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WORLD METEOROLOGICAL ORGANIZATION

Ninth Session of the Executive Committee

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The Ninth Session of the Executive Committee of W.M.O. took place at the Palais des Nations, Geneva, from September 24 to October 14, 1957. With the exception of Dr. Solotoutkhine (U.S.S.R), for whom Dr. M. A. Ivanov deputized, all members were present for most of the meetings. In addition, Professor J. van Mieghem, Monsieur A. Perlat, Mr. H. Thomson and Mr. R. G. Veryard attended some of the meetings in their capacities as Presidents of Technical Commissions.

The agenda was heavy, and already Third Congress, to be held in 1959, is casting long shadows. The Executive Committee had before it the herculean task of examining the entire internal staff rules of the Organization, and the approval of the recommendations of CAe, CIMO, CMM and CCl, as well as many procedural items relating to Congress. In accordance with custom, the work was divided between the two Standing Committees, on Programme under Dr. M. A. F. Barnett (New Zealand) and on Administration and Finance, under Professor H. A. Ferreira (Portugal). By eschewing most delights and living laborious days and nights the work was accomplished in time, the budgetary statement being completed only in the early hours of the morning of the final day.

There were many items of interest, which can be studied fully only when the Abridged Report is published, but one or two are sufficiently important to be singled out here. Perhaps the most significant of these is that relating to hydrology. The Executive Committee decided to support strongly the proposal of its Panel on Water Resources Development that W.M.O. should assume responsibilities in hydrology similar to its present responsibilities in meteorology. This implies the preparation of Technical Regulations, Guides and Yearbooks in hydrology, and the development of international standards for observations and networks, arrangements for exchange of data and the preparation of codes. Such a resolution cannot be implemented without changes in the W.M.O. Convention, which require the assent of Congress. The Secretary-General has been instructed to address a circular letter to all the Member countries of W.M.O., asking for comments on the resolution of the Executive Committee. If the replies indicate a substantial measure of support for the change, the

Executive Committee will have the task of drawing up draft amendments to the Convention at its next Session (April–May, 1958).

Another important resolution reflects the coming of jet aircraft into civil aviation on a wide scale. Already, I.C.A.O. has set up a Jet Operations Requirements Panel, which has produced a provisional list of requirements in meteorology. Many of these are very exacting, and in view of the importance and urgency of the problem the Executive Committee decided to establish a Panel of Experts to examine the implications for meteorology of future requirements for the routine commercial operation of jet aircraft and the extent to which existing techniques and facilities will allow these to be met. In addition, the Panel is asked to define any short-term developments in techniques and facilities that may be required, and to report to the Executive Committee at its next Session.

Among other matters, the Executive Committee considered the problems arising in the collection of data for the I.G.Y. and decided that the Geneva Centre must continue to operate on a self-financing basis, and that the other two centres (at Washington and Moscow) should be asked to pay for any microcards they may require. The Committee also examined the present position of the plans for the erection of a permanent building for W.M.O. in Geneva, and decided, in view of threatened delays, to ask the President and the Secretary-General to pursue the matter with vigilance.

Each Congress lays down a programme for the next four years, and decides upon a limit of expenditure. It is the duty of the Executive Committee to supervise the carrying out of the programme and to see that the maximum permissible expenditure is not exceeded. The general rise in costs throughout the world since 1955 has made this task impossible, and it was decided to ask Members to approve a supplementary estimate for the remainder of the present financial period.

It is clear that the volume of international work in meteorology is increasing rapidly, and as a consequence, the burden on the national services is becoming very heavy. Meteorologists must now rival diplomats in the number of journeys abroad they have to make, and it is remarkable that so much of the work of the Organization still continues to be on a “voluntary” basis. The spirit which led to the institution, over a century ago, of international co-operation in meteorology is still very much alive.

TELEVISION FORECASTING BY THE BRITISH BROADCASTING CORPORATION

By J. S. FARQUHARSON, M.A., D.Sc.

Many millions of people in this country have by now seen the television forecaster on their screens. They can probably be divided into two almost equal classes. One class likes Mr. A, and the other class dislikes him, Mr. A being any one of the forecasters who do this work. In fact, however, the scope for the development of personality is restricted, not only because of the shortness of the period of the broadcast, but also because an exact routine has to be observed when it is made. Whereas the usual television personality goes on the air after a considerable period of rehearsal, the television weatherman just steps in front of the

camera as part of his day's work, with no rehearsal. His day begins about 12 noon in the London Forecasting Office when one of his first tasks is to study the typescript of the recording of the previous evening's broadcast, and to compare the forecast then made with the weather that actually occurred. In the event of there being any important divergencies he prepares a short explanation. The 0600 G.M.T. chart is copied on the special card made for the B.B.C. and if the weather is behaving in any way abnormally, past weather records may have to be studied. Letters from fans, critics and just thirsters after knowledge have to be dealt with. But the main task of the television forecaster is to get his ideas into shape about the weather of the following day and to consider appropriate captions for the (fair copy) forecast chart. The writing of captions can be most difficult as may be realized when it is recalled that one chart is used to depict the entire weather of the period from 8 a.m. to midnight for the whole of the British Isles.

The time of the broadcast being now about 6 p.m., it is not possible for the forecaster to complete the preparations for his task in the London Forecasting Office. This has to be done at the Lime Grove studios. So at 4 p.m., with his "Atlantic" chart and two blank charts of the British Isles under his arm, the forecaster sets off for the studios. One of the charts has to be used for the prebaratic or forecast map, the other for the caption chart. By 4.30 p.m. the senior forecaster at Dunstable has completed the forecast chart and as soon as it is received at the London Forecasting Office, the details of it are telephoned to Lime Grove, together with the general synoptic review which, in effect, indicates the lines along which the thoughts of the senior forecaster are running. After drawing the forecast chart on the blank he has brought with him, the television forecaster considers it in the light of the general synoptic review and rings up the senior forecaster about 5.10 p.m. for a final discussion. By 5.45 p.m. the caption chart is completed and final touches having been given to the forecast map, both are passed into the studio for line-up.

On the air, the forecaster, after greeting his audience, first demonstrates the general situation by reference to what he calls the "Atlantic" chart for 0600 G.M.T. of that day. It shows the main features of the pressure distribution over the Atlantic and Western Europe. Following on from this, the 1200 G.M.T. prebaratic of the following day is slid into view, the synoptic developments on this chart being dealt with as a sequence from the earlier chart. Area forecasts for broad areas of the British Isles are given, the areas depending on the current synoptic situation. A "further outlook" is given and after bidding his audience good night, the forecaster leaves a fair copy of tomorrow's forecast chart on the screen for about 15 seconds, the whole broadcast being timed to last 3 minutes. Later in the evening, at the end of the day's broadcasting, a fair copy chart is again shown while an appropriate script is read by an announcer. This occurs just before a special chart for coastal shipping is televised.

As regards the substance of the broadcast, forecasters are so often victims of the human memory that they almost regard this as an occupational hazard. The memory of the good-old-days type and of the type which insists our weather is changing because we no longer have Dickensian Christmasses are familiar. But the vagaries of the human mind do not end there. There are some who think, for example, that the television weather forecaster on the B.B.C. "starts nearly every night with an apology". This was alleged early in June 1957 and,

in fact, examination of the records of the television broadcasts showed that what might be taken as apologies were made on May 7, 9, 14, 16, 22 and 29. Certainly that is rather a large number. But included among them is the apology: "Eastern and central districts had rather more cloud than I suggested last night . . ." and that is an admission of a relatively minor error. To address an audience of millions and convey the impression it is desired to convey is a tricky business. The forecaster on television sets himself the task of putting his audience in the same position as himself as regards knowledge of current and expected weather. If his task were perfectly performed so that his audience envisaged the probabilities as he does himself there would be no need for apologies. However, nothing is more irritating to the intelligent listener when, and if, a gross forecasting error has been made than for the forecaster blandly to carry on as though no error had been made. It is a concession to the intelligence and interest of the audience that efforts are made from time to time to explain the causes of error. But this must be done very carefully in order to avoid confusing the audience. In assessing the merits of the television forecast it is essential to remember that an absolute time limit of three minutes is imposed on the forecaster. Obviously if too much of this very brief period were given up to explanations the audience tuned in to receive a forecast might well be confused.

The forecasts given on television are for all practical purposes identical with those broadcast by the B.B.C. on sound radio at 5.55 p.m. In principle the television forecasts cover the period from 8 a.m. to midnight tomorrow while the 5.55 p.m. sound broadcasts on the B.B.C. cover the period of 24 hours from 6 p.m. In fact, however, the television forecaster can hardly escape mentioning any important phenomenon, such as frost or fog, which may be expected during the night. It is reasonable then to suggest that any checking or verification of the 5.55 p.m. forecast broadcast by the B.B.C. would be equivalent to checking or verifying the television forecast broadcast in the early evening. For over two years, from November 1954 onwards, two subjective methods were used to obtain a general indication of user reaction. In the first a number of geographically representative schools, scattered throughout the British Isles, was asked to listen daily to the forecasts broadcast by the B.B.C. (sound only) in respect of their area and to assess them either as "mainly right" or "mainly wrong", on the basis of the actual weather subsequently experienced. Over the period from May 1956, inclusive, average figures for all schools show that out of 100 forecasts, 90 were "mainly right".

A parallel scheme of slightly more rigorous kind consisted of having assessments made on the same forecasts by meteorological offices distributed over the British Isles so that at least one was in each B.B.C. region. In other words, on each B.B.C. regional forecast broadcast at 5.55 p.m. there was at least one report by Meteorological Office staff in the appropriate region. The forecasts were checked under four headings: (i) wind, (ii) weather, (iii) state of sky and (iv) temperature, and certain criteria were agreed where checking was not merely a matter of comparing an actual with a forecast reading. The forecast of each element was assessed as good, indifferent, or bad with marks 2, 1, and 0 respectively. A good forecast of all four elements would thus earn the maximum mark of 8. For the fourteen months from November 1955 to December 1956 the average score was 6.1 or 76 per cent, the lowest being 5.7 or 71 per cent in September 1956 and the highest 6.4 or 80 per cent in November 1956.

Neither of these systems of checking is objective, but they have some value as an indication of the impression made on the mind of a careful listener by comparing actual and forecast weather. They show that there is no foundation for sweeping statements about the poverty of the forecasting service. Indeed they indicate that the careful listener may well derive valuable assistance from them. This confirms the general impression made by such correspondence as is received in the Meteorological Office about forecasts and forecasting. To people who make use of the forecasts real help is given. The number of such users may be relatively small but that does not invalidate the fact. A clue may be given to this number by some information picked up about B.B.C. viewers. Out of every hundred in the audience probably 40 never take any interest in the television forecast. Of the remaining 60 half don't pay much attention to the forecast while the remaining 30 per cent of the total potential audience constitute the body of opinion on which an appropriate policy could be based. But of these thirty very few have sufficient interest or drive to comment when comment appears to be called for. The result of this is to cause exaggerated importance to be given to individual letters which may be received. Such exaggeration is justified by the facts so far as we know them and is not merely owing to the reason that comment is usually favourable.

The difficulty of applying a yardstick to forecasting so as to measure its success is one that has never been overcome, except for specialized forecasts specially designed for the purpose of being checked. A comparable difficulty exists in assessing the impact on the audience of the forecast as presented by the forecaster on television. An audience research questionnaire may be sent to ascertain views from a cross-section of the audience but the mere receipt of a request for an opinion is probably sufficient of a goad to jolt the particular individual into thinking of the programme in a novel way. Now this is not what is required—but rather the ordinary reactions of an ordinary audience writing or reporting under the ordinary stimulus, namely the initiative with which they were born. In my opinion the invited intrusion of the television forecaster into millions of homes has brought about a number of things which are all good for meteorology. To the relatively few keen meteorologists it has seemed to provide an esoteric discourse which they alone could fully appreciate and use, and to the interested amateur it has provided a stimulus. And for the professional in his seclusion at the Central Forecasting Office it has advertised that he can be a good mixer and indeed is quite glad to mix. Aloofness is not a choice but an accident, in his case.

Various suggestions have been made for improving the presentation of the television weather forecasting programme. One writer asks if it would be too expensive to have a permanent television link between Central Forecasting Office and the studios. The answer to this is emphatically affirmative. It has also been said that the charts used are merely simplified versions of the synoptic chart, showing abstractions but not a direct representation of the weather. Obviously the writer in this case is not familiar with the limited resolving power of the television camera, and the method of writing captions on a map is at the best a makeshift. "Gimmicks" such as stipple-rollers and prepared arrow-heads to be used in the illustration of points made have been tried and abandoned in favour of the simple straightforward presentation. The bulk of interested viewers, after all, want to know simply what tomorrow's weather is going to be in their area. If we can answer that question clearly against a

background for the specialist then probably this is about the most we could hope to achieve in the limited time made available to the forecaster. It is perhaps a measure of the success of the method that it is copied in the only weather programme under the Independent Television Authority where personal presentation of the forecast is made.

Summing up then, it can be said that the personal presentation of the forecast by a forecaster on B.B.C. television has established a valuable link between producer and interested user of forecasts. At its lowest valuation it has taught many people that such a science as meteorology exists and that its practitioners are very worthy people.

RECENT SEASONAL TRENDS IN THE NUMBER OF RAIN-DAYS OVER GREAT BRITAIN

By J. GLASSPOOLE, I.S.O., Ph.D.

In an earlier note¹ details were given of seasonal trends of temperature, sunshine and rainfall using 10-year moving averages and this note gives similar diagrams for rain-days (days on which precipitation reaches or exceeds 0.01 in. or 0.2 mm.). Monthly and annual values of the number of rain-days for England and Wales, and for Scotland, have been published in the annual volumes of *British Rainfall*. These values are available since 1919. They are based on the means for 48 stations over England and Wales and 27 stations over Scotland, a selection of 100 stations being made to cover the British Isles. The stations are selected to give a good representation over the country, and have only been replaced as they terminated or failed to give complete returns. The object of this note is to define recent trends in the number of rain-days, and also to ascertain whether there has been any marked change in the amount of rain per rain-day, especially in view of the general increase of temperature in the spring, summer and autumn from the decade 1922–31 to the present time.

Maps of the average number (1881–1915) of rain-days for each month have been published² and from these maps the general monthly values for England and Wales, and for Scotland, were evaluated. The seasonal values are 44, 43, 49 and 52 for England and Wales, 51, 52, 55 and 59 for Scotland, for the spring, summer, autumn and winter respectively. These values are shown on the diagrams. Serial monthly values have not been evaluated throughout this period, but annual values for England and Wales, and for Scotland, from 1881 to 1926 are given in *British Rainfall*, 1926³.

Number of rain-days (Fig. 1).— The curves for England and Wales and for Scotland show considerable similarity to those for rainfall. This is not surprising when it is recalled that there is a high correlation between the annual number of rain-days and amounts of rainfall—the correlation coefficient for the 45 years 1881–1925 for the British Isles is given as + 0.82 (Glasspoole 1927). Indeed the fact now shown that there is a difference in the trends of annual values of rainfall and rain-days partly explains why the correlation coefficient is not larger. The following points are of interest:

- (a) The annual curves show a steady decrease, followed by a small rise, but the rise in the number of rain-days is much less striking than the rise in the amount of rainfall.

(b) The curve of the number of rain-days for the autumn for Scotland is noticeably above the mean line of 55 (for 1881-1915). The curve for rainfall was similarly above the mean line for this period, although for the previous four decades the curve was much nearer the mean line.

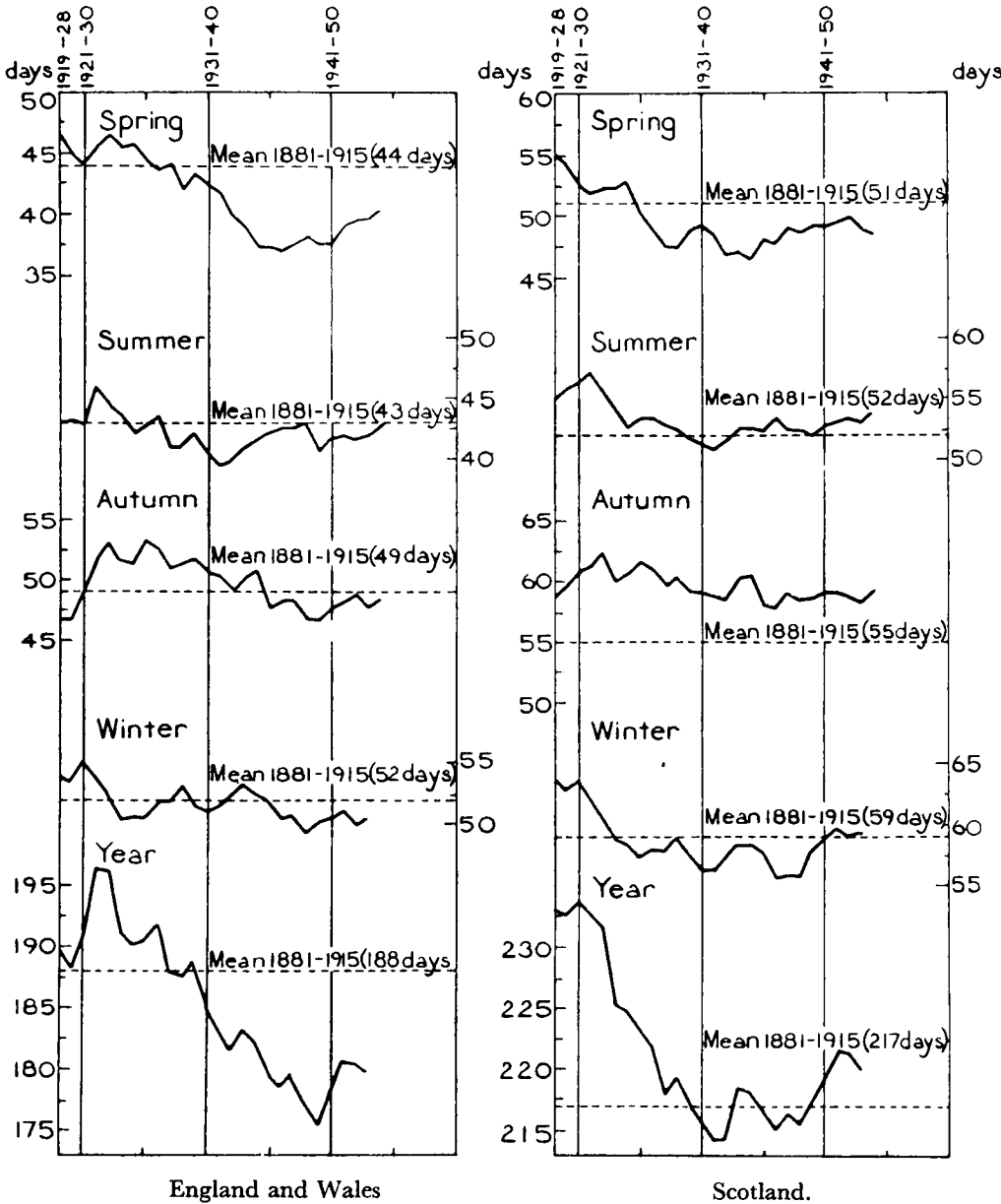


FIG. 1.—10-YR. MOVING AVERAGES OF RAIN-DAYS

Mean rain per rain-day (Fig. 2).—The most striking features of the curves are:

- (a) While the number of rain-days for the year has markedly decreased from the beginning to the end of the curves, the amount of rain per rain-day has noticeably increased, especially recently.

(b) There is marked similarity in the curve of mean rain per rain-day for the spring for England and Wales with the corresponding curve for temperature. Since 1922-31 the mean temperature has increased by 2°F., and the mean rain per rain-day by about 0.03 in. There is little similarity in the curves of mean rain per rain-day and temperature for the other seasons or for the year.

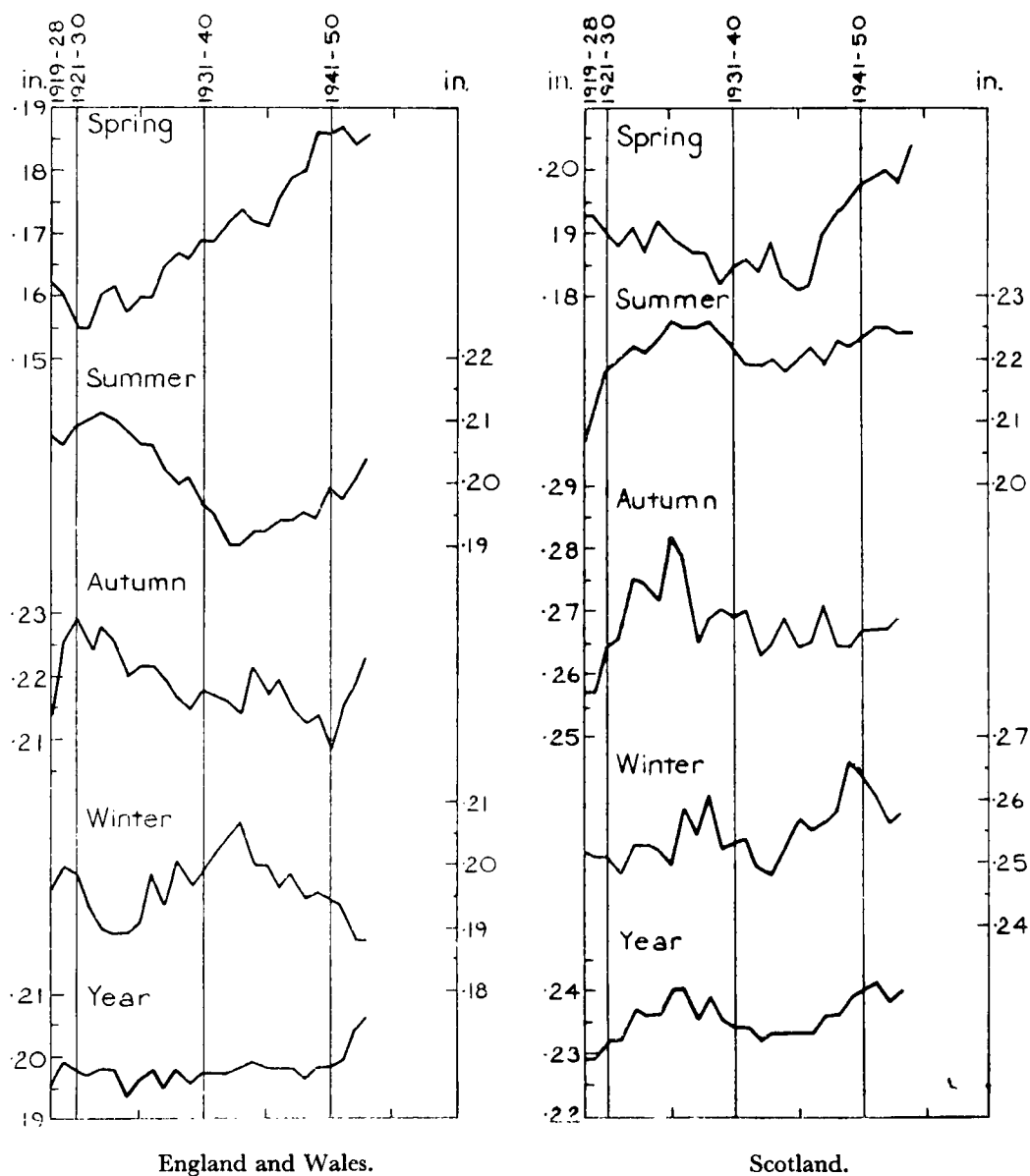


FIG. 2—MEAN RAIN PER RAIN-DAY

(c) The recent increase in the mean rain per rain-day for the year is due, over England and Wales, more especially to the increase for the summer and autumn. Over Scotland the recent increase is not so markedly due to an increase of any particular season.

(d) The recent increase in the mean rain per rain-day (and of the number of rain-days) both for England and Wales, and for Scotland shows some relationship to the corresponding curve for sunshine, suggesting a possible increase in instability rains.

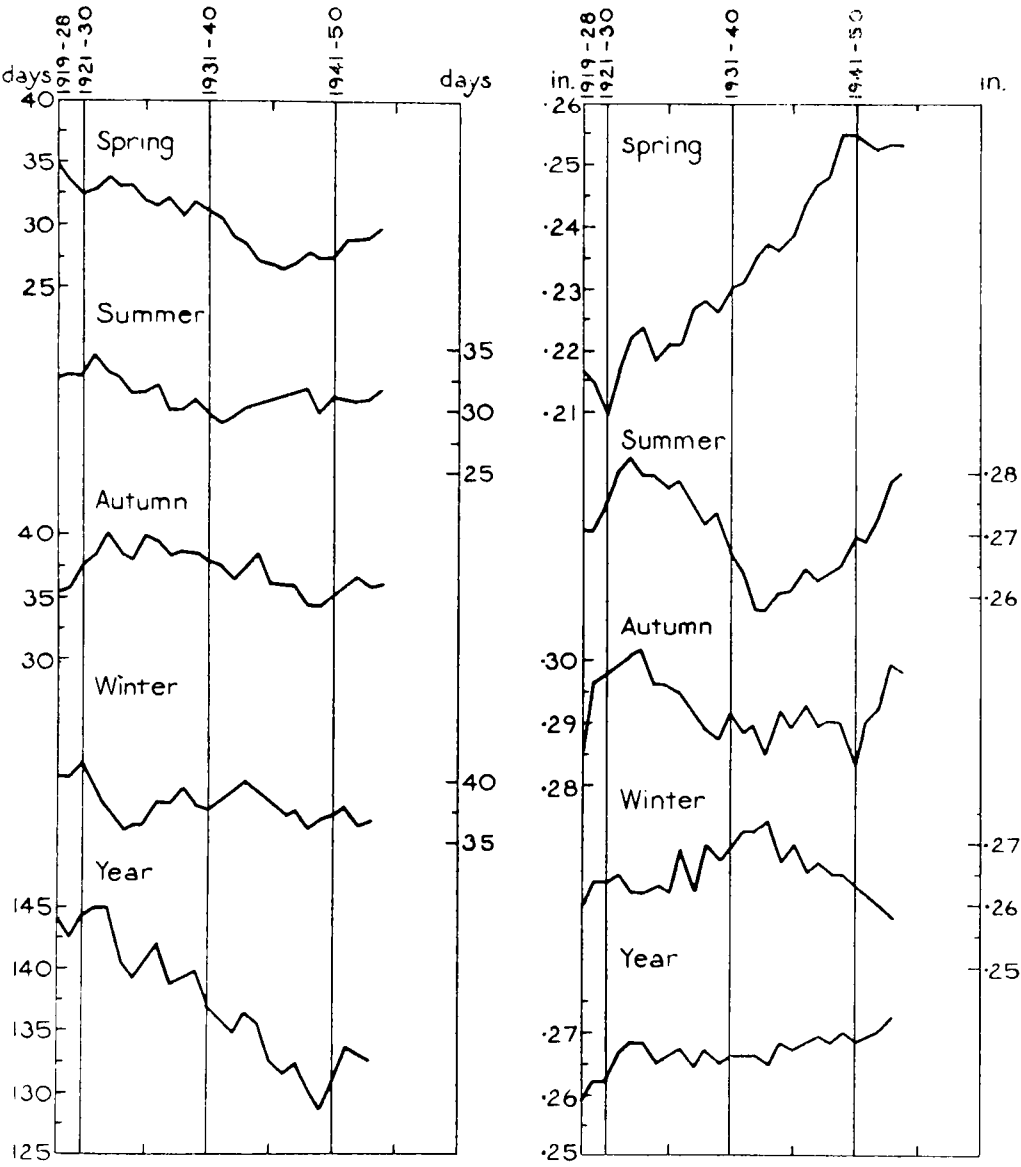


FIG. 3.—10-YR. MOVING AVERAGES OF WET-DAYS AND MEAN RAIN PER WET-DAY FOR ENGLAND AND WALES

Number of wet-days and mean rain per wet-day for England and Wales. (Fig. 3).—Similar monthly and annual values are available for wet-days (i.e., rain-days with 0.04 in. or 1.0 mm. or more of rain) from 1919, but the average values have not been computed for the standard period 1881–1915. The curves of the 10-year moving averages of wet-days for England and Wales are similar to those for rain-days. The main feature is the steady decrease in the

annual number of wet-days, with a small increase at the end of the period. The values of rain-days and wet-days both decreased from 1922-31 to 1940-49, the decrease in rain-days being 21 from 196 to 175 and with wet-days 16 from 145 to 129. The mean rain per wet-day shows a marked increase during the spring, similar to that for mean rain per rain-day. The two curves of Fig. 3 for the year also show a slight rise towards the end of the period. In calculating the mean rain per wet-day the general values of total rainfall have been used as given in the annual volumes of *British Rainfall*.

Conclusions.—The main trends in the number of rain-days and wet-days are similar to those for rainfall.

The differences are brought out by the curves of mean rain per rain-day and per wet-day. These show a similarity with temperature in the case of the spring and with annual sunshine for recent periods.

The variations in the mean rain per rain-day may be due to fluctuations in the predominating synoptic pattern accompanied by variations in evaporation or by variations in instability rains. These curves are reproduced as likely to provide a clue in future investigations of their inter-relationship and as part of our background knowledge.

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VARIATION OF VISIBILITY IN FOG AT EXETER AIRPORT, AND THE TIME OF FOG DISPERSAL

By W. E. SAUNDERS, B.Sc.

Summary.—An account is given of the variation in visibility at Exeter Airport during periods of fog. Main features of interest are the rapidity with which visibility falls to lower values within the fog range once fog has formed, the effectiveness of cloud cover as a fog-clearing agency, and the comparatively regular intervals between times of clearance of fog during the morning, and times of sunrise.

The site and observational programme.—The situation of the airfield is shown in Fig. 1. The airfield lies in a shallow basin formed by the high ground of Dartmoor to the south-west and west, Exmoor to the north, and the Blackdown Hills to the east. There are no intervening hills between the airfield and the English Channel to the south and the Exe estuary to the south-west. The only significant source of local smoke is the city of Exeter, some three miles west of the airfield.

The normal hourly and special observations of a synoptic station were made at Exeter throughout the period from which data have been used in this study. Additional temperature readings, which have been included in the notes on clearance of fog beneath cloud, were as follows:—

(i) Hourly readings of the grass minimum thermometer used as an ordinary thermometer at grass level, and of a bent-stem earth thermometer with the bulb at a depth of 2 in.

(ii) Twice daily readings of a bent-stem earth thermometer with the bulb at 8 in. These readings were made at 0900 and 2100 G.M.T.

Type of fog at Exeter.—The fog was predominantly water fog as defined by Corby and Saunders¹; that is, fog that did not form until after the relative humidity reached or exceeded 95 per cent. The investigation covers 145 cases, i.e. all the occasions of radiation fog during the period September 1953–December 1955. On only ten of these occasions did visibility enter the fog range with relative humidity less than 95 per cent., the lowest being 93 per cent. The results described therefore apply only to water fog. It is considered unlikely that they will apply to smoke fog, or to water fog containing a high smoke content. They may, however, be of interest to forecasters at other rurally placed stations, or to stations which experience “clean” fog when the air stream is moving from some known direction.

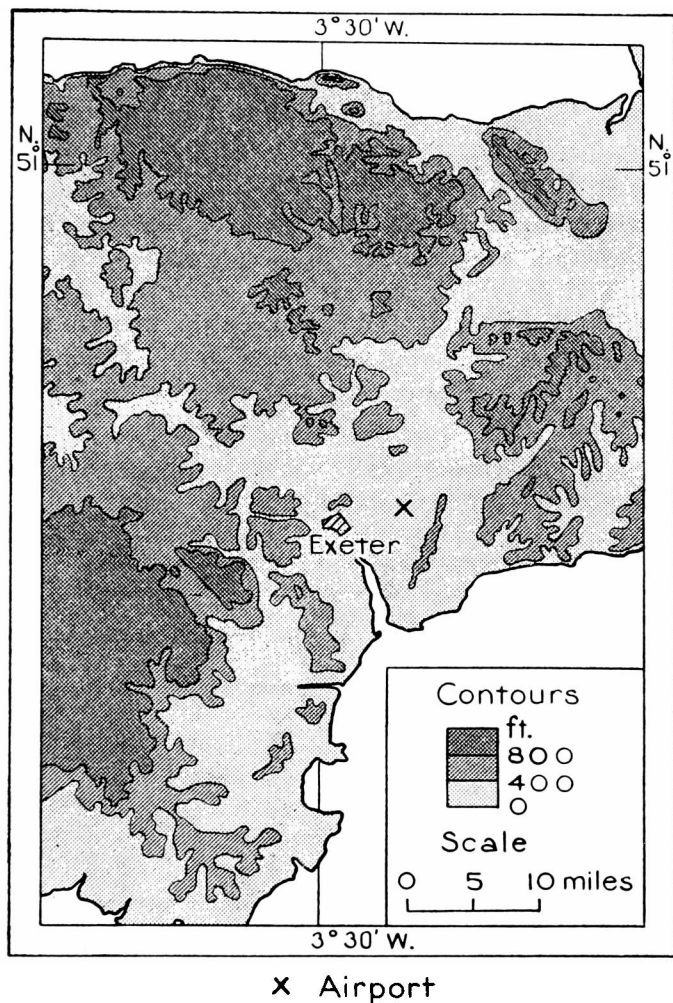


FIG. 1—MAP SHOWING THE LOCATION OF EXETER AIRPORT

Time taken for visibility to fall below certain limits.—The variation in visibility following the initial report of fog was studied in all cases (112 out of 145) in which fog-clearing agencies were not at work. The cases omitted were those in which there was freshening wind, cloud cover, frontal passage,

or those which occurred at the end of the night. Variations in visibility were examined in terms of the time taken to fall to 550 yd. or below, and to 220 yd. or below. On some occasions fog-clearing influences became apparent soon after the 550-yd. stage was reached, but there were 92 occasions suitable for examination in regard to the 220-yd. limit.

The over-all picture is given in Table I.

TABLE I—TIME TAKEN FOR VISIBILITY TO FALL BELOW 550 OR 220 YD.

Visibility	Hours from initial report of fog					Not reached
	0-1	>1-2	>2-3	>3-4	>4-5	
	<i>Number of occasions</i>					
550 yd. or below ...	96	11	1	0	0	4
220 yd. or below ...	47	21	6	6	1	11

Table I emphasizes the rapid fall of visibility in water fog. On 95 per cent. of occasions visibility is 550 yd. or less within 2 hr. of fog formation. The transition to dense fog is sometimes rather less rapid, but on 74 per cent. of occasions visibility is 220 yd. or less within 2 hr.

Variation with temperature.—The rate of decrease of visibility was examined in conjunction with the fog point, i.e. the temperature at which water fog formed, and the results are given in Table II. This shows that the four cases included in Table I as failing to reach the 550-yd. limit were all on occasions when the initial fog point was below 40°F. Otherwise the table is not very conclusive. Dense fog may still occur when the fog point is several degrees below freezing.

TABLE II—VARIATION OF TIME TAKEN WITH FOG-POINT TEMPERATURE FOR VISIBILITY TO REACH CERTAIN LIMITS

Fog point	Hours from 1st report of fog, for visibility to reach 550 yd. or less			Not reached	Hours from 1st report of fog, for visibility to reach 220 yd. or less					Not reached
	0-1	>1-2	>2-3		0-1	>1-2	>2-3	>3-4	>4-5	
°F.	Number of occasions									
60-64	3	1	0	0	2	1	1	0	0	0
55-59	5	0	1	0	3	0	0	2	0	0
50-54	21	2	0	0	11	3	1	1	0	2
45-49	27	2	0	0	9	10	2	1	0	2
40-44	19	3	0	0	11	4	1	0	0	3
35-39	11	2	0	2	6	1	1	0	1	2
30-34	7	1	0	1	4	2	0	0	0	1
25-29	3	0	0	1	1	0	0	2	0	1

Table III shows the further fall of temperature, once fog has formed, for visibility to reach 550 yd. or less, and 220 yd. or less. This shows that while, in general, only a slight fall of temperature amounting to a degree or so is required, there are a few occasions on which the fall is as much as five or six degrees. It might be expected on theoretical grounds that these would be the low-temperature occasions, but this is not borne out by the table.

Variation with visibility before fog formation.—In order to determine whether there was any connexion between the rate of fall of visibility preceding fog and in the fog, the rate of decrease of visibility was compared with the visibility three hours before fog formation, and the results are given in Table IV.

TABLE III—VARIATION OF FALL OF TEMPERATURE, WITH FOG POINT, FOR VISIBILITY TO REACH CERTAIN LIMITS

Fog point °F.	Fall of temperature, °F., from fog point, for visibility to reach 550 yd. or less						Fall of temperature, °F., from fog point, for visibility to reach 220 yd. or less					
	0-1	>1-2	>2-3	>3-4	>4-5	>5-6	0-1	>1-2	>2-3	>3-4	>4-5	>5-6
	<i>Number of occasions</i>											
60-64	2	1	1	0	0	0	1	0	1	2	0	0
55-59	3	1	0	2	0	0	1	1	0	2	1	0
50-54	16	3	1	2	1	0	8	3	1	3	1	0
45-49	24	1	1	0	1	2	11	1	4	1	1	4
40-44	16	4	1	0	1	0	6	7	3	0	0	0
35-39	8	2	2	1	0	0	5	1	1	0	2	0
30-34	7	1	0	0	0	0	4	1	1	0	0	0
25-29	2	1	0	0	0	0	2	0	0	1	0	0

TABLE IV—VARIATION OF TIME TAKEN WITH VISIBILITY THREE HOURS BEFORE FOG FORMATION FOR VISIBILITY TO REACH CERTAIN LIMITS

Visibility 3 hr. before fog formation	Hours from 1st report of fog, for visibility to reach 550 yd. or less			Not reached	Hours from 1st report of fog, for visibility to reach 220 yd. or less					Not reached
	0-1	> 1-2	> 2-3		0-1	> 1-2	> 2-3	> 3-4	> 4-5	
	<i>Number of occasions</i>									
>6¼ miles	27	2	0	1	15	7	1	0	0	3
2½-6¼ miles	36	5	0	0	15	7	3	3	1	5
2,200 yd.-2½ miles	18	3	0	3	12	6	1	0	0	3
1,100 yd.-2,200 yd.	15	1	1	0	5	1	1	3	0	0

TABLE V—VARIATION OF TIME TAKEN FOR VISIBILITY TO REACH CERTAIN LIMITS WITH WIND DIRECTION THREE HOURS BEFORE FOG FORMATION

Wind direction 3 hr. before fog formation	Hours from 1st report of fog, for visibility to reach 550 yd. or less			Not reached	Hours from 1st report of fog, for visibility to reach 220 yd. or less					Not reached
	0-1	>1-2	>2-3		0-1	>1-2	>2-3	>3-4	>4-5	
°	Number of occasions									
001-030	4	1	0	1	1	2	0	0	0	1
031-060	4	3	0	0	2	2	0	1	1	1
061-090	2	0	1	0	1	1	0	1	0	0
091-120	6	0	0	0	2	1	0	1	0	1
121-150	7	0	0	0	5	0	0	0	0	0
151-180	11	2	0	0	8	3	1	0	0	0
181-210	2	0	0	0	2	0	0	0	0	0
211-240	4	0	0	0	2	1	0	0	0	0
241-270	3	0	0	0	2	0	1	0	0	0
271-300	2	0	0	0	0	1	0	0	0	1
301-330	9	1	0	0	2	1	2	0	0	1
331-360	1	0	0	2	0	0	0	0	0	2
Calm	41	4	0	1	20	9	2	3	0	4

Table IV shows that there is some tendency for hazy initial conditions to be followed by a rather slower deterioration than when fog forms in clean air.

Variation with wind direction before fog formation.—The time taken for visibility to fall to the prescribed limits was compared with the wind direction three hours before the time of fog formation, as shown in Table V.

The large proportion of calms renders analysis of Table V difficult, but perhaps some tentative conclusions may be drawn. The most significant feature seems to be the rapidity of decrease of visibility with wind direction bringing moist air from the English Channel or the Exe estuary. Thus, in all cases with wind direction between SE. and W. (through S.) the visibility was 550 yd. or less within 2 hr., and 220 yd. or less within 3 hr. of fog formation.

Variation with state of ground.—The times for visibility to reach the agreed limits were compared with the reported state of ground before fog formation. The results, given in Table VI, show that in all cases of wet ground visibility fell to 550 yd. or less within two hours of fog formation, and that wet ground much reduces the chance of visibility 220 yd. or less not being reached.

TABLE VI—VARIATION OF TIME TAKEN WITH STATE OF GROUND BEFORE FOG FORMATION FOR VISIBILITY TO REACH CERTAIN LIMITS

State of ground before fog formation			Hours from 1st report of fog, for visibility to reach 550 yd. or less			Not reached	Hours from 1st report of fog, for visibility to reach 220 yd. or less					Not reached
			0-1	>1-2	>2-3		0-1	>1-2	>2-3	>3-4	>4-5	
			<i>Number of occasions</i>									
Dry	50	2	1	4	23	11	4	3	0	9
Wet	46	9	0	0	24	10	2	3	1	2

The effect of cloud cover on fog.—The effect of cloud spreading over existing fog was examined. The criteria adopted were that the cloud amount, excluding broken cirrus, should increase from four oktas or less to five oktas or more, or that an existing cloud sheet should lower significantly. Cases where other fog-clearing influences were at work, such as frontal passage or freshening wind, including cases where fog lifted to stratus, were omitted. Cases of sky-obscured fog were also omitted for obvious reasons. The effect of cloud cover on fog is shown in Table VII.

TABLE VII—TIME TAKEN FROM INCREASE IN CLOUD FOR VISIBILITY TO IMPROVE

Fog clearance. Hours taken from increase in cloud for visibility to increase to 1,100 yd. or more						No clearance
0-1	> 1-2	> 2-3	> 3-4	> 4-5	> 5-6	
<i>Number of occasions</i>						
18	11	4	2	4	1	10

Table VII shows that to a marked extent water fog is dispersed by any appreciable cloud cover. This applied on 40 out of 50 occasions, and on nearly half the nights when fog cleared it did so within one hour of the cloud arriving or increasing.

The temperature distribution during the fog preceding the arrival or increase of cloud was always of the same type. The lowest temperature of those measured was at the grass level. Of the soil temperatures at -2 in. and -8 in. the latter was always the higher. The screen temperature was intermediate between the grass and -2 in. temperatures. After the arrival of cloud the most pronounced change in temperature was at the grass level.

This always increased, in some cases by as much as 10 or 12°F. At both screen level and -2 in. changes were slight, often less than $\pm 1^\circ\text{F}$. After clearance of the fog, readings of screen and grass temperatures were usually nearly the same, though sometimes there was still an inversion between them.

The following is an example of recorded observations:—

Date	Time	Wind	Cloud	Visibility	Temperatures			
					Screen	Grass	-2 in.	-8 in.
18.11.53	G.M.T. 2356	Calm	Nil	yd. 160	42·2	40·9	46·7	48·8
19.11.53	0156	Calm	8/8 1,800 ft.	1,800	44·9	44·3	47·2	...

The records of all the foggy nights affected by cloud were examined to see to what extent the result was affected by height of cloud. This showed that on all occasions when the cloud was not above 2,500 ft. the fog cleared. Most of these cases cleared within 2 hr. of the arrival of cloud, but in one instance the process required 5-6 hr. The effects of medium and high cloud and of higher stratocumulus were much less regular. The records of cases which failed to clear under cloud contained some suggestion of west or north-westerly drift at some stage in most of them; this might imply some smoke content from Exeter. The investigation leaves a strong impression that clean water fog is readily cleared by cloud, and that if the cloud is not above 2,500 ft. the process is likely to be rapid.

The time of clearance of fog.—The time of clearance of fog was studied. In the absence of other fog-clearing influences such as increasing cloud cover or freshening wind the time of clearance should be roughly determined by the amount of insolation, which varies with the date, and by the vertical thickness of the fog. In the absence of measurements of the depth of fog, some guidance is given by the appearance of the fog from the ground, whether it is reported as sky obscured or sky visible.

In Fig. 2, for which the period of the investigation was extended to 1939-1955, the intervals between the times of sunrise and of fog clearance have been plotted against the date, and separated according as the sky was or was not visible at 0600 G.M.T. This time was selected partly because it marks a stage at which, taking the year as a whole, cooling is practically completed, and partly because it is a convenient time in relation to the issue of short-term forecasts on which many day-time activities depend. Occasions when the fog formed after 0600 G.M.T. were plotted as sky visible regardless of whether it later became obscured. Occasions omitted were those in which cloud appeared to affect the result, or when there was freshening wind. Cases of fog clearing by lifting to stratus were taken to be due to freshening wind and thus omitted. Occasions included on Fig. 2 should therefore be those of straightforward fog clearance due to insolation. The number of cases was sufficient to draw the mean curves AA and BB with fair accuracy, except in midwinter. The minimum time interval between sunrise and fog dispersal occurs in spring, and this is perhaps due to a somewhat lower water content in fogs at this season as compared with summer and autumn. A small number of sky-visible cases were noted in January-March in which the original fog point was below 32°F. and the clearance time mostly before sunrise. The fog-point temperature has been inserted against these cases in Fig. 2, and they

have been disregarded in drawing BB. Presumably the fog clearance in these cases was due to deposition of the moisture as frost. Fig. 2 shows that a substantial proportion of fogs cleared within one hour of the times indicated by AA and BB. It is not known how the scatter compares with accuracy at present attained by forecasters in predicting times of fog clearance, but preparation of diagrams of this type for various sites may help to prevent large errors. Perhaps the real significance of Fig. 2 is that it shows that a quite marked

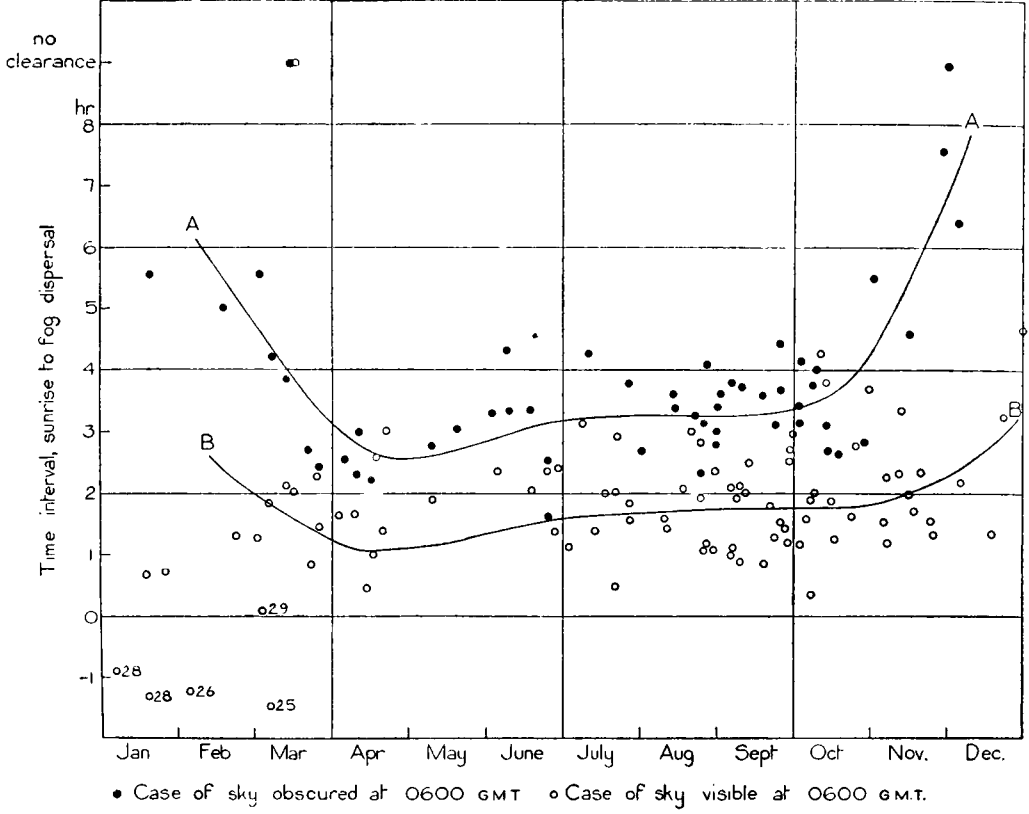


FIG. 2—VARIATION WITH TIME OF YEAR, OF TIME INTERVAL BETWEEN SUNRISE AND FOG DISPERSAL

Curve AA fits cases of sky obscured.
 Curve BB fits cases of sky visible.

The temperature of fog formation has been inserted beside the symbol if below 32°F.

separation can be obtained by use of a simple parameter to represent vertical thickness of fog. This suggests that if measurements of depth of fog were available it might be possible to replace AA and BB by a series of curves representing different thicknesses of fog, and so increase the usefulness of the diagram as a forecasting tool.

It is emphasized that the cases included must be regarded as water fog, and that for many sites it will be necessary to distinguish between clean and heavily polluted fog.

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1. CORBY, G. A. and SAUNDERS, W. E.; Water-fog point—a further test. *Met. Mag., London*, **81**, 1952, p. 225.



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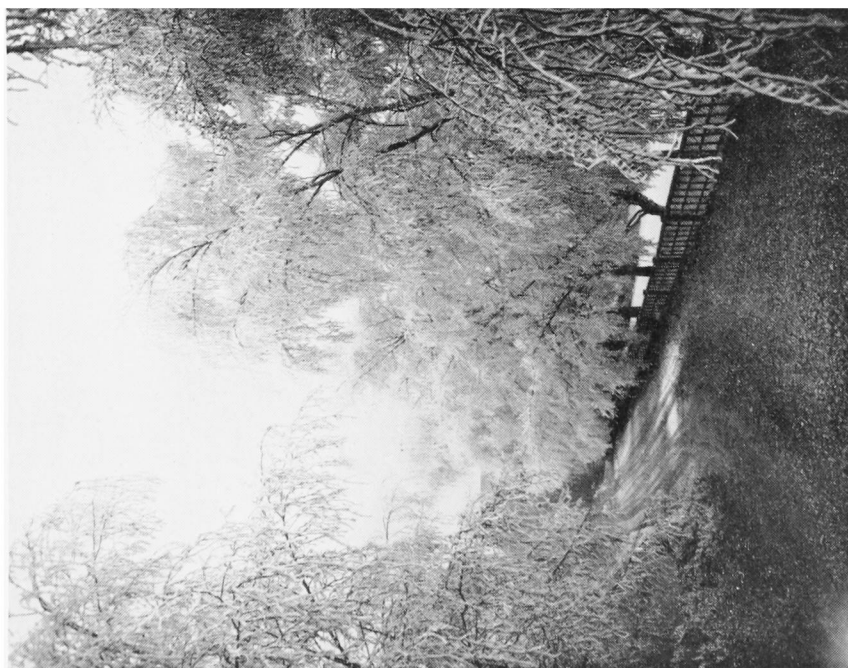


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STANDARD PRESENTED TO THE METEOROLOGICAL SQUADRON OF THE ROYAL
AIR FORCE

The presentation was made by Air Chief Marshal Sir Douglas C. S. Evill, G.B.E., K.C.B.,
D.S.C., A.F.C.

(see p. 379)



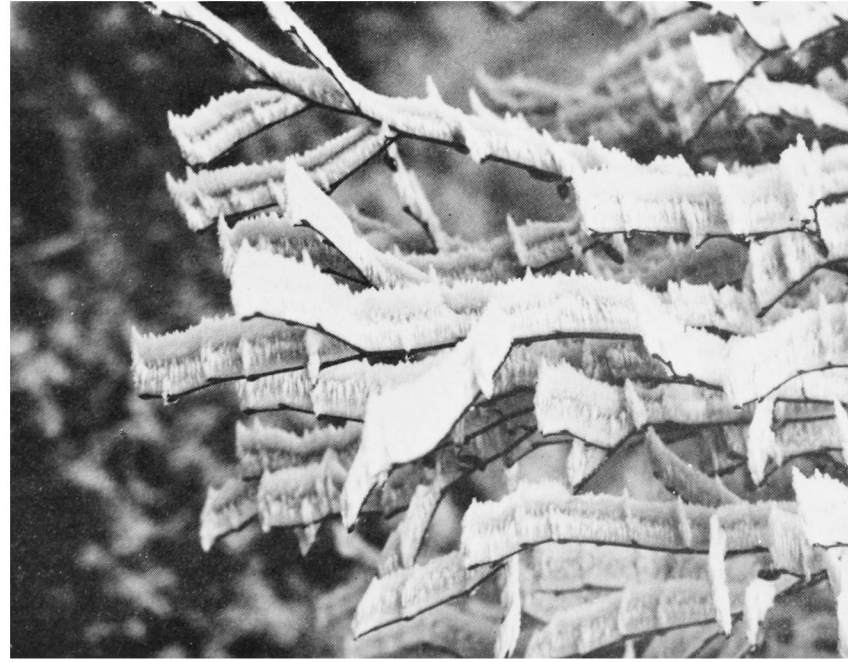
Photograph by Gayroma

We are indebted to Mr. G. R. Sankey, C.B.E., J.P. of Gay Hills, Lower Penn, Wolverhampton for the four photographs reproduced on this and the following page. Mr. Sankey took the pictures, on December 20 and 21, 1956, at his home.

RIME AT LOWER PENN



Photograph by Gayroma



Photograph by Gayrona



Photograph by Gayrona

DETAILS OF RIME FORMATION AT LOWER PENN



Photograph by Cambridge Daily News

CONDENSATION TRAILS OVER CAMBRIDGE

The trails were observed by Mr. L. L. Alexander, on September 5, 1957, in the vicinity of Waterbeach. Mr. Alexander reports that the contrails were from a fleet of Canberra aircraft flying to Farnborough and the trails were at 34,000 feet (measured); the shallow cumulus or stratocumulus was at 4,000 feet and the view is towards the south-west.

METEOROLOGICAL RESEARCH COMMITTEE

The Committee met on November 22, 1956, and reviewed in detail the progress reports from the three Subcommittees for March-August, 1956, and two reports from the Cloud Seeding Panel. The need for further investigation of slant visibility was noted, in view of the requirements for the safe landing of aircraft in conditions of bad visibility. There was general discussion on the organization and effort available for research within the Meteorological Office, with mention of several problems of weather and the atmosphere which merit study but for which provision has not yet been practicable.

Physical Subcommittee

At the meeting held on October 10, 1956, the Subcommittee, after reviewing the progress report for March-August, 1956, considered three papers dealing with aircraft condensation trails. The first paper presented observational data of trails made by the Canberra aircraft of the Meteorological Research Flight and indicated how the resulting analysis might aid the forecasting of the length of trails made by jet aircraft. The second paper included a treatment of the persistence of condensation trails as a problem of diffusion and also examined the relationship between observations on the height of persistent trails and the air temperature. The approach of the third paper was more general in that detailed account was taken of the effects of mixing, with the ambient air, of exhaust gases issuing with a given temperature and speed from a jet engine of which the fuel consumption and mass flow through the engine are known: an approach which, with the application of appropriate observational data, is likely to lead to results of assistance in forecasting the size and persistence of condensation trails. The other paper before the meeting indicated that the daily sequence of counts of freezing nuclei in the atmosphere, made during flights by the Meteorological Research Flight in January, 1956, gave no support to E. G. Bowen's hypothesis on the connection between rainfall peaks and meteoritic showers. There was discussion on the uncertainties associated with the determination of the concentration of freezing nuclei in the atmosphere.

At the meeting held on November 28, 1956, the Subcommittee noted, from comments obtained from three institutions concerned with the experimental investigations of fluid motion, that the operation of an incompressible fluid model for the study of two-dimensional air flow over a ridge (suggested by J. S. Sawyer in M.R.P. 935) would present serious difficulties. In the discussion, some suggestions were made for avoiding or reducing some of the difficulties and it was noted that laboratory experiments on the air flow over mountains are being made by the Department of Meteorology, Imperial College. A paper from Porton on the diffusion of airborne particles reported close agreement, up to 500 yards downwind, between vertical distribution of lycopodium particles emitted from a point 500 feet above ground and the distribution of the inclination of wind to the horizontal as recorded at the point of emission: and gave rise to discussion on the mechanism of atmospheric turbulence. Next, consideration was given to proposals for future research at the Meteorological Office radar station, taking into account the transfer of the station to another site within a few years and the expectation of obtaining millimetric radar in addition

to centimetric radar equipment. Finally, the desirability of instituting systematic work on atmospheric nuclei was considered on the basis of the survey provided in the fourth paper, with expression of views on the relative importance of investigations of dust particles, condensation nuclei and freezing nuclei in the light of existing techniques and general resources.

ABSTRACTS

HELLIWELL, N. C. and MACKENZIE, J. K.; Further observation of condensation trails. *Met. Res. Pap., London*, No. 979, S.C. III/206, 1956. Two methods of observing tops and bases of trails formed by a Canberra are described: by a second aircraft and by a camera in the tail operated by remote control. Temperature, height, airspeed and frost point were also measured. Observations during 1955 are tabulated and frost points of trail formation plotted against temperature and pressure. Plots of airplane ascents and photos of trails are given for three special cases. Plots also show length of trail against temperature difference from Mintra and depression of frost point, effect of engine setting and effect of relative humidity on temperature at contrail base. It is concluded that temperature is the most important variable in contrail formation, relative humidity and engine setting only secondary factors. The length of the trail is a complex function of temperature and humidity. A forecasting procedure is suggested.

BRIGGS, J.; Condensation trails formed by jet aircraft. *Met. Res. Pap., London*, No. 996, S.C. III/214, 1956. Assuming that heat and water vapour supplied by a jet aircraft mix with the air in a few yards, the critical temperature for initial trail formation in saturated air at pressures 150–500 mb. is calculated. The persistence of a trail depends on a number of factors and simple forecasting criteria are difficult to define, but a persistent trail is more likely at high humidity, low temperature and low wind speed. Theoretical critical values of pressure, temperature and wind are given for persistence over at least 10 sec. Reported heights of base or top of persistent trails are tabulated in respect of temperature.

JONES, R. F.; The exhaust trail from jet engines. *Met. Res. Pap., London*, No. 990, S.C. III/210, 1956. Knowing the rate of burning of fuel, flow of air through the engine, water vapour production (1.3 gm. for 1 gm. kerosene), temperature and pressure of ambient air and speed, formulae are calculated for temperature T_m and mixing ratio x_m of the exhaust trail and examples quoted. A table gives T_m and x_i , x_w (x_i over ice at 200 mb. x_w over water) for dry ambient air, and a diagram gives also curves for various mixing ratios of ambient air. When the trail is saturated latent heat of condensation must also be taken into account. Conditions for formation and persistence of a visible trail are then considered. By comparison with observations, it will be possible to forecast the temperature at which, for a particular aircraft, persistent trails are likely or not likely. Finally the diameter of a trail as a result of entrainment is considered.

MURGATROYD, R. J. and GARROD, M. P.; The measurements of natural freezing nuclei made by the Meteorological Research Flight during January, 1956. *Met. Res. Pap., London*, No. 998, S.C. III/215, 1956. Counts of natural freezing nuclei in a cold chamber carried by airplane are described, including instrumentation and limitations. Counts were made on 25 days in January 1956 up to 10,000 ft. over south England; numbers as observed and at -20° and -25°C .

are tabulated, and plotted against temperature, frost point and cloud. Day-to-day variations were not significant and gave no support to Bowen's meteor hypothesis; on the other hand horizontal variations were large. Concentrations of $+1/\text{litre}$ were not usual until temperature fell to -20°C . or below. Results of other workers are compared. Concentrations were low when vertical stability was low, suggesting that in contrast to condensation nuclei, freezing nuclei are not due to transport upwards from the ground. There was no correlation with air mass or wind direction.

SAWYER, J. S.; Dynamical similarity in an incompressible fluid model of two-dimensional air flow over a ridge. *Met. Res. Pap., London*, No. 935, S.C. III/191 and S.C. II/198, 1955. [An abstract of this paper was published in the *Meteorological Magazine*, Vol. 85, p.150.]

HAY, J. S. and PASQUILL, F.; Measurements of the short range diffusion of airborne particles at a height of a few hundred feet in the atmosphere. *Met. Res. Pap., London*, No. 1006, S.C. III/218, 1956. Experiments are described in which lycopodium spores were released at a height of (usually) 500 ft. and the vertical distribution at 100, 300 and 500 m. downwind was examined. Measurements of wind inclination were also made. The medium values of spore elevation and wind inclination agreed to 0.2° . Distributions of wind inclination and spore elevation were approximately Gaussian, and of similar dimensions. Results show that the Lagrangian correlation (related to time in the sense of following the motion) equals unity for at least 1 min., but Eulerian correlation (at a fixed point) falls to 0.2 in 10 sec. This is explained by motion in straight lines of individual elements (puffs) of the plume. Appendices discuss sampling technique and Eulerian autocorrelation coefficient of vertical component of eddy velocity.

HARPER, W. G.; A survey of facilities and research programme of the Radar Research Station. *Met. Res. Pap., London*, No. 1009, S.C. III/220, 1956. Radar research at East Hill, near Dunstable, began when the Meteorological Office took over the station in 1947. Equipment for cloud and precipitation echoes, upper winds and sferics is described. Past work is summarized and 21 papers originating from East Hill are listed. Future plans are outlined, including use of 8 mm. radar. An alternative site is being sought.

ODDIE, B. C. V.; Atmospheric nuclei. An estimate of the value and practicability of routine measurements. *Met. Res. Pap., London*, No. 1012, S.C. III/221, 1956. Counting of dust particles by Owens dust counter or of Aitken condensation nuclei seems unlikely to contribute much to other branches of meteorology, though counting Aitken nuclei at a few places might be useful. Counts of freezing nuclei under natural conditions would be valuable but difficult. Objectives are set out; none of the methods yet tried satisfy them but Cwilog's threshold temperature method and E. K. Bigg's new type of cloud chamber deserve further study.

Synoptic and Dynamical Subcommittee

At the meeting held on November 1, 1956, consideration was given to the progress report for March-August, 1956 and to papers on the synoptic study of anomalies of surface air temperature, atmospheric models for numerical integration of the equations of motion and a survey of heat sources and sinks at the earth's surface.

The evidence in the first paper, on the large area, slow motion and high degree of persistence of the main anomaly patterns of 5-day mean surface air temperature, and indications of associations between anomalies and the general circulation pattern, was regarded as an important contribution to the study of methods of approach to forecasting for periods beyond one or two days, though the need to search for dependable relationships was stressed. The papers on atmospheric models represent further stages and refinements in the preparations being made for the construction of forecast pressure-contour charts by numerical integration when an electronic computer is available in the Meteorological Office. There was discussion on fundamental details of the two papers. The survey of the effects of differences or changes in the state of the earth's surface on the energy available to the atmosphere suggested certain factors (e.g., an anomaly in sea surface temperature and some changes in the nature of the earth's surface) might be expected to influence atmospheric systems on a synoptic scale. In the discussion, it was stated that it is proposed that further study on these lines shall be linked to the study of anomalies of surface air temperature as reported in the first paper presented.

ABSTRACTS

CRADDOCK, J. M. and LOWNDES, C. A. S.; A synoptic study of anomalies of surface air temperature over the Atlantic half of the Northern Hemisphere. *Met. Res. Pap., London*, No. 994, S.C. II/214, 1956. Differences of 5-day temperature means from normal (1921-40) were charted for 240 stations in U.S.A., North Atlantic and Europe for May 1955-April 1956. Some of the charts showed very large anomalies. Ten salient periods are selected for discussion and illustrated by representative 5-day charts. The patterns of temperature anomaly are large, slow moving and long-lived. They may be of use for long range forecasting either through their persistence or as indicators of the general atmospheric circulation.

KNIGHTING, E.; An atmospheric model for numerical integration including the tropopause effects. *Met. Res. Pap., London*, No. 1002, S.C. II/216, 1956. The usual atmospheric models for numerical integration of the equations of motion ignore the transition from troposphere to stratosphere. This is illogical and a simple model is developed which includes a variable pressure surface corresponding with the tropopause. Prognostic equations include one for tropopause pressure.

KNIGHTING, E.; A non-geostrophic extension of the Sawyer-Bushby model of the atmosphere suitable for numerical integration. *Met. Res. Pap., London*, No. 1003, S.C. II/217, 1956. A two-level model is used in which divergence is not zero at the surface but is zero at 500 mb. Vertical velocity becomes the key to development. Prognostic equations are set out and stream and potential functions introduced. The equations are difficult to solve and some simplifications are suggested.

HOUGHTON, D. M.; Heat sources and sinks at the earth's surface. *Met. Res. Pap., London*, No. 1005, S.C. II/218, 1956. The factors in the heat balance of the earth's surface are discussed from the point of view of variations which may affect the circulation of the atmosphere over a wide area. Heat storage in the oceans is first considered and it is estimated that an anomaly of $+1^{\circ}\text{C.}$ in sea temperature would supply about $50 \text{ cal./cm.}^2/\text{day}$ to the air, rising to 1200 in

strong convection. Freezing of the sea causes a loss of 380 cal. by long-wave radiation. On the continents the factors are all highly variable; the maximum effects are (cal./cm.²/day): conduction ± 30 , thawing ground in sun -150 , thawing snow -40 , albedo of snow -180 , of dry ground -50 , evaporation and evapotranspiration (change from moist ground to desert or vice versa) ± 200 . An excellent bibliography is appended.

OBITUARY

Professor Carl-Gustaf Rossby

The news of the sudden death of Professor Carl-Gustaf Rossby in Stockholm on August 19, 1957 was received with grief and shock by meteorologists all over the world. In any science there are at any one time a few outstanding figures and in meteorology Rossby was one of these, but we shall never know what Rossby might have become had his physique measured up to the tremendous pace he set himself; he died a victim of overstrain at the height of his powers.

Born in Stockholm in 1898, Rossby graduated at the university of that city, spent some time at the Swedish Meteorological and Hydrological Institute (the State Meteorological Office), and in 1926 moved to America where, as it turned out, he was to remain for many years to become an American citizen, to marry an American wife, and to attain acknowledged leadership among American meteorologists. Before the war his associations were mainly with the Massachusetts Institute of Technology and the Woods Hole Oceanographic Institution, during and after the war with the Department of Meteorology of the University of Chicago although some two important years were spent with the Weather Bureau.

It was to the surprise of many people that Rossby, with his reputation steadily growing and with all the opportunities which the United States could provide, should in 1947 return to Sweden to take a chair at the University of Stockholm. But this was no example of the successful man retiring from the turmoil of American life to the quiet academic atmosphere of his small native country. He created a new institute, the International Meteorological Institute, a unique organization linked with the University of Stockholm but financed not only from Sweden but also from various other sources including the United States and both the United Nations Educational, Scientific and Cultural Organization and the International Union of Geodesy and Geophysics. In ten years a great deal had been done to justify the title and no one could attend the Institute either for extended study or as a member of one of the frequent seminars without feeling that meteorology was a vital world science, moving ahead, with a man of vision there to guide. Had Rossby been content to realize his vision of an International Institute he might, who knows, have lived to lead it for many years but his interests remained world-wide and during his last year he had visited the United States and Central America as well as Britain and other countries of Europe on meteorological business of many kinds. In happier circumstances he would have presided at the General Assembly of the International Association of Meteorology in Toronto, which opened but a few days after his death.

Rossby's position, secured as it was in recent years by his leadership, enthusiasm and warm personality, was of course built on a firm foundation of

personal achievement in the advancement of scientific knowledge. He will be remembered for his early work on the dynamics of ocean currents and on the drag between atmosphere and ocean as well as for his later meteorological work, mainly of the last two decades, on the large-scale motions of the atmosphere. The "Rossby diagram" of thermodynamics, "Rossby waves", the near-barotropic waves of the westerlies, and the "Rossby number", a ratio of central significance in planetary fluid motions, are sufficient to perpetuate his name in our science; there is no name in modern meteorology more deserving of remembrance.

R. C. SUTCLIFFE

LETTERS TO THE EDITOR

Poliomyelitis and water temperature

In his article on Poliomyelitis and weather¹ Mr. Lawrence makes the point that outbreaks of the disease follow periods of hot weather and also mentions the well-known fact that it reaches its maximum in the late summer and autumn. It seems, therefore, that bathing may play an important part in spreading the disease. This view has some official support as the B.B.C., during an outbreak, advises bathers to use chlorinated baths and not rivers.

There is an obvious correlation between maxima of the disease and anything else which occurs in the late summer and autumn but the probable relation between the disease and bathing suggests that water temperatures may be important in this respect. It is obvious that increase in water temperature would correlate quite well with increase in the disease but this may be important or merely fortuitous.

It might be possible to resolve the problem by comparing frequencies among riverside communities. The temperature of most rivers increases downstream and the disease should be more common in the lower reaches; but some rivers, probably flowing north, may fall in temperature downstream, at least over a section of their courses, and the distribution of the disease may be interesting.

As Mr. Lawrence says, there are many complicating factors one of which is the apparent natural immunity possessed by more primitive peoples. It may be that research on the lines suggested has already been carried out, but Mr. Lawrence's article gave the impression that it probably has not. It might be advantageous if it were.

H. S. TURNER

London Airport, July 23, 1956

[The relation between the incidence of poliomyelitis and water temperature may well be very important, but I believe that medical rather than meteorological research is more likely to throw light on this factor. During bathing, people's proximity may possibly help to spread the disease and the water in itself may possibly be a medium for its transmission, but any correlation between water temperature and the incidence of poliomyelitis may be merely fortuitous, as Mr. Turner suggests, because bathing tends to increase with increase of water temperature.

A positive correlation between the incidence of poliomyelitis and air temperature does not imply an "obvious correlation between poliomyelitis and anything

else which occurs in late summer''. In fact, though the incidence of poliomyelitis does show a positive correlation with certain functions of temperature which in turn could indeed correlate positively with vapour pressure, Dr. W. H. Bradley and Brig. A. E. Richmond² found no obvious connection between poliomyelitis and vapour pressure.

In an investigation into the incidence of poliomyelitis among riverside communities, a positive result could be merely a reflection of the fact that where river temperatures increase, air temperatures would tend to increase also, and vice versa. Furthermore, water near riverside settlements may have artificially caused local differences of temperature within the same community (for example, local sewerage) and these local, though not typical temperatures may be biologically crucial.

Recent papers^{3,4,5} on poliomyelitis and the environment state a relationship between poliomyelitis and factors which cause salt depletion of the body. The accentuation of salt depletion by frequent bathing is connected with the predisposition to paralytic poliomyelitis of countries with high standards of hygiene. —E. N. LAWRENCE.]

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1. LAWRENCE, E. N.; Poliomyelitis and weather. *Met. Mag., London*, **85**, 1956, p. 164.
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3. IRVING, F. A.; An investigation into the relationship between the incidence of poliomyelitis and the environment. Annual Report of the County Medical Officer of Health of Essex, 1954. Chelmsford, 1955, p. 113.
4. IRVING, F. A.; The environmental approach to the prevention of poliomyelitis, Maldon, 1956. (Communicated privately).
5. International Society of Bioclimatology and Biometeorology, Report of First Bioclimatological Congress, Vienna, 1957. (Communicated privately).

Ball lightning

You may like to have a note of a fire-ball—or what appeared to be one—seen by my wife and myself on Sunday, June 30.

We were motoring south-east along B.3135 across the Mendips in very heavy rain and poor visibility at the time—2.30 p.m. About half a mile before crossing the Radstock-Shepton Mallet railway, at map reference ST 6048 on the National Grid, there was, without any previous warning of thunder, a tremendous flash of lightning and instantaneous crash of thunder. One fork of lightning struck about 100 yd. to our left and, at the same time, about 200 yd. ahead and slightly to the right, a bright globe of light, perfectly round, appeared. It seemed to be raised a few feet above the ground, possibly poised on a tree or farm building—it was impossible to see clearly in the bad light—and to sink slowly to the ground. It lasted only a few seconds and had disappeared when we passed the spot.

Dazzle produced by the lightning seems to be excluded by the fact that my wife, who had been dozing, did not see the lightning but, roused by the thunder, did see the fire-ball.

There was no further thunder at that point, although we did drive through a thunderstorm and heavy rain between Warminster and Amesbury later.

G. H. BROWN

Red Cottage, Colley Way, Reigate, July 29, 1957.

Abnormal temperature and visibility variations at Little Rissington on December 19–20, 1956.

A ridge of high pressure over England on December 19–20, 1956 gave widespread dense fog over most of England and Wales.

Rapid fluctuations of temperature by day and night with sharp changes in visibility occurred at Little Rissington during this period. The thermograph trace (Fig. 1) shows rises and falls of temperature of up to 6°F., in short periods of 30 min. to 1 hr., and the visibility varied between 75 yd. and 1,600 yd. with the fog clearing the airfield completely at times, although the tops of the fog layer could be seen on these occasions just beyond the airfield perimeter. Visibility between the screen and the fog bank during these clearances could be described as excellent.

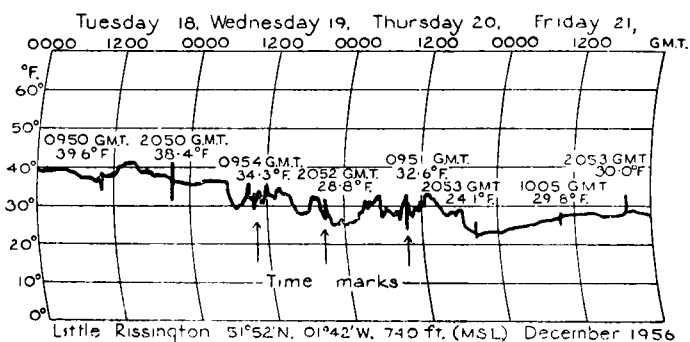


FIG. 1—THERMOGRAM SHOWING TEMPERATURE AT LITTLE RISSINGTON DECEMBER 18–21, 1956

The base of the inversion on the Crawley ascent for these two days (Figs. 2 and 3) varied between 988 mb. and 1010 mb. The recorded airfield pressure at Little Rissington during this period was between 1000–1003 mb. As the airfield at Little Rissington is situated on a high point in the Cotswolds at 750 ft. above mean sea level, it seems probable that the observed variations in temperature and visibility resulted from variations in the level of the inversion, drier and warmer air from above affecting the station from time to time. From observations of the thickness of the fog layer above and around the station it was estimated that the top of the fog layer was varying by about 50–150 ft. It would seem that Little Rissington was in or just below the inversion layer and this would account for the rapid rise and fall of the temperature and visibility.

Apart from small amounts of Ac. and Ci. at times, the sky was observed to be clear through the thin layer of fog or during temporary breaks. It will be seen from the thermograph trace that the sudden variations of temperature referred to continued during the night and cannot therefore be explained solely in terms of solar heating.

Calm conditions prevailed most of the time, although a few observations up to 3–6 kt. were recorded. The recorded sunshine during this period was 1.9 hr. on the 19th with visibility between 100–250 yd. and 2.8 hr. on the 20th

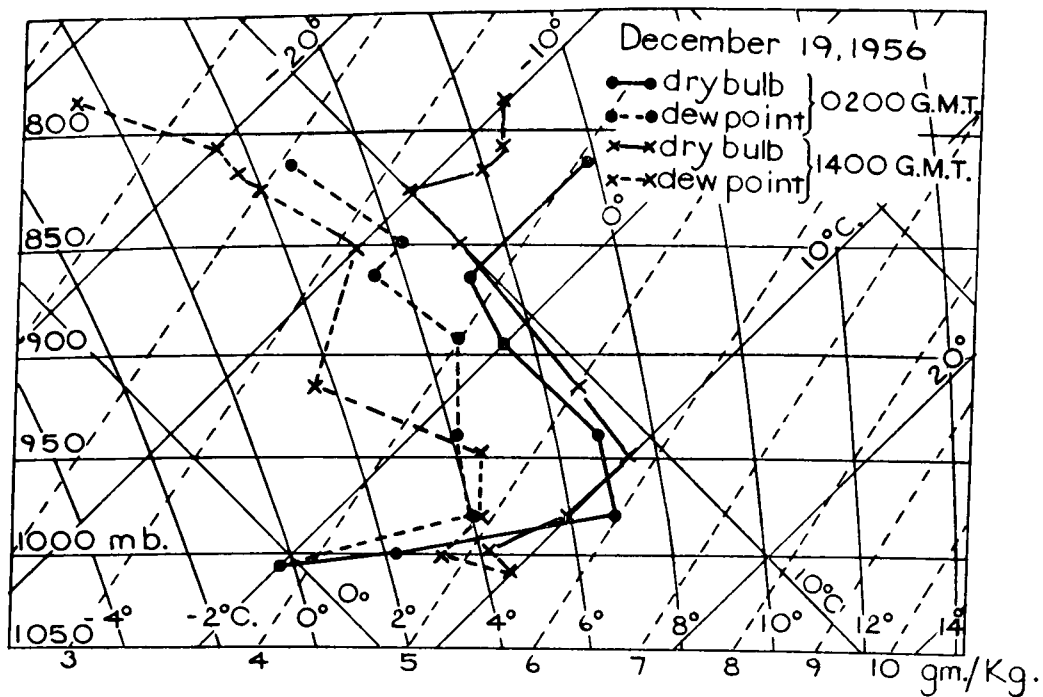


FIG. 2—TEPHIGRAM FOR CRAWLEY, DECEMBER 19, 1956

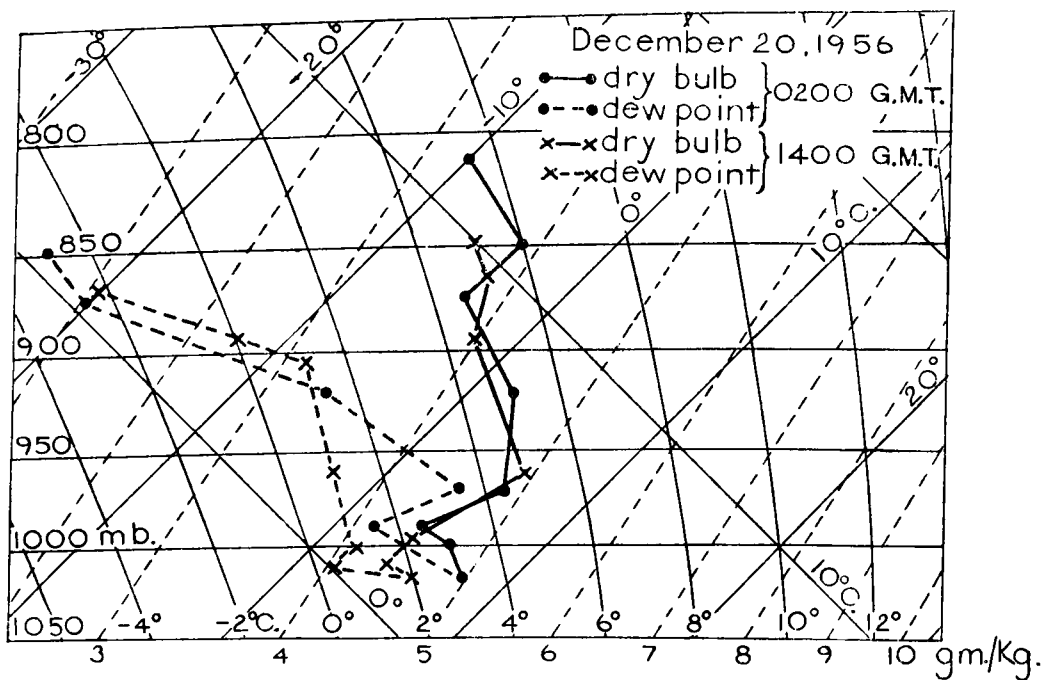


FIG. 3—TEPHIGRAM FOR CRAWLEY DECEMBER 20, 1956

with visibility between 150–700 yd. This was due to the fact that the fog bank was never further away than 700 yd. from the enclosure.

Hourly relative humidities for the period were between 99 per cent and 94 per cent on 32 out of 48 occasions, and even as low as 87 per cent and 83 per cent on the 20th at 1200 hr. and 1300 hr. respectively, when the fog bank was between 500–700 yd. from the screen. This again indicates the presence of drier air from above the inversion. The downwards movement of the inversion resulting in the replacement of moist cold air by drier warmer air and *vice versa*.

Little Rissington, Gloucester, January 18, 1957.

J. KONIECZNY

NOTES AND NEWS

Snow Survey of Great Britain

For the last three years the annual report of the Snow Survey has appeared in the December issue of the *Meteorological Magazine*. The report for the season 1956–57 and subsequent years will be published in *British Rainfall*, commencing with the 1957 volume. Advance copies of the 1956–57 report have been duplicated and distributed to co-operating observers. A limited number of copies are available to others interested in the Snow Survey and may be obtained on application to the Director-General, Meteorological Office, M.O.3.b., Headstone Drive, Harrow, Middlesex.

Meteorological Magazine: increase in price

We regret, as announced in our November number, that owing to further increases in the cost of printing and publication it has become necessary to again raise the price of the *Meteorological Magazine*. The price will be 2s. 6d. an issue with effect from the January 1958 number. The net annual subscription will become 32s. including postage. Present subscribers will remain on the existing rate until renewal of their subscriptions is due.

Microcards of International Geophysical Year meteorological data

Report No. 7 of the Meteorological Data Centre of the World Meteorological Organization contains full particulars of the microcards of I.G.Y. meteorological observations which the Centre is to produce.

The types of cards will be as follows:

1. Synoptic surface observations—land stations.
2. and 2b. Synoptic surface observations—sea stations.
3. Radio-sonde and rawin-sonde observations.
4. Upper-wind observations.

The observations will be grouped regionally. About 25 cards of Type 1 will comprise the world-wide data for 5 days and the complete set of Type 1 cards should not exceed 2,750. The number of the others will be larger, for Type 3 it is about 5,000. Full details and prices can be obtained from World Meteorological Organization, I.G.Y. Meteorological Data Centre, 1 Avenue de la Paix, Geneva, Switzerland.

Presentation of standard to 202 (Meteorological) Squadron, R.A.F.

On September 6, 1957 the ceremony took place at Aldergrove of the consecration and presentation of a standard to 202 Squadron, Royal Air Force, the squadron which carries out the "Bismuth" meteorological reconnaissance flights. The presentation was made by Air Chief Marshal Sir Douglas C. S. Evill, G.B.E., K.C.B., D.S.C., A.F.C., who commanded the squadron in 1916.

The Meteorological Office was represented at the ceremony and at the lunch which followed by Mr. S. P. Peters, D.D.M.O. (C), Mr. F. H. Dight, Chief Meteorological Officer, Headquarters Coastal Command, Mr. R. A. Buchanan, Senior Meteorological Officer, Northern Ireland and members of the staff at Aldergrove.

No. 202 Squadron was first formed at Eastchurch in 1914 as part of the Royal Naval Air Service. During the First World War its activities included the shooting down of a Zeppelin and reconnaissance work in preparation for the blocking of the harbours at Zeebrugge and Ostend.

After a period of disbandment the squadron was re-formed in 1929 as a flying-boat squadron and was stationed for some years in the Mediterranean.

During most of the Second World War 202 Squadron was stationed at Gibraltar and, flying in Catalina and Sunderland aircraft, helped to guard the approaches to the Mediterranean. Its record includes the sinking of three enemy submarines, a share in the sinking of three others and, in decorations, one Distinguished Service Order, two bars to the Distinguished Flying Cross, 12 Distinguished Flying Crosses, seven Distinguished Flying Medals and one George Medal.

Late in 1946 the squadron moved to Aldergrove and took over the meteorological reconnaissance work previously carried out by 518 Squadron. At first Halifax aircraft were used but in 1950 these were replaced by Hastings aircraft.

Five times a week a meteorological reconnaissance flight takes place along a track nominated by the Central Forecasting Office, and it is the firm belief of the aircrew that the Senior Forecaster there chooses the area of worst weather within range. During the recent North Atlantic Treaty Organization exercises the flights were temporarily increased to twice daily and on many occasions were designed to take the aircraft through the centre of the intense depression, previously known as Hurricane Carrie, which caused the loss of the sailing ship Pamir and threatened severe gales over the British Isles. The information gained on these flights was of outstanding value in the placing of the centre of the depression and the measurement of its depth.

REVIEW

Hailstorms of the United States. By S. D. Flora. 8½ in. × 5½ in., pp. xv + 368, *Illus.* University of Oklahoma Press, Norman, Oklahoma, 1956. Price: \$3.50. This book of facts, figures and pictures produced in sufficiently popular style for all classes of American laymen who require an informed attitude to the hail risk, should not be overlooked by farmers, insurance businesses or professional meteorologists in other countries. More than half the book, pp. 71-176, is given up to a description of the incidence of the hail hazard State by State

within the United States of America in some geographical detail, and a few pages at the end survey the rest of the world rather in the haphazard manner of newspaper reportage of weather phenomena abroad; but the first 70 pages contain information of wider interest which should command attention.

At Wichita in Kansas, the worst affected State in the Union, two hailstorms accompanied by tornadoes did \$9 million and \$14 million worth of damage within a two-year period. In the western plains between 100°W. and the Rocky Mountains one-tenth to one-twelfth of all the crops are destroyed annually by hail. In this region the risks are so serious that crop-hail insurance has become an important business, the rates being 15–20 per cent in the areas of greatest risk, and the 1950's have seen the development of a Severe Weather Warning Centre which attempts to forecast the size of hailstones.

Investigations so far conducted have suggested relationships between hail sizes and identifiable characteristics of the tephigram. Large hailstones with diameters 5 to 10 cm. or more are found almost exclusively when the "wet bulb freezing level" is 7,000 to 9,000 ft. above the ground. The standard severe-hail situation, which is plainly also a situation of maximum risk for thunderstorms and tornadoes, is related to the abrupt air-mass contrast between moist maritime tropical air streaming north from the Gulf of Mexico and föhn-dried cool air of Pacific origin descending from the Rockies. This makes the western plains particularly liable to violent phenomena.

Slightly heavier total losses have been assessed due to hail than to tornadoes: over the period 1944–53 the country-wide totals for the United States are given as \$53 million yearly due to hail and \$45 million yearly due to tornadoes. The two phenomena are however in some degree associated. These figures should serve as a sufficient warning against complacency anywhere where hail falls. The reviewer has pointed out that parts of southern and eastern England have a relatively high incidence of tornadoes; and newspaper photographs of hail lying in the streets of Tonbridge, Kent on August 6, 1956 match well with the scenes in towns in Kansas and Colorado illustrated in this book.

Maps show the incidence of hail damage over the United States, the average number of days a year with hail and the percentage of thunderstorm days on which hail is recorded. The latter percentage is highest in the maritime winter thunderstorms of the west coast, but the more serious hail is the late spring and summer hail of the Rocky Mountains and Great Plains. In this region aircraft need the provision of radar screens capable of detecting hail and farmers need insurance. The "man in the street" or on the farm in western Kansas who reads Mr. Flora's figures may also decide to change his haunts between 4 and 7 p.m.

H. H. LAMB

LETTER TO THE EDITOR

Computed forecast charts

In a paper entitled "Series of computed forecast charts and the movement of a depression, August 19–21, 1954" Potheary and Bushby¹ study the abnormal movement of a depression. It is claimed that conventional forecasting methods proved inadequate at the stage when the depression became stationary and later moved south-east. Referring to Fig. 1 of this paper it will be observed

that a large diffluent ridge-confluent trough pattern on the thickness chart is in evidence over the central and eastern Atlantic. This is the type of thickness pattern studied by J. Houseman and myself². In our paper we state that "any new depression developing on the confluent trough will move slowly south-east and fill". Figs. 10 and 11 of our paper illustrate this and are very comparable with the situation of Pothecaray and Bushby's work.

It is significant that the depression which they study does fill, whereas computation shows deepening at first and filling (but not sufficiently quickly) later. With the aid of our paper we can claim that conventional methods would have proved adequate and perhaps a little better than computation in this instance. It is also noteworthy that the anticyclone involved in the development behaved according to our hypothesis.

C. HAWORTH

REFERENCES

1. POTHECARY, I. J. W. and BUSHBY, F. H.; Series of computed forecast charts and the movement of a depression, August 19-21, 1954. *Met. Mag., London*, **85**, 1956, p. 133.
2. HOUSEMAN, J. and HAWORTH, C.; Anticyclogenesis in relation to a particular thickness pattern. *Met. Mag., London*, **86**, 1957, p. 321.

[I would like to add the following brief comments to Mr. Haworth's letter concerning the paper by Pothecaray and myself. In this particular situation I think the movement of the depression was of prime importance, and the variation in the central pressure of only secondary importance. Certainly, the differences between the computed and actual central pressures should not have led to any serious forecasting error.

Secondly, it is very difficult to estimate, after an event, the results of applying a subjective rule before the event. Mr. Haworth's rule that "any new depression developing on the confluent trough will move slowly south-east and fill" would not seem to describe the movement of this depression which moved due east, stagnated and then drifted slowly south-west.

F. H. BUSHBY]

OFFICIAL PUBLICATION

Climatological and sea-surface current charts of the North Atlantic.

This new publication, which has been prepared in the Marine Division of the Meteorological Office, consists of monthly charts of meteorological and ocean-current data covering the North Atlantic. These charts are being produced primarily for the benefit of the masters and officers of merchant ships, as a result of a suggestion made by the master of a voluntary observing ship. The contents are based on the data contained in *Monthly meteorological charts of the Atlantic* and *Quarterly surface current charts of the Atlantic*, which were compiled from observations made aboard British voluntary observing ships between 1855 and 1939. Printed on a single sheet, 23 in. × 39 in., the new charts show wind roses, ocean currents, ice limits, main shipping tracks, and, on small insets, mean air and sea temperatures, barometric pressure, visibility, and frequencies of gales and hurricanes.

The charts for May, June and July have already been published, and the remaining charts will be published at approximately monthly intervals by H.M.S.O. at the very reasonable price of 3s. each. Similar monthly charts for the South Atlantic are in the course of preparation, and those for the Indian Ocean and the North and South Pacific Oceans will also be prepared and published as soon as possible.

METEOROLOGICAL OFFICE NEWS

Halley Bay.—We note with pleasure that Mr. J. MacDowall is to become leader of the Royal Society International Geophysical Year Expedition, Halley Bay, in January 1958 in succession to Colonel R. A. Smart, R.A.M.C. who will return then to the United Kingdom as arranged in 1956. During 1957, Mr. MacDowall has been leader of the group—all members of the Meteorological Office—responsible for the Expedition's work in meteorology, geomagnetism, glaciology and seismology¹. Mr. B. G. Ellis and Mr. J. A. Smith, of the Meteorological Office, left England in M.V. *Tottan* on November 18, 1957 to join the party at Halley Bay for the remainder of the International Geophysical Year. Mr. P. H. Jeffries, after spending 1956 with the Trans-Antarctic Expedition advance party at Shackleton and then 1957 with the Royal Society Expedition, is to leave Halley Bay for England in January 1958.

We wish success to all at Halley Bay.

REFERENCE

1. Royal Society International Geophysical Year Expedition to Antarctica. *Met. Mag., London*, **86**, 1957, p. 25.

Academic successes.—In addition to the list published in the November magazine (p. 349) the following members of the staff have also been successful in their examinations:

B.Sc. (General): I. Jenkins.

General Certificate of Education (Advanced level): O. W. Brittain, N. Holdsworth, J. F. Holter, J. B. Lawson, Miss M. J. Moore, D. J. Smith, D. W. Sutton, C. F. Townsend, Miss J. B. Weldon and R. A. White.

Ordinary National Certificate: M. T. Tomlinson.

WEATHER OF OCTOBER, 1957 Great Britain and Northern Ireland

Over the greater part of the British Isles the weather in the first half of the month was anticyclonic and dry, without measurable rainfall in many midland and southern districts of England, but the second half was generally changeable.

An anticyclone, which was situated to the south-west of Ireland during the first three or four days of the month, gave mainly fine quiet weather over most of England and Wales, but over Scotland and Northern Ireland, there was some light rain and drizzle. Ground frosts were fairly widespread during the early hours of both the 1st and 2nd and by day the weather was bright especially in the south of England where in many places it was brilliantly sunny. Gales occurred in north Scotland on the 3rd and winds reached 70 kt. in the Orkneys as a vigorous depression off the north coast moved rapidly eastwards towards southern Scandinavia. On the 5th the anticyclone off south-west Ireland began to move eastwards to the continent, the highest pressure becoming situated over the central English Channel on the 6th and over the Balkans the following day. Most of the British Isles remained in a weak pressure gradient for another week, but with the movement of the anticyclone winds over the country backed from a northerly to a southerly direction and warmer air spread to many

districts. Early morning fog developed over eastern and southern counties on the 7th and, during this second week, fog became progressively more extensive each morning over England and Wales. Afternoon temperatures were mainly in the sixties and reached 70°F. locally in Devon on the 10th, while on the 13th, 14th and 15th, which were generally the warmer days of the month in southern England, temperatures were about 10°F. above the seasonal average.

The spell of settled weather was brought abruptly to an end early on the 16th by a burst of cold air which swept eastward across the country accompanied by a broad belt of rain which was heavy at times, and associated with strong westerly winds at high levels. Many places reported nearly an inch of rain on that day. With the westerly régime well established a vigorous depression moved eastward across Ireland and northern England on the 17th giving a wet almost sunless day with some unusually heavy rain in Scotland. The following day was somewhat similar, but on the 19th weather was generally brighter though there were showers with thunderstorms in places and it remained generally cold. Ground frost was widespread early on the 20th, and, though it was sunny at many places at first, another rain belt moved across the country during the day from the north-west, followed later by cooler bright and showery weather which persisted for the next two days. Further rain belts moved into the country on the 23rd, but on this occasion they became slow moving, and dull rainy weather persisted until the morning of the 26th. After a brief finer spell the sequence of events was repeated. Rainfall was particularly heavy in western districts and during the period 26th–29th a total of 12·71 in. was recorded at Blaenau Festiniog in Merionethshire. Widespread gales developed on the last day of the month as a deep depression moved from Denmark Strait to north Scotland; a gust of 70 kt. was reported from the Hebrides.

Temperature was above the average over the month as a whole and sunshine was mainly below average. Rainfall was 74 per cent of the average over England and Wales, 113 per cent over Scotland and 188 over Northern Ireland. It was less than half the average over much of Kent, Surrey and Sussex, over an area extending from Monmouthshire to Lincolnshire and over the eastern counties of Scotland. It was above average over North Wales, north-west England and the western half of Scotland. The dry weather during the first half of the month gave growers a chance to catch up with their cultivations and field work, even on the heaviest soils, became well advanced. Rain later in the month helped planting out and the bright sunshine completed the ripening to a good deal of fruit, including the outdoor tomato crop. Heavy rain at the end of the month caused local flooding in Wales and the Midlands.

The general character of the weather is shown by the following provisional figures:—

	AIR TEMPERATURE			RAINFALL		SUNSHINE
	Highest	Lowest	Difference from average daily mean	Per-centage of average	No. of days difference from average	Per-centage of average
	°F.	°F.	°F.	%		%
England and Wales ...	70	27	+1·4	74	—4	86
Scotland ...	65	20	+1·2	108	+1	79
Northern Ireland ...	64	33	+0·6	118	0	71

RAINFALL OF OCTOBER 1957

Great Britain and Northern Ireland

County	Station	In.	Per cent. of Av.	County	Station	In.	Per cent. of Av.
<i>London</i>	Camden Square ...	1·99	76	<i>Glam.</i>	Cardiff, Penylan ...	4·21	89
<i>Kent</i>	Dover	1·23	32	<i>Pemb.</i>	Haverfordwest ...	4·38	81
"	Edenbridge, Falconhurst	1·54	43	<i>Radnor</i>	Tyrmynydd ...	5·09	77
<i>Sussex</i>	Compton, Compton Ho.	2·60	57	<i>Mont.</i>	Lake Vyrnwy ...	6·43	110
"	Worthing, Beach Ho. Pk.	1·51	42	<i>Mer.</i>	Blaenau Festiniog ...	16·57	162
<i>Hants.</i>	St. Catherine's L'thouse	2·00	53	"	Aberdovey ...	6·96	146
"	Southampton (East Pk.)	2·39	61	<i>Carn.</i>	Llandudno ...	2·72	81
"	South Farnborough ...	1·59	50	<i>Angl.</i>	Llanerchymedd ...	4·90	109
<i>Herts.</i>	Harpenden, Rothamsted	2·38	75	<i>I. Man</i>	Douglas, Borough Cem.	5·82	128
<i>Bucks.</i>	Slough, Upton ...	2·02	72	<i>Wigtown</i>	Newton Stewart ...	4·99	110
<i>Oxford</i>	Oxford, Radcliffe ...	2·06	71	<i>Dumf.</i>	Dumfries, Crichton R.I.	4·79	121
<i>N'hants.</i>	Wellingboro' Swanspool	1·74	69	"	Eskdalemuir Obsy. ...	7·74	143
<i>Essex</i>	Southend, W. W. ...	1·43	57	<i>Roxb.</i>	Crailing... ..	2·58	90
<i>Suffolk</i>	Felixstowe	1·28	56	<i>Peebles</i>	Stobo Castle ...	3·31	96
"	Lowestoft Sec. School...	1·33	48	<i>Berwick</i>	Marchmont House ...	2·02	53
"	Bury St. Ed., Westley H.	1·54	57	<i>E. Loth.</i>	North Berwick Gas Wks.	1·21	41
<i>Norfolk</i>	Sandringham Ho. Gdns.	1·80	59	<i>Midl'n.</i>	Edinburgh, Blackf'd. H.	1·90	69
<i>Wilts.</i>	Aldbourne	2·40	67	<i>Lanark</i>	Hamilton W. W., T'nhill	3·87	119
<i>Dorset</i>	Creech Grange... ..	3·16	62	<i>Ayr</i>	Prestwick	3·74	130
"	Beaminster, East St. ...	2·82	63	"	Glen Afton, Ayr San. ...	5·88	115
<i>Devon</i>	Teignmouth, Den Gdns.	2·00	52	<i>Renfrew</i>	Greenock, Prospect Hill	6·60	130
"	Ilfracombe	5·08	111	<i>Bute</i>	Rothsay, Arden Craig ...	5·74	130
"	Princetown	7·67	91	<i>Argyll</i>	Morven, Drimnin ...	8·11	136
<i>Cornwall</i>	Bude	4·22	104	"	Poltalloch	8·21	167
"	Penzance	3·32	71	"	Inveraray Castle ...	11·70	166
"	St. Austell	3·43	65	"	Islay, Eallabus ...	5·76	121
"	Scilly, Tresco Abbey ...	2·01	53	"	Tiree	4·93	108
<i>Somerset</i>	Taunton	1·93	60	<i>Kinross</i>	Loch Leven Sluice ...	3·05	89
<i>Glos.</i>	Cirencester	2·10	61	<i>Fife</i>	Leuchars Airfield ...	1·42	55
<i>Salop</i>	Church Stretton ...	1·91	52	<i>Perth</i>	Loch Dhu	8·63	121
"	Shrewsbury, Monkmore	1·79	64	"	Crieff, Strathearn Hyd.	2·59	66
<i>Worcs.</i>	Malvern, Free Library...	1·10	37	"	Pitlochry, Fincastle ...	1·96	60
<i>Warwick</i>	Birmingham, Edgbaston	1·49	49	<i>Angus</i>	Montrose Hospital ...	1·27	46
<i>Leics.</i>	Thornton Reservoir ...	1·23	44	<i>Aberd.</i>	Braemar	1·95	52
<i>Lincs.</i>	Boston, Skirbeck ...	1·55	57	"	Dyce, Craibstone ...	1·39	41
"	Skegness, Marine Gdns.	1·47	54	"	New Deer School House	2·39	63
<i>Notts.</i>	Mansfield, Carr Bank ...	1·20	39	<i>Moray</i>	Gordon Castle	1·48	47
<i>Derby</i>	Buxton, Terrace Slopes	4·72	96	<i>Nairn</i>	Nairn Achareidh ...	1·53	67
<i>Ches.</i>	Bidston Observatory ...	2·63	80	<i>Inverness</i>	Loch Ness, Garthbeg ...	4·72	132
"	Manchester, Ringway ...	2·91	94	"	Loch Hourn, Kinl'hourn	17·54	178
<i>Lancs.</i>	Stonyhurst College ...	8·13	181	"	Fort William, Teviot ...	10·77	152
"	Squires Gate	4·29	121	"	Skye, Glenbrittle ...	11·13	135
<i>Yorks.</i>	Wakefield, Clarence Pk.	1·04	36	"	Skye, Duntulm... ..	7·97	146
"	Hull, Pearson Park ...	1·54	52	<i>R. & C.</i>	Tain, Mayfield... ..	1·59	58
"	Felixkirk, Mt. St. John...	2·03	70	"	Inverbroom, Glackour...	8·30	147
"	York Museum	2·03	75	"	Achnashellach	12·49	164
"	Scarborough	3·09	99	<i>Suth.</i>	Lochinver, Bank Ho. ...	7·92	172
"	Middlesbrough... ..	1·69	56	<i>Caith.</i>	Wick Airfield	2·02	68
"	Baldersdale, Hury Res.	3·75	101	<i>Shtland</i>	Lerwick Observatory ...	6·28	159
<i>Norl'd.</i>	Newcastle, Leazes Pk....	1·75	57	<i>Ferm.</i>	Crom Castle	4·90	151
"	Bellingham, High Green	2·66	68	<i>Armagh</i>	Armagh Observatory ...	3·49	128
"	Lilburn Tower Gdns. ...	1·90	51	<i>Down</i>	Seaforde	4·06	114
<i>Cumb.</i>	Geltsdale	4·67	126	<i>Antrim</i>	Aldergrove Airfield ...	3·23	108
"	Keswick, High Hill ...	6·29	112	"	Ballymena, Harryville...	4·12	111
"	Ravenglass, The Grove	4·76	110	<i>L'derry</i>	Garvagh, Moneydig ...	3·99	111
<i>Mon.</i>	A'gavenny, Plás Derwen	2·10	45	"	Londonderry, Creggan	4·18	111
<i>Glam.</i>	Ystalyfera, Wern House	7·89	115	<i>Tyrone</i>	Omagh, Edenfel ...	3·70	10

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