

M.O. 562

ANNUAL REPORT
OF THE DIRECTOR OF THE
METEOROLOGICAL OFFICE

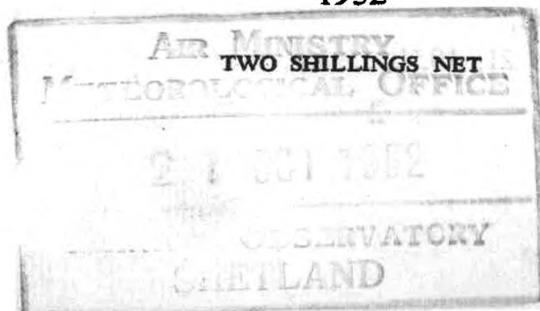
PRESENTED BY THE METEOROLOGICAL COMMITTEE
TO THE SECRETARY OF STATE FOR AIR

FOR THE YEAR
APRIL 1, 1951 TO MARCH 31, 1952



LONDON : HER MAJESTY'S STATIONERY OFFICE
1952

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Appointed by the Secretary of State for Air

Chairman :—Mr. A. M. Crawley, M.B.E., M.P. (to October 1951)

Mr. Nigel Birch, O.B.E., M.P. (from November 1951 to February 1952)

Mr. George Ward, M.P. (from March 1, 1952)

Vice-Chairman :—Professor G. M. B. Dobson, C.B.E., F.R.S. (Royal Society)

Members :—Mr. W. J. Bigg, C.M.G. (Colonial Office)

Instructor Captain P. Bracelin, O.B.E., R.N. (Admiralty) (from November 12, 1951)

Professor Sir David Brunt, F.R.S. (British Universities)

Air Chief Marshal The Hon. Sir Ralph A. Cochrane, G.B.E., K.C.B., A.F.C., A.D.C. (Air Ministry)

Mr. W. B. Foden, C.B. (Air Ministry)

Sir Harry Garner, K.B.E., C.B. (Ministry of Supply)

Professor W. M. H. Greaves, F.R.S. (Royal Society of Edinburgh)

Sir Nelson Johnson, K.C.B., D.Sc. (Director, Meteorological Office)

Major General K. F. Mack. Lewis, C.B., D.S.O., M.C. (War Office) (from December 15, 1950)

Captain R. F. Nichols, R.N. (Admiralty) (to November 11, 1951)

Captain J. H. Quick (Ministry of Transport)

Sir Edward Salisbury, K.B.E., F.R.S. (Ministry of Agriculture and Fisheries)

Mr. H. R. Smith, C.B. (Scottish Office)

Mr. G. W. Stallibrass (Ministry of Civil Aviation)

Professor O. G. Sutton, C.B.E., F.R.S. (Royal Society)

Secretary :—Mr. R. J. Williams

The Committee met on May 31, 1951.

ADVISORY COMMITTEE ON METEOROLOGY FOR SCOTLAND

Appointed by the Meteorological Committee

Chairman :—Sir Nelson Johnson, K.C.B., D.Sc. (Director, Meteorological Office)

Members :—Mr. E. G. Dymond, M.A. (University of Edinburgh)

Dr. A. E. M. Geddes, O.B.E., D.Sc., F.R.S.E. (University of Aberdeen)

Professor W. M. H. Greaves, F.R.S. (Royal Society)

Dr. David Jack, Ph.D., F.Inst.P., F.R.S.E. (University of St. Andrews)

Mr. J. S. Munro (Fisheries Division, Scottish Home Department)

Mr. James Paton, M.A., B.Sc. (Royal Meteorological Society)

Dr. R. G. Peters, M.D., D.P.H. (Department of Health for Scotland)

Professor W. M. Smart, D.Sc. (University of Glasgow)

Mr. A. R. Wannop, O.B.E. (Department of Agriculture for Scotland)

Sir Ernest Wedderburn, O.B.E., D.Sc., LL.D. (Royal Society of Edinburgh)

Secretary :—Mr. R. A. Watson, B.A.

The Committee met on June 21, 1951.

METEOROLOGICAL RESEARCH COMMITTEE

Appointed by the Secretary of State for Air

Chairman :—Professor G. M. B. Dobson, C.B.E., F.R.S.

Members :—Dr. G. E. Bell (Ministry of Civil Aviation)

Professor Sir David Brunt, F.R.S.

Professor S. Chapman, F.R.S.

Sir Harry Garner, K.B.E., C.B. (Ministry of Supply)

Sir Nelson Johnson, K.C.B., D.Sc. (Director, Meteorological Office)

Wing Commander N. G. Macfarlane, D.S.O. (Air Ministry)

Captain R. F. Nichols, R.N. (Admiralty) (to November 11, 1951)

Instructor Captain P. Bracelin, O.B.E., R.N. (Admiralty) (from November 12, 1951)

Sir Charles Normand, C.I.E., D.Sc.

Professor P. A. Sheppard

Professor O. G. Sutton, C.B.E., F.R.S.

Professor Sir Geoffrey Taylor, F.R.S.

The Committee met twice during the period covered by this report.

GASSIOT COMMITTEE

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, namely Meteorology, Terrestrial Magnetism, Atmospheric Electricity, Seismology and the cognate subjects.

Professor Sir David Brunt (Chairman)

Sir Edward Appleton

Professor T. G. Cowling

Professor G. M. B. Dobson

Mr. E. Gold

Professor H. W. Massey

Sir Charles Normand

Professor F. A. Paneth

Professor P. A. Sheppard

Professor O. G. Sutton

The Astronomer Royal

The President of the Royal Astronomical Society

The President of the Royal Meteorological Society

The Director of the Meteorological Office

There were two meetings of the Committee during the period under review.

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ANNUAL REPORT

OF THE DIRECTOR OF THE METEOROLOGICAL OFFICE PRESENTED
BY THE METEOROLOGICAL COMMITTEE TO THE SECRETARY OF STATE
FOR AIR FOR THE YEAR APRIL 1, 1951, TO MARCH 31, 1952

§ 1. FUNCTIONS OF THE METEOROLOGICAL OFFICE

The Meteorological Office is the State Meteorological Service. It forms part of the Air Ministry, the Director being responsible to the Secretary of State for Air through the Permanent Under Secretary of State.

General policy is controlled by the Meteorological Committee of which the Under Secretary of State for Air is Chairman. Almost all those Government Departments to which the Meteorological Office regularly provides services are represented on the Committee, and there are also representatives of the Royal Society, the Royal Society of Edinburgh, and British Universities.

The general functions of the Meteorological Office are :—

- (i) Provision of meteorological services to the Army, Royal Air Force, Civil Aviation, Ministry of Supply and the Merchant Navy.
- (ii) Liaison with the Naval Weather Service of the Admiralty and provision of basic meteorological information for use by that Service.
- (iii) Meteorological services to other Government Departments, public corporations, local authorities, the Press and the general public.
- (iv) Organization of meteorological observations in Great Britain and Northern Ireland, and in certain colonies.
- (v) Collection, distribution and publication of meteorological information from all parts of the world.
- (vi) Maintenance of certain British observatories, and publication and distribution of magnetic and seismological information obtained from them.
- (vii) Research in meteorology and geophysics.

The Meteorological Office also takes a leading part in international co-operation in meteorology.

The cost of the Meteorological Office is borne on Air Ministry Votes. Appendix V shows the provision made in the Air Estimates for expenses and receipts of the Meteorological Office for the financial year 1952-53.

§ 2. FORECASTING SERVICES RENDERED BY THE METEOROLOGICAL OFFICE

(1) Organization for Forecasting

(a) Central Forecasting Office.—The headquarters of the forecasting service and the main communications centre of the Meteorological Office are situated at Dunstable. The organization of the Central Forecasting Office, into Divisions and Branches under a Deputy Director, is shown in Appendix I.

The functions of the Central Forecasting Office are :—

(i) To collect meteorological data required for forecasting both at Dunstable and at outstations.

(ii) To disseminate the data to meet the needs of outstations and in accordance with international requirements.

(iii) To provide basic analyses and prognostic analyses covering a wide area for the guidance of forecasters at outstations and for the information of foreign meteorological services.

(iv) To provide the forecasts, weather warnings and other information on current weather required by Government Departments, public services and the general public.

(v) To prepare and keep up to date the forms, handbooks and other publications relating to the services provided.

(vi) To carry out research work on forecasting problems with the object of increasing the accuracy of the forecasts and extending the period for which they can be provided.

No important changes were made during the year.

During the Festival of Britain a weather forecasting unit was maintained in the Dome of Discovery, and a special *Souvenir Weather Report and Forecast* containing a chart and forecast was published twice daily. More than 150,000 copies were sold to visitors.

Publication of an overseas supplement to the *Daily Weather Report* commenced with the issue for January 1951. The supplement contains surface and upper air data from the British meteorological offices in the Mediterranean and Middle East area, and was published some months in arrears.

(b) Reporting stations.—A careful examination was made of the network of stations supplying reports in the full synoptic code, and a new list of 81 stations was brought into use on August 1, 1951. Of this total 19 are auxiliary stations where part-time observers supply the necessary information. In addition, a further 25 auxiliary stations supply a smaller amount of information in the AERO Code. The observers at these auxiliary stations, who are normally engaged in other occupations, maintained a high standard of observing.

Observations in the shorter AERO form are supplied by many of the smaller Meteorological Office stations, by Royal Naval Air stations and by United States Air Force stations in the British Isles. In all, observations from 168 stations are received at least twice a day, and in the majority of cases hourly.

(c) Ships' reports.—*Voluntary ships.*—The organization of voluntary observing ships is described on p. 21.

About 117 ships' reports were received daily at the Meteorological Communications Centre at Dunstable ; of these, 102 were from British ships and 15 from foreign ships ; 52 per cent. of these messages were received within one hour of the time of observation. Rapid transmission is ensured by a direct teleprinter line between the Central Forecasting Office and the Post Office wireless station at Burnham-on-Sea.

Ocean weather ships.—The British weather ships carried out a full programme of surface and upper air observations, which were communicated to the Central Forecasting Office by point-to-point W/T communication. Radio weather messages from ocean weather ships operated by other nations in the North Atlantic and from other foreign “selected” merchant ships were received regularly throughout the year.

(d) Meteorological flights.—Routine meteorological reconnaissance flights by R.A.F. aircraft were reduced to a minimum, sufficient only to maintain and develop the special techniques required. The meteorological reconnaissance flight over the Indian Ocean, based on Negombo, Ceylon, was discontinued on November 1, 1951. After that all flights were made over the eastern Atlantic from the R.A.F. station at Aldergrove.

Routine vertical ascents for the purpose of obtaining temperature and humidity measurements at a number of levels, together with detailed information of cloud structure, continued to be made by R.A.F. aircraft at Singapore. The operation of similar flights in the United Kingdom was transferred from the R.A.F. to civilian contractors on May 1, 1951.

(e) Radio-sonde and radar wind stations.—Measurements of pressure, temperature, humidity and wind in the upper atmosphere were made four times daily at eight stations in the United Kingdom and at the two British ocean weather stations until February 1, 1952, when the programme was reduced to two radio-sonde ascents (at 0300 and 1500) and four radar wind observations daily. Measurements at eight overseas stations under British control were continued unchanged at two a day.

The apparatus in routine use was unchanged during the year, but experimental work was continued with a view to improving accuracy, obtaining observations at greater heights, and reducing operational costs.

The training of new staff in radio-sonde work was transferred from Downham Market to Hemsby, near Great Yarmouth, when the radio-sonde unit moved to the latter station in November 1951.

(f) Thunderstorm location.—The network of four direction-finding stations engaged in the location of atmospherics (“Sferic”) continued in operation. The stations are at Hemsby (near Great Yarmouth), Camborne (Cornwall), Leuchars (Fifeshire) and Irvinestown (Northern Ireland); and the control and plotting work is performed at Dunstable.

Special observations were made, on behalf of scientists at Cambridge and London Universities and at the National Physical Laboratory, for use in investigations on the propagation and wave form of long radio waves.

An R.A.F. signals tender was fitted with thunderstorm-locating apparatus for use as a mobile station. With the aid of this van investigations were made, in collaboration with the National Physical Laboratory, into the suitability of a new site for a station in east Scotland and into the problem of local sources of error in direction-finding of this type.

(g) Meteorological communications.—*Land-line communications.*—Four teleprinter broadcasts were made from Dunstable. On Channel 1 basic data was supplied to 176 stations, an increase of 21 over last year’s figure; Channel 2 supplied supplementary data to 62 stations; Channel 3 was a relay of North

American data and reached 12 stations which were concerned with transatlantic flying ; Channel 4 supplied selected data to the western European teleprinter network.

The reliability of the circuit from Rome was sufficiently good for data to be relayed on the second-channel broadcast, and this speeded up the supply of reports from the Mediterranean area. Scandinavian data were received satisfactorily via Copenhagen and Quickborn.

The contents of the Channel 1 and 2 broadcasts were kept under constant review with a view to meeting, as far as possible, additional requirements arising from the operation of jet aircraft.

Jersey was connected to the Channel 1 network as a " private subscriber ".

Radio communications.—The continental, sub-continental and national W/T broadcasts originated by Dunstable were maintained with some minor changes in schedules. Steps were taken to acquire additional fields near the Central Forecasting Office, and plans were prepared for an extension of the present aerial array in order to improve reception of broadcasts from the more distant transmitters. Data so received will supplement that now received via Singapore and will facilitate the compilation of northern-hemisphere synoptic charts. Tests were carried out on the reception of an experimental radio-teleprinter broadcast from Sweden.

The reception of American data via the Azores and Paris continued to be reasonably satisfactory, but there were noteworthy interruptions, due to bad propagation conditions, when direct R/T and W/T interceptions at Dunstable were also affected. Arrangements were made whereby reports from ocean weather station A in the Atlantic (occupied by a United States weather ship) were collected by Dunstable when the ship was unable to contact Washington by wireless.

A British firm has developed a radio-facsimile transmitter and recorder, which, in essentials, meets the specification agreed by the World Meteorological Organization, European Regional Association. An order was placed for 2 transmitters and 6 recorders. It is planned to start an omni-directional radio-facsimile transmission from Dunstable in the spring of 1952. The recorders will be installed at selected outstations to test the quality of reproduction, ease of operation of the machines and usefulness of the results. If the trials are successful it is hoped to extend the service as apparatus becomes available.

It was not found possible to resume the radio-telephone AIRMET broadcasts, as no medium- or long-wave band was available.

(2) Supply of Forecasts for the General Public, Government Departments, etc.

The following are among the services rendered by the Meteorological Office :—

(a) British Broadcasting Corporation.—*Sound.*—Daily weather bulletins for the general public, shipping, and European services of the B.B.C. were maintained.

Television.—The daily broadcast of meteorological charts and forecasts from the London and Birmingham television studios was extended to include the North of England when the Holme Moss transmitter came into operation on October 12. Slightly more technical detail was included in these broadcasts.

(b) Railways.—Forecasts and warnings of snow, frost, fog and thunderstorms continued to be issued as in the previous year.

(c) Road Research Laboratory.—Forecasts and warnings of drifting snow and of ice formation on roads were supplied as in previous years.

(d) British Electricity Authority.—Daily forecasts of meteorological conditions affecting electricity loading were issued to Grid Control Centres. The supply of special week-end temperature forecasts was continued and a broad outlook for four days ahead was supplied to the Authority bi-weekly. The meteorological unit at the British Electricity Authority Headquarters was maintained.

(e) Belfast Harbour Power Station.—Special week-end temperature forecasts were issued throughout the year.

(f) Gas undertakings.—Warnings of expected changes in meteorological elements affecting day-to-day requirements of gas were issued as in previous years.

(g) Film companies.—Special weather forecasts for the Greater London area were supplied twice daily throughout the year, and for other areas on request.

(h) Agriculture and Horticulture.—Frost warnings were supplied to County Branch Officers of the National Farmers' Union for dissemination to fruit growers and market gardeners.

Warnings of snowfalls or drifts expected on high ground in northern England were supplied to County Branch Officers of the National Farmers' Union for dissemination to sheep farmers.

The fine-spell notification service was used extensively by farmers and others.

(i) Catchment Boards, etc.—Forecasts of conditions liable to result in flooding, or in substantial increases of river flow, were supplied to the Thames Conservancy Board and the Yorkshire Ouse and Great Ouse Catchment Boards.

(j) Docks and Inland Waterways Executive.—Warnings of persistent frosts, likely to produce ice on canals in the Wolverhampton area, were supplied.

(k) Road engineers and automobile clubs.—Warnings of the onset of meteorological conditions likely to cause bad road conditions were supplied to various Government Departments, local authorities and motoring associations. A greatly increased use was made of snow warnings to assist local authorities with snow-clearing schemes.

(l) Ministry of Fuel and Power.—Warnings of sharp falls in barometric pressure were issued to certain collieries, in connexion with experiments on a colliery warning system (see p. 34).

(m) Factories and other commercial undertakings.—Special forecasts were supplied, as in previous years, of weather conditions affecting industrial processes.

(n) Ceremonial occasions.—Forecasts for State Ceremonial and pageant occasions were issued as required. Special forecasts were supplied to the Earl Marshal's office and to the Household Cavalry in connexion with the funeral of His late Majesty King George VI.

(o) Sport and recreation.—Many special forecasts were issued on request in connexion with various sports and recreations.

(p) General Public.—Numerous forecasts were supplied, on request or by pre-arrangement, by the meteorological offices specified in the Post Office Guide.

(3) Services for the Royal Air Force

(a) Organization.—There was no important change in the organization of meteorological services to the Royal Air Force, but the expansion of the Defence Services during the year necessitated the opening of a number of new meteorological offices, mainly at stations in Flying Training Command.

Special arrangements were made to meet the meteorological requirements of the Royal Auxiliary Air Force Squadrons which were called up for full-time training during the period April–October 1951.

In the British zone in Germany the use of German forecasters and assistants under the supervision of British staff was continued.

Little change occurred in the Middle East area, but large-scale air movements resulting from disorders in the Canal Zone, Egypt, involved additional commitments at many stations. Technical control of meteorological services in Libya continued to be undertaken by the British Meteorological Office after the territory became independent in December 1951.

(b) Facilities.—In addition to the normal meteorological service, special facilities were provided for exercises, for long training flights by pilots of the R.A.F. Flying College, Manby, and the Central Navigation and Control School, Shawbury, and for flights by jet aircraft to the Far East and by Canberra aircraft to Australia. Mobile meteorological units were provided during Allied Exercises in western Europe. International Civil Aviation Organization sub-area broadcasts and R.A.F. broadcasts of weather reports and landing forecasts from R.A.F. stations in the United Kingdom, Gibraltar and the Middle East were maintained. Responsibility for the sub-area broadcasts in the British Zone in Germany was transferred to the German Zonal Meteorological Service.

Meteorological facilities were provided for the R.A.F. R/T Flight Information Service in the United Kingdom. TALK-TO-MET facilities, whereby meteorological information is supplied direct from the meteorological office to over-flying aircraft by radio-telephony, were maintained at El Adem, but the facilities at Shaiba were discontinued at the end of 1951.

In the Far East, additional meteorological facilities were provided for the military forces in Malaya and Hongkong.

A review was made of the criteria for the supply of intermediate reports of deterioration or improvement in weather conditions to Air Traffic Control Offices on R.A.F. airfields, and it was arranged that the critical values for which special reports of visibility and height of base of cloud are required should be agreed by the Meteorological Officer and the Senior Air Traffic Control Officer on each airfield.

(c) Royal Air Force Meteorological Policy Committee.—A meeting of this Committee was held on February 12, 1952; matters discussed included manning problems in the Meteorological Office, requirements for meteorological air reconnaissance and photographic reconnaissance, meteorological facilities overseas, the provision of upper air information in Middle East and Far East Commands, and recent meteorological research of concern to the Royal Air Force.

(d) Miscellaneous activities.—A short memorandum on the meteorological aspects of jet aircraft operations was prepared and issued for guidance to meteorological offices at home and overseas.

To facilitate the study of severe turbulence and of condensation trails, R.A.F. pilots continued to supply reports of these phenomena.

To assist in the forecasting of sea fog and low stratus cloud on the east coast of Scotland, efforts were made to increase the number of observations of sea-surface temperature received from ships in the North Sea.

Reports were collected on the incidence and characteristics of night thunderstorms in the Far East.

(e) Meteorological instruction for the Royal Air Force.—Meteorological instruction was given at a large number of schools in Flying Training Command, at Operational Conversion Units and at other R.A.F. units at home and overseas. Advice was also given on syllabi for meteorological courses.

Material was prepared for a new meteorological film strip dealing with high-altitude meteorology. Two meteorological instructional films were revised and re-made into three new films.

(4) Services for Civil Aviation

(a) Organization.—Meteorological facilities were provided in the United Kingdom and overseas, in conformity with the recommendations of the Regional Air Navigational meetings of the International Civil Aviation Organization. New "Specifications for meteorological services" for international air navigation, produced by the MET. Division of the International Civil Aviation Organization in conjunction with the Commission for Aeronautical Meteorology of the International Meteorological Organization, were brought into use on October 15, 1951, the internationally agreed date, together with the associated "Regional supplementary procedures" and "Combined meteorological tables for international air navigation".

The civil aviation element of the Air Traffic Control Centre, Gloucester, was transferred during the year to Uxbridge, and the main meteorological office at the latter centre became responsible for the supply to the Air Traffic Controller of weather information covering both the South-Eastern and South-Western Flight Information Regions. In agreement with the Ministry of Civil Aviation suitable modifications were made to meteorological telecommunications arrangements; the changes included the transfer of the South-West England Sub-Area Broadcast to Uxbridge. The main meteorological offices at Preston and Prestwick continued to provide information to the associated Air Traffic Control Centres.

Broadcasts by wireless telegraphy of aerodrome weather reports and forecasts, for the information of aircraft in flight, continued to be made from the three centres, Uxbridge, Preston and Prestwick. The broadcasts of half-hourly aerodrome weather reports in plain language on V.H.F. radio-telephony Area Control frequencies continued in accordance with the provisional arrangement made in 1950.

The meteorological requirements of the Air Traffic Control subcentres in Scotland continued to be met by the meteorological offices at Dyce and Grimsetter.

Representatives of the Meteorological Office attended the Commonwealth meeting on the operation of gas turbine aircraft, which was held in London in September and October 1951. A series of Comet "proving flights" was carried out by British Overseas Airways Corporation during the year, and three meteorological officers took part in them to study the meteorological aspects and to explain, to certain overseas meteorological services, some of the special problems involved in the day-to-day application of meteorological information to such operations.

Arrangements were made in conjunction with the Ministry of Civil Aviation and British European Airways for meteorological officers, employed on forecasting for British European Airways routes, to make flights between airfields in the United Kingdom, and between the United Kingdom and the first scheduled stop on continental routes. These "familiarization flights" were intended to provide forecasters with first-hand experience of operational conditions. Meteorological officers were allowed access to the flight deck, in order that they might obtain the maximum benefit from the flights.

(b) Services provided in the United Kingdom for trunk routes.—Civil aircraft operating on the trunk routes, including the North Atlantic, continued to be served by the meteorological offices at London Airport, Prestwick, Bovingdon and Hurn. The meteorological office at Bovingdon also provided forecasts and briefings for an increasing number of charter flights from that airport. The office at Hurn assisted in the training of Air Traffic Control Officers.

(c) Services provided in the United Kingdom for internal and European routes.—Meteorological offices were maintained at 20 civil aerodromes for the benefit of airlines operating on routes within the United Kingdom and to European terminals. This is a decrease of two since last year.

The telephone conferences held to co-ordinate technical opinion on weather conditions expected at the London terminals and alternate aerodromes, were continued four times daily ; but, in the light of experience, it was limited to the meteorological offices at London Airport, Northolt and the Air Traffic Control Centre, Uxbridge.

Meteorological organizations for a number of continental routes were agreed with various foreign meteorological services. The organization for the Dublin-United Kingdom routes was revised in agreement with the Irish Meteorological Service and in conformity with the new "Specifications for meteorological services".

Special arrangements were made for the provision of meteorological information for British European Airways helicopter services between Birmingham and London.

Arrangements were made by agreement with the French Meteorological Service for the experimental operation of "quick turn-round" procedures at certain aerodromes in the United Kingdom and France. Under these procedures the aircraft captain does not normally visit the meteorological office for personal briefing and debriefing, but a flight forecast for the return journey is handed to him in the aircraft by a company's representative.

At the invitation of the International Air Transport Association a representative of the Meteorological Office was present as an observer at the sixth meeting of the Association's Meteorological Panel for the Europe-Mediterranean Region.

Assistance was given to British European Airways Corporation in planning their pay loads by providing information of the probable equivalent headwinds on certain European routes.

(d) Services provided overseas.—The meteorological offices in the British West Indies continued to function under the control of the Meteorological Office until October 1951, when the newly appointed Director of the British Caribbean Meteorological Service assumed control.

Meteorological services for civil aviation were also provided at a number of joint-user airfields in the Middle East Command and, until the end of 1951, at Negombo, Ceylon.

(e) Examinations.—Examinations were held in meteorology for the Commercial Pilot, Senior Commercial Pilot, Airline Transport Pilot and Flight Navigator Licences, and for Instrument Ratings' and Air Traffic Control Officers' primary courses ; 971 candidates were examined. Minor modifications to the meteorological syllabi for the licence examinations were agreed with the Ministry of Civil Aviation.

(f) Special work.—Experiments to decide how best to assess from the ground the distance at which a pilot can see ground markers and lighting ("runway visual range") during an approach and landing, were continued at London Airport. Assistance was given to the Ministry of Civil Aviation in the introduction of arrangements for reporting "runway visual range" at most of their aerodromes in the United Kingdom.

Detailed reports on the meteorological aspects of a number of aircraft accidents including those at Petersfield on January 4, 1952, and near Snowdon on January 10, 1952, were prepared for the Accidents Investigation Branch, Ministry of Civil Aviation.

Memoranda on altimeter-setting procedures and the boundaries of altimeter-setting regions were prepared for the Ministry of Civil Aviation.

Most of the text of the meteorological section of the United Kingdom Air Pilot was re-written in order to bring it up to date. The introduction of the new International Civil Aviation Organization "Specifications for meteorological services" also necessitated extensive revision and re-printing of all flight and aerodrome forecast forms.

A Meteorological Office representative was appointed to the Committee formed by the Ministry of Civil Aviation to consider the development of an international language for aviation.

A subsidiary forecasting office was set up at Hatfield on June 23, to supply meteorological information and advice to the organizers and competitors in the Festival of Britain National Air Races. Similar arrangements were made for the *Daily Express* Air Race at Shoreham on August 6, and again on September 22.

Assistance was given in connexion with the National Gliding Contests at Camphill in July 1951.

Special meteorological route organizations were prepared for a number of Royal Flights which took place during the year.

(5) Services for the Royal Navy*

Certain main meteorological offices overseas continued to provide synoptic data, analyses and forecasts for the Royal Navy.

Cyclone warnings for an area of the Indian Ocean were provided by Negombo, Ceylon. From January 1, 1952, the Ceylon Meteorological Service took over responsibility for the preparation of shipping forecasts (see p. 15).

Special meteorological facilities were provided for R.N. and R.A.F. personnel during joint R.N. and R.A.F. Exercises.

(6) Services for the Army

The meteorological office at the School of Artillery, Larkhill, was maintained.

Meteorological requirements at Artillery Practice Camps were met either by the temporary attachment of meteorological staff or by the provision of information from a nearby meteorological office. Meteorological facilities for the Army continued to be provided in overseas commands.

The provision of mobile meteorological units to operate with Army formations was considered.

(7) Services for the Ministry of Supply

Various meteorological techniques for sound-ranging were examined, and investigations were carried out with the aim of improving the accuracy of wind data used in gunnery.

(8) Services for the Merchant Navy and Fishing Fleets

The Central Forecasting Office maintained the service of gale warnings and forecasts for shipping as in former years. These warnings and forecasts for coastal sea areas of the British Isles are disseminated in B.B.C. radio programmes and by G.P.O. coastal radio stations. In the B.B.C. Light Programme gale warnings are read out within a few minutes of issue. They are repeated at the beginning of each weather bulletin in the Home Service, at 6.55 a.m. (except Sundays), 7.55 a.m., 12.55 p.m., 5.55 p.m. clock times. The forecasts for shipping, for the areas shown in Appendix IV, are given in the same bulletins. By arrangement with the Ministry of Transport through the Coastguard Services visual gale-warning signals in the form of canvas cones are exhibited at many points on the coast.

The North Atlantic shipping bulletin, broadcast twice daily by the Admiralty and Portishead Radio at 0930 and 2130 G.M.T., includes storm warnings and forecasts for the north-eastern Atlantic Ocean. An analysis of pressure and frontal systems for the use of shipping is broadcast daily at 1130 G.M.T.

Forecast centres near ports issue on request local forecasts or weather reports to masters of ships and others concerned with the movements of shipping or with the loading and discharging of cargo.

* The Director of the Naval Meteorological Service submits an *Annual Report* to the Board of Admiralty.

(9) Services for the Commonwealth

(a) **Middle East area.**—*Malta.*—The Meteorological Office continued to maintain a forecasting service at Luqa and a radio-sonde/radar wind unit at Qrendi. Meteorological facilities were provided for all R.A.F. and civil aviation services, and the exchange of meteorological information with neighbouring countries was maintained.

Cyprus.—The Meteorological Office continued to maintain a forecasting service and a radio-sonde/radar wind unit at Nicosia, and three reporting stations in Cyprus. Meteorological facilities were provided for all R.A.F., military and civil aviation services.

Aden.—A forecast service and a radio-sonde/radar wind unit were maintained at Khormaksar to meet the meteorological requirements of the R.A.F., of shipping and of civil aviation. Meteorological reporting stations along the south Arabian coast and on Kamaran Island continued to operate.

British Somaliland.—Agreement was reached with the Colonial Office for the British Meteorological Office to exercise technical control of the reporting station at Hargeisa.

Pakistan.—A forecasting service was maintained at the R.A.F. Staging Post, Mauripur, to meet the requirements of the Royal Air Force and of the Royal Pakistan Air Force.

(b) **Far East area.**—*Ceylon.*—Forecasting facilities for all R.A.F. and, until the end of 1951, for all civil aviation services operating in and through Ceylon were provided by the British meteorological office at Negombo. The meteorological reporting station at Trincomalee was closed in December 1951.

During 1951 forecasters of the Ceylon Meteorological Service were attached to the meteorological office, Negombo, for practical training and undertook roster duties. They were withdrawn when responsibility for providing meteorological services for civil aviation and shipping was formally handed over to the Ceylon Meteorological Service in January 1952 (see also p. 14).

Close liaison was maintained with the Ceylon Meteorological Service, which is expected to take over meteorological W/T receptions early in 1952 and to assume responsibility for meteorological W/T transmissions later in the year.

Male.—Stores were supplied to the synoptic and upper wind reporting station at Male. The Maldivian Government accepted responsibility for the maintenance of this station.

Malaya.—The Meteorological Office continued to be responsible for meeting the requirements of the R.A.F. and maintained offices at Changi, Tengah, Seletar and Butterworth. Negotiations for the Malayan Meteorological Service to undertake the commitments for the R.A.F. continued.

To meet the meteorological requirements of jet aircraft, radar wind observations were made twice weekly from a site near Singapore using an Army radar set operated by Army personnel, the computations being made by meteorological staff. Many ascents exceeded a height of 70,000 ft., and a note dealing with the observations for one year was in preparation.

Nicobar Islands.—A meteorological reporting station was maintained at Car Nicobar.

Hongkong.—A small complement of Meteorological Office staff assisted the Royal Observatory in meeting the requirements of the Army and Royal Air Force. A British meteorological office was opened at Sekkong to meet R.A.F. requirements.

(c) **British West Indies.**—The United Kingdom continued to operate the meteorological service in the British West Indies until October 1951, when the newly appointed Director of the Caribbean Meteorological Service assumed control.

(d) **Falkland Islands.**—The Meteorological Office continued to maintain a radio-sonde/radar wind unit at Port Stanley.

(10) Services in Foreign Countries

(a) **European area.**—*Germany.*—The Meteorological Office continued to be responsible for the provision of meteorological services in the British Zone of Germany and in Berlin (until July 1951) to meet the needs of the British occupational forces and the High Commission.

Control over the German Zonal Meteorological Service, which provides a basic network of reporting stations and meets the needs of the German economy, was maintained. Responsibility for meteorological services at civil airports was transferred to the German Zonal Service in June 1951; this released British staff and instruments from a number of stations.

The Chief Meteorological Officer, 2nd Tactical Air Force, continued to be the British representative on the Allied Meteorological Board under the General Committee of the Allied High Commission. The Board continued to negotiate with officials of the German Federal Republic for the fusion of the German meteorological services in the three western zones of Germany.

Austria.—A meteorological office was maintained at Schwechat (Vienna) with a British officer in charge of Austrian forecasters and assistants.

(b) **Middle East area.**—*Libya.*—Technical control of meteorological services in Libya was exercised by the Director of the British Meteorological Office through the Chief Meteorological Officer, Middle East Air Force, both before and after the territory became independent in December 1951. Staff based on the United Kingdom continued to fill posts for which suitably trained staff of local origin were not available. Forecasting offices at Castel Benito and El Adem, linked with small networks of reporting stations in Tripolitania and Cyrenaica respectively, were maintained.

Egypt.—Despite defections by locally engaged staff, full meteorological services were provided for British Military Forces in the Canal Zone. Deficiencies in the meteorological signals organization, resulting from the loss of local civilians, were remedied by the use of R.A.F. wireless operators.

Sudan.—A small staff including two forecasters was provided at Khartoum, primarily to meet R.A.F. requirements.

Eritrea.—Technical control over meteorological services in Eritrea was exercised by the Director of the British Meteorological Office who provided forecasting officers at Asmara. A scheme was prepared for training Eritrean assistants to replace those of other nationalities.

Jordan.—A reporting station was maintained at Amman, where assistants were trained to make observations. These will provide staff for a reporting station at Mafraq. Some technical assistance was provided for the Arab Legion.

Iraq.—The Meteorological Office was responsible for forecasting offices at Habbaniya and at Shaiba. Close liaison was maintained with the Iraqi Meteorological Service. The arrangement, whereby the Iraqi Meteorological Service, Baghdad covers meteorological requirements for civil aviation at Basra between the hours of 1900 and 1000 G.M.T. the next day, continued; commitments outside this period were covered by Habbaniya or Shaiba.

Persian Gulf.—The forecasting service and radio-sonde/radar wind unit at Bahrein and the reporting station at Sharja were maintained. The staff was increased to meet the requirements of a Flight Information Centre, which was opened at Bahrein in September 1951.

§ 3. CLIMATOLOGICAL SERVICES RENDERED BY THE METEOROLOGICAL OFFICE

The Climatology Division, situated at Harrow, is concerned with British Climatology (including the British Rainfall Organization), World Climatology, Agricultural Meteorology, and Upper Air Climatology, and includes the Meteorological Office Central Library (see p. 40). Marine Meteorology is the responsibility of the Marine Branch, also located at Harrow.

The Edinburgh office collects and stores climatological records (including rainfall records) made in Scotland, and maintains the library of the old Scottish Meteorological Society. It deals with meteorological questions concerning or arising in Scotland, and acts as the centre for the administration of the climatological stations in Scotland and of such telegraphic and auxiliary reporting stations as are not attached to airfields. The magnetic records of the geophysical observatories at Eskdalemuir and Lerwick are prepared for publication and discussed in the Edinburgh office.

(1) British Climatology

(a) **Organization and functions.**—The British Climatology Branch is charged with the supervision, including periodical inspection, of all voluntary climatological and rainfall stations in Great Britain and Northern Ireland; with collecting, summarizing, and preserving permanent records of surface observations; and with replying to climatological inquiries from the general public, commercial and industrial firms, and Government Departments.

(b) **Stations.**—There are five classes of stations contributing climatological observations, referred to as observatories, synoptic, crop weather, climatological and rainfall stations. Appendix III shows how these stations are distributed among the 15 regions into which Great Britain and Northern Ireland are divided for climatological purposes.

All these stations provide observations at 0900 G.M.T., while the synoptic stations forward climatological returns for at least the main climatological hours 0300, 0900, 1500 and 2100 G.M.T. Some stations provide hourly summaries of wind, rainfall and sunshine, and frequency tables of intense falls of rain.

Crop weather stations are maintained in co-operation with the Ministry of Agriculture and Fisheries. Climatological and rainfall stations are maintained by private observers, or by municipal or other local authorities. Great public

spirit is shown by those who participate in the operation of these stations, often at personal inconvenience because of the necessity for daily readings at fixed times. Some of the climatological stations make additional reports for daily issue to the Press under a Health Resorts Scheme.

Nine additional rainfall stations were established on Exmoor, including one at Dunkery Beacon. Additional rainfall records were provided from selected sites in the Pennines to the west of Sunderland.

The meteorological observations at the Royal Observatory, Greenwich, will terminate with the complete transfer of staff to Hurstmonceux. It was therefore arranged that observations should be commenced at the National Maritime Museum, Greenwich, so that the long record at Greenwich may be continued (see also p. 41). There is a possibility that the site of the station at Oxford (Radcliffe Observatory), dating back to 1815, may not remain available. Observations were therefore arranged on another site in order to secure overlapping records.

(c) **The British Rainfall Organization**, which was taken over by the Air Ministry in 1919, collects all rainfall records and data on the duration and intensity of precipitation, droughts and rain spells, evaporation and percolation.

(d) **Publications.**—*The Monthly Weather Report*, which contains full monthly and annual summaries of observations at synoptic and climatological stations, was issued regularly.

Monthly Frequency Tables of upper winds, clouds and visibility for September to December 1947 were published. The monthly publication of these tables ceased after these numbers.

British Rainfall.—The volume for 1949 was published in January 1951, that for 1950 was sent to the printers, and that for 1951 was in preparation.

The Observatories' Year Book, containing the geophysical records of the observatories, has not been published since the volume for 1937.

(e) **Special work.**—*Climatological Atlas of the British Isles.*—Publication of this work is expected in August 1952. The volume includes 52 pages of text and 56 pages of maps and diagrams.

Hydrology.—The need of industry, agriculture and domestic users for ever-increasing supplies of water justifies a closer study of what happens to precipitation after it reaches the ground. A special section was formed to co-ordinate the available information on hydrology, and to carry out further investigations in collaboration with other interested departments and establishments.

The River Boards Act 1948, Section 9, provided that a River Board shall record rainfall as directed by the Minister of Local Government and Planning. Plans were in preparation which include a statement of the requirement for daily and recording rain-gauges for each of the 32 River Boards in England and Wales.

Committees.—The British Climatology Branch was represented on the following committees :—

- (i) the Hydrological Research Group of the Institution of Water Engineers

(ii) the Wind Power Generation Committee of the British Electrical and Allied Industries Research Association

(iii) the British Rainfall Fund Committee of the Royal Meteorological Society

(iv) a technical panel of the Sub-Committee on Land Drainage of the Central Advisory Water Committee

(v) the Study Committee on Basic Design Temperatures for Space Heating Installations of the Institution of Electrical Engineers.

Inland Water Survey Committee of the Ministry of Local Government and Planning.—The Assistant Director (Climatology) sat on this Committee as an assessor.

(f) Inquiries.—A great many requests were received for climatological information in connexion with law cases, water supply and flooding problems, town planning, etc., and also with the work of agricultural, industrial and research organizations, both within Government Departments and outside. Many of these inquiries involved considerable investigation and the presentation of data in special ways. Among them may be mentioned the assistance given to the Joint Fire Research Organization on the incidence of fires caused by sparks from locomotives, the Department of Scientific and Industrial Research (Road Research Laboratory) on the size of storm-water sewers, the Ministry of Health on the incidence of poliomyelitis, and the Anglo-Iranian Oil Co. on the supply of suitable petrol to various parts of the country at various seasons.

Rainfall data were supplied to Government Departments and to numerous engineering firms in connexion with water supply and hydro-electric schemes. In a number of cases in Civil Courts evidence was provided on aspects of climate or on particular weather records.

Monthly reports on the rainfall of the Thames and Lea Valleys were supplied to the Metropolitan Water Board, Thames Conservancy and Lea Conservancy Boards. Weekly, quarterly and annual summaries of the weather were sent to the Registrar-General for England and Wales, and similar information was supplied each quarter and year to the Government of Northern Ireland. Weekly summaries of the data from crop weather stations were prepared for circulation by the Ministry of Agriculture and Fisheries under the crop weather scheme. Data for Northern Ireland were supplied regularly to the Irish Republic.

In Scotland, inquirers whose needs could be met by routine reports, made monthly or quarterly, included the Registrar-General for Scotland, the Department of Agriculture, the Institute of Seaweed Research, the National Association of Seed-Potato Merchants, the British Electricity Authority, the Gatty Marine Laboratory, the University of Aberdeen, the North of Scotland Hydro-Electric Board, the B.B.C., the Department of Plant Pathology, Sir Alexander Gibb and Partners, River Flow Records, and the *Inverness Courier*. Inquiries on questions of fact came from shipping, insurance and legal firms, county and water engineers, forestry workers, business firms and private individuals. There was an increase in the number of inquiries from research organizations and business concerns which involved discussion.

(2) World Climatology

The Branch dealing with World Climatology is responsible for collecting and summarizing climatological observations from a number of stations overseas, and for preparing reports, memoranda and tables on weather conditions in all parts of the world.

(a) **Overseas stations.**—Stations in operation overseas at the end of 1951 numbered 83, distributed as follows : Europe 6, Africa 38, Asia 20, South America 1, West Indies and other oceanic islands 12. In addition, by courtesy of the Directors of the Meteorological Service of New Zealand and of the British West African Meteorological Service respectively, manuscript returns were received from 10 islands in the Pacific Ocean and from 6 stations in west Africa. Manuscript returns were also received from 6 bases in the Falkland Islands Dependencies for 1950.

From January 1952 meteorological returns from the British West Indies were no longer received, the responsibility for this area being taken over by the Director of the British Caribbean Meteorological Service.

The collection of meteorological summaries from colonial territories was continued. Further progress was made in the preparation of the "Notes" for the years 1939 to 1947. Copies of meteorological summaries for 1950 were received from 10 colonies and arrears were received as follows : Gold Coast 1939 to 1949, Grenada 1939 to 1943, and Bahamas 1945 to 1949.

(b) **Réseau Mondial.**—No progress was made with the volumes for 1933–39. No data were received during the year.

(c) **Naval Handbooks.**—Work was continued on Volumes I and II of "Weather in the Mediterranean". Besides the preparation of the frequency tables of wind, visibility, and cloud, studies were made of the frequency of fronts, depressions, anticyclones and the different air masses affecting the area. Monthly maps were drawn showing the distribution of temperature in the upper air at five levels up to 40,000 ft.

It is expected that the manuscripts of both handbooks will be completed by the end of 1952.

(d) **Admiralty Pilots.**—Five Pilots were revised during the year.

(e) **Falkland Islands Dependencies.**—Substantial progress was made in the work of summarizing and preparing for publication the climatological data from the bases of the Falkland Islands Dependencies for the years 1944 to 1950.

(f) **Special work.**—Progress was made in the preparation of the final charts showing the distribution of vapour pressure over the world for January, April, July and October.

Data from the monthly CLIMAT broadcasts organized by the World Meteorological Organization were tabulated month by month ; monthly charts were plotted of the mean pressure, mean temperature and total rainfall, with their departures from normal, over a large part of the northern hemisphere.

(g) **Inquiries.**—This section deals with many requests for information about the climate of all parts of the world, some involving minor investigations. The inquiries came from Government Departments, commercial firms, research

workers and the general public ; about half the total came from industry especially engineering firms dealing with ventilation and heating equipment, and exporting firms. The main subjects of interest were again temperature and humidity ; about 1,000 tables of these elements were issued.

(3) Marine Meteorology

(a) **Organization and collection of observations.**—*Voluntary ships.*—The Marine Branch has Port Meteorological Officers in London, Liverpool, Southampton, Cardiff and Glasgow, and Agents in the Forth, Tyne and Humber areas. It is the duty of these officers to visit the masters of merchant ships and interest them in keeping meteorological records. These officers also issue meteorological instruments to certain classes of ships and test them as opportunity offers. During the year some 3,750 visits were made to ships.

The Voluntary Observing Fleet consists of the following classes of observing ships:—

(i) “ Selected ” ships, which make meteorological observations at standard synoptic hours. Meteorological instruments, instructions and log-books are supplied to these ships. The observations are transmitted by wireless in the international code to various meteorological services for all oceans. Approximately 500 ships co-operate in this manner.

(ii) Supplementary ships, which make observations in an abbreviated form at the main synoptic hours. These ships are supplied with a mercury barometer, thermometers and screen; these instruments are sufficient for reporting in the abbreviated code. The number of supplementary ships is about 50.

(iii) About 80 coastal vessels (MARID ships) which make, and transmit by wireless, observations of sea temperature in home waters for the benefit of the forecast service.

(iv) Ten light-vessels, which have been “ recruited ” to provide observations of wind, visibility, air and sea temperature twice daily, at 0600 and 1500 G.M.T. These observations are transmitted to shore radio stations by radio-telephony and thence by telegram to the Central Forecasting Office, Dunstable. Six of these light-vessels make and report observations of waves.

In addition to sending in radio weather messages all these ships also keep log-books of their observations which are forwarded to the Marine Branch for climatological analysis. On the average, some 75 log-books were received each month. Meteorological log-books kept aboard Australian and Canadian observing ships were also received by the Marine Branch.

Four captains of “ selected ” ships were presented with barographs by the Director for their long and excellent voluntary service to the Meteorological Office.

Arrangements were made for “ selected ” British whalers to co-operate with the Anglo-Scandinavian Expedition to the Antarctic by providing synoptic reports at the standard hours. Reports were sent by W/T via South Africa, where they were also found very useful.

Ocean weather ships.—During the year each of the 4 British ocean weather ships completed 4 years' service as a weather ship. Station J, in position 52° 30' N., 20° 00' W., was manned on 354 days of the year by either a British or a Netherlands weather ship; the station was vacated on 4 days owing to a ship returning to Londonderry for repairs to her radar and on 8 days due to fuel shortage and repairs to boilers. Station I in position 59° 00' N., 19° 00' W. was manned by a British weather ship on 346 days, but, although technically "on station", the ship was moved to position 61° 21' N., 13° 30' W. for special operations on 63 days. Of the 20 days when the station was vacated, 4 were through returning to Londonderry to land a sick man, 1 was through shortage of fuel occasioned by heavy weather, and 15 were due to the late sailing of the relief ship occasioned by the necessity to make further repairs.

As explained on p. 6 the weather ships carried out a full programme of meteorological work, including surface and upper air observations, which were transmitted to the Central Forecasting Office by W/T. Search and rescue exercises were carried out at frequent intervals in co-operation with aircraft of Coastal Command, with the aim of keeping the ships' companies conversant with search and rescue organization and drill. During these exercises mail, newspapers and urgently required spare parts for the radio were dropped by the aircraft. *Weather Explorer* was alerted on March 23, 1951, and from March 24-28 various areas were searched on request of Shannon for a missing United States Globemaster aircraft. On the 29th the ship returned to Station J having covered 1,027 miles on search duties.

The weather ships' navigational aids are regularly used by both civil and Royal Air Force aircraft flying over the North Atlantic Ocean; 3,603 aircraft made use of the facilities provided by the ships during the year. Radio contact was made frequently with ocean weather ships of other nations.

Practical tests of two types of immersion suit were carried out under various weather conditions. One was considered suitable for air/sea rescue purposes, and each ship is to be provided with three of these suits.

Successful tests were carried out with a marked dan buoy for measuring wave heights; each ship will in future use this apparatus.

Special observations were made with a balanced-bridge psychrometer to obtain the vertical gradient of temperature and humidity under various wind conditions.

Oceanographical work was carried out for the Ministry of Agriculture and Fisheries and the Scottish Home Department, Fisheries Division. This included towing of plankton recorders, taking plankton samples, taking samples of sea-surface water and jettisoning of drift bottles.

The ocean weather ships generally experienced unusually severe gales and bad weather whilst on station in the North Atlantic during the year.

Log-books and upper air data were received regularly from ocean weather ships at Stations I and J. Microfilmed weather data (surface and upper air) were received from all the Atlantic and Pacific ocean weather stations.

(b) Analysis of observations.—Routine work during the year included:—

(i) Observations from log-books received from voluntary observing ships of Great Britain, Australia and Canada, and from British ocean weather ships and from Naval log-books were punched on Hollerith cards. The total number of observations punched was 251,000.

(ii) Duplication of data from the North Atlantic by the Netherlands Meteorological Service continued. Three batches of cards were shipped, comprising 1,664,000 cards.

(iii) Tabulations of all observations in the southern hemisphere made by British observing ships, totalling 49,873 observations, were supplied to the Massachusetts Institute of Technology for a special project. The United States Weather Bureau stated that these observations form the largest and most extensive collection of ocean data received for this project.

(iv) Duplicates of the 3½ million Hollerith cards held by the Marine Branch were made by R.A.F. Milton for despatch to the United States Weather Bureau on repayment.

(c) Currents and ice.—The computation of data for the preparation of surface current charts of the North Pacific Ocean, eastward of long. 160° W. was continued.

Work on the atlas of surface currents of the South Pacific Ocean, westward of long. 160° W. was approaching completion.

Assistance was given to Mr. J. M. Wordie of Cambridge in preparing an international ice nomenclature for the World Meteorological Organization.

Progress was made with the investigation of the meteorological conditions preceding the occurrence of ice on the north-west coast of Iceland.

(d) Admiralty Pilots.—The sections relating to currents were entirely rewritten for new editions of five Admiralty Pilots, and generalized current charts prepared. Sections relating to ice in seven Pilots were also rewritten. The revision of the meteorological sections of Pilots required during the year was co-ordinated with the World Climatology Branch and meteorological charts prepared for these publications.

(e) Special work.—There was close co-operation between the Marine Branch and the National Institute of Oceanography about various marine meteorological problems.

Papers were produced on the following subjects:—

- (i) Waterspouts
- (ii) Seasonal variation of the axes of low-latitude pressure and divergence patterns over the oceans
- (iii) Seasonal variation of mean pressure distribution over the world and some inferences about the general circulation
- (iv) Development of modern techniques in marine meteorology
- (v) Adaptation of mechanical tabulating and sorting machines to research in marine meteorology
- (vi) Comparison of bucket and intake methods for measuring sea-surface temperature
- (vii) Meteorology in relation to the carriage of goods by sea.

Work proceeded on investigations into the relationship between surface wind and pressure gradient over the oceans, deviation between the directions of the wind at 50 and 2,000 ft. over the oceans, the distribution of relative humidity at sea, and various other subjects.

(f) Inquiries.—Much information, including statistical tables and charts of marine data, was prepared for other Government Departments, the Naval Weather Service and various commercial firms. Many of these inquiries were concerned with legal cases or investigations into shipping casualties.

(4) Agricultural Meteorology

The Agricultural Branch is responsible for the application of meteorological knowledge and facilities to agricultural problems, and also for research into fundamental questions of climate in relation to agriculture and horticulture.

(a) Liaison with other organizations.—As in previous years the main channel of the work of the Branch was through the officials of the National Agricultural Advisory Service of the Ministry of Agriculture. All the experimental farms of the Ministry were visited at least once during the year, and help was given in the selection of sites for meteorological stations both for standard and special observations. The Branch was also consulted on the design of shelterbelts for farms and on problems relating to the conduct of field trials and experiments.

Weekly weather summaries were issued for official circulation, and many special summaries of climatological data were supplied for special needs or investigations.

Research Institutes were visited and subjects of mutual interest discussed with research workers in many fields. There was an especially large increase in work done in conjunction with the Universities of London (Wye College), Aberystwyth, Reading, Nottingham (Sutton Bonnington) and Oxford. Many field experiments and investigations are being carried out by these authorities and the advice of the Branch was much in demand.

The Office was represented on the Conference for the Prevention of Frost Damage in Orchards, and a paper on the frost frequency in East Anglia and the Vale of Evesham was presented to the Conference in the autumn. A summary of the ecological and physical effects of wind-breaks and shelterbelts was also presented to the Natural Resources (Technical) Committee.

Lectures were given at the British Mycological Society's Conference, at the British Sugar Beet Corporation Conference, and also to students at Wye College, Kent Farm Institute, and Aberystwyth University.

A meteorological display was arranged in conjunction with the Department of Agriculture for Scotland and the North of Scotland College at the Royal Highland and Agricultural Show at Aberdeen. Display material was also lent for the Royal Cornwall Show.

(b) Special work.—Considerable progress was made in four main directions. In respect of irrigation and the water needs of crops, figures were calculated for all areas of Great Britain, and these together with details of rainfall variations provided the basis for the revision of the Ministry of Agriculture's bulletin on irrigation and for the writing of a technical bulletin on irrigation needs.

Much knowledge of the effect of shelter on plants, animals and buildings was summarized, and applied to current problems and research in co-operation with bodies such as the Royal Forestry Society and the Nature Conservancy.

Work on frost included detailed analysis of frost frequency and its relation to topography, soil types and average minimum temperature. Special experiments on the frost liability of certain areas were carried out and assistance given to experiments on methods of frost protection.

Climate under glass was the subject of several experiments at Cheshunt, Botley and Chichester, and more were planned at Swanley and Sutton Bonnington; much information was obtained of importance in glass-house practice.

Other experiments concerned the temperature inside sugar beet clamps, and the use of "dry-ice" to protect flowers and fruit during transit to markets.

Papers concerning the incidence of dry spells over the whole of southern and eastern England were written; other investigations included the humidity variations on a hillside, the relation between screen and soil-surface maximum temperature, and the wind flow behind an obstacle.

The potato-blight warning system operating in co-operation with the Plant Pathology Laboratory and the synoptic reporting stations was continued in 1951. See also p. 9.

(c) **Inquiries.**—In answering the increased number of inquiries attempts were again made to provide the inquirer with the most appropriate information and to assist in the interpretation of the data. A wide variety of subjects was dealt with, and included animal feeding and behaviour, growth of rye grass, depth of freezing of soils, water needs of crops, mushroom growth, soil erosion by wind or water, diseases in cereals and cocoa plantations, siting of windmills, pest extermination, damage by salt spray, drainage, watercress beds, grain drying, diseases of apples, and hop storage.

(5) Upper Air Climatology

A separate Branch to deal with upper air climatology was formed in May 1951. Up to that time the work had been carried out by a section of the Overseas Climatology Branch, but its increasing importance both for aviation and research necessitated making it a Branch. An additional Principal Scientific Officer for research was posted to the Branch in January 1952.

(a) **Collection and publication of observations.**—Monthly returns of daily observations by radio-sonde and radar were received from 25 stations. Of the five aircraft flights in operation on April 1, 1951, that at Gibraltar ceased on April 6, and that at Negombo on November 30. The Office controls 8 radio-sonde stations in the British Isles, 7 in the Mediterranean and Middle East, 2 on ocean weather ships in the Atlantic and one in the Falkland Islands. The control of 2 of the 4 stations in the British Zone of Germany was handed over to the German Meteorological Service between April and June, but arrangements were made for the continuance of the monthly returns. Returns were received from Valentia, Nairobi and Hongkong through the courtesy of the Directors of the Irish Republic Meteorological Service, the British East African Meteorological Department and the Royal Observatory Hongkong, respectively. Through the courtesy of the Director of the Meteorological Service of the Netherlands returns in similar form were also received for ocean weather station J during the periods when it was manned by the Dutch. An offer, by the Director of the British West African Service to send returns when observations started at the radio-sonde station at Ikeja, Lagos, was gratefully accepted.

Arrangements were made with the United States Weather Bureau for the exchange of data for ocean weather ships on punched cards instead of on microfilm.

The forms and Hollerith cards for entering the data remained unchanged during the year. The scheme of checking the records before they were punched continued to work well, although it inevitably led to some delay in the receipt of the data. The punching of the Hollerith cards was gradually centralized at Fazakerley, and by July the transfer was complete; an appreciable increase in accuracy resulted. By arrangement with the Central Statistical Branch at Stanmore prints were made from the Hollerith cards for the months January to October 1948 for which no manuscript returns were available in the Branch.

Much time was spent in evolving the most efficient methods of summarizing the data on Hollerith machines, and by the autumn of 1951 sufficient experience had been gained for a specification to be put forward of the type of Hollerith machine most suitable for permanent use. A tabulator, fitted with certain additional devices, was ordered but delivery had not been made by the end of the year. In the mean time by using spare capacity of equipment at the War Office and in the Marine Branch some progress was made in tabulating the arrears of data during the latter part of 1951.

Specimens of the tables to be included in a volume of upper air data summarizing radio-sonde observations of temperature, humidity and height of isobaric surfaces, and radar wind measurements during the years 1946-50 were compiled and approved for publication. The volume will be issued in parts, station by station. In the interest of speed and economy it will be reproduced, experimentally, as manifolded typescript. Part I, containing data for Larkhill, was signed for press in January. The preparation of data in similar form for Lerwick was completed, and some progress was made with the compilations for other stations.

The tabulation and plotting of the data included in the CLIMAT TEMP broadcasts was continued, and by the end of the year the series of monthly charts for the levels 700, 500, 300 and 200 mb. was completed from January 1949, when the broadcasts started, to May 1951.

(b) Special work.—The preparation of world charts of the average upper air temperature of the isobaric surfaces 700, 500, 300, 200, 150 and 100 mb. and of the standard deviations of temperature in the four mid-season months was continued. Provisional charts for April, July and October were prepared and issued to certain airfields at home and overseas for guidance in forecasting for long-distance flights. Manuscript and microfilm data of daily observations or charts of average isopleths were received from the Directors of the Meteorological Services of Canada, Australia, the United States and Norway, and information about the tropopause from India and the Union of South Africa. These formed a very valuable addition to the published data, and led to the redrafting of the charts for April. By the end of the year the compilation of data for the charts for July and October was almost complete.

Some attention was given to the study of the tropopause with a view to marking its position on the charts, but no satisfactory method was found of dealing with double tropopauses. A note on the application of "probability paper" to upper air climatology with special reference to the tropopause was prepared for the Meteorological Research Committee. A paper on seasonal and spatial variations of the tropopause and jet streams in the region from north temperate latitudes to the equator was also prepared.

(c) **Inquiries.**—The number of requests for upper air data received during the year was nearly double that of the previous year. The inquiries were mainly for frequencies, averages or extremes of temperature and wind, particularly in the upper troposphere and stratosphere. Several inquirers were provided with facilities to extract data for research.

§ 4. RESEARCH AND DEVELOPMENT

(1) Co-ordination of Research

(a) **Meteorological Research Committee.**—The programme of research is formulated and reviewed by the Meteorological Research Committee (see p. 3), the constitution and functions of which are described in the Report for August 1945 to March 1947.

As in the three preceding years, the detailed work of the Committee was done largely through three Sub-Committees, each concerned with a particular field of work and each consisting of a selection of members of the main Committee together with outside specialists, and representatives of interested organizations and of the Meteorological Office. The Chairmen of these Sub-Committees were:—

Instruments development	Asst. Prof. P. A. Sheppard
Synoptic and dynamical research	Sir Charles Normand
Physical research	Prof. O. G. Sutton.

Fifteen meetings of Sub-Committees were held during the year to discuss papers describing the results of research, to review progress and make recommendations to the main Committee. In all about ninety papers and reports were dealt with. Approved papers were circulated to other institutions and individual workers, while arrangements were made for the communication of selected papers to a scientific society or journal.

The greater part of the research and investigational work is carried out within establishments of the Meteorological Office. Some increase in the number of staff engaged in research was possible during the year.

Valuable assistance, mainly in instrumental development, was given by the research establishments of the Ministry of Supply, by the National Physical Laboratory, and by the Clarendon Laboratory, Oxford.

The joint Committee, set up in 1949 by the Meteorological Research Committee and the Aeronautical Research Council, to promote the investigation of gusts in relation to aeronautics held three meetings.

(b) **Joint Meteorological Radio Propagation Sub-Committee.**—This Sub-Committee of radio-physicists and meteorologists, under the chairmanship of the Director of the Meteorological Office, was not convened. Work continued on items with which this Sub-Committee is concerned and is mentioned on p. 32.

(c) **Collaboration with the Royal Society.**—The Gassiot Committee of the Royal Society (see p. 3) fosters basic research on the composition and photo-chemistry of the atmosphere and on atmospheric radiation, with special reference

to the stratosphere and upper atmosphere. Research on different aspects of these subjects is in progress at a number of Universities, and is assisted by grants of public funds made to the Royal Society.

Included in this scheme is the development of a method for measuring, from an aircraft, the absorption of solar radiation by gases in the stratosphere. This work, which has necessitated laboratory research into the absorption characteristics of the gases concerned, is being carried out by Dr. Wormell and Dr. Goody of Cambridge University. Some promising results were obtained by the use of specially designed spectrophotometric equipment mounted in a Mosquito aircraft of the Meteorological Research Flight.

A method for obtaining, by free balloon ascents, samples of air from the stratosphere is being developed under the direction of Prof. Simon at Oxford University.

As part of the Gassiot Committee's investigation on ozone, under the direction of Sir Charles Normand, measurements of atmospheric ozone are being made at four of the Meteorological Office upper air stations in the United Kingdom.

(d) Other activities.—The Meteorological Office is represented on the British National Committees for Geodesy and Geophysics and for Scientific Radio, on the Gust Research Committee of the Aeronautical Research Council and the Meteorological Research Committee, on the Atmospheric Pollution Research Committee, on the Road Research Laboratory Joint Committee on Soils of the Department of Scientific and Industrial Research, and on several other scientific committees of Government Departments and other bodies. Contact was maintained with research activities elsewhere within the Commonwealth and other countries.

As in recent years, a number of University students, mainly of physics or mathematics, spent periods of up to eight weeks in the summer vacation at Meteorological Office research centres to obtain insight into, and take some part in, the investigations in progress.

(e) Research programme.—The principal items to which effort was directed are given in summary form below. Most of these items comprise several associated lines of work.

(i) Development of aircraft thermometers and hygrometers, with extension if possible to automatic recording suitable for high-speed (jet) aircraft

(ii) Development of instruments and technique for use on aircraft in exploring the physical processes of turbulence in the atmosphere, in clouds or in clear air

(iii) Development of simpler and more economical methods of measuring upper winds by radar

(iv) Application of radar methods for detecting cloud, precipitation, turbulence and icing regions

(v) Exploration of the physical structure of rain-producing clouds

(vi) Investigation of meteorological factors affecting ice accretion on aircraft

(vii) Formation, persistence and dispersal of radiation fog

(viii) Improvements in accuracy of short-range forecasts

(ix) Extension of weather forecasts to cover three or four days

(x) Investigation of the temperature and water vapour content of the troposphere and lower stratosphere under various conditions and further examination of the processes by which condensation trails are formed

(xi) Investigations of tropopause conditions and the exchange of air between troposphere and stratosphere

(xii) Various problems connected with the operation of high-level high-speed aircraft.

(2) Instrument Development

The Instrument Development Division is situated at Harrow. There is one Branch devoted to general instruments and a second to radio-sonde and aircraft instruments. In addition, the Branch concerned with the provisioning, accounting, testing and calibrating of instruments is controlled by the Assistant Director (Instrument Development); its work is described on p. 38.

(a) General instruments.—Progress on the development and trials of methods of measuring air-to-ground visibility was slow largely because of the low incidence of fogs. A recording visibility meter using photographic film as the light sensitive medium was developed for use in the fog research programmes.

It is known that most cup anemometers over-estimate wind speed in fluctuating winds. Experiments were made to overcome this defect.

Recording instruments for use in polar regions were developed for test under field conditions on Deception Island (Falkland Islands Dependencies).

The first part of a new "Handbook of meteorological instruments" was written. This part deals with general meteorological instruments for surface use.

(b) Aircraft instruments.—Progress was made in the design of aircraft thermometers, and the cause of the variation of the thermometer speed-correction coefficient with height and speed was discovered. Several experimental designs of thermometer were tested; the use of a wind tunnel at the Royal Aircraft Establishment, Farnborough, was obtained to facilitate these tests.

A fully automatic frost-point hygrometer purchased from a firm of instrument makers and subsequently re-built at the Clarendon Laboratory, Oxford, was under trial by the Meteorological Research Flight. Another instrument of the same type but of different design was nearing completion.

(c) Radio-sonde and radar wind instruments.—Development of the radar-sonde theodolite proceeded satisfactorily. A start will shortly be made in equipping an experimental ground station.

The Mk. IIB radio-sonde, which employs a much shorter aerial than the former Mk. II to reduce the risk of damage to overhead electric power lines, was put into production.

Development of a light-weight short-range sonde for temperature measurement was almost completed. The instrument weighs less than $\frac{1}{2}$ lb.

A pulsed-light cloud-base meter was given initial trials. Further development work will be carried out to improve its performance at short ranges to enable low cloud heights to be measured.

(3) Forecasting Research

The Forecasting Research Branches (see Appendix I) are attached to the Central Forecasting Office at Dunstable. The following are the most important activities of the past year:—

(a) Research on short-period forecasting (up to 24 hours ahead).—

(i) Conditions at high levels were further studied especially as affecting the forecasting of winds for high-flying aircraft. Although the observational difficulties naturally increase at high levels, tests showed that forecasting by standard methods is still reasonably good if observations are available. On the other hand tests of prediction by a new statistical technique developed by Mr. C. S. Durst, which is very rapid to apply, showed a similar standard of average success. A careful analysis showed that a wind of relatively high velocity was present near the tropopause every day throughout a trial month in the vicinity of western Europe. The maximum speed and direction of the wind was, however, very variable, and the term "jet stream" was not always appropriate.

(ii) Mathematical research led to a system of equations which might lead to a mathematical forecast and some progress was made in planning to use an electronic calculating machine. The main difficulty remains, however, that the mathematics are only approximate and there is still no evidence that the computer will do as well as the conventional forecaster.

(iii) Research directed to improving the precision of forecasts of rainfall was begun. Fronts were further investigated, and some attention was given to the formation of anticyclones.

(b) Research on long-range forecasting.—With a view to extending the period of time for which useful broadcasts may be given the following investigations were made:—

(i) Experimental forecasts were prepared twice weekly, for four days ahead throughout the year. Such forecasts can be made with a measure of success but not with uniform reliability. It remains to be decided whether the potential value of the forecasts is sufficient to justify the expense of employing extra staff on this work at present.

(ii) Large-scale weather types and changes were studied by means of synoptic charts of the northern hemisphere, both for the earth's surface and the upper atmosphere.

(4) Research in Physical Meteorology

An outline of some of the chief activities is given below.

(i) Problems relating to the formation of radiation fog received increased attention. With the purpose of investigating the factors which chiefly determine whether radiation fog will or will not develop on apparently favourable occasions, a special experimental programme was instituted at Cardington to measure temperature, humidity and wind speed at intervals from the ground up to 2,000 or 3,000 ft. (using a kite balloon), temperature within the ground, and visibility at two levels. Measurements of drop size in fog are also to be undertaken.

A theoretical study of the condensation of moisture on atmospheric nuclei to form liquid drops indicated the importance of the size of the nuclei, and of the rate of cooling of the air, in the development of radiation fog.

Investigations were in progress at selected airfields on the relation between horizontal visibility and visibility from air to ground on occasions of poor visibility. The methods used included observations from aircraft and observations from the ground of rocket flares, balloon-borne lights and intersecting searchlight beams.

(ii) The size distribution of water drops enters into problems of cloud physics. A theoretical examination of the process of coalescence as a factor in determining drop-size distribution led to the conclusion that condensation is much more important than coalescence in clouds with small average drop size, with small liquid water content, or with a large degree of supersaturation.

(iii) A survey of the present state of knowledge relating to the formation of ice on aircraft in flight showed the need for additional quantitative information on the liquid water content in supercooled cloud of different types and on the rate of icing. It is hoped that the rotating disc icing-rate meter, recently brought into use in this country, will provide some of the required information.

(iv) Further work was done on the detailed analysis of meteorological factors and systems on occasions when aircraft encountered turbulence or bumpiness, in clear air at heights above 20,000 ft. The matter is of importance to high-speed aircraft operating at great heights. The latest work confirmed earlier indications that there is an association between the occurrence of turbulence and marked variation in wind speed in the vertical or the horizontal (or both). The distribution of clear-air turbulence in relation to the high-level, high-speed air currents, known as jet streams, seems now fairly clearly indicated, but as yet no general criterion for the onset of turbulence is known.

(v) The Meteorological Research Flight, based at the Royal Aircraft Establishment, Farnborough, and equipped with two Hastings and two Mosquito aircraft, continued to make frequent high-level ascents for the investigation of the temperature and humidity structure of the upper troposphere and lower stratosphere. Detailed explorations of fronts and jet streams were made. Experiments were carried out on the use of smoke trails emitted from aircraft, as a means of examining the nature of clear-air turbulence. Further investigation was made of rapid fluctuations of temperature at various levels in the atmosphere and their relation to other meteorological factors including turbulence. Work on the physics of cloud included three successful experiments on the modification of cloud by "seeding" with solid carbon dioxide, measurements of liquid water content and drop size, and measurements of icing by means of the rotating disc meter.

Extension of the investigational work to greater heights and the flight-testing of specialized meteorological instruments awaits the provision of an aircraft capable of operating at higher levels and greater speeds than the Mosquito aircraft now available.

(vi) Research into the application of radar to meteorological problems, using equipment operating on 10-cm. and 3-cm. wave-lengths, continued at the Meteorological Office station at East Hill. There was further co-operation with aircraft from the Royal Aircraft Establishment, flying under the control of East Hill, for the exploration of the structure of, and vertical currents in, cumulus and cumulonimbus. With the collaboration of the Meteorological Research Flight, trials commenced with the use of "window" (radar reflecting material), released from aircraft, as a marker to enable radar measurements of turbulence within cloud to be made.

A report was completed on an analysis of aircraft observations on the nature and amounts of cloud particles—ice crystals and water drops—in clouds giving rise to radar echoes. The observations were made by aircraft of the Royal Aircraft Establishment and the Meteorological Research Flight in sorties controlled by East Hill in the last few years. A number of useful provisional conclusions were reached on the relative roles of ice crystals and water drops in the production of radar echo above the freezing-point level, but more precise results depend on the availability of improved means of observing and measuring the amounts and sizes of the cloud particles.

(vii) Measurements of air temperature and humidity made at 4 heights between ground level and 350 ft. at Rye during a three-year period were further employed to examine the variation with height of the atmospheric refractive index on occasions of off-shore and on-shore winds. This information is relevant to problems of the propagation of centimetric radio waves. In this same field of inquiry, a preliminary investigation was made of the variation of humidity with height above the sea, using routine, and also specially arranged, observations obtained by British ocean weather ships in the eastern Atlantic.

(viii) The Meteorological Office unit attached to the School of Agriculture, Cambridge University, conducted a series of field experiments to determine the evaporation from a field of oats at successive stages of the growth of the crop. Observationally, the method depends on the accurate measurement of air temperature, humidity and wind speed at approximate heights above the crop. The results obtained indicated that a considerable measure of success can be achieved by this technique, but that certain features of the method require further investigation.

Other investigations of agricultural problems are mentioned on p. 24.

(ix) Further analysis of radio-sonde and radar wind measurements made in the last few years at British meteorological stations in low latitudes has advanced our knowledge of the structure of the upper troposphere and lower stratosphere.

(5) Work of the Observatories and Geophysical Research

(a) Kew Observatory.—The normal observation, recording and tabulation of meteorological elements, and of solar radiation, natural illumination and electrical potential gradient continued unchanged. Seismological records were maintained with the three-component Galitzin installation and a short-period vertical component instrument.

Meteorological observations and records.—Arrangements for the recording of the rate of rainfall were improved.

Night sky, i.e. pole star, records were commenced on January 1, 1952.

To facilitate answers to inquiries, the Observatory's meteorological records were somewhat elaborated. Some of the records date from 1871.

Measurement of solar radiation.—The autographic records of solar intensity at normal incidence, and of total and diffuse radiation received on a horizontal surface, were standardized on all suitable occasions by measurements with the Ångström pyrheliometer. The instrument for recording the natural illumination incident on a horizontal opal glass surface, and the similar instrument exposed on the roof of Victory House in central London, were standardized photometrically each month. The first five-year period of continuous records of solar radiation and illumination was recently completed, and the analysis of the records begun.

Laboratory and field investigation of a bimetallic radiation recorder resulted in marked improvement in the sensitivity and performance of the instrument.

Lengthy comparisons of "substandard" Ångström and Silver Disc pyrheliometers were concluded. The results were in close accord with measurements made at the National Physical Laboratory before 1939.

Seismology.—The Galitzin seismographs were standardized. The *Monthly Seismological Bulletin* issued during the year contains the analysis of 383 earthquakes recorded at Kew, the epicentres of 84 being determined.

Special investigations.—An intricate investigation, mentioned in the last Report, of the short-period fluctuations of wind and temperature at 25 cm. above a short grass surface was continued. Certain unexpected features were revealed necessitating further examination.

Other items.—The number of inquiries received again increased; they included requests for temperature and humidity data in connexion with industrial air conditioning and cooling problems, and for advice on radiation problems associated with agriculture and horticulture.

Visiting scientists from other countries were particularly numerous immediately before and after the General Assembly of the International Union of Geodesy and Geophysics at Brussels in August 1951.

(b) Meteorological Office, Edinburgh.—In conformity with the arrangements of the International Association of Terrestrial Magnetism and Electricity, three-hourly magnetic range-indices (*K*) for Eskdalemuir and Lerwick, together with modified *K* values to be used in evaluating a planetary index of magnetic disturbance, were forwarded monthly to De Bilt. Particulars of geomagnetic "sudden commencements" and geomagnetic solar flare effects were similarly forwarded. The *K* indices are published in the *Journal of Atmospheric and Terrestrial Physics*.

Investigations in solar-terrestrial relationships continued. Connexions between ionospheric and geomagnetic phenomena were discussed with the Cavendish Laboratory, Cambridge and the Directorate of Scientific and Industrial Research, Radio Research Station, Slough.

(c) **Eskdalemuir Observatory.**—The standard procedure of observing, recording and reducing meteorological, magnetic and atmospheric electrical elements remained unchanged.

During a large part of the period comparative observations of horizontal magnetic force were made using Q.H.M. magnetometers Nos. 119 and 120 and the observatory Schuster-Smith coil magnetometer. Comparison was also made between vertical force determined by B.M.Z.35 magnetometer and the corresponding value determined from observations with the Schuster-Smith horizontal force instrument and the Schulze dip inductor.

Hourly values of magnetic declination were contributed weekly to mining journals, and copies of magnetic records were supplied on request. Notifications of magnetic disturbance exceeding prescribed limits were sent to the National Physical Laboratory.

An officer of the Ceylon Meteorological Service received training in magnetic work.

(d) **Lerwick Observatory.**—Hourly meteorological reports were sent to the Central Forecasting Office by teleprinter. Autographic meteorological records and the normal observational and recording work in terrestrial magnetism and atmospheric electricity were maintained. Eye observations of aurora were made when cloud permitted.

An unfortunate accident in a gale delayed the commencement of records of total and diffuse radiation received on a horizontal surface.

Early in the period observations of horizontal and vertical magnetic force with the Observatory standard instruments were compared with observations made with Q.H.M. magnetometer No. 119 and B.M.Z.35 magnetometer respectively.

Radio-sonde and radar wind ascents were made at six-hourly intervals, except that from February 1 radio-sonde ascents were made only for 0300 and 1500 G.M.T. in accordance with the revised national programme. A number of special high-level soundings were made, one reaching 104,000 ft.

(6) Special Investigations

The effect of wind and temperature on the operation of jet aircraft, particularly when flying at high altitudes, led to much discussion. A note on a possible technique for estimating winds in tropical regions was supplied for a meeting of the Committee of Air Navigation and Ground Organization of Southern Africa Air Transport Council held at Salisbury, Rhodesia, in June 1951.

The charts of normal winds up to 40,000 ft. over a considerable portion of the globe were revised, so that the best information should be available to navigators; and provisional normal charts of temperature were also circulated to those who needed them. The statistics of take-off conditions in regard to temperature and wind were supplied for a number of airfields. Statistical advice was given not only to Comet aircraft for their proving flights but also to Canberra aircraft flying to Australia and America.

In conjunction with the Ministry of Fuel and Power experiments were made on the association between falling atmospheric pressure and the efflux of fire damp in coal-mines. It was demonstrated that in mines of a certain type it is

possible to predict an increase of fire damp by the prognosis of pressure changes. This was consistently done in actual practice in the case of the Point of Ayr Colliery, Flintshire.

§ 5. ORGANIZATION

(1) Structure

(a) Headquarters.—The administrative headquarters of the Meteorological Office is situated in Victory House, Kingsway, London, W.C.2. Here are accommodated the Director, Principal Deputy Director, Deputy Director (Services), Deputy Director (Research) and some of the Assistant Directors and Heads of Branches, with their staffs.

The Headquarters structure is shown in Appendix I, and a list of the Directorate and Heads of Branches in Appendix II.

During the year a new Branch (M.O.23) was formed to deal solely with Upper Air Climatology (see p. 25).

(b) Branch Meteorological Office, Edinburgh.—No important change in organization was made during the year, but the establishment was increased by one Scientific Officer.

(2) Staff

(a) Complements.—Recruitment of civilian staff for established officer grades continued, through the competitions conducted by the Civil Service Commissioners. As a result 52 officers accepted established appointments during the year, of whom 35 were candidates already in the Meteorological Office. In addition, 32 temporary appointments were made. Many of the newly appointed officers were still in training at the end of the year, and the officer strength continued below that needed to meet all requirements.

(b) Strength of staff.—The strength of staff on March 31, 1952, is shown in the table below.

For the purpose of comparison, the strength a year ago is also given.

	March 31, 1951	March 31, 1952
Scientific Officer Class	160	165
Experimental Officer Class	613	643
Nautical Officers	8	8
Assistant Class	1,470*	1,433*
Radio (Meteorological) Mechanics ..	49	46
Locally entered Staff (overseas) ..	203	192
Clerical and Typing Staff	70	74
Miscellaneous	28	28
Total	2,601	2,589

* Excluding non-effective meteorological airmen undergoing service training.

The pay and "trade structure" of Radio (Meteorological) Mechanics were considerably improved during the year. Nevertheless, recruitment lagged behind requirements.

The high rate of resignation among assistants continued to cause serious loss of efficiency, which results partly from the constant changes of staff involved and partly from the high proportion always under training.

The detailed figures are:—

Number of airman-meteorologists not accepting re-appointment as civilian assistants on completion of national service	57
Resignations and other losses of assistants	245
Total losses	302
Number of assistants recruited during the year	225
Temporary assistants granted established appointments during the year	117
Number of assistants still under training at March 31, 1952	85

The number of airmen-meteorologists not accepting re-instatement represents 32 per cent. of those completing national service during the year, compared with 35 per cent. in the preceding year.

(c) Uniformed personnel.—The number of airmen serving in the trade of Meteorologist on engagements under National Service Acts, was 274 on March 31, 1952. They were held against the civilian establishment of assistants.

Class “H” reservists.—A National Service airman is deemed to be enlisted in Class “H” of the Reserve following his release from whole-time service unless he volunteers and is accepted for part-time service in an Auxiliary or Volunteer Reserve.

During the year 159 airmen-meteorologists were placed in Class “H” reserve; 72 of these found employment outside the Meteorological Office, and will be called on for 15 days continuous training in each of the second and subsequent years of their service as “H” reservists; those employed in the Meteorological Office are not liable for annual technical training.

Royal Air Force Volunteer Reserve (Meteorological Section).—The strength of this Reserve on March 31, 1952, was 89 officers and 43 airmen and airwomen, a gain of 17 officers and 5 airmen and airwomen over the strength a year before. At the end of the year 75 officers and 42 airmen and airwomen were considered capable of filling posts appropriate to their rank in an emergency.

Valuable assistance was given by this Reserve during their annual training in filling posts vacated through leave or other absence of Meteorological Office staff. Seven officers and 6 airmen/women participated in the major air exercises of the year. Sixteen officers were given a formal course in advanced forecasting at the Meteorological Office Training School (see p. 37).

One airman obtained the necessary academic qualifications and was granted a commission. Three airwomen were transferred to other branches of the Reserve on being granted commissions.

Squadron-Leader J. L. Galloway was appointed Chief Meteorological Officer, Royal Air Force Reserve, and placed in charge of the technical training of meteorologists in both volunteer and class “H” branches of the R.A.F. Reserve.

Air Meteorological Observers.—In last year’s Report reference was made to a change in the policy for recruiting Air Meteorological Observers. Six civilian

assistants were seconded to the Royal Air Force in January, on regular engagements of two and a half years' duration, in the aircrew category in question. They will replace the National Service airmen as they become due for release.

(d) Training of staff.—The Meteorological Office has its own Training School, which also attends to the concessions by which staff are encouraged to pursue their studies in subjects related to their work.

The Training School moved during the year from Kingsway to Stanmore, Middlesex. Details of the various training courses given by the school are shown below.

An important addition to the courses for Scientific Officers and Forecasters was introduced during the past year. This takes the form of lectures on briefing technique, which are given by Officers from the R.A.F. Flying College, Manby. The lectures cover the special requirements of the pilot and the navigator, and describe in detail the manner in which each wants meteorological information presented to him.

Courses for Scientific Officers.—The normal course lasts for four months. During the year one course was held for 10 Scientific Officers. In addition special courses were arranged for one Senior Scientific Officer, one Scientific Officer and one Officer appointed to the Meteorological Service of Northern Rhodesia.

Initial courses for Forecasters.—For new entrants these courses last for 12 or 15 weeks according to the previous experience of the trainees. Five courses have been held for a total of 42 officers, of whom 31 were formerly Scientific Assistants in the Meteorological Office.

Advanced course for Forecasters.—All Assistant Experimental Officers must take this course before they can qualify for promotion to Experimental Officer in a forecasting post. The course lasts for six weeks, and is concerned mainly with the application of upper air data to forecasting. Four courses have been held, and 24 officers trained.

Initial course for Assistants.—An eight-week course of training is given to new assistants. Nineteen courses were held during the year and 223 assistants attended.

Courses for Voluntary Observers.—One course attended by 20 observers was held in November 1951. The course lasted 4 days and was arranged in collaboration with the Climatology Division.

Training of Dominion, Colonial and foreign personnel.—The Meteorological Office was asked by a number of governments to provide courses in forecasting for personnel recruited to their meteorological services. During the year the following officers were trained:—

Officers for Colonial Meteorological Services	..	4
Falkland Islands Dependencies Survey	2
Ceylon Meteorological Service	2
Iraq Meteorological Service	1
Sudan Meteorological Service	1
Burma Meteorological Service	2
Jersey Meteorological Service	1

Courses for Royal Air Force Volunteer Reserve Officers.—During the past year special problems arose in connexion with the training of Officers of the Meteorological Branch of the Reserve. Many of them had been forecasters during the war, and this experience, together with that obtained in post-war Reserve service, had qualified them to receive training for higher duties. Short courses on the lines of the Advanced Forecasting Courses already referred to were therefore arranged and were given during the period of 15 days' continuous training for which Reserve Officers are liable. Two such courses were held in the summer of 1951 and 16 officers attended.

External training.—Staff of the Office are encouraged to take external studies in order to obtain qualifications above the basic minimum required for entrance to their particular class. Facilities granted to those whose course of study is approved include the payment of fees and time off with pay to attend classes and for examinations. During the past year one Experimental Officer passed the B.A. (Special) examination in Mathematics with 2nd Class Honours and 10 members of the staff were successful in the Intermediate B.Sc. examination.

(e) **Technical Discussions.**—Meetings for the discussion of recently published meteorological papers or of research work in progress in the Office were held once a month from October 1951 to March 1952.

These meetings are attended by members of the staff, and, on invitation, by staff of other Government Departments or University research workers interested in the subject under discussion.

The subjects discussed and the openers were :—

October 8, 1951	Evaporation as a factor in hydrology	Mr. A. Bleasdale
November 12, 1951	Winds in the stratosphere over Great Britain	Mr. T. H. Kirk
December 10, 1951	Blocking action in the middle troposphere and its effect upon regional climate ..	Mr. F. E. Lumb
January 14, 1952	Forecasting winds at 30,000 to 40,000 ft. and above ..	Mr. C. S. Durst and Mr. R. Murray
February 11, 1952	Measurement of free air temperature from aircraft ..	Mr. D. R. Grant
March 14, 1952	Visibility—its diurnal and seasonal variation and its dependence upon atmospheric pollution as determined by wind speed and direction	Mr. L. Sugden and Mr. H. L. Wright

At the first three meetings recently published papers were discussed and at the remaining three research work in progress in the Office was considered.

(3) Supply of Instruments

(a) **Provision and production of equipment.**—During the year 1,343 orders and contracts were placed. The total expenditure was £213,561. During the same period £45,847 was received by the sale of equipment and for services rendered, e.g. testing and inspecting instruments.

(b) Issue of equipment.—Regular supplies of instruments and stores were made to maintain meteorological offices at home and overseas. Advice was given to inquirers on the best sources of equipment.

A new edition of the “Vocabulary of meteorological equipment” was prepared ; this included separate parts covering general meteorological instruments, radio-sonde and radar wind equipment and a priced supplement.

Demands for stores numbered 13,644 as compared with 10,814 last year. Included in these demands were some from Commonwealth, Colonial and foreign Governments and from co-operating observers who are allowed to buy their instruments from official stocks. Equipment was lent to other Government Departments and public authorities for particular investigations. The number of loans made during the year was 73.

The following issues are worthy of mention :—

Radar wind equipment to South Africa and the Sudan

Equipment to Birmingham University for an expedition to west Spitsbergen

Equipment to Durham University for an expedition to Breida Merkujokull, Iceland

Equipment to British Schools' Exploration Society for an expedition to the Hoffajokull Glacier, Iceland

Instruments for the Festival-of-Britain Exhibit

Equipment to R.R.S. *Discovery II* for a Festival Antarctic exhibition

A balloon psychrometer to Prof. Pollock, Dublin, for use in cosmic-ray investigations

Psychrometers to the British Sugar Corporation for investigation of heating-up in beet clumps

Instruments to West Deeping, Peterborough, for investigations into potato blight.

(c) Testing and calibrating.—*General instruments and aircraft instruments.*—The total number of instruments tested, excluding balloons, was 95,856. The number of balloons of all sizes received and submitted to a 5 per cent. check was 283,659.

A pamphlet on the “Regulations for testing and inspecting meteorological instruments” was approved and issued.

The fees charged for examining equipment for outside authorities and manufacturers amounted to £1,006.

Radio-sondes.—The total number of calibrated radio-sonde transmitters received from the makers was 12,782. In addition 4,265 recovered after flight were overhauled and re-calibrated in the Office for future use. Large numbers of radio-sondes were also tested for general efficiency. Towards the end of the year samples of a new radio-sonde with a quarter-wave aerial were tested before the commencement of manufacture in bulk. The new calibration plant referred to in last year's Report was built, but has not yet been installed for general use. It was used, however, for experimental work in redetermining the temperature correction of the barometer element of the Mk. II radio-sonde over a range of + 130° to - 130° F., a range never previously covered.

(d) Maintenance of radar wind equipment.—Inspections of the radar wind equipment at stations in the United Kingdom were not made as often as is desirable, owing to lack of staff. Radar wind equipment for South Africa, Khartoum and Ceylon was overhauled prior to shipment. Training courses for new recruits to the grade of Meteorological Mechanic were undertaken.

Among the special work carried out by this section may be mentioned :—

- (i) Design and production of twelve prototype radio-sonde oscilloscopes
- (ii) Modification of radar range-scale treblers to eliminate the use of thyratrons, the performance of which is variable
- (iii) Introduction of a modification to the monitor to facilitate retuning the equipment during a flight, and affording continuous display
- (iv) Replacement of high-speed magstrip dials to eliminate errors in dividing
- (v) Introduction of a visual method of aligning intermediate frequency receivers in the radar wind equipment.

(4) Library and Publications

The Meteorological Office Library is at Harrow.

(a) Library.—*Exchange of publications.*—The exchange of publications with other national meteorological services and independent institutions continued. The number of such exchange agreements now totals 305.

Publications are issued gratis, by “ special sanction ” to 13 institutions.

Accessions.—The total number of publications taken into the Library during the year, exclusive of *Daily Weather Reports*, was 8,293. This number included 328 photographic copies of papers appearing in periodicals not received in the Library. These figures show how great the volume of meteorological literature has become in the post-war period, and how widely it is scattered among publications on applied science. Published papers of direct meteorological interest catalogued in the Library during the year numbered 5,010. This may be contrasted with the average of 2,300 papers that appeared annually during the later nineteen thirties.

Microfilms of marine meteorological and upper air data were catalogued and used extensively. In addition the Library acquired 36 microfilms of publications and papers that were either out of print or not available.

218 lantern slides, 426 photographs and 2 films were added to the Library's collection of visual aids.

Financial arrangements for purchase of non-periodical publications.—The Meteorological Office Library now receives a vote, which is independent of the Air Ministry Library vote, to allow for the purchase of publications required by the Meteorological Office Library or by the technical libraries at Victory House and Dunstable. This procedure was introduced in April 1951 and has proved satisfactory. A similar vote was approved for the year 1952-53.

Repair of war-time omissions.—An excellent start was made on the arrears of binding that had accrued since 1938, and 1,056 volumes were bound.

Two of the three crates of German meteorological records were copied by the Air Ministry Photographic Reproductions Branch, and the originals were returned to Germany. Work continued on the copying of the remainder.

Co-operation with other British libraries.—Sixty-one copies of the Library's *Monthly Bibliography of Meteorological Literature* of accessions are now distributed to other libraries and institutions, in addition to those distributed to Meteorological Office staff.

Co-operation was maintained with the Science Library, the National Central Library and the libraries of the Royal Geographical Society and the Royal Meteorological Society. To the last named much assistance was given with the classification of papers appearing in the *Quarterly Journal of the Royal Meteorological Society* and with other library matters. The National Central Library was also given assistance in connexion with its German Union Catalogue.

The Astronomer Royal kindly offered to the Meteorological Office Library the publications of purely meteorological interest that were held by the library of the Royal Greenwich Observatory, and the offer was gratefully accepted.

Inter-library loans continued to be very numerous. The following table shows the number of publications borrowed from other libraries :—

	No. of publications
Science Museum	339
Ministry of Supply	158
Other Government Departments	154
National Central Library	78
Libraries of Universities and Colleges	16
Scientific Societies and Research Institutes	77

The Library continued as a corporate member of the Association of Special Libraries and Information Bureaux. It provided the Association with particulars of new meteorological, climatological, and other geophysical publications, appearing in English, for inclusion in *ASLIB book-list*.

Loans.—The number of publications issued on loan reached 10,076. The arrangement was continued by which the library spontaneously sends newly received papers to staff known to be especially interested in the subject. Specialist workers thus see the papers as soon as possible, and before the publication of the *Monthly Bibliography of Meteorological Literature* creates a general demand.

Lantern slides and photographs were lent to the staff of the Office and hired to the public as required for illustrating lectures ; 492 lantern slides were issued on loan to staff and 132 hired to the public. Films were issued on loan on 64 occasions and 13 film strips were lent.

Bibliographies.—The *Monthly Bibliography of Meteorological Literature* continued to be issued in its expanded form. Annotations or short abstracts were included wherever the title was considered inadequate or where the importance of the paper merited further attention.

Selected bibliographies were provided on request and included bibliographies on : surface winds over the world ; climate of Antarctica ; climate of China ; isentropic analysis ; methods in micrometeorology ; ground and water minimum temperature ; cold pools ; standing waves in relation to gliding.

Inquiries.—A large number of inquiries continued to be received from other Government Departments and from members of the public as well as from the staff of the Office. The following are examples of the great variety of subjects : weather forecasting appliances of the nineteenth century ; variation of wind with height ; relationship between sun-spots and rainfall ; ultra-violet radiation in different latitudes ; intensity of solar radiation in connexion with its direct utilization ; shape of snow cover and its effect on vegetation ; isotach analysis ; scattering of light in connexion with aircraft cockpit illumination ; electronic apparatus and forecasting ; tactical use of weather in war ; gustiness in free air ; long-range forecasting ; radiative properties of clouds ; the European “ monsoon ”.

Much use was made of the Library by the meteorological staff of the United States Air Force in Great Britain.

(b) Publications.—*Geophysical Memoirs, Professional Notes, Meteorological Reports.*—A list of papers published under these general titles is given in Appendix VI. One *Geophysical Memoirs* and one *Professional Notes* are in the press.

Meteorological Magazine.—The *Meteorological Magazine* was published regularly throughout the year. The price had, unfortunately, to be raised from 1s. 6d. to 2s. from the January 1952 number because of increased cost of paper and printing.

The articles published covered a wide field, including upper air climatology, the numerical forecasting of the pressure field, meteorology in relation to building, and the effects on aircraft of turbulence at great heights and of “ lee waves ” caused by mountains. Reports on the first Congress of the World Meteorological Organization and on the contribution of the Meteorological Office to the Festival of Britain also appeared.

Marine publications.—Publication of the *Marine Observer* was continued with the four quarterly numbers for April, July and October 1951 and January 1952.

An amendment list to the seventh edition of the “ Marine observer’s handbook ” was published, and a revised reprint of the book sent for press.

The second edition of the “ Marine observer’s guide ” was published.

The editing of a new publication “ Meteorology for mariners ” was in hand.

Work on a new atlas “ Quarterly surface current charts of the western South Pacific Ocean ” was held up for a time but later was approaching completion.

The preparation of a revised edition of the atlas “ Monthly meteorological charts of the Greenland and Barents Seas ” was started.

A summary of meteorological conditions and currents at the ocean weather stations “ I ” and “ J ” up to March 31, 1950, was issued.

Other publications.—The Naval handbook “ Weather in the Indian Ocean, Vol. II, Part I, Red Sea ” was published and “ Meteorology for aviators ” reprinted.

Publications in the press include the “ Observer’s handbook ”, “ Climatological atlas of the British Isles ”, “ Handbook of statistical methods in meteorology ” by C. E. P. Brooks and N. Carruthers, and “ A century of London weather ” by W. A. L. Marshall.

§ 6. INTERNATIONAL CO-OPERATION

(1) World Meteorological Organization

The Director of the Meteorological Office is a member of the Executive Committee of the World Meteorological Organization and was President of the first Congress of the Organization held in the early part of the year.

The Marine Superintendent of the Meteorological Office is President of the Commission for Maritime Meteorology.

A representative of the Office was chairman of the final meeting of the Eastern Caribbean Hurricane Sub-Commission.

The Office was also represented at a meeting at Lausanne to discuss technical assistance to Libya, and at a Conference on Maritime Meteorology at Genoa in September 1951 (500th anniversary celebrations of the birth of Columbus).

(2) International Civil Aviation Organization

Representatives of the Meteorological Office attended the following meetings :—

Second South American South Atlantic Regional Air Navigation meeting, Buenos Aires, November 1951

Third Europe-Mediterranean Regional Air Navigation meeting, Paris, February 1952.

The Meteorological Office was consulted on the meteorological aspects of the United Kingdom briefs for the following meetings :—

Communications Division Fourth Meeting, Montreal, 1951

Aeronautical Information Division, Montreal, Autumn 1952.

Arrangements were made under the International Civil Aviation Organization Technical Assistance Programme for a representative of the Meteorological Office to visit Jordan to advise the Government on the meteorological organization required to meet the needs of civil aviation.

(3) Commonwealth Meetings

Briefs on meteorological aspects of the agenda were prepared for delegates attending the South African Committee for Air Navigation and Ground Organization and its Meteorological Sub-Committee, and for the South Pacific Air Transport Council meetings. In addition, as mentioned on p. 12, the Office was represented at the Commonwealth meeting on the operation of the gas turbine aircraft.

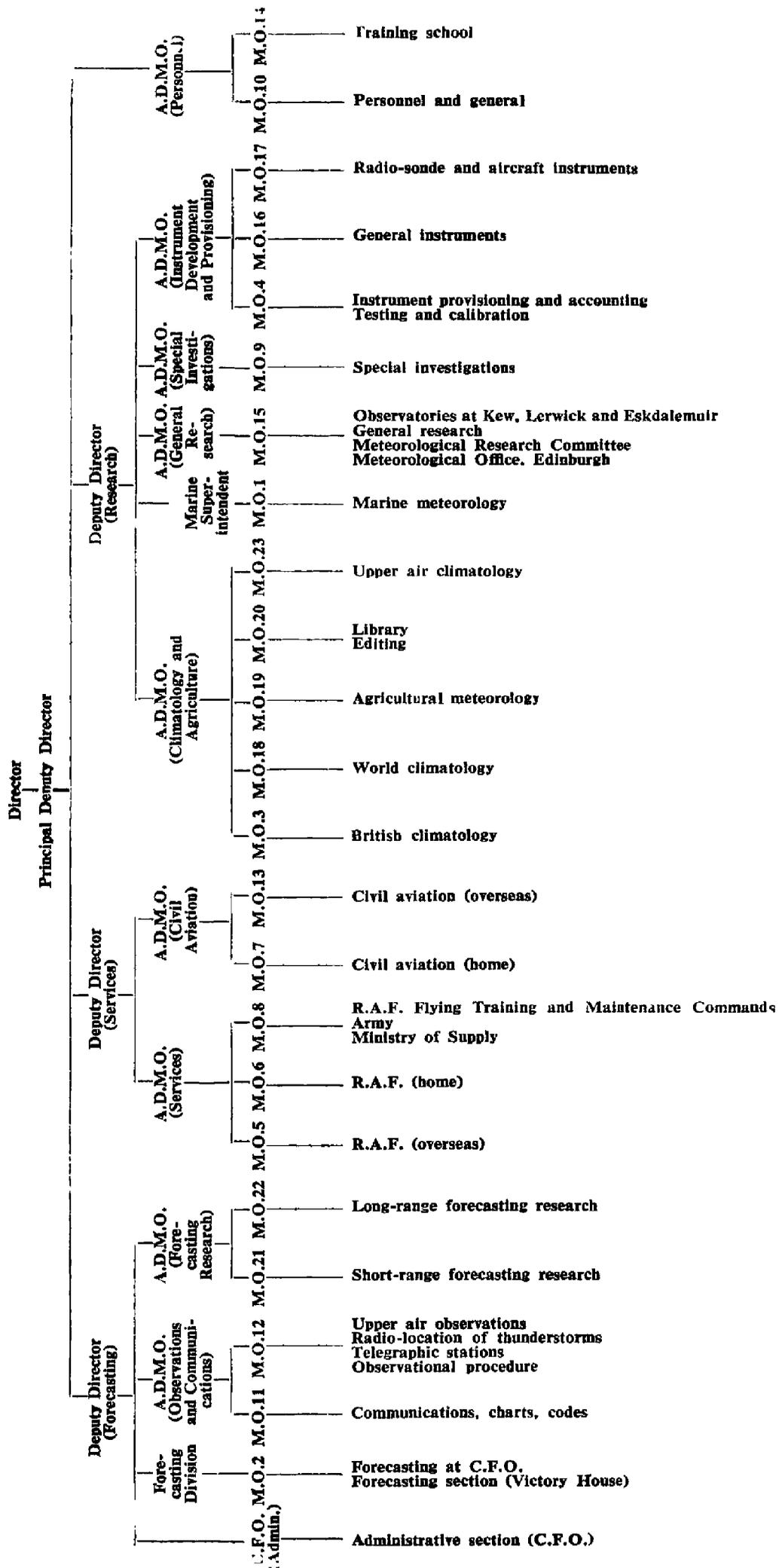
(4) International Union of Geodesy and Geophysics

The Ninth General Assembly of the Union was held in Brussels from August 21 to September 1, 1951. Representatives of the Office took part in the activities of the Associations of Meteorology and of Terrestrial Magnetism and Electricity and to a less extent those of the Association of Hydrology and of Seismology. Prof. S. Chapman, member of the Meteorological Research Committee, was elected President of the Union for the period 1951-54, and Dr. J. M. Stagg completed his term of office as General Secretary.

The compilation of the *International Seismological Summary* under the auspices of the International Association of Seismology continued in accommodation provided at Kew Observatory.

APPENDIX I

ORGANIZATION OF THE METEOROLOGICAL OFFICE



APPENDIX II

DIRECTORATE OF THE METEOROLOGICAL OFFICE AND HEADS OF BRANCHES

DIRECTOR

Sir Nelson Johnson, K.C.B., D.Sc., A.R.C.S.

PRINCIPAL DEPUTY DIRECTOR

J. M. Stagg, O.B.E., M.A., D.Sc.

<p>DEPUTY DIRECTOR (RESEARCH)</p> <p><i>Assistant Director (General Research)</i> General Research and Observatories Branch (M.O.15)</p> <p><i>Assistant Director (Special Investiga- tions)</i></p> <p>Special Investigations Branch (M.O.9)</p> <p><i>Assistant Director (Instrument Develop- ment and Provisioning)</i></p> <p>General Instruments Branch (M.O.16)</p> <p>Radio-sonde and Aircraft Instru- ments Branch (M.O.17)</p> <p>Instrument Provisioning Branch (M.O.4)</p> <p><i>Assistant Director (Climatology and Agriculture)</i></p> <p>British Climatology Branch (M.O.3)</p> <p>World Climatology Branch (M.O.18)</p> <p>Agricultural Meteorology Branch (M.O.19)</p> <p>Library and Editing (M.O.20)</p> <p>Upper Air Climatology Branch (M.O.23)</p> <p>Marine Superintendent (M.O.1) ..</p>	<p>A. H. R. Goldie, C.B.E., M.A., D.Sc., F.R.S.E. H. W. L. Absalom, B.Sc., A.R.C.S., D.I.C.</p> <p>A. C. Best, M.Sc.</p> <p>C. S. Durst, O.B.E., B.A. L. Dods, B.Sc.</p> <p>F. J. Scrase, O.B.E., M.A., Sc.D., F.Inst. P. R. Frith, M.A., Ph.D.</p> <p>D. N. Harrison, D.Phil.</p> <p>P. N. Skelton, M.B.E.</p> <p>R. H. Mathews, O.B.E., B.A. J. Glasspoole, M.Sc., Ph.D. J. Pepper, Ph.D.</p> <p>L. P. Smith, B.A. G. A. Bull, B.Sc.</p> <p>Miss E. E. Austin, M.A. C. E. N. Frankcom, O.B.E., Cmdr., R.N.R. (Retd.)</p>
<p>DEPUTY DIRECTOR (FORECASTING)</p> <p><i>Forecasting Division</i> (M.O.2)</p> <p><i>Assistant Director (Observations and Communications)</i></p> <p>Communications; Charts and Codes Branch (M.O.11)</p> <p>Upper Air Observations (M.O.12) ...</p> <p><i>Assistant Director (Forecasting Research)</i></p> <p>Short-Range Forecasting Research Branch (M.O.21)</p> <p>Long-Range Forecasting Research Branch (M.O.22)</p>	<p>E. G. Bilham, B.Sc., A.R.C.S., D.I.C. C. K. M. Douglas, O.B.E., B.A., J. S. Farquharson, M.A., D.Sc., S. P. Peters, B.Sc.</p> <p>C. V. Ockenden, B.Sc.</p> <p style="text-align: center;">—</p> <p>A. L. Maidens, B.Sc.</p> <p>R. C. Sutcliffe, O.B.E., B.Sc., Ph.D.</p> <p>J. S. Sawyer, M.A.</p> <p>A. G. Forsdyke, B.Sc., Ph.D., A.R.C.S., D.I.C.</p>
<p>DEPUTY DIRECTOR (SERVICES)</p> <p><i>Assistant Director (Services)</i></p> <p>R.A.F. (Overseas) Branch (M.O.5)</p> <p>R.A.F. (Home) Branch (M.O.6) ..</p> <p>Flying Training, Army and Ministry of Supply Branch (M.O.8) ..</p> <p><i>Assistant Director (Civil Aviation)</i> ...</p> <p>Civil Aviation (Home) Branch (M.O.7)</p> <p>Civil Aviation (Overseas) Branch (M.O.13)</p> <p><i>Assistant Director (Personnel)</i></p> <p>Personnel and General Branch (M.O.10)</p> <p>Training Branch (M.O.14)</p>	<p>J. Durward, M.A. R. P. Batty, O.B.E., B.A. S. T. A. Mirrlees, M.A., B.Sc. T. W. V. Jones, B.Sc.</p> <p>H. L. Wright, M.A. W. H. Bigg, O.B.E., B.Sc.</p> <p>N. H. Smith, B.Sc.</p> <p>J. C. Cumming, M.A. M. T. Spence, O.B.E., B.Sc.</p> <p>B. C. V. Oddie, B.Sc.</p> <p style="text-align: center;">—</p>

APPENDIX III

CLASSIFICATION OF BRITISH STATIONS WHICH REPORT TO THE BRITISH CLIMATOLOGY BRANCH

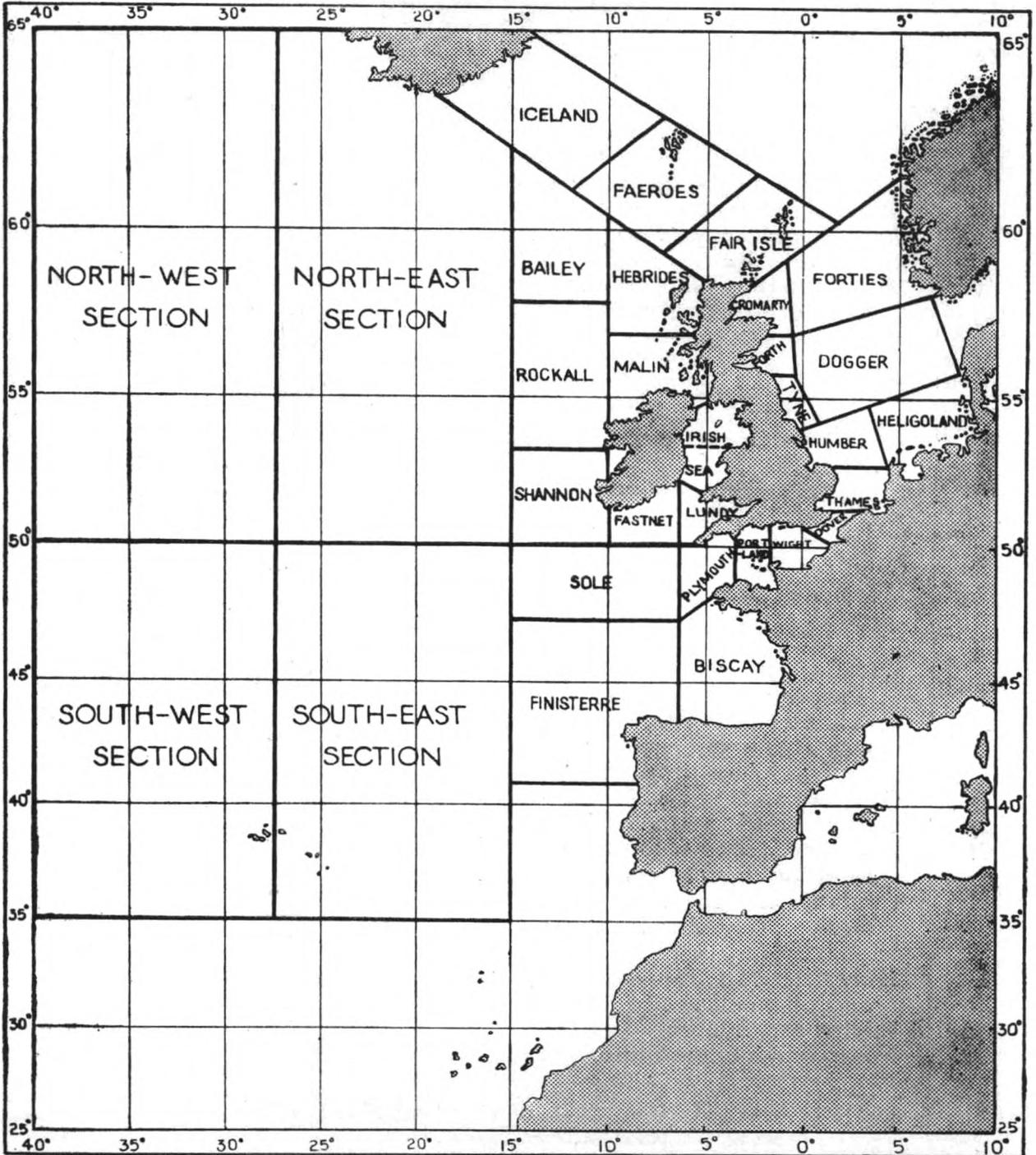
	Stations					Autographic records		
	Observatories	Synoptic	Crop weather	Climatological	Rainfall	Sunshine	Rainfall	Wind
Scotland, N.	1	8	0	9	152	12	9	2
Scotland, E.	0	7	3	34	352	35	15	3
Scotland, W.	1	5	2	24	388	20	12	6
England, N.E.	0	10	3	20	307	22	11	5
England, E.	0	7	12	20	484	29	26	7
England, Midlands	0	12	12	38	1,037	47	40	2
England, S.E.	1	14	8	51	749	55	51	14
London District	0	2	0	12	43	7	4	2
England, S.W.	0	9	5	26	499	32	11	6
England, N.W.	0	6	2	21	443	24	26	7
Wales, N.	0	1	1	12	196	9	6	2
Wales, S.	0	2	4	16	279	19	8	4
Isle of Man	0	2	0	2	10	4	1	1
Scilly and Channel Isles	0	1	0	2	17	3	0	1
Northern Ireland	0	2	0	7	87	4	4	1
Total	3	88	52	294	5,043*	322	224	63

* Includes stations in earlier columns.

APPENDIX IV

CHART SHOWING THE AREAS USED IN GALE WARNINGS AND WEATHER BULLETINS FOR SHIPPING

effective from November 1, 1948



APPENDIX V

PROVISION IN AIR ESTIMATES FOR METEOROLOGICAL SERVICES

The approximate cash provision in Air Estimates, 1952-53, for meteorological services is as follows :—

Item	Service	Provision	Vote
		£	
1	<i>Staff</i>		
1a	Salaries, wages, etc. of staff at headquarters of the Meteorological Office	209,000	3
1b	Salaries, wages, etc. of civilians at meteorological observatories and outstation offices and in ocean weather ships	1,393,000	4
1c	Pay, etc. of airmen employed as air meteorological observers and meteorologists and of air force personnel of the meteorological research flight ..	50,500	1
1d	National insurance contributions	2,800	1
1e	Pay, etc. of meteorological personnel of the Royal Air Force Reserve	7,000	2
1f	Superannuation allowance and gratuities	11,500	10
1g	Conveyance of personnel; travelling allowances and expenses	69,000	5
2	<i>Equipment and Supplies</i>		
2a	Meteorological equipment	550,000	7
2b	Radio, radar and electrical equipment for meteorological services	30,000	7
2c	Conveyance of equipment for meteorological services	16,500	5
2d	Mechanical transport vehicles for meteorological services	56,000	7
2e	Solid fuel, electricity, gas, water and sanitary services for meteorological observatories and outstation offices	3,200	6
2f	Liquid fuel, lubricants, etc. for aircraft of the meteorological research flight and for vehicles required for meteorological services	18,500	6
2g	Liquid fuel for ocean weather ships	20,000	6
2h	Other equipment and services for aircraft of the meteorological research flight	40,000	7
2i	Other equipment and services for ocean weather ships	40,000	7
2j	General stores for meteorological services	1,300	7
2k	Food and ration allowances for air force personnel; food for crews of ocean weather ships	29,500	6
2l	Clothing, clothing allowance and laundry services for airmen; clothing for crews of ocean weather ships	9,200	7
3	<i>Works services for meteorological observatories and outstation offices</i>		
3a	Capital expenditure	38,000	8
3b	Maintenance expenditure	18,000	8
4	<i>Telecommunication services for meteorological purposes</i>	50,000	9
5	<i>Flights by civil aircraft for meteorological purposes ..</i>	5,000	9
6	<i>Contribution to the World Meteorological Organization</i>	7,000	9
7	<i>Fees for special services relating to meteorological research</i>	3,000	9

Item	Service	Provision	Vote
		£	
8	<i>Grant to the Royal Society in aid of meteorological research</i>	5,000	9
9	<i>Other miscellaneous effective services</i>	7,500	9
	GROSS TOTAL	£2,690,500	
10	<i>Deduct-Appropriations in aid</i>		
		£	
10a	Repayment in respect of meteorological staff employed on special services, etc.		
	Salary, wages, etc. ..	266,000	4
	Movement expenses ..	15,000	5
	Contributions towards non-effective benefits ..	4,000	10
		285,000	
10b	Receipts relating to meteorological equipment	80,000	7
10c	Payments by airmen for issues of clothing and footwear	1,500	7
10d	Receipts for miscellaneous meteorological services	7,000	9
		373,500	
	NET TOTAL	£2,317,000	

APPENDIX VI

PUBLICATIONS

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

The following official publications were issued or signed for press during the period of this report :—

Periodical

Daily Aerological Record, containing information respecting meteorological conditions in the upper air over the British Isles (to March 31, 1952).

Daily Weather Report, containing weather maps for the northern hemisphere, British Isles, etc. and data (to March 31, 1952).

Daily Weather Report Overseas Supplement, containing surface and upper air data (to January 1952).

Meteorological Magazine (to March 1952).

Monthly Weather Report, with a summary for the year (to January 1952).

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 1947).

Seismological Bulletin. A diary of seismological disturbances recorded on the Galitzin aperiodic seismographs at Kew Observatory, Richmond (to February 1952).

Marine Observer (quarterly) (to January 1952).

British Rainfall 1949. A report on the distribution of rain in space and time over Great Britain and Northern Ireland as recorded by about 5,000 observers.

Annual Report and results of meteorological observations 1948. Southport Auxiliary Observatory. By George A. Lidster.

Occasional

Observer's handbook. Instructions in the exposure of meteorological instruments and in the making of weather observations both instrumental and non-instrumental at all types of stations. 1952.

Weather in the Indian Ocean to latitude 30° S. and longitude 95° E. including the Red Sea and Persian Gulf. Volume II. Local Information. Part I. Red Sea. 1951.

Geophysical Memoirs :—

Vol. XI :—

87. Characteristics of air masses over the British Isles. By J. E. Belasco, Ph.D.

Meteorological Reports :—

Vol. II :—

9. Ice accretion on aircraft.

10. Memorandum on the intertropical front. Compiled by J. S. Sawyer, M.A.

Professional Notes :—

Vol. III :—

103. Stratus cloud near the east coast of Great Britain. By G. A. Bull, B.Sc.

104. Meteorological aspects of turbulence affecting aircraft at high altitude. By J. K. Bannon, B.A.

105. Diurnal variation of pressure in the Mediterranean area. By H. Jameson, D.Sc.

The following books or papers by members of the staff were published during the year.

E. G. BILHAM, B.Sc., D.I.C.:—

First Congress of the World Meteorological Organization. *Met. Mag., London*, **80**, 1951, p. 153.

H. W. L. ABSALOM, B.Sc., D.I.C.:—

General assembly of the International Union of Geodesy and Geophysics, Brussels, 1951. *Met. Mag., London*, **80**, 1951, p. 326.

C. K. M. DOUGLAS, B.A.:—

The evolution of 20th century forecasting in the British Isles. *Quart. J. R. met. Soc., London*, **78**, 1952, p. 1.

Forecasting for the D-Day landings. *Mar. Obs., London*, **22**, 1952, p. 16.

J. S. FARQUHARSON, D.Sc.:—

Well done, selected ship! *Mar. Obs., London*, **22**, 1952, p. 39.

F. J. SCRASE, Sc.D., F.Inst.P.:—

Radio-sonde and radar wind measurements in the stratosphere over the British Isles. *Quart. J. R. met. Soc., London*, **77**, 1951, p. 483.

R. C. SUTCLIFFE, Ph.D.:—

Mean upper contour patterns of the northern hemisphere—the thermal-synoptic view-point. *Quart. J. R. met. Soc., London*, **77**, 1951, p. 435.

The quasi-geostrophic advective wave in a baroclinic zonal current. *Quart. J. R. met. Soc., London*, **77**, 1951, p. 226.

R. C. SUTCLIFFE, Ph.D., E. J. SUMNER, B.A. and F. H. BUSHBY, B.Sc.:—

Dynamical methods in synoptic meteorology. *Quart. J. R. met. Soc., London*, **77**, 1951, p. 457.

J. K. BANNON, B.A.:—

Severe turbulence encountered by aircraft near jet streams. *Met. Mag., London*, **80**, 1951, p. 262.

J. E. BELASCO, Ph.D.:—

Freezing days in Great Britain. *Met. Mag., London*, **80**, 1951, p. 213.

E. J. BELL:—

Radio communication applied to meteorology. *Mar. Obs., London*, **21**, 1951, p. 180.

A. C. BEST, M.Sc.:—

Drop-size distribution in cloud and fog. *Quart. J. R. met. Soc., London*, **77**, 1951, p. 418.

Effect of turbulence and condensation on drop-size distribution in cloud. *Quart. J. R. met. Soc., London*, **78**, 1952, p. 28.

The size of cloud-droplets in layer-type clouds. *Quart. J. R. met. Soc., London*, **77**, 1951, p. 241.

F. H. BUSHBY, B.Sc.:—

Forecasting methods based on barotropic wave theory. *Met. Mag., London*, **81**, 1952, p. 1.

Relaxation methods and their application to meteorological problems. *Met. Mag., London*, **80**, 1951, p. 71.

N. CARRUTHERS, B.Sc. and R. GRAY:—

Upper air over the Falkland Islands. *Met. Mag., London*, **80**, 1951, p. 125.

- L. S. CLARKSON, M.Sc. :—
 Evidence for a stratospheric circulation in vertical meridional planes between polar and equatorial regions in winter. *Met. Mag., London*, **80**, 1951, p. 309.
- J. M. CRADDOCK, M.A. :—
 An apparatus for measuring dewfall. *Weather, London*, **6**, 1951, p. 300.
 The warming of arctic air masses over the eastern North Atlantic. *Quart. J. R. met. Soc., London*, **77**, 1951, p. 355.
- A. F. CROSSLEY, M.A. :—
 Meteorological examinations for civil pilots and navigators. *Met. Mag., London*, **80**, 1951, p. 318.
- D. DEWAR, B.Sc. :—
 Abrupt seasonal changes in tropopause level and stratosphere temperature at Habbaniya. *Met. Mag., London*, **80**, 1951, p. 323.
 Extreme upper air temperatures over the British Isles. *Met. Mag., London*, **80**, 1951, p. 200.
 First year of upper air observations by ocean weather ships. *Met. Mag., London*, **80**, 1951, p. 245.
- R. H. ELDRIDGE, B.Sc. :—
 Katabatic wind at Driffield. *Met. Mag., London*, **80**, 1951, p. 288.
- A. G. FORSDYKE, Ph.D., D.I.C. :—
 Zonal and other indices. *Met. Mag., London*, **80**, 1951, p. 156.
- C. E. N. FRANKCOM, R.N.R. :—
 Maritime meteorology in the Dome of Discovery at the Festival of Britain Exhibition. *Mar. Obs., London*, **21**, 1951, p. 202.
- R. FRITH, Ph.D. :—
 Recent work of the meteorological research flight of the Meteorological Office. *Quart. J. R. met. Soc., London*, **77**, 1951, p. 478.
 The size of cloud particles in stratocumulus cloud. *Quart. J. R. met. Soc., London*, **77**, 1951, p. 441.
- A. H. GORDON, M.S. (Pasadena) :—
 Development of modern technique in marine meteorology. *Met. Mag., London*, **80**, 1951, p. 78.
 Seasonal variation of the axes of low-latitude pressure and divergence patterns over the ocean. *Quart. J. R. met. Soc., London*, **77**, 1951, p. 302.
 Waterspouts. Part II. *Mar. Obs., London*, **21**, 1951, p. 87.
- G. E. W. HARTLEY, M.A. :—
 Wind recording instruments for use near the site of the proposed suspension bridge over the Severn. *Met. Mag., London*, **80**, 1951, p. 284.
- J. HENNESSY :—
 Obituary notice of Capt. L. A. Brooke-Smith. *Mar. Obs., London*, **21**, 1951, p. 132.
- G. W. HURST, B.Sc., D.I.C. :—
 High-level cloud photographs. *Met. Mag., London*, **80**, 1951, p. 89.
- H. JAMESON, D.Sc. :—
 Recent British marine meteorological and surface current atlases. *Mar. Obs., London*, **21**, 1951, p. 115.

- T. H. KIRK, B.Sc. :—
A systematic smoothing technique useful in the construction of marine climatological charts. *Met. Mag., London*, **80**, 1951, p. 46.
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