry bulb, the other as a wet bulb. The thermometer stems are carried in a frame fixed above the chamber. Underneath the chamber is a Dewar flask containing a piece of moistened sponge; a simple arrangement enables the pilot to depress the wet-bulb thermometer so that its bulb may pass into the Dewar flask and become moistened with water even though the temperature may be far below freezing point.

When the machine is in flight, air passes through the duct and ventilates the bulbs of the thermometers so that the latter should indicate the temperature of the air which enters the duct. It is hoped to secure two advantages by this arrangement:—

- (1) Readings of the thermometers should be much facilitated as compared with those of the strut-psychrometer so that greater accuracy should be secured in the determination of humidity.
- (2) The arrangement for moistening the wet bulb as frequently as necessary should enable reliable readings of the wet bulb to be obtained far below freezing point.

METEOROLOGY FOR THE ROYAL NAVY

Owing to the continued development of meteorological work in the Fleet the work of the Navy Services Division rapidly increased during the year 1929-30. In 1928, the Admiralty appointed a committee, called the Fleet Meteorological Committee, to advise on all meteorological questions affecting the Navy. On the recommendation of this committee the Admiralty approached the Air Ministry with the object of the Superintendent of the Navy Services Division travelling to the east in order to improve the supply of meteorological aid to the Navy on the China and East Indies Stations. The Air Ministry having expressed their approval of the proposal, conferences were arranged by the Commanders-in-Chief, China and East Indies, to be held in February and March, 1930. The Superintendent attended these conferences and very valuable reports regarding the meteorological requirements of the Fleet on each station and the best means of meeting these requirements have been prepared. During his journey the Superintendent had opportunities of visiting the meteorological services at Hong Kong, Zi-ka-Wei, Malaya, Ceylon, India and the Middle East. A large amount of preliminary work connected with the conferences was necessary before the Superintendent left England on September 12, 1929, and the Conference of Empire Meteorologists offered an excellent opportunity of laying before the directors of the meteorological services of the British Dominions and Colonies a preliminary statement of the general meteorological requirements of the Fleet. The liaison established at the Conference of Empire Meteorologists contributed in no small measure to the success of the conferences on the China and East Indies Stations.

The scheme for the transmission of weather reports by H.M. Ships continued to operate satisfactorily during the year, 848 reports being received in London and a large number in Malta. Similar schemes for weather reporting by H.M. Ships are being introduced on other stations.

The work of training naval officers in meteorology has continued and rapidly developed during the year. Fourteen naval officers attended courses during the year and one or more officers were under instruction during 25 weeks of the year. At the request of the Admiralty arrangements are being made for the officers who have attended these courses to make periodical visits to the Meteorological Office to discuss their meteorological problems with the professional staff. In addition the Superintendent of the Navy Services keeps in personal touch with practically all the officers who have been to him for training.

Special attention has been given to the development of a complete, and, so far as possible, uniform organization for use on all aircraft carriers, and investigations have been carried out with the purpose

of developing a standard method of determining the true wind from a carrier and from aircraft in flight. Other investigations connected with the improvement of the method of making balloon observations from ships, both during the day and the night, have been undertaken.

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 Beatty, who was put in charge of this investigation last year, has continued his work and has now prepared a report which it is hoped to consider in the near future. Trials of some of the methods developed in this investigation are already being carried out in H.M.S. *Argus*, and it is proposed to try these methods on other carriers. Lieut.-Commander Josselyn has also carried out investigations in cloud forms in relation to fronts at Lee-on-Solent with the same object in view.

The investigation of the upper atmosphere from H.M. Ships has been continued. One hundred and six observations of wind in the upper air were received during the year, 13 being night ascents; 60 ascents exceeded 10,000 feet, the maximum height reached being 29,000 feet. Sixteen observations of upper air temperatures were also received. The preparation of a chart showing the distribution of upper air observations (from all sources) over sea areas is nearing completion, and this chart will be published by the Admiralty and distributed to all ships undertaking observations.

Procedure has been established whereby the Navy Services Division becomes more closely concerned than hitherto with the supply of meteorological stores to the Admiralty and considerable attention has been given to improving the instrumental equipment on board H.M. Ships. Help has also been given in the installing of special meteorological equipment in a number of ships.

METEOROLOGY FOR THE ARMY.

The meteorological stations at Shoeburyness and Larkhill have been maintained, as in the past, to provide meteorological data required by the artillery units at these stations. The Officers-in-Charge at both meteorological stations have from time to time delivered lectures to artillery officers and other ranks on the applications of meteorology in gunnery. Assistance has been given by the staff at Shoeburyness in connexion with the investigation of the audibility of gunfire which is referred to on page 30.

During the summer of 1929, temporary stations were maintained at five artillery practice camps, for the purpose of supplying meteorological information to the units based there and similar information has been supplied at Larkhill to the summer camps on Salisbury Plain and at Shoeburyness to the Coast Artillery School.

The Meteorological Section of the Royal Air Force Reserve was called up for a period of training at Cranwell during the summer. The Section maintains a high standard of efficiency and now consists of 7 officers and 25 other ranks.

The Superintendent of the Army Services Division takes an active interest in atmospheric problems connected with the work of the Chemical Warfare Committee and acts as Chairman of the Meteorological Sub-Committee.

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 1927 was issued during the year under review.

KEW

Seismology.—The Galitzin seismographs have been in operation without interruption. The Elinvar spring which was fitted to the vertical seismograph in May, 1928, to overcome the difficulty previously experienced with ordinary steel springs has, on the whole, proved successful. For several months the new spring was gradually extending, but by the middle of 1929, a stable condition was reached and the full advantage of the insensitivity of the spring to temperature changes was realised. A paper dealing with the spring was published in the *Journal of Scientific Instruments* in December, 1929.

The arrangements for the addition of data regarding earthquakes to the ordinary meteorological broadcast messages have continued. During the year, particulars regarding earthquakes were added to the synoptic messages issued by the Air Ministry on 22 occasions, and during the same period, 13 reports of earthquakes were received on the meteorological messages issued by the Weather Bureau, Washington. Amongst the earthquakes recorded during the year were two very small ones which were felt in the British Isles. The first of these, the epicentre of which was in Gloucestershire, occurred on July 2, 1929; the second occurred in Brittany during the evening of January 9, 1930, and was felt in Essex.

Atmospheric Electricity.—It is well known that in fine weather there is a continuous flow of electricity from the air to the earth. Indeed, the question how this current is maintained is the crucial problem of atmospheric electricity. Continuous records of the air-earth current are much to be desired. In the development at Kew of apparatus for obtaining such records, various practical difficulties have been encountered, but success appears to have been attained at last.

Comparisons between the conductivity of the air as measured by the Wilson apparatus at ground level and on a tripod 4 feet above ground have been continued. Incidentally the sensitivity of the Wilson apparatus has been raised by the substitution of a Lindemann electrometer for the gold-leaf system. The reliability of the routine observations with this apparatus is thereby considerably increased.

Preparation has been made for recording the quantity of electricity discharged from a point at the top of a mast. The system adopted is that designed by Mr. T. W. Wormell at Cambridge.

Radiation.—Interruptions of the record of the Gorczynski pyrheliometer having been very frequent a new heliostatic mounting was designed and constructed. This mounting is carried by a pendulum clock and is much more robust than the old one.

Observations with the Benson radiometer are being continued.

During the winter a series of observations were made with a large number of grass minimum thermometers distributed over a considerable area. The lowest readings (about 0.8°C . below the Observatory standard) were obtained on the site which appeared to have the most open exposure to the sky.

Atmospheric Pollution.—Since 1927, a series of comparisons of deposit gauges has been in progress on behalf of the Atmospheric Pollution Committee of the Department of Scientific and Industrial Research. During the year 1929, four gauges, A, B, D, E were in use. Gauges A and B had a normal exposure whilst D and E were close to the walls of one of the huts.

The discrepancies between the amounts of deposit in gauges A and B were appreciable and systematic. These are apparently to be attributed to differences in the construction of the supporting framework. At the beginning of March, 1930, the gauges A and B were replaced by two identical gauges of the pattern now issued by the Department of Scientific and Industrial Research. The new gauges which are of glass (instead of earthenware) have stands of the same pattern. The use of gauges D and E has been discontinued.

Simultaneous observations of the number of Aitken nuclei and of the number of coarser particles obtained with Dr. Owen's jet dust-counter are made at the same time as the observations of electrical conductivity.

Meteorology.—In October the Robinson-Beckley anemograph which had been in operation almost without interruption since the beginning of 1868 was dismantled to make room for a Dines anemograph. The disappearance of the whirling cups which for more than 60 years were the most characteristic feature of the Observatory will be regretted by many, but the new instrument, with its vane 6 metres above the Observatory dome, and with tubes of wide bore to convey from vane to float-chamber the pressure created by the slightest movement, gives the truer picture of wind structure.

Investigation of the Upper Atmosphere.—Fifty-three soundings of the upper air by means of registering balloons were made during the year. Of these 38 yielded results, in the remainder the instruments were lost. Twelve of the successful soundings were made from Kew Observatory, the remainder from Sealand. The heights reached were as follows :—

20 kilometres and upwards	...	...	...	3
10 to 20 kilometres ...	...	...	...	21
Below 10 kilometres	...	...	...	14

The comparatively large number of small heights reached was mainly due to poor quality of balloons. On one occasion only did the meteorograph fail to make a satisfactory record throughout the sounding. The mean height reached was 12·7 Km., the maximum 22·8 Km. The latter, which was attained with the aid of an especially large balloon, is the greatest height recorded in England since the early days of the enterprise.

The Dines meteorograph has been employed as before, substantially in its original form, but fitted now with a detachable hair hygograph.

Eight meteorographs have been submitted for test by outside firms during the year.

A pamphlet has been published descriptive of the Dines balloon meteorograph and the method of using it. This publication embodies all the essential features of the routine of making upper air soundings by means of registering balloons as carried out in England, and incorporates the results of many years' experience in the use of the instrument.

Observations were made through the winter with the small captive balloon on the temperature gradient in fogs, and the information supplied at once to the Aviation Services Division.

The Propagation of Air Waves to Great Distances.—During the last three years an investigation of the propagation of air waves to great distances has been in progress. It has been found that waves produced by the firing of a gun can, at times, be recorded by suitable apparatus at places where the firing cannot be heard. There are now stations equipped for this purpose at Birmingham, Bristol, Cardiff, Exeter, Nottingham and Sheffield. With the co-operation of the War Office and the British Broadcasting Corporation arrangements have been made so that when the larger guns are being fired at Shoeburyness or at Woolwich signals are broadcast from Daventry. Accordingly the times of passage of the air waves can be determined with the greatest accuracy.

It is found that at a station at a suitable distance from a gun the air waves are, during the summer, received with great regularity. For example, the waves produced at Shoeburyness are always received at Birmingham 130 miles away. The waves take longer to cover the distance than would sound waves travelling near the ground, the delay being on the average about 100 seconds. It is deduced from the observations that the waves have passed through the air at great heights and it is the aim of the investigation to obtain information about the state of the atmosphere at such heights, 40 kilometres and more above the ground and far beyond the levels attained by balloons. It is now almost certain that the temperature at 40 kilometres is as high as near the ground and still higher temperatures are indicated by some of the observations.

There were four successful experiments during the summer of 1929 when the air waves were recorded at one or more stations. The remaining five experiments made during the year served only to confirm the remarkable law that the air waves are not to be observed during the winter months at places to the north or west of the source. As experiments of a similar character in Germany indicate that the waves travel readily to the east in winter, it appears that there are air currents at great heights blowing from the east in summer and from the west in winter.

Library.—The 526 papers from Dr. Chree's library, kindly presented to the Observatory by Miss Chree are a valuable addition to the library.

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, although declination observations were made on every day except Sunday.

In addition to the standard autographic records, auxiliary records of declination, horizontal force and vertical force have 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 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 lost 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.

During his magnetic survey tour of the south of Scotland, Mr. H. L. P. Jolly of the Ordnance Survey Department, kept in touch with the Observatory and made absolute observations of horizontal force and declination at the Observatory on May 17 and June 4. Subsequently values of the horizontal force and declination from the Observatory records were supplied to Mr. Jolly for the times of his field observations of these elements.

Owing to the exposed position of the Eskdalemuir Observatory, there has always been great difficulty in keeping the houses weather-tight. The original construction of the buildings was not all that could be desired and water has found its way into the interior of most of the houses. Considerable work has been undertaken during recent years on the Superintendent's house and during the year under review extensive repair operations have been necessary on the main Observatory building. Dry rot was found to have obtained a strong hold on much of the timbering in the building. It is hoped that the repairs now carried out will remove the difficulty.

ABERDEEN

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

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.

A new Watson quartz-fibre vertical-force magnetograph supplied by the Cambridge Instrument Company was installed in the recording house at the end of November. Considerable difficulties were experienced in adjusting the instrument, chiefly owing to the restricted space in which it has to work. The instrument took several months to settle down, but on January 1, 1930, it was working sufficiently satisfactorily to be taken into use as the standard instrument. The Munro vertical-force instrument thus released, together with other spare instruments, has been set up in a hut to give a duplicate record of the three magnetic elements. These auxiliary instruments have been arranged to function at a low sensitivity. In this way they will provide a record when the trace of the more sensitive standard instruments has passed beyond the width of the paper.

Detailed observation of the aurora, supplemented by photography, continues to form an important part of the work during the winter months. After trial of several types of photographic plates, a plate has been found which, being sufficiently fast and responsive to the predominating green light of the aurora, gives satisfactory results.

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 70 and the number of rainfall stations about 860.

The Edinburgh Office also receives the monthly registers and autographic records from Scottish telegraphic stations before they are forwarded to London.

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

It was mentioned in last year's *Annual Report* that a scheme of research to be undertaken under the guidance of the Edinburgh Meteorological Committee had been formulated and had received the approval of the Air Ministry. The object of this research is to investigate the meteorological conditions in depressions as they cross the country, especially the structure of the wind. Some progress along these lines has been made during the year, recording anemometers having been established at the Butt of Lewis and at the Bell Rock Lighthouse, and a computer appointed to reduce the records obtained. The first records from the Butt of Lewis are particularly remarkable as indicating a very high average wind velocity. During December, 1929 an average wind speed of 27 m.p.h. was recorded. For comparison it may be added that the normal wind speed at Kew Observatory for the month of December is 8.5 m.p.h. The first record received from the new anemometer erected on the Bell Rock Lighthouse revealed the great value of wind records obtained in this situation. The head of the anemograph on the Bell Rock is 138 feet above open sea while the site is distant 12 miles from the nearest point of coast. No other anemometer is exposed to such undisturbed wind conditions, and the consequence is shown in the almost entire absence of gusts and lulls in the record, the "ribbon" of the trace of the Dines anemometer being the narrowest of any record yet examined. The perfect exposure will make the records obtained from this anemometer of the greatest value.

MALTA

It was mentioned in last year's report that the Air Ministry had arranged for Dr. T. Bergeron to spend six months in Malta to study with the staff of the Malta Meteorological Office the peculiar problems connected with weather forecasting in the Mediterranean. Dr. Bergeron's visit came to an end at the end of March, 1929, and therefore the first six months of the year under review follow immediately on his departure from Malta. It was therefore a period of "trying-out" in practical forecasting the result of previous study. The new methods enabled developments to be made in the reports for the Navy and for merchant shipping, also greater precision of statement became possible in certain of the forecasts. Although the full application of Dr. Bergeron's methods is impossible in the Mediterranean owing to the scarcity of observations and their unequal quality, there can be no doubt that very great value has been obtained from his visit.

The Navy again continued to make the largest demand on the staff of the Malta Meteorological Office, and as several naval officers had taken an interest in Dr. Bergeron's work it was possible to apply his methods in reports and forecasts prepared for the Navy, and it became the practice to add to the synoptic messages issued for the Fleet information regarding "fronts" which were the main subject of Dr. Bergeron's studies.

The information available for the preparation of forecasts continued to improve slowly; the chief improvement occurred in the Eastern Mediterranean owing to re-organization of the messages issued by the Meteorological Service of Greece under the guidance of Prof. Eginitis. These were brought into line with those of the rest of Europe and the evening observations were issued immediately instead of on the following morning as had previously been the practice. Additional stations were also included in the messages. These improvements were very useful especially in the preparation of forecasts for ships in the Eastern Mediterranean. The lack of data from the Sahara continued to be greatly felt, especially when disturbances approaching by that route vitiated the forecasts, but some changes were made at the close of the year in the transmission of observations for the Sahara region which should be of very great help if they prove to be satisfactory. The scarcity of reports from the sea area still continues to be the chief handicap in forecasting for the Mediterranean area.

METEOROLOGICAL SECTION, MIDDLE EAST

The work of this Section has continued satisfactorily, there being no major change in procedure. The headquarters remain at Helio-polis and four outstations are maintained: at Aboukir, Ismailia, Ramleh and Amman. The demands on the staff have however increased, mainly owing to the greater activity on the civil aviation line Cairo-Baghdad-Karachi and it has been necessary to send out an additional Senior Professional Assistant.

A considerable amount of attention has been given to forecasting for Imperial Airways, Ltd., especially for the part of their route which crosses the Mediterranean, and the Superintendent visited Athens to discuss with Professor Eginitis, Director of the Meteorological Service of Greece, methods of improving the meteorological information supplied for that section of the route which lies between Athens and Alexandria. Professor Eginitis was extremely helpful and the result of the conference has been a great improvement in the information received.

Close co-operation has existed 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.

PUBLICATIONS

A list of publications by members of the staff which have appeared during the year is given on pp. 51-3. Among the publications of the Office may be mentioned a new and completely revised edition of "The Weather Map." The task of re-writing this pamphlet, which aims at setting out in simple language the method of constructing synoptic charts and the principles underlying their use in the forecast service of the Office, has been entrusted to Mr. J. S. Dines. Originally written during the war as a book of instruction for those entering the meteorological services in the field without previous training in meteorology, the book proved one of the most popular of the publications of the Office and had a large sale when issued to the general public. In the new edition due regard is taken of the changes which the developments of the last ten years have brought forward.

Mr. L. H. G. Dines has been responsible for "The Dines Balloon Meteorograph and Method of Using it." The account of this instrument prepared by the late Mr. W. H. Dines, F.R.S., has long been out of print and great difficulty has been experienced as a consequence in dealing with the many inquiries addressed to the Office from overseas for information regarding the instrument and the method of using it. It is to be feared that the lack of an up-to-date account of this branch of the work of the Office has hindered the wider adoption of Mr. Dines's methods. Advantage has been taken of the opportunity to include an account of the many devices adopted in the Upper Air Section for saving labour in the calibration of the instruments and in the evaluation of the records.

Four *Geophysical Memoirs* have been issued, dealing with a variety of subjects. Included in the number is a "Report on Thames Floods" which gives an account of the examination of this question undertaken as a result of the disastrous floods experienced in the tidal reaches of the river in January 1928. The report is in two parts. In the first part Dr. A. T. Doodson of the Tidal Institute, University of Liverpool, examines the general question of storm surges in relation more particularly to the North Sea and the Thames Estuary. In the second part Mr. J. S. Dines discusses the practicability of a system of flood warnings similar to the gale-warning service, but reaches the conclusion that in view of the large number of false alarms that would inevitably be given under any regular system, such a public service must be considered impracticable.

The remaining *Memoirs* deal with meteorological observations in the Sahara made by Mr. Francis Rennell Rodd, F.R.G.S., on expeditions in 1922 and 1927 (C. E. P. Brooks and S. T. A. Mirrlees), the technique of the Galitzin seismograph (F. J. Scrase) and the conditions giving rise to good visibility and fog at Malta (J. Wadsworth).

The Office is again well represented in the proceedings of learned Societies. The Director delivered the twentieth Kelvin lecture before the Institution of Electrical Engineers and chose "Lightning" for his subject. The lecture, which was reprinted in *Nature*, gives a useful summary of our knowledge of this branch of atmospheric electricity. In the Alexander Pedlar Lecture delivered before the Manchester Literary and Philosophical Society the Director deals similarly with the problems of "Past Climates." In the publications of the Royal Meteorological Society there is a *Memoir* by the Director dealing with terrestrial radiation. It forms a continuation of work on similar lines published in earlier *Memoirs*. The geographical distribution by 10° zones of incoming and outgoing radiation during the months January and July is examined, and the interesting result is reached that there is great uniformity in the intensity of the outgoing radiation both in time and space and that, apart from small irregularities, the total outgoing radiation from the earth as a whole just balances the incoming solar radiation at all times of the year.

Dr. Whipple contributes to the Society's *Journal* a paper on potential gradient and atmospheric pollution in which he shows that the introduction of summer time, acting through the medium of the smoke pollution, has perceptibly affected the run of the diurnal variation of potential gradient, one of the few instances on record in which the activities of man can be found to have affected the course of atmospheric phenomena. Captain C. K. M. Douglas contributes a paper on "Some aspects of surfaces of discontinuity" in which he carries a stage further his application of the ideas of the Norwegian school to the structure of depressions and anticyclones. The general line of argument in the present paper is that the more important pressure changes are due mainly to large-scale horizontal movements of air at high levels considered in conjunction with the movements at lower levels.

The *Proceedings of the Royal Society* contain a paper by Mr. D. Brunt on the transfer of heat by radiation and turbulence in the lower atmosphere. Certain simplifying assumptions, based on Hettner's measurements of absorption by water vapour, make it possible to reduce this difficult problem to tractable form and interesting results are obtained by the mathematical analysis employed. In the technical press dealing with water engineering, there have been several papers by Dr. J. Glasspoole in which the vast amount of data held by the British Rainfall Organization is used. The Notes contributed by members of the staff to *Nature* and other periodicals again cover a wide range of subjects and testify to the many-sidedness of the Office activities.

STAFF

Details of the staff and its distribution will be found on pages 45-9. The increased demands for forecasts and reports made upon the Meteorological Section in the Middle East, to which reference has already been made, has resulted in a material increase in the extension of the hours of duty of the professional staff, to cope with which additional staff has been required. It has, therefore, been necessary to increase the establishment in the Middle East by one senior professional assistantship, and to fill the new post by transferring to it an experienced officer from the home establishment.

The resulting vacancy at home, and two further vacancies, one standing over from last year, and the other due to resignation in the course of the year under review, have been filled by new appointments. The lack of adequately trained staff on the professional side has again been felt as a serious handicap, and it has, therefore, been decided to increase the establishment by six junior posts for training purposes, in order that the Office may be able to cope with extensions of work on the aviation side, such as that in the Middle East, without detriment to work in other directions. Two of these new posts had been filled by the end of the year, and appointments for the remaining four were in process of being made.

Establishment as clerical officers has been conferred on 33 officers who had joined the staff as temporary clerks since 1923, when the position of the clerical staff was reviewed. Eight clerical officers have been assigned to the Office by the Civil Service Commissioners to fill vacancies.

The Symons Gold Medal of the Royal Meteorological Society, which is awarded biennially for distinguished work in connexion with meteorological science, was awarded to the Director in January, 1930.

Mr. R. G. K. Lempfert, Assistant Director, was elected President of the Royal Meteorological Society in January, 1930.

INTERNATIONAL CO-OPERATION

International Commission for Synoptic Weather Information.—A meeting of the International Commission for Synoptic Weather Information, of which Lieut.-Colonel E. Gold is President, was held in Copenhagen from September 13-8, 1929.

The principal matter dealt with at the meeting was the revision of the codes which had been prepared at the meeting in London in 1928, and which had been circulated to the directors of the different meteorological services for their observations. Considerable changes were made as a result of the suggestions which had been received, in particular in the specification of the form of cloud. The changes generally were in the direction of simplification. It was not found practicable to secure agreement on a single form of code for use all

over the world for reports from stations on land, but agreement was reached to adhere to two forms of code, one intended primarily for use at stations where the height of the cloud and the barometric tendency could be obtained and were of importance, and the other form at stations (usually in tropical regions) where these conditions were not available or were not considered of primary importance.

A similar difficulty arose in connexion with the code for reports from ships at sea. In this case, agreement was reached on two forms of code consisting respectively of seven and six groups of five figures each. In both forms of code the first four groups of figures are identical and include the information which is generally available and of the greatest importance.

The Commission also considered further at its meeting the question of the arrangements of the wireless exchange of information which had been discussed at the meeting in London. The general arrangement which had been proposed at that meeting and referred to in last year's *Report*, was approved after additions in regard to the arrangements for the exchange of reports between Europe and America and the issue of reports in the south-east of Europe and by the U.S.S.R. The result is indicated by the resolution of the Conference on this question which is as follows:—

“ 56. The Conference remarks that great wireless transmissions issued from stations of long range because of their peculiarly international character are required under present conditions for the synoptic meteorology of the northern hemisphere. It also observes that there are five nations in a specially favourable position for the collection of the information required for these issues and for their transmission to meet international requirements.

“ The five issues are as follows :

- (a) The collective transmission on the reserved wave-length of 6,660 metres for western Europe.*
- (b) The collective transmission on the reserved wave-length of 3,350 metres for central Europe.†
- (c) The collective transmission of reports from stations in the U.S.S.R., including the U.S.S.R. in Asia.
- (d) The collective transmission of reports from Europe and the eastern Atlantic to America.
- (e) The collective transmission of the reports from America and the western Atlantic to Europe.

* This collective transmission includes the observations made in Iceland, British Isles, France, Holland, Belgium, Switzerland, Italy, Spain, Portugal, North Africa. It would be made three times daily from a station of sufficient power to reach regularly the whole of Europe.

† This collective transmission includes the observations made in Norway, Sweden, Denmark, Finland, Poland, Estonia, Lithuania, Latvia, Czechoslovakia, Austria, Germany and Hungary. It would be made three times daily from a station of sufficient power to reach regularly the whole of Europe.

“The nations most favourably situated for the transmission of these reports are :

for (a) France,

for (b) Germany,

for (c) U.S.S.R.,

for (d) England, and

and for (e) the United States of America.

“The Conference expresses the hope that the meteorological services of these five countries will be able to undertake the services mentioned in the interest of the meteorology of the northern hemisphere.

“The Conference observes that although two or three further transmissions of a similar character will be required to complete the representation of synoptic meteorology of the northern hemisphere the plans for these further transmissions are not yet sufficiently advanced for the Conference to make definite recommendations in regard to their issue.”

The recommendations of the Commission in regard to codes were subsequently approved by the International Meteorological Conference who also adopted the following recommendation of the Commission :—

34. In synoptic messages issued by wireless telegraphy for international exchange, the pressure will be expressed in millibars.

International Commission for Air Navigation.—A meeting of the the Meteorological Sub-Commission of the International Commission for Air Navigation was held in Paris in February, 1930. At this meeting some minor amendments were made in Annex G of the International Convention for Air Navigation, and a preliminary draft of the revision of the Annex, which has become necessary in consequence of the decisions of the International Meteorological Conference at Copenhagen, was prepared.

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

International Commission for the Exploration of the Upper Air.—Mr. R. G. K. Lempfert has continued to act as one of the Secretaries of this Commission, the other being Dr. Th. Hesselberg, the Director of the Norwegian Meteorological Service. Professor H. Hergesell, Director of the Lindenberg Observatory is its President. At the meeting of the Commission held in Leipzig in 1927 it was recommended that the results of the ascents made on the international days of the year 1924 should be prepared for press in London in the form adopted in the specimen volume for 1923, which had been

prepared for submission at Leipzig by Sir Napier Shaw, formerly President of the Commission ; the material for subsequent years was to be prepared for press under the personal direction of the new President. The data for 1924 have been prepared for printing in the Meteorological Office, the cost being defrayed from funds belonging to the Commission. A meeting of the Commission will be held at an early date, at which arrangements for printing will be further considered.

Conference on Atmospheric Ozone, Paris, 1929.—In recent years much attention has been given to ozone as a constituent of the atmosphere. Though the quantity of ozone is small and the gas apparently exists only at great heights, it has important effects and the variations in its amount are found to be intimately related to the weather conditions in the lower atmosphere. One of the effects is the maintenance in the upper atmosphere of the high temperature to which is attributed the propagation of air waves to great distances, a phenomenon to which reference is made elsewhere in this report. A conference of persons interested in the study of atmospheric ozone met in Paris on May 15, 1929, by invitation of Prof. Charles Fabry. The Meteorological Office was represented by Dr. Whipple. There was a full programme of papers and discussions which occupied the Conference for three days.

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	10	1	4	4	0	0
1	"	E.	1	1	2	2	27	343	17	4	3	2	2	2
6A	"	W.	1	1	0	0	20	315	14	3	3	2	2	1
2	England, N.E.	...	0	1	2	3	20	263	14	3	2	1	0	0
3	"	E.	0	2	2	4	21	471	25	4	5	5	3	2
4	"	Midlands	0	2	3	3	42	994	30	10	1	3	2	2
5	"	S.E.	0	7	3	5	41	815	40	8	8	7	6	5
	London District	...	2	0	0	0	6	657	7	8	0	0	2	0
8B	England, S.W.	...	0	1	2	3	29	576	21	5	3	3	4	2
7A	"	N.W.	0	0	1	1	21	440	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	205	9	3	1	1	1	0
9	Ireland, N.	...	0	1	3	0	6	122	5	3	4	4	1	1
10	"	S.	1	0	2	0	15	129	6	2	2	6	0	0
6B	Isle of Man	...	0	0	0	0	1	9	1	0	0	0	0	0
11	Scilly and Channel Isles	...	0	0	2	0	1	29	3	0	2	2	1	0
TOTAL			6	17	28	23	270	5067	230	64	43	43	26	17
Corresponding number for last year			6	17	28	23	269	4877	219	64	40	42	26	17

The observatories and distributive stations which are classified in the table are operated by the staff of the Office. Reports on the work of the observatories will be found on pages 27-32. The distributive stations are administered by the Army, Aviation, and Airship Services and particulars of their work will be found on pages 26-7 and 21-4. The telegraphic stations are, as a rule, maintained at coastguard stations or lighthouses by arrangement with the respective authorities. The meteorological observations at these stations are made expressly for the purposes of the daily weather service and form part of the regular work of the station staff, for which payment is made from the Office. The "crop-weather stations" are maintained at certain agricultural colleges and research institutions, in connexion with the study of the relations between the weather and growing crops. They report partly to the Meteorological Office and partly to the Ministry of Agriculture and the Department of Agriculture for Scotland, and the arrangements for the observations are under the general control of a committee on which the Office is represented.

APPENDIX II

GALE WARNINGS ISSUED DURING THE YEAR 1929

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	13	85	47	11	21	68
B	8	75	38	6	11	45
2. Scotland, E. ...	9	100	33	9	13	67
3. Scotland, N.W. ...	16	94	48	15	17	67
4. Scotland W. and North Channel ...	15	100	48	15	19	71
5. Ireland, N. ...	15	100	50	15	19	68
6. Ireland, S. ...	14	100	40	14	18	80
7. Irish Sea ...	11	82	41	9	23	78
8. St. George's Channel	13	92	40	12	18	75
9. Bristol Channel ...	18	89	37	16	13	78
10. England, S.W. ...	26	92	41	24	9	80
11. England, S....	17	94	39	16	15	79
12. England, S.E. ...	18	89	39	16	18	90
13. England, N.E. ...	10	90	35	9	15	69
14. England, E....	18	94	34	17	13	88
TOTALS ...	221	92	610	203	242	73

APPENDIX III

FINANCIAL STATEMENT

The year under review, 1929-30, is the ninth in which the cost of the Meteorological Office has been borne on Air Ministry Votes. The accounts are not yet closed, it is therefore impossible to give the exact amounts for the expenses and receipts of the Meteorological Office, but the following tables give the approximate figures :—

APPROXIMATE STATEMENT OF EXPENDITURE AND RECEIPTS IN RESPECT
OF METEOROLOGICAL SERVICES DURING THE YEAR 1929-30.

<i>Expenditure.</i>				<i>Amount.</i>	
				£	£
Salaries and Wages—H.Q. Establishments	...	...	...	51,351	
„ „ —Out-station Establishments	...	...	...	57,333	
					108,684
Fuel and Light	...	...	...		436
Transport of Personnel and Equipment	...	...	...		4,402
Instruments, Equipment and Stores	...	...	...		8,310
Minor Works Services, Rents, Repairs and Maintenance of Buildings	...	...	...		4,552
Research	...	...	...		1,266
Telegrams, Cables and Telephones	}	...	...		12,149
Subventions and Reporting Stations					
Miscellaneous	...	...	...		1,734
Superannuation	...	...	...
Total					£141,533
<i>Receipts.</i>					
Receipts from Royal Society	...	...	...		605
„ „ National Debt Commissioners (Annuities)	...	...	...		107
Sale of Instruments, Carriage, etc.	...	...	...		3,901
Daily Weather Reports, Forecasts, etc.	...	...	...		2,362
Receipts from War Office	...	...	...		6,183
Total					£13,158

APPENDIX IV

THE GASSIOT COMMITTEE, 1929

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.

Sir ERNEST 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, 1930

THE STAFF AT HEADQUARTERS

DIRECTOR :

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

Assistant Directors R. G. K. Lempfert, C.B.E., M.A., F.Inst.P.
E. Gold, D.S.O., F.R.S.
Senior Professional Assistant Miss E. E. Austin, M.A.
Junior Professional Assistants J. C. Cumming, M.A. ; J. Pepper, M.A., B.Sc.
(4 vacancies).

GENERAL SERVICES DIVISION.

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

MARINE DIVISION.

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

BRITISH CLIMATOLOGY DIVISION.

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

GENERAL CLIMATOLOGY DIVISION.

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

FORECAST DIVISION.

Superintendent R. Corless, O.B.E., M.A.
Assistant Superintendents ... 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.
Senior Professional Assistants F. H. Dight, B.Sc. ; C. H. Kellett, B.Sc. ; Miss
L. F. Lewis, B.Sc. ; S. C. Russell, LL.B.
Junior Professional Assistants D. Dewar, B.Sc. ; D. W. Johnston, B.Sc.,
L. H. Starr, M.Sc.
Clerk, Grade I W. Hayes.
Clerks, Grades II & III ... 20
Telephone-Typists 8

APPENDIX V—continued.

AVIATION SERVICES DIVISION.

<i>Superintendent</i>	...	...	F. Entwistle, B.Sc.
<i>Assistant Superintendent</i>	...	...	R. S. Read, M.A., B.Sc., A.R.C.S., F.Inst.P.
<i>Senior Professional Assistants</i>	...	...	R. F. Budden, M.A.; L. Dods, 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, Grades II & III</i>	...	...	4

AIRSHIP SERVICES DIVISION.

<i>Superintendent</i>	...	...	M. A. Giblett, M.Sc.
<i>Clerks, Grade III</i>	...	...	2

NAVY SERVICES DIVISION.

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

ARMY SERVICES DIVISION.

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

<i>Superintendent</i>	J. S. Dines, M.A.
<i>Senior Professional Assistant</i>	J. E. Belasco, B.Sc.
<i>Junior Professional Assistant</i>	...	...	(one vacancy).
<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.
<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>	...	...	W. A. Harwood, D.Sc.
<i>Senior Professional Assistants</i>	...	...	G. A. Bull, B.Sc.; R. C. Sutcliffe, Ph.D.
<i>Clerk, Grade II</i>	...	...	1
<i>Clerks (locally entered)</i>	...	...	4

METEOROLOGICAL OFFICE, MIDDLE EAST.

HELIOPOLIS.

<i>Superintendent</i>	...	...	J. Durward, M.A.
<i>Senior Professional Assistant</i>	...	...	W.D.Flower, B.Sc., 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.

<i>Clerks, Grade II</i> ...	4
<i>Clerks (locally entered)</i> ...	4

KEW OBSERVATORY, Old Deer Park, Richmond, Surrey.

<i>Assistant Director</i> ...	F. J. W. Whipple, Sc.D., F.Inst.P.
<i>Senior Professional Assistants</i> ...	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.
<i>Junior Professional Assistant</i> ...	P. A. Sheppard, B.Sc.
<i>Clerk, Grade I</i> ...	E. Boxall.
<i>Clerks, Grades II & III</i> ...	5
<i>Caretaker and Handyman</i> ...	2

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

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

VALENTIA OBSERVATORY, Cahirciveen, Co. Kerry.

<i>Assistant Superintendent</i> ...	M. T. Spence, B.Sc.
<i>Clerks, Grade III</i> ...	4
<i>Messenger</i> ...	1

THE OBSERVATORY, ESKDALEMUIR, Langholm, Dumfriesshire.

<i>Assistant Superintendent</i> ...	R. E. Watson, B.Sc., Ph.D.
<i>Senior Professional Assistant</i> ...	H. L. Wright, M.A.
<i>Clerks, Grade III</i> ...	3
<i>Housekeeper, Mechanic and Handyman</i> ...	3

THE OBSERVATORY, King's College, ABERDEEN.

<i>Clerk, Grade I</i> ...	G. A. Clarke.
<i>Clerks, Grade III</i> ...	2

THE OBSERVATORY, LERWICK, Shetlands.

<i>Senior Professional Assistant</i> ...	J. M. Stagg, M.A., B.Sc.
<i>Clerks, Grade III</i> ...	3
<i>Caretaker</i> ...	1

PORT METEOROLOGICAL OFFICE, Liverpool.

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

AVIATION SERVICES STATIONS

ALDERGROVE.

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

BIGGIN HILL.

<i>Clerks, Grades II & III</i> ...	3
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APPENDIX V—continued.

CALSHOT.

<i>Assistant Superintendent</i> ...	H. F. Jackson, M.S.E.
<i>Junior Professional Assistant</i>	E. A. Cope, B.Sc.
<i>Clerks, Grades II & III</i> ...	4

CRANWELL.

<i>Assistant Superintendent</i> ...	G. R. Hay, M.A.
<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 (one vacancy).

HOLYHEAD.

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

<i>Senior Professional Assistant</i>	R. H. Mathews, B.A.
<i>Clerks, Grades II & III</i> ...	3

LYMPNE.

<i>Junior Professional Assistant*</i>	F. E. Coles, B.Sc.
<i>Clerks, Grades II & III</i> ...	6

MANSTON.

<i>Senior Professional Assistant</i>	C. W. Lamb, M.C., B.Sc.
<i>Clerks, Grades II & III</i> ...	3

MOUNT BATTEN.

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

<i>Junior Professional Assistant*</i>	A. G. Forsdyke, B.Sc.
<i>Clerks, Grades 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.;
 B. C. V. Oddie, B.Sc.; S. P. Peters, B.Sc.,
 A.Inst.P.
*Junior Professional Assistant** C. W. G. Daking, B.Sc.
Clerks, Grades II & III ... 5
Draughtsman ... 1
Telephone-Typist ... 1

ARMY SERVICES STATIONS

METEOROLOGICAL OFFICE, SHOEBOURNESS.

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

METEOROLOGICAL OFFICE, LARKHILL.

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

METEOROLOGICAL OFFICE, PORTON.

Clerks, Grades II & III ... 5

SECONDED FOR DUTY WITH OTHER BODIES

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

* Held against vacancy for Senior Professional Assistant.

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, 1930).

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, 1929).

Seismological Bulletin. A diary of seismological disturbances recorded on the Galitzin Aperiodic Seismographs at Kew Observatory, Richmond (to February, 1930).

British Rainfall, 1928. 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, 1927. 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, 1922. 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, 1928. By J. Baxendell.

Weekly Weather Report for the period February 26, 1928 to March 2, 1929. 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.

Dines Balloon Meteorograph and the method of using it. By L. H. G. Dines, M.A.

APPENDIX VI—continued.

OCCASIONAL :—continued.

Marine Observer's Handbook. With separate Cloud Plate. 5th edition, 1930.

Meteorological Reports issued by Wireless Telegraphy in Great Britain and the countries of Europe and North Africa. 7th edition, 1929.

Meteorology in Relation to Air Pilotage. Reprint of Chapter XI of the "Manual of Air Pilotage."

The Weather Map. An introduction to modern meteorology. 2nd edition, 1930.

Charts :—

Currents on the Main Trade Routes of the North Atlantic.

Geophysical Memoirs :—

Vol. V :—

47. Report on Thames floods. By A. T. Doodson, D.Sc., Tidal Institute, University of Liverpool. Meteorological conditions associated with high tides in the Thames. By J. S. Dines, M.A., Superintendent, Forecast Division, Meteorological Office.
48. Meteorological results of journeys in the southern Sahara, 1922 and 1927, made by Francis Rennell Rodd, F.R.G.S. Discussed by C. E. P. Brooks, D.Sc., and S. T. A. Mirrlees, M.A.
49. Two notes on the operation of Galitzin seismographs. By F. J. Scrase, M.A., B.Sc.

Professional Notes :—

Vol. IV :—

52. Bumpiness on the Cairo-Basra air route. By J. Durward, M.A.
53. Relation between the duration of bright sunshine registered by a Campbell-Stokes sunshine recorder and the estimated amount of cloud. By C. E. P. Brooks, D.Sc.
54. Variations of pressure distribution in the northern hemisphere during the period 1904-13, based on 10-day means. By C. E. P. Brooks, D.Sc. and Winifred A. Quennell.
55. Report on the observations of terrestrial magnetism made in the British Isles on the occasion of the total solar eclipse of June 29, 1927. By H. W. L. Absalom, B.Sc.

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.—

The distribution of terrestrial radiation. *London, R. Meteor. Soc., Mem.*, 3, No. 23, 1929, pp. 53-78.

Meteorology in the polar regions. *London, Geog. J.*, 74, 1929, pp. 258-62, disc. pp. 263-70.

Continents and oceans. *Nature*, 124, 1929, pp. 837-8 and p. 948.

The twentieth Kelvin lecture. "Lightning." *London, J. Inst. Electr. Engin.*, 67, 1929, pp. 1269-82, pl. See also *Nature*, 124, 1929, pp. 801-12.

Past climates. The Alexander Pedler Lecture, 1929. *Manchester, Mem. Lit. Phil. Soc.*, 74, 1929-30, pp. 1-34. See also *Nature*, 124, 1929, pp. 988-91.

APPENDIX VI—continued.

By E. GOLD, D.S.O., F.R.S.—

Note on the frequency of occurrence of sequences in a series of events of two types. *London, Q.J.R. Meteor. Soc.*, **55**, 1929, pp. 307-9.

Remarkable snowfall in London. *London, Q.J.R. Meteor. Soc.*, **55**, 1929, pp. 196-7.

Wind at a moderate height in a suburban garden. *London, Q.J.R. Meteor. Soc.*, **55**, 1929, pp. 205-6.

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

Earthquake sounds heard at great distances. *Nature*, **124**, 1929, p. 688.

Potential gradient and atmospheric pollution: the influence of "summer time." *London, Q.J.R. Meteor. Soc.*, **55**, 1929, pp. 351-60, disc. p. 361.

Researches on the transmission of air waves to great distances. *Beitr. Geophysik, Leipzig*, **24**, 1929, pp. 72-5.

By E. G. BILHAM, B.Sc., A.R.C.S., D.I.C.—

An instrument for the optical examination of sunshine recorder lenses. *London, J. Sci. Instr.*, **6**, 1929, pp. 283-7.

Meteorological instruments [at Twentieth Annual Exhibition of the Physical and Optical Societies]. *London, J. Sci. Instr.*, **7**, 1930, pp. 74-5.

The anemometer on the Bell Rock Lighthouse. *London, Q.J.R., Meteor. Soc.*, **56**, 1930, p. 30, pl.

By C. E. P. BROOKS, D.Sc.—

A contribution to the climatology of western China. *London, Q.J.R. Meteor. Soc.*, **55**, 1929, pp. 399-403.

Cycles in natural phenomena. *Nature*, **125**, 1930, pp. 18-9.

Climate: a handbook for business men, students and travellers. London, Ernest Benn, Ltd. 1929.

By D. BRUNT, M.A., B.Sc.—

Article "Meteorology" in "Encyclopædia Britannica," 13th ed.

The transfer of heat by radiation and turbulence in the lower atmosphere. *London, Proc. R. Soc.*, **124** (A), 1929, pp. 201-18.

The index of refraction of damp air and optical determination of the lapse-rate. *London, Q.J.R. Meteor. Soc.*, **55**, 1929, pp. 335-9.

By J. S. DINES, M.A.—

Empirical factors in weather forecasting. *Nature*, **124**, 1929, p. 726.

By A. H. R. GOLDIE, M.A., F.R.S.E.—

Magnetic storm of February 26-28, 1929. *Nature*, **123**, 1929, p. 494.

By C. E. BRITTON, B.Sc.—

Weather record attributed to Dr. Buxton. *London, Q.J.R. Meteor. Soc.*, **55**, 1929, pp. 397-8.

By L. H. G. DINES, M.A., A.M.I.C.E.—

The Baker automatic release for dropping the meteorograph from a registering balloon at a pre-determined height. *London, Q.J.R. Meteor. Soc.*, **55**, 1929, pp. 117-21.

By C. K. M. DOUGLAS, B.A.—

Some aspects of surfaces of discontinuity. *London, Q.J.R. Meteor. Soc.*, **55**, 1929, pp. 123-47, disc. pp. 147-51.

The cold spell of February, 1929. *London, Q.J.R. Meteor. Soc.*, **55**, 1929, pp. 199-202.

By W. H. PICK, B.Sc.—

Fogs during winter with unsaturated air at various town, rural and seaside stations in the British Isles. *London, Q.J.R. Meteor. Soc.*, **55**, 1929, pp. 305-6.

The persistence of types of pressure distribution over the British Isles in winter. *London, Q.J.R. Meteor. Soc.*, **55**, 1929, pp. 403-4.

The persistence of types of pressure distribution over the British Isles in summer. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 82-4.

APPENDIX VI—continued.

- By W. H. PICK, B.Sc., and A. G. FORSDYKE, Ph.D., A.R.C.S., D.I.C.—
A note on fogs in the region of the Channel Islands. *London, Q.J.R. Meteor. Soc.*, **55**, 1929, p. 362. 1.
- By W. H. PICK, B.Sc., and F. E. COLES, B.Sc., A.R.C.S., D.I.C.—
A note on the value for forecasting of observations of swell on the open sea. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 57–58.
- By W. H. PICK, B.Sc., and D. E. DAVIES, M.Sc.—
“Exceptional visibility” in relation to the type of air prevailing. *London, Q.J.R. Meteor. Soc.*, **55**, 1929, pp. 195–6.
- By J. E. BELASCO, B.Sc.—
Snow temperatures in Switzerland. *London, Q.J.R. Meteor. Soc.*, **55**, 1929, pp. 314–6.
- By J. GLASSPOOLE, M.Sc., Ph.D.—
Average and extreme seasonal rainfall over the British Isles. *London, Trans. Inst. Water Engin.*, **33**, 1928, pp. 51–69, disc. pp. 69–74.
Extremes of rainfall over the British Isles. *Off. Circular, Brit. Waterworks Ass.*, No. 81, 1929, Pp. 9. See also *Water and Water Engin.*, *London*, **31**, 1929, pp. 421–4.
The areas covered by intense and widespread falls of rain. *London, Proc. Inst. Civ. Engin.*, **229**, 1929, Pt. 1. Pp. 32 in reprint form.
The dry period of January to March, 1929. *London, Q.J.R. Meteor. Soc.*, **55**, 1929, pp. 312–314.
- By D. N. HARRISON, D.Ph.—
The ozone in the earth's atmosphere. *Nature*, **124**, 1929, pp. 58–61.
- By F. J. SCRASE, M.A., B.Sc., A.I.C.—
The thermal and elastic properties of elinvar: a study of an elinvar spring in the Galitzin vertical seismograph at Kew Observatory. *London, J. Sci. Instr.*, **6**, 1929, pp. 385–392.
- By J. M. STAGG, M.A., B.Sc.—
(Review of) Australasian Antarctic Expedition, 1911–14. Scientific Reports. Series B. Vol. III and Vol. IV. Meteorology. *London, Q.J.R. Meteor. Soc.*, **56**, 1930, pp. 92–95.
- By R. A. WATSON, B.A.—
The cyclone season 1927–8 at Mauritius. *Mauritius, Royal Alfred Observatory, Misc. Publ.*, No. 7. 1929, Pp. 4, pls. 47.
Disturbed and quiet day variations of magnetic force 1916–26 at Mauritius. *Mauritius, Royal Alfred Observatory, Misc. Publ.*, No. 8, 1929. Pp. 46, pls. 3.

APPENDIX VII.

LIST OF DELEGATES ATTENDING THE CONFERENCE OF EMPIRE
METEOROLOGISTS, LONDON, 1929.

Australia ...	...	Capt. H. J. Feakes, R.A.N.	Commonwealth Naval Representative in London.
Barbados ...	...	Mr. C. J. P. Cave	—
Canada and Newfoundland.	...	Mr. J. Patterson	Director, Canadian Meteorological Service.
Ceylon ...	...	Mr. A. J. Bamford	Superintendent, Colombo Observatory.
East African Group (Kenya, North Rhodesia, Tanganyika, Uganda, Zanzibar) and S. Rhodesia ... Sudan ...	...	Mr. A. Walter	Director, British East African Meteorological Service.
Egypt (unofficial observer).	...	Mr. L. J. Sutton	Director, Meteorological Service.
Gambia ...	...	Mr. A. J. Brooks	Director of Agriculture.
Gold Coast ...	...	Mr. Auchinleck ... Mr. N. P. Chamney	Director of Agriculture. Superintendent of Agriculture.
Great Britain ...	...	Dr. G. C. Simpson	Director, Meteorological Office.
Hongkong ...	...	Mr. T. F. Claxton	Director, Royal Observatory.
India ...	...	Dr. C. W. B. Normand	Director-General of Observatories.
Irish Free State ...	...	Mr. M. H. Eliassoff	—
Leeward Islands ...	...	Mr. H. H. Croucher	Imperial College of Tropical Agriculture, Trinidad.
Malaya ...	...	Mr. J. Dewar	Assistant Surveyor-General.
New Zealand ...	...	Mr. D. C. Bates	—
Nigeria ...	...	Capt. J. Calder Wood Mr. S. M. Jacob	Deputy Surveyor-General. Government Statistician.
Nyasaland ...	...	Mr. E. J. Wortley	Director of Agriculture.
Sierra Leone ...	...	Mr. R. Temple	Lands Officer.
Somaliland ...	...	Dr. R. S. Taylor	Principal Medical Officer.
South Africa ...	...	Mr. C. Stewart	Chief Meteorologist.
Trinidad ...	...	Capt. A. B. Smith, R.N.R.	Harbour Master.
Uganda ...	...	Mr. C. G. Hansford	Mycologist.
Windward Islands	...	Major E. E. Turner	Chief of Police, Grenada.

APPENDIX VII—*continued.*

AGRICULTURAL SECTION

In addition to the delegates to the Conference, whose names are given above, the following attended the meetings of the Agricultural Section.

Australia ...	...	Mr. A. S. Fitzpatrick ...	—
Ceylon ...	...	Mr. T. H. Holland ...	Manager, Experiment Station, Peradeniya.
Egypt ...	...	Dr. Lawrence Balls ...	Chief Botanist.
		Dr. J. Templeton ...	First Botanist.
Gold Coast ...	...	Mr. H. Nicholas ...	Superintendent of Agriculture.
		Mr. A. C. Miles ...	" "
New Zealand ...	...	Dr. G. H. Cunningham ...	Plants Research Officer.
Northern Ireland		Mr. Ian W. Seaton ...	Ministry of Agriculture.
Nyasaland ...	...	Capt. A. J. W. Hornby ...	Agricultural Chemist.
Sudan ...	...	Mr. W. A. Davie ...	Director of Agriculture and Forests.
Trinidad ...	...	Sir Algernon Aspinall, C.M.G., C.B.E.	Secretary, Imperial College of Tropical Agriculture.

