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SIR NELSON K. JOHNSON, K.C.B., D.Sc., A.R.C.S.

The death is recorded, with deep regret, on March 23, 1954, of Sir Nelson K. Johnson, who retired in September 1953 from the post of Director of the Meteorological Office.

All who knew Sir Nelson, and especially those who worked in close contact with him during the anxious years of the war and the reconstruction period which followed, will deeply regret the passing of this hard-working and most conscientious of Civil Servants.

His scientific and official careers were described in the *Meteorological Magazine* of October 1953. Now it is appropriate to dwell more on his personal qualities of devotion to duty, his insight into complicated scientific and administrative problems and ability to resolve them into their essential constituents, his unassuming manner, unfailing courtesy and ability to get the best work out of his staff. In international meteorology, among his fellow Directors and the senior staff of the World Meteorological Organization, the quality of his control as President over difficult and delicate meetings was renowned.

The sympathy of all Sir Nelson's colleagues will be extended to Lady Johnson and her son and daughter in their great loss.

CHANGES IN THE STRUCTURE OF THE METEOROLOGICAL OFFICE

By THE DIRECTOR OF THE METEOROLOGICAL OFFICE

The Meteorological Office has a dual responsibility: first, to provide the national weather service and second, to undertake investigations in the science of meteorology. This two-fold task necessitates an organization which is efficient both as a public service and as a scientific institution. Like any other large organization, public or private, the Office must adjust its structure from time to time to ensure that these requirements are met.

Since taking up my duties in September 1953 I have given much time and thought to the problems which the Office has to face and solve, both now and in the future. It is probably fair to say that in the past 30 years meteorologists everywhere have been more preoccupied with the exploration of the upper air and with the consequences of the rapid development of aviation than with other problems. Today we are faced with a growing demand for services for the general public and for agriculture and industry. This is a challenge which the Office is glad to accept.

To meet all these requirements necessitates some changes in the chain of responsibility and the creation of some new senior posts. The operational and investigational sides must be able to develop on their own and yet exchange ideas freely. To allow this to be done efficiently I have re-allocated certain responsibilities. The operational side of the Office is now entirely the responsibility of the Deputy Director (Forecasting) and the Deputy Director (Services), and the Deputy Director (Research) takes charge of all investigations. Climatology has been divided into two groups, one under the Assistant Director (Climatological Research) who is responsible to D.D.M.O.(R) and one under the Assistant Director (Climatological Services), who comes under D.D.M.O.(F) (this underlines the fact that the provision of climatological advice to industry, agriculture, etc., is becoming more closely linked with forecasting than before). The three Senior-Principal-Scientific-Officer posts in the Forecasting Division have been abolished, and in future the operations room at Dunstable will be controlled by the Assistant Director (Central Forecasting) under D.D.M.O.(F).

The substantial increase in the past few years of specialized forecasting and advisory services for Government departments, public corporations, industry and commerce, and recent developments in the use of broadcasting, both sound and television, have shown the need for an officer of senior grade, on the staff of D.D.M.O.(F), to devote his undivided attention to these matters. It is only by the establishment of personal relationships with inquirers and users that their meteorological problems can be fully appraised. A new post, that of Assistant Director (Public Services) has therefore been created. A.D.M.O.(P.S.) will be given the responsibility of watching, on behalf of D.D.M.O.(F), the public need and how it is being met. It is my hope that in this way it will be possible to make our work of greater use, and greater interest, to the nation as a whole.

On the research side, the Forecasting Research Division will come under D.D.M.O.(R), but the Assistant Director (Forecasting Research) will continue to give advice to the Forecasting Division when requested. The Marine Superintendent and the Marine Branch will, in future, be directed by D.D.M.O.(F), but with the provision that research in marine climatology will be supervised by D.D.M.O.(R), when requested to do so by D.D.M.O.(F).

The general effect of these changes is to give expression to the principle that meteorology, although covering an enormous field, is essentially a whole. To separate one branch of the subject from another is to restrict progress everywhere—the climatologist has much to give the synoptician and the forecaster can contribute greatly to climatology. I believe this to be true in both the operational and investigational sides of the Office, and the present re-allocation of posts is, I hope, a step in the right direction.

WEATHER WISDOM BY TELEVISION

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

Introductory.—The presentation on television broadcasts of meteorological information and forecasts by co-operation between the Meteorological Office and the B.B.C. was begun on July 29, 1949, as described by Mr. Bilham in the *Meteorological Magazine* for October 1949. The form of this presentation was largely determined by the resources of the B.B.C. and was certainly not regarded as wholly satisfactory by the Meteorological Office. The latter wanted a more personal and "live" form. Early last year the B.B.C. indicated that an increase in their resources was expected such that an improved form of presentation could be considered. This was an opportunity which was welcomed by the Meteorological Office, and work was immediately begun on devising something better than had hitherto been possible. A tenet of the Forecast Division has long been that if only the forecaster could speak to his "client", as is done, for example, when a forecaster briefs a pilot at an airport, then that "client" is far more likely to be satisfied than through an intermediary who is a layman, even if that layman is a B.B.C. announcer reading a carefully prepared script. Early in the planning stage the idea was revived, strongly backed by the new Director of the Meteorological Office, that the forecaster himself should appear in the television studio and impart his forecast personally. There were considerable difficulties in the way of this idea, an example of which is that forecasters are generally chosen for their scientific and professional ability as meteorologists and not normally with any eye to their photogenic or histrionic attributes.

Technical resources.—What were the new technical resources which the B.B.C. had to offer? In Mr. Bilham's article, referred to, it was stated that three cameras were used, and for the new presentation, we had only two. But one of these was a "split-beam" camera which essentially could be regarded as two fixed cameras suitable only for "viewing" stationary objects at fixed distances, such as weather charts on easels. The other camera was the movable camera normally used for viewing the announcer. But the most important addition to resources was a special announcer's studio which would also be used as a "weatherman's" studio. Early attempts to use the split-beam camera for work other than that for which it was designed had to be abandoned, and any suggestions that it should be so used could only be rejected. With only one movable camera to juggle with, an urgent problem was how to move from forecaster to announcer without the deplorable gaffe of "panning" from one to the other. To get over this it was essential to interpose a chart (split-beam camera) between any presentation of the forecaster and the announcer so that there may be a picture sequence: forecaster, chart, announcer. In assessing the technique of the new form of presentation, it is imperative to have in mind the rigid technical limits within which work must be carried on.

Purpose of broadcasts.—This is to impart to ordinary folk, who happen to have a television set, the ideas of a professional forecaster concerning the weather of today and tomorrow, the latter leading on from the former—in the serial-story form mentioned by the Director in the March *Meteorological Magazine*. The language used is of the easy conversational style one might employ at a friendly fireside chat. But since all the world enjoys being given a peep behind the scenes, a certain limited technicality is permissible to give the listener the feeling he is sharing in the process of forecasting. Incidentally also this technicality has an educational intention, a pill which the skilful expositor can coat with jam, and, finally, it may give some clues to the technically informed. Hence, for example, the references to fronts rather than to troughs of low pressure. The diversity of points of view of his audience, which the television forecaster must keep in mind, is such that he cannot aim to satisfy fully the technically informed, but must aim to give satisfaction to the greatest number.

Form of presentation.—For the benefit of those who have not seen it, the form of presentation, in outline, is:—

1. The forecaster, after greeting his audience, turns to a simplified version of the 1500 G.M.T. chart of the day on a scale specially devised for the purpose, and describes the weather of the day by reference to it, high-lighting outstanding items and harking back to the forecast of the previous day to bring out any relevant points.

2. Following on from 1, he slides in another chart, the 1200 G.M.T. prebaratic chart of the next day, on the same scale as the previous one, and after dealing with the general synoptic situation as a continuation from his previous discourse, he proceeds to give area forecasts for broad areas of the British Isles.

3. The camera then leaves the charts and turns exclusively to the forecaster who gives a "Further outlook" in brief general terms for the day following tomorrow, and after bidding his audience "Goodnight" he refers them to:

4. A "fair copy" of tomorrow's prebaratic and forecast chart.

This last item, viewed by the split-beam camera, is introduced as a "cover-up" to allow the mobile camera, used for all the other items, to turn from the forecaster to the B.B.C. announcer.

The charts are specially prepared at Victory House before the broadcast, and the epoch to which the chart of "today" refers is dictated by the time necessary for this.

As the Director mentioned in his article in the March Magazine, the forms of presentation in other countries were considered, but, partly for technical reasons, it was decided to evolve our own. We in this country have a different broadcasting technique from that in America, and the taste of our listening public is probably also different from that in America.

The form of presentation had certain desiderata: the forecaster should appear in the picture as much as possible, and the static nature of the charts should be enlivened as much as possible by illustrating movement. Now to present both the forecaster and a readable chart on the television screen while at the same time preserving a technique of presentation acceptable by the standards of the B.B.C. is difficult. The difficulty can only be partially overcome by bringing chart and forecaster into the picture more or less alternately, though parts of the forecaster can be seen for most of the presentation. On the chart itself legibility can often be obtained only by the sacrifice of detail, and for this the forecaster has to try and make up by exposition. Fronts are delineated in symbolic form, but a forecaster cannot diverge too far from his immediate task to go into detailed explanation of the symbols. Otherwise his audience may confuse his explanation with his description of the weather of today and his forecast of tomorrow's weather. Strictly, the forecaster should refer to nothing which is not being looked at by his audience, if a good technique is to be followed. Pressures on a very few isobars are marked in millibars, but such markings must be kept to a minimum. The problem of showing wind direction and strength on charts has yet to be solved satisfactorily, but the forecaster indicates from time to time how this may be deduced, and by reference to fronts or otherwise he frequently indicates the broad general movement of air masses.

Development.—Sufficient letters have been received from owners of television sets to justify the belief that the new form of presentation is preferred by the majority to the old, and one may, with proper caution, say that the reception by our "clients" of this new service is encouraging. Some suggestions for improvement are impracticable because of the technical difficulties of presentation. Others have already been incorporated in the presentation.

The Director in his article in the March Magazine indicated that the present period was regarded as one of experimentation, and it is certainly true that the service is constantly under surveillance with a view to its improvement. At present only four minutes is allowed for the broadcasts, but this may be increased to five minutes, with decided advantage to the broadcaster. However, it is better that there should be requests for more time to be given to the broadcasts rather than for less.

It may be that the scale or the area of the charts now used could be modified with advantage, and this is a point which will receive attention. As for the general technique, the television forecasters themselves are building up day by day a volume of experience not hitherto available, and in course of time that experience may dictate changes for the general improvement of the service. The best is sometimes the enemy of the good, and it is probably true to say that had we waited for the best service we should still be waiting. The new presentation on television, achieved with the friendly and assiduous co-operation of Mr. Clive Rawes of the B.B.C., gives the Forecast Division of the Meteorological Office a great opportunity of which it is fully conscious and of which it intends to make the most.

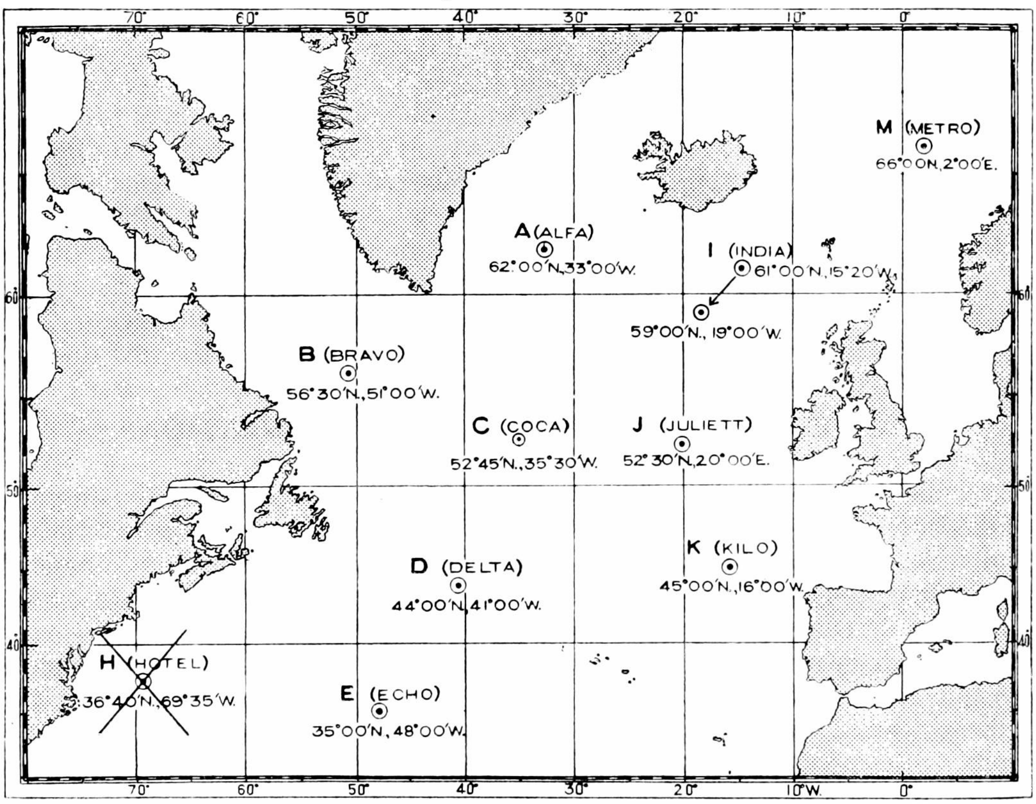
Since the above was written a further innovation has been made by showing at the end of each television programme the fair copy of the forecast chart, while the allied forecast and outlook, prepared by the television forecaster, are read by the announcer on duty. This addition was made for the first time on April 15, 1954.

NORTH ATLANTIC OCEAN WEATHER STATIONS

By Cmdr C. E. N. FRANKCOM, R.N.R. (Retd)

The Fourth North Atlantic Ocean Station Conference held under the auspices of the International Civil Aviation Organization opened in Paris on February 9 and ended on February 25, 1954. This was a full-scale technical and financial conference, and it took place as the result of a recommendation made by the Third Conference (the terms of reference of which were restricted to financial matters) which was held at Brighton in June 1953. At the Third Conference it became obvious that owing to financial considerations some reduction in the network would be inevitable, but the limited terms of reference of that conference prevented any technical discussion, which was an essential preliminary to any modification to the network, and it was for this reason that the Fourth Conference took place. The statement, issued by the United States Authorities in October 1953, that they contemplated withdrawing all their vessels from the scheme even though it was followed by a later statement (in December 1953) that they would co-operate in a limited network, combined with the need of all the participating countries to economize, and the consequent difficulties of finding the finance necessary for manning sufficient stations on the European side did not seem to augur well for the success of the Conference.

As it happened, it can be said with justification that international goodwill and a ready spirit of compromise prevailed with the result that a very satisfactory agreement was signed. All the national authorities present at the conference recognized the meteorological importance of this network, not only for the safety and efficiency of transatlantic aviation but also for meteorological research and for general meteorological purposes. There was general agreement among those present that for technical reasons it was important that the network should be reduced as little as possible, bearing in mind the necessity for economy and the number of ships available for manning the network. It was clearly shown in the technical discussions that, because of the complex meteorological situation in the North Atlantic, as soon as one station was removed from the network the consequent displacement of other stations which became necessary tended to destroy the balance of the network as a whole. After considerable discussion it was agreed that, as it was obvious for financial reasons that some reduction in the network was essential, the elimination of station H (situated between Bermuda and New York) would cause the least harmful effect upon the network, but that it was extremely desirable that the remainder of the network should remain as it was. It was agreed that station I should be moved somewhat to the south-west of its present location.



NORTH ATLANTIC OCEAN WEATHER STATIONS

To be manned by European vessels, A, I, J, K, M.
To be manned by North American vessels, B, C, D, E.

After taking into account the number of Atlantic crossings of aircraft belonging to the various States, and taking also into consideration non-aeronautical benefits, an agreement was reached whereby Europe would operate the "eastern" chain of stations (A, I, J, K and M) while the United States and Canada would between them operate the "western" stations (B, C, D and E). Non-aeronautical benefits are simply those benefits which are derived from the network by other interests than civil aviation. Although past conferences have been unable to devise any method of taking these into account and although no precise method of evaluating them has yet been developed, the Paris Conference agreed that they should be given weight in distributing responsibilities among States even though only a rough and ready assessment could be made. It was agreed that the ratio of aeronautical to non-aeronautical benefits derived from the network would be assessed in the ratio of 80 to 20, and that the aggregate non-aeronautical benefits for the United States and Canada as against those for European States would be in the proportion of 1 to 3, with the realization that the weather tends to move from west to east across the Atlantic and that Europe therefore tends to benefit more from certain sections of the network than does North America. In making this assessment it was agreed that benefits to meteorological research should not be taken into account as this benefited all countries. Nor should benefits to shipping be considered, owing to the international nature of shipping and the fact that ships contribute so much voluntary meteorological information.

A major consideration was the number of vessels available to man the network, and it soon became obvious that the maximum number of vessels which Europe could provide and yet keep within reasonable financial bounds was 10 (France 2, Netherlands 2, Norway and Sweden combined 2, and the United Kingdom 4).

After a somewhat lengthy discussion by the European operating countries, an ingenious "rotation" scheme was developed (by Dr. Bleeker of the Netherlands), and accepted by the countries concerned, whereby stations A, I, J, K and M could be operated by the available 10 European vessels. The United States and Canada at the same time agreed that they would operate the remaining stations B, C, D and E with 11 vessels. A generous gesture was made here by the North American operators agreeing to undertake somewhat more than their calculated responsibility. This arrangement meant, nevertheless, a heavy task for the European operators, because the 5 "European" stations had previously been operated by a total of 12 vessels (10 European and 2 United States). However, the "Bleeker schedule", although it will mean some increase in operating costs for all European operators, does enable the European States to discharge their task in the new scheme without going to the considerable expense of bringing additional vessels into service.

Under the new agreement it is the responsibility of the operating countries to provide vessels as follows: United States and Canada combined 11, Netherlands 2, Norway and Sweden combined 2, France 2 and United Kingdom 4. Belgium, Denmark, Israel, Italy and Switzerland agreed to make substantial cash contributions, which will be shared among the European operating countries. Iceland and Spain were not immediately in a position to adhere to the prescribed new agreement, but there is every reason to hope that they will adhere before long, as cash contributors. Ireland agreed to contribute a token payment of £1,000. As a result of this, the United Kingdom continues to operate her 4 vessels but receives a substantial cash payment. After taking into account the cost of the greater extent to which the United Kingdom vessels will need to be operated, the eventual net cost of the new agreement to the British taxpayer will be about £30,000 a year less than before.

The new agreement comes into force when the present one expires at 0001 on July 1, 1954, and lasts for two years, after which it may be extended automatically from year to year in the absence of twelve months notice of objection by States having specified responsibility.

For the operation of the "European" stations during the first six months of the new agreement the 2 Norwegian vessels will occupy station A, the Netherlands vessels station M, the United Kingdom vessels stations I and J and the French vessels will remain at station K. On the completion of the first six months the Norwegian vessels will return to station M, and the French, British and Netherlands vessels will occupy stations A, I, J and K in rotation. The exception to this rotation scheme is that whenever a French vessel would be assigned to duty at station I at the same time as a British vessel at station K two vessels will switch round so that the British vessel goes to station I and the French vessel to station K. Under this arrangement station A is obviously the most difficult to operate, and this will be occupied by each of the 8 vessels concerned (4 British, 2 Netherlands and 2 French) in strict rotation. Thus in a year, 4 British vessels will do 8 voyages at station A and 4 voyages at station K. Owing to their small size and limited fuel capacity, whenever a British vessel occupies stations A or K they will need to re-fuel at Reykjavik or Milford Haven respectively, both outward and homeward bound. In order to carry out the rotation scheme effectively and provide sufficient time in harbour at the end of each voyage to undergo repairs, give leave, etc., each vessel will need to spend 24 days on station in future instead of 21 days as at present. The average time in harbour at the end of each voyage will be about 16 days. It was decided that the meteorological programme of the network was already satisfactory, and that no changes should take place. Some minor changes were approved by the Conference concerning air/sea rescue equipment and communication arrangements between the ocean weather ships and aircraft in flight, and the international aspect of the oceanographical programme of the network was somewhat modified.

The Chairman of the Conference was Dr. Dekker (Netherlands) who is Chairman of the Netherlands Weather Ship Committee and had also been Chairman of the Third North Atlantic Ocean Station Conference at Brighton. Dr. Sutton (United Kingdom) was elected Chairman of the Financial Committee and Capt. Meaux (France) Chairman of the Technical Committee. International organizations representated at the Conference included the World Meteorological Organization, the International Association of Physical Oceanographers, the International Air Transport Association, and the International Federation of Airline Pilots Association.

From the British viewpoint it can be stated that the new agreement is not unsatisfactory. A reasonable meteorological network in the North Atlantic is essential if we are to provide satisfactory meteorological information for transatlantic aircraft leaving United Kingdom airfields, and such a network is extremely valuable from the viewpoint of general forecasting and for meteorological research in this country. Such a network has been achieved at the expense of some greater effort on the part of the ocean weather ships themselves, and, as already noted, owing to the greater cash contributions provided by non-operating countries the cost of British participation has been reduced. From the operational viewpoint and particularly for those who serve aboard the ocean weather ships, the longer distance the ships will have to go at times to man the stations and the somewhat longer time they will have to spend at sea each

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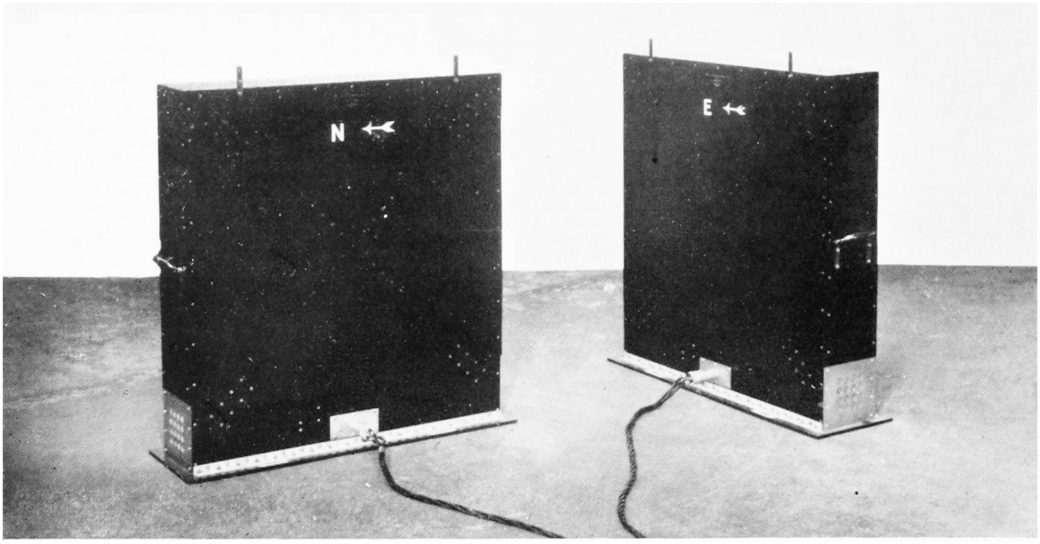
THE DIRECTOR OF THE METEOROLOGICAL OFFICE SIGNING THE NEW AGREEMENT ON NORTH ATLANTIC OCEAN STATIONS IN PARIS, FEBRUARY 1954

Mr. E. Weld, Assistant Secretary-General of the International Civil Aviation Organization is on the Director's right (see p. 133)



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LOOP AERIALS AND CONSOLE OF THE NEW DESIGN OF RADIO DIRECTION FINDER FOR LOCATING THUNDERSTORMS (SFERIC) voyage, combined with the shorter aggregate time in harbour will raise some problems and cause some inconvenience—but it does not seem that any of these problems are insoluble.

This new agreement is necessarily somewhat more complicated than its predecessors, but it does provide a rather striking example of international co-operation in a businesslike and practical manner, which contributes not only to the safety of air navigation but to the whole cause of meteorological science.

NEW DESIGN OF RADIO DIRECTION FINDER FOR LOCATING THUNDERSTORMS

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Abstract.—The instrument described is a twin-channel cathode-ray direction finder for use at frequencies of about 10 Kc./sec. and is designed for locating thunderstorms. Its performance is similar to that of earlier designs, but it is smaller, easier to use, cheaper to manufacture, and suitable for use in tropical climates. The description includes only the main features of the design; a more complete account is in preparation.

General.—The location of thunderstorms by radio means has now become an established part of meteorology, and it seems likely that additional networks of observing stations for location at long ranges will be required. In anticipation of possible future demands for twin-channel cathode-ray direction finders of the type used by the British Meteorological Office[1,2], the re-design of the apparatus has been undertaken. The equipments in present use were designed to have the highest possible accuracy, but they are bulky and unnecessarily complex for routine use. Moreover the experience gained with these instruments has shown that their high instrumental accuracy cannot be fully used because of errors introduced by external factors such as imperfections of the sites. Little use is made, in practice, of the wide tuning range provided, and the sensitivity is greater than is normally required.

In re-designing the equipment, therefore, the main emphasis was placed on simplification and improved convenience of operation, ease of servicing, and reduction in weight, size and manufacturing cost. These objects have been achieved with no significant reduction in accuracy and with a small but acceptable reduction in sensitivity.

New design.—The equipment consists of two enclosed loop aerials and a console housing all other units, shown in the photographs opposite. The loops are wound in two layers about 1 m. square, and are orientated in north–south and east–west directions. They are connected by coaxal cables to the twin amplifiers in the upper section of the console. These amplifiers are normally tuned to a frequency of 10 Kc./sec., but may be tuned to other pre-determined frequencies by means of switched condensers. Signals from the amplifiers are applied to the deflection plates of the cathode-ray tube in the central display unit and produce a diametral trace, the bearing of which corresponds to the direction of arrival of the atmospheric. A perspex cursor is used in reading the bearings.

On the right of the display unit is a brilliance-modulator unit which is actuated by the atmospheric and momentarily increases the brilliance of the trace; only those atmospherics with amplitudes greater than a predetermined level trigger the modulator. On the left of the display unit is a test-signal generator which is used for matching the characteristics of the two amplifiers. The unit below the writing shelf is the power pack.

Simplification of the equipment has been achieved by restricting the frequency range and by using only radio-frequency amplification (the previous design incorporated superheterodyne receivers). Each amplifier consists of a cathode-follower input stage, two resistance-capacitance coupled amplifier stages, a phase-splitter and a push-pull output stage. Only the loop-aerial circuits and the output transformers are tuned; the variable condensers in these circuits have small capacitance and serve mainly to adjust the phase response. The gains of the amplifier are adjusted by means of a pair of matched attenuators which are ganged.

For the alignment of the apparatus, test signals are injected into the aerials, and corresponding stages in the two amplifiers are adjusted to have the same gain and phase-shift characteristics over a small band of frequencies. These adjustments are carried out stage-by-stage and switches between corresponding stages of the two amplifiers enable the grids of the valves to be connected or either one earthed. The substantial reduction in the number of switches and adjustments greatly simplifies the alignment procedure.

An automatic selector is provided for use in the co-ordination of observations at several stations. This device, originally developed for research investigations, was adapted by the Meteorological Office for use in routine observations with the older type of direction finder[3]. In the new instrument it is an integral part of the built-in telephone equipment. At any one station each atmospheric of sufficient intensity to trigger the brilliance modulator causes an audible pulse to be passed over the telephone network and serves as a signal for the other observers to read the bearings. The pulse is followed by a quiescent period long enough for the bearings to be recorded.

To resolve the 180° ambiguity in the bearings a sense channel has been designed, to be used with a short vertical aerial. The inclusion of this unit is optional; it is not normally required in a network of several stations.

The equipment is suitable for use in a vehicle and in tropical climates. The prototype has in fact been installed in a Meteorological Office van, equipped with radio-communication apparatus and plotting facilities, and has been used on a number of temporary sites.

About ten equipments have been made commercially to this design, and a more detailed description is in preparation.

Acknowledgements.—The direction finder was developed for the Meteorological Office by the Radio Research Organization of the Department of Scientific and Industrial Research, and this description is published by permission of the Director of Radio Research in that Department, and of the Director of the Meteorological Office. Messrs. C. Clarke and V. A. W. Harrison were largely responsible for the detailed design, construction and testing of the instrument.

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MEASURES OF SUCCESS IN FORECASTING

By A. F. CROSSLEY, M.A.

Part II.—Forecasts of elements subject to continuous variation

An index of success.—An index of success for use with forecasts of scalar or vector elements was proposed by Priestley[6]. Let ε denote the standard error of the forecasts, i.e. the root mean square of the differences between the forecast and the actual values at time t, this being the period of the forecasts. Also let σ_t denote the root mean square of the variation between the values of the element initially and after time t. Then if there is no correlation between the forecast value and the forecast error, i.e. assuming the variations are not consistently under- or over-estimated, the variance of the element may be expressed as

$$\sigma_t^2 = \varepsilon^2 + S^2,$$

where S^2 is the part which is successfully forecast. S may be termed the success, and its variance is given by

$$S^2 = \sigma_t^2 - \varepsilon^2.$$

From this the index of success is written as

$$P = \frac{S}{\sigma_t} = \left(1 - \frac{\varepsilon^2}{\sigma_t^2}\right)^{\frac{1}{2}}. \qquad \ldots\ldots (10)$$

Priestley discusses the effect of errors in the observations and also in the analyses on which the forecasts are based, and shows that disregard of the errors tends to make the formula under-estimate the success. It is not however practicable to include the errors in a useful manner, owing to the uncertainty of those arising from analysis, so that the formula is best used in the form given although it will necessarily be subject to some limitation. It is seen that it is applicable to both scalars and vectors, provided that in the latter case ε and σ_t are taken to be the standard vector error and standard vector variation respectively.

The upper limit of the index is unity, and this is reached when the variance of the forecast errors becomes negligibly small in comparison with the time variance. Now suppose the forecast value of the element at time t is always the same as the initial value; then ε is by definition identical with σ_t. Thus for persistence forecasting, the value of the index is zero. On occasions a forecast will give a greater error than that which would occur by use of persistence. If this were to happen often enough, it would lead to ε becoming greater than σ_t, so that P would become imaginary. This implies merely that the forecasts are worse than those obtained by the use of persistence. In cases where forecasting is of value, the limits of the index are 0 and 1. As the index is non-dimensional, and, as seen, measures the improvement over forecasting solely by persistence, it therefore constitutes an appropriate index for the measurement of success in forecasts of continuously varying elements.

The improvement of one technique over another.—Since the maximum value of the index P is unity, the improvement of one method of forecasting over another, as a fraction of the maximum possible improvement, is given by

$$\frac{P' - P}{1 - P}. \qquad \ldots\ldots (11)$$

This expression is of the same type as the formula (9) for "black and white" forecasts. For persistence forecasts, P is zero and the above formula reverts simply to P'.

Applications to forecasts of continuous elements.—*Forecasts of height of pressure surface.*—An evaluation of the index of success for forecasts of contour heights was made by Priestley[6]. Forecasts for 12-hr. periods at Larkhill were made four times daily from prognostic contour ("prontour") charts, and the results compared with direct observations. Values of ε, σ_t and P were derived for each month from August to December 1944, for pressures of 750, 500 and 300 mb. These figures show no marked difference in the success between the three levels, but there is considerable variation of the index from month to month. This suggests that in order to derive a satisfactory value of the index, the average should be taken over a number of months, or over a number of years for the same month. The causes of the variations were discussed by Priestley, and it is clear that they are due to circumstances which cannot be eliminated by choice of index, but only by averaging over a longer period. Combined figures for three months have been derived and are given in Table IX as an illustration.

TABLE IX—12-HR. FORECASTS OF HEIGHT OF PRESSURE SURFACE AT LARKHILL
September–November 1944

Pressure	Standard deviation: Forecast error	Standard deviation: 12-hr. variation	Index of success
mb.	*feet*		%
300	263	358	68
500	162	240	74
750	108	149	69

Forecasts of upper wind.—12-hr. forecasts of upper wind at Larkhill were also dealt with by Priestley[6] in a manner similar to that just described for the heights of pressure surfaces, and for the same periods. As with the height forecasts, there is no systematic variation of the index with height, while the variation from month to month is less marked in this case, although still considerable. It is clear that figures for individual months are influenced by the varying meteorological conditions, and that longer periods are required to give reliable estimates. Figures for three months have been combined to give Table X.

TABLE X—12-HR. FORECASTS OF UPPER WIND AT LARKHILL
September–November 1944

Pressure	Standard vector deviation: Forecast error	Standard vector deviation: 12-hr. variation	Index of success
mb.	*knots*		%
300	36	44	57
500	24	29	56
750	15	22	73

Forecasts of equivalent tailwinds.—An analysis of forecasts of equivalent tailwinds on the great circle route Shannon–Gander has been given by Harley[7]. From figures given for the standard deviation of the forecast errors and for the variation of equivalent tailwind with time, Priestley's index of success may be computed. The results are shown in Table XI.

In interpreting these figures, it is necessary to consider the method by which they were obtained. The forecast equivalent tailwinds were derived from composite contour charts, the time of flight being about 9 hr.; the mid time of

TABLE XI—FORECASTS OF EQUIVALENT TAILWINDS, SHANNON–GANDER

April 1949–May 1951

	Standard error of forecasts		Standard deviation of 24-hr. variation		Index of success	
	700 mb.	500 mb.	700 mb.	500 mb.	700 mb.	500 mb.
	knots		*knots*		*per cent.*	
Winter	8·7	12·5	10·2	14·8	52	54
Spring	7·8	10·5	9·7	13·5	59	63
Summer	6·5	8·5	8·3	9·6	62	47
Autumn	8·1	10·5	10·0	12·3	59	52
Year	7·9	10·7	9·5	12·5	56	52

these charts was about 24 hr. ahead of the time of the basic charts from which they were prepared. On the other hand, the "actual" equivalent tailwinds, with which the forecasts were compared, were derived from ordinary contour charts for a fixed time which agreed approximately with the mid time of flight. The 24-hr. variations were similarly derived from the fixed-time charts. The errors introduced by this use of fixed-time charts were examined and found to be small. Further, all the winds used were geostrophic, but this approximation is held to be satisfactory when the results are averaged over a long route, since the ageostrophic components then tend to cancel out. It appears therefore that the results given in Table XI are reasonably accurate.

With the aid of known correlation coefficients, R_t, between equivalent tailwinds at times 0 and t, Harley[7] also derives values of the standard errors which would be expected if the forecasts were made statistically on the basis of a regression equation

$$v_t' = R_t v_0 \qquad \ldots\ldots (12)$$

where v_0 is the vector departure from the mean equivalent tailwind at time 0 and v_t' is the expected departure at time t. In each season the standard errors so found exceed those associated with the conventional forecasts so that the index of success is reduced. It may be shown on the other hand that the statistical forecasts necessarily improve on the persistence forecasts, i.e. those for which v_t' is assumed equal to v_0. Thus from the regression equation, the mean square error of the statistical forecasts, n in number, is:

$$\varepsilon^2 = \frac{1}{n}\Sigma(v_t' - v_t)^2 = \frac{1}{n}\Sigma(R_t v_0 - v_t)^2$$

but since $$\frac{1}{n}\Sigma v_0^2 = \frac{1}{n}\Sigma v_t^2$$

and $$\Sigma v_0 v_t = R_t \Sigma v_0^2$$

$$\varepsilon^2 = \frac{1}{n}(1 - R_t^2)\Sigma v_0^2.$$

For persistence forecasts, the mean square error is given by

$$\sigma_t^2 = \frac{1}{n}\Sigma(v_0 - v_t)^2$$

$$= \frac{2}{n}(1 - R_t)\Sigma v_0^2.$$

Therefore $$\varepsilon^2 = \frac{1}{2}(1 + R_t)\sigma_t^2. \qquad \ldots\ldots (13)$$

So that ε is less than σ_t, since R_t is less than 1 for t greater than 0.

The extent of the improvement is shown by the values of the index of success which are given in Table XII, it being recalled that the index for persistence forecasts is zero. It will be noted also that each value of success in Table XII is less than the corresponding value in Table XI.

TABLE XII—STATISTICAL FORECASTS OF EQUIVALENT TAILWINDS

	Standard error of forecasts		Index of success	
	700 mb.	500 mb.	700 mb.	500 mb.
	knots		*per cent.*	
Winter ...	9·3	13·5	41	41
Spring ...	9·2	12·6	32	36
Summer ...	7·6	8·9	40	37
Autumn ...	9·4	11·8	35	28
Year	8·9	11·7	35	35

The standard deviation of the 24-hr. variation is the same as in Table XI.

Wind expectations for 36 hr.—At the present time, the equivalent tailwinds expected 36 hr. ahead on various air routes over Europe are being supplied to airline operators on the basis of the regression equation (12). In Table XIII is given a statistical summary for two of the routes, namely Northolt to Barcelona with diversion to Nice, and Northolt to Copenhagen with diversion to Hamburg, for the period January–May 1952.

TABLE XIII—COMPARISON OF 36-HR. WIND EXPECTATIONS WITH ACTUAL WINDS FOR CERTAIN AIR ROUTES AT 10,000 FT.

	Northolt–Barcelona–Nice			Northolt–Copenhagen–Hamburg		
	Standard error of forecast winds (ε)	Standard deviation of 36-hr. variation of wind (σ_t)	Index of success	Standard error of forecast winds (ε)	Standard deviation of 36-hr. variation of wind (σ_t)	Index of success
	kt.	kt.	%	kt.	kt.	%
Jan. ...	9·7	11·2	50	12·6	14·6	51
Feb. ...	7·0	7·4	32	8·7	9·6	42
Mar....	7·5	8·9	54	7·2	7·5	28
Apr. ...	7·1	7·7	39	7·7	8·4	40
May ...	4·8	5·3	42	6·8	7·2	33
5 months	7·4	8·3	46	8·9	9·8	44

From equation (13) the index of success is given by

$$P^2 = 1 - \frac{\varepsilon^2}{\sigma_t^2}$$

$$= \tfrac{1}{2}(1 - R_t). \qquad \ldots\ldots (14)$$

In the case under discussion the value of R_t is 0·60, and in consequence one would expect the value of P to be 45 per cent. This agrees with the average value actually found over the five months, so confirming that the average success over a period of several months can be calculated in advance from the known value of the correlation coefficient of equivalent tailwinds with time.

Forecasts of night minimum temperature.—The following modification of the index of success in equation (10) for elements subject to diurnal variation was suggested by F. E. Lumb. In this case σ_t is to be interpreted as the root-mean-square difference between the forecast value of the element and the observed value on the day (night) preceding that to which the forecast refers. It will be seen that in other respects the characteristics of the index remain unchanged.

For the three months January–March 1953 forecasts of minimum air temperature made at Liverpool (Speke) airport at 1600 G.M.T. daily for the ensuing night gave the following values: $\varepsilon = 3{\cdot}38$°F., $\sigma = 4{\cdot}77$°F., percentage success 71.

Part III.—Summary

An index of the usefulness of forecasts of the "black or white" type is adopted in the form $I = \frac{1}{2}(c + c')$, where c,c' are the forecast accuracies of blacks and whites respectively. The success of this type of forecast, defined as the improvement beyond the point reached by persistence, is given by $J = (I - I_0) / (1 - I_0)$, where I_0 is the value of I corresponding with persistence forecasts.

For forecasts of continuously varying elements, Priestley's index is adopted, $P = (1 - \varepsilon^2/\sigma_t^2)^{\frac{1}{2}}$, where ε^2 is the variance of the forecast errors and σ_t^2 the time variance of the element. This index measures the improvement over persistence, the latter corresponding with $P = 0$.

The improvement of one method of forecasting over another is given by $(I' - I)/(1 - I)$ or $(P' - P)/(1 - P)$, where I' and I or P' and P are the individual indices.

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EXCEPTIONAL WEATHER OF NOVEMBER 1953 TO EARLY FEBRUARY 1954

By L. F. LEWIS, M.Sc.

The exceptional mildness of November and December 1953 in the British Isles has aroused widespread interest. In England and Wales the mean temperature in November 1953 was 1°F. lower than that in 1938 and almost the same as in 1939, otherwise it was higher than in any November since comparable figures are available, that is since 1901; in Scotland, apart from November 1920 when the mean value equalled that for 1953, it was higher than in any November since before 1901. December was the mildest December both in England and Wales and in Scotland since 1934. It was, however, the combined temperature for the two months which was so exceptional. The graph in Fig. 1 shows the mean temperature for these two months at Oxford in each year from 1815 to 1953. It will be seen that the value for 1953 is higher than in any year since 1852, that is for more than 100 years. The values for England and Wales as a whole going back to 1901 give a similar curve. Incidentally, the Oxford graph illustrates the great variability of the climate in the British Isles, particularly as the figures refer to the mean temperature over a period of two months. Several temperature records were broken in 1953 at individual places; at Oxford the lowest minimum temperature in November, 35°F., was the highest for November in a record going back to 1881. In the period December 2–4, there were exceptionally high maximum temperatures, 64°F. at Llandudno on the 2nd was the highest temperature for December since before 1901, while 59°F. at Falmouth on the 2nd was the highest there in December since before 1871, and the same value at Kew Observatory on the 4th equalled that on December 4, 1931, which was the highest since before 1871. At Oxford no air frost was recorded throughout the four months September–December 1953; the previous latest date for the first air frost of this period was November 22, 1898.

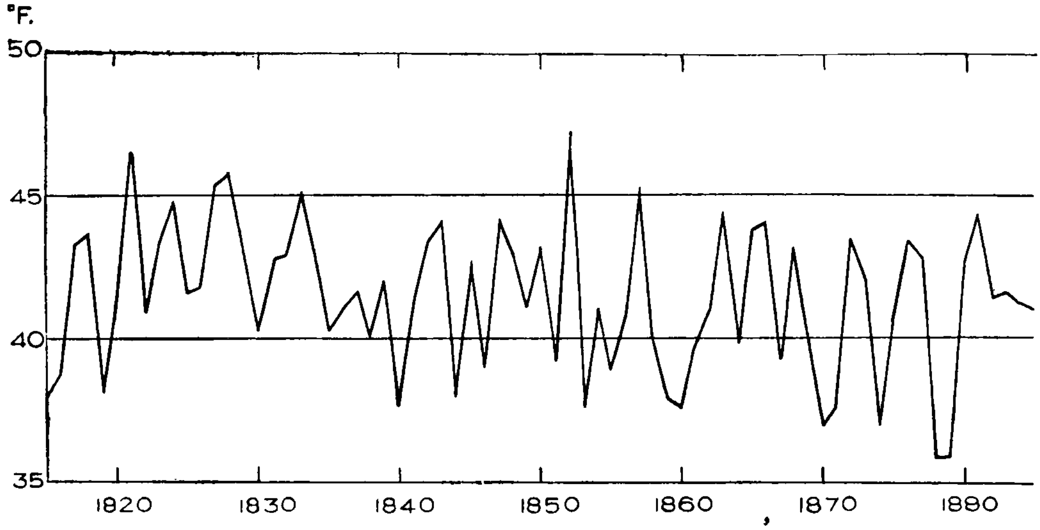


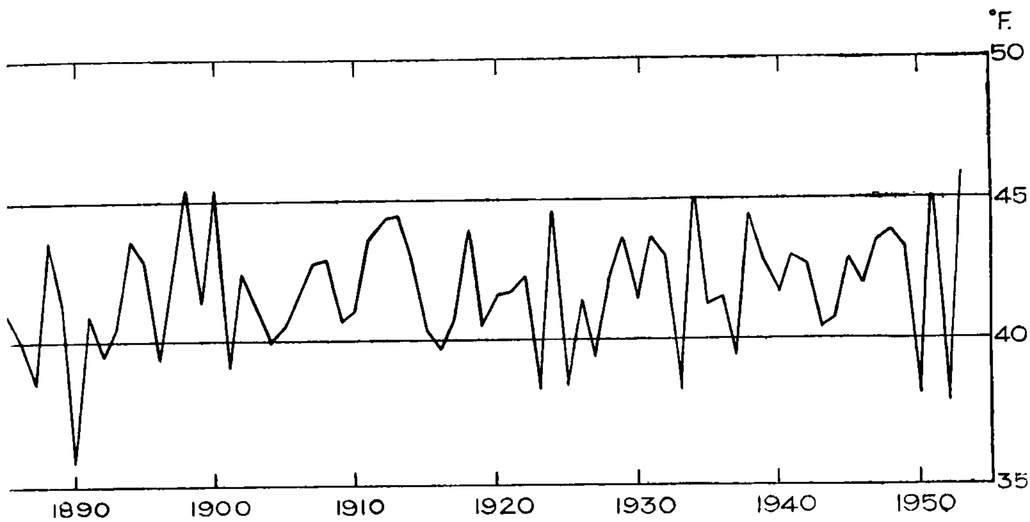
FIG. I—MEAN TEMPERATURE AT OXFORD,

The table below gives the weekly deviations from average temperature for south-east England for November to early February during 1938–39, 1939–40 and 1953–54. The averages used for 1938–39 and 1939–40 refer to the period 1906–35, while those for 1953–54 refer to the period 1921–50 but on the whole the changes are relatively small.

No. of week	Week ending about	1938–39	1939–40	1953–54
			degrees Fahrenheit	
44	November 5	+ 4·4	− 0·6	− 1·9
45	November 12	+ 7·9	+ 5·8	+ 4·5
46	November 19	+ 8·2	+ 6·3	+ 2·4
47	November 26	+ 1·5	+ 1·1	+ 4·3
48	December 3	+ 0·6	+ 7·6	+ 8·8
49	December 10	+ 3·3	− 0·3	+ 6·3
50	December 17	+ 5·8	− 1·1	+ 6·2
51	December 24	−13·7	− 6·0	+ 2·9
52	December 31	− 2·9	− 8·1	− 0·5
1	January 7	− 2·7	− 6·3	− 4·5
2	January 14	+ 2·8	− 5·1	+ 3·9
3	January 21	+ 8·1	−12·8	+ 3·2
4	January 28	− 0·4	− 9·4	−10·2
5	February 5	− 3·5	− 8·7	−13·5

It shows that the exceptionally mild November of 1938 was followed by mild weather during the first half of December but the week ending on December 24 (week 51) was extremely cold, the deviation from the average temperature for the week being −13·7°F. November 1939 was followed by a rather cold December, the latter half of the month being very cold, while the following month, January 1940, was one of the coldest Januaries on record. In 1953 the mild weather persisted for the most part throughout November and December. The first nine days of January were mainly cold; this was followed by a long mild spell, and it was not until the 23rd that an extremely cold, wintry spell set in and persisted into the first part of February.

Over most of England, particularly in the south, another interesting feature of the weather of November and December 1953 was the deficiency of rainfall,



NOVEMBER AND DECEMBER COMBINED, 1815–1953

December being notably dry. In contrast, in England in 1938, November and December were both wetter than usual, while in 1939 November was excessively wet and December dry, though not so dry as in 1953.

The exceptionally long mild spell was responsible for many anomalies in bird and insect life and in the early flowering of plants. There were widespread observations of spring flowers and shrubs being in flower, and of birds nesting much earlier than usual. The writer saw a butterfly on a window of a house in Clifton, Bristol, on December 27.

COASTAL FOG PATCHES

By L. JACOBS, M.A., M.Sc.

Wales is an area where the topography particularly lends itself to local weather variations, and studies such as those made by Howe[1,2] are invaluable, if considered with the synoptic charts, for giving information regarding the local synoptic climate.

The distribution of temperature round the frost hollow shown by Howe[2] as existing on the night of November 29, 1952, appears to be fairly normal, but it is rather surprising that, on a radiation night, the warming effect of the Aberystwyth built-up area, and of the nearby sea could so exactly balance the radiation loss that the temperature at Dinas School remained constant, at about 32°F., for the six hours of observations. Some records of local winds on this occasion would have been interesting.

The shallow fogs mentioned by Howe[2] as drifting from the sea, must have been either existing sea-fog patches or coastal-fog patches forming *in situ* by uplift of nearly saturated air over the coastline, the fog being brought over land by the sea-breeze setting in at the end of the fine morning, which Howe mentions as preceding the fog.

It is clear from Lamb's accounts of North Sea haars[3] and of sea-breezes[4] that there are many local features to be considered both for the sea-breeze formation and the drift and persistence of the fog, and local investigations into these factors would be useful.

Howe[2] gives three examples of the appearance of sea-fog at Aberystwyth: on May 18, 1952, August 2, 1952 and February 27, 1953. As the synoptic chart showed fog to be impossible on the second date, the writer wrote to Mr. Howe who now agrees that this date is wrong, and states that he cannot trace the correct date.

Examination of the synoptic charts for the period round May 18, 1952, suggests that this was a case of fairly extensive sea-fog being formed on that day as the light south-easterly air flow on the previous day was replaced by a light, decreasing, westerly air flow with increasing dew points over Wales. At Pembroke Dock it was calm with no low cloud (2 oktas of upper cloud) and visibility 4 miles at 0600 G.M.T.; at 0900 the wind was WNW., force 2, the visibility was 2½ miles with fog in sight, the cloud 5 oktas at 100 ft., the dew point having increased from 52°F. at 0600 to 55°F. at 0900 (the average sea-surface temperature for May is 51°F. off south Wales and 49–50°F. off north Wales). At 0900 none of the stations, Aberporth, Harlech or Valley reported fog or low cloud, although all recorded light winds off the sea and showed dew points well above sea-surface temperatures. However, by 1200 Aberporth and Valley both reported fog; it is presumably about this time that the fog came in to Aberystwyth with the sea-breeze. The non-appearance of fog at Harlech may well have been associated with the formation of large cumulus cloud in the early afternoon. The synoptic charts for 1200 and 1500 G.M.T. for May 18, 1952 show that sea-breezes had set in on many coasts of England and Wales; the sea-breeze at Spurn Head had brought in fog from the North Sea between 0900 and 1200.

The Aberystwyth fog of February 27, 1953 appears to be a case of sea-fog or very low stratus, which was originally present from February 21 to 25 in a moist south-westerly air stream with strong winds, persisting in patches over the sea in the slackening gradient on February 26–27, and coming over land with the sea-breeze of the late morning of February 27 (Howe gives no wind observations except in the statement "the mist advanced slowly eastward"). Radiation from the top of the fog (or of the low stratus falling to the surface) must have helped the fog to persist, the fog, from Howe's figures, becoming some 4°F. colder than the sea-surface temperature. Douglas[5] has discussed, with examples, how land radiation fogs can persist and become colder over the sea, drifting back to land after a change of wind, and Jacobs[6] has given instances of the persistence and drift of sea-fog patches over the Gulf of St. Lawrence for some time after the main fog or low stratus has cleared away.

February 27 is early in the year for a sea-breeze, and the topography of the district round Aberystwyth must have aided the setting in of the sea-breeze, first at 200 ft. up on Constitution Hill and 15 min. later on the lower ground. Sea-breezes did not occur at the other (synoptic) reporting stations in west Wales, Pembroke, Aberporth, Harlech and Valley (where the temperature rose higher that day than at Aberystwyth); early morning (probably radiation) fog at or near the first three stations had cleared by 1200, while low stratus at Valley cleared by 1500. That there was indeed fog present at sea that morning was shown by the 0600 observation at St. Goven lightship (off south-west Wales), by the fog at Scilly at 0300 and by the formation of fog at Midleton (near Cork) between 0300 and 0600 with a light wind off the sea, the dew point rising from 35° to 42°F.

In the absence of wind observations it is difficult to give the exact reason for the dispersal of the Aberystwyth fog at 2000. It seems most likely that the sea-breeze had died out long before then and that a slight land-breeze drove the fog out to sea.

Ruck's cases[7] of very low stratus appearing in the early afternoon over St. David's Head and a few miles out to sea, which are quoted by Howe[2], appear to be due to the sea-breeze ("SW. wind of about 10 m.p.h.") either bringing in a patch of existing low stratus, the clearance out to sea being due to subsidence at the origin of the sea-breeze, or causing sufficient turbulence in nearly saturated air ascending near the coastline. Without study of the synoptic charts—no dates or times are given—it is not possible to be more precise about the reason for the formation and later dispersal of the cloud. The clearance "before evening" in Ruck's cases could have been a combined effect of the subsided air arriving at the coastline in the sea-breeze circulation and of the afternoon heating over land.

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METEOROLOGICAL OFFICE DISCUSSION

Some applications of meteorology to agriculture

A discussion on some applications of meteorology to agriculture was held at the Royal Society of Arts on Monday, January 18, 1954. The opener was Mr. L. P. Smith of the Agricultural Meteorological Branch. He pointed out that the Agricultural Branch was a branch engaged on work of applied meteorology and operational research, not pure research. They had taken as their model the methods by which meteorology had been applied to aviation problems, especially during the recent war. For successful application it was necessary for the meteorologist to have a good working knowledge of the sciences and subjects with which he was dealing. Members of the Branch, one of whom was stationed at a provincial headquarters of the National Agricultural Advisory Service at Bristol, acquired their knowledge of agriculture by constant liaison and discussion with agriculturists, horticulturists and foresters. This contact arose in the course of visits to research stations, experimental farms, universities, county institutes and National Agricultural Advisory Service establishments; the visit was always welcome and the only complaints received were to the effect that the visits were too infrequent.

Meteorology entered into every farming operation and the difficulty was the choice of a subject for investigation. A policy was adopted of attacking the problems in which some good chance of success seemed possible. The aim of the lecturer in the present discussion was to give some details of four problems in which considerable advance had been made. It was not meant to be a comprehensive survey, but it illustrated the principles of collaboration and application on which the work of the Branch was based.

The first two problems were those of plant pathology and frost; both had been the subjects of articles in the *Meteorological Magazine*[1,2,3] and would therefore only be treated in outline. Co-operation between reporting stations, Dunstable, Harrow and the Plant Pathology Laboratory at Harpenden enabled the Ministry of Agriculture to issue press notices of potato-blight forecasts. Slides were shown illustrating how use of hourly observations of weather and detailed disease assessments were combined. In 1953 the warning system had been very successful. In regard to frost the main aim was to help in the selection of frost-free sites, and the method described by Mr. Lawrence[3] was applied to a Ministry of Agriculture farm near Stratford. Observations of minimum temperature over the spring-frost period (April–May) suggested that a drop of 56 ft. in altitude from the side of a hill to the Avon valley resulted in a decrease of average minimum temperature of about 1·5°F. and an increase in the probable frequency of damaging May frosts from 1 year in 10 to 7 years in 10.

The speaker then dealt with problems of wind and shelter. The work of Mr. Gloyne at Bristol had gathered together all the accessible evidence regarding wind flow over obstacles, and as a result much was now available for application to crop-husbandry and animal-husbandry problems. Slides were shown of the wind pattern behind barriers, the effect of barriers on other meteorological elements, and the effect of wind on trees and plants. It was emphasized that any problem of shelter was one that could only be solved by co-operation with other scientists such as foresters, soil chemists, husbandry experts and so on. Shelter was not an unmixed blessing, and correct planning was essential to obtain maximum benefit. Experiments were now in progress relating to the protection of horticultural crops from wind.

With respect to irrigation the theory due to Dr. Penman[4] had been applied with the aid of data from synoptic stations to obtain the averages of potential transpiration for all areas in Great Britain. Using the known pattern of variation of rainfall about the average it was thus possible to estimate the frequency and extent of irrigation need. An example was quoted of the rainfall-transpiration balance at a Somerset dairy farm, showing that good dairy areas were those in which most years gave adequate rain for the growth of grass. The theory thus was not contradicted by ecological facts. The simplification of the calculations by use of regression equations on sunshine was explained, and two examples of irrigation plans in a current year were shown. The method was thus suitable for long-term planning and for practical use to a fair degree of field accuracy[5].

Dr. Penman (Rothamsted), opening the general discussion, expressed the appreciation of the agricultural scientists for the help they were receiving from the Meteorological Office. He mentioned the effects of increased yield that could be obtained by correct irrigation, and felt that, even if the figures for transpiration had to be modified slightly at a future date, the correct order of differences had been established.

Mr. Large (Plant Pathology Laboratory) gave further details of the potato-blight investigation and warning service. He showed slides which illustrated the build-up of the disease, and thanked the observers of the Meteorological Office outstations for their co-operation; further work was continuing on the problem and the techniques might be applied to other important diseases.

Dr. Ångström (Sweden) expressed his interest in the slides concerning the effect of shelter, and mentioned examples of this type of problem which arose in his country.

The Director asked questions relating to Dr. Thornthwaite's method of planning the sowing of peas at Leabrook Farms, New Jersey, and to the souring of milk. Mr. Smith, in reply, outlined the principles underlying the timing of planting and harvesting of peas, namely that the growth rate is linked to the potential transpiration, the monthly averages for which are known; both he and other speakers suggested that high temperatures (and possibly high humidities) were the predominating factor in milk going sour.

Mr. Gloyne outlined methods and instruments which might be used in considering the problem of local climate so that a valid assessment of the agricultural potential of a site could be made. From information of this type, the question of land utilization could be approached.

Mr. Gold inquired regarding the spraying of potatoes and asked whether the problem of water supplies had been considered. The effect of protective spraying and the "burning-off" of haulms was explained, and Mr. Smith said that the implications of the calculated water needs were realized, and the aim of the Branch was to provide adequate statistics so that they could be considered in any national policy decision; a working party was examining the problem. This was confirmed by Mr. Hudson (National Agricultural Advisory Service) who said that the advisory services were very grateful for the assistance of the agricultural meteorologists in many diverse aspects of their work.

Major Dobb (Agricultural Land Service) spoke of the help that was given in relation to forestry and estate management, and quoted the United States of America as an example of large-scale irrigation undertakings.

Dr. Glasspoole outlined the work of Sir Napier Shaw in relation to agricultural meteorology and his inception of the crop-weather scheme of observations.

Mr. Jacobs (Gloucester) gave figures showing the increased demand of farmers for forecasts by telephone, and emphasized the growing interest of firms of agricultural contractors in accurate short-term forecasts.

Dr. Stagg mentioned the use of dew ponds and raised the question of dew-gauges. He inquired whether it was possible for plants to absorb water through the leaves and transmit it to the soil via the roots. In reply, Mr. Smith said he thought that dew ponds were small catchment areas with low evaporation, and that any form of water conservation was an advantage. Plants certainly could absorb liquids through the leaves, and it was an accepted practice to spray trees to relieve certain mineral deficiencies in the soil.

Shortage of time rather than topics occasioned the end of the meeting, and in conclusion the Director thanked all who had taken part in the discussion which had been of unusual interest. He said that the application of meteorology to agriculture was an example of what could be done for the general public.

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METEOROLOGICAL RESEARCH COMMITTEE

At the meeting on November 24 the Synoptic and Dynamical Sub-Committee considered a paper by Mr. Sawyer[1] on the rainfall of depressions which move eastward near the English Channel (the third contribution to a tetralogy), a paper by Messrs. Bannon and Gilchrist[2] which gives a statistical study of the variation of temperature in the troposphere and lower stratosphere, and a paper by Mr. Jenkinson[3] which discussed the average vector distribution of the upper air in temperate and tropical latitudes. Two other papers of synoptic interest were also discussed, one by Dr. Farquharson[4] dealing with vorticity and synoptic development and one by Messrs. Murgatroyd and Goldsmith[5] which discussed observations of cirrus cloud over southern England.

ABSTRACTS

1. SAWYER, J. S.; Rainfall of depressions which move eastward near the English Channel. *Met. Res. Pap., London,* No. 816, S.C. II/153, 1953.

Rainfall distributions over Great Britain were drawn for depressions moving east along or near the English Channel during 1941–50. Average map is shown, also profiles of relation to distance from track, frequency diagrams, etc. Variations in individual depressions are related to track, speed and central pressure, and expressed as a regression equation; 1000–500-mb. thickness is also considered.

2. BANNON, J. K. and GILCHRIST, A.; A statistical study of the variation of temperature in the troposphere and lower stratosphere. *Met. Res. Pap., London,* No. 819, S.C. II/154, 1953.

To find latitude and season for which Dines's model applies, correlations were evaluated for stations from 73°N. to Malta between height of 300-mb. level (H_{300}), tropopause pressure (P_T) and temperatures at 500–60 mb. Results are set out in detailed tables. Causes of variable stratosphere coefficients are discussed, including different effects of vertical motion and advection in different latitudes, seasons and years. Relation between temperature in lower stratosphere and P_T or H_{300} decreases with height. Dines's model holds only in regions affected by travelling depressions and anticyclones.

3. JENKINSON, A. F.; The average vector wind distribution of the upper air in temperate and tropical latitudes. *Met. Res. Pap., London,* No. 823, S.C. II/156, 1954.

Revised charts are presented for levels of 500, 300, 200 and 100 mb. for the world between 60°N. and 50°S. for January, April, July and October. They show stream-lines and isotachs (lines of equal vector speed), based on geostrophic vector winds computed from mean M.S.L. pressure charts with the addition of thermal vector winds in a succession of layers, constructed from upper air temperature charts recently prepared in the Meteorological Office. A grid of 234 points was used, checked by upper air wind data.

4. FARQUHARSON, J. S.; Vorticity and synoptic development. *Met. Res. Pap., London,* No. 829, S.C. II/157, 1953.

Difficulties in application of Sutcliffe's 1947 ideas are discussed. Relative divergence between pressure levels is important but comparing developments in the thicknesses 1000–700, 1000–500, 1000–300 mb. in a deepening depression (February 4, 1951) shows that the area of maximum development varies with thickness of atmosphere considered. The term $\text{curl}(\partial \mathbf{V}/\partial p . dp/dt)$ is shown as possibly important for forecasting. Sutcliffe's form of the vorticity equation is evaluated for 950 and 500 mb. for February 4, 1951; an area of increasing cyclonic vorticity was followed by development of a small secondary depression. A similar development was found on October 3, 1952.

5. MURGATROYD, R. J. and GOLDSMITH, P.; Cirrus cloud over southern England. *Met. Res. Pap., London,* No. 833, S.C. II/158, 1953.

Frequencies of cirrus observed at three ground stations are tabulated and the reality of peculiarities such as peaks at dawn and dusk in summer and night minimum are discussed. Frequencies of various types of cirrus are tabulated. Aircraft observations, 1949–52, are summarized; in only 27 per cent. are large areas found clear of cirrus. Base mostly 25,000–30,000 ft. at temperatures −40° to −50°F. (−40°F. is limit of spontaneous nucleation). Tops near tropopause at −40° to −75°F. A "moist layer" is generally found at 28,000–32,000 ft. Part 3 gives notes on forecasting high cloud and condensation trails.

OFFICIAL PUBLICATION

The following publication has recently been issued:—

GEOPHYSICAL MEMOIRS

No. 92.—Day-to-day variations in the tropopause. By J. S. Sawyer, M.A.

A series of 6-hourly charts has been drawn in detail showing the topography of the tropopause over a period of one month. The features of this series of charts are compared with previous studies of the tropopause, and the existence and behaviour of discontinuities in the tropopause surface are illustrated; these are most marked in association with the jet stream but minor disturbances occur elsewhere. The tropopause "funnels", reported by Palmén, are described and discussed. An analysis of the movements of the tropopause with the aid of estimated air trajectories suggests that the tropopause usually moves as a material surface embedded in the air current, and that of the changes of tropopause height at one place about half are to be explained by horizontal advection and about half by vertical air movements.

ROYAL METEOROLOGICAL SOCIETY

At the meeting of the Society held on January 20, 1953, the President, Dr. O. G. Sutton, in the Chair, a discussion was held on the subject of smog with special reference to the fog of early December 1952.

Mr. H. W. L. Absalom, Meteorological Office, described the meteorological conditions associated with fog. He described first the climatology of fog in Great Britain, pointing out with the aid of charts from the "Climatological atlas of the British Isles" that the higher frequencies of fog occurred in industrial districts and discussing the loss of sunshine in the centres of large cities. Next, he described the meteorological situation associated with the fog of early December 1952, and the meteorological observations made in the fog following the account by Douglas and Stewart in the *Meteorological Magazine* of March 1953.

Dr. E. T. Wilkins, Fuel Research Station, described the atmospheric-pollution observations made during the fog. No unusual substance was found in the pollution though the amount of pollution by smoke and sulphur compounds was very high. The smoke and sulphur-dioxide concentrations in the worst areas at respectively 4–5 and 1·3 mg./m.^{3} were appreciably greater than in the latest previous severe fog of November 1948 and were about ten times the normal. The curves of smoke and sulphur-dioxide concentrations and of deaths were shown in a slide to be nearly parallel with deaths lagging a little on the pollution. A striking fact was that the pollution at Lewisham, though high for the area, was only about equal to the normal at Westminster. Calculations of the amount of sulphur dioxide in the air over London during the fog compared with the amount produced by fires showed the efficiency of removal of the gas from the atmosphere was about 97 per cent. If this was right a fall from almost 100 per cent. to 97 per cent. efficiency was a disaster. Dr. Wilkins discussed methods of removal of sulphur dioxide, and concluded that atmospheric turbulence was more important than sedimentation of water droplets containing the dissolved gas or diffusion from the top of the fog.

Dr. N. Oswald, St. Bartholemew and Brompton Hospitals, discussed the physiological effects of smog. He said that the victims of chronic bronchitis suffer most during smoke fogs. In bronchitis there was an increase in the excretion of mucus in the lung passages. The excessive excretion of mucus and an associated inflammation of the walls of the passages restricted the flow of air in the lung, and led to certain degenerative changes in the lung from which recovery was slow and which could lead, in severe cases, to death from heart failure. He said many deaths occurred weeks after the fog which would probably not have occurred without the fog. There were no firm conclusions as to the manner in which the air pollution affected the lung, and the question was very complex. The annual rate of deaths ascribed to bronchitis was about twice as great in cities as in rural areas, but the greater ease of transmission of infection in cities may be at least as important as air pollution.

Many speakers took part in the subsequent discussion. Mr. E. Gold gave calculations to show that in traffic jams in city streets during calm weather the concentration of carbon monoxide might rise to levels sufficient to have deleterious effects. Mr. Whiten and Mr. Bonacina said London fogs were not nearly so thick and black as they were 50 years or more ago, and could not believe the concentrations of pollution were so large. Dr. A. R. Meetham discussed phenomena such as absorption of sulphur dioxide by smoke which might affect the measurement of concentration, and Dr. C. J. Regan said the London County Council's observations of carbon monoxide in streets and tunnels did not show any concentration of physiological importance.

LETTERS TO THE EDITOR

Unusual condensation-trail phenomena at Cranwell

On January 1, 1954 two aircraft forming dense persistent condensation trails in clear air entered cirrus cloud over Cranwell. When they entered the cloud they appeared to clear a lane in it leaving a trail of blue sky behind them.

Observations were made by Mr. A. Blackham at Cranwell; a summary, in chronological order, of what Mr. Blackham saw is as follows:—

At 1210 G.M.T. a very small patch of cirrus, isolated in a blue sky, showed a brilliant parhelion.

At 1350 the sky to the south was blue in the eastern sector and there was thin cirrus only in the western sector, mainly around the sun. Two aircraft flying from east to west were leaving well marked and persistent contrails.

At 1355 a brilliant parhelion was seen on one of the contrails (this was still visible when a photograph was taken later and is indicated at A on the diagram below the photograph facing this page).

At 1400 it was noticed that the contrails were still plainly visible in the blue sky, but where the aircraft entered the cirrus there were, in place of the contrails, "blue lanes" in the cloud. The dividing line between the cirrus and blue sky was at that time well marked and coincided with the change from contrail to "blue lane".

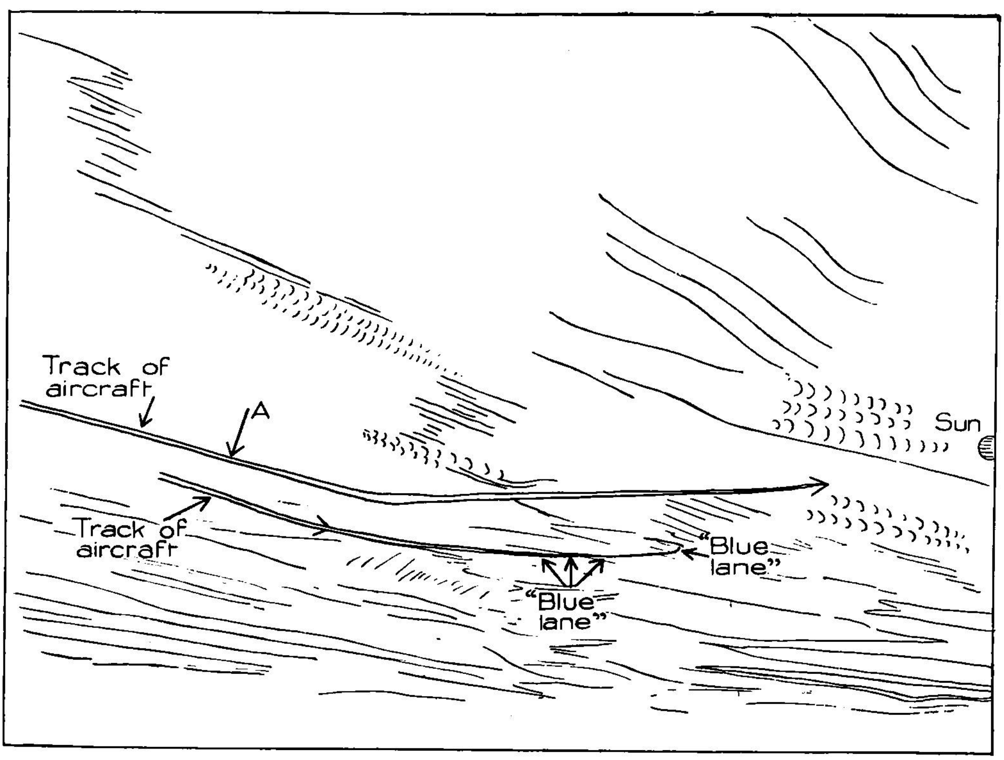
A few minutes later the upper edges of cirrus immediately below the sun (about 10°) were seen to be brightly coloured, the brightest colour being purple.

Although the contrails were very persistent, the "blue lanes" began to fill up quickly (the cirrus was spreading rapidly), and by the time a photograph was taken at 1410 most of the "lanes" had vanished.

Despite inquiries it proved impossible to find out the height of the aircraft.

In the *Meteorological Magazine* for January 1953, R. S. Scorer put forward a tentative explanation of a somewhat similar phenomenon which he had observed. In his case the aircraft formed a contrail with a clear lane on each side but all the phenomena took place in a cloud, and Scorer's explanation hinged on the possibility that part of the cloud was composed of ice crystals and part of water droplets.

Reproduced by courtesy of A. Blackham



CONTRAILS AND DISTRAILS OVER CRANWELL, JANUARY 1, 1954

(see p. 152)

Reproduced by courtesy of R. O. Harris

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FRAZIL ICE FORMATION AT SHOEBURYNESS, JANUARY 25, 1954

In the Cranwell case the contrail formed in clear air and the distrail in cloud. A parhelion was observed on both contrail and cloud strongly suggesting that both were composed largely of ice crystals. It seems unlikely therefore that Scorer's explanation could apply in this case.

The only reasonable explanation which occurs to me is as follows. The contrail formed in the normal way in clear air. The addition of extra water vapour to the cloud where ice crystals were present resulted in the growth of these crystals and to the subsequent precipitation of the larger particles so formed out of the cloud layer into drier air below thus clearing a lane behind the aircraft. Mr. Blackham did not notice precipitation virgae below the cloud when the blue lanes were forming, but he was not watching through field glasses and it is doubtful whether such a phenomenon would be observed by the naked eye unless one was watching specially for it. The process suggested would take appreciable time to operate so that the cloud would hardly clear instantaneously behind the aircraft, but as Mr. Blackham never actually saw the aircraft this is not contrary to the observations.

On the afternoon of January 1, 1954, an anticyclone of 1043 mb. was centred just south-west of Ireland while a weak warm front moved slowly south-east across Scotland. There is no upper air ascent which can be described as typical of the air over Cranwell at 1400 G.M.T. Cranwell is almost midway between Hemsby and Liverpool, and from a study of the 1400 G.M.T. radio-sonde ascents from these places it is probable that the tropopause height was about 36,000 ft. with a temperature of about −80°F. The mintra level was about 22,000 ft. (−28°F.). The upper air ascent from Hemsby is fairly dry up to the limit of humidity observations (21,000 ft.). Liverpool shows a shallow isothermal layer around 21,000 ft. with near saturation at that level, but this is just below the mintra level. Winds were between N. and NNE. about 20 kt. at 2,000 ft. increasing fairly steadily to about 65 kt. at the tropopause.

R. A. S. RATCLIFFE

Morton Hall, January 22, 1954.

Frazil ice formation at Shoeburyness

The photographs opposite were taken between 1300 and 1330 G.M.T. on Monday, January 25, 1954, following two days of fresh E.–SE. winds, with day temperatures only a few degrees above freezing and frost at night. The day maxima on the Saturday and Sunday preceding had been 38°F. and 35°F. respectively and night minima for the previous two nights 30°F. and 29°F., the minimum on the grass being 26°F. on both occasions.

On the day on which the photographs were taken, the sky had been covered all morning by a continuous layer of cirrostratus and the temperature did not rise above 32°F. until after midday, when the cloud sheet commenced to break slowly, decreasing to 4 oktas by 1500. The wind was 120–140°, 12–18 kt., during the morning. The temperature at the time of the photograph was 33°F. and the humidity 71 per cent.

The depth of the ice formation varied between 12 and 18 in., and was not covered by snow—in fact, up to that time, no snow had fallen. It consisted of soft, friable ice into which the feet sank as into fresh snow, and was interspersed with lanes of clear water.

It extended at that time for about 200 yd. towards the sea, though this distance tended to vary considerably during the period through which the formation persisted, and stretched continuously along the whole length of the shore as far as could be seen. The frazil ice tended to break up to some extent as the tide came in, and detached portions floated on the surface of the water, but it re-formed as the water receded. The phenomenon persisted throughout that week and the following week until February 8, with similar weather conditions continuing, though there were considerable variations in the depth and extent of the ice from day to day.

R. O. HARRIS

Shoeburyness, March 22, 1954.

NOTES AND NEWS

Low tropopause temperature

The report of the Meteorological Officer-in-Charge aboard *Weather Recorder* for voyage 49, mentions that whilst at 61°N., 15°05'W. (station INDIA), a temperature of −108°F. was recorded at the tropopause (pressure 160 mb., height 42,800 ft.) at 1400 G.M.T., January 9, 1954. This equals the lowest temperature so far recorded in January at Lerwick, which is at a comparable latitude 60°N.

The following figures supplied by the Upper Air Climatology Branch give the lowest temperatures recorded at the tropopause over Lerwick in each month up to the end of 1950:—

	°F.		°F.
January	−108	July	− 86
February	−107	August	− 81
March	−110	September	− 89
April	− 91	October	− 97*
May	− 88	November	−104
June	− 86	December	−111

The *Daily Aerological Record* quotes the Lerwick tropopause temperature as −101°F. (pressure 183 mb., height 39,700 ft.) at 1400 G.M.T. on January 9, 1954.

C. E. N. FRANKCOM

REVIEWS

The restless atmosphere. By F. K. Hare. *Hutchinson's University Library.* 7½ in. × 5 in., pp. 192, *Illus.*, Hutchinson & Co., London, 1953, Price: 8*s.* 6*d.*

"The restless atmosphere", as the author explains, is written for geographers and its main purpose is to give a description of the "dynamic" climatology of a large area of the world. "Dynamic" implies that the day-to-day processes of the weather are described and their effects on regional climates, instead of the more statistical descriptions of climate given by many textbooks on climatology.

The author has achieved considerable success in this different approach to the explanation of world climates, and his book will be welcomed by geographers as well as being well worth reading by professional meteorologists.

In the first part of the book the author discusses briefly the physical processes which go to the making of the weather. The discussion is intentionally almost

* Taken from frequency tables of early observations at Lerwick; this is the lower value of a 2° range.

completely non-mathematical, and should be understood by any one with only a moderate knowledge of physics. The second part of the book describes certain regional climates. Chapter I deals with the "energy budget" of the atmosphere and the exchange of radiant energy between the earth and its atmosphere. Chapter II deals with moisture in the atmosphere. The various quantities used in describing the humidity of the atmosphere are explained lucidly and simply. In this chapter, too, there is also a brief description of rain-making processes by seeding cloud with dry ice and other nucleants. The processes of cloud and fog formation are also described. Chapter III deals with convective processes, and Chapter IV with the relation between wind and the pressure gradient.

In Chapters V and VI the author treats ably and at some length with air-mass analysis, fronts, etc., and the depressions of middle latitudes. In the latter chapter, however, one statement needs partial correction. Commenting on the work of the Bergen school of meteorologists, the author says "there was some conservative reluctance on the part of the official forecast services of the world to accept these revolutionary ideas and methods; it was not until 1934, for example, that the British Service began drawing fronts on its working charts." In fact, the British Meteorological Office fully realized the importance of the work of the Bergen school at an early date, and in the winter of 1925–26, at the invitation of the British Meteorological Office, J. Bjerknes spent some months in London demonstrating the new ideas and methods. Similarly T. Bergeron spent the winter of 1928–29 at the Headquarters of the British Meteorological Office at Malta for the same purpose. J. Bjerknes also spent a further period in London during the winter of 1935–36. Although it was not until 1934 that fronts were inserted regularly on the official published reports of the British Meteorological Office, fronts were drawn on certain types of working charts as early as 1926. Caution was justified since it is now known that the idealized pictures of fronts as depicted originally by the Bergen school are frequently not realized. Furthermore it took time to achieve a sufficiently high standard of frontal analysis.

In this first section of the book the author has drawn upon his experience in the British Isles and North America to illustrate his statements. The reader may not realize, however, from the text that it is the more usual course of events that is described, and that variations from this are not uncommon, otherwise weather forecasting would be relatively easy.

The second part of the book, which the reviewer found most interesting, deals with the climates of different regions of the world from the "dynamic" or "synoptic" aspect.

The chapter on the intertropical belt provides interesting reading. As the author explains, the original over-simplified idea of weather in the tropics has been abandoned; in fact the synoptic climates of these regions are often very complicated and sometimes difficult to explain. It must be remembered that the descriptions in this chapter apply to the oceans themselves. Heavy orographic rainfall can and does occur in favourable localities when the trades are blowing.

In the chapter on intertropical Africa the treatment is mainly based on "A study of the atmospheric circulation over tropical Africa" by C. E. P. Brooks and S. T. A. Mirrlees, while the work of Hamilton and Archbold on the climate of west Africa is also treated at some length.

The chapter on North America deals with the air masses and depressions affecting that region, and a regional climatic division of the continent is proposed, based on the source of rainfall, namely the rainy Pacific coastal area, the semi-arid western plateaux and plains, and the rainy eastern area or Atlantic province.

The monsoonal climates of the East are next dealt with. The descriptive treatment follows the lines of work done by the author when he was a member of the staff of the Meteorological Office during the late war. The author does not, however, make it clear to the reader that within the compass of a single chapter only the broad outlines of the climate of such a vast area can be dealt with, and that detail is inevitably lost. In no other part of the world, perhaps, are the effects of topography so marked and the variation between the winter and summer monsoons so great as in many localities of this vast region. The final chapters deal with Europe and the Mediterranean. The air masses affecting these regions are described, and a brief summary of the main weather types is also given. In the chapter on the Mediterranean the author gives a description of the formation of Alpine lee-depressions. Mention is also made of Atlas lee-depressions about which the author has written in an unpublished memorandum.

In the preface to "The restless atmosphere" the author pays a tribute to Mr. C. S. Durst under whom he served during the war and to whom the book is dedicated. He explains that most of the ideas presented in the later chapters of the book were acquired while working in the Investigations Branch of the Meteorological Office, of which Mr. Durst was the head. L. DODS

English weathervanes, their stories and legends from mediaeval to modern times. By A. Needham. 8½ in. × 5½ in., pp. iv + 102, *Illus.*, Charles Clarke (Haywards Heath) Ltd., 1953. Price: 10*s.* 6*d.*

In this book, weather-vanes are described from the literary and artistic rather than the technical point of view. The meteorologist or amateur mechanic seeking instruction on how to make a wind vane which will operate remotely a wind-direction dial in his house will not find it here; but those who are interested in the appearance and history of weather-vanes will enjoy this book.

After a brief preface the author gives what is described as "a brief history of English weathervanes", but which is in fact a good deal more than this; it refers to early Egyptian, Greek and Roman vanes, and then quotes a number of references to weather-vanes in English literature from the eighth century onwards.

Next there is a short section giving hints on the best ways to observe, photograph and draw existing weather-vanes.

In the following section, on construction, erection and use of weather-vanes, a 100-year-old recording instrument at Greenwich Observatory is described, though no reference is made to modern wind-recording instruments; a cup anemometer is wrongly described as a wind vane, and an obsolescent pattern of a Meteorological Office wind vane illustrated. Methods of strengthening large sheet-metal vanes, and several ways of mounting the rotating part of the vane to ensure free rotation, are shown; and some brief notes on the exposure and orientation of the vane are given.

After this the book is devoted to illustrations and descriptions of all kinds of weather-vanes observed and recorded by the author; they are classified under four headings by the types of buildings on which they are mounted: churches, public buildings, business premises and private dwellings; they are quite fascinating, and their variety is enormous. Cocks, dragons, ships, fishes, wyverns, locomotives, arrows, armorial bearings, lions, policemen, classical dancers, fox and geese, monks drinking ale, are but a few of the subjects for the weather-vane maker's art; there are some fine examples of metal work in the scrolls supporting the vanes and their direction letters.

With each illustration, and there are 275 of them, the author gives some descriptive or historical note which adds greatly to the interest and pleasure of the reader.

Altogether, a most entertaining book; and it is hoped that at a future date more weather-vanes will be collected, recorded and published.

G. E. W. HARTLEY

Tables of barometric pressures at varying temperatures. By J. D. W. Ball. 8½ in. × 5½ in., pp. 24. Constable & Co. Ltd, London, 1953. Price: 5*s*. net.

These tables are for the engineer. They are tables for the conversion from a measured height of mercury in inches, or millimetres, and at a known temperature, to a pressure expressed in kilogrammes per square centimetre, pounds per square inch, or pounds per square foot. There are subsidiary tables converting kilogrammes per square centimetre to bars at standard gravity or at Greenwich gravity. There are no tables which allow this conversion to be made for any other value of gravity. R. FRITH

ADDENDUM

April 1954, PAGE 114, reference 6; *for* "(in the press)" *read* "**7**, 1954, p. 176".

METEOROLOGICAL OFFICE NEWS

Retirements.—Mr. C. E. Britton, Principal Scientific Officer, retired on April 8, 1954. He joined the Office in 1919 and, during nearly 35 years' service, his work has been mainly concerned with meteorological services for the Army at Shoeburyness and Larkhill. In 1939 he was posted from Shoeburyness to Headquarters to take charge of the arrangements for the Meteorological Section, Royal Air Force Volunteer Reserve, and on the partial militarization of the Meteorological Office in 1943 he continued to serve in the Personnel and General Branch with particular responsibility for matters relating to Service personnel and meteorological training. In 1947 he was posted to Larkhill where he has remained until his retirement. During the First World War 1914–18 he served in the Royal Army Medical Corps and later in the Meteorological Section, Royal Engineers. Mr. Britton has accepted a temporary appointment in the Meteorological Office. A retirement gift is being made to Mr. Britton to which those with whom he has been associated have contributed.

Mr. T. F. Twist, Senior Experimental Officer, retired on March 25, 1954. He joined the Office in 1920 and during his 34 years' service he has worked at several aviation outstations and in the Forecast Division at Headquarters. From 1947 until his retirement he served at Trinidad. He served four years in the Infantry in the First World War 1914–18, was wounded and was a prisoner of war in Germany. Mr. Twist has accepted a temporary appointment in the Colonial Service and returns to the West Indies for further service with the British Caribbean Meteorological Service. A retirement gift is being arranged for Mr. Twist to which contributions have been made by those with whom he was associated.

Academic success.—To the lists published in the March *Meteorological Magazine* should be added:

Intermediate B.Sc.: pure and applied mathematics, physics, D. J. Clark.

Nuffield Foundation Research Fellowship.—We congratulate Mr. L. P. Smith on the award of a Nuffield Foundation Research Fellowship tenable from June 1, 1954, for 10 months. Mr. Smith intends to study the application of meteorology to agriculture in France, Ireland, Scandinavia, New Zealand, Australia, South Africa, the Low Countries and Germany.

Five shillings reward.—The finder of a radio-sonde transmitter has sent a humorous letter in the shape of a formal claim for £12 10*s.* 2½*d.* (the reward offered is five shillings) to meet damages and expenses under such headings as £2 for the shock of finding a potentially dangerous weapon while searching for mushrooms, £2 for eye-strain caused by reading the partly obliterated label, and 4*s.* 8*d.* for refreshments incurred in telling the tale of the finding in the village "locals".

Sports activities.—On February 26, 1954, Mr. G. M. Band successfully defended his title as Road Walking Champion of the Iraq Command of the Royal Air Force over a seven-mile course.

Mr. B. L. Wood, Assistant at Bovingdon, gained third place in the Air Ministry Backstroke Swimming Championship held on March 12, 1954.

WEATHER OF MARCH 1954

Mean pressure was below normal over an exceptionally large area including most of Europe (except Scandinavia), the North Atlantic and the eastern United States. The greatest deficit of mean pressure, 9 mb., occurred in the region south of Iceland at about 60°N.; the mean pressure here was 998 mb. Over western Europe and the west Mediterranean, mean pressure was generally between 3 and 7 mb. below normal.

The mean temperature over most of Europe was generally 2°F. above normal, associated with the mean pressure gradient for S.–SW. winds. The mean temperature over the United States, however, was generally 4°F. below normal.

In the British Isles the weather was very changeable. Unusually cold wintry conditions during the first few days were followed about the 5th by a milder westerly type of weather. From the 10th to the 12th mild southerly winds prevailed with temperature rising to 60°F. locally. These were followed by dull cold easterlies which continued until the 18th. From this time onwards a south-westerly to westerly type of weather predominated.

On the 1st a small depression off our south-west coasts turned eastward along the English Channel and there was widespread snow in south Wales and much of southern England during the day or the following night; at 0900 on the 2nd snow lay 5½ in. deep at Wootton Courtenay, near Minehead, and 4½ in. deep at Dale Fort, Pembrokeshire. On the 1st and 2nd, temperature in the screen fell below 20°F. at a number of places, notably 6°F. at Burnley and 7°F. at Chapel-en-le-Frith, Derbyshire on the 1st and 7°F. at Eskdalemuir and Kielder Castle, Northumberland on the 2nd. Between the 2nd and 4th a complex, deep depression moved eastward from the Atlantic to near the Scottish Border and thence to the North Sea. Snow occurred widely, except in the south-west, on the night of the 2nd–3rd but it soon melted over much of England and turned to sleet on low ground in the north of the British Isles. There were strong winds or gales at exposed places, and snow drifts were 4½ ft. deep at 0900 on the 3rd at Bwlchgwyn, 1,267 ft. above M.S.L., in Denbighshire. There was snow over much of the high ground also on the 3rd and 4th, and in north-east Scotland the snowfall was heavy with deep drifts. The 5th was a sunny day generally, with north-westerly winds and scattered showers. On the 6th a deep depression south of Iceland moved slowly east to the north of Scotland and later turned north-east. Milder south-westerly to westerly winds prevailed, reaching gale force in places; rain fell generally and was heavy locally (2·25 in. at Watendlath Farm, Cumberland and Swansea Waterworks, Brecknockshire and 2·11 in. at Llyn-y-fan-Fach, Carmarthenshire on the 6th), and the weather was mainly showery with long bright periods in most places on the 7th. On the 8th and 9th a ridge of high pressure moved north over the country giving long sunny periods in most areas on the 8th and locally in northern districts on the 9th. During the 10th–12th there was a mild southerly type; mild, sunny weather in the south-east on the 10th spread to most districts by the 12th; there was, however, a good deal of fog locally on the north-east coast, which kept temperatures low. Maxima of 60°F. or above were registered in many parts of England on the 11th and locally in west and north-west Scotland on the 12th (64°F. at Camden Square on the 11th and 62°F. at Prestwick on the 12th). With the development of an anticyclone over Scandinavia on the 12th, cold, mainly dull easterly winds set in on the 13th and lasted until the 18th; there was little rain during this spell except in the south-west. The fall in temperature with the onset of the easterly wind was marked; at Cranfield, Bedfordshire, the maximum on the 13th was 19°F. below that on the 12th. On the 19th–20th a depression moved east over southern districts and during the 22nd–24th a deep depression moved slowly north-east into Ireland and then moved away south-south-east and filled; rain fell fairly generally during this period, particularly on the 19th, 21st and 22nd. Rainfall was rather heavy locally in north-west England and south Scotland on the 21st, and in west Scotland and north-west Ireland on the 22nd–23rd (1·96 in. at Ambleside on the 21st). During the rest of the month there was a changeable south-west to west type of weather; the 26th and 27th were mostly sunny, but rain occurred fairly frequently and was rather heavy locally, for example on the 25th and 29th (1·13 in. at Point of Ayre, Isle of Man on the 25th and 2·06 in. at Loch Dhu, Perthshire and 1·94 in. at Ramsey, Isle of Man, on the 29th). The last two weeks were mainly mild; temperature rose to 62°F. at York on the 21st and 63°F. at Llety-evan-Hen near Aberystwyth on the 22nd, but there was slight air frost locally at times in the last week. Thunderstorms occurred locally on the 30th and 31st.

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

	AIR TEMPERATURE			RAINFALL		SUNSHINE
	Highest	Lowest	Difference from average daily mean	Percentage of average	No. of days difference from average	Percentage of average
	°F.	°F.	°F.	%		%
England and Wales ...	64	6	−0·1	117	0	87
Scotland	62	4	−1·0	89	−4	97
Northern Ireland ...	59	21	−0·2	117	−2	94

RAINFALL OF MARCH 1954

Great Britain and Northern Ireland

County	Station	In.	Per cent. of Av.	County	Station	In.	Per cent. of Av.
London	Camden Square ...	2·15	117	*Glam.*	Cardiff, Penylan ...	5·03	160
Kent	Dover	2·95	141	*Pemb.*	Tenby	4·53	146
,,	Edenbridge, Falconhurst	3·20	129	*Radnor*	Tyrmynydd	4·87	91
Sussex	Compton, Compton Ho.	4·11	148	*Mont.*	Lake Vyrnwy	5·83	130
,,	Worthing, Beach Ho. Pk.	3·36	175	*Mer.*	Blaenau Festiniog ...	8·71	101
Hants.	Ventnor Park	3·96	189	,,	Aberdovey	3·38	102
,,	Southampton (East Pk.)	3·28	144	*Carn.*	Llandudno	2·06	101
,,	South Farnborough ...	2·35	118	*Angl.*	Llanerchymedd ...	3·28	110
Herts.	Royston, Therfield Rec.	1·83	100	*I. Man*	Douglas, Borough Cem.	3·90	132
Bucks.	Slough, Upton	2·21	126	*Wigtown*	Newton Stewart ...	3·90	113
Oxford	Oxford, Radcliffe ...	2·54	154	*Dumf.*	Dumfries, Crichton R.I.	3·16	106
N'hants.	Wellingboro' Swanspool	2·20	123	,,	Eskdalemuir Obsy. ...	4·44	91
Essex	Shoeburyness	2·02	150	*Roxb.*	Crailing...	1·32	61
,,	Dovercourt	1·36	88	*Peebles*	Stobo Castle	2·77	96
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