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ERRATA.

Page 159, line 45, *for* " lower " *read* " higher."
See also pages, 22, 118, 184.

ILLUSTRATIONS.

M.O. 284.

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The Optics of the Sunshine Sphere

By E. G. BILHAM, B.Sc., D.I.C.

IN the well-known sunshine recorder devised by Sir G. G. Stokes and based on earlier instruments by J. F. Campbell of Islay, R. H. Scott and Sir G. B. Airy, several conditions have to be fulfilled if comparable records are to be obtained from different localities. The need for an uninterrupted exposure and for correct adjustment of the instrument are well-known. Little attention has, however, been paid to the need for very close agreement between individual spheres, with regard to their optical properties, and it is the purpose of this article to indicate briefly the nature of the problem involved.

It will be recalled that the Campbell-Stokes instrument consists of a metal frame or collar, provided with slots into which cards may be inserted for the reception of the image of the sun formed by a glass sphere four inches in diameter. For a discussion of the theory of the instrument, the reader is referred to Sir G. Stokes's paper in the *Quarterly Journal of the Royal Meteorological Society*, Vol. VI., pp. 83-93. It will suffice for our present purpose to point out that exact coincidence between the centre of the sphere and the centre of the spherical surface of which the bowl forms a part is essential. In other words, there is no possibility of allowing for small differences in the focal lengths of individual spheres by varying the position of the sphere relative to the card. The focal length of the sphere must,

Wt 69—P 1 1000 2/26 M &.C

therefore, conform to a predetermined value. Now, in practice absolute exactitude is not obtainable in any form of scientific applicance, and it is customary to permit the manufacturer a certain latitude or "tolerance." We have, therefore, to determine (A) what should be the focal length of the sphere and (B) what degree of divergence from the specified value is permissible.

It is rather curious that in Stokes's original description of his recorder, the focal length of the sphere for which it is intended is nowhere stated in exact terms. In discussing the dimensions, he states that "if the glass spheres be of four inches diameter, and the glass be free from lead, R (*i.e.*, the focal distance for best burning) will be a little under three inches." The perpendicular distance from the centre to each of the supporting surfaces for the cards was, however, fixed at 2·89 inches. The cards are ·02 inch thick, so that the minimum distance between the centre and the solar image on the card is 2·87 inches. The maximum distance is about 2·90 inches. Some of the earliest spheres in use have been found to have a visual focal length of 2·97 inches, and this value was adopted in the Meteorological Office specification which was in force until 1921. It seems clear, therefore, that Stokes was aware of the fact, which we shall subsequently enlarge upon, that the card must not be placed exactly at the visual focus in order to get the best burning.

In 1921 it was decided, in order to secure greater permanence of colour, to make a change in the variety of crown glass used for the manufacture of spheres. This change involved a slight reduction in the focal length, from 2·97 inches to 2·95 inches. Actually, the specified data were the diameter (3·99 to 4·01 inches) the refractive index for sodium light (1·511 to 1·513), and the weight (2·96 to 3·04 lbs.). This specification permitted of variations of focal length from 2·94 to 2·96 inches. It will be seen later that this change was not likely to affect the burn appreciably, and comparisons between spheres made in accordance with the two specifications did, in fact, show no perceptible differences. We shall see that the adopted value is appropriate to the standard bowl of Stokes's specification, and in view of the fact that glass of the prescribed refractive index can be made with satisfactory uniformity nothing would be gained by further change in the specification.

It is of interest, however, to consider the question from the abstract point of view, and it is curious that investigations have been proceeding simultaneously and independently both at South Kensignton and at Potsdam with closely parallel results. The general conclusions may be illustrated by a very simple experiment, during the performance of which the investigator must wear dark spectacles. A sunshine sphere is placed on a suitable support in bright sunshine and a card is slowly brought upwards towards the sphere on the side remote from the sun. The following phenomena are observed: with the card well outside the focus a diffuse patch of light is observed which becomes brighter and more concentrated as the card approaches the focus. Very little tendency to burn is observed, however, until the card is within a tenth of an inch of the focus. The card then begins to burn more and more freely. When the focus is passed the image takes the form of a sharply defined disc of gradually increasing diameter. The card continues to burn quite readily even when the card is within half an inch of the sphere. It is seen, therefore, that conditions are markedly different, both optically and thermally, on the two sides of the focus. If an ordinary magnifying glass is substituted for the sphere it will be found that burning only occurs close to the visual focus. Clearly therefore, a sunshine sphere cannot be treated as a simple lens.

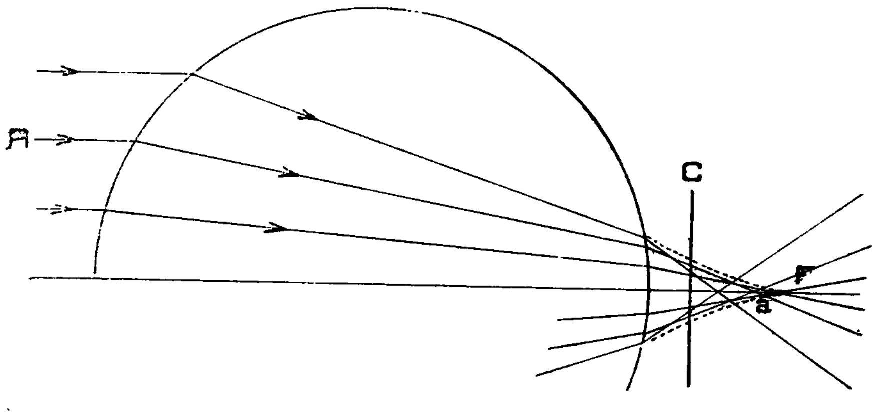


Fig. I.

The reason for this becomes clear if we consider Fig. I. which shows the paths of rays of light incident at varying distances from the axis. The emergent beam consists of a cone of rays enveloped by a caustic surface whose apex represents the focus F for a very narrow pencil of rays along the axis. A ray such as A, not on the axis, comes to a focus at a point *a* between F and the sphere, the distance F*a* increasing with the distance of A from the axis. It will be seen that all rays beyond F are divergent, while between F and the sphere any point on the axis is a focus for some particular zone. The asymmetry noticed in the experiment is thus accounted for. If a card is placed at some such position as C the image is found to consist of a bright ring of light, representing the line of intersection of the plane of the card by the caustic surface, with a central bright spot and an intermediate zone of lower luminosity. If the card is placed in actual contact with the sphere, a bright ring of diameter about 2 cm.

will be seen. If the diameter of the ring is measured and the diameter of the sphere is known, the refractive index, and thence the focal length, can readily be calculated. F. Albrecht,* of Potsdam, has adopted this as a standard method of determining the focal length. The same investigator has recently determined the actual distribution of temperature in the region of the focus and has shown that, in the case of a sphere of refractive index 1·5, the maximum burning power occurs at a point about 6 mm. nearer to the sphere than the visual focus F. The position of this point was found to be dependent to some extent on the nature of the card used in the recorder.

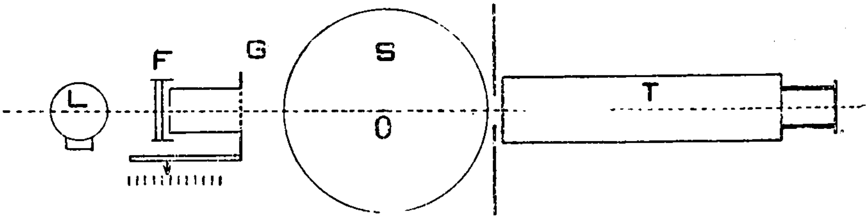


FIG. II.

At first sight it might appear that this result merely arises from the possibility that the rays which are chiefly instrumental in burning the card lie outside the visible spectrum. From the known facts about the distribution of energy in the solar spectrum, however, we should not expect to find the best burning focus in the ultra violet, which is the natural consequence of this suggestion. Albrecht's result is more reasonably interpreted as meaning that the integrated effect of all the rays, converging or diverging, reaches a maximum value at the point found. This experimental result is all that need concern us, since for a given quality of glass it is only necessary to specify the focal length for a given wave length in order to reproduce the standard distribution of energy along the axis, exactly.

From the above considerations it will be clear that it is very important to ensure that the focal length of the sphere is fairly close to the specified value, and it is also clear that too short a focal length is a much more serious fault than an error in the opposite direction. It has been decided to retain 2·94 inches as the minimum for spheres used in the standard Meteorological Office recorder, the values given referring to sodium light confined to an axial pencil about 3/16 inch in diameter.

For the determination of the focal length the method illustrated diagrammatically in Fig. II. is in use at the Meteorological Office, South Kensington. S is the sphere, geometrically supported on a suitable stand, and G a finely engraved graticule

* Met. Zs. Heft. 11, 1925, pp. 443-6.

for focussing purposes. This graticule is mounted on a carriage movable by rack and pinion along the axis, the distance of G from O, the centre of the sphere, being indicated on a scale. A short length of brass tube fixed to the graticule mount cuts out stray light and also supports the filter F which transmits approximately monochromatic light whose wave length is that of the D lines of sodium. The stop which defines the width of the pencil is placed just in front of F. A lamp L with opal bulb provides the illumination. T is a telescope focussed for infinity. It will be seen that if the graticule G is placed at the back focus of S, the graduations will appear sharply focussed on looking through T. To use the apparatus it is only necessary to focus the graticule by means of the rack and pinion and read the scale, which gives the focal length immediately. The focussing is remarkably sharp and the focal length can be determined readily to within ·01 inch.

Before concluding, some mention should be made of the effect of those faint striations which are frequently seen if a sunshine sphere is examined closely. They are due to imperfect optical homogeneity and a badly affected sphere may fail to yield a clear image in any position when tested by the method just described. To test the effect on the burning power of the lens a very clear sphere and a badly striated sphere of the same focal length were carefully compared against a standard at Kew Observatory. The two spheres were used on alternate days in the same bowl and the record obtained was expressed in each case as a percentage of that yielded by the standard recorder. The effect of the striations was found to be unexpectedly small. No perceptible diminution of record, even at times of faint sunshine, was in fact found. On the other hand, a clear sphere of focal length 2·89 inches was found to give a perceptibly weaker burn than one of standard focal length and there was an appreciable loss of record during feeble sunshine.

OFFICIAL PUBLICATIONS

The following publication has recently been issued :—

Advisory Committee on Atmospheric Pollution. Eleventh Annual Report ; for the year ending March 31st, 1925.

THE report is divided into four sections. In the first section, which deals with the deposit of impurity at forty-eight stations, it is shown that the deposit of tar was lower than the average for the previous five years. There was little difference in the deposit of sooty matter but the total impurity was somewhat less than the average in most stations. Section 2 deals with the automatic recorder for suspended impurity, and the effect of wind in governing the concentration of impurity is also discussed at some length. Section 3 describes dust counter observations made in different countries, while in section 4 the special researches undertaken by the Committee are given.

GEOPHYSICAL MEMOIRS—

No. 28. *The Doldrums of the Atlantic.* By C. S. Durst, B.A. (No. 254*h*).

This publication deals with the meteorology of the interesting region of calms and variable winds, usually found just north of the equator, termed the Doldrums. It is found to vary considerably in position, and the variations are associated with variations in the humidity of the two trade winds which bound it on either side. This leads to a theory to explain the existence of a belt of doldrums.

Discussions at the Meteorological Office

January 18th. *Polareis und atmosphärische Schwankungen.* By W. Wiese (Geog. Ann. Stockholm VI, 1924, pp. 273-299), and *Die Einwirkung der mittleren Lufttemperatur im Frühling in Nord-Island auf die mittlere Lufttemperatur des nachfolgenden Winters in Europa.* By W. Wiese (Met. Zs. 42, 1925, pp. 53-57). *Opener*—Sir Gilbert Walker, C.S.I., F.R.S.

The papers discussed deal first with methods of forecasting the amount of ice in the Barents Sea, especially by means of the position of the trough of low pressure in the Norwegian Sea: it appears also that the ice is very persistent, and the amount in one year is an important element in the forecast for the following year. The main contention of Wiese is that the Barents Sea is an important action centre, and the amount of ice there is related to the general atmospheric circulation, rainfall in equatorial regions, etc. It also provides a useful method of forecasting the rainfall in south-east Russia. The discussion brought out the fact that many of the correlations employed were based on short periods of years, and were not confirmed when the period was extended. An article on the subject by Sir Gilbert Walker will appear in the *Meteorological Magazine* for March.

February 1st, 1926. *Solar radiation and weather or forecasting weather from observations of the sun.* By H. H. Clayton (Smithsonian Misc. Coll. 77, No. 6, pp. 64). *Opener*—Capt. H. F. Jackson, M.S.E.

A review of the above work will be found on p. 237 of the November issue of the *Meteorological Magazine.* An interesting discussion followed the exposition of the paper by Capt. Jackson. Dr. G. C. Simpson said that it was not easy to attach an actual physical meaning to many of the diagrams shewn. His chief impression of the paper was the entire lack of judgment displayed in drawing deductions from the data. It was now becoming recognised that the day to day fluctuations of the observed values of the solar constant were essentially connected with variations in the transparency of our atmosphere. Sir Napier Shaw said that there had been a great amount of effort expended on the work but he felt it would have been better if the author had merely presented the data and left each reader to draw his own conclusions. Interesting contributions to the discussion were also made by Sir Gilbert Walker and Col. Gold.

The subjects for discussion for the last two meetings of the session will be—

March 1st, 1926. *On radiation and climate.* By Anders Angström (Geog. Ann. Stockholm, VII., 1925, pp. 122-142). *Opener*—Mr. J. Crichton, M.A., B.Sc.

March 15th, 1926. Untersuchungen über die Elemente des Nebels und der Wolken. By H. Köhler (Stockholm, Statens Meteor.-Hydrog. Anstalt. Med. Bd. 2, No. 5). *Opener*—Lieut.-Col. E. Gold, D.S.O., F.R.S.

Royal Meteorological Society

THE Annual General Meeting of the Society was held on Wednesday, January 20th, at 49, Cromwell Road, South Kensington, Mr. C. J. P. Cave, M.A., President, being in the Chair. The Report of the Council for 1925 was read and adopted, and the Council for 1926 duly elected, the new President being Sir Gilbert Walker, C.S.I., F.R.S.

The Symons Gold Medal which is awarded for distinguished work done in connection with meteorological science was presented to Lieut.-Col. Ernest Gold, D.S.O., F.R.S.

Mr. C. J. P. Cave delivered a brief address on the work of the Society during the past year and then showed a collection of lantern slides of cloud photographs.

AT the invitation of Colonel H. G. Lyons, F.R.S., Director of the Science Museum, fellows of the Royal Meteorological Society visited the new meteorological gallery of the Science Museum on Wednesday, February 3rd, at 5 p.m., to see the meteorological collection.

The collection is now housed in a spacious and well-lighted gallery on the second floor of the new building of the Museum from which the instruments on the roof of the Meteorological Office can be seen, and next to it are the geophysical, astronomical, and mathematical sections of the Museum. Those who remembered the former arrangement of the collection in the old " Western Galleries," in the building now occupied by the Imperial War Museum, were agreeably surprised to see the enormous increase in accommodation which is afforded by the new gallery ; and the effective display of the exhibits in the care of the Museum, many of which had hitherto been kept in store owing to lack of accommodation, was freely commented upon. Many new exhibits were seen, and particular mention should be made of the historical collection of thermometer screens from various countries, which will be of special interest to meteorologists who have followed the attempts to devise a satisfactory screen for the measurement of air temperature. There is also a historical collection of British Weather Maps, and arrangements are being made for the display of a number of fine transparencies of cloud photographs by Mr. G. A. Clarke, of Aberdeen Observatory. The meteorological and geophysical instruments now in use in this country are well represented in the collection.

It is evident that the authorities of the Science Museum have realized the great importance of setting out the historical development of the subject, and this feature is specially to be commended.

Correspondence

To the Editor, *The Meteorological Magazine*

A Blue Moon

On my way to the station this morning, shortly before eight, the sunrise, on very fleecy cirro-cumulus clouds in the south-east and south, gave them a rather unusual tint. The pink had a touch of brown, giving a shade perhaps best described as pale salmon. There seemed to be clear interspaces, but probably these too were tinted. The moon, visible through cloud nearly as much as interspace, instead of taking the usual greenish tint by contrast, was of an exquisite pale blue, deeper on the brighter outer edge. The shade of colour is hard to describe. Among flowers the nearest I can think of are the sea holly and Miss Jekyl's " Love in a Mist." Both of these probably have a slight touch of green. It reminded me too of the blue flashes one gets with an opal. By 8 o'clock the moon was growing white as the sunrise tints disappeared. It was watched for 10 minutes and attracted the attention of others as well as myself. Was the phenomenon widespread ?

J. Edmund Clark.

41, *Downscourt Road, Purley, Surrey. January 8th,* 1926.

Smoking Snow

On Tuesday, December 29th, when motoring across the North Yorkshire moors, I observed a phenomenon which was particularly interesting to me although it is quite possible that many of your readers have observed similar occurrences. The exceptionally heavy falls of snow in Yorkshire both before and during Christmas week have been reported and commented upon in many newspapers, the deep drifts on the moorland roads making traffic quite impossible for a time. A general thaw set in about Boxing Day, December 26th, but on the afternoon of December 29th there were still many deep snowdrifts and banks of piled up snow on the roadsides on the high moors between Pickering and Whitby.

On this particular afternoon a strong, very warm southwesterly wind was blowing and frequent heavy rainstorms occurred. As we passed along all the heaps of snow appeared to be giving off white clouds of "smoke" which blew away to leeward for a short distance and then disappeared as the moisture temporarily condensed by contact with the snow again evaporated. I have read of the "banner cloud" and of Cervin (the Matterhorn) "smoking his pipe" in similar conditions (*vide* Dr. Richard Garnett's *A little book on Water Supply*), but I have never before seen piles of snow smoking like rubbish heaps!

The afternoon of December 29th was unusually warm, the maximum reading on my return to York was 57·8° F., which may be compared with a minimum reading of 21° F. during the night of December 24th-25th, incidentally showing a fairly wide range of temperature over a period of five days.

A. WENTWORTH PING.

St. Peter's School, York. January 4th, 1926.

Possible Errors in Annual Rainfall Totals obtained by the Summation of Daily Records

THE methods suggested in my communication of April 2nd, 1925,* for obtaining the rainfall of a year free from the inaccuracy resulting from the accumulation of a large number of small errors in the daily records, have now been in use for 12 months with the following result :—The official record has given 181 rain days with an arithmetical total of 24·99 in. Water was, however, found in the gauge on 212 days, on 31 of which the amount was below ·005 in. The total of these traces was ·087 in. On only 31 days did the reading agree exactly with the official record ; on 83 days the amount being above, and on 67 days below, by quantities ranging from ·001 to ·004 in. The excesses (including the traces) amounted to ·264 in., and the deficiencies to ·223 in., so that they nearly balanced each other, and the rainfall for the year, when all the readings were made with the highest attainable accuracy came out 25·031 in. (the traces being included) or ·16

* See *Meteorological Magazine*, 60 (1925), 88.

per cent. above, or, if the traces are ignored, 24·944 in., or ·19 per cent. below the official record. The remeasurement in bulk (at the end of each month) of the stored water gave a total of 25·054 in.

As far, therefore, as this test goes, it would appear that recording daily falls to the nearest hundredth of an inch gives a total of quite sufficient accuracy.

I regard the measurement of the stored water as the most accurate method, but I would submit the following considerations. For measuring large volumes the cylinder holding ·50 in. is the very worst form. In my own case I had to fill it 50 times to measure 25 in. of rain. A globiform flask, with a narrow neck, holding 5 or 6 in. of rain would be an ideal form. A 2-litre flask (obtainable from any dealer in chemical apparatus) would hold water equal to 6·216 in. of rain on a 5 in. gauge and 4 fillings would supersede 50 fillings of the ordinary cylinder, with a great gain in accurate reading and much economy of time.

MORTYN J. SALTER.

Bank House, Mickleton, Glos., January 1st, 1926.

NOTES AND QUERIES

Wireless Weather Reports from Greenland

A telegram was received in the Meteorological Office on Friday night, February 5th, from Dr. la Cour, Director of the Danish Meteorological Institute, saying that the wireless station at Julianehaab in Greenland (half-way between Cape Farewell and Cape Desolation, about 100 miles from either) was beginning to transmit meteorological observations from Greenland twice a day, the transmission being made at noon and midnight. The first actual report received was that for midnight on Saturday, February 6th, having been re-transmitted at 7h. 35m. on Sunday morning by the Danish station at Lyngby. As this is a report of historic interest we reproduce it :

"Julianehaab 06 0000 GMT 46081 25361"

(Barometer, 746 mm. falling. Wind, East, Force 1. Weather, Fog. Temperature, –°3C. Past Weather, Cloudy).

So long ago as 1880, the International Meteorological Committee, at its Berne meeting, examined a proposal of Captain Hoffmeyer, to remedy to a certain extent the disadvantages of the situation in which the European Meteorological Service was placed, by the establishment of meteorological stations at the Faeroes, Iceland, Greenland and the Azores, in telegraphic communication with Europe.

It is over 30 years since the first part of the scheme was made possible by the completion of the cable to the Azores (first report from Ponta Delgada, October 20th, 1893). On October 11th, 1906, the reports from the Faeroes and Iceland commenced. Now, nearly half a century after Captain Hoffmeyer's proposal, his plan has been completed by the establishment, not of a cable connection with, but of a wireless station in, Greenland* The achievement, so far as Faeroes, Iceland and Greenland are concerned, is due to the efforts of Captain Hoffmeyer and his successors in the Directorship of the Danish Meteorological Institute ; so far as the Azores are concerned, it was due to Col. Chaves. All Europe is their debtor.

E.G.

A Course of Training for Observers

It is proposed to hold a fourth general course of training for meteorological observers, at Kew Observatory, Richmond, Surrey, during the week, April 19th to April 24th, 1926, both dates inclusive, provided that a sufficient number of applications are received.

The subjects to be dealt with will include the following :—

Meteorological instruments and methods of observation.
Recording of observations and their transmission to the Meteorological Office.
The Weather Map ; charting of observations distributed by wireless telegraph.
Climatology.

The course is addressed primarily to observers at stations which report regularly to the Meteorological Office. Others will, however, be admitted, at the discretion of the Director, as far as the accommodation permits. Applications for tickets of admission should be made to the Director, Meteorological Office, Air Ministry, Kingsway, London, W.C. 2. There will be no fee for the course, but travelling and other incidental expenses incurred by observers attending the course will in no case be paid by the Meteorological Office.

Climatic Changes in America

It would be a useful exercise in geography to read the four papers included in "Quaternary Climates"† and then to attempt to combine the evidence presented by the different authors and deduce an account of the climatic changes in the western part

* In the autumn of 1922 a temporary wireless station was set up at Mygbugten, on the east coast of Greenland, by a Norwegian hunting expedition equipped for the purpose by the Norwegian Meteorological Service. Weather messages were transmitted twice daily until August, 1923, when the expedition left Mygbugten. (See the *Meteorological Magazine* 58 (1923) 256).

† Carnegie Inst. Wash. Publ. No. 352. July, 1925. Quaternary climates. Geologic history of Lake Lahontan. By J. Claude Jones. On the pleistocene history of the Great Basin. By Ernst Antevs. The Big Tree as a climatic measure. By E. Antevs ; and Tree growth and climatic interpretations. By Ellsworth Huntington. pp. v. + 212. (*Illus.*)

of the United States which does not conflict with any of the facts.

The materials are briefly as follows: in southern California and Arizona there grow the "Big Trees" (*Sequoia*), which live to an age of three thousand years or more. A. E. Douglass has shown that the variations of the rate of growth of these trees, indicated by the width of the annual rings, depend very closely on the variations of the rainfall, so that we have a natural record of the rainfall over a period of more than three thousand years. The chief difficulty is that the scale of the record varies. A tree grows more rapidly when it is young than when it is middle-aged, and when it is old its growth becomes irregular. Evidently some standard is required by means of which the ratio of growth can be corrected to a uniform scale. Professor Huntington, in an earlier paper, employed the fluctuations of the level of the Caspian Sea, but since the early levels of this sea are themselves very doubtful, and their connexion with changes in western America is not yet proved, calibration by this method is not satisfactory. By a fortunate chance it happens that in the region where grow the Big Trees there are a number of salt lakes, and in the first paper Professor Jones attempts to determine the age of Lakes Pyramid and Winnemucca from the amount of salt at present contained in those lakes. Four determinations were made, with the following results:—

Rate of accumulation of chlorine from Truckee River	3,880 years.
Rate of accumulation of sodium from Truckee River	2,450 years.
Accumulation of chlorine in last 31 years ..	1,956 years.
Rate of concentration of chlorine by evaporation	2,400 years.

The concordance is not very good, and the way in which the evidence is presented leaves a great deal to be desired, but the figures seem to show that the lakes contained fresh water between 2,000 and 3,000 years ago. A lake may be fresh for one of two reasons, either because it has an outlet so that the water in it is continually being changed or, if it has no outlet, because it has only just been formed and has not had time to become salt. Since Lakes Pyramid and Winnemucca show no signs of having ever overflowed, the second explanation must be the correct one. After the lakes were formed they stood for some time at a level 120 feet above the present, then rose rapidly to their maximum height, and sank again by easy stages to a point probably below their present level. The sequence of levels can be determined with some accuracy from the lake terraces, but not the actual dates.

In the third paper Dr. Antevs calibrates the growth-curve of the Big Trees from intrinsic evidence alone. The maxima on his curves enable us to date the various stages in the history of the lakes with great accuracy, after which the lake changes enable us to make a final correction of the tree-growth curve. The final result is a curve of the variations of rainfall in western North America which is by far the finest "long-series" which we possess. The change from a long period of dry climate to a period of heavy rainfall appears to occur at 850 B.C., a date which fits very well with a similar change in Europe and Asia. In the fourth paper, however, Professor Huntington arbitrarily reduces the figures derived from the salt content to less than 1,300 years, to fit in with the low level of the Caspian about 650 A.D. This modification of Jones' figures is quite unnecessary and raises a whole host of difficulties. Professor Jones attributes to the cycle of changes since 1,000 B.C. a series of lacustrine deposits which obviously refer to an older cycle dating from the Ice Age, and thereby arrives at some impossible conclusions regarding the persistence of extinct animals into historic times. Dr. Antevs in the second paper places the corresponding series in the Great Basin in their correct geological position, but ignores the possibility of a more recent cycle of changes. The views of these two authors are accordingly quite incompatible, and a certain amount of confusion is likely to be created in the mind of the unwary reader. Nevertheless the publication in a single volume of papers which deal with the same subject from different aspects has much to recommend it, if only because it shows that our knowledge of the happenings is not quite so sure as any individual author would lead us to believe. We also welcome this evidence of the activity with which palaeoclimatology is being pursued in America.

C.E.P.B.

The Deterioration of Climate in Greenland

RECENT excavations near Cape Farewell, described by William Hovgaard in the *Geographical Review* for October, 1925, throw light on the fate of one at least of the early Norse colonies in Greenland, and incidentally provide a definite proof of a change of climate in historic times. The colony referred to is the "Eastern settlement," just west of Cape Farewell, and the interesting finds come from the cemetery, where they have been preserved by being permanently frozen into the ground, a condition which must have persisted for at least five hundred years. When the bodies were buried, however, the soil must have thawed, at least at midsummer. The costumes and many of the coffins, even the deepest-lying, are pierced and matted by the roots of plants, which could not have happened if the ground was permanently frozen.

The remains speak very eloquently of the fate which overtook the colonists after their abandonment by the mother country in 1410. In the constant fight with the changing climate, their physique deteriorated and their numbers diminished until, early in the sixteenth century, we have the tragic end:—" the last Norseman . . . . . lying dead and unburied by his desolate and deserted dwelling, and holding in his hand the emblem of the cultural superiority of the European, the iron knife, which had been ground and ground to the verge of possibility."

Portable Receiver for the Electric Cup Anemometer

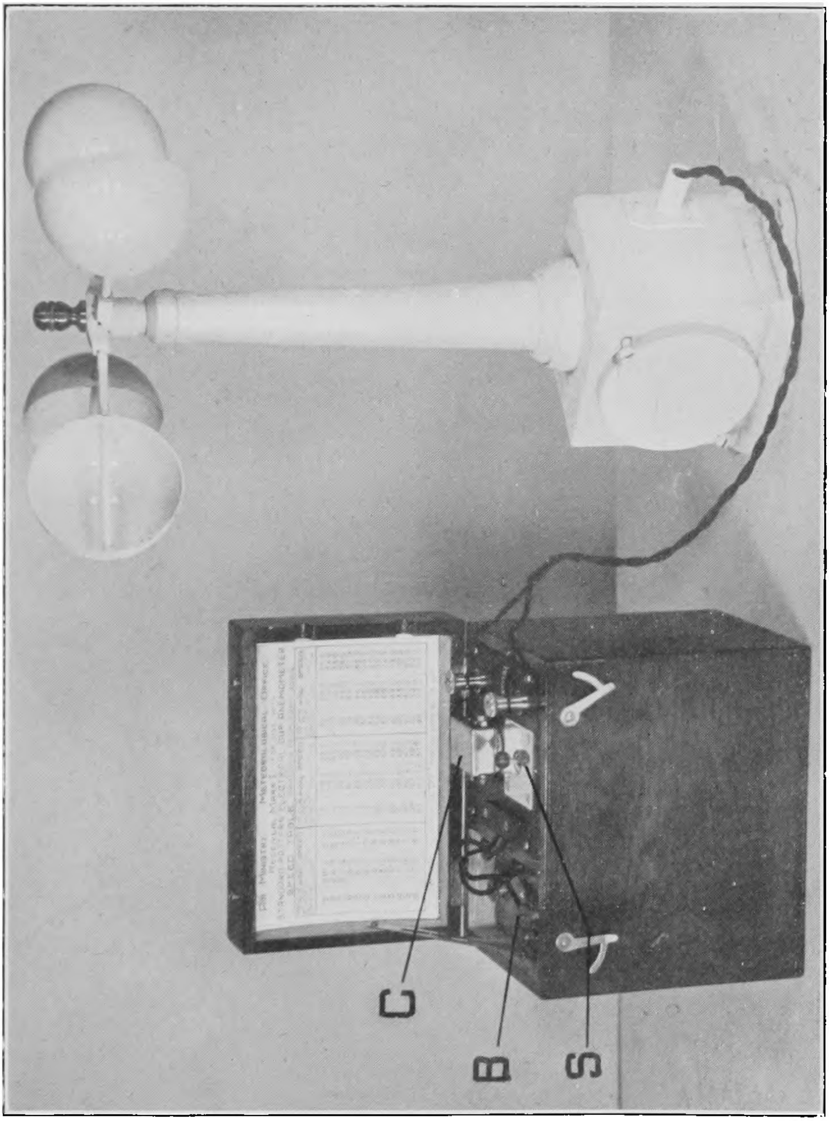
A small anemometer of the Robinson type is an inexpensive instrument for the measurement of wind velocity, in circumstances where the question of expense prohibits the installation of a more elaborate instrument, such as the Dines pressure tube anemograph. If electric contacts are provided whereby the rate of rotation of the cups may be measured through the agency of a small buzzer and battery, the instrument may be permanently erected in a well exposed situation, and connected by means of twin conductor cable to the remainder of the apparatus which may be in any convenient position. For use with anemometers of this type, a convenient form of receiver has recently been designed in the Meteorological Office, and is illustrated in our photograph. The anemometer itself, shown on the right of the picture, is provided at its base with two terminals. The receiver is also fitted with two terminals and all that is necessary, when the anemometer has been installed, is to run a length of twin cable from the instrument to the receiver and connect up the two pairs of terminals at either end. In the receiver, the connection between the batteries, marked B, and the buzzer, C, are made through a switch, S. When the switch is put to the " On " position the buzzer emits a note at regular intervals corresponding with the contacts made by the rotation of the cups. To take a measurement, all that is necessary is to measure the average interval between the buzzes, preferably with a stop watch. Tables showing the relation between this interval and the speed of the wind are supplied by the makers of the anemometers and may conveniently be pasted into the lid of the receiving apparatus.

Tapered Rain Measures

IN the article on " A New Rain Measure " in the issue of the *Meteorological Magazine* for September, 1924,* it was stated that the measure can be conveniently stored when not in use by inverting it on a fixed vertical peg in a protected position, thereby

* See also *Meteorological Magazine*, 60 (1925), 265.

to face p. 14.



Electric Cup Anemometer and Portable Receiver.

minimising the risk of breakage. In a few cases difficulty has arisen owing to the wooden peg fitting the glass measure too closely and in one instance the swelling of the peg actually broke the measure. To obviate this the diameter of the peg should be cut a little smaller than that of the measure to allow for swelling in damp weather.

Two Sunsets on One Day

THE March number of the *Marine Observer* contains a short note of an unusual refraction phenomenon observed by Mr. J. C. Kelly Rogers, in Lat. 29°S, Long. 16°E, on March 31st, 1925. He says that the unusual refraction during the afternoon caused two distinct horizons to appear, the distance between them subtending a vertical angle of from ten to fifteen minutes of arc at its greatest. The double horizon was not uniform all round the compass. The sun completely set on the upper horizon first then reappeared on the lower one and set for the second time.

The same number of the *Marine Observer* contains a sketch of a very unusual halo observed in the Caribbean Sea on March 6th, 1925.

"A Red Sky at Night......"

AN attempt has been made, since October, 1918, to classify, systematically, sunrise and sunset sky colourations in the London Area. This colour classification has consisted of resolving sunrises and sunsets into (1) reds or yellows, (2) a predominance of red over yellow, or vice versa, and (3) a combination of both colours neither one of which can be said to predominate. From this colour classification the following five types have been evolved :—

Type R (Red). All colour gradations from pink through red to crimson.

Type Y (Yellow). All colour gradations from yellow through gold to orange.

Type R+ (Red predominating). R and Y colour gradations in combination, but R predominating.

Type Y+ (Yellow predominating). Y and R colour gradations in combination, but Y predominating.

Type R+Y (Red and Yellow). R and Y gradations in combination, singly or collectively.

In order to cover the large number of cases of entirely overcast skies at sunrise and sunset a sixth type, designated X, has been used.

Both violet and green colourations have been omitted from the above classification, violet on account of its comparative rarity (in London), and green because it seldom forms an integral part of the period of sunrise or sunset considered, occurring as a rule too early in the case of sunrise and too late in the case of sunset. Further it appeared desirable that some limit should be set to the number of types. The observations, covering a period of six years, have been grouped into Winter, October 1st to March 31st, and Summer, April 1st to September 30th. The table appended is a summary of sunrises and sunsets classified under their respective types with the percentage frequency of precipitation following the type. Entirely red sunrises and sunsets (R) occur most frequently in the winter half of the year, a red sunrise in summer being a comparatively rare phenomenon, averaging only five per summer during the period.

Type	Winter Sunrise Oct.-March, 1918-24			Winter Sunset Oct.-March, 1918-24			Summer Sunrise April-Sept., 1919-24			Summer Sunset April-Sept., 1919-24		
	No.	Precipitation followed before next		No.	Precipitation followed before next		No.	Precipitation followed before next		No.	Precipitation followed before next	
		Sunset	Sunrise		Sunrise	Sunset		Sunset	Sunrise		Sunrise	Sunset
		%	%		%	%		%	%		%	%
R	94	33	61	100	16	29	30	50	70	61	25	43
Y	103	30	40	92	42	59	274	31	38	159	23	51
R+	118	33	73	139	22	34	77	53	70	194	5	27
Y+	122	26	48	140	36	50	122	29	36	188	18	46
R+Y	110	18	39	141	21	38	120	26	33	194	10	27
X	547*	45	60	482*	51	62	475*	43	50	302*	40	55

There is a very marked predominance of yellow sunrises (Y) in the summer half of the year, this type yielding the largest individual number of any considered. It was of very frequent occurrence during the dry summer of 1921. Red predominating (R+) is comparatively infrequent at summer sunrise as is the case with all red (R). Types Y+ and R+Y show a fairly even seasonal distribution both at sunrise and sunset. Entirely overcast skies, X, occur most frequently at sunrise in winter and least so at sunset in summer, but both winter sunset and summer sunrise yield a comparatively high percentage of overcast skies. R and R+ sunrises, both in winter and summer, are followed by a high precipitation frequency, the reverse holding for sunsets, more especially in winter. Y and Y+ sunrises, especially Y in summer, are followed by a low precipitation frequency, the reverse holding for sunsets, more especially in winter. Sunrises and sunsets classified as type R+Y are followed by a relatively low precipitation frequency, both at sunrise and sunset, and in winter and summer. Entirely overcast skies, X, yield a com-

* For Type X precipitation was actually occurring at the time of observation in 135 cases (25%) at Winter Sunrise, 153 cases (32%) at Winter Sunset, 91 cases (19%) at Summer Sunrise, 99 cases (33%) at Summer Sunset, and these numbers have been deducted in arriving at the succeeding precipitation frequency.

paratively high succeeding precipitation frequency for all periods, the lowest occurring with summer sunrise, and the highest with winter sunset.

It is proposed, on a future occasion, to consider the cloud form or forms associated with the respective colour types.

SPENCER RUSSELL.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1925.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays)

Averages for Readings

		Oct.	Nov.	Dec.
Cloudless days:—				
Number of readings	n	5	9	8
Radiation from sky in zenith ...	πI	519	401	373
Total radiation from sky ...	J	553	431	405
Total radiation from horizontal black surface on earth ...	X	736	633	606
Net radiation from earth ...	X—J	183	202	201

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

		Oct.	Nov.	Dec.
Cloudless days:—				
Number of readings	n_0	4	4	4
Radiation from sky in zenith ...	πI_0	29	19	19
Total radiation from sky ...	J_0	32	28	24
Cloudy days:—				
Number of readings	n_1	4	3	3
Radiation from sky in zenith ...	πI_1	118	87	38
Total radiation from sky ...	J_1	105	79	31

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

Upper Air Work in the Argentine

THE report of the Meteorological Office of the Argentine Republic for 1924, has just been issued, and from it we learn that great efforts have been made during 1924 to obtain the necessary funds and materials for the re-organization of the aerological work which was initiated 15 years ago, but which has not been able to be maintained. In the meanwhile, by the help of voluntary contributions, work has been started at the Villa Ortúzar, Buenos Aires. Forty-three pilot balloon ascents were made between December 8th and 31st, usually one at 7h. 30 m., and one at 13 h. 30 m. On the 27th the balloon sent up at 13 h. 30 m. was observed to a height of 10,350 m. (33,950 ft.), the readings being then suspended on account of the rain.

Isle of Wight Weather

Mr. J. E. Cowper informs us that at Shanklin, Isle of Wight, the rainfall of 43·71 in. measured in 1925 only just failed to equal the largest total on record (43·82 in. in 1912) in spite of the record drought of June (only a " trace ") and the total of 0·28 in. in March, the smallest known in that month. At Newport the annual fall was 48·40 in., at Sandown only 34·56 in.

On the morning of January 7th, 1926, a severe rain and hailstorm was experienced in the Island, accompanied by a dense black cloud, heavy wind and in some places thunder. At Niton, near Ventnor, the disturbance was seen to sweep in from the sea about 10h. 30m. and apparently had some of the characteristics of a tornado. Hay, straw and light articles were whirled aloft to great heights. The only notable damage was on the top of the hill where the brick gable end of a large cow-shed gave way under the wind pressure and a large portion of corrugated iron roofing was torn away from the rafters, some of the sheets of iron being blown 100 ft. away. At Shanklin the hailstones were remarkably large.

Frequency of Rainy Days in London

Mr. C. A. Bracey has made an analysis of the daily amounts of rainfall at Brixton for the 40 years 1871 to 1910. From 1871 to 1905 the record was maintained at Acre Lane by the late Mr. F. Gaster, and subsequently by Mr. Bracey at St. James's Road. The day covers the 24 hours beginning 9 a.m. on the day of entry, and days with no rain or only traces (less than 0.005 in.) are counted as dry. The 40 daily values were tabulated for each calendar day throughout the year, and the means extracted. In addition, the number of days on which January 1st was rainless were counted, and so on for each day of the year. The annual average was 24·32 in. on 166 days, so that the mean fall per day was 0·067 in. and the mean fall per day of rain 0·147 in. For the whole period the percentage of dry days was 55, but for each of the seven months, March to September, the percentage was nearly 60, and for each of the remaining five months, October to February, it was only 50. It is of interest to be reminded at this time of the year that in London the chances are even of a day with measurable rain or with negligible rain of less than 0·005 in., while in the summer months dry days are more frequent than rainy days. Statistics similar to the above can be computed for various stations in the British Isles from data given in the *Book of Normals of Meteorological Elements for the British Isles*, Section I. As would be expected, stations with more rain than London have more rain-days, but, apart from this, there is a fairly regular increase in the number of rain-days from the south-east of the British Isles to the north-west. At Nairn, which is situated on the Moray Firth, and is to the north-north-west of London, the average annual rainfall is about the same as London (24·94 in.), but only 42 per cent. of the days throughout the year are dry, and in no months are more than half the days dry. Mr. Bracey also gives statistics of the frequency of occurrence of dry days on any particular date. The values throughout the year are fairly uniform. The extremes are of interest: September 14th was dry on 32 occasions out of the 40, and December 6th on only 8 occasions. It is remarkable that from September 9th to 20th as many as 65 per cent. of the days were dry. For the 10 days preceding Christmas, dry days predominated, forming as many as 61 per cent., and of the 40 Christmas days, 21 were dry. Although with a longer period the values would tend to be equalised, the seasonal variation with fewer days of rain in the summer months is well marked. The working sheets are available for reference in the Meteorological Office, and it would be interesting to be able to refer to similar results for a number of stations situated in various parts of the British Isles.

J.G.

Reviews

The Influence of Rainfall on the Yield of Wheat at Rothamsted. By R. A. Fisher (London, Phil. Trans. R. Soc. B. 213 (1924), pp. 89-142.)

This paper deals mainly with a comparison of rain statistics with wheat data derived from the Broadbalk field at Rothamsted. At Broadbalk thirteen plots have been continuously under uniform treatment since 1852. An account of the variations in yield of grain of these plots has already been published.* It was found that the variations could be divided into groups ascribable to three separate causes: (1) on many of the plots

* *An examination of the Dressed Grain from Broadbalk*, by R. A. Fisher, J. Agric. Sci. 11, 1921, pp. 107-135.

a progressive diminution is observable owing to the exhaustion of certain of the essential plant nutrients in the soil; (2) on all the plots slow changes in yield have taken place, which may be ascribed to variations in the weed infestation of the field as a whole; this variation, unlike that ascribable to the other two causes, is in all the plots approximately proportional to the mean yield; and (3) a variation ascribed primarily to variations of the whole sequence of weather influencing the crop from its inception to the time the product is weighed. The present paper considers the third variation, viz.: the fluctuations in yield from year to year in relation to the rainfall record.

The readings of rainfall are taken from a large gauge 0·001 acre in area, which was built for the purpose in 1853. The author disposes of the readings from other rain gauges in two sentences —the "readings of this large gauge have been consistently higher than those of the 5-inch and 8-inch gauges which are at present placed beside it. It may be concluded that the large gauge gives a better estimate of the amount of rain falling in the field." The relationship between these three gauges is not quite so simple, and it would have been more satisfactory had the author discussed in greater detail the variations of the three gauges.

The number of subdivisions into which the rainfall of each year should be divided is discussed. If the number is too small, different crop stages will be confused, while if the number is too large, the statistical treatment will present difficulties. To obviate the irregularity of the calendar the year was taken to be of 366 days, commencing on either August 31st or September 1st prior to the sowing of the seed. This 366 day year was subdivided into 61 equal periods of six days.

It is pointed out that the information provided by a comparison of the rain record with the subsequent yields tell us the effect, not so much of rain, as such, as of the combination of meteorological phenomena associated with rain. Thus, rain is associated with temperatures below normal in summer and above normal in winter, and generally with diminished sunshine. The effects of these "form an integral part of the value of a rain record as a means of foreseeing the prospects of the crop." In addition rain supplies fully aerated water while it doubtless hinders root development by soil saturation.

Curves showing the average effect on the yield for each additional inch of rain, throughout the year, have been constructed for the 13 plots of wheat. In all the plots the effect of rainfall above the normal is in general harmful. In October the average loss per inch of rain is small, and a rainfall above the average may even be beneficial. In 11 out of the 13 plots the autumn period of benefit, or but little loss from heavy rain is followed by a period centred in January in which dry conditions appear to be particularly desirable. At this time of the year each additional inch of rain costs from one to two bushels in the crop, but this effect is shown least on the unmanured plot, which confirms the conclusion arrived at from the statistical analysis, that the damage done by winter rains is principally occasioned by the washing out of soluble nitrates from the soil.

In the paper an attempt is made to develop formulæ which shall predict the yield from the weather statistics, and in the last section a summary is given of previous investigations bearing on the present data. J.G.

Cloud Studies. By A. W. Clayden. (Second Edition.) $8 \times 5\frac{3}{4}$, pp. xvi.+200. *Illus.* London, John Murray, 1925. 15s. net.

Although the study of clouds is becoming more and more important as a feature of meteorological routine, the number of works dealing specifically with the subject is still surprisingly small. In recent years there have been two substantial additions to the literature—G. A. Clarke's *Clouds*, and Schereschewsky and Wehrle's *Les Systèmes Nuageux.* Nevertheless, our libraries are far from being overburdened with books on the clouds, and the appearance of a new edition of A. W. Clayden's well-known work is very welcome.

Twenty years, full of incident in the development of meteorology, have passed since the publication of the first edition, and it is not surprising, therefore, that the author has found it necessary to make some additions and alterations to the text. With the exception of a few worthy additions, however, the illustrations are unaltered. In these days of ready-made panchromatic plates, the photography of clouds is shorn of its terrors and it is no longer necessary to invoke the aid of a black mirror in order to bring cirrus clouds within range. When Clayden began his work nobody had given much attention to the problem and he had to devise means of obtaining results with a medium which was fundamentally unsuited to the purpose. The success which he achieved was very remarkable and it is unnecessary to be either a meteorologist or a photographer to appreciate the beauty and fidelity of his pictures.

In common with many of those who have devoted their talents to the study of clouds, Clayden is not satisfied with the classification adopted for the *International Cloud Atlas.* He thinks we should go further and give specific names to all the different varieties of the same type of cloud which are seen to present themselves. We are thus brought face to face with such names as "Alto-cumulus castellatus fractus." He figures no fewer than nine varieties of cirrus, four of cirro-stratus and three of cirro-cumulus, while subdivisions in the middle and lower groups are almost as numerous. There is no doubt that such a term as cirrus includes, in practice, a considerable variety of more or less distinct forms, and it is a matter for consideration as to whether the time has not now arrived to reconsider the whole question of cloud nomenclature. It seems unlikely, however, that any large measure of support would be forthcoming for so extensive a scheme as that adopted in the book now before us. E.G.B.

E. T. Busk. A pioneer in flight. By Mary Busk. Size $8 \times 5\frac{3}{4}$, pp. x.+167, London, John Murray, 1925, 7s. 6d.

The book comprises a biography of E. T. Busk and a short memoir of his younger brother H. A. Busk, written by their mother. E. T. Busk showed an aptitude for mechanical construction and an interest in aeronautics at an early age: at Cambridge he proved his mathematical ability. A few years after leaving the University the problem of aeroplane stability interested him and, at his home in Sussex, he fitted up a workshop in which he made his own experimental outfit. His work at this time included research into the nature and causes of wind gusts; he constructed several instruments for recording wind velocities, one of which is now at the National Physical Laboratory, Teddington. The results of these investigations are not given in the biography.

In the summer of 1912, Busk was appointed head of the "Physics" Department at the Royal Aircraft Factory, Farnborough, and here he continued his investigations into aeroplane stability, doing a considerable amount of experimental flying. He was one of the first aviators to apply scientific methods to the investigation of the behaviour of an aeroplane in flight, being mainly responsible for the design of an inherently stable aeroplane of a type used extensively by British Forces in the field during the early part of the war. The gold medal of the Aeronautical Society of Great Britain was awarded to him in 1914 for his services to aeronautics. Busk lost his life in November, 1914, when the aeroplane in which he was flying caught fire in the air: the country lost an able research worker in aeronautics at a time when his services would have been of the greatest value.

H. A. Busk was a pilot in the Royal Naval Air Service and served in the Eastern Mediterranean in 1915 and 1916, meeting his death while returning from a bombing expedition.

M.T.S.

Erratum

Vol. 60, January, 1926, p. 292, the percentage values of the rainfall for 1925 should read, England and Wales, 108, Scotland, 101, Ireland, 98, and the British Isles, 104.

News in Brief

An exceptional fine display of the Aurora Borealis was witnessed in many parts of Norway on the night of January 26th to 27th. The sky visible from southern Norway was ablaze with rose-coloured light while from the north the predominant colour was white. The reflection was observed in Sweden and Denmark.

Mr. A. D. Pilkington, of Newbury, Berks., reports that his thermometer registered 4° below zero, *i.e.*, 36° of frost at 2 feet from the ground about 11 p.m. on the night of the 16th.

Mr. J. J. Somerville, B.A., B.L., Meteorologist-in-Charge at Renfrew Aerodrome, was called to the Bar, by the Honourable Society of Gray's Inn, on January 26th, 1926.

The Seventh Annual Soirée of the Meteorological Office Staff was held on Friday, February 12th, at Australia House. Some 240 past and present members of the Staff and their friends enjoyed a programme of music, conjuring and dancing, with a comedy sketch provided by the staff at South Kensington. Members were present from many out-stations.

The fifth Annual Dinner of the Meteorological Office Staff, at Shoeburyness, was held at the Queen's Hotel, Westcliff, on Saturday, January 30th, 1926. Mr. D. Brunt was to have been the guest upon this occasion, but was unavoidably prevented at the last moment from being present. Past members of the staff now stationed elsewhere were present and a very enjoyable time was spent. A musical programme consisting of original items was rendered by members of the staff.

Books Received.

THE PYCNOSONDE. An apparatus for hydrographic soundings. By D. la Cour, pp. 13 (Det Danske Meteorologiske Institut Yearbooks, Copenhagen), 1926.

The Weather of January, 1926

The mild unsettled weather which prevailed at the close of December continued during the first part of January. The mean temperature for the first week of the year was everywhere considerably above normal, the greatest excess being 5·8° F. in the Midlands. Rain and high winds occurred almost daily during the first ten days, the heaviest rain being reported on the 1st, when 85 mm. (3·33 in.) occurred at Tynywaun (Glamorgan), and on the 8th when 61 mm. (2·40 in.) occurred at Achnashellach. The floods which were so widespread over the country at the beginning of the month began to subside gradually about the 8th. After the 11th the high pressure area over Europe became connected, by a narrow ridge across the British Isles to the Azores anticyclone, and pressure fell over southwest Europe bringing a definite change to our weather. Thick fog occurred in many places early on the 12th, and the easterly winds were associated with a decided fall in the temperature. The following day a depression near Spain caused a gale in the English Channel and snow fell during the night. Further falls became general for some few days as the low pressure system shifted northwards. Owing to the persistence of frosty weather much of the snow lay on the ground for many days and by the 16th was about a foot deep at South Farnborough. Temperature remained below the freezing point for some days in succession. At Leafield and Cranwell the maximum was as low as 22° F. on the 16th, while screen minimum readings fell to 7° F. at Cambridge on the 16th and to 4° F. at Rothamsted on the 17th, and ground minima to 0° F. at Oxford and —2° F. at Cranwell on the 17th. At Hampstead the grass minimum temperature of 6° F. recorded there on the 16th was the lowest since March, 1909. On the 17th depressions approaching from the Atlantic brought milder weather to the western districts, though in the eastern districts cold weather persisted with snow and fog at times. By the 23rd, however, strong warm southwest winds had extended to the North Sea and mild unsettled weather predominated during the last week with further high winds and heavy rain at times but many bright intervals. The total rainfall of the month was more than twice the normal at isolated stations in south and east England, east Scotland and southeast Ireland, but below the normal in parts of northeast Scotland. In Ireland the month was the wettest January since 1877; the general fall was 184 per cent. of the average, compared with 198 per cent. in 1877.

Pressure was below normal over the British Isles, Iceland and the northern part of the North Atlantic Ocean but above normal in both southwestern and northern Europe. This distribution favoured southerly winds over the British Isles. Except in Sweden and the extreme north of Norway, the temperature and rainfall were above normal generally in western Europe. At Spitsbergen the temperature excess was as much as 6° F. and at Valencia (Ireland) the rainfall excess 126 mm. Heavy rains fell over most of Europe during the beginning of the month, and these combined with the thaw which occurred in the latter part of December caused serious floods in many parts of the continent. The suffering and damage done in the parts of the countries under water were very great. Many of the dykes burst in Holland and a serious landslide occurred near Lucerne. The floods began to abate slowly on the 4th and 5th though the Seine continued to rise until about the 9th. On the 11th the intensely cold weather which had been prevalent in the north of Russia spread also across Europe and the flood waters froze, causing still greater distress in the west where the ice was not strong enough to bear vehicles. Many ships were icebound in the Baltic and snow storms occurred as far south as the Riviera, Naples, and the province of Valencia. Gales were reported from Barcelona and the Bay of Biscay on the 12th and 13th, and from Las Palmas between the 16th and 19th. During the last ten days there was a return to warmer conditions generally.

In Africa, early in the month, the prolonged drought caused great anxiety in the Transvaal and the Orange Free State, and intense heat was experienced in Pretoria. Towards the middle of the month torrential rains fell in southern Rhodesia and Portuguese East Africa,and floods occurred on the Pungwe River.

Heavy rain, which is most unusual at this time of the year, flooded parts of Bombay on the 2nd and 3rd. A hurricane was reported from Samoa and Society Island on the 1st causing several deaths and much damage. The rainfall in Australia was generally below normal, except in Kimberley where it was about twice the normal. In parts of the north and central coasts of Queensland it was less than half the normal. Several bushfires have followed the intense summer heat in Victoria.

Floods occurred early in the month in Mexico.

From the 24th to the end of the month severe storms were experienced over the Atlantic when both the "Antinoe" and the "Laristan" were lost after the gallant rescues by the "President Roosevelt" and the "Bremen." Sir Napier Shaw, in an article in the *Times* on Winter Storms over the Atlantic, points out the similarity which the meteorological situation on January 31st, 1926, bore to that on February 6th, 1899, about which time many casualties occurred on the Atlantic.

The special message from Brazil states that the rainfall distribution was irregular in the northern and central districts, where the totals were 39 mm. below normal and 32 mm. above normal respectively. In the southern districts the rainfall was abundant, being 74 mm. above normal. The cotton and cane crops are suffering from lack of rain in the north, and the vegetables, through excessive rain in the south. At Rio de Janeiro pressure was 0·7 mb. below normal and the temperature normal.

Rainfall, January, 1926—General Distribution

England and Wales ..	152	per cent. of the average 1881-1915.
Scotland	141	
Ireland	184	
British Isles	156	

Rainfall: January, 1926: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square	2·64	67	142
Sur.	Reigate, Hartswood	3·38	86	150
Kent.	Tenterden, Ashenden	3·02	77	140
,,	Folkestone, Boro. San.	2·65	67	...
,,	Margate, Cliftonville	1·43	36	86
,,	Sevenoaks, Speldhurst.	3·60	91	...
Sus.	Patching Farm	4·46	113	171
,,	Brighton, Old Steyne	3·47	88	143
,,	Tottingworth Park	4·95	126	183
Hants	Ventnor, Roy. Nat. Hos.	3·99	101	155
,,	Fordingbridge, Oaklnds	5·37	136	194
,,	Ovington Rectory	7·18	182	266
,,	Sherborne St. John Rec.	3·89	99	167
Berks	Wellington College	3·17	81	160
,,	Newbury, Greenham	4·89	124	211
Herts.	Benington House	2·77	70	152
Bucks	High Wycombe	3·71	94	178
Oxf.	Oxford, Mag. College	3·67	93	214
Nor.	Pitsford, Sedgebrook	2·91	74	156
,,	Eye, Northolm	2·63	67	...
Beds.	Woburn, Crawley Mill	...	...	...
Cam.	Cambridge, Bot. Gdns.	1·86	47	124
Essex	Chelmsford, County Lab	2·21	56	146
,,	Lexden, Hill House	2·41	61	...
Suff.	Hawkedon Rectory	2·23	57	128
,,	Haughley House	1·86	47	...
Norf.	Beccles, Geldeston	2·09	53	126
,,	Norwich, Eaton	2·78	71	142
,,	Blakeney	3·59	91	208
,,	Swaffham	3·21	81	177
Wilts.	Devizes, Highclere	3·36	85	154
,,	Bishops Cannings	3·20	81	138
Dor.	Evershot, Melbury Ho.	4·94	125	142
,,	Creech Grange	5·87	149	...
,,	Shaftesbury, Abbey Ho.	4·51	115	173
Devon	Plymouth, The Hoe	5·79	147	174
,,	Polapit Tamar	6·97	177	187
,,	Ashburton, Druid Ho.	9·62	244	189
,,	Cullompton	6·16	157	190
,,	Sidmouth, Sidmount	3·83	97	134
,,	Filleigh, Castle Hill	6·98	177	...
,,	Barnstaple, N. Dev. Ath.	5·55	141	170
Corn.	Redruth, Trewirgie	7·16	181	170
,,	Penzance, Morrab Gdn.	5·57	141	147
,,	St. Austell, Trevarna	7·62	193	178
Soms	Chewton Mendip	6·40	163	167
,,	Street, Hind Hayes	3·46	88	...
Glos.	Clifton College	5·36	136	189
,,	Cirencester, Gwynfa	5·14	131	199
Here.	Ross, Birchlea	4·05	103	167
,,	Ledbury, Underdown	3·40	86	155
Salop	Church Stretton	3·95	100	156
,,	Shifnal, Hatton Grange	2·49	63	128
Staff.	Tean, The Heath Ho.	3·26	83	127
Worc.	Ombersley, Holt Lock	2·93	74	153
,,	Blockley, Upton Wold	3·24	82	138
War.	Farnborough	3·57	91	166

CO.	STATION.	In.	mm.	Per-cent of Av.
War.	Birminghm, Edgbaston	3·11	79	154
Leics	Thornton Reservoir	2·88	73	145
,,	Belvoir Castle	2·57	65	145
Rut.	Ridlington	3·22	82	...
Linc.	Boston, Skirbeck	2·79	71	172
,,	Lincoln, Sessions House	2·33	59	139
,,	Skegness, Estate Office.	2·64	67	153
,,	Louth, Westgate	2·92	74	135
,,	Brigg	3·24	82	181
Notts.	Worksop, Hodsock	2·22	56	125
Derby	Mickleover, Clyde Ho.	2·82	72	141
,,	Buxton, Devon. Hos.	5·19	132	116
Ches.	Runcorn, Weston Pt.	2·58	65	109
,,	Nantwich, Dorfold Hall	2·53	64	...
Lancs	Manchester, Whit. Pk.	2·90	74	116
,,	Stonyhurst College	4·75	121	111
,,	Southport, Hesketh	3·29	84	129
,,	Lancaster, Strathspey.	4·37	111	...
Yorks	Sedbergh, Akay	8·82	224	160
,,	Wath-upon-Dearne	2·23	57	116
,,	Bradford, Lister Pk.	3·90	99	135
,,	Wetherby, Ribston H.	3·17	81	154
,,	Hull, Pearson Park	3·21	81	178
,,	Holme-on-Spalding	2·52	64	...
,,	West Witton, Ivy Ho.	4·43	113	...
,,	Felixkirk, Mt. St. John	2·16	55	108
,,	Pickering, Hungate	2·66	68	...
,,	Scarborough	2·29	58	115
,,	Middlesbrough	1·69	43	106
,,	Baldersdale, Hury Res.	3·76	95	106
Durh.	Ushaw College	2·97	75	145
Nor.	Newcastle, Town Moor.	2·45	62	120
,,	Bellingham, Highgreen	3·57	91	...
,,	Lilburn Tower Gdns.	3·51	89	...
Cumb	Geltsdale	3·65	93	...
,,	Carlisle, Scaleby Hall	2·77	70	112
,,	Seathwaite M.	20·10	511	152
Glam.	Cardiff, Ely P. Stn.	6·74	171	178
,,	Treherbert, Tynywaun	16·16	411	...
Carm	Carmarthen Friary	7·38	187	168
,,	Llanwrda, Dolaucothy.	8·03	204	151
Pemb	Haverfordwest, School	7·97	202	173
Card.	Gogerddan	4·63	118	113
,,	Cardigan, County Sch.	4·91	125	...
Brec.	Crickhowell, Talymaes	7·10	180	...
Rad.	Birm. W. W. Tyrmynydd	9·51	242	151
Mont.	Lake Vyrnwy	8·77	223	155
Denb.	Llangynhafal	2·91	74	...
Mer.	Dolgelly, Bryntirion	6·39	162	112
Carn.	Llandudno	2·65	67	103
,,	Snowdon, L. Llydaw 9	20·30	516	...
Ang.	Holyhead, Salt Island.	3·21	82	110
,,	Lligwy	3·50	89	...
Isle of Man				
	Douglas, Boro' Cem.	5·35	136	160
Guernsey				
	St. Peter P't, Grange Rd	5·70	145	195

Rainfall: January, 1926: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av
Wigt.	Stoneykirk, Ardwell Ho	4·50	114	152	*Suth.*	Loch More, Achfary	6·95	177	95
,,	Pt. William, Monreith	5·60	142	...	*Caith*	Wick	2·22	56	90
Kirk.	Carsphairn, Shiel.	14·15	359	...	*Ork*	Pomona, Deerness	3·20	81	93
,,	Dumfries, Cargen	7·19	183	180	*Shet.*	Lerwick	5·22	133	123
Roxb	Branxholme	4·37	111	159		———			
Selk.	Ettrick Manse	9·84	250	140	*Cork.*	Caheragh Rectory	10·21	259	...
Berk.	Marchmont House	3·16	80	151	,,	Dunmanway Rectory	11·17	284	187
Hadd	North Berwick Res.	2·61	66	152	,,	Ballinacurra	7·59	193	191
Midl	Edinburgh, Roy. Obs.	2·67	68	150	,,	Glanmire, Lota Lo.	9·36	238	218
Lan.	Biggar	4·00	102	...	*Kerry*	Valencia Obsy.	10.48	266	191
,,	Leadhills	13·63	346	...	,,	Gearahameen	18·50	470	...
Ayr.	Kilmarnock, Agric. C.	4·28	109	123	,,	Killarney Asylum	9·45	240	160
,,	Girvan, Pinmore	7·93	201	168	,,	Darrynane Abbey	9·29	236	185
Renf.	Glasgow, Queen's Pk.	4·64	118	139	*Wat.*	Waterford, Brook Lo.	8·41	214	228
,,	Greenock, Prospect H.	10·73	273	157	*Tip.*	Nenagh, Cas. Lough	7·34	186	185
Bute.	Rothesay, Ardencraig.	7·40	188	165	,,	Tipperary	8·52	216	...
,,	Dougarie Lodge	7·53	191	...	,,	Cashel, Ballinamona	7·31	186	192
Arg.	Ardgour House	14·15	359	...	*Lim.*	Foynes, Coolnanes	5·32	135	141
,,	Manse of Glenorchy	13·69	348	...	,,	Castleconnell Rec.	5·11	130	...
,,	Oban	7·72	196	...	*Clare*	Inagh, Mount Callan	8·40	213	...
,,	Poltalloch	7·70	196	152	,,	Broadford, Hurdlest'n.	6·75	171	...
,,	Inveraray Castle	12·44	316	149	*Wexf*	Newtownbarry	10·32	262	...
,,	Islay, Eallabus	8·41	214	175	,,	Gorey, Courtown Ho.	8·24	209	264
,,	Mull, Benmore	14·80	376	...	*Kilk.*	Kilkenny Castle	7·42	188	232
Kinr.	Loch Leven Sluice	5·11	130	162	*Wic.*	Rathnew, Clonmannon	7·92	201	...
Perth	Loch Dhu	16·20	411	178	*Carl.*	Hacketstown Rectory	7·91	201	223
,,	Balquhidder, Stronvar.	13·98	355	165	*QCo.*	Blandsfort House	7·13	181	217
,,	Crieff, Strathearn Hyd.	7·71	196	191	,,	Mountmellick	7·69	195	...
,,	Blair Castle Gardens	6·48	165	195	*KCo.*	Birr Castle	4·55	115	161
,,	Coupar Angus School	4·81	122	203	*Dubl.*	Dublin, FitzWm. Sq.	4·30	109	188
Forf.	Dundee, E. Necropolis.	4·78	121	245	,,	Balbriggan, Ardgillan	3·93	100	172
,,	Pearsie House	7·36	187	...	*Me'th*	Drogheda, Mornington	3·69	94	...
,,	Montrose, Sunnyside	3·91	99	200	,,	Kells, Headfort	5·66	144	180
Aber.	Braemar, Bank	5·12	130	160	*W.M*	Mullingar, Belvedere	6·21	158	193
,,	Logie Coldstone Sch.	2·36	60	107	*Long*	Castle Forbes Gdns.	6·25	159	188
,,	Aberdeen, King's Coll.	3·24	82	149	*Gal.*	Ballynahinch Castle	10·18	259	164
,,	Fyvie Castle	2·70	69	...	,,	Galway, Grammar Sch.	4·94	125	...
Mor.	Gordon Castle	1·76	45	87	*Mayo*	Mallaranny	9·61	244	...
,,	Grantown-on-Spey	1·64	42	68	,,	Westport House	7·38	187	159
Na.	Nairn, Delnies	1·74	44	87	,,	Delphi Lodge	16·50	419	...
Inv.	Ben Alder Lodge	8·48	215	...	*Sligo*	Markree Obsy.	6·05	154	154
,,	Kingussie, The Birches	3·10	79	...	*Cav'n*	Belturbet, Cloverhill	5·19	132	174
,,	Loch Quoich, Loan	19·00	483	...	*Ferm*	Enniskillen, Portora	6·32	161	...
,,	Glenquoich	...	...	...	*Arm.*	Armagh Obsy.	4·90	124	195
,,	Inverness, Culduthel R.	1·91	49	...	*Down*	Warrenpoint	6·19	157	...
,,	Arisaig, Faire-na-Squir	5·82	148	...	,,	Seaforde	7·63	194	242
,,	Fort William	12·25	311	127	,,	Donaghadee, C. Stn.	3·87	98	152
,,	Skye, Dunvegan	11·04	280	...	,,	Banbridge, Milltown	3·87	98	173
,,	Barra, Castlebay	4·26	108	...	*Antr.*	Belfast, Cavehill Rd.	4·91	125	...
R&C	Alness, Ardross Cas.	3·18	81	84	,,	Glenarm Castle	6·84	174	...
,,	Ullapool	4·26	108	...	,,	Ballymena, Harryville	4·98	127	134
,,	Torridon, Bendamph.	13·39	340	143	*Lon.*	Londonderry, Creggan	5·64	143	157
,,	Achnashellach	12·41	315	...	*Tyr.*	Donaghmore	6·89	175	...
,,	Stornoway	5·47	139	106	,,	Omagh, Edenfel	6·49	165	183
Suth.	Lairg	2·92	74	...	*Don.*	Malin Head	4·98	127	191
,,	Tongue Manse	2·67	68	68	,,	Duntanaghy	6·23	158	154
,,	Melvich School	1·78	45	54	,,	Killybegs, Rockmount	7·07	180	126

Climatological Table for the British Empire, August, 1925

STATIONS	PRESSURE		TEMPERATURE										PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean								
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	mm.	mm.			
London, Kew Obsy.	1015·4	+ 0·1	77	47	68·5	54·0	61·3	− 0·3	56·2	87	7·6	65	+ 8	15	4·6	32
Gibraltar	1016·5	− 0·2	89	64	82·5	68·5	75·5	− 0·5	66·4	76	6·8	1	− 2	2	...	...
Malta	1014·9	− 0·4	102	70	85·8	74·4	80·1	+ 1·0	74·6	77	1·2	0	− 3	0	11·1	82
Sierra Leone	1014·3	+ 1·0	85	71	81·9	72·5	77·2	− 1·0	73·7	85	7·9	873	− 29	23	...	...
Lagos, Nigeria	1011·7	− 1·9	86	72	83·1	73·7	78·4	+ 1·3	74·2	80	8·5	33	− 35	10	...	...
Kaduna, Nigeria	1014·4	+ 0·6	88	63	81·8	66·1	73·9	0·0	69·7	89	2·2	423	+177	24	...	...
Zomba, Nyasaland	1018·1	+ 1·4	80	47	76·2	53·8	65·0	+ 0·3	...	77	4·8	3	− 6	1	...	...
Salisbury, Rhodesia	1019·0	+ 0·2	82	34	74·9	43·9	59·4	− 0·5	50·4	51	0·5	0	− 2	0	10·4	90
Cape Town	1020·3	+ 0·6	77	42	63·8	49·7	56·7	+ 1·1	51·6	89	5·3	40	− 43	9	...	...
Johannesburg	1022·6	+ 1·7	78	35	69·0	45·8	57·4	+ 3·5	44·3	54	0·5	2	− 7	1	10·2	92
Mauritius	1021·4	+ 0·9	77	54	74·5	61·3	67·9	− 0·6	63·3	69	6·2	60	0	16	7·3	64
Bloemfontein	....	...	79	26	71·0	34·7	52·9	+ 0·7	42·7	63	0·9	6	− 6	1	...	...
Calcutta, Alipore Obsy.	1000·3	− 0·7	93	78	89·9	80·0	84·9	+ 1·9	79·9	89	8·8	204	−118	11*	...	...
Bombay	1005·1	− 0·8	87	76	85·4	78·1	81·7	+ 1·0	76·6	83	8·1	196	−171	15*	...	...
Madras	1004·7	− 0·8	98	73	93·7	77·1	85·4	− 0·5	76·2	74	6·9	152	+ 34	9*	...	...
Colombo, Ceylon	1009·2	− 0·5	87	73	85·0	76·9	80·9	− 0·2	77·2	76	8·8	122	+ 45	12	6·3	51
Hong Kong	1003·8	− 1·3	93	76	87·4	78·9	83·1	+ 1·0	77·9	74	7·1	143	−214	11	7·3	57
Sandakan	...	...	91	72	87·4	76·0	81·7	− 0·2	76·1	81	...	145	− 60	6	...	...
Sydney	1021·0	+ 2·8	75	40	61·3	46·4	53·9	− 1·1	49·6	72	5·5	123	+ 47	13	5·8	53
Melbourne	1021·7	+ 3·6	68	31	57·4	41·2	49·3	− 1·8	44·9	78	6·5	35	− 11	16	5·5	51
Adelaide	1022·7	+ 3·5	75	36	60·8	44·1	52·5	− 1·4	47·2	71	6·2	42	− 22	14	5·4	50
Perth, W. Australia	1023·0	+ 4·2	72	38	64·1	45·6	54·9	− 1·9	49·4	65	3·6	48	− 96	9	8·0	73
Coolgardie	1023·4	+ 4·1	72	32	63·7	39·6	51·7	− 1·9	43·9	58	2·9	2	− 24	4	...	...
Brisbane	1020·3	+ 1·1	78	43	69·5	51·2	60·3	− 0·1	53·5	69	3·5	80	+ 26	9	7·5	67
Hobart, Tasmania	1017·5	+ 3·9	65	33	53·8	38·9	46·3	− 1·7	41·2	74	5·5	41	− 6	16	6·2	60
Wellington, N.Z.	1014·7	0·0	63	30	54·0	42·7	48·3	− 0·3	45·3	82	7·7	208	+ 94	21	3·3	31
Suva, Fiji	1013·0	− 1·3	87	62	77·7	66·9	72·3	− 1·4	68·1	79	6·3	129	− 80	11	...	...
Apia, Samoa	1011·4	− 0·8	90	70	85·1	74·1	79·6	+ 1·8	75·6	75	4·4	19	− 61	6	8·3	71
Kingston, Jamaica	1013·5	0·0	93	69	90·6	73·0	81·8	+ 0·3	72·1	83	3·8	43	− 50	7	...	...
Grenada, W.I.	1013·8	+ 1·2	89	70	84·5	74·5	79·5	0·0	76·3	82	6·6	269	+ 30	27	...	...
Toronto	1018·0	+ 2·6	88	48	79·2	58·3	68·7	+ 2·1	62·2	76	3·5	63	− 7	7	9·6	69
Winnipeg	1013·4	− 0·5	91	44	78·8	56·2	67·5	+ 4·5	58·0	88	3·9	76	+ 16	15	7·9	54
St. John, N.B.	1015·3	− 0·1	83	47	70·0	54·2	62·1	+ 1·5	58·2	81	6·0	69	− 29	11	6·3	45
Victoria, B.C.	1016·5	− 0·7	82	47	68·4	53·0	60·7	+ 0·6	56·0	75	4·0	9	− 8	5	9·5	66

*For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

Erratum Vol. 60, January, 1926, p. 300. Mauritius July, 1925, *for* "Wet Bulb 71·1" *read* "Wet Bulb 66·0."

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Some recent Papers by W. Wiese

By Sir GILBERT WALKER, C.S.I., F.R.S.

THERE has of late been considerable meteorological activity in Russia; and while much of it is devoted to increasing our knowledge of the general science, some of it deals with particular problems. Of the latter, the work of Wiese upon conditions in the North Atlantic is of special interest for the light that it may throw on English weather; but, unluckily, the Russian journals in which it mostly appears are not easily accessible in this country, and the fortunate possession of a set of Wiese's papers calls for an attempt to give some idea of their contents.

A. *On the possibility of a forecast of the ice conditions in the Barents Sea.** The data of the ice are percentages of surface covered by ice as estimated by the Danish Meteorological Institute. Associated with years of much ice, and appearing in advance of the abnormality, is a south-eastward displacement of the axis of the trough of low pressure off the west coast of Norway; the position of the trough is measured on charts derived from ship's logs in March and April, and its relationship with Barents Sea ice in May and June has a correlation coefficient of 0·69, as based on 21 years of data. With pressure Archangel *minus* Gjesvaer in March and April the same ice has a coefficient of —0·65, and with pressure Leningrad *minus* Bodo, —0·47. With ice during the same months of the previous year the

**Bull. Cen. Hydro-meteor. Bur, Leningrad,* I., 1923.

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relationship is 0·43. With the pressure factors of January and February the coefficients are smaller but appreciable, and by combining these factors in the ordinary manner results of considerable value for prognostication have been derived by Wiese.

With the amount of ice in August the pressure differences Valencia *minus* Grimsey of June and July have coefficients of —0·70 and —0·65 respectively, while the ice of July has a coefficient of 0·60; but curiously the ice of July appears harder to forecast than that of the other months.

B. *Ice in the polar seas and the general circulation of the atmosphere.*† Wiese here points out that over ten years there is a correlation coefficient of —0·44 between the air temperature at the South Orkneys (as an index of the ice conditions in the Antarctic) and the ice in the Barents Sea, which is also related during this period with pressure at Cape Pembroke. The conclusion that conditions in the Arctic and Antarctic are similar is supported by relationships of 0·42 and 0·54 holding between 16 monthly values at McMurdo Sound and pressure values at Gjesvaer (Norway) and north-east Greenland respectively. I have, however, succeeded in obtaining data for 21 years of the June to August South Orkneys temperature and the contemporary Barents ice, and the correlation coefficient given between them is only 0·02; the sympathy between the variations of the Arctic and Antarctic appears to be therefore unproven.

C. *Ice in the Barents Sea and air temperature in Europe.*‡ As might be expected there is a very close relationship (reaching —0·80) between Barents ice and contemporary temperature over the neighbouring land; but an examination of about 70 places shows that such relationships extend to a considerable distance, that of Barents ice with Visby (Gotland) being —0·60, and with Warsaw —0·58.

Knowing that the amount of ice is connected with the position of the trough off Norway and with the amount of ice in the previous year, it is obvious that there will be relations between these last factors and the temperatures of May and June on the Murman and Mesen coasts, near Kalmar in Sweden, and at Warsaw. By using a number of factors and data of 20 years Wiese obtains relationships of 0·7 or 0·8 between the temperatures and the previous conditions.

D. *The influence of the mean air temperature in spring in N. Iceland on the mean air temperature of the following winter in Europe.** Wiese had in 1922 drawn attention to the effect of early summer ice in the Greenland sea upon cyclonic activity and pressure in the following autumn, and in this paper he

†*J Geophys.* (*Russian*), I., 1924.
‡*Bull. Cen. Hydro-meteor. Bur., Leningrad,* III., 1924.
**Met. Zs.*, 1925, *pp.* 53-57.

correlates the spring temperature at Grimsey in Iceland, March to May, with the temperature of the following December and January over a large part of Europe. Abundant ice may be expected to lower each of these; and of the correlation coefficients those of 0·23, 0·41 and 0·38 with Berlin, Kristiansund and Vardo may be taken as representative, the years under examination being 1882-3 to 1918-9. In view of the rareness of relations exercised after an interval of nine months it seemed desirable to include the data for 1880 and 1881, the latter being a phenomenally cold year at Grimsey, of which the figures are supported by those of Berufjord and Stykkisholm: the data for 1896 are not however here available. With the temperatures of the winter months, December to February, Wiese's years give 0·25, 0·44 and 0·31; and the inclusion of the additional years changes these figures to 0·0, 0·08 and 0·10 respectively; also the data of Greenland ice support these figures. There is no obvious reason for excluding a year of abundant ice in trying to ascertain the effect of such a condition; and it would therefore seem safer to postpone confidence in the reality of the proposed relationship until more data are available.

E. *The fluctuations of hydrological elements, specially of the water-level of Lake Victoria, in relation with the general circulation of the atmosphere and the sun's activity.*† Wiese finds here some remarkable relations with Barents ice, —0·72 for the contemporary level of Lake Victoria, —0·61 with the year's rainfall in equatorial America, and —0·48 with May-October rain in the Bahamas; and with sunspots the correlation coefficients of Barents ice (May, June) and rainfall in equatorial America are —0·58 and 0·55. With the pressure difference Punta Arenas *minus* Cape Pembroke (February to April) the level of Lake Victoria (January to April) has a correlation coefficient of —0·46, and the number of sunspots has one of —0·65.

Although it is difficult to assign a reason for these coefficients arising sporadically over regions with little obvious cause for relationship, it would be unwise to accept without further examination Wiese's conclusion that variations in Barents ice and of rain in the equatorial regions are determined by the same variations in the general circulation. With Indian rainfall and the Nile floods the relationship of Barents ice is negligible, and this is also true of Port Darwin pressure, which affords probably the best index of the general circulation in the southern hemisphere.

F. *Long-range forecasting of rain in central and east Russia in April and May.*‡ Wiese begins by showing that the rainfall has a coefficient of 0·55 with the May-June ice in the Barents sea, and as the latter is closely related with the antecedent conditions

†*Bull. Hydrol. Inst., Russia*, No. 13, 1925.
‡*Geophys. Rev.*, IV., 3, 1925.

described under A. above, it follows that a forecast of the rain can be produced. For the rain of April, May the joint coefficient derived from the position of the trough of pressure off the Norway coast in January and February and the ice of the previous year is 0·71.

G. *Polar ice and atmospheric fluctuations* * This contains an excellent summary (in German) of Wiese's paper on ice in the Greenland sea (Ann. d. Hydrographie, 1922, X.) and of A. and C. above, with a number of charts illustrating the geographical features and the results obtained.

Summing up we are indebted to Wiese for a decided addition to our knowledge of conditions in the North Atlantic. It would appear that while conditions in the Barents sea do not exercise a profound influence on those of the southern hemisphere generally, they are of importance in a fairly wide region of the northern hemisphere: and their usefulness is greatly enhanced by their persistence. My calculations show a correlation coefficient of 0·84 of June-August ice with that of April-May of the same year, of 0·60 with that of June-August ice of the previous year, and of 0·44 with Greenland ice of the following year.

The Structure of Fronts

By Dr. J. BJERKNES.

WHEN cold fronts and warm fronts are investigated by aid of autographic records of winds, temperature, etc., it is only in exceptional cases that strict discontinuity is found. Discontinuous conditions may also within rather a short time change into continuous and vice versa. Such changes of the structure of a front may render useful indication as to the physical processes involved. The case which was demonstrated in my lecture† showed a cold front starting as a well-defined line of discontinuity, and within the range of the map changing into a double cold front. The foremost of the two cold fronts showed only a very small drop of temperature and veer of wind, whereas the second, which followed not more than 30 miles behind, was well defined both in respect to temperature and wind. Nevertheless, the rain accompanied the first of the cold fronts, and the second did not give any precipitation whatever. The equation of continuity applied to the field of motion (deduced from the anemobiagraph records) shows that the air immediately behind the first cold front was descending and that all the air between the two fronts originated from that descending current. Hence its temperature was higher than that of the air behind the second cold front, and hence also its dryness, which prevented that air from producing rain when lifted up again at the second cold front.

The descending of the air behind cold fronts is quite a frequent

*Geog. Ann. Stockholm, 3, 4, 1924. † See page 47.

phenomenon. The equation of continuity must give descending motion in the cold air wherever it arrives with a sudden gust (line squall), followed by subsequent decrease of wind speed. A definite second cold front is however not always present. Very often there is a continuous transition between the descending air behind the line squall and the non-descending air farther back. The aerological analogy to this phenomenon has been described by Giblett in *Nature*, Dec., 1923, p. 863. He found in ascents made just after the passage of cold fronts that the cold and the warm air were separated by a layer of very dry air of intermediate temperature. Since this air was much drier than both the warm and cold air separately, it can not have been formed by the mixing of the two, but only by downward motion within the cold air. Combining this aerological result with surface data, we get the picture of a downward sliding current in the part of the cold wedge which borders directly on the warm air. If this current reaches the ground it produces a zone of air with temperatures intermediate between that of the cold and the warm air—in other words, it converts the line of discontinuity into a zone of definite breadth with more or less continuous change of temperature and wind.

It can also be shown that this downward current is connected with the problem of the acceleration of the cold front. The downward current arises preferably in accelerated cold fronts. Therefore, once a cold front has attained high speed, so much dry and relatively warm air has come down behind it that its character as a true line of discontinuity has disappeared. If the cold front is slowing down again, air from the transitional zone starts ascending. The effect of this will be that the area of transitional air will decrease, so that the cold and warm air again border more abruptly on each other.

These phenomena show how the atmosphere manages to obliterate discontinuities which have once been formed by horizontal advection. And they also show how the atmosphere finds the way back from continuous to discontinuous conditions.†

OFFICIAL PUBLICATIONS

The following publications have recently been issued :—

GEOPHYSICAL MEMOIRS.

No. 29. *On the absolute daily range of magnetic declination at Kew Observatory, Richmond,* 1901 *to* 1910. By J. M. Stagg, M.A., B.Sc. (No. 254*i*).

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† This latter process, the gradual creation of a sharp front, is very well shown in the paper of Bergeron and Swoboda : " Wellen und Wirbel an einer quasistationären Grenzfläche durch Mitteleuropa," Veröff. d. Geophys. Inst. d. Univ. Leipzig. The same phenomena are being further investigated by T. Bergeron in a paper to appear shortly.

No. 30. *Comparison of magnetic standards at British Observatories, with a discussion of various instrumental questions involved.* By C. Chree, F.R.S. (No. 254*j*).

During 1923 and 1924 a comparison was effected between the standard unifilar magnetometer and dip circle of Kew Observatory and the corresponding standards in use in Greenwich, Stonyhurst, Valencia and Eskdalemuir Observatories. Further, during seven months of 1924, simultaneous weekly observations of magnetic horizontal force were taken with the standard unifilar magnetometer at Kew Observatory and the Schuster-Smith coil magnetometer operated by the staff of the National Physical Laboratory at Teddington. This memoir deals with the results of these observations and with a number of instrumental questions which bear on the accuracy obtainable with unifilar magnetometers.

Discussions at the Meteorological Office

February 15th, 1926. *Die reduzierte Laufzeitkurve und die Abhängigkeit der Herdtiefe eines Bebens von der Entfernung des Inflexionspunktes der primären Laufzeitkurve.* By S. Mohorovičić (Beitr. z. Geophs. xiii., pp. 217-40, xiv., 1915, pp. 187-198); and *Über die Konstitution des Erdinnern, erschlossen ans Erdbebenbeobachtungen.* By B. Gutenberg (Phys. Zs. xiv., 1913, pp. 1217-8). *Opener*—Dr. H. Jeffreys, F.R.S.

The chief sedimentary rocks, sandstones and shales, are believed by geologists to have been derived mainly from granite, which is itself the commonest igneous rock in the continents. Accordingly it has been widely supposed that granite is the principal constituent of the continents; lines of investigation based on the earth's thermal state and isostasy support this view and suggest that the depth of the granite layer is about 15 or 20 km. Prof. A. Mohorovičić, studying the seismograms of near earthquakes, found that observing stations received two distinct compressional waves, which he called $\overline{P}$ and P. The former had travelled directly through the granite layer, while the latter had gone down into the rocks below, travelled along in these, and then been refracted up again. The times of arrival indicated velocities of 5·5 km/sec in the upper layer, and 8·0 km/sec in the lower. The former agrees with laboratory determinations for granite, but the latter is rather greater than for any rock yet tested. His son, Prof. S. Mohorovičić, follows up his results, and attempts to find the depth of focus and the depth of the granite layer. His methods are mathematically of great elegance, but their application to this problem depends entirely on the curvature of the graphs of time of transit against distance; and actually these graphs are straight lines within the limits of the error of observation, small as that is. Dr. Jeffreys considered that they established that these depths were not greater than 50 km, but thought them consistent with much smaller depths. In his later paper Prof. S. Mohorovičić uses observations of P waves at great distances to determine the velocities of propagation at various depths within the earth. The results indicate a continuous increase of velocity from 8 km/sec just below the granite layer to about 13 km/sec at a depth of 0·22, the radius of the earth being taken as unity. This level corresponds to the Wiechert discontinuity, separating the outer rocky shell of the earth from a metallic core, and otherwise inferred from the theory of the figure of the earth. Below that level the velocity remains nearly constant to a depth of about 0·4 of the radius. The paper anticipates in many respects the independent work of C. G. Knott.

It was found by R. D. Oldham in 1906 that compressional waves near the antipodes of the focus arrived so late as to show that there must be a region of low wave-velocity near the centre of the earth. Gutenberg develops the idea further, and finds that the radius of this region must be about 0·6, and the velocity within it about 9 km/sec. According to the laws of refraction this should lead to a shadow for epicentral distances between 103° and 144°, where no compressional waves should be observed, while large amplitudes about 144° should indicate their re-emergence at minimum deviation. These predictions correspond well with the facts. This central core does not transmit distortional waves, and therefore is probably a true liquid.

March 1st, 1926. *On radiation and climate.* By Anders Ångström (Geog. Ann. Stockholm, VII., 1925, pp. 122-142). *Opener*—Mr. J. Crichton, M.A., B.Sc.

The author investigates the quantities of radiation which reach the ground at Stockholm in each month and the quantities of heat lost from the surface. From pyranometer readings for two years it was found that if Q_s be the radiation received on a day with 100S per cent. of possible sunshine, and Q_o the radiation received on a perfectly clear day at that time of year, then $Q_s = Q_o\ (0{\cdot}25 + 0{\cdot}75S)$. The annual variation of radiation received was calculated from this formula. The loss of heat from the surface is made up of outward radiation, heat of evaporation and reflection from a snow surface in winter. The outward radiation is obtained by the formula $R_m = R_o\ (0{\cdot}25 + 0{\cdot}75S)$, where $m = 1 - S$, and it was pointed out that this formula is not entirely justified. The various quantities were then analysed into Fourier series, and compared with the annual variation of temperature at Stockholm. It was found that during the winter months more heat is lost than is received, while in summer the opposite holds, the balance on the year being a slight loss of heat which must be made good by convection and advection. The balance, radiation income minus heat lost, is termed the temperature effective energy. The temperature curve lags about a month behind the radiation curves and the curve of temperature effective energy, which all reach their annual maxima and minima together. The annual range of temperature is related to this lag, and both range and lag are considered as climatological elements, the distribution of which in other parts of the world is briefly discussed. Finally, it is shown that the annual variation of cloudiness at Stockholm raises the temperatures of all months above what they would be if the cloudiness were constant at its present mean annual value.

In the discussion, Dr. G. C. Simpson pointed out that the author had made use of an extrapolation formula which was not applicable to climates very different from that of Stockholm. He had also left out of account the transfer of heat from the equator to the poles. Other speakers emphasised that the flow of heat into unit volume should have been considered instead of transfer of heat across unit horizontal surface. It would then be possible to take account of the lateral transfer of heat as well as the vertical transfer of heat by turbulence.

Royal Meteorological Society

THE monthly meeting of this Society was held on Wednesday, February 17th, at 49, Cromwell Road, South Kensington, Sir Gilbert Walker, C.S.I., F.R.S., President, in the Chair.

T. H. Somervell, M.A.—On Temperature at high altitudes. Meteorological observations of the Mount Everest Expedition, 1924: *and F. J. W. Whipple, M.A.—Some lessons from the observations.*

In this paper Dr. Somervell has set out the observations taken during the Expedition, both on the journey through Tibet and at the various camps on the slopes of Everest. These observations were often taken under exceedingly trying conditions, and it is remarkable that so complete a record was obtained. It is pointed out that the performance of any little extra work, such as even the recording of a temperature, is very irksome at high altitudes. Temperatures were usually recorded at 8h. 30m., 12h. and 16h. each day, as well as readings from a minimum thermometer freely exposed to the sky about 1 foot above the ground. The lowest temperature recorded from this freely exposed thermometer was at Camp iii. (21,000 ft.), the reading being —24° F. Only a few observations were taken at Camp iv. (23,000 ft.) towards the close of the Expedition. In the second part of the paper, Mr. Whipple discusses the significance of the observations and the lapse rate of temperature with respect to height.

Vaughan Cornish, D.Sc.—Observations of wind, wave and swell on the North Atlantic Ocean.

When hove-to during a storm in the Bay of Biscay the author measured the speed of the waves by the time which they took to run the length of the ship. He also measured their period by timing the intervals between their arrival. The speed calculated from the period by the usual formula agreed closely with the observed speed. When a ship is under way it is more difficult to determine the period and speed of the waves, but on a voyage in 1912 the author found that it was possible to do so by timing the rise and fall of a spot of spent foam on the surface. On a later voyage the period of the waves in deep water far from land was observed daily and the velocity of the wave calculated from the period was compared with the velocity of the wind as given by an anemometer. It was found that when there was no crossing swell, the speed of the waves was so nearly equal to that of the wind that their crests were travelling in almost calm air. When there was a crossing swell, however, the speed of the waves was much less than that of the wind, the difference being greatest when the crossing swell was not from a following but from an opposing direction. The height of the waves was also kept down by a crossing swell, and since seamen estimate the force of the wind largely from the state of the sea the former is liable to be under-estimated under these conditions. Also, a crossing swell makes the sea curl and break in a direction different from that of the wind, leading to errors in the estimation of wind direction, which is given more accurately by the general run of the waves.

Comm. L. G. Garbett, R.N.—Admiral Sir Francis Beaufort and the Beaufort scales of wind and weather and their subsequent development.

This paper contains an historical account of the Beaufort scales of wind and weather and their subsequent development. The author at first recalls some of the chief events of the distinguished career of the designer of these scales, Francis Beaufort (afterwards Admiral Sir Francis Beaufort, K.C.B., F.R.S.). Extracts of meteorological interest are quoted from Beaufort's private logs which show the interest he took in the study of the weather. The author then traces the development of the wind and weather scales from 1806, the year in which they were devised by Beaufort when in command of H.M.S. "Woolwich," and gives a facsimile of the page in the log showing the original scales. It is pointed out in the paper that although the scales were devised in 1806 they were not introduced into the Navy until 1838 and then in a form somewhat modified from the original. The consecutive re-issues of the scale of weather are given in tabulated form.*

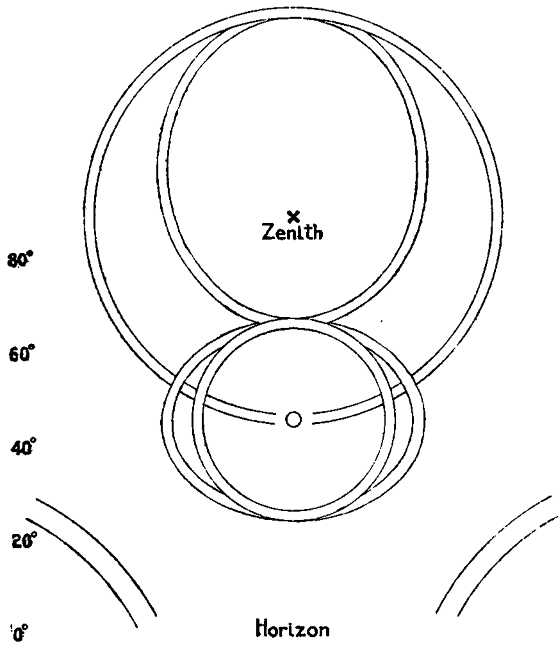
Dr. J. Bartels.—On the determination of minute periodic variations.
A method is described for obtaining the best possible values for amplitude and phase of a periodicity of given length, if the period is hidden by comparatively large irregular fluctuations. The method is applied to the determination of the lunar diurnal variation of atmospheric pressure in higher latitudes.

Correspondence

To the Editor, *The Meteorological Magazine*

A Brilliant Halo

A most interesting display of solar halos was observed by H.M.A.S. "Moresby," whilst at sea off the Keppel Islands, in Lat. 23° 06′ S, Long. 150° 57′ E, off the east coast of Queensland, on November 4th, 1925. The commander of the vessel, Captain J. A. Edgell, R.N., who forwarded the accompanying sketch, is to be congratulated on having secured so accurate a record of the phenomenon.



The first portion of the halo to be seen (at 8h.) was an arc of the halo of 22° above the sun, on a "semi-transparent, misty cloud." Shortly afterwards a corresponding arc appeared below the sun. These arcs remained the brightest and clearest portions throughout the display. At 8h. 15m. the inner halo, the radius of which was $22\frac{1}{4}$° by measurement, was complete.

* Readers will recall that it was recently decided (see *Meteorological Magazine*, 60, 1925, p. 133) that in the reports furnished by Observers to the Meteorological Office, the letters b, c and o should again be given their original significance as defined by Beaufort.

Thereafter the phenomenon developed rapidly and reached its climax as shown in the sketch by 8h. 30m. The outer portions began to fade at 8h. 45m. until at 9h. 30m. the halo of 22° was again all that was visible. This gradually faded also, the last portion seen being that below the sun which finally disappeared at 10h. 45m. The colours of the spectrum were well seen, the red on the inside being most clearly marked on the parts of the arc first seen. The horizontal circle and the large " ellipse " tangent to the halo of 22°, " were of a faint white colour like white clouds." The altitude of the sun at 8h. 40m. was 47°. The large " ellipse " referred to above is generally shown as two intersecting arcs, but it is probable that with the sun at an altitude of 47°, it would be very difficult to distinguish, by eye, between the two arcs and an ellipse. It seems rather remarkable that neither the halo of 45° nor any mock suns were recorded. The most interesting feature of the display is the very low altitude in which it occurred.

On November 4th, pressure was rather high along the Queensland coast. At the same time, a low pressure trough, connected with a southern depression, was moving eastwards across the region. This trough was, apparently, not sufficiently strongly developed to overcome the anticyclonic regime in the lower and middle layers of the atmosphere. The cloud and thunderstorms normally associated with such a trough, therefore failed to extend beyond the coast. An uninterrupted view of the cloud developments associated, in the upper air, with the passage of the trough, was consequently obtained.

EDWARD KIDSON.

Meteorological Bureau, Melbourne. January 4th, 1926.

Wind and Tide

I note with interest the investigations which have been undertaken at Holyhead* to determine the connexion, if any, between wind and tide. The results there showed no connexion, but I am now sending you the results of a similar investigation for the year 1925, obtained from the anemometer curves at Calshot which show a distinct if small variation at the turn of the tide.

The wind was tabulated for each hour of the three hours before and after high and low water respectively. Thus except for a short period at half-tide, varying from 8 to 22 minutes, the whole of the flood and ebb tides was dealt with. The various states of tide were also subdivided into day and night periods according to whether the sun was above the horizon or not. The times taken were for the first high-water, after which the current sets outward near Calshot. The position of the station is peculiar

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* See *Meteorological Magazine*, 60 (1925), 221.

and far from ideal on account of the " double " tide in the Solent. The winds were divided into two sections—those blowing with the general run of the tide through Spithead, E to SSE; and those blowing up the Solent, S to WSW. Winds between WSW and E round by N were omitted as land winds. Unfortunately, during the year under review, there is very little data available for SE winds on account of their scarcity, and even SW winds were rare during the three months March, June and November. Thus only 9 months' records could be tabulated.

1925	Low Tide: Hours before			Low Tide: Hours after			High Tide: Hours before			High Tide: Hours after		
	3	2	1	1	2	3	3	2	1	1	2	3
Oct. ...	15·6	15·5	15·0	17·3	17·4	17·7	17·4	17·5	17·8	16·6	16·1	15·4
Dec. ...	16·3	16·9	16·8	17·7	17·6	17·3	16·9	17·1	17·6	16·1	16·5	16·7
Jan. ...	17·2	17·5	17·9	18·3	19·0	19·0	18·6	18·9	18·8	17·6	16·9	17·4
Feb. ...	15·3	15·8	16·0	18·5	18·3	18·4	18·1	17·9	18·3	17·3	16·9	16·5
April ...	15·2	15·1	15·6	16·5	17·2	17·1	15·9	16·4	16·6	15·5	15·8	15·7
May ...	16·0	14·9	15·3	16·3	16·3	16·6	16·9	16·5	17·0	17·2	16·7	16·6
July ...	16·4	16·3	16·5	15·6	16·7	15·7	15·2	15·1	15·0	14·5	14·5	13·9
Aug. ...	14·0	13·3	12·4	13·2	12·6	12·9	13·5	13·5	13·7	13·6	13·5	13·3
Sept. ...	14·6	14·9	15·1	15·1	14·4	14·4	15·6	15·9	16·6	16·0	18·4	17·3
Mean Oct. to Jan.	16·1	16·4	16·4	17·9	18·1	18·1	17·7	17·9	18·1	16·9	16·6	16·5
Mean April to Sept.	15·2	14·9	15·0	15·3	15·4	15·3	15·4	15·5	15·8	15·4	15·8	15·3
Mean for year	15·6	15·6	15·6	16·5	16·6	16·6	16·5	16·5	16·8	16·0	16·1	15·9

The tables given are for all sea-winds and the day and night tides combined. The night winds showed more variation; but, on the whole, had the same characteristics as those of the day on a lesser scale. The 4 winter months available show a distinct, if small, variation at the turn of the tide—an increase during the first hour of the flood, which is more or less maintained until high-water, when it decreases on the ebb-tide. During the summer months, April to September, these variations, with the exception of April, are practically eliminated, probably owing to the great prevalence of SW sea-breezes in the Solent. These usually commence towards the end of March and continue until the end of September. It was on this account that it was considered advisable to divide the year into winter and summer periods. However, as will be seen, the yearly mean still shows the same variation.

T. F. TWIST.

Fawley, Southampton. January 7th, 1926.

Crepuscular Rays

THE phenomenon referred to under this title in the September, December and January *Meteorological Magazine* is not uncommon in our climate. At Barcelona it is most frequent in the latter part of July when it may be seen 20 minutes after sunset as a glory arising from behind the hills of Tibidaba on the west-north-west horizon. It has the form of alternating dark and rose divergent rays which almost disappear at the zenith, but sometimes reappear, converging again in the darkness of the east-south-east marine horizon, as a faint glory of very strange effect, opposite the principal one.

Since 1920 when I called attention to the phenomenon in the Bulletin of the " Centre Excursionista de Catalunya " many of the fellows of that society have observed these rays. The circumstances under which they appear are always the same ; a perfect clearness of the air over the Pyrennean region.

An easy computation leads to a very probable cause of the phenomenon. At the time when they are visible, the sun is setting in the Bay of Biscay and its last rays, after passing tangent to the Cantabrian Sea, illuminate the tops of the mountains of the Mont Perdu and Vignemale chains in the High Pyrennees (more than 3000 m. or 10,000 ft. high). At this moment the shadows of the peaks and the rays which pass through the breaks correspond roughly with the glory seen from our town. The altitude of these crepuscular rays at our zenith is undoubtedly higher than the upper limit of the troposphere.

It is possible that a similar explanation is suitable in other cases, though then one might also consider the possibility of the same effect being due to the shadows of very distant and disseminated cloudlets.

E. FONTSERÉ.

C. Salmeron 11, *Barcelona. February* 1*st*, 1926.

NOTES AND QUERIES

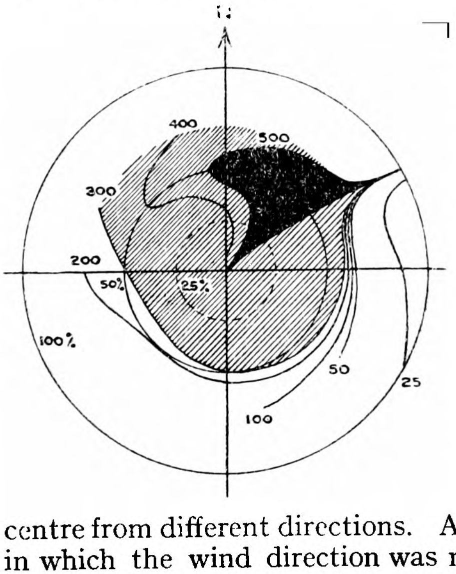
The Edge of the Doldrums

THE meteorological processes which take place along the equator are of great interest, and it is quite possible that the scattered islands between the parallels of 5° north and south may prove to be among the key stations for the world's weather. Here it is desired to call attention to some curious relationships between the rainfall of these islands and the direction and steadiness of the wind. The connexion was first noticed in studying a weather journal for Christmas Island in the western Pacific, and it may be of interest to quote the following table from the *Meteorological Office Circular*, No. 44 :—

Period.	Average rainfall per month mm.	No. of winds per month NE	E
November, 1917, to March, 1918 ..	3	4	21
January to May, 1919	369	13	11

The inquiry was extended to other islands in the equatorial Pacific, and it was found that in all of them there was the same extraordinary dryness with winds from east or southeast compared with those from other directions.*

Figures of the resultant direction and " constancy "† of the wind for each month at Malden Island and Ocean Island are now published regularly in the *Réseau Mondial*, and data for six years are available. For these years the 72 monthly rainfall totals at each station were plotted on diagrams. These diagrams showed the relation between rainfall and wind very clearly, in fact in the diagram for Ocean Island it was possible to draw isopleths of equal rainfall amount, which are shown in the figure. The concentric circles represent the constancy and the irregular lines show the corresponding rainfall in millimeters with winds blowing towards the centre from different directions.



At this station, out of 32 months in which the wind direction was more than 60° from north, and the " constancy " exceeded 70 per cent., there was only one in which the rainfall exceeded 100 mm., while out of the remaining 40 months there was only one in which the rainfall was less than 100 mm. Such a close relation argues a great difference between the constitution of the air currents in the two groups, but there is no very definite difference between the temperature and humidity of winds from different directions at Ocean Island, and it is not easy to see how winds blowing over such great stretches of uniform

* *London, Q.J.R., Meteor. Soc.*, 47, 1921, p. 1.

† The resultant direction and " constancy " are computed as follows : each observation of direction is regarded as a unit vector and the resultant direction is obtained by compounding the unit vectors. The " constancy " is represented by 100 times the ratio of the vector sum of the unit vectors to the number of observations (calms included). Direction is specified by the azimuth of the point from which the wind is blowing, and is measured in degrees from north through east.

ocean could maintain such differences of constitution. It is not a question of the exposure of the rain gauges, for these islands are mostly very flat, and the effect is the same at a number of different islands.

Malden Island lies in 4° S, and the prevailing wind direction is almost due east. During the six years under discussion the monthly mean directions lay entirely between 355° and 130° through 0° (*i.e.*, between N½W and SE), and for the most part between 80° and 110°, while the constancy varied from 29 to 98 per cent. There is very little annual variation of either rainfall or wind direction. Ocean Island lies in 1° S, and the prevailing wind direction is slightly south of east. At both stations there is an obvious relation between rainfall and "constancy" of the wind, as shown by Table 1.

TABLE I. RELATION OF RAINFALL TO WIND "CONSTANCY."

Constancy per cent....	1–20	21–40	41–50	51–60	61–70	71–80	81–90	91–100
Malden Island								
No. of months ...	—	3	5	6	2	9	21	23
Rainfall mm.... ...	—	411	267	255	263	186	32	31
Ocean Island								
No. of months ...	7	12	6	11	4	4	15	14
Rainfall mm.... ...	325	335	388	315	52	34	38	22

The relatively high rainfall with a constancy of 81-90 per cent. at Ocean Island is due to a single large total of 450 mm. occurring with a resultant wind from north-east in April, 1919. The remaining 14 months with this constancy all had a resultant wind from east, and for these months the mean rainfall was only 39 mm. The correlation between wind constancy and the rainfall in the same month is —0·73 at Malden Island and —0·72 at Ocean Island. At the latter station, if April, 1919, is omitted, the coefficient becomes —0·76.

At first sight there is also a close relation between rainfall and the direction of the wind. In Table 2 the upper group of figures shows for each station the average rainfall with months of different resultant wind direction when all months are considered. At Malden Island months with winds from north or north-east have nearly five times the rainfall of months with winds from east or south-east. At Ocean Island months with resultant winds between 65° and 120° are sharply distinguished by their low rainfall from all other months, which have about five times as much rain. The winds at Ocean Island are too scattered for the method of correlation to be employed, but at Malden Island a coefficient was calculated between the rainfall and the departure of the wind in degrees from its mean direction of 84°, northerly winds being considered as negative ; this gave a value of —0·58. The lower group of figures in Table 2 shows the corresponding figures when only the months of lower constancy are included. Owing to the greater steadiness of the wind at Malden Island it was necessary to take a higher upper limit for the constancy at this station. When only these months

TABLE II. RELATION OF RAINFALL TO WIND DIRECTION.

Station	Malden Island		Ocean Island					
Wind Direction	355°-60° N - NE	65°-135° E - SE	65°-90° ENE	95°-120° ESE	125°-240° SE - SW	245°-300° WSW - WNW	305°-360° NW - NNW	5°-60° NNE - NE
All Months								
Number	13	55	18	25	5	11	7	6
Rainfall (mm.)...	317	67	65	88	356	313	368	423
Constancy ...	29 - 75 %				4 - 60 %			
Number	13	10	3	5	5	11	7	5
Rainfall (mm.)...	317	196	254	288	356	313	368	418

of more variable wind are considered, the ratio of the rainfall in months with " wet " winds to that in months with " dry " winds is decreased from five to one to little more than three to two. This shows that the apparent dryness of winds from east or south-east is due largely to their greater constancy. On the other hand the " partial " correlation coefficient between wind direction and rainfall at Malden Island, constancy being eliminated, is still —0·57, showing that the relation between wind direction and rainfall is also real, and does not depend entirely on the greater constancy of winds from east and south-east.

The results show, therefore, that while at the equatorial Pacific Islands winds from east and south-east are somewhat drier than winds from other directions, the greatest source of rain is to be found in the occurrence of winds of conflicting directions. The occurrence of varying directions probably indicates eddy-motion, and the edge of the doldrums may be taken as the line along which the solid current of the trade winds breaks up into eddies.

C.E.P.B.

Kamaran Island

A DESERT ISLAND IN THE RED SEA.

Kamaran Island is one of the largest of the numerous islands in the Red Sea off the coast of Yemen, south-west Arabia. It lies some 5 miles off the mainland, 12 miles south of Lohaia, and is about 5 miles across from east to west, and twice as long. It forms part of the desert region which includes the Sahara in the west and the Dahna Desert of Arabia in the east. The island is practically devoid of vegetation, except for a small palm grove on the western side. The population is scanty and very cosmopolitan: there is a small Arab village in the west, and the remainder of the inhabitants are connected with the Quarantine Station, which has a well-equipped hospital used chiefly for pilgrims travelling to and from Mecca.

The following notes on the climate of Kamaran Island have been compiled from the meteorological observations taken by the Civil Administrator from September 1922 to 1925, which are communicated regularly to the Meteorological Office. The meteorological station is situated on an inlet on the eastern side of the island with the sea to the north and to the east. The instruments are set on the cliffs about 20 feet above the sea. The thermometers are housed in a screen with a double roof; the wet and dry bulb thermometers are read at noon, the maximum and minimum thermometers are read and set at 6 a.m., and the readings are entered to the previous day. There is no rain-gauge.

KAMARAN ISLAND (Lat. 15° 12′ N. Long. 42° 36′ E.).

Month	Temperature					Relative Humidity Noon %	* Mean Cloudiness Noon 0-10	Prevailing Wind Direction Noon	No. of Days with Rain
	Dry Bulb Noon °F	Mean Daily Max. °F	Mean Daily Min °F	Highest Max. °F	Lowest Min. °F				
January	81	82	74	88	69	77	3	S	2
February	81	82	75	88	71	71	3	S	1
March* ...	84	86	77	93	72	69	1	S	1
April ...	88	91	81	98	75	68	1	S	0
May ...	92	95	84	101	77	67	0·6	W	0
June ...	94	97	85	103	81	66	0·7	W	1
July ...	96	98	86	103	77	59	1	NW	1
August ...	94	96	85	102	77	62	1	NW	1
September	95	97	85	104	81	62	2	W	1
October...	91	93	83	100	79	65	2	S	1
November	85	87	79	92	68	69	0·9	S	1
December	82	83	76	90	71	70	0·4	S	0
Year ...	89	91	81	104	* 68	67	1	—	10

* Based on 1 year's observations only.

The climate of Kamaran Island is extremely enervating. The weather is hot, but in spite of the deserts on either side and the scantiness of the rainfall, the air is damp and the winds, though strong, bring no relief. The daily range of temperature is only about 10° F. (see table), and the nights average above 80° F. for more than half the year. The highest temperature recorded during the period was 104° F. in September, 1923, but temperatures over 100° F. were, at some time, observed during all the months from May to October. The lowest temperature recorded was 68° F. in November, 1925, during a heavy rain shower. The humidity is high, at times reaching 100 per cent. without precipitation; on September 23rd, 1923, the observer noted that at 4 p.m. the wet bulb temperature reached 100° F.

Rain falls about 10 days in the year, chiefly as drizzle. Short heavy showers were recorded three times during the observation period of $3\frac{1}{2}$ years, twice in January and once in August. Thunder is often heard on the mainland, but rain-bearing thunderstorms seldom reach the island. No record of hail has been made during the whole period.

There is very little cloud observed; from May to December the cloudiness at noon seldom exceeds one-tenth of the sky. During January to April, 1925, 13 days of overcast sky were recorded, and 270 days out of the whole year had a clear sky at noon. In some months the sun shines continuously from sunrise to sunset on every day.

The prevailing wind direction is from south from October to April, and from between west and north-west from May to September. Sandstorms are experienced chiefly with winds from west and north-west, though they can also occur with winds from the north-east: of the six sandstorms recorded, none occurred with winds having a southerly component.

W.A.Q.

Leaky Rain Gauges

SOME examples have recently been brought to the notice of the Meteorological Office of inconsistent rainfall values reported from stations with rain-gauges which, on investigation, were found to have leaked, although in no case was any leak evident on a superficial examination.

In one case the attention of the observer was drawn to the monthly values which were large in comparison with neighbouring records. He reported that the gauge was apparently sound, but that it had been moved recently, and attributed the large values to the move. A gauge was subsequently lent by the Meteorological Office and placed alongside, and this gave considerably lower values. The old gauge was then carefully examined and found to have a slight leak in the seam. It was surprising that so small a leak could have been responsible for a catch of as much as 110 per cent. of that of the standard gauge alongside, but when the leak was mended the readings from the two gauges were in accord.

In another case the metal funnel had weathered, so that water percolated through the outside of the funnel and the record was again bigger than that at neighbouring stations. The observer overcame the defect by varnishing the outside of the funnel. The improvement could only be regarded as of a temporary character and a new gauge was installed. In both the examples mentioned above, the gauge was of the Glaisher pattern, a type of gauge which owing to the number of soldered joints is particularly liable to leak and is therefore not recommended for regular use. Such gauges should more especially be examined for leaks.

The third example was that of a Snowdon pattern gauge, which recorded about 8 per cent. less than a new standard gauge alongside. On inspection both appeared sound. Subsequently the observer plugged the outlet of the funnel, filled it with water and discovered a small leak in the seam of the copper funnel near its junction with the part of the outer case which carries the funnel. He also found that loss only occurred when the defective portion faced the wind. It was found that in such winds, water found its way through the leak, trickled down the inside of the outer cylindrical case which carries the funnel, then between that case and the fixed part of the gauge and so out of the gauge entirely, leaving no trace behind. After the defect was remedied, the gauges gave similar readings.

Observers should, therefore, note :—

(1) That a leak may result in high values as well as low values.

(2) That an insignificant leak may give a large error.

To guard against inaccuracies due to this cause, observers should arrange for the gauge to be tested periodically and should note that a superficial examination is frequently not sufficient to detect a leak. Each portion of the gauge should be tested by filling with water to ensure it is water-tight. The outlet of the funnel should be closed during the test of that portion.

News in Brief

We regret to learn of the death on February 8th, at the age of 69, of Sir John Burchmore Harrison, Director of the Department of Science and Agr culture, in British Guiana.

Mr. L. F. Richardson, B.A., F.Inst.P., Lecturer at the Westminster Training College, has been recommended by the Council for election into the Royal Society.

Dr. J. Bjerknes delivered an interesting lecture on the *Structure of Fronts* at the Meteorological Office, South Kensington, on March 1st.

Mr. Stanley Single sends us a sketch of a lunar halo which he observed at Villars S/Bex, Switzerland, at 21h. on January 26th. The halo consisted of an ellipse with the major axis vertical. From the description it appears that the major axis was about 22½°, and the minor axis about 20°, but exact measurements were not taken. All spectators agreed that it was an ellipse and not a circle. Within the halo the sky was a deep blue.

The Weather of February, 1926.

Apart from some rather cold weather near the middle of the month, February was generally mild, with heavy rain at times, and much less than the average amount of sunshine in many districts. During the first week a depression over the Atlantic maintained southerly winds with much general rain, 44 mm. (1·75 in.) were measured at Lerwick on the 6th, and 38 mm. (1·50 in.) at Crowborough on the 5th. Floods occurred in the Midlands and the Thames Valley and in eastern Ireland. Subsequently, as pressure became relatively low over France for some days, the winds became more easterly and temperature fell considerably. Snow occurred in some eastern and northern districts, and " snow lying " was reported at a few places. On the 12th high pressure over Scandinavia spread southwards, giving fine weather in the north on the 12th, and in the south-east on the 13th. A screen minimum as low as 9° F. occurred at Balmoral on the 12th and 13th, and a grass minimum of 5° F. at Balmoral on the 12th. On the 10th, 11th and 12th maximum readings were as low as 32° F. in parts of the northern districts. The approach of another depression south of Iceland caused the winds to freshen to gale force in the Hebrides on the 14th, and mild rainy conditions began to predominate again with bright intervals, 56 mm. (2·20 in.) were measured at Sawrey (Lancashire) and 35 mm. (1·37 in.) at Festiniog (Merioneth) on the 14th. Thunderstorms accompanied by hail in some instances were experienced in several midland and south-western districts on the 15th and 16th, while further north, snow or sleet fell locally on the 16th. A secondary which passed across southern England on the night of the 17th-18th caused gales in the English Channel. After the 19th the weather became particularly mild, the thermometer rising above 50° F. on most days, except in the extreme north ; 60° F. was recorded at Hampstead on the 26th, the highest registered there for February since records began in 1910. Heavy rain occurred generally on the 22nd, *e.g.*, 48 mm. (1·89 in.) at Festiniog (Merioneth.) and 41 mm. (1·63 in.) at Llyn Fawr (Glamorgan), but after this the rainfall decreased considerably. During the last few days good sunshine records were obtained in various parts of the country, among the largest amounts being 9·5 hrs. at Plymouth and Ross-on-Wye, and 9·3 hrs. at Portsmouth on the 25th.

Pressure was below normal over western Europe, the North Atlantic and Spitsbergen, the deficit amounting to 14·3 mb. at St. Johns, N.B. Over the Mediterranean regions, Scandinavia and northern Russia pressure was above normal. This distribution favoured southerly winds over the British Isles. Temperature and rainfall were both above normal in most countries except that the rainfall was deficient in northern Norway, and the temperature low in northern Sweden. Severe gales were encountered over the Atlantic and off Gibraltar in the first part of the month, and several ships were sunk. Thunderstorms, accompanied by heavy rain, occurred in various parts of France about the 4th, and heavy rain was experienced in Spain, causing floods in Seville, Valladolid and near Corunna ; the church tower of San Justo, near Valladolid, was undermined by water and collapsed. Heavy falls of snow were reported from Switzerland and all parts of Soviet Russia about the middle of the month. Floods occurred on the Saar, Mosel and Rhine about the 20th owing to the heavy rains in Rhineland, but they did not last long.

A severe storm with heavy falls of snow and hail was experienced in northern Morocco on the 12th. Endeavours to repair the washaways on the Beira-Nyasaland route between Chindio and Baue have been frustrated by another rapid rise of the Zambesi.

As the result of four days continuous rain the mail convoy between Baghdad and Jerusalem was bogged for five days 50 miles west of Ramadi at the beginning of the month.

Severe cold and heavy snow occurred in the eastern United States and eastern Canada during the first ten days of the month, —42° F. being recorded at Doucet, Quebec and —22° F. at Canton, N.Y., on the 8th. Owing to an ice jam at Port Day the brink of the Niagara Falls on the United States side was completely frozen on the 10th.

A heat wave passed across Queensland and New South Wales during the middle of the month, temperatures of over 100° F. being recorded at many stations. On the 22nd it was reported from Wagga-Wagga that bush fires were burning along a front of 100 miles in the Riverina district. The rainfall of Australia was below normal, the deficit amounting to 6in. in the north of Queensland. In Tasmania the rainfall was generally above normal.

The special message from Brazil states that the rainfall was abundant in the northern and central districts, being 36 mm. and 74 mm. above normal respectively, but very scarce in the southern districts, where it was 52 mm. below normal. The anticyclones that passed across the country were fewer in number and moved more slowly than in the previous month ; they also followed unusual tracks. The cotton, cane, coffee and cocoa crops were better in the north owing to the larger rainfall, but the tobacco crop was suffering from lack of rain. At Rio de Janeiro pressure was 0·6 mb. below normal, and temperature 2·7° F. below normal, which is very unusual.

Rainfall, February, 1926—General Distribution

England and Wales ..	118	per cent. of the average 1881-1915
Scotland	125	
Ireland	106	
British Isles	117	

Rainfall: February, 1926: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square	3·07	78	184
Sur.	Reigate, Hartswood	2·77	70	135
Kent.	Tenterden, Ashenden	2·84	72	144
,,	Folkestone, Boro. San.	...	..	...
,,	Margate, Cliftonville	1·94	49	141
,,	Sevenoaks, Speldhurst.	3·15	80	...
Sus.	Patching Farm	3·02	77	137
,,	Brighton, Old Steyne	3·28	83	162
,,	Tottingworth Park	2·94	75	125
Hants	Ventnor, Roy. Nat. Hos.	2·52	64	120
,,	Fordingbridge, Oaklnds	2·08	53	84
,,	Ovington Rectory	2·25	57	87
,,	Sherborne St. John Rec.	1·53	39	66
Berks	Wellington College	2·11	54	112
,,	Newbury, Greenham	2·00	51	91
Herts.	Benington House	2·65	67	166
Bucks	High Wycombe	2·71	69	147
Oxf.	Oxford, Mag. College	1·93	49	122
Nor.	Pitsford, Sedgebrook	3·23	82	193
,,	Eye, Northolm	1·39	35	...
Beds.	Woburn, Crawley Mill.	2·67	68	180
Cam.	Cambridge, Bot. Gdns.	2·24	57	175
Essex	Chelmsford, County Lab	2·62	67	177
,,	Lexden, Hill House	1·96	50	...
Suff.	Hawkedon Rectory	2·35	60	155
,,	Haughley House	1·55	39	...
Norf.	Beccles, Geldeston	1·86	47	136
,,	Norwich, Eaton	1·91	49	117
,,	Blakeney	1·59	40	107
,,	Swaffham	2·03	52	129
Wilts.	Devizes, Highclere	2·08	53	105
,,	Bishops Cannings	1·76	45	83
Dor.	Evershot, Melbury Ho.	1·75	44	56
,,	Creech Grange	2·52	64	...
,,	Shaftesbury, Abbey Ho.	2·11	53	91
Devon	Plymouth, The Hoe	3·20	81	108
,,	Polapit Tamar	3·26	83	102
,,	Ashburton, Druid Ho.	5·17	131	109
,,	Cullompton	2·95	75	106
,,	Sidmouth, Sidmount	2·33	59	93
,,	Filleigh, Castle Hill	3·01	76	...
,,	Barnstaple, N. Dev. Ath.	2·32	59	86
Corn.	Redruth, Trewirgie	3·31	84	80
,,	Penzance, Morrab Gdn.	2·56	65	77
,,	St. Austell, Trevarna	3·59	91	94
Soms	Chewton Mendip	3·14	80	93
,,	Street, Hind Hayes	1·72	44	...
Glos.	Clifton College	2·22	56	94
,,	Cirencester, Gwynfa	2·15	55	93
Here.	Ross, Birchlea	1·83	46	91
,,	Ledbury, Underdown.	2·07	53	114
Salop	Church Stretton	2·38	60	108
,,	Shifnal, Hatton Grange	1·90	48	117
Staff.	Tean, The Heath Ho.	3·44	87	171
Worc.	Ombersley, Holt Lock.	2·47	63	151
,,	Blockley, Upton Wold.	2·22	56	98
War.	Farnborough	2·46	62	119
War.	Birminghm, Edgbaston	2·18	55	129
Leics	Thornton Reservoir	3·19	81	191
,,	Belvoir Castle	1·34	34	80
Rut.	Ridlington	2·56	65	...
Linc.	Boston, Skirbeck	1·73	44	119
,,	Lincoln, Sessions House	1·18	30	81
,,	Skegness, Marine Gdns.	...	..	...
,,	Louth, Westgate	1·20	30	63
,,	Brigg	1·45	37	84
Notts.	Worksop, Hodsock	1·47	37	95
Derby	Mickleover, Clyde Ho.	2·85	72	173
,,	Buxton, Devon. Hos.	3·52	89	94
Ches.	Runcorn, Weston Pt.	3·28	83	176
,,	Nantwich, Dorfold Hall	2·90	74	...
Lancs	Manchester, Whit. Pk.	2·90	74	152
,,	Stonyhurst College	5·77	147	172
,,	Southport, Hesketh	3·14	80	150
,,	Lancaster, Strathspey.	4·53	115	...
Yorks	Sedbergh, Akay	8·27	210	186
,,	Wath-upon-Dearne	1·52	39	93
,,	Bradford, Lister Pk.	2·88	73	123
,,	Wetherby, Ribston H.	1·04	26	60
,,	Hull, Pearson Park	1·59	40	96
,,	Holme-on-Spalding	1·66	42	...
,,	West Witton, Ivy Ho.	2·91	74	...
,,	Felixkirk, Mt. St. John	1·58	40	94
,,	Pickering, Hungate	2·47	63	...
,,	Scarborough	1·59	40	95
,,	Middlesbrough	1·54	39	119
,,	Baldersdale, Hury Res.	2·83	72	92
Durh.	Ushaw College	2·14	54	135
Nor.	Newcastle, Town Moor.	2·89	73	182
,,	Bellingham, Highgreen	3·58	91	...
,,	Lilburn Tower Gdns.	2·67	68	...
Cumb	Geltsdale	3·52	89	...
,,	Carlisle, Scaleby Hall	3·81	97	171
,,	Seathwaite M.	19·00	483	160
Glam.	Cardiff, Ely P. Stn.	3·27	83	109
,,	Treherbert, Tynywaun	9·30	236	...
Carm	Carmarthen Friary	3·87	98	105
,,	Llanwrda, Dolaucothy.	5·66	144	130
Pemb	Haverfordwest, School	5·32	135	153
Card.	Gogerddan	4·01	102	126
,,	Cardigan, County Sch.	2·78	71	...
Brec.	Crickhowell, Talymaes	3·50	89	...
Rad.	Birm. W.W. Tyrmynydd	4·37	111	83
Mont.	Lake Vyrnwy	6·18	157	136
Denb.	Llangynhafal	1·34	34	...
Mer.	Dolgelly, Bryntirion	5·11	130	115
Carn.	Llandudno	1·47	37	71
,,	Snowdon, L. Llydaw 9	18·97	482	...
Ang.	Holyhead, Salt Island.	2·83	72	116
,,	Lligwy	2·75	70	...
Isle of Man				
	Douglas, Boro' Cem.	5·23	133	164
Guernsey				
	St. Peter P't, Grange Rd	2·90	74	118

Rainfall: February, 1926: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av
Wigt.	Stoneykirk, Ardwell Ho	4·19	106	160	*Suth.*	Loch More, Achfary	3·57	91	54
,,	Pt. William, Monreith	5·19	132	...	*Caith*	Wick	2·10	53	93
Kirk.	Carsphairn, Shiel.	8·23	209	...	*Ork.*	Pomona, Deerness	2·00	51	66
,,	Dumfries, Cargen	5·59	142	144	*Shet.*	Lerwick	4·62	117	146
Roxb	Branxholme	3·74	95	142					
Selk.	Ettrick Manse	6·38	162	...	*Cork.*	Caheragh Rectory	7·11	181	...
Berk.	Marchmont House	4·62	117	222	,,	Dunmanway Rectory	7·44	189	127
Hadd	North Berwick Res.	2·42	61	155	,,	Ballinacurra	3·59	91	96
Midl	Edinburgh, Roy. Obs.	3·01	76	189	,,	Glanmire, Lota Lo.	4·81	122	122
Lan.	Biggar	3·29	84	138	*Kerry*	Valencia Obsy.	5·07	129	98
,,	Leadhills	7·09	180	...	,,	Gearahameen	15·00	381	...
Ayr.	Kilmarnock, Agric. C.	4·47	113	156	,,	Killarney Asylum	4·88	124	94
,,	Girvan, Pinmore	4·18	106	98	,,	Darrynane Abbey	5·28	134	114
Renf.	Glasgow, Queen's Pk.	3·49	89	119	*Wat.*	Waterford, Brook Lo.	2·95	75	91
,,	Greenock, Prospect H.	7·08	180	126	*Tip.*	Nenagh, Cas. Lough	3·99	101	128
Bute.	Rothesay, Ardencraig	6·45	164	161	,,	Tipperary	3·31	84	...
,,	Dougarie Lodge	4·95	126	...	,,	Cashel, Ballinamona	3·30	84	103
Arg.	Ardgour House	8·49	216	...	*Lim.*	Foynes, Coolnanes	3·18	81	100
,,	Manse of Glenorchy	6·66	169	...	,,	Castleconnell Rec.	3·16	80	...
,,	Oban	4·91	125	...	*Clare*	Inagh, Mount Callan	5·55	141	...
,,	Poltalloch	6·91	176	160	,,	Broadford, Hurdlest'n.	4·18	106	...
,,	Inveraray Castle	7·72	196	114	*Wexf*	Newtownbarry	3·23	82	...
,,	Islay, Eallabus	5·72	145	139	,,	Gorey, Courtown Ho.	3·05	77	109
,,	Mull, Benmore	15·20	386	...	*Kilk.*	Kilkenny Castle	2·84	72	112
Kinr.	Loch Leven Sluice	5·08	129	180	*Wic.*	Rathnew, Clonmannon	2·34	59	...
Perth	Loch Dhu	10·60	269	142	*Carl.*	Hacketstown Rectory	2·67	68	89
,,	Balquhidder, Stronvar	5·60	142	79	*QCo.*	Blandsfort House	2·66	68	99
,,	Crieff, Strathearn Hyd.	6·87	174	195	,,	Mountmellick	3·12	79	...
,,	Blair Castle Gardens	4·11	104	147	*KCo.*	Birr Castle	2·17	55	95
,,	Coupar Angus School	4·27	108	202	*Dubl.*	Dublin, FitzWm. Sq.	1·74	44	92
Forf.	Dundee, E. Necropolis	4·95	126	264	,,	Balbriggan, Ardgillan	2·73	69	139
,,	Pearsie House	6·71	170	...	*Me'th*	Drogheda, Mornington	2·17	55	...
,,	Montrose, Sunnyside	4·21	107	229	,,	Kells, Headfort	2·61	66	97
Aber.	Braemar, Bank	1·70	43	60	*W.M*	Mullingar, Belvedere	2·64	67	95
,,	Logie Coldstone Sch.	1·99	51	96	*Long*	Castle Forbes Gdns.	3·04	77	107
,,	Aberdeen, King's Coll.	3·49	89	170	*Gal.*	Ballynahinch Castle	6·00	152	117
,,	Fyvie Castle	3·01	76	...	,,	Galway, Grammar Sch.	3·39	86	...
Mor.	Gordon Castle	1·42	36	74	*Mayo*	Mallaranny	6·91	175	...
,,	Grantown-on-Spey	·87	22	41	,,	Westport House	4·49	114	114
Na.	Nairn, Delnies	1·13	29	63	,,	Delphi Lodge	9·57	243	...
Inv.	Ben Alder Lodge	6·05	154	...	*Sligo*	Markree Obsy.	3·20	81	91
,,	Kingussie, The Birches	1·92	49	...	*Cav'n*	Belturbet, Cloverhill	2·54	65	97
,,	Loch Quoich, Loan	9·30	236	...	*Ferm*	Enniskillen, Portora	2·67	68	...
,,	Glenquoich	9·29	236	91	*Arm.*	Armagh Obsy.	2·27	58	102
,,	Inverness, Culduthel R.	1·24	31	...	*Down*	Warrenpoint	3·11	79	...
,,	Arisaig, Faire-na-Squir	4·00	102	...	,,	Seaforde	4·31	109	141
,,	Fort William	6·80	173	90	,,	Donaghadee, C. Stn.	3·06	78	133
,,	Skye, Dunvegan	5·11	130	...	,,	Banbridge, Milltown	2·05	52	99
,,	Barra, Castlebay	2·62	67	...	*Antr.*	Belfast, Cavehill Rd.	4·57	116	...
R&C	Alness, Ardross Cas.	3·19	81	97	,,	Glenarm Castle	4·15	105	...
,,	Ullapool	3·02	77	...	,,	Ballymena, Harryville	3·32	84	103
,,	Torridon, Bendamph	6·28	160	80	*Lon.*	Londonderry, Creggan	2·85	72	89
,,	Achnashellach	5·70	145	...	*Tyr.*	Donaghmore	4·27	108	...
,,	Stornoway	3·23	82	72	,,	Omagh, Edenfel	...	...	...
Suth.	Lairg	2·35	60	...	*Don.*	Malin Head	2·72	69	113
,,	Tongue Manse	2·33	59	67	,,	Dunfanaghy	2·61	66	74
,,	Melvich School	1·89	48	63	,,	Killybegs, Rockmount	5·70	145	114

Climatological Table for the British Empire, September, 1925

STATIONS	PRESSURE		TEMPERATURE									PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1015·3	− 2·1	68	39	60·8	46·2	53·5	− 3·6	48·3	88	7·4	64	+ 16	17	4·2	33
Gibraltar	1016·8	− 0·5	85	57	77·9	65·6	71·7	− 0·8	64·1	80	6·1	0	− 35	0	...	...
Malta	1016·3	− 0·6	96	64	82·1	71·8	76·9	+ 0·9	72·2	80	3·3	5	− 27	6	8·7	71
Sierra Leone	1013·1	+ 0·5	86	69	82·3	72·2	77·3	− 1·9	74·3	86	7·5	581	−144	30	...	...
Lagos, Nigeria	1010·2	− 2·6	88	72	83·9	74·1	79·0	+ 0 9	74·9	81	8·4	152	+ 22	12	...	...
Kaduna, Nigeria	1013·5	+ 0·7	91	61	84·7	65·1	74·9	− 0·4	72·2	86	2·7	280	− 12	24	...	...
Zomba, Nyasaland	1013·4	− 1·0	91	52	81·1	59·1	70·1	+ 0·8	...	79	3·6	27	+ 18	4	...	...
Salisbury, Rhodesia	1014·2	− 1·1	87	41	75·8	50·3	63·1	− 3·1	56·1	58	2·9	57	+ 49	7	7·8	65
Cape Town	1020·2	+ 1·4	92	44	68·0	52·6	60·3	+ 2·9	54·9	82	5·2	35	− 26	10	...	...
Johannesburg	1018·2	+ 0·1	78	33	67·1	45·2	56·1	− 3·2	49·4	72	2·8	54	+ 30	5	8·7	73
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	82	30	72·4	41·9	57·1	− 2·0	48·9	62	3·5	50	+ 27	2	...	...
Calcutta, Alipore Obsy.	1005·2	+ 0·7	93	73	89·3	79·1	84·2	+ 1·2	79·6	89	6·8	190	− 61	14*	...	...
Bombay	1009·1	+ 1·1	91	75	86·8	77·5	82·1	+ 1·3	76·2	82	6·1	89	−182	8*	...	...
Madras	1008·1	+ 1·6	100	74	94·2	77·9	86·1	+ 1·0	77·4	72	4·3	34	− 93	1*	...	...
Colombo, Ceylon	1010·3	+ 0·3	89	71	87·4	74·9	81·1	+ 0·2	77·1	68	6·1	310	+161	11	7·7	63
Hong Kong	1008·6	+ 0·2	91	72	86·4	77·2	81·8	+ 0·8	75·0	70	6·5	252	− 2	13	8·5	70
Sandakan	...	...	92	74	88·8	75·7	82·3	+ 0·6	76·5	79	...	318	+ 79	14	...	...
Sydney	1015·5	− 0·7	75	44	67·0	47·7	57·3	− 1·9	52·3	59	2·4	21	− 53	5	9·1	76
Melbourne	1015·9	+ 0·1	76	37	60·1	44·9	52·5	− 1·6	47·5	67	6·7	41	− 20	18	4·9	42
Adelaide	1018·6	+ 1·1	78	38	63·5	47·6	55·5	− 1·5	50·0	65	6·9	81	+ 31	16	5·4	46
Perth, W. Australia	1020·4	+ 2·5	81	40	68·4	49·1	58·7	+ 0·4	53·8	64	5·0	90	+ 5	15	7·5	64
Coolgardie	1020·0	+ 2·9	86	36	71·4	44·5	57·9	− 0·7	48·4	49	1·9	30	+ 15	5	...	...
Brisbane	1017·3	− 0·1	87	45	74·2	52·2	63·2	− 1·9	55·5	57	2·3	11	− 42	4	8·8	74
Hobart, Tasmania	1009·0	− 1·7	71	36	58·2	43·3	50·7	− 0·1	44·8	65	7·0	16	− 38	16	6·2	53
Wellington, N.Z.	1004·5	− 9·0	65	32	57·3	44·6	50·9	− 0·7	47·7	69	5·8	84	− 20	19	6·5	55
Suva, Fiji	1014·4	+ 0·1	86	63	81·3	68·3	74·8	+ 0·3	70·9	76	5·1	241	+ 64	16	...	...
Apia, Samoa	1012·7	+ 0·6	87	69	85·6	73·3	79·5	+ 1·3	75·2	71	3·7	35	− 95	6	8·8	73
Kingston, Jamaica	1012·3	+ 0·1	91	66	88·1	72·5	80·3	− 1·2	72·1	87	6·3	87	− 17	12	...	...
Grenada, W.I.	1012·4	+ 0·6	89	70	84·8	75·1	79·9	− 0·3	76·6	79	6·3	158	− 47	22	...	...
Toronto	1016·2	− 1·6	86	36	69·2	54·2	61·7	+ 2·5	56·4	85	5·4	97	+ 16	12	4·7	38
Winnipeg	1014·6	− 0·2	92	32	66·6	45·3	55·9	+ 2·5	47·0	93	4·7	60	+ 10	6	4·6	36
St. John, N.B.	1015·3	− 2·2	79	34	60·7	47·3	54·0	− 1·9	50·0	83	6·4	140	+ 45	14	...	...
Victoria, B.C.	1014·7	− 1·8	79	47	65·5	50·4	57·9	+ 2·3	53·0	75	5·0	13	− 38	4	7·6	60

*For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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The Travel of Depressions

By LIEUT.-COL. E. GOLD, D.S.O., F.R.S.

A correspondent has recently asked for some information as to the bearing of the new ideas in meteorology on the travel of depressions.

In the earlier days of weather forecasting, attention was directed mainly to the cyclone or depression. In it was sought the key of weather forecasting and the search was directed mainly by the idea of averages. The average distribution of the meteorological elements in the different sectors of the depression was worked out and the average paths of the centres of depressions at different times of the year were laid down. This information was both necessary and useful. If the distribution of weather had never varied very much from the average and if the paths of all centres had been very close to the average paths, the method would indeed have solved the problem of forecasting; but actually the distribution of weather in a cyclone varies between wide limits and the centres of cyclones move on tracks which are separated widely apart and the speeds of the centres along the tracks vary between zero and 50 or 60 miles per hour. Many of the changes of weather in this part of the world are produced by discontinuities in the circulation round depressions whose centres remain more or less stationary, generally in the triangle formed by Iceland, Scotland and the South of Greenland, and a knowledge of the genesis and motion

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of these discontinuities is almost as important as a knowledge of the motion of the centres of the cyclones.

Progress beyond the limits of averages was being made gradually by such studies as those of Shaw and Lempfert on the life history of surface air currents where the idea of an unsymmetric discontinuous cyclone began tentatively to emerge ; or those of Lempfert and of Durand-Gréville on the phenomena of the squall line. But until the development by Bjerknes of the idea of cold and warm sectors in the individual cyclone, separated by definite surfaces of discontinuity, practically the only guides which the forecaster had for the direction of motion of the cyclone were the average tracks and the barometric tendencies (the amount of rise or fall of the barometer in 3 hours) observed simultaneously at different places. From their very nature, the latter could give the probable direction of motion only for the comparatively short period of 3 or 6 hours after the time at which they were observed.

By their study of individual cyclones, the Bergen school were enabled to divide cyclones into different classes according to their stage of development. The simplest broad distinction is between:

(A) Cyclones which have a definite warm sector with definite lines of separation from the cold sector.

(B) Cyclones in which there is no warm sector at the surface of the earth.

Generally speaking, class A are growing cyclones which usually move with increasing speed as they grow, and class B are dying cyclones which tend to become stationary. In the method of averages these two classes were treated simply as one class and naturally the result of such treatment could not be very satisfactory. When they are treated separately, as they should be, it is found (and this is a discovery of fundamental importance) that the centres of cyclones of class A move in the direction of motion of the air in the warm sector and very nearly with the speed of motion of that warm air (the direction of motion of this air is taken to be along the isobars and its speed about three-quarters of the speed of the " gradient wind"). A diagrammatic representation of such a cyclone is given in Fig. 1.

OAB is the warm sector ; OA and OB are the lines of discontinuity dividing the warm air from the cold air. The lines a_1 b_1 ; a_2 b_2, etc., are isobars ; they are drawn straight because in practice they are found to be nearly straight in the warm sector. The direction of motion of the centre O is parallel to AB and its speed is determined by the distance between the isobars (more strictly by the distance between the isobars multiplied by the sine of the latitude). As the whole system is moving in the direction of motion of the warm air, AB is naturally a changing direction, but the change takes place continuously, and not as a rule very rapidly.

(Usually AB " backs " so that the path of the centre O tends to curve towards the left ; this is practically always the case with a large cyclone ; but sometimes, with a small cyclone moving along the edge of a warm anticyclone, the change is in the opposite direction).

This discovery does constitute a great step forward in our knowledge. But if the discovery applied only to those depressions which have a properly constituted warm sector, its application would be limited to a comparatively small number of occasions, though occasions of great importance. As I mentioned above, much of our weather is associated with nearly stationary depressions, and the Bergen school have discovered that in these

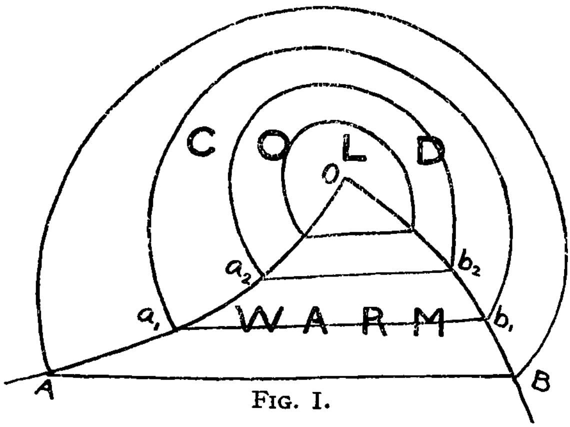


FIG. I.

depressions we get discontinuities having the same characteristics of weather as those found in the neighbourhood of the discontinuities between the warm and the cold air in the normally constituted cyclones ; and these discontinuities in the stationary cyclone move in the direction and with the approximate speed of the air in the sector which has the weather characteristics of a warm sector.

There are, however, occasions when the discontinuity in the stationary cyclone is practically a single discontinuity and no distinctive warm sector can be identified ; in such cases the discontinuity moves around the cyclone at a speed equal to the component of the colder wind at right angles to the line of discontinuity. There is one other case which should be mentioned : that of a secondary cyclone developing in, and usually to the south of, a dying cyclone. Such a secondary, if it has a warm sector, has its motion determined by that warm sector. If it has no warm sector, then it moves around the primary cyclone like any other discontinuity.

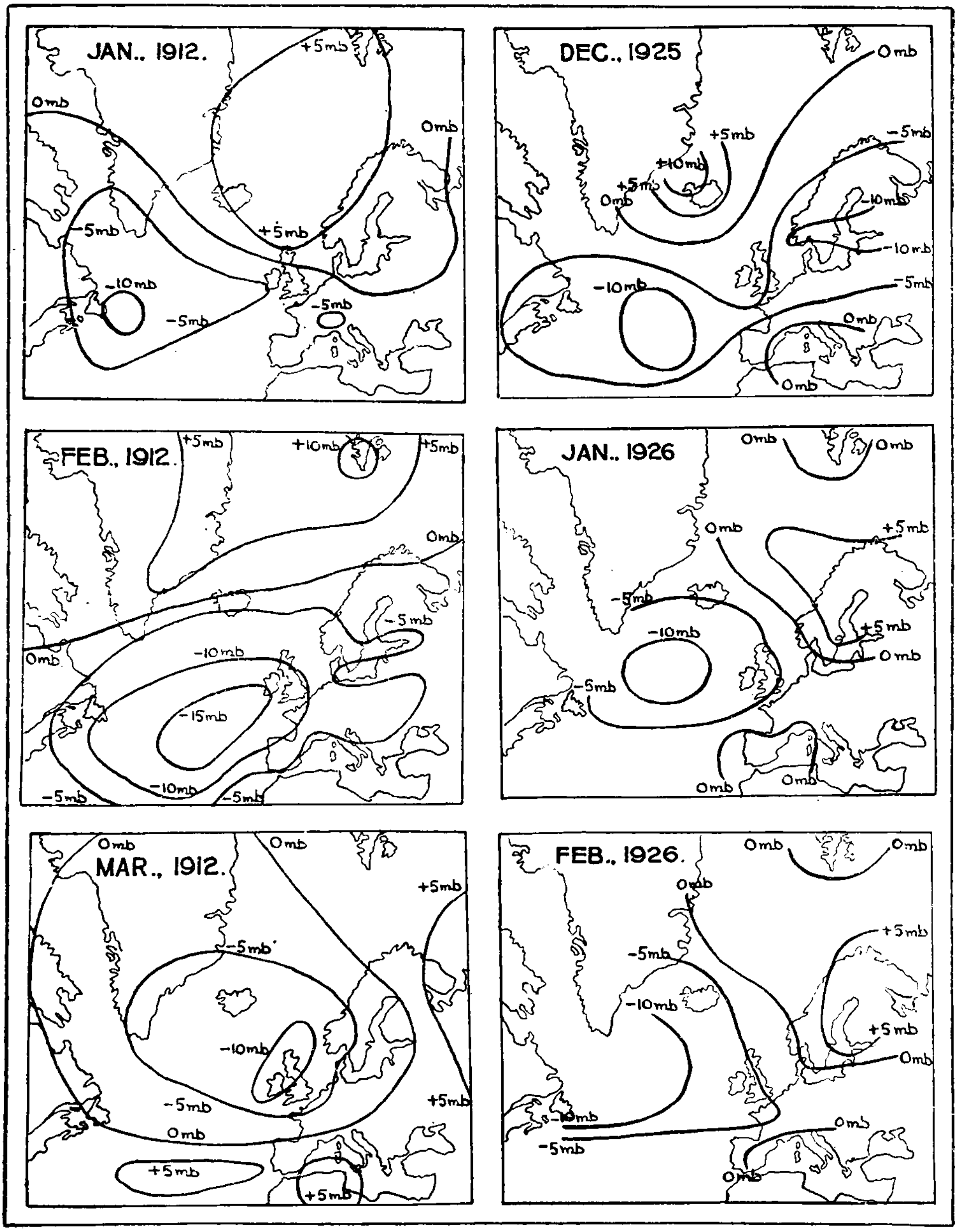
To return to the consideration of the constitution of the cyclone, those classed above as A eventually lose their warm sector and change into class B. Actually the warm sector only disappears at the earth's surface ; the warm air which constitutes the sector is lifted up by the colder air and the discontinuity which has disappeared at the surface will continue to exist at greater heights. If the change from class A to class B takes place while the centre is still over the Atlantic (or in such a position that the major part of the depression is over the Atlantic) discontinuities develop in the depression owing to the variation in the temperature of the ocean and the resulting variation in the temperature of the air. The (cold) air as it approaches the southern regions of the depression gets warm and by the time it has made the circuit and come back to the region of France or the British Isles it may have become warm air relative to the air over these lands. It will never be quite so effective as warm air which has come up into a depression from the equatorial regions but it is sufficiently warm to produce on a small scale the characteristic weather phenomena of the large " normally constituted " depression.

This note is only intended to give some indication of the way in which the question put by our correspondent is being answered. It is not possible to give in simple language in a short article anything like a complete account of the results of the long technical investigations of other people : nor to explain in detail all the precautions necessary in practice to prevent oneself being misled by peculiarities in observations taken at the earth's surface.

The Weather of the Past Winter

THE winter of 1925-26 will long be remembered for the remarkable storminess which prevailed throughout over the North Atlantic Ocean, and which resulted, among other events, in the loss of the Antinoë and the Laristan, and the heroic rescues of their crews. Sir Napier Shaw, in an article published in the *Times* of February 6th, compared the meteorological situation at the end of January with that at the beginning of February 1899 : " one vast cyclonic circulation some 2,000 miles across, covering the North Atlantic from the north of Greenland to the Azores and from Nova Scotia to the English Channel." In 1898-99 the stormy period lasted from December 18th to February 15th ; in 1925-26 the weather was very disturbed from December 17th to February 27th, so that from this point of view the two periods were almost exactly analogous.

The charts on the right hand side of the figure show the deviation of pressure from normal over the North Atlantic and western Europe during December, 1925, January and February, 1926. The points to notice are that in all three months pressure was more than 10 mb. below normal over a considerable part of the



PRESSURE ANOMALIES IN TWO WINTERS.

ocean lying between Newfoundland and the British Isles, and that an area of pressure, 5 mb. or more above normal, lay to the north—Iceland in December, Scandinavia in January and February. In each month pressure was more than 5 mb. below normal over some part of the British Isles, but in no month was the deficit actually centred over these islands. In December, the position of Great Britain relatively to the lines of equal pressure deviation was such as to favour north-easterly winds, and this month, while it was rather cold and snowy, was not especially wet in England, and was appreciably drier than usual in Scotland and Ireland. In January and February the British Isles lay between the deficit of pressure over the North Atlantic and the excess of pressure over Scandinavia, and stormy southerly winds prevailed, giving generally mild, rainy weather. The rainfall of the British Isles was 156 per cent. of the normal in January, and 117 per cent. in February ; there was a short cold spell in the middle of each month, but the mean temperature of January was above normal, while February was on the whole remarkably warm.

The charts of pressure deviations for December 1898, January and February, 1899, while they resemble those for 1925-26 in showing pressure below normal over the greater part of the North Atlantic, the deficit reaching 10 mb. over the Azores during February, differ considerably over Europe and Iceland. In December pressure was 5 mb. above normal over France and Spain, and 5 mb. below normal over Iceland ; in January and February the pressure distribution over southern Europe was similar to that during the same months of this year, but pressure was markedly below normal over Scandinavia. A much closer parallel to the sequence during the past winter is provided by the first three months of 1912, the charts for which are shown on the left hand side of the figure. These are based on the pressure deviations at land stations only, while in the charts for 1925-26 the wireless reports from ships have been utilised to provide information from a point in the mid-Atlantic ; if the same information had been available for 1912, the areas of greatest pressure deficit might have extended further over the ocean. As it is, the charts show an area with pressure more than 10 mb. below normal somewhere between Newfoundland and Ireland in each of the three months, while that for February, with a deficit of 15 mb. extending from the Azores to Valencia, is highly abnormal. According to the *Monthly Weather Report* for that month : " Cyclonic systems were never absent, and were often very deep, and had their centres much further south than usual." The chief differences between 1912 and 1925-26 were that the area of excess over Scandinavia did not develop until March in 1912, while the same month shows areas of 5 mb. above normal over the Azores and Algeria which are absent in the chart for February, 1926.

In each of the three periods, 1898-99, 1912 and 1925-26, the long period of stormy conditions over the North Atlantic and of unsettled weather over these islands was followed by a period of anticyclonic weather, and the way this came about is of some interest. In 1899, an anticyclone spread across the British Isles from Denmark on February 27th, and except for the passage of a depression across Scotland on March 6th to 9th, pressure remained generally high until March 26th, giving a fine, dry month. In 1912, pressure remained generally high near the Azores throughout March, and in April a definite anticyclone moved north-eastward across the British Isles, though it was not until April 13th that the anticyclonic centre actually lay over southern Ireland and England. In 1926, events seem to be following a course which is strikingly similar to that of 1912. An anticyclone which lay over Bermuda in the middle of February apparently moved eastward on the 27th. From the beginning of March until the 11th it lay between the Azores and the Bay of Biscay, and by the 16th it had come to occupy a position directly over these islands. Continuing its northerly progress it was centred over the Faroes on the 17th, and between Iceland and Scandinavia until the 24th, after which it moved eastward and lay over Scandinavia. At the same time an extensive depression gradually approached our south-western coasts and began to influence our weather in the closing days of March. The chart of mean pressure deviations for March 1926 (described on p. 72) bears an extraordinary resemblance to that for April 1912.

These great atmospheric surges go far beyond anything to be accounted for by changes of density due to variations of temperature in the surface waters of the Atlantic which are communicated to the overlying air. Sir Napier Shaw, in the article referred to, calculates that the great depression of the beginning of February 1899, "involved, or perhaps was caused by, the removal of nearly two million million tons of air from the area between 40° and 60° North and between 10° and 60° West, and the quantity removed to make the depression that caused the end of the Antinoë and the Laristan is fully two million million tons." It is noteworthy that the "storm-centre" usually occurs in the west of the ocean where the contrasts of temperature within a short distance are greatest, but an examination of the charts for the months preceding the development of stormy conditions has not so far revealed any striking feature of which we can say "This is the villain," probably because we do not know where to look. The calm after the storm, which we have seen occurred in all three of our examples, may perhaps admit of a more facile treatment. The two million million tons of excavated air must go somewhere, and the natural place for it is the anticyclonic belt in sub-tropical regions south of the storm centre. Thus we should expect an excess of pressure to develop between Bermuda and Madeira, and we find by experience that such an excess, when it occurs, tends to move slowly first eastwards and then north-eastwards, generally crossing the British Isles in its course, and giving us a period of fine weather which terminates the long spell of unsettled conditions.

Sir Napier Shaw has pointed out to me that, while in the North Atlantic the geographical situation tends to bring the centres of depressions together in a focus near Newfoundland, the southern hemisphere is quite differently situated, storminess being more or less equally developed in a band surrounding the pole, so that the focus of cyclonic activity, instead of being a point, becomes a line.

C. E. P. B.

OFFICIAL PUBLICATIONS

The following publications have recently been issued :—

The Meteorological Observer's Handbook. Approved for the use of observers by the Meteorological Office and the Royal Meteorological Society, 1926 Edition.

The 1926 edition of *The Meteorological Observer's Handbook* contains instructions in regard to the exposure, use and adjustment of the various instruments at ordinary meteorological stations and in the method of making and reporting non-instrumental observations. The edition differs from its predecessor, that for 1921, mainly in the fact that the instructions for completing the schedules of observations, and for preparing summaries of them have been omitted. It is proposed to issue these separately as supplements to the present volume, a separate supplement being devoted to each type of station.

The volume has been partially re-written, the section on the method of reducing barometer observations having been completely revised. Certain matter which did not directly affect the observer has been omitted, and a new section on the observation of visibility has been introduced.

Discussions at the Meteorological Office

March 15th, 1926. Untersuchungen über die Elemente des Nebels und der Wolken. By H. Köhler (Stockholm, Statens Meteor.-Hydrog. Anstalt. Med. Bd. 2, No. 5). *Opener*—Lieut.-Col. E. Gold, D.S.O., F.R.S.

Col. E. Gold gave an account of Dr. Köhler's investigations of the constituents of fog and cloud. Dr. Köhler found from his researches at the Haldde Observatory, in continuation of previous researches in Sweden, that fog consisted of water drops, which may be super-cooled, but did not form crystals even down to a temperature of —28°C. He examined the deposit from fog, both on wires and on plates, microscopically and found that drops were always present, even when ice crystals were falling through or from the fog. His observations of the size of the drops in fog and in cloud which were based on observations of coronæ, led him to the deduction that the drops were formed either by the combination of 2 drops of the same size or by the division of a drop into two drops of equal size, so that the masses of the drops of water in a fog are 2^n times the mass of some fundamental drop. Dr. Köhler analysed also the rime deposited from fog and found that this contained, on the average, about the same amount of chlorine as was found in rain water in England. The amount of chlorine on individual occasions varied greatly; from ·07 milligrams per litre to 50 milligrams per litre of melted rime, but the same law of 2 appeared to be indicated in these amounts of chlorine, each amount being 2^n of the average amount, 3·52 milligrams per litre.

Dr. Köhler also found that cumulus, alto-cumulus and strato-cumulus clouds consisted of water drops, at least when they produced coronæ. In the case of cirrus and alto-stratus clouds it seemed at first sight that they were formed of ice crystals, but on further examination of his results Dr. Köhler came to the conclusion that even in these clouds when coronæ were formed, they were formed by drops.

In the discussion, Dr. Simpson expressed the view which he propounded 14 years ago that coronæ could not be formed by ice crystals but must be formed by drops. He was also convinced that there were no satisfactory physical reasons for the law of 2 which Dr. Köhler had advanced. The process of growth or diminution of drops was a continuous one, or if anything like quanta were involved, they were much smaller quanta than the smallest drops with which Dr. Köhler was dealing.

Sir Napier Shaw referred to the importance of probing these matters of drops and nuclei in the atmosphere to the very bottom. Upon evaporation in the atmosphere sea-water would not crystallise as "sea salt" but as separate components. If sea salt were present in a foggy atmosphere it would be in the form of solution of separate salts.

Captain Douglas referred to the great vertical extent of clouds consisting of ice crystals compared with the vertical extent of cloud-sheets consisting of water drops and confirmed that ice crystals were sometimes found below a cloud of drops as though they had fallen from it.

Other speakers mentioned phenomena which they had observed, and at the end of the discussion Dr. Simpson referred to the fact that this was the end of the 21st series of these discussions which had been inaugurated by Sir Napier Shaw in 1905.

Royal Meteorological Society

THE meeting of the Society, held on Wednesday, March 17th, at 49, Cromwell Road, with Sir Gilbert Walker, C.S.I., F.R.S., President, in the Chair, was devoted to the customary March lecture. These lectures were first started in 1893 to replace the exhibition of instruments, etc., which had been held annually by the Society between 1880 and 1892. From 1926 the expenses of this lecture are to be borne by the Symons Memorial Fund established in 1901, and the lecture is accordingly now termed the "Symons Memorial Lecture." On this occasion Professor S. Chapman, F.R.S., gave an account of "Some recent advances of Atmospheric Physics." Theories of the daily variation of the earth's magnetism require the existence in the upper atmosphere of a layer which is strongly ionized (ionization is the process of production of free positive and negative electrified particles or ions). Such a layer is a conductor of electricity, and is also required to explain the long distance transmission of wireless waves, and its existence has recently been strikingly demonstrated by observations of the reception of wireless signals at night reaching the ground at a high angle. Where data as to the ionized layer given by the wireless and magnetic results overlap, they are found to be in fair agreement, both qualitative and quantitative. The origin of the ionization appears to be capable of explanation as being due to ultraviolet radiation from the sun, absorbed by the atmosphere during the day, certain objections advanced by Swann on the ground that the amount of radiation available is insufficient, having been found invalid. Additional ionization occurs, at night as well as during the day, in higher latitudes, in association with auroræ. In this case, the nature of the ionizing agent is somewhat obscure, but the most likely hypothesis seems to be a stream of charged corpuscles. Various considerations show that the charges on these corpuscles are not all of the same sign, but a slight residual charge would suffice to explain the effect. The auroral spectrum shows that nitrogen is the principal gas which is ionized at the level at which the aurora occurs.

Correspondence

To the Editor, *The Meteorological Magazine*

Excessive Rain in Nyasaland

YOU asked correspondents abroad to send you accounts of any remarkable weather conditions experienced in their area. In parts of this Protectorate excessive rain has been experienced both last year and this.

The rainfall for the early months of 1925 was the greatest ever experienced since European knowledge of this part of the tropics began, and resulted in excessive damage to crops and communications, both here and in Rhodesia and also in parts of South Africa.

January, 1926, seems to be a repetition and in parts even worse. The Zambesi floods so far as the writer is aware are not so extensive, but in a tributary of the Pungwe River (Portuguese East Africa), no less than 40 in. fell in 10 days. The rainfall for Blantyre and for Zomba was approximately 30 in. at each place for January, 1926, three times the normal fall.

L. S. NORMAN.

Konjeni Siding, Luchenza, Nyasaland Protectorate. February 8th, 1926.

Rainfall Intensities at Cork

THE outstanding results of an examination of thirteen years' (1913-25) records of automatic rainfall gaugings made here with a Hyetograph may be of interest to your readers, principally because of the low values of rainfall intensities.

No shower lasting less than two hours had an intensity even approaching the lower limit for " Remarkable " showers of the British Rainfall classification. The following formula gives a curve approximating closely to that drawn through the plotted values of the maximum recorded intensities of showers lasting less than two hours.

$$i = \frac{9 \cdot 2}{\sqrt{t}}$$

where i = intensity in inches per hour and t = duration in minutes for times not exceeding 120 minutes.

The corresponding relation for the heaviest showers lasting from 2 to 15 hours is given very closely by the equation

$$I = \frac{1 \cdot 42}{T^{0 \cdot 76}}$$

where I = intensity in inches per hour, and T = duration in hours.

The maximum rainfall on a rainfall day recorded here since the beginning of 1884 is 2·78 in. on November 16th, 1916. The maximum amount recorded for two consecutive days is 4·85 in. on December 23rd and 24th (2·51 in. and 2·34 in. respectively), 1895. The average annual rainfall here is approximately 40 in.

H. N. WALSH.

University College, Cork. February 16th, 1926.

"A Red Sky at Night......"

I was much interested in reading the article on this subject by S. C. Russell, in the *Meteorological Magazine* for February, as I have studied this subject for years and followed the teaching laid down by the late Admiral Fitzroy, as to the varied colour evident at sunrise and sunset.

Weather clear or cloudy, a rosy sky at sunset presages fine weather ; a sickly looking greenish hue, wind and rain ; a dark or Indian red, rain ; a red sky in the morning, bad weather or much wind, perhaps rain. A bright yellow sky at sunset presages wind, a pale yellow, wet. My experience is that these various colours confirm the forecast which a student by observations and recording may make at sunset and sunrise, and follow fairly near Fitzroy's directions, although the morning reds if rosy are similar in result to the evening reds. Admiral Fitzroy said by these means coming weather could be foretold very nearly.

HENRY A. ROGERS.

31, *Fernbank Road, Redlands, Bristol.* *March 3rd,* 1926.

Prolonged Thunderstorm at S'Hertogenbosch March 4th, 1926

AN unusual thunderstorm for the time of year occurred here at S'Hertogenbosch yesterday evening. The town lies on an open plain in the province of Noord-Brabant, Holland, with much water on all sides, especially after the wet spell since the year commenced.

On the morning of March 4th, after a wild and stormy night, with south-west winds, an inky blackness with heavy rain and hail occurred at 9 a.m. This however soon passed, giving way to a beautiful day of sunshine with strong westerly winds. Towards 5 p.m. heavy cumulo-nimbus clouds gathered in the west and south, and a storm could be seen in the north moving from west to east but only a few drops of rain fell here. At 7 p.m. we had wild flurries of wet snow and angry sporadic gusts of cold west air that whirled the snow in all directions, and at 7.15 there was suddenly a blinding flash of lightning accompanied by an instantaneous clap of thunder that shook the place, while "torrential" snow and hail fell for a few minutes blotting out everything. Within ten minutes children were snowballing with the accumulated snow and hail. The thunder and lightning continued for two hours though there were fairly long intervals of quietness and at times the lightning flickered as it does so often in summer. The whole storm culminated in a heavy hail shower during which the wind quickly veered to west-north-west, and the temperature, which was over 40° F. at 7 p.m., fell considerably. By 10 p.m. all was calm though hail and snow fell again later in the night. The lightning caused a conflagration at a village 2 miles from this town.

J. E. COWPER.

S'Hertogenbosch, Holland. *March 5th,* 1926

An Extraordinary Thunderstorm

THE 3rd of March, 1926, was fair and sunny until 11.30 a.m. : the barometer at 9 a.m. stood at 29·95 in. (1014·2 mb.), the mercury having fallen steadily since March 1st, 9 a.m., when it had been 30·42 in. (1030·1 mb.). The wind on the 3rd was from west in the morning : slight rain fell at 11.30 a.m., and the wind veered to north-west increasing in force ; after this, the clouds cleared away, and it became rather cold ; the evening was clear and cold. At 9 p.m. the wind was rising, the sky became totally clouded, and some lightning flashes were seen ; at 9.40 p.m. it was raining, bar. 29·7 (1006 mb.) : at 9.48-50 there was a heavy squall from the north-west and a very strong flash, followed by a heavy hail storm, lasting a few minutes. The stormy weather cleared rather rapidly, and at 10.30 the stars were shining, the wind had gone down, but occasional lightning continued until 11 p.m. My barograph showed a steady falling line, but at 10.48-50 there was a well-marked " kick " of 0.05 in. (1·7 mb.) followed by a rapid fall at 11 p.m. with irregular line. Next day, the 4th, the barometer at 9 a.m. was 29·7 (1006 mb.), and hail storms continued from north-west until about 5 p.m.

In the morning of the 4th, I was informed that three lights on the roof of a room in C. & J. Clark's factory, on the east side, had been blown, two lights outwards and one inwards. Could this be caused by suction action of squall from north-west at time of lightning ?

I noticed the thunder, after the flash at 9.48-50 on the 3rd, came in about 2 to 3 seconds : a few days later I heard that an extraordinary hole had been made in a field in Sedgmoor, about a mile and a half from Hind Hayes, Street. The position of hole is about 51°7′40″ N, 2°44′20″ W. The Polden Hills ridge is just above this portion of Sedgmoor ; it rises to about 250-300 feet above mean sea level, falling steeply to the moor : the hole made by lightning is about 25 ft. above mean sea level, and about 400 yds. from the foot of the Polden Range ; about one-third of mile from the hole is a farm house, " New Ivythorn Farm," near the bottom of the hill, and facing south. The owner was, I believe, outside on the lawn when the lightning came ; he described it as very vivid and almost blinding.

Captain Edmund Page, the owner of the land, found the hole made in the grass field, about 2-3 ft. deep, into the black soil below. The hole was circular, about 7-8 ft. across ; from the lip of this crater ran north-east a zig-zag cut or furrow about 5 yds. in length, and half a foot to a foot deep. By the nearest tree, about 150 yds. north-east of the hole, were found next morning (4th) three cows in a ditch. One died soon after being got out : on examination by a veterinary surgeon it showed evident signs of being lightning struck. The other two cows were apparently not hurt. As many as seven horses were also found in the rhynes (wide ditches) near the hole; these horses were not injured, but a horse, that had been either struck or stunned by the lightning, fell over a wire fence (there were no marks of galloping) and was seriously injured. The sods of turf were apparently thrown as far as 150 yds. from the hole: no signs of scorching on the sides of the hole were found.

Mr. Henry Corder, of Bridgwater, 12 miles west by north, tells me that, there also, about 9.45 p.m., there was a similar tremendous flash. Could it be the same as struck finally at Ivythorn? Could this have been ball-lightning? Are there many recorded effects of lightning as described?

JOSEPH CLARK.

Hind Hayes, Street, Somerset. March 20th, 1926.

NOTES AND QUERIES

The Aurora of March 9th

A fine aurora was widely observed over the British Isles on the night of March 9th and accounts of the phenomenon have kindly been sent to the Meteorological Office by many spectators. Only a few reports, however, have been received from Scotland, Ireland and Wales. The aurora was well seen in the Midlands but it is noteworthy that the majority of the more detailed and enthusiastic descriptions of the spectacle emanate from the south of England, over a region extending from Essex to Cornwall. This fact, coupled with the scarcity of reports north of Yorkshire, may indicate that the aurora was actually brighter as viewed in the south, but on the other hand it must be remembered that bright auroræ, and particularly those showing marked colour, are rare in our southern counties and hence attract much greater attention. It seems to be generally admitted that the aurora was the most brilliant one seen in the south during recent years.

The phenomenon appears to have attained its maximum development for a short time about 20h. over the greater part of the area and to have been almost entirely limited to the period 19h. 30m. to 20h. 30m. There are however two exceptions, the Yorkshire observers, who give the time as about 21h., and Mr. Hicks, of Rugby, who states that he made observations between 20h. 30m. and 21h. 30m.

The aurora mainly took the form of an extensive glow, sometimes with large detached masses, from which long beams resembling searchlights radiated upwards. A few observers noted that the part nearest the horizon formed a pearly arch with a well defined upper edge. The true auroral arch, with darker sky both below and above it, as was observed at Bourne-mouth on the night of Christmas Day, 1918, is not clearly described in the present reports. The aurora was subject to rapid changes but more by the fading out of some parts and brightening of others than by an actual motion of translation across the sky. The latter motion is a very common one during fine displays but only six observers noted it on March 9th, while the Rev. W. M. De la Touche, of Wistanstow, Shropshire, stated that no movement was visible.

The predominating colour was red, and in widely separated parts of the country the glow was mistaken for that from a big fire. There was also much whitish light, while a considerable number of observers reported a green colour—undoubtedly a rare colour in auroræ observed in southern England.

A selection of parts of some of the more interesting accounts are given below.

Capt. F. Tymms writes that : " The aurora was first observed from Plough Lane near the Croydon Aerodrome buildings shortly after 7.30 p.m. The first appearance was similar to a battery of searchlights seen over the tops of buildings towards the north-northwest. The regularity of the beams, however, soon attracted further attention and when a clearer view of the northern horizon was obtained it was seen to consist of a belt of green light low down on the horizon stretching nearly from northwest to northeast ; above this was an arch of rose-coloured light extending to an altitude of approximately 30°-35° with a maximum intensity round about 25°-30° altitude ; the arch was most intense at that time near the northwest and northeast extremities ; projecting through the arch of rose-coloured light at each end were shafts of white light similar in appearance to searchlight beams ; these beams extended varying distances, up to a maximum of about 50° of altitude. The beams towards the northwest were most intense. This display lasted with varying brilliancy for about 10 minutes or more."

Meteorological Officer, Holyhead. " An aurora of exceptional brilliance was observed here . . . . By 20h. the illumination took the form of an arch from which streamers stretched to the zenith. The lines were red and streaked with apple green and extended from about westnorthwest to eastnortheast, gradually disappearing and leaving a searchlight effect to west and east."

Meteorological Officer, Larkhill. " This portion of the sky (the northwest) assumed a flame colour . . . . Through this the strongest white rays could still be seen penetrating, increasing and diminishing both in length and in width and the intensity of the light varying rapidly."

Mr. L. C. W. Bonacina, Hampstead. " The northern sky was a brilliant white . . . . This illuminated part was abruptly bounded by an arc and long yellow streamers shot with red darted incessantly towards the zenith."

Mr. E. A. L. Attkins, Squirrel's Heath, Essex. "It was a magnificent spectacle. There was a high pearly arch over the horizon with four shafts 40° long . . . . In the northwest there was a glorious rose coloured pyramid extending to Cassiopeia's Chain. The pyramid moved slowly to the west, became stationary and faded out."

Mr. J. B. M. Ridout, Swanage. "It was deep red in colour . . . . It had no particular shape and may be said to have been in practically two portions, the eastern portion being about half the size of the western, the two being joined by a narrow band. Every now and again several vertical shafts of nearly white light, like the rays from a searchlight, appeared but only lasted for a minute or less."

Mr. R. T. Holmes, Monkokehampton, Devon. "The sky from west to northeast was ablaze with a beautiful pink and golden arch imposed on a greenish background, with streamers shooting up like lances to the height of the Pole Star . . . . The streamers were in constant movement with a slow rolling motion."

Observers who are interested in auroræ have good opportunities for observing the phenomenon during 1926 and the two following years, this being the period of maximum solar activity during the present cycle. An interval of about two days after a large sunspot has crossed the central meridian of the sun's disc constitutes a particularly favourable time for the appearance of auroræ but their manifestation is not confined to these occasions. There was no large spot accompanying the aurora of March 9th.

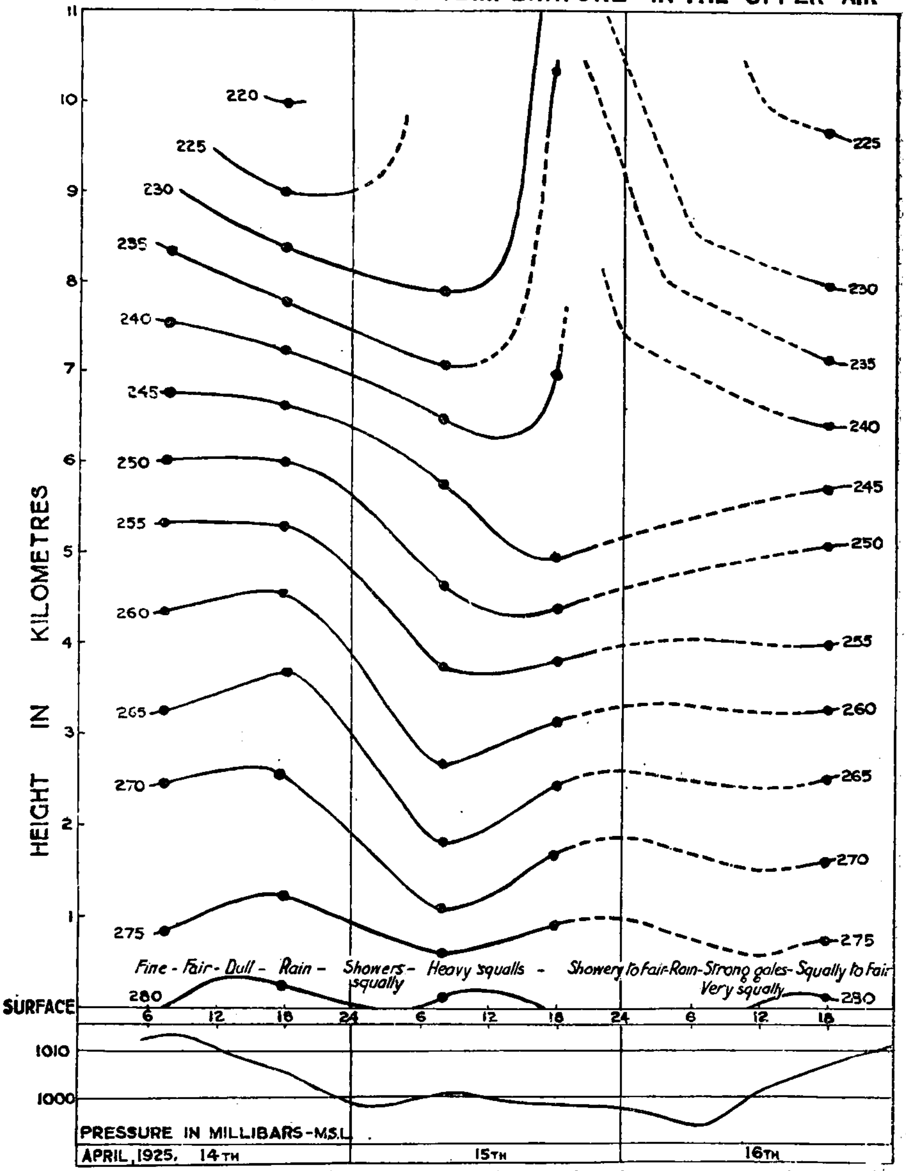
E.W.B.

Remarkably low base of the stratosphere during the passage of a depression

On April 14th, 15th, and 16th, 1925, a deep depression passed from the region south of Iceland towards the North Sea. The chart in the *Monthly Weather Report* shows that its motion was generally easterly, but of rather an erratic nature. From 18h on the 15th till 1h on the 16th, it was travelling south from the Orkneys to Inverness, thereafter it turned eastward again. It happened that an International period for the investigation of the upper air coincided with the passage of this depression, and a series of registering balloon ascents were made from Sealand on these three days. The illustration shows both the changes of surface pressure at Sealand, and isopleths of temperature up to 11 km.

The most noteworthy feature is the extremely small lapse rate of temperature above 5 km. at 18h on the 15th, that is at about the middle of the trough period at the surface. No definite inversion marked the base of the stratosphere on this

SEALAND – ISOPLETHS OF TEMPERATURE IN THE UPPER AIR



occasion, but at a height of 5·1 km. the lapse rate changed suddenly from 9° C. per km. to 2° C. per km., and hardly again exceeded that value on the average. This suggests that 5·1 km. should be considered as the base of the stratosphere, which is a remarkably low value. In the cases of the other ascents made both before and after, an inversion was found as usual at the boundary between the troposphere and stratosphere. The isopleths show that between 2 and 6 km. a mass of warm air on the 14th was replaced by a definitely colder mass on the 15th, but the peculiarity noted did not take place till some 12 or 18 hours after the arrival of the cold mass.

A detailed examination of the available data shows that on the evening of the 14th the troposphere was on the whole in a stable state, on the morning of the 15th the lower part of it was very unstable with respect to saturated air, while on the evening when the low stratosphere was found, traces of instability existed from 2 to 5 km., but the surface layers were fairly stable. By the evening of the 16th the troposphere showed no special peculiarities at any level.

The run of the surface isobars was westerly on the 14th and 15th, and north-westerly on the 16th, with a geostrophic velocity of about 55 m.p.h. on the 15th and 80 m.p.h. on the morning of the 16th, decreasing later. The run of the balloons was towards south-east on the 14th, east on the 15th, south-east on the 16th.

It was most unfortunate that a gap occurred in the sequence of ascents on the morning of the 16th, but the weather conditions at Sealand were such that it was impossible to launch a balloon. For the illustration I am indebted to Mr. G. Manley who prepared it from the original records.

L. H. G. DINES.

The Royal Alfred Observatory, Mauritius

Mr. A. Walter, who has been associated with the Royal Alfred Observatory at Mauritius for more than 25 years, at first as assistant and since 1911 as Director, retires this year in order to take up the appointment of Director of Statistics in Kenya. Mr. Walter is well known for his valuable work in the meteorology of Mauritius and of the Indian Ocean in general. He was among the first meteorologists to make use of the method of statistical correlation, which he applied to the conditions affecting the sugar crops (" The Sugar Industry of Mauritius," London, 1910), and he has continued these valuable studies in recent years (see *Meteorological Magazine* 60, 1925, p. 147). In 1915 he extended the service of storm signals during the cyclone season to include the ocean surrounding Mauritius to a distance of 500 miles, sending warnings when necessary to Madagascar, Réunion and Rodriguez. In 1923, arrangements were completed for sending daily weather messages to Pretoria. The investigation of the upper air has not been neglected, an aerological station being established at Vacaos in 1922, while plans have been made for a kite station on the coast. We wish Mr. Walter all success in his new work.

Atmospheric Pollution

We have received from Mr. Robert W. Ascroft, M.B.E., F.R.H.S., a pamphlet entitled "The Conservation of the Nation's Vegetation," which points out very strongly the serious effect of coal smoke on plant life, and the consequent economic loss to the country. The damage is due partly to the corroding effects of the sulphuric and sulphurous acids introduced into the air, partly to the blocking of the stomata by tarry matter, and partly to the direct loss of daylight. Private fires in sitting rooms supply most of the deleterious substances, and the remedy is to be found in the more extended use of gas and coke. The effect of the smoke pall in diminishing the sunshine records in great towns is well-known to meteorologists, and we hope that this pamphlet will help to draw the attention of the general public to the evil.

Obituary

We regret to learn of the death of Mrs. F. J. W. Whipple in a motor accident in the New Forest on April 6th.

We also regret to announce the death, on March 18th, consequent on injuries received in a motor cycle accident, of Mr. G. F. Golding, Grade III. clerk of the Meteorological Office, stationed at Lympne.

News in Brief

Dr. G. C. Simpson, F.R.S., read a paper "On Lightning" before the Royal Society on Thursday, March 25th.

On Saturdays, May 15th and 22nd, Dr. Simpson will deliver two lectures on "Atmospheric Electricity" at the Royal Institution, at 3 p.m.

Meteorological observers are reminded that Summer Time will come into force this year in Great Britain and northern Ireland, as well as in France and Belgium, at 2h. G.M.T. on Sunday, April 18th.

Books Received

Bollettino della sezione meteorologica della Cirenaica, Anno 1924. R. Ufficio Agrario, No. 4. Tripoli, 1925.

Meteorology. Extracts from statistics of New Zealand for the year 1924. Wellington, 1925.

Diepteloodingen in den Indischen Archipel (Depth soundings in the East Indian Archipelago). K. Magn. Meteor. Obs.

Batavia, Verh. No. 17, Vol. 1, part 1, Size $10\frac{1}{2} \times 7$, pp. 12 (Dutch) +4 (English). *Illus.* Batavia, 1925.

Calendario della Basilica Pontificia del santissimo rosario in Valle di Pompei per l'anno 1926. Pompei, 1926.

The Weather of March, 1926

WITH the exception of a few days near the middle of the month, fair mild weather, with a scarcity of rain, prevailed generally throughout March. During the first fortnight the passage of vigorous secondaries associated with depressions near Iceland frequently caused the winds to strengthen to gale force, and considerable damage was done to shipping. On the 3rd and 4th, and again on the 9th and 10th, gusts of 70-80 miles per hour occurred in several places: Fleetwood registered a gust of 84 miles per hour on the 10th. In the rear of a depression which passed across Scandinavia on the 4th there was a marked, though temporary drop in temperature, with snow, hail or sleet showers in many places. Precipitation was heavy locally in the north and west early in the month; among the largest amounts recorded being 90 mm. (3·45 in.) at Achnashellach (Ross-shire) and 112 mm. (4·43 in.) at Snowdon (Carnarvon) on the 7th. A brilliant display of the Aurora Borealis was witnessed from many parts of the British Isles on the evening of the 9th.* After the 14th an anticyclone moved northwards across England, giving fair misty weather with fog locally inland, and then a few days later the winds became easterly, and there was a decided drop in the temperature. High easterly winds prevailed in the English Channel on the 21st to 23rd, and at times on the east coast also. Snow or sleet fell in many places, including London, though the amounts were generally small. A grass minimum reading of 11° F. occurred at Wisley on the 22nd, and a screen minimum of 23° F. at a few stations on the night of the 24th to 25th. Meanwhile a decrease of pressure was spreading from the southwest, and by the 26th a warm, southerly current was affecting the southern counties. Temperature rose above 55° F. again, and a shallow depression over the English Channel caused some rain in many places. During the last few days of the month a large depression approached from the Atlantic, giving cloudy showery weather in the northwest, though fair weather continued to prevail in the east. The total rainfall was much below normal in England and Ireland (only 10 per cent. of the normal occurred at Woburn, Bedford), but more than twice the normal in parts of North Scotland.

Pressure was above normal over the British Isles and southern and central Europe, the greatest excess being 7·3 mb. at Scilly, and below normal over the northern Atlantic and northern

* See p. 66.

Europe, where the deficit amounted to 9·4 mb. at Vardo. This distribution favoured westerly winds over northwest Europe. Rainfall was below normal except in Spitsbergen and Norway. and temperature was above normal generally. In Sweden temperature was 4° to 5° F. above normal over the whole country, and precipitation normal. Early in the month there were heavy falls of snow in the Rhone Valley and in Switzerland, where winter sports were resumed. Gales were widespread over Italy between the 5th and 7th, after which the temperature dropped considerably and there were heavy falls of snow on the Apennines. Further snow and gales, extending even as far south as Sicily, were reported on the 12th. In Lithuania a sudden thaw about the 9th caused serious floods in Kovno and the neighbouring districts. Towards the end of the month snow again occurred in many parts of France. Reports from Moscow state that about the middle of the month a great storm raged over Central Asia for 26 hours, falling most heavily on the districts of Merv and Poltoratsk.

A great want of rain and the failure of the crops is reported from the Er Rif, Morocco.

The great heat experienced in South Australia in February continued for the first days of March, but about the middle of the month light and plenteous rains occurred generally, which proved the salvation of the cattle and sheep industries, and assured water supplies. Later the rains became heavy, and serious floods were threatened in Queensland and New South Wales.

Severe cold was experienced in Canada during the first fortnight −38° F. being recorded at Doucet, Quebec, on the 14th and 16th, and −36° F. at White River, Ontario, on the 5th and 11th. High winds and heavy snow storms occurred in the Middle States from the Rockies to New England on the 29th and 30th, and on the 31st a storm was raging along the east coast.

The special message from Brazil states that abundant rainfall fell in the northern and central districts, the totals for the month being 87 mm. and 114 mm. above normal respectively, while in the southern districts the rainfall was scanty, being 64 mm. below normal. Pressure changes were more frequent than in the previous month. The cotton and vegetable crops suffered from excess of rain in the north, but the coffee and cane crops are in excellent condition. At Rio de Janeiro, pressure was 0·8 mb. above normal, and temperature 0·2° F. below normal.

Rainfall, March, 1926—General Distribution

England and Wales ..	35	per cent. of the average 1881-1915
Scotland	103	
Ireland	55	
British Isles	57	

Rainfall: March, 1926: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per cent of Av.
Lond.	Camden Square	·30	8	16	*War.*	Birminghm, Edgbaston	·61	16	32
Sur.	Reigate, Hartswood	·42	11	19	*Leics*	Thornton Reservoir	1·15	29	63
Kent.	Tenterden, Ashenden	·30	8	14	,,	Belvoir Castle	·49	12	27
,,	Folkestone, Boro. San.	·25	6	...	*Rut.*	Ridlington	·56	14	...
,,	Margate, Cliftonville	·28	7	18	*Linc.*	Boston, Skirbeck	·66	17	42
,,	Sevenoaks, Speldhurst.	·44	11	...	,,	Lincoln, Sessions House	·53	13	34
Sus.	Patching Farm	·43	11	20	,,	Skegness, Marine Gdns.	...	..	...
,,	Brighton, Old Steyne	·59	15	29	,,	Louth, Westgate	·46	12	22
,,	Tottingworth Park	·50	13	20	,,	Brigg	·65	17	36
Hants	Ventnor, Roy.Nat.Hos.	·42	11	20	*Notts.*	Worksop, Hodsock	·64	16	38
,,	Fordingbridge, Oaklnds	·70	18	30	*Derby*	Mickleover, Clyde Ho.	1·28	33	72
,,	Ovington Rectory	·43	11	17	,,	Buxton, Devon. Hos.	2·09	53	51
,,	Sherborne St.JohnRec.	·87	22	39	*Ches.*	Runcorn, Weston Pt.	1·05	27	52
Berks	Wellington College	·54	14	27	,,	Nantwich, Dorfold Hall	1·02	26	...
,,	Newbury, Greenham	·67	17	30	*Lancs*	Manchester, Whit. Pk.	1·44	37	64
Herts.	Benington House	...	..	...	,,	Stonyhurst College	2·46	63	67
Bucks	High Wycombe	·34	9	17	,,	Southport, Hesketh	1·02	26	46
Oxf.	Oxford, Mag. College	·62	16	41	,,	Lancaster, Strathspey.	1·38	35	...
Nor.	Pitsford, Sedgebrook	·54	14	31	*Yorks*	Sedbergh, Akay	4·03	102	89
,,	Eye, Northolm	...	..	...	,,	Wath-upon-Dearne	·61	15	35
Beds.	Woburn, Crawley Mill	·17	4	10	,,	Bradford, Lister Pk.	1·36	35	56
Cam.	Cambridge, Bot. Gdns.	·29	7	20	,,	Wetherby, Ribston H.	·92	23	47
Essex	Chelmsford, CountyLab	·20	5	12	,,	Hull, Pearson Park	·54	14	30
,,	Lexden, Hill House	·09	2	...	,,	Holme-on-Spalding	·72	18	...
Suff.	Hawkedon Rectory	·24	6	13	,,	West Witton, Ivy Ho.	...	..	...
,,	Haughley House	·37	9	...	,,	Felixkirk, Mt. St. John	·82	21	42
Norf.	Beccles, Geldeston	·30	8	17	,,	Pickering, Hungate	·65	17	...
,,	Norwich, Eaton	...	..	...	,,	Scarborough	...	..	...
,,	Blakeney	·27	7	16	,,	Middlesbrough	·77	20	50
,,	Swaffham	·38	10	21	,,	Baldersdale, Hury Res.	2·42	61	79
Wilts.	Devizes, Highclere	·65	17	31	*Durh.*	Ushaw College	·68	17	31
,,	Bishops Cannings	·74	19	33	*Nor.*	Newcastle, Town Moor.	1·12	28	53
Dor.	Evershot, Melbury Ho.	·59	15	20	,,	Bellingham, Highgreen	2·61	66	...
,,	Creech Grange	·77	20	...	,,	Lilburn Tower Gdns.	·98	25	...
,,	Shaftesbury, Abbey Ho.	·80	20	34	*Cumb*	Geltsdale	1·63	41	...
Devon	Plymouth, The Hoe	1·11	28	38	,,	Carlisle, Scaleby Hall	1·43	36	58
,,	Polapit Tamar	·90	23	30	,,	Seathwaite M.	7·92	201	71
,,	Ashburton, Druid Ho.	1·40	36	31	*Glam.*	Cardiff, Ely P. Stn.	·81	21	25
,,	Cullompton	·69	17	25	,,	Treherbert, Tynywaun	2·81	71	...
,,	Sidmouth, Sidmount	·64	16	26	*Carm*	Carmarthen Friary	·94	24	25
,,	Filleigh, Castle Hill	·83	21	...	,,	Llanwrda, Dolaucothy.	1·89	48	41
,,	Barnstaple, N.Dev.Ath.	·52	13	20	*Pemb*	Haverfordwest, School	·72	18	21
Corn.	Redruth, Trewirgie	...	..	...	*Card.*	Gogerddan	1·60	41	46
,,	Penzance, Morrab Gdn.	1·05	27	33	,,	Cardigan, County Sch.	·63	16	...
,,	St. Austell, Trevarna	·95	24	28	*Brec.*	Crickhowell, Talymaes	1·20	30	...
Soms	Chewton Mendip	1·38	35	39	*Rad.*	Birm.W.W.Tyrmynydd	2·44	62	45
,,	Street, Hind Hayes	·97	25	...	*Mont.*	Lake Vyrnwy	2·21	56	52
Glos.	Clifton College	1·03	26	41	*Denb.*	Llangynhafal	·94	24	...
,,	Cirencester, Gwynfa	·84	21	35	*Mer.*	Dolgelly, Bryntirion	2·93	74	59
Here.	Ross, Birchlea	·22	6	11	*Carn.*	Llandudno	·66	17	30
,,	Ledbury, Underdown	·38	10	20	,,	Snowdon, L. Llydaw 9	8·57	218	...
Salop	Church Stretton	·89	23	38	*Ang.*	Holyhead, Salt Island	·47	12	18
,,	Shifnal, Hatton Grange	·61	15	33	,,	Lligwy	·61	15	...
Staff.	Tean, The Heath Ho.	...	..	...	*Isle of Man*				
Worc.	Ombersley, Holt Lock	·39	10	23		Douglas, Boro' Cem.	1·42	36	48
,,	Blockley, Upton Wold	·73	19	34	*Guernsey*				
War.	Farnborough	·78	20	37		St. Peter P't, Grange Rd	1·19	30	48

Rainfall: March, 1926: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per cent of Av
Wigt.	Stoneykirk, Ardwell Ho	1·76	45	68	*Suth.*	Loch More, Achfary	14·75	375	230
,,	Pt. William, Monreith	1·80	46	...	*Caith*	Wick	2·78	71	122
Kirk.	Carsphairn, Shiel	5·76	146	...	*Ork.*	Pomona, Deerness	5·35	136	190
,,	Dumfries, Cargen	2·49	63	69	*Shet.*	Lerwick	6·11	155	195
Roxb	Branxholme	2·31	59	80					
Selk.	Ettrick Manse	3·22	82	...	*Cork.*	Caheragh Rectory	2·56	65	...
Berk.	Marchmont House	1·58	40	60	,,	Dunmanway Rectory	2·78	71	57
Hadd	North Berwick Res.	1·17	30	62	,,	Ballinacurra	2·17	55	76
Midl	Edinburgh, Roy. Obs.	1·57	40	88	,,	Glanmire, Lota Lo.	1·64	42	53
Lan	Biggar	2·66	68	108	*Kerry*	Valencia Obsy.	1·72	44	38
,,	Leadhills	4·63	118	...	,,	Gearahameen	3·50	89	...
Ayr.	Kilmarnock, Agric. C.	3·07	78	110	,,	Killarney Asylum	...	...	...
,,	Girvan, Pinmore	3·04	77	81	,,	Darrynane Abbey	2·25	57	55
Renf.	Glasgow, Queen's Pk.	2·76	70	106	*Wat.*	Waterford, Brook Lo.	1·04	26	38
,,	Greenock, Prospect H.	6·13	156	124	*Tip.*	Nenagh, Cas. Lough	2·16	55	70
Bute.	Rothesay, Ardencraig	4·98	127	139	,,	Tipperary	1·90	48	...
,,	Dougarie Lodge	3·31	84	...	,,	Cashel, Ballinamona	1·78	45	65
Arg.	Ardgour House	11·94	303	...	*Lim.*	Foynes, Coolnanes	1·70	43	58
,,	Manse of Glenorchy	9·75	248	...	,,	Castleconnell Rec.	1·65	42	...
,,	Oban	4·98	126	...	*Clare*	Inagh, Mount Callan	2·57	65	...
,,	Poltalloch	4·92	125	128	,,	Broadford, Hurdlest'n.	1·83	46	...
,,	Inveraray Castle	11·14	283	180	*Wexf*	Newtownbarry	...	...	...
,,	Islay, Eallabus	4·11	104	108	,,	Gorey, Courtown Ho.	·63	16	27
,,	Mull, Benmore	8·40	213	...	*Kilk.*	Kilkenny Castle	...	...	...
Kinr.	Loch Leven Sluice	1·56	40	52	*Wic.*	Rathnew, Clonmannon	·65	17	...
Perth	Loch Dhu	8·40	213	127	*Carl.*	Hacketstown Rectory	·77	20	27
,,	Balquhidder, Stronvar	6·39	162	103	*QCo.*	Blandsfort House	·97	25	37
,,	Crieff, Strathearn Hyd.	1·82	46	57	,,	Mountmellick	1·73	44	...
,,	Blair Castle Gardens	2·55	65	97	*KCo.*	Birr Castle	1·11	28	46
,,	Coupar Angus School	·96	24	44	*Dubl.*	Dublin, FitzWm. Sq.	·87	22	45
Forf.	Dundee, E. Necropolis	1·17	30	57	,,	Balbriggan, Ardgillan	·94	24	47
,,	Pearsie House	1·70	43	...	*Me'th*	Drogheda, Mornington	·91	23	...
,,	Montrose, Sunnyside	·65	17	31	,,	Kells, Headfort	1·54	39	56
Aber.	Braemar, Bank	1·49	38	50	*W.M*	Mullingar, Belvedere	1·55	39	57
,,	Logie Coldstone Sch.	1·11	28	43	*Long*	Castle Forbes Gdns.	1·43	36	48
,,	Aberdeen, King's Coll.	·99	25	41	*Gal.*	Ballynahinch Castle	2·01	51	39
,,	Fyvie Castle	...	...	...	,,	Galway, Grammar Sch.	·78	20	...
Mor.	Gordon Castle	1·37	35	59	*Mayo*	Mallaranny	2·50	63	...
,,	Grantown-on-Spey	1·84	47	70	,,	Westport House	2·16	55	55
Na.	Nairn, Delnies	2·08	53	111	,,	Delphi Lodge	5·33	135	...
Inv.	Ben Alder Lodge	6·84	174	...	*Sligo*	Markree Obsy.	2·09	53	60
,,	Kingussie, The Birches	3·53	90	...	*Cav'n*	Belturbet, Cloverhill	1·35	34	49
,,	Loch Quoich, Loan	20·50	509	...	*Ferm*	Enniskillen, Portora	2·46	62	...
,,	Glenquoich	16·59	421	171	*Arm.*	Armagh Obsy.	1·73	44	74
,,	Inverness, Culduthel R.	2·66	68	...	*Down*	Warrenpoint	1·81	46	...
,,	Arisaig, Faire-na-Squir	4·14	105	...	,,	Seaforde	1·60	41	55
,,	Fort William	11·12	282	162	,,	Donaghadee, C. Stn.	1·05	27	48
,,	Skye, Dunvegan	5·05	128	...	,,	Banbridge, Milltown	1·05	27	48
,,	Barra, Castlebay	1·50	38	...	*Antr.*	Belfast, Cavehill Rd.	1·81	46	...
R&C	Alness, Ardross Cas.	4·38	111	135	,,	Glenarm Castle	2·70	69	...
,,	Ullapool	7·44	189	...	,,	Ballymena, Harryville	2·22	56	71
,,	Torridon, Bendamph	9·54	242	127	*Lon.*	Londonderry, Creggan	2·50	64	78
,,	Achnashellach	13·00	330	...	*Tyr.*	Donaghmore	2·62	67	...
,,	Stornoway	4·34	110	106	,,	Omagh, Edenfel	2·10	53	67
Suth.	Lairg	5·90	150	...	*Don.*	Malin Head	1·69	43	73
,,	Tongue Manse	3·81	97	113	,,	Duntanaghy	...	...	...
,,	Melvich School	3·42	87	120	,,	Killybegs, Rockmount	4·01	102	79

Climatological Table for the British Empire, October, 1925

STATIONS	PRESSURE		TEMPERATURE									PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	Am'nt	Diff. from Normal	Days •	Hours per day	Percentage of possible.
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1013·9	− 0·1	69	33	58·6	45·7	52·1	+ 2·2	47·4	93	7·8	78	+ 9	12	2·7	26
Gibraltar	1017·0	− 0·2	79	53	73·0	60·9	66·9	+ 0·8	60·4	84	5·6	34	− 50	9	...	...
Malta	1014·3	− 2·3	79	59	72·6	64·6	68·6	− 2·3	66·1	87	5·3	180	+107	15	6·7	59
Sierra Leone	1013·4	+ 1·4	90	67	85·1	72·3	78·7	− 1·5	74·9	85	6·7	501	+180	24	...	...
Lagos, Nigeria	1010·8	− 0·9	89	73	85·7	74·4	80·1	+ 1·0	75·3	79	8·6	76	−120	9	...	...
Kaduna, Nigeria	1013·5	+ 1·2	91	63	87·2	66·7	76·9	+ 0·6	75·7	93	2·5	110	+ 55	15	...	...
Zomba, Nyasaland	1012·0	+ 0·8	92	53	84·0	61·5	72·7	− 1·4	...	79	5·3	67	+ 28	4	...	...
Salisbury, Rhodesia	1011·6	− 0·3	88	49	81·6	55·2	68·4	− 2·4	57·7	46	2·3	46	+ 16	7	9·3	74
Cape Town	1018·1	+ 0·9	84	43	69·3	54·7	62·0	+ 0·8	57·1	77	5·1	82	+ 39	13	...	...
Johannesburg	1014·4	+ 0·3	82	41	73·4	50·1	61·7	− 0·9	50·9	53	2·1	35	− 26	6	10·3	81
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	89	33	78·3	46·2	62·3	− 2·3	52·7	49	2·7	19	− 24	3	...	...
Calcutta, Alipore Obsy.	1011·1	+ 1·7	94	67	87·1	74·4	80·7	0·0	75·5	89	4·2	222	+116	8*	...	...
Bombay	1010·0	+ 0·2	94	77	91·7	79·6	85·7	+ 3·4	77·4	78	2·8	6	− 36	1*	...	...
Madras	1009·5	+ 0·6	96	71	88·5	74·9	81·7	− 0·6	76·3	83	6·9	425	+127	13*	...	...
Colombo, Ceylon	1010·6	+ 0·3	87	73	86·3	75·4	80·9	+ 0·6	78·0	74	7·2	349	+ 17	27	6·3	53
Hong Kong	1015·4	+ 1·8	86	67	80·2	71·7	75·9	− 1·0	67·8	60	4·1	81	− 42	5	8·7	75
Sandakan	...	...	91	73	87·8	74·5	81·1	− 0·4	76·3	81	...	307	+ 53	15	...	...
Sydney	1014·1	− 1·0	93	46	71·3	53·5	62·4	− 1·1	57·4	59	5·0	19	− 56	11	7·9	61
Melbourne	1012·1	− 2·6	96	39	69·6	49·1	59·3	+ 1·7	52·3	57	6·5	28	− 38	13	6·8	52
Adelaide	1013·9	− 2·2	89	39	72·2	50·1	61·1	− 0·8	53·1	50	6·1	24	− 20	9	7·7	60
Perth, W. Australia	1017·6	+ 0·8	88	42	67·2	51·9	59·5	− 1·5	54·7	65	6·6	55	+ 1	18	6·6	52
Coolgardie	1014·5	− 0·7	90	37	77·2	49·4	63·3	− 0·3	51·8	46	2·1	11	− 8	3	...	...
Brisbane	1015·5	− 0·8	91	46	78·3	59·0	68·7	− 1·1	61·9	57	3·5	9	− 58	4	9·5	75
Hobart, Tasmania	1006·1	− 4·5	87	37	63·4	45·5	54·5	+ 0·5	48·3	60	6·9	42	− 15	17	6·4	48
Wellington, N.Z.	1014·3	+ 2·0	73	35	61·0	48·9	54·9	+ 0·6	51·8	70	6·4	144	+ 39	18	6·0	45
Suva, Fiji	1012·8	− 0·4	86	65	80·3	69·6	74·9	− 1·1	71·7	77	8·1	465	+267	26	...	...
Apia, Samoa	1011·3	− 0·2	90	71	86·0	73·8	79·9	+ 1·5	75·2	71	5·1	129	− 25	11	7·1	57
Kingston, Jamaica	1012·8	+ 1·3	94	69	89·0	72·2	80·6	+ 0·1	71·2	82	3·0	44	−146	8	...	...
Grenada, W.I.	1012·7	+ 1·7	87	72	84·7	74·9	79·8	− 0·3	76·6	80	5·7	184	− 2	22	...	...
Toronto	1014·9	− 3·1	65	24	49·2	35·5	42·3	− 4·6	37·7	88	5·4	67	+ 5	19	4·2	38
Winnipeg	1017·3	+ 2·0	57	6	39·5	26·5	33·0	− 7·8	...	...	7·3	34	− 4	14	3·1	29
St. John, N.B.	1009·8	− 6·7	58	20	48·2	35·5	41·9	− 3·4	37·8	83	5·2	214	+ 99	18	5·0	45
Victoria, B.C.	1019·1	+ 1·5	66	39	55·9	44·8	50·3	− 0·1	47·0	86	7·0	29	− 36	10	4·5	41

*For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

M.O. 284.

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The Cold Nights at Garforth

By E. H. GEAKE, M.Sc.

FOR some time it has been noticed that the minimum temperatures registered in the screen at Manor Farm, Garforth (6½ miles east of Leeds) are low compared with those at neighbouring stations; even the 35-year normal published in Section I. of the *Book of Normals* shows this phenomenon conspicuously, the normal minimum for the year being lower at Garforth than at any other station in England and Wales. In fact there are only three stations in Scotland which record lower minimum temperatures and two of these are high-level stations. Fig. 1, in which the mean annual minimum temperature at a selection of these stations is plotted with the latitude clearly shows that the minimum at Garforth is abnormally low for its latitude and height; another station on this diagram which also appears to record lower minima than its surrounding stations is Salisbury, 39·5° F. at a height of 190 ft. In Table I. some striking examples of low minimum temperatures at Garforth in comparison with neighbouring stations are given.

An inspection of the station was carried out in 1921 but the question of the lowness of the minimum temperatures was not raised until 1922, when inquiry in June from the authority in charge of the observations, Prof. R. S. Seton, of Leeds University, elicited the suggestion that the cause of the discrepancy was probably the site as "the instruments are now practically in a wood." Experiments, however, carried out in Germany in

Wt 69—P 1 1000 5/26 M & C

1897 and described by J. Schubert* and comparisons made in Sweden by H. E. Hamberg† show that the effect of a wood is to

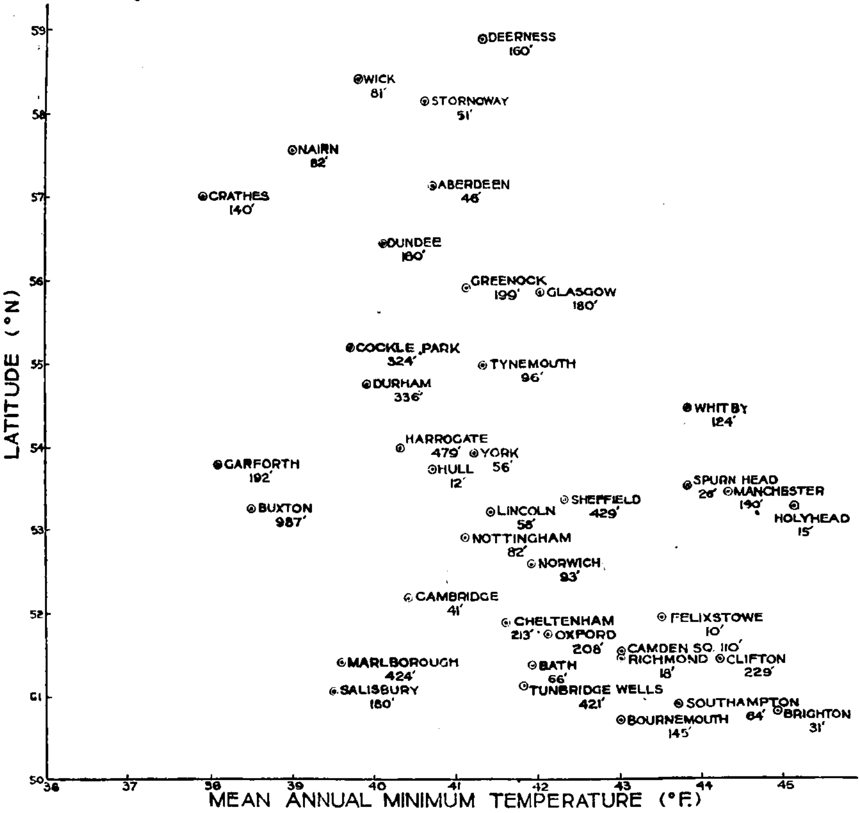


FIG. I.

raise the minimum temperature, although temperatures taken at other times are lowered, and so it is probable that the low minima at Garforth are due to some cause other than woodedness of site.

TABLE I.

Height of Station			Garforth 192 ft.	Wakefield 124 ft.	Bradford 439 ft.	Huddersfield 410 ft.	Harrogate 479 ft.	Garforth Wind at 9 hr.	Garforth Weather since Midnight
1921	Oct.	4th	30	52	50	50	49	N 2	Overcast
,,	,,	17th	33	53	55	55	54	S 2	Fine
,,	Dec.	9th	24	50	49	50	48	N 2	Fog
,,	,,	17th	23	47	42	47	46	NE 2	Overcast
1924	Jan.	10th	14	23	22	—	19	E 2	Overcast
,,	Mar.	3rd	3	18	19	16	20	W 1	Fine
,,	,,	4th	9	18	21	17	23	Calm	Fine

* *Abhandlungen des Königlich Preussischen Meteorologischen Instituts*, Bd. I. No. 7, 1901.

† HAMBERG, H. E. Om. Skogarnes inflytande på sveriges klimat. (De l'influence des forêts sur le climate de la Suède). Part II., température. Stockholm, 1896.

The station at Garforth was inspected in June, 1924. After careful examination the inspector was satisfied that the phenomenon was not due to faulty manipulation of the minimum thermometer or to instrumental error. Moreover other experiences of the observer inclined him to think it a genuine feature of the locality as, for example, the complete destruction of potatoes in an adjacent field on an occasion when a suspiciously low minimum had been recorded in the screen. The inspector did not consider the site wooded although it was not an open exposure. The chief wooded areas in the neighbourhood are the lake wood, Hawks Nest Wood about half a mile away, and the Cathills plantation about 700 yards to the south-east. The thermometer screen lies between a hedge and a row of trees which is parallel to the hedge and 10 ft. to the west of it, the line of the hedge and trees being approximately north and south. The trees are 25-30 ft. in height and the hedge had grown to a height of 6-7 ft. in January, 1924, when it was cut. It was 3 ft. high at the time of the inspector's visit in June, 1924. The screen is about 4 ft. from the hedge.

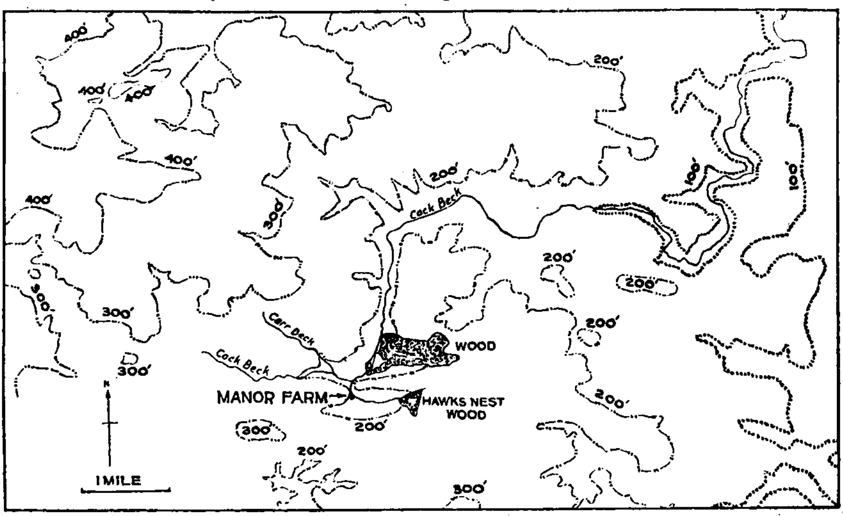


FIG. 2.

As can be seen from the contour map (Fig. 2) the whole station lies in a shallow basin, or rather on a small mound in a shallow basin, with a lake about 700 yards to the north-east by north. It has been suggested that the low minimum temperatures at Garforth may be attributed to the effect of this shallow basin; the inspector says " It seems apparent that the solution of the problem at Garforth lies in the fact that the station is in a shallow basin. On cold calm nights or on nights with light winds the cold air drains down to the lowest levels, collects there and remains stagnant thus giving low minimum temperatures in the screen. Examination of the occasions on which these low minimum temperatures occur show that they have occurred under calm conditions or in light winds. The observer himself has remarked these particularly low minimum temperatures with light northwest winds which blow down the valley of the 'Cock Beck.'"

With this explanation in mind the wind and weather prevailing at Garforth on mornings of low minimum temperatures were investigated. The criterion of low minimum was that the

TABLE II.

Direction.	Wind at 9 h. Total frequency	(a) Total No.	(a) °/o	(b) Total No.	(b) °/o	Force.	Wind at 9 h. Total frequency	(a) Total No.	(a) °/o	(b) Total No.	(b) °/o
N ...	153	55	36	23	15	Calm	82	45	55	19	23
NE ...	104	33	32	11	11	1	206	89	43	31	15
E ...	77	31	40	11	14	2	311	112	36	47	15
SE ...	45	14	31	3	7	3	212	71	33	21	10
S ...	103	41	40	11	11	4	164	36	22	10	6
SW ...	169	44	26	18	11	5	58	9	16	2	3
W ...	228	71	31	27	12	6	33	5	15	2	6
NW ...	123	38	31	13	11	7	3	1	—	—	—
Calm ...	82	45	55	19	23	8	2	1	—	—	—

WEATHER SINCE MIDNIGHT.

	Total frequency.	(a) Total No.	(a) %	(b) Total No.	(b) %
Fine	402	171	43	67	17
Dull	362	97	27	39	11
Showers	111	27	24	6	5
Rain	77	16	21	6	8
Snow	7	3	40	3	40
Fog	77	38	49	13	17
Mist	15	9	60	3	20
Squall	10	1	10	1	10
Detached cloud	29	14	48	1	3

minimum temperature at Garforth was (*a*) 3° F. or more, lower than that at Wakefield, (*b*) 6° F. or more, lower.‡ Three years were examined, 1924, 1925 and later 1921, as 1921 being a calm year, it was thought it should be favourable for low minima. The results of the 3 years were added together and are given in Table II. This table shows that quiet weather is the most favourable for low minima at Garforth although they do appear to have occurred occasionally with moderate or strong winds. These latter occurrences may, however, be due to a change of

‡ As the minimum thermometer at Garforth reads 0·3°F. too low these differences are actually 2·7°F. and 5·7° F.

weather between the time of the minimum temperature and the 9h. observation of wind. The actual direction of the wind does not seem to be of much importance and there is no sign of northwest winds being particularly favourable as mentioned by the observer. It is worthy of note that the calm year 1921 has 178 occurrences in class (*a*) and 81 in class (*b*) as against totals of 198 and 58 respectively for the two years 1924-5 together. This table rather supports the idea that the low minima at Garforth are due to drainage of cold air into the basin, but if this really is the cause it is rather surprising that no other stations in the British Isles (except perhaps Salisbury) show it to the same extent, as many of them must be situated in valleys. Probably at Garforth there are two effects operating, the effect of the local shallow basin and the effect due to the fact that the ground to the northwest rises to the Yorkshire Moors.

In order to obtain an estimate of the abnormality of the minimum temperatures at Garforth compared with those at other stations, regression equations were obtained connecting the annual mean of the daily minima with the latitude and the height, first at all stations in Great Britain, and second at a selection of inland stations at about the same distance as Garforth from the east coast. The " partial " correlation coefficients were as follows :—

Minimum temperature with	Latitude.	Height.
All stations ..	—·62 ..	—·56
Inland Stations ..	—·59 ..	—·59

The regression equations were as follows ; the mean annual minimum being expressed in Fahrenheit degrees, the latitude in degrees north of 50° and the height in feet :—

All stations .. Min. temp.=44·5—0·55° (Latitude)—·0047 (Height).
Inland stations .. Min. temp.=42·7—0·47° (Latitude)—·0028 (Height).

The first equation, which includes coast as well as inland stations, naturally gives a higher basal temperature than the second, which deals only with inland stations. The fact that the coastal stations are generally at a relatively low level makes the apparent decrease with height rather rapid when all stations are considered, and the height coefficient obtained from the inland stations only is probably more accurate. In the same way the large number of stations on the south coast makes the apparent effect of latitude too great when all stations are considered. It is curious that even when only the inland stations are considered the decrease of the mean annual minimum with height is practically at the standard rate of 3° F. per 1,000 ft., showing that very few of the low level stations show the " basin effect " appreciably. The mean annual minimum at Garforth calculated from the regression equation for all stations is 41·4° F., and that calculated from the regression equation for inland stations only is 40·3° F. The observed mean annual minimum is 38·1° F. Garforth thus has its temperature lowered by 2·2° F. which is of about the same amount as the difference between an average inland station and an average coastal station in the same latitude.

The regression equation obtained from the inland stations has been applied to some of the other stations in the *Book of Normals* with the following results :—

Salisbury .. (180 ft.)	2·2°F. too low.	Buxton .. (987 ft.)	0·1°F. too high.
Marlborough (424 ft.)	1·3°F. „ „	Harrogate (479 ft.)	0·8°F. „ „
Cambridge .. (41 ft.)	1·0° F. „ „		

Salisbury shows the same depression of minimum temperature as Garforth. It is favourably situated for the drainage of cold air, being on lower ground to the south of the high ground of Salisbury Plain and near the centre of convergence of several valleys. A footnote, however, in the *Book of Normals* states that " until recently the thermometers were exposed in a Glaisher Stand." The result of I. D. Margary's comparison of observations taken in a Stevenson screen and a Glaisher Stand at Camden Square* shows that the minimum in the Glaisher Stand is about 1° F. lower than in the Stevenson screen. If this correction is applied, the depression of the minimum at Salisbury becomes 1·2° F., thus leaving Garforth as the station in Great Britain with the lowest minimum for its situation.

It is rather difficult to believe that such large depressions of the minima at Garforth as shown in Table I. are entirely due to drainage of cold air into the basin. Another factor that can be suggested is that the soil may have some effect on the night temperatures. Soils which reflect most of the radiation they receive cannot absorb much and therefore do not radiate much heat at night. Salisbury and Marlborough are examples of this on chalk ; Garforth is on limestone, but until further information is available as to the influence of the subsoil on temperature this question cannot be pursued.

Royal Meteorological Society

THE monthly meeting of this Society was held on Wednesday, April 21st, at 49, Cromwell Road, South Kensington, Sir Gilbert Walker, C.S.I., F.R.S., President, in the Chair.

J. Glasspoole, M.Sc., Ph.D.—The driest and wettest years at individual stations in the British Isles, 1868-1924.

The paper includes statistics and maps which show for all parts of the British Isles (1) the driest year, (2) the wettest year, (3) the percentage fall in the driest year, and (4) the percentage fall in the wettest year. The years 1887 and 1921 are shown to

* *London, Q. J. R. Meteor. Soc.,* 50 (1924) pp. 209-226.

be the driest in the series 1868 to 1924 over 40 and 31 per cent. of the British Isles, and the years 1872 and 1903 the wettest years over 49 and 19 per cent. of the whole British Isles respectively.

The variability of the climate of the British Isles is illustrated by the fact that out of the 57 years under discussion as many as 42 were the driest or wettest at some one or more stations in the British Isles. In addition each of the four years 1875, 1880, 1897 and 1915, occur as the driest in one part of the British Isles and the wettest in the series in another part. The four maps reproduced in the paper form a summary of the extremes of annual rainfall given in the series of annual rainfall maps which are being published by the Society in a Rainfall Atlas.

C. E. P. Brooks, M.Sc.—The meteorological conditions during the glaciation of the present tropics, being some remarks on the climatological basis of Wegener's theory of continental drift.

During the Upper Carboniferous and Lower Permian Periods the distribution of climatic zones was highly abnormal. Over a considerable part of the present tropics, including parts of Australia, India and South America and most of the southern half of Africa, there were extensive ice-sheets, while further north there were coal-measure forests in Europe, Asia and part of North America, and coral reefs in the latitude of the present Mediterranean. Wegener's theory of continental drift overcomes the difficulty caused by this anomalous distribution by supposing that South America, Africa, India and Australia all formed parts of a large continent surrounding the South Pole, which lay close to the south coast of South Africa. According to this reconstruction the equator passed through Europe and North America, and the coal-measures were formed by tropical rain-forests. A number of recent researches in North America have shown, however, that powerful glaciers extended to sea-level in that country also, on the site of Wegener's equator. Thus there are the same climatic objections to Wegener's reconstruction as to that based on the present positions of the continents. In order to see what distribution of climates might be expected from the latter the reconstruction of the Upper Carboniferous given by Th. Arldt (*Handbuch der Palæogeographie*) was taken as a basis, and the probable distribution of warm and cold ocean currents and of winds was discussed. The reconstruction shows an extensive and lofty continent (Gondwanaland) including most of South America, South Africa, India and Australia ; north of this were three small continents occupying parts of North America, Europe and Asia, separated from Gondwanaland by an extension of the present Mediterranean (the " Central Sea " or Tethys), which was open on the east and west to the Pacific Ocean. It was shown that a warm current would traverse this " Central Sea," thus accounting for the coral reefs and the rich vegetation of the coal-measures. To the south of Gondwanaland the Southern Ocean would have been much colder, giving a permanent monsoon crossing the lofty continent of Gondwanaland, and it was suggested that under certain circumstances—especially a high degree of cloudiness caused by the condensation of moisture from the rising air—snow might fall regularly at a height of 6,000 feet and upwards, thus giving rise to extensive glaciers. The occurrence of the American glaciation is readily explicable owing to the neighbourhood of an arm of the Arctic Ocean. The author regarded it as significant that the only period in which glaciers reached sea-level within the present tropics was also the only period in which the reconstruction of the land and sea distribution based on the present positions of the continents rendered such an event even remotely possible.

C. E. P. Brooks, M.Sc.—The variation of pressure from month to month in the region of the British Isles.

A chart of the deviation of means of pressure from normal in any month usually shows " centres " of maximum excess or maximum deficit. The changes in the positions of these centres from one month to the next have been studied on nearly 500 monthly charts of pressure deviations. It is found that centres of excess of pressure tend to move along fairly well-defined tracks. A statistical investigation shows that in the majority of instances the movement takes place from west to east. The main track runs from Alaska south-eastward to the centre of the United States, then eastward to the Azores, north-eastward to the British Isles or Scandinavia and again eastward to northern Russia or the Kara Sea. The whole journey would take about six months, though no single centre was found which persisted long enough to travel from Alaska to Russia. Centres of deficit are somewhat more variable in their movements, but also tend to move from west to east. The causes of these movements were briefly discussed, and were attributed to the movements of large " warm " anticyclones and of foci of cyclonic activity.

Correspondence

To the Editor, *The Meteorological Magazine*

Halos and Parhelion

At 7.10 a.m. (B.S.T.) to-day I noticed a rather bright tangential arc forming to the 23° halo, which itself only developed later and did not become very clear. Looking higher there were no signs of the large halo, but a large stretch of its tangential circumzenithal arc quickly became bright, with colours clearly developed, finally increasing to more than a semi-circle. The arc of the smaller halo disappeared in about ten minutes, but there was still a portion of the other arc at 7.30, when also a bright but rather irregular parhelion was conspicuous east of the sun, lasting some little time.

The eastern sky had been clear at sunrise except for a few fleecy cloudlets, but then a grey haze began developing over the whole heavens, changing to thin cirrus. Before 8 o'clock the whole of this had given way to fleecy clouds similar to those at sunrise.

J. EDMUND CLARK.

41, Downscourt Road, Purley, Surrey. April 20th, 1926.

A Horizontal Rainbow

AT 11 a.m. to-day a great, highly coloured rainbow was observed by three persons at the same time. It was lying horizontally on the floor of the Suir Valley. The summit of the arch lay against the hills on the north side of the valley and the ends curved round and lay against the south side immediately below the three observers who were on a road which rose obliquely up the hill side, the observers being 350 ft. or 400 ft. above the tidal level in the valley below. The sun shone above and behind them. The bow was of a woolly appearance, purple, blue, green and orange from the observers outwards and northwards. Some of the objects in the valley could be seen through the richly coloured woolly bow which appeared to be 40 or 50 ft. thick and to cover from end to end, measured around the bow, 16 or 19 miles of country according as the measurement was estimated on the inner or outer edge of the bow.

J. ERNEST GRUBB.

Seskin, Carrick-on-Suir, Ireland. April 8th, 1926.

Horizontal Rainbow from a Street Lamp

THE following notes on a horizontal rainbow formed by a street lamp on a wet road and pavement may be of interest. The bow took the form of an almost semi-circular band of white light which was visible on the road a few feet in front of the observer as he stood with his back to the lamp and at a short distance from it. The centre of the semi-circle was the shadow of the observer's head, the bow only being visible on the side nearest to the observer. As one walked away from the lamp the bow increased its distance from the observer only slightly and was always stronger on the smooth surface of the pavement than it was on the rougher surface of the road. Measurement showed that when standing at 43 ft. from the lamp the nearest point of the rainbow was 4½ ft. in front of the observer, which gives a deviation of the lamp's light of approximately 142°, whereas the deviation in the case of a rainbow, with the source of light at infinity, is 140° to 130°.

The night, November 17th, 1925, was fine but there were drifting fog banks in places, although by suitably screening off a part of the lamp light it was judged that the fog was not responsible for the rainbow. There was no frost on the ground. Similar rainbows were noticed with other street lamps in this neighbourhood during the two or three hours preceding midnight.

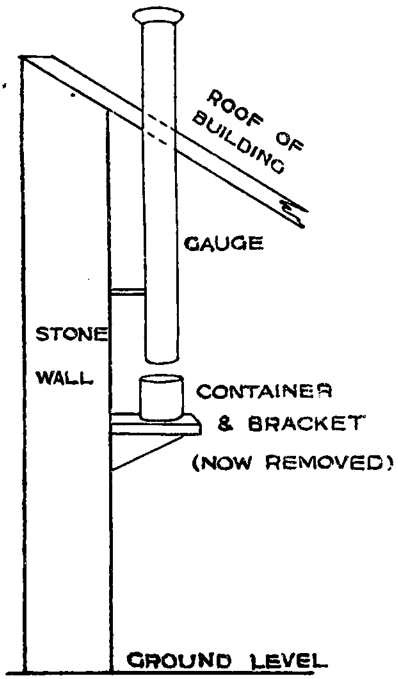
I am indebted to Mr. F. J. W. Whipple for the explanation of the phenomenon.

S. MORRIS BOWER.

10, Langley Terrace, Oakes, Huddersfield. March 31st, 1926.

A Curious Old Rain Gauge

AT Synone House, 4 miles north of Cashel, are the remains of the old rainfall recorder, of which I give a sketch from memory. The date of its establishment is uncertain, but probably the late owner of the place, Mr. Johnson, who was a scientific farmer, was responsible for its construction. He died about 20 years ago, and the gauge has been disused since; it is probably 60 or 70 years old. The present occupier, Mr. K. C. Fitzgerald, is an observer of rainfall, but uses a more modern type of instrument.



The gauge consists simply of a metal cylinder, resembling a section of the pipe commonly used to convey rain-water down from the eaves of a building, but slightly larger in diameter. It passes through the roof of one of the outbuildings and might easily be taken for a chimney. There is a considerable lip at the top, but no appearance of any funnel. The container rested on a bracket attached to the inner wall of the building, which has now been removed, and evidently the rain was measured with a gauged glass, in the same way as at present. It is probable that Mr. Johnson established the instrument for his own information in connection with farming operations and that the returns were never sent to the British Rainfall Organization, or any other Society. In this case absolute accuracy in the readings might not be required, but it seems as if evaporation from the inner surface of the long cylinder would cause a considerable loss of the rainfall. I have never seen or heard of a similar type of rain-gauge and this is certainly interesting as a primitive style.

E. W. MONTAGU MURPHY.

Ballinamona, Cashel, Co. Tipperary. March 19th, 1926.

The Dry Spring

THE month of March proved the driest month of that name in 20 years' observations at this station, total rainfall 0·38 in. A partial drought prevailed from February 24th to April 6th, a period of 42 days, with rainfall 0·39 in. A dry spell also occurred from March 5th to April 6th, a period of 33 days, none of which had more than 0·03 in.

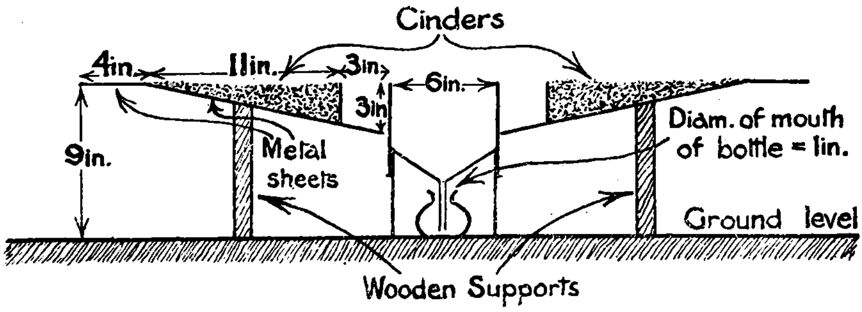
R. P. DANSEY.

Kentchurch Rectory, Hereford. April 7th, 1926.

NOTES AND QUERIES

Experiments with a Shielded Rain Gauge

SOME experiments have been carried out by Mr. P. F. Jarrold at Aberdeen Observatory with a shielded rain gauge, the daily catch being compared with that from an unshielded gauge. The comparison covered the year May, 1924 to May, 1925, the gauges being set up in a field, 4 yards apart. The sketch represents a vertical section through the centre of the shielded rain gauge.



The shield was designed to prevent up-draught near the mouth of the gauge, while cinders were used to minimise the chance of insplashing.

For the whole period the following values were obtained: Shielded gauge 771 mm., and unshielded gauge 735 mm. The records from the unshielded gauge were in agreement with those of the standard gauge at the Observatory. Thus the effect of the shield was to increase the catch by 5 per cent. The daily falls were grouped into light, moderate and heavy rains as judged from personal observations and from the traces of the Beckley automatic gauge, and also according to the general intensity of the wind as recorded by the Dines pressure-tube anemograph. The results are set out below :—

PERCENTAGE EXCESS OF SHIELDED OVER UNSHIELDED GAUGE.

Rains.	Winds.			
	Force 0-2 Calms.	Force 3-4 Moderate.	Force 5-6 Strong.	Means of Percentages.
Light ..	0	10	9	6
Moderate ..	2	5	6	4
Heavy ..	3	2	0	2
Means of Percentages ..	2	6	5	4

Mr. Jarrold suggests that the effect of eddying in the unshielded gauge would be most pronounced with high winds and with light rains—light rain being more easily blown about than heavy rain. The analysis above indicates that with high winds and light rains the shielded gauge does catch more than the unshielded gauge. Mr Jarrold concludes therefore that the effect of the shield is to minimise any loss due to eddying. The results of the observations suggest that insplashing is a negligible factor. When the amounts are classified according to the wind direction there is very little difference in the relative catch. This may be due to the similarity of the exposures in all directions.

The results would have been more valuable if Mr. Jarrold had used standard gauges. He is nevertheless to be congratulated on making a comparison which can only be undertaken at stations where automatic records of rainfall and wind are available.

The Aurora of March 9th, 1926

The following interesting accounts of the Aurora seen on March 9th were received too late for inclusion in the April number of the Magazine.

Mr. W. J. Gibson, of Waringstown, Co. Down, writes that "At 7.30 p.m. I noticed a strong brightness in the north, and therefore waited for further developments, knowing it to be an auroral display in its early stages. A passing shower at 7.35 p.m. intervened and obscured everything, but by 7.45 all was clear again, and the entire north quadrant of the sky presented the appearance of a sanguineous sunrise. A well defined greenish white arc spanned the boreal horizon, from which sheaves of auroral flame were diffused in all directions, red was the predominating colour. At 8 p.m. the heavens were aflame including the north, east and west, right overhead, and even a portion of the south. The scene at this time was tremendously grand, the beauty being accentuated by a general undulation of the masses of light. A kind of fiery corona was formed at the zenith, and in the east where the constellations of Boötes and Corona were rising, there was a green pillar of suffused flame. In the western quadrant, the constellations of Auriga, Gemini, Orion, Taurus and Canis Minor and Major, were in a sea of fire, whilst a procession of coloured streamers passed from west to east. I have been a close observer of the heavens for many years and with the exception of the auroral display in January, 1907, I have never seen one of the same magnitude as the display of March 9th, 1926. On March 9th, two sun spots were visible. There has been tremendous solar activity since January and several auroral displays. The April activity, however, so far appears to indicate a temporary wane."

Dr. F. R. Walters, of Farnham, Surrey, describes the occurrence near Waverley Abbey, in these words. "A band of pale green sky and over this a broad band of red extending about 50° or 60° upwards and over nearly half a circle, the brightest part being to the north. The red glow was interrupted by streaks radiating upwards, the main streaks—about 6 or 8 in number—being white. Much more numerous smaller streaks, white, bluish white and greenish white, filled up the intervals and extended for a much shorter distance upwards."

Aeroplane Struck by Lightning.

THE *Aeroplane* of April 21st, 1926, reports that Mr. F. L. Barnard while flying from Paris to London on April 16th with his fourteen passengers, had an alarming experience. He ran into a thunderstorm over Picardy between Beauvais and Poix. Suddenly there was a loud report as a flash of lightning struck the machine. A large patch of fabric on the lower plane was burnt, the compass was put entirely out of action and one engine started missing, as apparently the permanent field of one of the magnetos had been upset. Mr. Barnard did not like to land immediately, thinking that the machine might have become highly charged with electricity, and in landing might spark to earth and ignite the machine. He therefore flew on and eventually reached Lympne in safety and without sparking to earth. On examination it was found that in addition to the hole in the fabric one of the main spars was scorched, all the bonding was fused and one of the ailerons damaged. Mr. Barnard had not let out his aerial as he had found earlier in the day that atmospherics were so bad that wireless speech was impossible.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1926.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays)

Averages for Readings

		Jan.	Feb.	Mar.
Cloudless days :—				
Number of readings	n	8	2	4
Radiation from sky in zenith ...	π I	414	431	435
Total radiation from sky ...	J	438	474	466
Total radiation from horizontal black surface on earth ...	X	620	702	705
Net radiation from earth ...	X—J	182	228	239

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

		Jan.	Feb.	Mar.
Cloudless days :—				
Number of readings	n_0	2	1	1
Radiation from sky in zenith ...	πI_0	20	20	30
Total radiation from sky ...	J_0	30	38	44
Cloudy days :—				
Number of readings	n_1	3	3	5
Radiation from sky in zenith ...	πI_1	64	73	79
Total radiation from sky ...	J_1	65	72	71

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

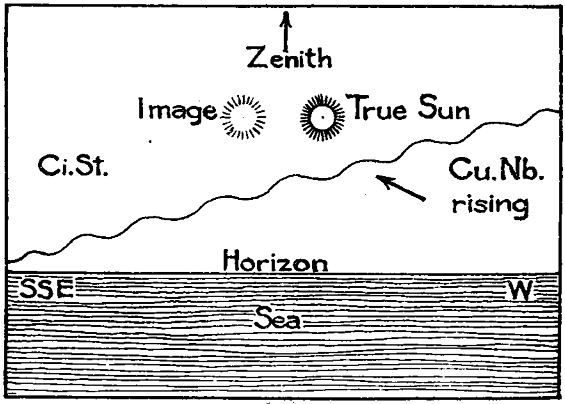
"Medium Range" Forecasting

Monsieur J. Jaumotte, Director of the Institut Royal Meteorologique of Belgium, gives in *Ciel et Terre* for January, 1926, a brief description of an experiment which has been carried out since the beginning of 1926 by the "Service du Temps" for forecasting for a few days in advance. The forecasts, which are based on the method of the polar front, are made for at least three days, but if at the end of this time no change is expected, the forecast is renewed for a further period. The forecast is generally in less detail than the daily forecast and usually only refers to one or two elements such as temperature and wind direction. Four such forecasts were made between January 1st and February 11th and were all successful. The two cold spells and the two periods of warm weather with a south-west wind and intermittent rain were predicted.

An Unusual Mock Sun

Dr. C. C. Vigurs, of Newquay, sends us the following note which he has received from his son. No explanation of this curious phenomenon has been suggested.

Tuesday, Feb. 16th, 1926. S.S. "Manchester Civilian" on passage from U.S.A. to Avonmouth, in Lat. 51° 32′ N Long. 6° 34′ W. Hook Point, Waterford bearing 339° (clockwise from North) and distant 38 miles, and St. Ann's Head bearing 80½° and distant 54 miles. Barometer 29·54 in. falling slowly. Dry bulb 47·2° F. Wet bulb 46·0° F. Wind W'S, force 5, Cloud 7, cirro-stratus around the sun and to the south and cumulo-nimbus below the sun and to the west; clear blue arc of sky to the north-northwest.



The phenomenon was first seen at 15h. 46m. G.M.T. when the true sun, with an altitude of 14° and bearing 227° was shining brightly with good limb in medium sextant shade, and a heavy squall was moving from west to south-southeast with the upper edge of the cumulo-nimbus cloud at a point vertically below the sun and having an altitude of 8°. The phenomenon was an uncoloured image of the true sun at the same altitude and at an angular distance of 10° to the left, certainly not 22°. It was fairly well defined, sufficiently so for an azimuth bearing, but not enough for anything but a doubtful sextant altitude. The image had the appearance of the true sun shining through denser layers of cloud, although the cirro-stratus was fairly uniform in density; but with a slightly mottled appearance. No image was seen to the right of the true sun, and probably, though not certainly, the corresponding position to the right of the sun was already occupied by the moving cumulo-nimbus. No halo or mock-sun-ring was observed.

The image dimmed as the squall approached the true sun and disappeared when the true sun became covered.

J. T. C. Vigurs, 2nd Officer.

The Weather Map for the 16th shows a low of less than 966 mb. between Iceland and the Faroes and a high of more than 1,026 mb. over Portugal, etc., with regular isobars between and moderate southwest winds over St. George's Channel. At Valencia pressure fell slightly from 1h. to 7h. and rose again; at St. Ann's Head it rose from 7h. to 18h. and fell afterwards; the passage of a small secondary eastwards seems to be suggested.

[It would seem probable that the bright uncoloured spot observed was on the parhelic circle. The phenomenon may possibly have been produced by reflection from ice crystals of such formation as to tend to send much light to an observer, from a point on the parhelic circle about 10°, in azimuth, from the sun. Bright uncoloured spots, known as the parhelia of 120°, have occasionally been seen on the parhelic circle 120° from the sun. The origin of these is uncertain but it has been suggested that they are due to reflection from the faces of indentations in tabular crystals.—Ed. *M.M.*]

Reviews

Atlas elemental de Núvol. By Prof. E. Fontseré. With a French translation by Ph. Wehrlé. Size $11\frac{1}{4} \times 8\frac{3}{4}$, pp. xi.+30 (Catalan)+16 (French) (*illus.*), 32 plates, Barcelona, Gustau Gili, C. Enric Granados 45, 1925.

Of recent years there has been much discussion upon the adequacy of the illustrations given in the *International Cloud Atlas*, and the best proof that these could be considerably improved upon has been given by the publication lately in several countries of what are really "national" atlases of clouds. Of these the present volume is the most recent. In criticising the cloud pictures in the International Atlas, it should be remembered that these photographs were obtained at a time when photographic methods were, relatively speaking, in their infancy, and that, therefore, the pictures then obtained were highly creditable to their authors. But a glance at the very fine pictures in Prof. Fontseré's atlas will convince anyone of the inestimable benefit meteorology has received by the introduction of the panchromatic plate and of filter-screen methods of recording colour-contrast.

In his appreciative preface to the present volume, General Delcambre comments upon the scant attention clouds have received in the past, and expresses the opinion that their more complete observation will be of great advantage to meteorology in the future.

The text of the present atlas is written in Catalan, but there is also a literal translation in French by M. Ph. Wehrlé, one of the authors of the now famous *Systèmes Nuageux.* The text itself consists of the "International" definitions of each cloud type enlarged by further notes upon the types and their variations; these definitions are accompanied by small reproductions in two tints, blue and grey, of portions of the plates which follow; by this novel and effective means, very realistic pictures of the cloud-types are produced. The rather unusual method is adopted of giving the definitions, not in the order found in the International Atlas, but in groups which contain the basic names, cirrus, stratus, cumulus, and nimbus, quite irrespective of the altitude of the clouds. The thirty-two plates in the atlas cannot be too highly commended, and the photographers, Senors Pons, Campo, and Pulvé, are to be congratulated upon their work. Some very fine skies are shown, particularly of fracto-cumulus, flat alto-cumulus, delicate cirro-cumulus, and massive cumulo-nimbus; but perhaps the finest is the wonderful representation on Plate XXIV of a cumulo-nimbus, consisting of a huge mass of cumulus topped by a finely-developed "anvil," the edges of which exhibit mammillation; the whole picture most beautifully rendered by its author Senor Campo.

If a word of criticism might be added, it is that the examples of strato-cumulus shown in Plates XXI and XXII seem to the writer to be closed-up cumuli arranged in lines, but then strato-cumulus is always the cloud-type upon which divergence of opinion among observers is greatest. To criticise such a splendid atlas would seem most ungracious.

GEO. A. CLARKE.

Los Huracanes de las Antillas. By S. Sarasola, S.J., (Observatorio Nacional de San Bartolomé de Bogotá, Notas Geofisicas y Meteorologicas, Numero II.) Size $12\frac{1}{4} \times 8$, pp. vi. + 173 (*illus.*). Bogota, 1925.

THE hurricanes of the West Indies have been the subject of several detailed official publications during the course of the present century, but this work by Father S. Sarasola strikes a new note. It contains little statistical material, but is full of the results of practical experience gained by the author during twenty years of meteorological work in Cuba, before he took over the duties of Director of the Observatorio Nacional of Bogota, Colombia, in 1922. This personal acquaintance is supplemented by wide reading, and the whole is directed towards the problem of forecasting hurricanes in the West Indies, particularly in Cuba. The book is divided into two parts, of which the first is entitled: "Scientific bases for the prediction of hurricanes," and the second "Recent advances in forecasting atmospheric perturbations." The first part deals with the general meteorology of the Antilles, the structure of tropical cyclones, including the upper currents, with what may be called the "prognostications" of hurricanes, with recent advances in forecasting due to the introduction of wireless telegraphy, and with practical seamanship during the hurricane season.

The second part of the book is more controversial. After a brief reference to the Norwegian school of forecasting, and to the methods of Guilbert, the author devotes three chapters to the method of forecasting variations of pressure from the analysis of periodicities. The theses are developed that "there is a periodical inversion of pressure at intervals of thirty days," and that "depressions occur periodically at intervals of 20 days." It is stated that the occurrence of barometric depressions can be predicted by means of these principles, but not their intensity. Vercelli's method of forecasting by the analysis of barograms is then discussed, and the need for further research is remarked. It is concluded that "barometric waves appear to be periodic, but the causes are not yet known." Finally we have a reference to the work of H. H. Clayton, and a somewhat optimistic account of the possibility of forecasting hurricanes by means of sunspots. This part of the work is of great interest, but it shows up the chaos which reigns in the subject of long-range forecasting at present.

Books Received

Seismological Report of the Apia Observatory, Samoa, 1923. July to 1924, December, pp. 9, Samoa, 1925.

Rainfall Types in India in the cold weather period, December 1st to March 15th. By Sir Gilbert T. Walker, C.S.I., F.R.S., and J. C. Kamesvararav, D.Sc. Ind. Met. Memoirs. XXIV., 1925. Part XI., pp. 347-354. Calcutta, 4 annas. 5d.

Monthly Rainfall of India for 1923. Published by the various Provincial Governments and issued by The Meteorological Department, Calcutta. 2 rupees, 8 annas ; 4s. 6d.

Obituary

Admiral Sir John Franklin Parry, K.C.B.—Admiral Sir John F. Parry, whose death occurred on April 21st, was Hydrographer of the Navy and an ex-officio member of the Meteorological Committee from August, 1914, to August, 1919.

Born in 1863, he entered the Royal Navy in 1877, and had a very distinguished career in the surveying branch of the Service. In 1910 he was made Assistant Hydrographer of the Navy and while holding this appointment he performed many valuable services outside the ordinary routine of his office ; amongst them the following may be mentioned. He represented the Admiralty at the Conference on the observation of ice by vessels in the North Atlantic, held in 1912, after the loss of the *Titanic* ; he represented Great Britain at the French Conference on the use of wireless telegraphy in connection with time and weather; he was also chairman of an important Admiralty Committee dealing with charts.

His tenure of office as Hydrographer, which covered the period of the War, was the most remarkable of recent years, and contributed greatly to the advancement of nautical science. During the War the work of the Hydrographic Department proved invaluable. It was not only concerned with safeguarding our ships from ordinary maritime disasters, but the newer forms of sea warfare such as mine-laying were found to be almost entirely dependent on the accuracy of surveying work.

Sir John Parry became President of the International Hydrographic Bureau on its formation, a post which he held until his death. He presided at the International Hydrographic Conference held in London during 1919, when 45 delegates, representing 25 nations, assembled to endeavour to apply the lessons and experiences of war to the needs of peace, and made considerable progress towards standardising international practice.

We regret to learn of the death of Major H. W. Buddicom, J.P., who kept a barograph station at Penbedw, Flint, for over 25 years.

News in Brief

Sir Napier Shaw, F.R.S., formerly Director of the Meteorological Office, has been elected an honorary member of the Norwegian Academy of Sciences, Oslo, in the class for Mathematics and Natural Science.

The last two lectures on "Past Ice Ages of the World, and their control of animal and plant life, with special reference to the Australian evidence," which were to have been given by Sir T. W. Edgeworth David, C.M.G., D.S.O., F.R.S., at Imperial College, Royal School of Mines, at 5.15 p.m., on Mondays, May 10th and 17th, will now be given at 5.15 p.m. on Mondays, May 31st and June 7th.

The *British Gazette* for May 11th states that Lieut.-Comm. R. Byrd, of the United States Navy, reports that he successfully flew from Spitsbergen over the North Pole and back again, the flight lasting 16½ hours. He did not land.

On April 26th, the Air Ministry Lawn Tennis team (two members of which belong to the Meteorological Office) won the Interdepartmental Winter mixed doubles Tournament.

The Weather of April, 1926

Apart from two short spells of fine warm weather, one at the beginning of the month and one near the middle, the conditions during April were generally cloudy and unsettled. Under the influence of light southerly breezes between an anticyclone over the continent and a depression on the Atlantic temperature rose to about 70° F. in many places during the first few days: 72° F. at Kew Observatory on the 2nd was the highest reading there in the first half of April since 1871, while 76° F. at Geldeston on the 4th (Easter Sunday) was the highest on record there for the whole of April. A secondary depression moving northeast from the Bay of Biscay caused heavy local rain and thunderstorms on the 3rd and 4th, 47 mm. (1·85 in.) being reported from Guernsey on the 3rd and 38 mm. (1·49 in.) from Kelvedon (Essex) on the 4th. Subsequently temperature fell gradually but on the whole remained above the average until the middle of the month. Further secondary depressions caused a fair amount of rain in southern England about the 7th to 8th, but an anticyclone which passed across the British Isles during the next few days gave the second short spell of dry sunny weather with local frost at night. A grass minimum temperature of 15° F. was registered at Rounton (Yorkshire) on the 12th. Day temperature did not rise as high as during the first spell, 68° F. on the 13th and 14th being the highest maximum recorded. The approach of a depression from the Atlantic caused a renewal of unsettled weather about the 14th. Much rain fell, 130 mm. (5·13 in.) being registered at Snowdon (Carnarvon) and 64 mm. (2·50 in.) at Dungeon Ghyll (Westmoreland) on the 14th, and secondaries near the southwest coasts were associated with high winds at times. Pressure later became low to the north and east of the British Isles giving more northerly winds and changeable showery weather with local thunderstorms and hail. On the 25th a depression over France caused high winds and gales in and near the southern part of the North Sea, and considerable rain in eastern England and Scotland on the 25th and 26th. From then until the end of the month unsettled rainy weather continued with sunny intervals but a low temperature.

The total rainfall for the month was more than twice the normal in parts of south-east England. In northern England, Wales, Ireland and most of Scotland it was below normal, the greatest deficit being in Wales and Yorkshire.

Pressure was below normal over the Atlantic and the western sea-board of Europe (the deficit amounting to 8·1 mb. at St. Johns, Newfoundland, and 8·9 mb. at 50° N. 30° W.) and above normal over southern Europe, Sweden, northern Norway and Spitsbergen. Temperature and rainfall were generally above normal except that temperature in Spain and rainfall in the extreme north of Norway were below normal. In Sweden the lowest temperature $-28°$ F. was observed at Gällivare on the 7th. The total precipitation was more than twice the normal in north Sweden but about half the normal in the south. Owing to the rapid thaw of the heavy snows of last winter serious floods occurred in the neighbourhood of Baghdad about the middle of the month and in various parts of European Russia towards the end. The Tigris broke its bank near the Royal Palace at Baghdad on the 9th and parts of the city were under 6 ft. of water on the 11th. Blocks of drifting ice also helped to cause the Moskva river to overflow. The low lying parts of Leningrad, Moscow, and many other towns were all under water on the 25th. On the 24th a strong gale occurred in the Bay of Naples doing some damage. Snow is reported to have fallen in the Auvergne district on the 25th, while a heat wave occurred in Berlin on the 25th and 26th when the maximum temperatures for both these days reached 79° F., 2° F. below the record for April. Heavy rain occurred in Normandy on the 27th to 28th.

At the beginning of the month ten fishing boats capsized in a storm off Mororan, Hokkaido, Japan.

Good rains were reported throughout Victoria, Australia, early in the month, more than 3 in. being registered up to the 5th in the Mallee district. The total rainfall in Australia was about normal in Western and South Australia and Tasmania, below normal in Queensland and above normal in New South Wales and Victoria.

On the 7th a disastrous fire occurred at the Union Oil Company's tank farm at San Luis Obispo, California. Two oil reservoirs were struck by lightning during an early morning thunderstorm and the fire spread to the other reservoirs and tanks. The damage is estimated at £3,000,000. In Chicago heavy snow occurred during the first week which is unusual for this time of the year.

The special message from Brazil states that the rainfall was abundant in all districts, being 44 mm., 102 mm. and 92 mm. above normal in the northern, central and southern districts respectively. The anticyclones moved on less meridional tracks than in the previous month. Vegetables and the tobacco, coffee and cotton crops are suffering from excess of rain. At Rio de Janeiro pressure was 0·5 mb. below normal and temperature 0·4° F. under normal.

Rainfall, April, 1926—General Distribution

England and Wales ..	134	per cent. of the average 1881-1915.
Scotland	108	
Ireland	88	
British Isles	118	

Rainfall: April, 1926: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square	3·15	80	204	*War.*	Birminghm, Edgbaston	2·42	61	139
Sur.	Reigate, Hartswood	3·94	100	254	*Leics*	Thornton Reservoir	2·23	57	131
Kent.	Tenterden, Ashenden	3·50	89	218	,,	Belvoir Castle	1·63	41	107
,,	Folkestone, Boro. San.	3·10	79	...	*Rut.*	Ridlington	2·26	57	...
,,	Margate, Cliftonville	2·69	68	199	*Linc.*	Boston, Skirbeck	1·71	43	127
,,	Sevenoaks, Speldhurst.	4·30	109	...	,,	Lincoln, Sessions House	1·79	45	129
Sus.	Patching Farm	2·83	72	162	,,	Skegness, Marine Gdns.	1·56	39	116
,,	Brighton, Old Steyne	3·45	88	213	,,	Louth, Westgate	1·77	45	106
,,	Tottingworth Park	4·14	105	224	,,	Brigg	1·92	49	122
Hants	Ventnor, Roy. Nat. Hos.	3·28	83	195	*Notts.*	Worksop, Hodsock	1·87	47	127
,,	Fordingbridge, Oaklnds	4·56	116	249	*Derby*	Mickleover, Clyde Ho.	1·86	47	108
,,	Ovington Rectory	3·31	84	175	,,	Buxton, Devon. Hos.	2·25	57	77
,,	Sherborne St. John Rec.	...	...	...	*Ches.*	Runcorn, Weston Pt.	·82	21	47
Berks	Wellington College	2·77	70	172	,,	Nantwich, Dorfold Hall	1·25	32	...
,,	Newbury, Greenham	3·13	80	172	*Lancs*	Manchester, Whit. Pk.	1·53	39	80
Herts.	Benington House	2·87	73	188	,,	Stonyhurst College	1·89	48	70
Bucks	High Wycombe	3·01	76	192	,,	Southport, Hesketh	1·22	31	66
Oxf.	Oxford, Mag. College	2·54	65	165	,,	Lancaster, Strathspey	1·78	45	...
Nor.	Pitsford, Sedgebrook	2·82	72	184	*Yorks*	Sedbergh, Akay	2·37	60	73
,,	Eye, Northolm	1·85	47	...	,,	Wath-upon-Dearne	1·25	32	79
Beds.	Woburn, Crawley Mill	2·59	66	173	,,	Bradford, Lister Pk.	1·47	37	73
Cam.	Cambridge, Bot. Gdns.	3·00	76	221	,,	Wetherby, Ribston H.	1·20	30	68
Essex	Chelmsford, County Lab	4·55	116	356	,,	Hull, Pearson Park	2·00	51	128
,,	Lexden, Hill House	4·28	109	...	,,	Holme-on-Spalding	1·80	46	...
Suff.	Hawkedon Rectory	3·24	82	210	,,	West Witton, Ivy Ho.	1·77	45	...
,,	Haughley House	3·04	77	...	,,	Felixkirk, Mt. St. John	0·65	17	39
Norf.	Beccles, Geldeston	2·58	66	266	,,	Pickering, Hungate	1·00	25	...
,,	Norwich, Eaton	2·81	71	164	,,	Scarborough	1·16	29	74
,,	Blakeney	2·46	62	192	,,	Middlesbrough	1·20	30	88
,,	Swaffham	2·10	53	142	,,	Baldersdale, Hury Res.	1·87	47	80
Wilts.	Devizes, Highclere	3·32	84	175	*Durh.*	Ushaw College	1·13	29	60
,,	Bishops Cannings	3·08	78	152	*Nor.*	Newcastle, Town Moor.	1·04	26	63
Dor.	Evershot, Melbury Ho.	2·83	72	120	,,	Bellingham, Highgreen	2·11	54	...
,,	Creech Grange	4·74	120	...	,,	Lilburn Tower Gdns.	2·09	53	...
,,	Shaftesbury, Abbey Ho.	3·56	90	170	*Cumb*	Geltsdale	3·09	78	...
Devon	Plymouth, The Hoe	2·28	58	100	,,	Carlisle, Scaleby Hall	2·66	68	136
,,	Polapit Tamar	2·11	54	90	,,	Seathwaite Field	7·71	196	104
,,	Ashburton, Druid Ho.	3·25	83	107	*Glam.*	Cardiff, Ely P. Stn.	2·22	56	88
,,	Cullompton	2·24	57	99	,,	Treherbert, Tynywaun	4·65	118	...
,,	Sidmouth, Sidmount	2·15	55	101	*Carm*	Carmarthen Friary	2·36	60	86
,,	Filleigh, Castle Hill	2·40	61	...	,,	Llanwrda, Dolaucothy	3·77	96	114
,,	Barnstaple, N. Dev. Ath.	1·77	45	89	*Pemb*	Haverfordwest, School	2·26	57	86
Corn.	Redruth, Trewirgie	2·59	66	90	*Card.*	Gogerddan	1·99	51	76
,,	Penzance, Morrab Gdn.	2·66	68	109	,,	Cardigan, County Sch.	1·67	42	...
,,	St. Austell, Trevarna	2·94	75	101	*Brec.*	Crickhowell, Talymaes	4·00	102	...
Soms	Chewton Mendip	3·72	94	125	*Rad.*	Birm. W. W. Tyrmynydd	3·42	87	93
,,	Street, Hind Hayes	2·50	64	...	*Mont.*	Lake Vyrnwy	...	...	...
Glos.	Clifton College	2·50	64	116	*Denb.*	Llangynhafal	1·76	45	...
,,	Cirencester, Gwynfa	3·65	93	190	*Mer.*	Dolgelly, Bryntirion	2·60	66	71
Here.	Ross, Birchlea	2·73	69	144	*Carn.*	Llandudno	0·81	21	45
,,	Ledbury, Underdown	2·48	63	136	,,	Snowdon, L. Llydaw 9	8·45	215	...
Salop	Church Stretton	2·15	55	100	*Ang.*	Holyhead, Salt Island	1·66	42	80
,,	Shifnal, Hatton Grange	1·46	37	87	,,	Lligwy	1·73	44	...
Staff.	Tean, The Heath Ho.	1·83	46	92	*Isle of Man*				
Worc.	Ombersley, Holt Lock	1·88	48	124		Douglas, Boro' Cem.	1·54	39	62
,,	Blockley, Upton Wold	4·43	113	228	*Guernsey*				
War.	Farnborough	3·24	82	165		St. Peter P't, Grange Rd	4·58	116	228

Rainfall: April, 1926: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	1·50	38	71	*Suth.*	Loch More, Achfary	3·66	93	75
,,	Pt. William, Monreith	1·69	43	...	*Caith*	Wick	2·71	69	136
Kirk.	Carsphairn, Shiel.	3·72	94	...	*Ork*	Pomona, Deerness	3·80	97	184
,,	Dumfries, Cargen	2·39	61	90	*Shet*	Lerwick	1·68	43	74
Roxb	Branxholme	2·80	71	148					
Selk	Ettrick Manse	4·09	104	...	*Cork*	Caheragh Rectory	3·49	89	...
Berk.	Marchmont House	3·30	84	163	,,	Dunmanway Rectory	3·12	79	75
Hadd	North Berwick Res.	1·66	42	119	,,	Ballinacurra	2·37	60	92
Midl	Edinburgh, Roy. Obs.	1·55	39	112	,,	Glanmire, Lota Lo.	2·41	61	86
Lan	Biggar	2·58	66	149	*Kerry*	Valencia Obsy.	3·74	95	102
,,	Leadhills	3·58	91	...	,,	Gearahameen	3·30	84	...
Ayr	Kilmarnock, Agric. C.	1·67	43	81	,,	Killarney Asylum	3·65	93	110
,,	Girvan, Pinmore	2·50	64	84	,,	Darrynane Abbey	2·59	66	75
Renf.	Glasgow, Queen's Pk.	2·34	59	119	*Wat.*	Waterford, Brook Lo.	2·29	58	90
,,	Greenock, Prospect H.	2·73	69	75	*Tip*	Nenagh, Cas. Lough	2·63	67	105
Bute	Rothesay, Ardencraig	2·84	72	95	,,	Tipperary	2·63	67	...
,,	Dougarie Lodge	2·42	61	...	,,	Cashel, Ballinamona	2·29	58	92
Arg	Ardgour House	4·99	127	...	*Lim*	Foynes, Coolnanes	2·72	69	111
,,	Manse of Glenorchy	2·72	69	...	,,	Castleconnell Rec.	2·54	65	...
,,	Oban	3·18	81	...	*Clare*	Inagh, Mount Callan	4·01	102	...
,,	Poltalloch	2·30	58	76	,,	Broadford, Hurdlest'n.	3·13	80	...
,,	Inveraray Castle	3·76	96	82	*Wexf*	Newtownbarry	...	...	...
,,	Islay, Eallabus	2·57	65	90	,,	Gorey, Courtown Ho.	1·86	47	85
,,	Mull, Benmore	3·90	99	...	*Kilk.*	Kilkenny Castle	1·92	49	88
Kinr.	Loch Leven Sluice	2·20	56	115	*Wic*	Rathnew, Clonmannon	1·59	40	...
Perth	Loch Dhu	4·45	113	94	*Carl.*	Hacketstown Rectory	1·95	50	74
,,	Balquhidder, Stronvar	3·10	79	69	*QCo.*	Blandsfort House	2·16	55	83
,,	Crieff, Strathearn Hyd	2·67	68	122	,,	Mountmellick	...	...	...
,,	Blair Castle Gardens	2·01	51	95	*KCo.*	Birr Castle	1·87	47	87
,,	Coupar Angus School	1·99	51	120	*Dubl.*	Dublin, FitzWm. Sq.	1·70	43	89
Forf.	Dundee, E. Necropolis	2·07	53	122	,,	Balbriggan, Ardgillan	1·71	43	86
,,	Pearsie House	2·75	70	...	*Me'th*	Drogheda, Mornington	1·14	29	...
,,	Montrose, Sunnyside	1·73	44	95	,,	Kells, Headfort	2·02	51	81
Aber.	Braemar, Bank	2·04	52	86	*W.M*	Mullingar, Belvedere	...	...	...
,,	Logie Coldstone Sch.	2·85	72	142	*Long*	Castle Forbes Gdns.	2·02	51	85
,,	Aberdeen, King's Coll.	2·44	62	131	*Gal*	Ballynahinch Castle	3·57	91	101
,,	Fyvie Castle	2·72	69	...	,,	Galway, Grammar Sch.	1·89	48	...
Mor	Gordon Castle	2·12	54	121	*Mayo*	Mallaranny	3·40	86	...
,,	Grantown-on-Spey	3·30	84	168	,,	Westport House	3·03	77	112
Na	Nairn, Delnies	1·15	29	77	,,	Delphi Lodge	5·43	138	...
Inv.	Ben Alder Lodge	2·85	72	...	*Sligo*	Markree Obsy.	2·65	67	100
,,	Kingussie, The Birches	2·02	51	...	*Cav'n*	Belturbet, Cloverhill	1·85	47	81
,,	Loch Quoich, Loan	6·00	152	...	*Ferm*	Enniskillen, Portora	2·30	58	...
,,	Glenquoich	4·57	116	70	*Arm.*	Armagh Obsy.	1·82	46	87
,,	Inverness, Culduthel R.	1·76	45	...	*Down*	Warrenpoint	1·98	50	...
,,	Arisaig, Faire-na-Squir	...	...	...	,,	Seaforde	2·10	53	80
,,	Fort William	4·49	114	101	,,	Donaghadee, C. Stn.	1·79	45	89
,,	Skye, Dunvegan	3·18	81	...	,,	Banbridge, Milltown	...	...	...
,,	Barra, Castlebay	1·42	36	...	*Antr.*	Belfast, Cavehill Rd.	2·49	63	...
R&C	Alness, Ardross Cas.	3·27	83	135	,,	Glenarm Castle	1·76	45	...
,,	Ullapool	2·36	60	...	,,	Ballymena, Harryville	2·05	52	78
,,	Torridon, Bendamph	4·47	114	86	*Lon*	Londonderry, Creggan	2·54	65	99
,,	Achnashellach	4·66	118	...	*Tyr*	Donaghmore	1·88	48	...
,,	Stornoway	2·32	59	77	,,	Omagh, Edenfel	2·15	55	82
Suth.	Lairg	2·41	61	...	*Don*	Malin Head	1·14	29	58
,,	Tongue Manse	1·91	49	73	,,	Dunfanaghy	...	...	...
,,	Melvich School	1·72	44	74	,,	Killybegs, Rockmount	2·84	72	79

Climatological Table for the British Empire, November, 1925

STATIONS	PRESSURE		TEMPERATURE							Rela-tive Humi-dity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Per-cent-age of possi-ble.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1014·3	− 0·3	60	24	45·0	36·3	40·7	− 3·3	37·8	91	6·3	38	− 18	12	2·6	30
Gibraltar	1014·6	− 3·4	76	45	64·0	52·6	58·3	− 2·2	52·5	83	6·3	501	+339	14	...	...
Malta	1012·4	− 4·1	75	51	69·3	60·5	64·9	+ 1·0	61·6	87	8·3	82	− 9	11	4·8	47
Sierra Leone	1012·9	+ 2·1	90	69	86·4	73·2	79·8	− 1·4	75·9	83	5·6	188	+ 54	14	...	...
Lagos, Nigeria	1010·3	− 0·5	91	72	88·3	75·4	81·9	+ 0·6	76·8	81	8·2	73	+ 7	7	...	...
Kaduna, Nigeria	1013·0	+ 1·7	92	...	89·4	...	...	...	...	...	3·0	13	+ 10	1	...	...
Zomba, Nyasaland	1009·3	− 0·3	92	61	86·5	64·9	75·7	+ 0·5	...	74	6·1	170	+ 30	11	...	...
Salisbury, Rhodesia	1008·4	− 0·7	91	53	84·3	59·5	71·9	+ 1·0	62·2	52	2·3	74	− 18	10	9·5	74
Cape Town	1016·0	+ 0·1	84	51	72·2	55·8	64·0	− 0·2	57·9	72	5·0	49	+ 23	9	...	...
Johannesburg	1013·1	+ 0·8	84	41	74·4	53·7	64·1	+ 0·7	54·6	59	4·2	102	− 6	13	8·2	62
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	94	35	84·3	52·2	68·3	− 0·1	57·7	55	3·3	43	− 15	8	...	...
Calcutta, Alipore Obsy.	1014·7	+ 1·4	87	58	82·6	65·5	74·1	+ 1·0	65·7	82	1·9	8	− 9	2*	...	...
Bombay	1011·7	− 0·3	93	71	90·5	77·1	83·8	+ 3·3	73·2	71	2·9	9	− 2	2*	...	...
Madras	1011·9	+ 0·6	88	63	83·9	72·8	78·3	− 0·6	74·7	85	6·7	422	+ 60	15*	...	...
Colombo, Ceylon	1010·0	− 0·1	89	70	85·9	73·6	79·7	0·0	76·7	76	8·0	640	+361	22	5·8	49
Hong Kong	1017·9	+ 0·3	83	61	76·9	68·6	72·7	+ 3·1	65·5	64	6·5	28	− 15	4	6·8	62
Sandakan	...	...	88	73	86·3	74·9	80·6	− 0·4	76·6	78	...	435	+ 62	19	...	...
Sydney	1017·2	+ 3·3	97	51	72·5	59·5	66·0	− 1·1	62·3	64	6·8	121	+ 49	11	7·0	50
Melbourne	1018·6	+ 4·4	97	42	70·7	51·3	61·0	− 0·3	55·8	60	6·6	51	− 5	10	6·3	45
Adelaide	1018·9	+ 3·8	105	44	79·7	56·0	67·9	+ 1·0	56·9	41	4·7	10	− 19	4	9·2	66
Perth, W. Australia	1017·7	+ 2·4	102	51	80·2	59·1	69·7	+ 3·7	61·5	53	3·9	6	− 14	4	10·1	74
Coolgardie	1016·5	+ 3·4	101	47	87·7	58·6	73·1	+ 2·3	58·9	42	3·4	15	− 2	4	...	...
Brisbane	1017·0	+ 2·5	86	53	79·0	63·4	71·2	− 2·4	66·6	65	5·8	217	+124	17	7·2	54
Hobart, Tasmania	1016·1	+ 6·7	84	38	64·9	47·4	56·1	− 1·1	50·3	61	7·4	19	− 45	11	7·6	52
Wellington, N.Z.	1011·7	+ 0·1	69	40	63·4	50·9	57·1	+ 0·3	52·7	66	5·8	40	− 48	15	7·3	51
Suva, Fiji	1015·0	+ 3·9	86	68	81·5	70·9	76·2	− 1·0	72·2	73	7·9	105	−137	18	...	...
Apia, Samoa	1011·0	+ 1·5	89	70	85·5	74·5	80·0	+ 1·3	76·8	74	6·4	211	− 25	17	5·5	43
Kingston, Jamaica	1012·5	+ 0·1	91	68	86·2	71·3	78·7	− 0·6	70·0	88	5·5	45	− 35	10	...	...
Grenada, W.I.	1012·5	+ 1·9	88	70	84·1	74·3	79·2	− 0·1	75·9	80	6·3	235	+ 27	18	...	...
Toronto	1017·6	+ 0·8	56	15	43·3	31·9	37·6	+ 1·3	33·2	84	6·3	93	+ 18	11	3·1	32
Winnipeg	1019·2	+ 2·5	58	−7	31·8	17·8	24·8	+ 4·0	20·6	85	5·1	6	− 18	6	3·9	43
St. John, N.B.	1015·6	+ 1·7	55	2	41·3	28·7	35·0	− 1·7	31 9	85	5 0	100	− 12	10	4·4	46
Victoria, B.C.	1018·1	+ 2·6	55	35	48·5	41·0	44·7	+ 0·3	42·3	88	8·0	45	−119	20	2·7	29

*For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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The Polar Flight of the Airship Norge I.

THE landing of the airship *Norge I.* at Teller, Alaska, following her flight over the Pole from King's Bay, Spitsbergen, terminated successfully the Amundsen-Ellsworth Arctic expedition. The flight was undertaken with two main objects in view. The first of these was a desire to make an aerial survey of the extensive unexplored area lying between the Pole and Alaska, and the second was to provide an opportunity of obtaining meteorological observations over the polar basin. Such observations would have a certain value from the purely scientific point of view, and also from the standpoint of assisting in the determination of the extent to which the north polar regions might be utilised at certain times of the year as an air route to the Far East. On the other hand the value, from either standpoint, of results obtained from a single flight is limited. It is at present difficult to say to what extent the objects of the flight were achieved, but as Colonel Nobile, the designer and pilot of the airship, has recently remarked, "a new demonstration of aeronautics in the progress of civilisation has been made."

The *Norge I.* is an Italian semi-rigid airship, 325 feet long, designed by Colonel Nobile, who is in charge of the Italian Government Airship Factory, Rome. She has a capacity of 650,000 cubic feet, and is therefore small compared with existing rigid airships such as H.M. Airship R. 33. Her fuel capacity is such as to enable her to fly about 3,500 miles in still air, at a speed of about 50 miles per hour.

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The flight from Rome to Spitsbergen was undertaken in three stages: (1) Rome to Pulham, Norfolk; (2) Pulham to Leningrad, via Oslo; (3) Leningrad to King's Bay, Spitsbergen, via Vadsö in northern Norway (Fig. I.).

Rome was left at 9.30 on the morning of April 10th, after a delay due to unfavourable weather, for a strong mistral, which had been blowing during the two previous days, had rendered conditions unsuitable between Rome and southern France. There were two meteorologists on board, Professor F. Eredia, Director of the recently reorganised Italian "Forecasts Office," and Mr. F. Malmgren, of the Bergen Meteorological Institute, who was meteorologist to the expedition, and destined to accompany the airship across the Pole. Major G. H. Scott, the officer in charge of British airship flying, also accompanied the *Norge* on her journey from Rome to Pulham, giving Colonel Nobile the benefit of his wide and valuable experience of conditions in this region. During this stage, special meteorological information was passed to the airship, at first from the Air Ministry, London, and later from the Meteorological Office at Pulham, to assist in coming to a decision whether to land at one of several alternative aerodromes in France, or to make Pulham in one flight. From Rome to Toulouse a following wind was enjoyed, and by 10 p.m., about which time the airship reached Toulouse and headed for Rochefort, the wind in that region had become more definitely south-east, consequent on the eastward movement of an area of low pressure to the west of Spain. Very good progress was therefore made as far as Rochefort, a speed of 75 miles per hour with the wind being attained at times. At Rochefort a sharp turn north was made, and, as the wind had there become north of east and somewhat stronger, progress was for a time considerably impeded. However, as favourable wind conditions were forecast for housing the airship at Pulham, the flight was continued to that station. Pulham was eventually reached at about 3 p.m. on Sunday, April 11th. The landing, however, occupied over two hours owing to sudden changes in temperature resulting from alternations of sunshine and cloud, causing rapid variations in the lift of the airship, and thus rendering handling near the ground difficult. She was ultimately housed in one of the sheds at about 6 p.m. The distance of 1,400 miles from Rome to Pulham had been covered in approximately 30 hours at an average altitude of 1,000 feet.

At this stage the meteorological problem arising was that of forecasting a favourable opportunity for the airship to leave Pulham for Oslo and Leningrad, allowing suitable conditions for her to be moored to a mast at Oslo for at least 12 hours, and providing suitably light winds at Leningrad for landing and housing the airship. In order to provide the necessary forecasts, charts were drawn at Pulham to cover a very extensive area: northern and western Europe (including Russia), the Atlantic Ocean and America. A very suitable opportunity for undertaking the second stage of the flight was soon found, and as unfavourable conditions were seen to be approaching from the Atlantic, the occasion was utilised and the *Norge I.* left Pulham for Oslo at 11.40 p.m. on Tuesday, April 13th. Fog was encountered over the North Sea and over Denmark, proving some handicap to navigation, though not a serious one; Oslo was reached in the early afternoon of the 14th, and the airship was secured to the mooring mast for refuelling. The departure for Leningrad took place at 1.0 a.m. on the following morning, and apart from some further difficulties in navigation owing to fog, the flight was satisfactorily terminated at Gatchina Aerodrome, 35 miles south of Leningrad, at 7.30 p.m. in the evening of the same day.

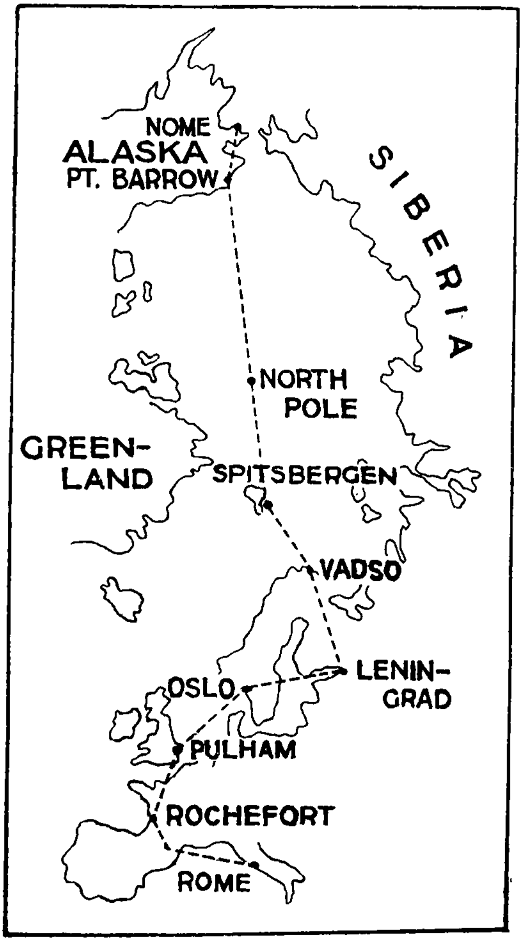


FIG. 1

The third and last stage of the flight from Rome to Spitsbergen could not be undertaken until all preparations for receiving the airship at Spitsbergen had been made. Leningrad was eventually left at 9.30 on the morning of May 5th, and with the assistance of a southerly wind current between an anticyclone centred over Spitsbergen, having an extension across the White Sea, and a shallow depression over southern Norway, Vadsö was reached at 4.30 a.m. on the following morning. The airship was moored there for refuelling, and left for King's Bay, Spitsbergen, at 2.30 p.m. in the afternoon of the same day.

Pressure was then high between the White Sea and Spitsbergen, and weather conditions appear to have been very favourable for this stage of the flight, which might quite well have proved the most difficult of all. King's Bay was reached on the morning of May 7th, and it was here that the expedition was joined by Amundsen and Ellsworth.

On the morning of May 11th, the *Norge I.* left King's Bay for her flight over the North Pole. Some fog was encountered near the Pole, which was reached at 1 a.m. on the morning of the 12th. Course was then set for Point Barrow, Alaska, which is approximately 1,300 miles from the Pole. From the Press accounts of the remainder of the journey, weather conditions then appear to have been somewhat adverse, considerable fog being met, which proved to be, indirectly, the most serious difficulty encountered. During the passage of the airship through a fog (or cloud), ice formed on the gondolas and rigging, causing an increase of weight. A further difficulty arose as this ice dropped off in pieces, and was caught by the propellers and shot up through the fabric of the ship. Loss of gas ensued, and although the holes made in the fabric were kept repaired, the airship became steadily heavier, and it seems to have been on this account that a landing had to be made at Teller, 60 miles north west of Nome, instead of at Nome itself. The flight from King's Bay to Teller occupied 71 hours, of which 25 hours were spent in reaching Teller from Point Barrow, owing to much fog and strong winds.

The voyage of the *Norge I.* has made flight by airship across the north polar basin an accomplished fact, and many valuable lessons have been learnt from it. From the meteorological standpoint, which is the main one in the problem of air navigation over Arctic regions, it would seem that the conditions obtaining over the Pole should, in many ways, be reasonably favourable, at any rate during certain seasons of the year. We may mention for example, that there is, firstly, practically a permanent inversion of temperature, which in calm weather is from the surface upwards to 1,500 to 3,000 feet, and during wind from something of the order of 500 feet up to 1,500 to 3,000 feet.* Secondly, there seems to be an almost complete absence of storms over the polar basin itself. "According to the *Fram* observations, the average maximum wind velocity in the polar basin proper was scarcely over 10 metres per second; only very seldom were velocities over 15-18 metres per second observed. In brief, the basin appears to be practically storm free. Cyclones appear to be phenomena of the rim of the basin rather than of its interior, penetrating the basin but infrequently."† The significance,

* SVERDRUP, H. U. The north polar cover of cold air. *M. W. Rev., Washington D.C.* 53 (1925), pp. 471-5.

† VARNEY, B. M. Meteorological conditions in the Eurasian sector of the Arctic. *M. W. Rev., Washington D. C.* Vol. 53 (1925), pp. 475-9.

from the point of view of airship navigation, of this second consideration needs no comment. The importance of the first lies in the fact that an inversion of temperature makes for stability in flight. If an airship, flying just on the top of an inversion, becomes suddenly heavy, due, say, to a fall in temperature of the gas, she will tend to lose height, but on doing so will, on account of the inversion, immediately encounter colder air, which will increase her buoyancy and restore stability. The converse effect will result if the airship should become suddenly light. The violent vertical air currents associated with thundery conditions, too, would be absent in the polar basin. Fog should not be a great hindrance to airship navigation in polar regions with the development of position finding by radio-telegraphy: in any case, it is only prevalent in the summer months, from about May until the end of September. The most adverse weather conditions, however, are likely to be met on the "rim of the polar basin," that is to say, between northern Scandinavia and Spitsbergen and along the north of Alaska (on the route traversed by the *Norge I.*), and it is difficult to imagine aviation being employed in the polar regions for many years for anything but exploration, the primary object of the present expedition.

It is to be hoped that the achievement of the *Norge I.* is only the first of a series of such enterprises to be undertaken with a view to obtaining further meteorological information regarding the polar regions. The publication of the meteorological observations taken on the *Norge I.* between Spitsbergen and Alaska will be awaited with interest.

S. P. PETERS.

Royal Meteorological Society

THE monthly meeting of this Society was held on Wednesday, May 19th, at 49, Cromwell Road, South Kensington, Sir Gilbert T. Walker, C.S.I., F.R.S., President, in the Chair.

E. S. Player.—Meteorological Conditions and Sound Transmission.

This paper first describes a series of observations made by the author at Joss Gap, near the North Foreland, during the years 1921-22, when the sound from the siren of the North Goodwin light-vessel was observed. The audibility of the siren showed very marked fluctuations, the changes sometimes occurring with great rapidity. The fluctuations were recorded by means of a galvanometer connected to a Wheatstone bridge, one arm of which consisted of a doubly-resonated hot-wire microphone.

The experiments show that acoustical conditions depend on wind, temperature and humidity, as might be expected from general considerations. The effect of wind depends on its direction: for example, if the wind increases with height, the wave front downwind is carried forward more rapidly at a height than it is at the ground, and, consequently, the sound keeps low; while upwind the effect is reversed, the sound being deflected upwards, and so lost. The effect of temperature may be deduced from the fact that sound travels faster in warm air than in cold air, so that temperature decreasing with height tends to deflect sound upwards, while temperature increasing with height deflects sound downward. The latter is thus more favourable for audibility along the ground. It was noted in the paper, and again brought up in the subsequent discussion, that as the effect of the changes of temperature with height is the same for all horizontal directions, if it reinforces the wind effect for sound travelling in one direction, it will oppose the wind effect for sound travelling in the opposite direction. The experiments showed that humidity is also a very important factor, and a diagram is given showing how, during the day, audibility would diminish as humidity diminished, and increase as humidity increased.

It is noted that the worst acoustical conditions occurred on days such as are usually described as "oppressive," during the warmer months of the year, when there is little or no wind, the sky is cloudless, but there is a considerable haze at an altitude.

During the summer of 1925 a series of flights by R.A.F. machines was organised for continuing the experiments, and observing the audibility from the ground of sources of sound in the air. Observations of the intensity of the sound from an aeroplane were made by ear and instrumentally, and it was found that the intensity varied very considerably, and, further, that good audibility from a height was not of necessity associated with good audibility along the surface. On occasions, as the aeroplane circled round, it appeared from time to time to pass into a well-marked silent zone. These 1925 experiments again showed the very marked effect of humidity. The measurements of audibility were compared with observations of temperature and humidity made by an observer in an aeroplane, and some remarkable observations of this nature are given in the paper.

In the course of the discussion which followed, the effects of variations of wind and temperature with height were elaborated, and emphasis was laid on the possible effect of sharp discontinuities in temperature and humidity.

J. Glasspoole, M.Sc., Ph.D.—The wet summer of 1924 *and other wet seasons in the British Isles.*

C. E. P. Brooks, M.Sc.—Pressure distributions associated with wet seasons in the British Isles.

In a paper read before this Society in February, 1922, some features of the remarkable drought of 1921 were discussed and compared with those of previous droughts in these Islands. The abnormal rainfall of 1924 provides an opportunity for a similar study of pronounced wet seasons. Maps are given of the rainfall (as a percentage of the normal) of other wet seasons over the British Isles since 1870, of from three to seven months' duration, together with brief notes of the rainfall distributions of the individual months of these wet periods. A list of the periods discussed in the paper is given below :—

April-Oct., 1924.	Nov., 1911-Mar., 1912.	April-Sept., 1879.
Dec., 1919-May, 1920.	April-June, 1907.	Nov., 1876-Feb., 1877.
July-Sept., 1918.	Jan.-Mar., 1903.	Sept.-Nov., 1875.
Nov., 1914-Feb., 1915.	April-Oct., 1903.	Sept., 1872-Jan., 1873.
Mar.-May, 1913.	Aug.-Dec., 1891.	Jan.-July, 1872.
June-Aug., 1912.	Sept., 1882-Feb., 1883.	

A comparison of the maps with those for dry periods indicates that while large deficiencies are confined mainly to the south and east of these islands, large excesses do occur in the north and west. The results of the present investigation form a basis for the comparison of current weather, and are indicative of the excesses likely to be experienced in the future.

The second paper discusses the average pressure distribution over the northern hemisphere during each of the wet periods enumerated above, from 1876 to 1924. The pressure distributions were represented as deviations from normal, and it was found that they fall into two clearly defined types :—

a. Greatest deficit of pressure over Iceland.

b. Greatest deficit of pressure over the British Isles.

The classification of the different periods was as follows :—

Type *a*.	Type *b*.	Intermediate.
Aug.-Dec., 1891.	Nov., 1876-Feb., 1877.	
Jan.-Mar., 1903.	April-Sept., 1879.	
Mar.-May, 1913.	April-Oct., 1903.	
Dec., 1919-May, 1920.	April-June, 1907.	
	Nov., 1911-Mar., 1912.	Sept., 1882-Feb., 1883.
	June-Aug., 1912.	
	Nov., 1914-Feb., 1915.	
	July-Sept., 1918.	
	April-Oct., 1924.	

Out of fourteen charts only one could be regarded as intermediate between the two types. With a pressure distribution of type *a* the south-west winds over these islands would be stronger than normal, giving more orographic rain on the western highlands, and in all the four periods classed as of this type the rainfall distribution was found to be mainly orographic. With a pressure distribution of type *b* there would be a tendency for depressions to pass directly across these islands, giving an excess of rainfall over the whole country (cyclonic type), and with the exception of April-June, 1907, all the periods with a pressure distribution of type *b* had this type of rainfall distribution.

The conditions in the Atlantic Ocean during and preceding these wet periods were then investigated. The conclusions may be summarised as follows :—

Conditions favourable to a wet period of the mainly orographic type :—

- North-east trade wind velocity below normal nine to twelve months before.
- South-east trade wind velocity below normal twelve months before.
- Pressure difference, Sydney (Nova Scotia) minus Ivigtut (Greenland), above normal three months before.
- Amount of ice near Iceland below normal during the wet period.

Conditions favourable to a wet period of the mainly cyclonic type :—

- Pressure difference, Sydney minus Ivigtut, above normal three months before.
- Amount of ice near Iceland above normal in preceding spring, but below normal during the wet period.

The weak north-east and south-east trades and the large pressure difference between Sydney and Ivigtut all contribute to a lower temperature in the North Atlantic, which may thus be the chief cause of a wet season in the British Isles. The part played by the Iceland ice is probably to determine the location of the greatest deficit of pressure.

Correspondence

To the Editor, *The Meteorological Magazine*

The Sunny South-West

An article on "Seasonal Sunshine in Great Britain," by Mr. Charles Harding, appeared in *Nature* of March 20th. The results are based on the 35 year mean 1881-1915. Comparing south-east England with south-west England and south Wales the writer says "The average sunshine for the year in south-east England is 4·49 hours a day, and in south-west England and south Wales, including the so called Cornish Riviera, it is 4·28 hours. In the winter south-east England has an average daily sunshine of 1·92 hours and in south-west England and south Wales the value is 1·91 hours a day; in spring the hours of sunshine for the two districts are respectively 5·50 and 5·36, in summer 6·88 and 6·41, and in autumn 3·46 and 3·31 hours."

An examination, however, of the Meteorological Office figures upon which these values are based, show that more sunshine is experienced in the south-west than in the south-east. This fact is hidden through the district being linked up with south Wales, which has different climatological characteristics. South-west

England and south Wales have now been made separate districts by the Air Ministry for forecasting purposes, but the original larger areas are still retained for climatological investigation. The counties included in south-west England have an area of 6,548 square miles, and those in south-east England 7,224 square miles. As these districts are situated in approximately similar latitudes there is but little difference between them for purposes of comparison of sunshine values. The addition of south Wales, however, with its additional 4,762 square miles of country brings the south-western district up to 11,310 square miles, and the lowering effect upon the sunshine values is apparent.

The results for south-east and south-west England are as follows :—

	South-east England.	South-west England.
Spring (Mar., Apr., May) ..	5·50 hours	5·66 hours
Summer (June, July, Aug.) ..	6·88 ,,	6·75 ,,
Autumn (Sept., Oct., Nov.) ..	3·67 ,,	3·68 ,,
Winter (Dec., Jan., Feb.) ..	1·92 ,,	2·01 ,,
Year	4·49 ,,	4·53 ,,

J. B. PHILLIPS.

The Observatory, Falmouth. April 28th, 1926.

Winter in Spain

HAVING just returned from a 5 months' visit to Barcelona, and having kept a daily record of the temperatures in that city from November to April, I submit the following data :—

Month.	Mean Max.	Mean Min.	Mean Temp.	Diff. from Average.
December..	56·2	47·5	51·9	+1·9
January ..	58·6	45·0	51·8	+3·8
February ..	62·3	49·3	55·8	+5·8
March ..	64·1	53·2	58·7	+6·0
April ..	67·3	56·4	61·9	+3·9
Averages ..	61·7	50·3	56·0	4·3

This shows a result much above the average, the latter being 51·73 only. There was no reliable record of rainfall, but it could not have exceeded 2½ to 3 in. during the whole period. There was a great excess of sunshine, but this was not recorded officially. Barcelona is considerably warmer than Madrid during the winter months, the mean isotherms being on a level with the south of Italy. Madrid has higher day temperature, but the nights are much cooler, making the range far greater there than at Barcelona : at the latter the cool winds and rain invariably come with a northerly current from the Pyrenees, and many mountains on this range were capped with snow at the end of April.

A. F. PARBURY.

Newbridge Road, Bath, Somerset. May 6th, 1926.

A Cloud Pendant at Eskdalemuir

ON April 20th a cloud pendant was observed to the south of the Observatory and appeared to be just over a mile away. It was first seen at 9.39 G.M.T. in the form of a funnel with definite edges (Fig. 1) linking the cloud to the top of the hills. This cloud was strato cumulus with a well defined base. The sky was

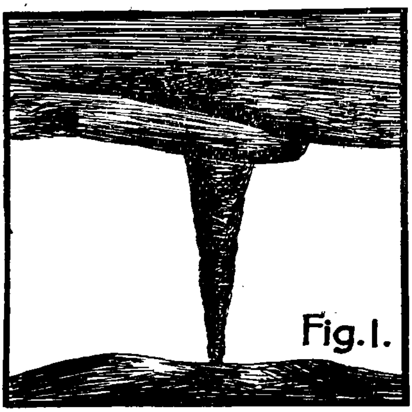


Fig. 1.

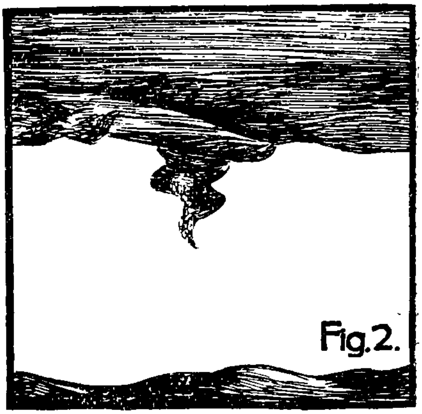


Fig. 2.

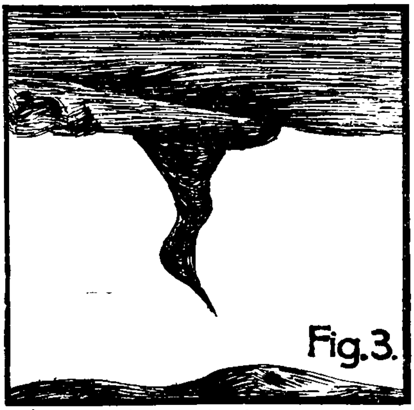


Fig. 3.

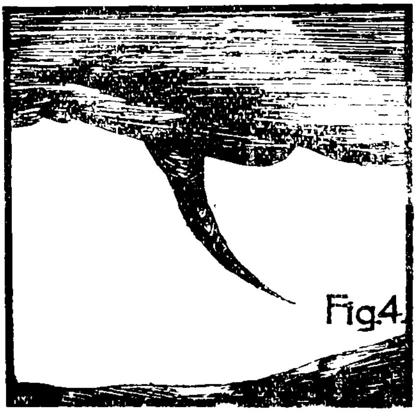


Fig. 4.

9/10ths clouded with strato cumulus moving from the north-west. The anemometer record for this period shows light north westerly airs to calm. The lower part of the pendant then left the hill and became very thin. Soon after, this bottom part or tail curled up as in Fig. 2 and swayed about like an elephant's trunk (Fig. 3). Presently it swayed into the direction of the wind (Fig. 4) and as it moved over the Esk Valley it gradually dwindled away.

It was seen by several people in the district. One farm-hand stated that it came within 2 or 3 feet of the ground (according to this man the distance between the base of the cloud and the ground was roughly 100 ft.) No rain fell from the pendant.

R. V. M. GARDINER.

The Observatory Eskdalemuir. April 27th, 1926.

Rare Halos

I was fortunate enough to witness a somewhat unusual halo this afternoon. At 14 h. 30 m. (G.M.T.) the sky was apparently clear except for detached cumulus, but close inspection showed a very tenuous sheet of cirrus spreading up from the south-west. The normal halo of 22° was clearly visible and brightly coloured, but inside it was a second halo having a radius of about 15°. This halo was also coloured, the red being nearest the sun as in the 22° halo. The two halos persisted and at the time of writing (19 h. 40 m.) they can still be distinguished even though the sun has set. At about 16 h., a third halo became visible outside that of 22°. It was colourless and had a radius of roughly 35°. The writer was careful to measure the radius as it was obviously not the halo of 46°.

Pernter and Exner* mention these halos as rarities.

At no time were any parhelia or tangent arcs visible nor was there any sign of the horizontal ring.

CHARLES LEAF.

7, Grange Road, Cambridge. April 16th, 1926.

[The coloured halo of about 15° radius is of extremely rare occurrence. Just as the 22° and 46° halos are produced by refraction at 60° and 90° refracting angles respectively, oriented for minimum deviation, so the 15° halo would be produced by refraction at a refracting angle of 45°. The origin of white halos is somewhat obscure, but they are considered to be produced by refraction and total reflection at the sides of the ice crystals.—ED. *M.M.*]

NOTES AND QUERIES

A Dragon's Tail

Mr. Joseph Clark, of Street, Somerset, sends us word that on April 7th, from 1.30 to 1.45 p.m., a " waterspout " was seen on the Polden range of hills, about 2½ miles from the observer, on the south side of the Wirral Hill, Glastonbury The main heavy mass of cloud from which the pendant came was travelling quickly from west to east. When first seen, the funnel-shaped

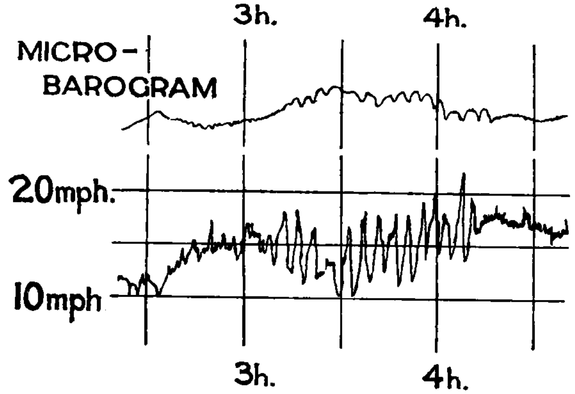
* PERNTER J.M., AND EXNER F.M. *Meteorologische Optik,* 2nd edition, Vienna and Leipzig, 1922, pp. 297-8.

pendant appeared to be touching the ground. Later this broke in two, but joined again. After about 8 to 10 minutes the pendant faded into the background. This type of cloud is known locally as a "Dragon's Tail," and Mr. Clark remarks that in a long life he has only seen four, the first one being pointed out to him as a boy about 74 years ago.

An example of stationary pressure waves at Holyhead

SOME interesting records of wave motion were obtained at Holyhead on the anemogram and the microbarogram of November 19th, 1925. Attention was directed to them by Mr. H. L. Pace, who is in charge of the meteorological station at Salt Island. The essential parts of the records are reproduced in the figure.

It will be seen that these outstanding oscillations, commencing almost abruptly at 3h. 11m., extended over exactly one hour, at the end of which time the effect could no longer be traced. If allowance is made for the time errors on the two charts, it is evident that the pressure and wind changes occurred simultaneously. During this interval of time fourteen complete oscillations can be traced, having a period of 4·3 minutes. Further, by taking the mean wind speed as 15 miles per hour, the wave length is found to be 1,900 yards. From the wind record it is also apparent that there is a secondary disturbance which has a period approximately four times that of the primary disturbance. At the time the disturbance commenced the surface wind was east, and backed slowly to east-north-east between 3h. 30m. and 3h. 50m., while just as these oscillations were dying out it commenced to veer again to east.



The general meteorological situation at the time was such that for a day or two an easterly wind current extended from western Germany across the northern Midlands, assuming a more southerly direction over northern Ireland. During November 18th, a separate centre of the anticyclone formed over southern Scotland, a light northerly wind current passing over the north of England, and showing also at Eskdalemuir at the 7h. and 18h. observations. A considerable number of pilot balloon ascents in the late afternoon of the 18th made it possible to examine the tracks of the air arriving at Holyhead at various levels. These agree in indicating that at almost all levels up to 6,000 feet the air must have crossed the north Midlands, Cheshire, the eastern Irish Sea, and thence passed over the Isle of Anglesey. It appears improbable that a track crossing the mountains of north Wales could have been followed, and that the waves were set up as a result of passing over this high ground.

The readings at Holyhead at 16h., November 18th, are singular in that there is distinct evidence of a light wind slightly east of north at about 2,500 feet, while both below and above that height the wind was stronger and almost due east. This effect was not observed at any other station, and was not found at Holyhead in the next balloon ascent made at 9h. on November 19th. The speeds and directions shown by the ascent at 16 h. are given below :—

Height.	Wind Speed (miles per hours).	Direction (degrees from North).
500 feet	15	85
1,000 "	12	85
1,500 "	7	65
2,000 "	7	25
2,500 "	5	38
3,000 "	9	85
3,500 "	15	94

Aeroplane ascents were made at Duxford on the mornings of November 18th and 19th, temperature inversions produced by subsidence being registered on each occasion with very dry air above the inversion. On November 18th at 10h. 45m. there was an inversion of 3·5° F. between 365 and 800 feet, of 1° F. at 2,400 feet, and of 2° F. at 5,200 feet. On November 19th at 10h. an inversion of 13° F. was found at 2,150 feet, and one of 1° F. at 6,900 feet. It seems unlikely that so large an inversion as 13° F. could be produced at Holyhead by 3h. of November 19th, but it is significant that the level of this inversion is approximately the same as that at which the different wind direction and speed were found at Holyhead.

It appears probable that the waves observed were set up at this surface of discontinuity. From the readings obtained in the pilot balloon ascent at Holyhead at 16h., November 18th, the surface was probably at a height between 2,500 and 3,000 feet, where the north wind dies out and is replaced by the east wind above it. Another point worth noting is that at a level of about 7,500 feet the wind is again north-north-east, and this height is comparable with that found at Duxford (6,900 feet) on the following morning for the second inversion of temperature.

This second surface of discontinuity may help to account for the feebler wave of longer period super-imposed on the main wave.

The striking fact with regard to these waves is that the formation of inversions is by no means an infrequent occurrence, and one might thus be led to expect evidence of them on the autographic records much more often than appears to be the case.

R. S. READ.

Memòires Patxot

TO encourage research in Physics and Mathematics principally in Catalonia, M. Raphaël Patxot i Jubert in 1922 and the following years has offered prizes for the best essays on certain subjects connected with Catalonia. The winning essays published by M. Patxot i Jubert are known as the Memòires Patxot. The subject chosen for the 1926 (the fifth) competition is a meteorological one, the title being " Météorologie de la Méditerranée Occidentale et plus spécialement de la côte Catalane." This time the competition is international, and the essays may be written in Catalonian, any one of the Latin languages, or in English. The prize offered is 5,000 pesetas. The competition closes on December 31st, 1927. Further particulars can be obtained from M. R. Patxot i Jubert, Rue de la Cucurulla, 1 and 3, Barcelona.

Weather in the Argentine

THE remarkably hot weather which prevailed in the middle latitudes of Argentina since the third week of December, 1925, terminated on the 9th of April when the advent of a high pressure system in the south (1,030 mb. at Port Madryn at 8 a.m. on the 9th) caused a rapid fall of temperature with the first snows of the season in Patagonia on the 8th. The mean daily maximum temperature of the first eight days of the month in Buenos Aires was 7·0° F. above the average of the 20 years 1906-1925, while the nocturnal warmth was even more marked, the mean of the minima being as much as 10·6° F. above the normal. It is worthy of note that the summers of 1924-25 and 1925-26 have been exceptionally hot in Buenos Aires. Taking the four months December to March, there was in 1924-25 a record excess of 3·8° F. in the mean temperature (mean of 24 hours), and in 1925-26 of 3·2° F. January of this year with a mean temperature of 77·7° F. shared with January, 1858, the distinction of being the hottest month in Buenos Aires during the 70 years 1856-1925. The month following with a mean of 77·0° F. constituted another record, for although the Februaries of the years 1925 and 1913 were slightly hotter than that of 1926 there was no previous instance of two consecutive months in Buenos Aires with a mean of 77·0° F. or above as has just happened. It is of interest to note that in both these hot summers the lines of temperature inversion on the Atlantic Coast were located a little south of Rio on the one hand and south of Santa Cruz on the other. The hot summer in Argentina has been associated with a remarkable fall in the River Uruguay which, at Paso De Los Libres (Lat. 30° S., Long. 57° W.) is lower than since the year 1877. On the other hand the river Parana at Rosario some 310 miles south west of Libres is in high flood, as are also some of the southern rivers.

R. C. MOSSMAN.

Climatic Fluctuations in China

Mr. Co Ching Chu has made a useful contribution to the subject of climatic fluctuations by a study of the weather records in the Chinese archives since the first century A.D. This study has been published in the *Geographical Review* for April, 1926. The most important results refer to variations of rainfall, for which his method is similar to that employed in discussing the long-period fluctuations of rainfall in the British Isles.* The numbers of records of floods and of droughts are tabulated for each century, and in order to eliminate the secular increase due to the greater frequency of records in more recent centuries, the ratio of droughts to floods is taken as the measure of dryness. Converted to the same measure of "raininess" as was employed for the British Isles, the figures give :—

Century	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
"Raininess" per cent. ...	34	38	11	33	20	23	43	36	36	37	49	36	49	31	34

It will be noticed that the figures are all below 50 per cent., indicating that drought is a greater enemy than flood in China, whereas in Britain the reverse holds. The figures point to a marked minimum of rainfall in the fourth century and to lesser minima in the sixth to seventh and in the fifteenth centuries, while there were maxima in the eighth, twelfth and fourteenth. The droughts of the seventh and fifteenth centuries are confirmed by records of extensive emigration at those times, due to pressure of population caused by droughts and famines. The author might also have remarked that the dry period from the fourth to the seventh centuries coincides with a long period of anarchy and general disruption in China.

Fluctuations of temperature are more difficult to determine, since there is no ready way of eliminating the secular increase in the number of records. The author tabulates the frequency of severe winters in China, and finds a maximum in the twelfth to fourteenth centuries. He compares these Chinese figures with

* *Meteor. Mag.*, 60 (1925) p. 108.

Brückner's data of severe winters in Europe, which show a similar maximum in the twelfth to fourteenth centuries, and points out that the Chinese records of sunspots also reach a maximum at the same time.

These data from the east of Asia do in fact add appreciably to the evidence in favour of world-wide climatic fluctuations during the historical period, by the remarkable agreement which they show with similar data from Europe. The latter may be represented by a curve of "raininess" published in 1925,* and obtained by tabulating the records of floods and droughts for western and central Europe from the beginning of the Christian era, and combining these figures with the available evidence of lake and glacier fluctuations, Alpine settlement, etc. This curve shows a maximum of rainfall in the second century A.D., pronounced minima in the fourth, sixth and seventh centuries, and a prolonged maximum from the beginning of the eleventh to the middle of the fourteenth century. The agreement between the major swings of the two curves is very close, and seems to show that there were real changes in the direction of greater dryness in the north temperate belt after the third century A.D. and back to increased rainfall in the eleventh to fourteenth centuries.

Smoke Trail behind Aeroplane

ON December 23rd, 1925, at 12h. 45m., while watching an aeroplane in which electrical heating experiments were being carried out, at a height of about 25,000 ft., Flight-Lieutenant Shales noticed that the aeroplane had a long following almost straight trail of steam or smoke, which became trumpet-shaped towards the end. The trail lasted about the same time as the smoke used for sky writing. It was not continuous but the longest clear length was about 50 times the length of the aeroplane and stood out white and clear against the blue sky. The day was fine, very cold and clear, with occasional cumulus cloud at a height below the aeroplane. Temperatures recorded on the same day and about the same time by other areoplanes were below —44° C. (—47° F.) at this height, and the cloud was due to the condensation of the water of combustion owing to the low temperature.

On January 4th, 1926, while flying the same aeroplane at a height of about 25,000 ft. at —42° C. (—44° F.) Squadron Leader Haig observed the formation of swirls of snowy mist from the exhaust. Alterations of the altitude control, to alter the mix-

* *Discovery, VI.*, (1925) p. 473.

ture, did not apparently alter the volume of the snow formation. The trail was not observed from the ground in this case as the aeroplane was above cloud.

Fifty Years' Observations

Mr. H. Mellish has included with his summary of "The weather of 1925, at Hodsock Priory, Worksop," tables of the mean and extreme values during a period of fifty years. Mr. Mellish started the station at Hodsock Priory in 1876, for the observation of rainfall, wind and cloud. When he joined the Royal Meteorological Society, in 1879, he extended the observations to include pressure and temperature, and in 1881 a sunshine recorder was added to the equipment. Now he has published tables giving means for all these elements for either 45 or 50 years, together with a brief description of the main features of the period. Throughout the whole of the time, Mr. Mellish has been personally responsible for the observations and we are sure that our readers will join with us in congratulating him on this long record.

Reviews

National Bureau of Standards, its functions and activities, Dept. of Commerce. Circular of the Bureau of Standards, No. I. Size 10×7, pp. v+113 (*illus.*). Washington, 1925, 50 cents.

This publication is intended to interest the general public of the United States in the work of the National Bureau of Standards, Washington. It is an interesting and well illustrated popular account of the functions of the Institute, and as such deserves notice on this side of the Atlantic as well as in America. The treatment of each individual section of the work is necessarily brief but nevertheless the book runs to over a hundred pages and includes nearly that number of photographs. As in most American publications of the kind, the printing and paper are admirable.

The Bureau of Standards was established by Congress in 1901 for the purpose of fulfilling the Constitutional authority to "fix the standard of weights and measures." The act of establishment gave the Bureau legal authority to fix standards of every kind necessary for modern commerce as well as to carry out any research work associated with its main functions. These terms of reference have been interpreted very broadly and the Bureau appears to be prepared to investigate any problem associated with standardisation, even in cases where the physicist is less concerned than the industrial psychologist. The Bureau has, for instance, standardised the cardboard boxes used for packing hosiery.

It will be realised that the functions of the Bureau extend beyond those of our own National Physical Laboratory, an institution which, in other respects, it closely resembles. In particular, the Director of the National Physical Laboratory is not the custodian of the British standard weights and measures.

To the meteorologist there is little of direct interest in this pamphlet, no description being given of the methods of test applied to meteorological instruments. The meteorologist is, however, interested as much as anyone else in the general question of precision and the methods of obtaining it. He will therefore peruse the book with considerable interest, wishing at the same time, perhaps, that something similar was available in connexion with the British counterpart of the Bureau.

E.G.B.

Graphic studies in Climatology. I. Graphic representation of a classification of climates, by J. B. Leighly, Univ. California Publications in Geography, Vol. 2, No. 3, pp. 55-71. Berkeley, California, 1926.

The comparison of climatological data in an easily understandable way is a problem which frequently confronts teachers and lecturers. Köppen's climatic formulæ would be admirable for the purpose, were it not that they are based entirely on numerical definitions ; for English readers they have the additional disadvantage that the original numbers when converted to English measures lose their simple character. The author has therefore devised graphical methods of representing Köppen's divisions ; he neatly describes his figures as the converse of climatological maps, representing the distribution of geographical areas within the frame of possible climatic variation.

Books Received.

India Weather Review. Annual Summary for 1923, pp. 263; Calcutta, Government of India Press, 1915, 12 rupees 8 annas. 20s.

News in Brief

Mr. G. B. Hamlin reports that during a thunderstorm at Burlow, Hellingly, Sussex, on May 22nd, the temperature fell 12° in less than 30 minutes.

The *Irish Times* states that a remarkable display of solar halos was discernible at Dublin on May 2nd. Most of the day the sky was covered with cirriform cloud, and between 5 and 6 p.m. a number of coloured intersecting circles developed, though, curiously enough, the 22 degrees primary halo was not produced.

Erratum

March, 1926, p. 39, line 17, *for* " altitude," *read* " latitude."

The Weather of May, 1926

THE weather of May was generally unsettled and cool during the first part, with a change to warm sunny conditions after the 20th. Easterly winds and fair to cloudy skies were prevalent during the first two or three days, but on the 4th the winds backed to north. Secondaries moving southwards in this northerly current caused showers of rain, hail, sleet and snow, and occasional thunder ; 28 mm. were measured at Brighton on the 5th, and, during a thunderstorm at Hampstead on the 7th, 11 mm. fell in 11 minutes. Screen minimum temperatures about 30° F. occurred at several places, and at a few northern stations the maximum temperature did not reach 50° F. during this period. Between the 9th and 14th a depression developing south of Iceland moved slowly south-east across the British Isles, causing a slight rise in temperature with the change in wind direction. Showers occurred at most places, but the amounts measured were small. Northerly winds were renewed in the west on the 12th in the rear of the depression, and later over the whole country. During the cold spell which followed, ground temperatures were slightly lower than during the first week, 15° F. being recorded at Rhayader on the 16th. Snow occurred in parts of Scotland and the south Midlands on the 14th. On the same day 46 mm. (1·81 in.) of rain were measured at Winchmore (Gloucester), 38 mm. (1·50 in.) at Tenterden (Kent), and, during a thunderstorm in and around London, 45 mm. (1·77 in.) fell at Hampstead, the largest amount recorded there in May since records began in 1910. Between the 16th and 20th the weather continued cloudy and cool, but on the 21st there was a considerable rise in temperature as a high pressure area became established over the country. Light variable winds with warm sunny weather and some local thunderstorms prevailed for the next four or five days, and maximum temperatures above 70° F. were recorded at many stations, 79° F. being reached at Camden Square, London, on the 26th. Meanwhile a fresh depression approached from the Atlantic, causing rain generally in the west on the 24th, which extended to the eastern districts on the 27th. Changeable weather with cooler westerly winds continued until the end of the month.

Pressure was above normal over Spitsbergen, Iceland, northern Scandinavia and the Iberian Peninsula, the excess being as much as 6·4 mb. at Spitsbergen, and below normal elsewhere in Europe and over the northern Atlantic. Temperature was generally below normal except in Spitsbergen and rainfall was above normal except in the extreme north and west. Much damage was done by storms and floods in central and western Europe during the first part of the month. Three people were

Continued on p. 124.

Rainfall: May, 1926: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square	2·30	58	131	*War.*	Birminghm, Edgbaston	3·87	98	181
Sur .	Reigate, Hartswood	1·49	38	88	*Leics*	Thornton Reservoir	3 80	97	189
Kent.	Tenterden, Ashenden	3·49	89	222	,, .	Belvoir Castle	3·07	78	145
,, .	Folkestone, Boro. San.	1·62	41	...	*Rut* .	Ridlington	2·47	63	...
,, .	Margate, Cliftonville	0·76	19	48	*Linc.*	Boston, Skirbeck	2·47	63	140
,, .	Sevenoaks, Speldhurst.	1·28	33	...	,, .	Lincoln, Sessions House	1·61	41	86
Sus .	Patching Farm	3·45	88	187	,, .	Skegness, Marine Gdns.	1·41	36	83
,, .	Brighton, Old Steyne	3·02	77	187	,, .	Louth, Westgate	2·73	69	135
,, .	Tottingworth Park	3·00	76	167	,, .	Brigg	2·00	51	107
Hants	Ventnor, Roy. Nat. Hos.	1·95	50	115	*Notts.*	Worksop, Hodsock	1·66	42	83
,, .	Fordingbridge, Oaklnds	1·98	50	95	*Derby*	Mickleover, Clyde Ho.	3·20	81	162
,, .	Ovington Rectory	2·14	54	99	,, .	Buxton, Devon. Hos.	4·13	105	133
,, .	Sherborne St. JohnRec.				*Ches.*	Runcorn, Weston Pt.	3·71	94	161
Berks	Wellington College	1·45	37	78	,, . .	Nantwich, Dorfold Hall	4·03	102	...
,, .	Newbury, Greenham	1·90	48	101	*Lancs*	Manchester, Whit. Pk.	3·37	85	159
Herts.	Benington House	·			,, . .	Stonyhurst College	3·57	91	125
Bucks	High Wycombe	2·69	68	153	,, . .	Southport, Hesketh	3·09	79	148
Oxf. .	Oxford, Mag. College	2·99	76	167	,, . .	Lancaster, Strathspey.	2·95	75	...
Nor .	Pitsford, Sedgebrook	3·29	84	172	*Yorks*	Sedbergh, Akay	2·87	73	90
,, .	Eye, Northolm	2·52	64	...	,, .	Wath-upon-Dearne	1·63	41	80
Beds.	Woburn, Crawley Mill.	2·38	61	123	,, .	Bradford, Lister Pk.	2·81	71	134
Cam.	Cambridge, Bot. Gdns.	2·05	52	116	,, .	Wetherby, Ribston H.	2·73	69	132
Essex	Chelmsford, CountyLab	1·05	27	73	,, .	Hull, Pearson Park	1·99	51	103
,, .	Lexden, Hill House	0·89	23	...	,, .	Holme-on-Spalding	1·70	43	...
Suff .	Hawkedon Rectory	1·67	42	90	,, .	West Witton, Ivy Ho.	3·32	84	...
,, .	Haughley House	1·00	25	...	,, .	Felixkirk, Mt. St. John	2·53	64	135
Norf.	Beccles, Geldeston	2·01	51	114	,, .	Pickering, Hungate	1·99	51	...
,, .	Norwich, Eaton	1·52	39	79	,, .	Scarborough	1·55	39	81
,, .	Blakeney	2·10	53	133	,, .	Middlesbrough	1·64	42	85
,, .	Swaffham	2·55	65	146	,, .	Baldersdale, Hury Res.	2·28	58	86
Wilts.	Devizes, Highclere	3·16	80	175	*Durh.*	Ushaw College	1·98	50	92
,, .	Bishops Cannings	3·51	89	180	*Nor* .	Newcastle, Town Moor.	3·29	84	162
Dor .	Evershot, Melbury Ho.	3·03	77	149	,, .	Bellingham, Highgreen	2·92	74	...
,, .	Creech Grange	2·51	64	...	,, .	Lilburn Tower Gdns.	2·43	62	...
,, .	Shaftesbury, Abbey Ho.	2·47	63	117	*Cumb*	Geltsdale	2·97	75	...
Devon	Plymouth, The Hoe	1·34	34	65	,, .	Carlisle, Scaleby Hall.	2·81	71	118
,, .	Polapit Tamar	1·11	28	55	,, .	Seathwaite M.	7·44	189	101
,, .	Ashburton, Druid Ho.	1·81	46	68	*Glam.*	Cardiff, Ely P. Stn.	2·47	63	99
,, .	Cullompton	1·91	49	88	,, .	Treherbert, Tynywaun	5·44	138	...
,, .	Sidmouth, Sidmount	1·00	25	51	*Carm*	Carmarthen Friary	2·64	67	96
,, .	Filleigh, Castle Hill	2·37	60	...	,, .	Llanwrda, Dolaucothy.	3·87	98	115
,, .	Barnstaple, N. Dev. Ath.	1·22	31	59	*Pemb*	Haverfordwest, School	2·30	58	92
Corn.	Redruth, Trewirgie	2·41	61	104	*Card.*	Gogerddan	2·64	67	100
,, .	Penzance, Morrab Gdn.	2·19	55	99	,, .	Cardigan, County Sch.	1·94	49	...
,, .	St. Austell, Trevarna	2·31	59	95	*Brec.*	Crickhowell, Talymaes	3·00	76	...
Soms	Chewton Mendip	3·27	83	118	*Rad* .	Birm. W. W. Tyrmynydd	3·54	90	103
,, .	Street, Hind Hayes	2·07	53	...	*Mont.*	Lake Vyrnwy	4·29	109	136
Glos. .	Clifton College	2·59	66	124	*Denb.*	Llangynhafal	3·13	80	...
,, .	Cirencester, Gwynfa	3·87	98	183	*Mer* .	Dolgelly, Bryntirion	3·47	88	105
Here.	Ross, Birchlea	2·43	62	114	*Carn.*	Llandudno	1·99	51	105
,, .	Ledbury, Underdown.	2·99	76	147	,, .	Snowdon, L. Llydaw 9	12·35	314	...
Salop	Church Stretton	3·60	91	140	*Ang* .	Holyhead, Salt Island.	2·18	55	111
,, .	Shifnal, Hatton Grange	3·00	76	146	,, .	Lligwy	2·83	72	...
Staff.	Tean, The Heath Ho.	·			*Isle of Man*				
Worc.	Ombersley, Holt Lock.	3·02	77	147		Douglas, Boro' Cem.	2·72	69	109
,, .	Blockley, Upton Wold.	4·35	110	202	*Guernsey*				
War.	Farnborough	2·71	69	121		St. Peter P't, Grange Rd	2·81	71	165

Rainfall; May, 1926: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	·			*Suth.*	Loch More, Achfary...	3·33	85	76
,, .	Pt. William, Monreith.	2·14	54	...	*Caith*	Wick	1·89	48	91
Kirk.	Carsphairn, Shiel.	4·52	115	...	*Ork.*	Pomona, Deerness	1·63	41	82
,, .	Dumfries, Cargen	·			*Shet.*	Lerwick	2·19	55	105
Roxb	Branxholme	2·46	62	109		———			
Selk.	Ettrick Manse	4·28	109	...	*Cork.*	Caheragh Rectory	4·11	104	...
Berk.	Marchmont House	1·95	50	79	,, ..	Dunmanway Rectory.	4·30	109	126
Hadd	North Berwick Res....	2·25	57	113	,, ..	Ballinacurra	2·27	58	96
Midl	Edinburgh, Roy. Obs..	3·33	85	178	,, ..	Glanmire, Lota Lo. ...	2·49	63	102
Lan.	Biggar	3·17	81	158	*Kerry*	Valencia Obsy.	4·33	110	137
,, .	Leadhills	6·59	167	...	,, .	Gearahameen	3·20	81	...
Ayr.	Kilmarnock, Agric. C..	2·79	71	121	,, .	Killarney Asylum.....	3·59	91	117
,, .	Girvan, Pinmore......	3·10	79	104	,, .	Darrynane Abbey	4·34	110	146
Renf.	Glasgow, Queen's Pk..	2·69	68	110	*Wat.*	Waterford, Brook Lo..	2·50	64	108
,, .	Greenock, Prospect H..	3·18	81	92	*Tip.*	Nenagh, Cas. Lough...	2·44	62	99
Bute.	Rothesay, Ardencraig.	3·01	76	99	,, .	Tipperary	2·66	68	...
,, .	Dougarie Lodge	3·59	91	...	,, .	Cashel, Ballinamona ..	1·95	50	81
Arg.	Ardgour House	4·91	125	...	*Lim.*	Foynes, Coolnanes	3·59	91	154
,, .	Manse of Glenorchy..	4·12	105	...	,, .	Castleconnell Rec.	2·53	64	...
,, .	Oban	2·79	71	...	*Clare*	Inagh, Mount Callan ..	4·40	112	...
,, .	Poltalloch	2·59	66	90	,, .	Broadford, Hurdlest'n.	3·41	87	...
,, .	Inveraray Castle......	4·37	111	111	*Wexf*	Newtownbarry	2·11	54	...
,, .	Islay, Eallabus.......	3·48	88	131	,, .	Gorey, Courtown Ho...	2·91	74	131
,, .	Mull, Benmore	6·10	155	...	*Kilk.*	Kilkenny Castle	2·33	59	106
Kinr.	Loch Leven Sluice	2·63	67	118	*Wic.*	Rathnew, Clonmannon	2·03	52	...
Perth	Loch Dhu	5·45	138	121	*Carl.*	Hacketstown Rectory.	2·18	55	84
,, ..	Balquhidder, Stronvar.	4·26	108	105	*QCo.*	Blandsfort House.....	2·99	76	123
,, ..	Crieff, Strathearn Hyd.	3·41	87	137	,,	Mountmellick	·		
,, ..	Blair Castle Gardens ..	2·86	73	141	*KCo.*	Birr Castle...........	2·57	65	115
,, .	Coupar Angus School..	2·19	56	90	*Dubl.*	Dublin, FitzWm. Sq...	2·28	58	111
Forf.	Dundee, E. Necropolis.	2·31	59	111	,, .	Balbriggan, Ardgillan.	1·79	45	86
,, .	Pearsie House........	3·18	81	...	*Me'th*	Drogheda, Mornington	·		...
,, .	Montrose, Sunnyside..	1·92	49	94	,, .	Kells, Headfort......	2·28	58	84
Aber.	Braemar, Bank	2·12	54	89	*W.M*	Mullingar, Belvedere.	2·29	58	94
,, .	Logie Coldstone Sch. ..	3·03	77	122	*Long*	Castle Forbes Gdns....	2·61	66	101
,, .	Aberdeen, King's Coll..	1·53	39	66	*Gal.*	Ballynahinch Castle ..	5·12	130	142
,, .	Fyvie Castle	2·50	64	...	,, .	Galway, Grammar Sch.	4·16	106	...
Mor.	Gordon Castle........	2·54	65	120	*Mayo*	Mallaranny..........	4·47	113	...
,,	Grantown-on-Spey....	2·24	57	96	,, .	Westport House......	4·18	106	147
Na.	Nairn, Delnies........	2·02	51	112	,, .	Delphi Lodge	6·56	167	...
Inv..	Ben Alder Lodge	3·81	97	...	*Sligo*	Markree Obsy.	4·20	107	150
,, .	Kingussie, The Birches	2·21	56	...	*Cav'n*	Belturbet, Cloverhill..	3·15	80	127
,, .	Loch Quoich, Loan....	5·10	130	...	*Ferm*	Enniskillen, Portora ..	3·45	88	...
,, .	Glenquoich	·			*Arm.*	Armagh Obsy.	2·79	71	117
,, .	Inverness, Culduthel R.	2·04	52	...	*Down*	Warrenpoint	1·91	49	...
,, .	Arisaig, Faire-na-Squir	·			,, .	Seaforde	2·50	64	95
,, .	Fort William.........	3·08	78	77	,, .	Donaghadee, C. Stn...	2·13	54	94
,, .	Skye, Dunvegan......	3·56	90	...	,, .	Banbridge, Milltown.	2·23	57	99
,, .	Barra, Castlebay	1·83	47	...	*Antr.*	Belfast, Cavehill Rd. .	2·81	71	...
R&C	Alness, Ardross Cas. ..	2·96	75	114	,, .	Glenarm Castle.......	2·39	61	...
,, .	Ullapool............	1·89	48	...	,, .	Ballymena, Harryville	3·48	88	122
,, .	Torridon, Bendamph..	5·04	128	111	*Lon.*	Londonderry, Creggan	5·36	136	147
,, .	Achnashellach	3·10	79	...	*Tyr.*	Donaghmore	3·21	82	...
,, .	Stornoway	3·45	88	135	,, .	Omagh, Edenfel	4·03	102	156
Suth.	Lairg	2·87	73	...	*Don.*	Malin Head	2·50	63	126
,, .	Tongue Manse........	2·08	53	87	,, .	Dunfanaghy	·		
,, .	Melvich School.......	2·62	67	128	,, .	Killybegs, Rockmount.	5·19	132	144

Climatological Table for the British Empire, December, 1925

STATIONS	PRESSURE: Mean of Day M.S.L. (mb.)	PRESSURE: Diff. from Normal (mb.)	TEMPERATURE: Absolute Max. (°F.)	Absolute Min. (°F.)	Mean Values Max. (°F.)	Mean Values Min. (°F.)	Mean Values ½ max. and min. (°F.)	Mean Values Diff. from Normal (°F.)	Mean Wet Bulb (°F.)	Relative Humidity (%)	Mean Cloud Am'nt (0—10)	PRECIPITATION: Am'nt (mm.)	Diff. from Normal (mm.)	Days	BRIGHT SUNSHINE: Hours per day	Percentage of possible
London, Kew Obsy.	1008·5	− 5·2	56	23	44·4	34·5	39·5	− 0·8	36·0	91	6·3	68	+ 10	16	1·7	21
Gibraltar	1020·3	+ 0·2	69	44	64·0	54·7	59·3	+ 3·3	54·7	86	7·5	176	+ 34	15	...	...
Malta	1019·8	+ 3·2	72	44	60·8	52·8	56·8	− 1·1	52·7	83	6·1	16	− 78	3	5·5	56
Sierra Leone	1012·8	+ 1·6	89	72	86·6	75·2	80·9	− 0·6	76·6	83	4·5	4	− 33	1	...	...
Lagos, Nigeria	1009·4	− 1·1	92	69	90·0	74·7	82·3	+ 1·0	76·8	84	7·4	0	− 21	0	...	...
Kaduna, Nigeria	1014·8	+ 2·0	91	...	87·9	...	...	...	...	...	3·9	0	0	0	...	...
Zomba, Nyasaland	1009·6	+ 0·4	93	61	83·5	65·5	74·5	+ 1·6	...	83	8·7	306	+ 34	19	...	...
Salisbury, Rhodesia	1008·8	+ 0·1	93	56	82·3	60·5	71·4	+ 1·5	64·4	64	4·5	72	− 74	11	8·2	62
Cape Town	1016·2	+ 1·8	101	50	76·5	57·7	67·1	− 0·5	59·7	70	4·6	6	− 16	4	...	...
Johannesburg	1011·1	+ 1·1	94	52	80·4	58·6	69·5	+ 4·4	57·7	58	4·7	84	− 39	11	9·2	67
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	101	47	91·6	57·9	74·7	+ 2·9	61·6	45	2·7	55	− 7	6	...	...
Calcutta, Alipore Obsy.	1017·2	+ 1·5	81	50	76·9	57·0	66·9	+ 0·4	57·0	81	3·6	0	− 5	0*	...	...
Bombay	1013·3	− 0·2	92	68	87·2	72·8	80·0	+ 2·5	67·7	67	2·8	0	− 1	0*	...	...
Madras	1014·4	+ 0·9	85	65	81·0	70·6	75·8	− 0·9	72·3	87	5·6	350	+202	13*	...	...
Colombo, Ceylon	1011·0	+ 0·3	90	71	86·9	73·4	80·1	+ 1·1	75·5	74	5·2	211	+ 79	17	7·6	65
Hong Kong	1021·5	+ 1·8	77	47	68·3	58·3	63·3	+ 0·3	54·7	55	6·1	6	− 23	4	5·9	55
Sandakan	...	...	86	72	84·5	74·9	79·7	− 0·4	76·7	83	...	628	+179	24	...	...
Sydney	1013·0	+ 1·0	104	56	77·5	63·3	70·4	+ 0·2	64·5	60	6·9	29	− 43	9	7·4	51
Melbourne	1014·5	+ 2·0	101	47	73·7	55·4	64·5	+ 0·2	56·6	57	6·6	9	− 50	7	7·1	48
Adelaide	1015·2	+ 2·0	110	47	83·3	58·5	70·9	− 0·3	58·5	43	4·1	5	− 19	4	10·2	71
Perth, W. Australia	1013·5	+ 0·3	98	53	80·4	62·3	71·3	+ 0·6	63·8	53	5·8	17	+ 2	7	8·0	56
Coolgardie	1011·3	+ 0·1	108	54	92·4	63·6	78·0	+ 2·2	62·1	40	2·3	51	+ 33	3	...	...
Brisbane	1012·8	+ 0·9	90	62	84·6	68·8	76·7	+ 0·2	70·8	65	5·4	157	+ 31	14	8·4	61
Hobart, Tasmania	1009·0	− 0·7	92	41	68·7	50·7	59·7	− 0·7	52·4	61	6·6	40	− 10	14	8·8	58
Wellington, N.Z.	1011·5	− 0·6	71	48	66·6	54·4	60·5	+ 0·2	56·1	66	6·2	54	− 27	11	7·3	49
Suva, Fiji	1011·4	+ 2·8	87	64	84·5	73·2	78·9	0·0	75·6	76	6·9	146	−162	13	...	...
Apia, Samoa	1007·3	− 1·1	88	72	84·6	75·2	79·9	+ 0·6	77·6	76	6·8	470	+124	21	5·1	40
Kingston, Jamaica	1014·0	0·0	89	65	86·4	68·8	77·6	− 0·1	64·7	74	2·8	21	− 20	5	...	...
Grenada, W.I.	1013·8	+ 1·9	86	70	82·9	73·8	78·3	+ 0·2	74·1	79	4·8	144	− 44	25	...	...
Toronto	1013·1	− 4·3	48	−14	31·6	21·3	26·5	+ 0·3	23·4	64	8·7	33	− 39	17	1·7	19
Winnipeg	1020·5	+ 2·6	43	−20	15·5	3·7	9·6	+ 3·9	...	...	6·2	16	− 8	11	3·3	40
St. John, N.B.	1007·2	− 7·0	48	− 7	30·1	15·3	22·7	− 1·7	20·3	67	6·4	83	− 23	10	3·6	41
Victoria, B.C.	1018·1	+ 1·3	53	37	47·3	36·5	41·9	+ 0·4	43·5	94	8·0	122	− 28	22	1·7	20

Climatological Table for the British Empire for the Year 1925

STATIONS	Pressure: Mean of Day M.S.L. (mb.)	Pressure: Diff. from Normal (mb.)	Temperature: Absolute Max. (°F.)	Temperature: Absolute Min. (°F.)	Temperature: Mean Values Max (°F.)	Temperature: Mean Values Min. (°F.)	Temperature: Mean Values ½ max. and min. (°F.)	Temperature: Mean Values Diff. from Normal (°F.)	Temperature: Mean Wet Bulb (°F.)	Relative Humidity (%)	Mean Cloud Am'nt (0—10)	Precipitation: Am'nt (mm.)	Precipitation: Diff. from Normal (mm.)	Precipitation: Days	Bright Sunshine: Hours per day	Bright Sunshine: Percentage of possible
London, Kew Obsy.	1014·5	− 0·9	87	23	56·8	43·4	50·1	+ 0·4	45·0	87	6·9	649	+ 43	164	4·0	31
Gibraltar	1018·1	+ 0·3	89	41	69·5	57·1	63·3	− 1·0	56·1	80	5·7	997	+ 88	75	...	...
Malta	1016·2	+ 0·3	102	43	70·3	61·1	65·7	− 0·4	60·7	78	4·7	543	+ 39	77	7·5	61
Sierra Leone	1012·7	+ 0·9	97	65	86·7	72·7	79·7	− 1·2	74·8	79	5·4	3561	−356	165	...	...
Lagos, Nigeria	1009·9	− 1·4	93	63	87·0	74·7	80·9	+ 0·7	75·5	80	7·8	1942	+122	116	...	...
Kaduna, Nigeria	1013·6	+ 1·2	99	...	87·2	...	...	...	...	...	2·0	1689	+439	123	...	...
Zomba, Nyasaland	1012·3	− 0·4	93	46	79·7	60·5	70·1	+ 0·8	...	84	6·8	1719	+322	153	...	...
Salisbury, Rhodesia	1012·6	− 1·0	93	34	76·5	53·6	65·1	− 0·2	58·1	64	3·7	1089	+281	117	8·0	67
Cape Town	1017·2	+ 0·4	102	37	72·0	54·7	63·4	+ 1·1	56·4	78	4·4	621	− 16	96	...	...
Johannesburg	1016·6	+ 0·1	94	28	69·5	49·3	59·4	− 0·1	50·7	66	3·8	826	+ 26	107	8·1	68
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	101	19	74·8	46·3	60·5	− 0·9	51·9	68	3·4	588	− 7	77	...	...
Calcutta, Alipore Obsy.	1007·6	0·0	103	47	87·2	71·1	79·2	+ 0·5	71·7	85	5·4	1508	− 81	88*	...	...
Bombay	1008·8	− 0·4	95	56	87·4	75·7	81·5	+ 1·0	73·1	74	4·2	1291	−542	65*	...	...
Madras	1008·8	0·0	104	60	90·6	74·6	82·6	− 0·4	75·0	76	5·2	1697	+408	66*	...	...
Colombo, Ceylon	1009·7	− 0·3	92	63	86·6	74·7	80·6	− 0·1	76·9	73	7·1	3148	+1042	205	6·7	55
Hong Kong	1012·6	0·0	93	40	76·2	67·7	71·9	− 0·3	66·3	72	7·1	2225	+ 93	128	6·0	5·0
Sandakan	...	...	92	71	86·8	75·1	80·9	− 0·4	76·3	81	...	3981	+933	176	...	...
Sydney	1016·2	+ 0·2	104	40	70·6	55·7	63·1	0·0	58·1	68	5·6	1279	+ 64	145	6·6	54
Melbourne	1017·0	+ 0·7	101	31	66·8	49·7	58·2	− 0·1	52·4	70	6·9	447	−200	144	5·6	45
Adelaide	1017·8	+ 0·7	110	36	72·2	52·8	62·5	− 0·4	54·1	57	5·7	555	+ 23	118	7·0	57
Perth, W. Australia	1017·1	+ 0·7	102	37	73·2	54·8	64·0	− 0·2	57·2	63	4·9	798	− 63	126	7·6	63
Coolgardie	1016·6	+ 0·6	108	32	76·3	51·9	64·1	− 0·4	53·3	54	3·6	401	+143	56	...	...
Brisbane	1015·8	− 0·1	106	37	76·5	59·6	68·1	− 0·8	61·7	67	4·7	1350	+195	138	7·3	61
Hobart, Tasmania	1014·1	+ 1·6	92	31	61·2	46·3	53·7	− 0·6	48·0	70	6·8	577	− 25	170	6·0	49
Wellington, N.Z.	1014·1	0·0	78	30	61·4	49·3	55·3	0·0	51·6	73	6·4	1327	+ 91	175	5·6	45
Suva, Fiji	1011·4	0·0	91	60	82·7	70·6	76·6	− 0·4	72·8	78	6·5	2710	−144	217	...	...
Apia, Samoa	1010·5	+ 0·2	90	67	85·0	74·1	79·5	+ 1·0	76·2	75	5·5	2631	− 83	181	6·6	55
Kingston, Jamaica	1013·7	0·0	94	62	87·4	70·2	78·8	− 0·5	68·9	81	3·9	474	−387	74	...	...
Grenada, W.I.	1013·7	+ 1·3	89	67	83·9	73·5	78·7	0·0	74·4	76	5·7	1618	−309	229	...	...
Toronto	1016·1	− 0·2	95	−14	53·8	37·8	45·8	+ 1·4	40·4	73	5·7	776	− 74	151	5·6	44
Winnipeg	1016·5	+ 0·2	93	−31	45·8	27·3	36·6	+ 2·3	...	...	5·3	407	−110	129	5·2	41
St. John, N.B.	1014·0	− 0·7	89	−19	48·3	33·7	41·0	− 0·2	37·0	77	6·2	1258	+ 38	166	...	...
Victoria, B.C.	1016·6	+ 0·2	95	31	56·6	44·3	50·5	+ 1·0	...	...	...	525	−302	142	6·1	47

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

Continued from p. 119.

killed in the storms which raged in the neighbourhood of Warsaw between the 1st and 3rd, and gales and torrential rains in northern Italy about the 15th caused several rivers, including the Po, to overflow. Milan and other towns were partly flooded. The worst floods since 1895 were reported from Nijni Novgorod and towns watered by the Volga, which burst its banks near Kostrema, say the reports, and spread for twenty miles across country. Serious floods have also occurred in France and western Germany, and there has been an abundant fall of snow in the higher districts of France and Switzerland. It is said to be 31 years since snow was seen in the region of the Côte d'Or at this time of year. Owing to the heavy rains, Lake Lugano rose 5 ft. in two days. After the 18th there was a general improvement in the weather over the whole of western Europe, but severe storms followed by floods were encountered in Yugo-Slavia and the Caucasus, between Tiflis and Mengliz, towards the end of the month.

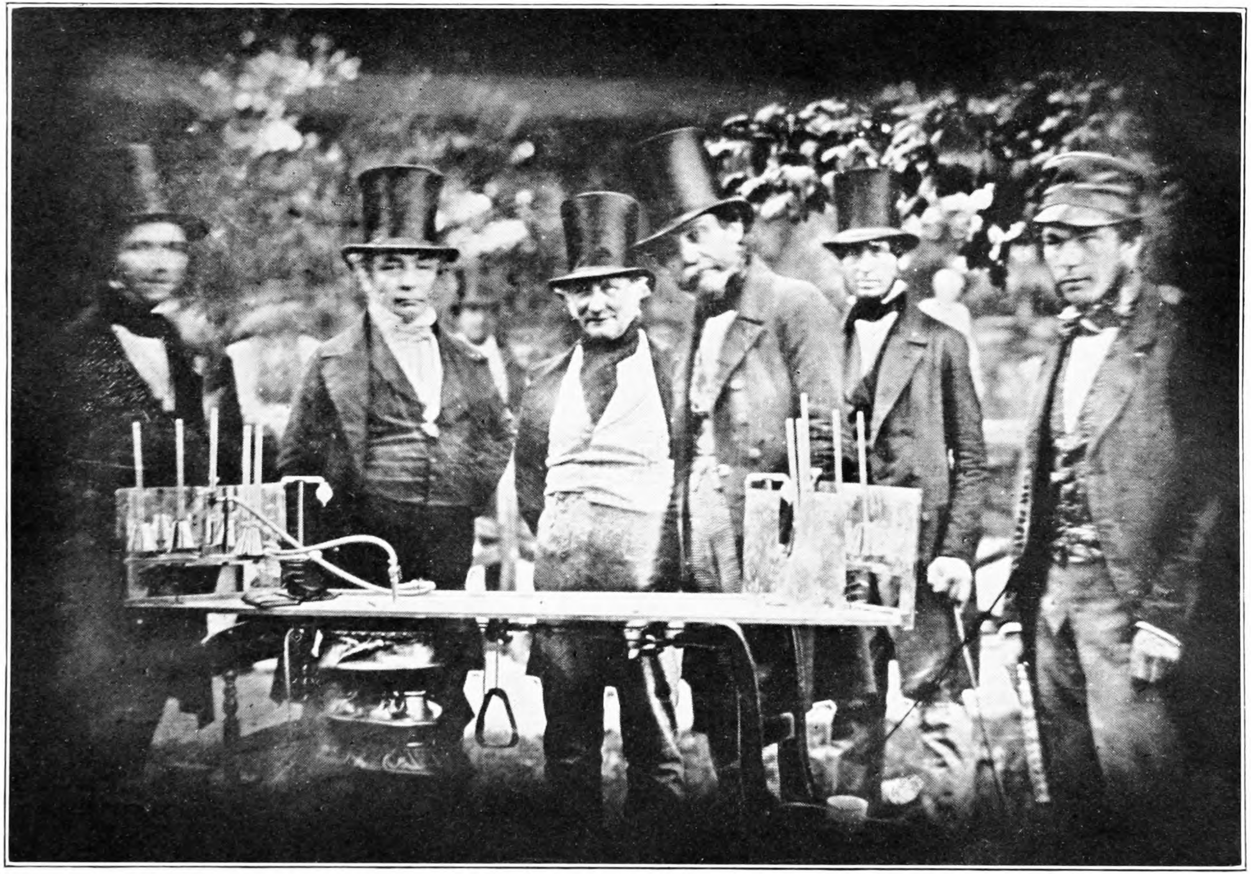
Heavy rain did considerable damage to houses in Aden on the 23rd, but the season is prosperous as there has been plenty of rain over the Yemen and the Hadramaut as well as in Somaliland. The heat wave under which Calcutta had suffered for some days was abruptly broken on the 24th by a severe cyclone which though it lasted only a few minutes caused the loss of several lives at Kidderpore docks and on the Hooghly. The same cyclone passed over Burma on the 25th and caused some loss of life and much damage in the Akyab district. A tidal wave swept up the Naaf river on the same day and it is feared that about 1,200 people were killed.

A large number of forest fires were raging in Minnesota. Wisconsin and Michigan on the 18th. Owing to a severe drought in the interior of Colombia, navigation in the Magdalena river is almost suspended.

The special message from Brazil states that the rainfall in the northern regions was scanty, being 33 mm. below normal, in the central regions abundant with 53 mm. above normal, and in the southern regions irregular in distribution with a total 44 mm. below normal. The atmospheric circulation was abnormal, the tracks of the anticyclones being limited to the interior of the country while depressions were active. The cotton, cane, tobacco and coffee crops were generally in good condition. At Rio de Janeiro pressure was 0·6 mb. above normal and temperature 0·4° F. below normal.

Rainfall, May, 1926—General Distribution

England and Wales ..	121	per cent. of the average 1881-1915.
Scotland	109	
Ireland	117	
British Isles	117	



Apparatus for Mr. Welsh's Balloon Ascents, Vauxhall Gardens, July, 1852

(See page 125)

Frontispiece

M.O. 284.

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LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE

To be purchased directly from H.M. STATIONERY OFFICE at the following addresses: ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 28, ABINGDON STREET, LONDON, S.W.1; YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF; or 120, GEORGE STREET, EDINBURGH; or through any Bookseller.

An Episode in the History of Kew Observatory.

By Sir NAPIER SHAW, F.R.S.

Mr. F. J. W. Whipple, Superintendent of Kew Observatory (Richmond), has found among the archives of the Observatory a photograph (see frontispiece), apparently a collodion positive, which is an interesting reminder of the activity of the Observatory in its early days. The photograph is dated July, 1852, and represents the paraphernalia for meteorological observations undertaken by J. Welsh, F.R.S., Superintendent of the Observatory, in the balloon ascents which were made from Vauxhall Gardens in 1852. Welsh had been appointed superintendent in that year, after two years' service in the Observatory as assistant. He succeeded Sir Francis Ronalds, who had been honorary superintendent from 1842, when the use of the building was granted by the Crown to the British Association for the establishment of a physical observatory, with the lofty idea of being in the van of progress in all such matters as the design and development of new instruments for meteorology, atmospheric electricity, terrestrial magnetism, including its relation to the sun, the variations of gravity, as well as the testing and certifying of all kinds of instruments for physical investigation.

We are somtimes inclined to think that ideas of progress in the investigation of the earth, the air and the sun are a special characteristic of the twentieth century. The following extract, from a memorandum which led to the acquisition of the Observa-

Wt 69—P 1 1000 6/26 M & C

tory in the Old Deer Park in Richmond, will deserve to be remembered, among other things, in 1942, when the celebration of the hundredth anniversary of what is " known by a misnomer of at least half a century's date as the Kew Observatory " will come due.

> " Among instruments which have been proposed, and which will probably not be constructed and brought into use without the assistance which an Institution like this alone can afford, may be mentioned : a universal meteorograph, which will accurately record half-hourly indications of various meteorological instruments, dispensing entirely with the attendance of an observer ; an apparatus for recording the direction and intensity of the wind simultaneously at various heights above the earth's surface ; an apparatus for telegraphing the indications of meteorological instruments carried up in balloons or by kites, to an observer at the earth's surface."

The balloon ascents at Vauxhall are sufficient indication that the aspirations of the memorandum were not disregarded, and perhaps the impression of vigorous activity might have been still greater if Welsh had not been the victim of tuberculosis at an early age in 1859, after testing marine barometers on voyages to Leith and the Channel Islands, setting up at the Observatory the standard barometers which are still there, Beckley's modification of Robinson's anemometer, De la Rue's heliograph, the recording magnetographs which have now been removed to Shetland, and having undertaken the magnetic survey of Scotland. "Well begun is half done," but, in the geophysical sciences, the other half is an arduous task. If to do were as easy as to know what were good to be done, Kew Observatory would have become for the average Londoner, as it is now for those who know something more than an island in the mid Surrey Golf course.

In the photograph Welsh is shown on the extreme right with headgear appropriate for ballooning. On a table in the foreground are the instruments to be used for determining the temperature and humidity of the air, provided with adequate means for securing efficient ventilation. Behind the table are members of the Kew Committee; on the extreme left Professor W. A. Miller, of King's College, London, whose celebrated book on chemistry was a source of inspiration to many students in the second half of the nineteenth century ; next to him, J. P. Gassiot, Chairman of the Kew Committee, who provided an endowment fund for the Observatory amounting to £10,000, when it had become the Central Observatory of the newly founded Meteorological Office under the Royal Society, and the British Association had withdrawn its grant in 1871. The fund is still in the possession of the Royal Society. Next again is Sir E.

Sabine, at that time sixty-four years of age, President of the British Association and Vice-President of the Royal Society, the leading geophysical spirit of the time. Next to him again, Colonel W. H. Sykes, " one of the members of the British Association Committee, almost its first chairman." Between these notable scientific authorities and Welsh is a Beadle of the Gardens.

We have no record of the balloon ascent on the occasion of the photograph, if the date, July, 1852, is correct. We learn that two ascents were reported to the British Association in that year : the meeting was held at the beginning of September, and might, therefore, have received the reports of two of the four ascents which are described in the *Philosophical Transactions* of 1853. The dates of the four are August 17th and 26th, October 21st and

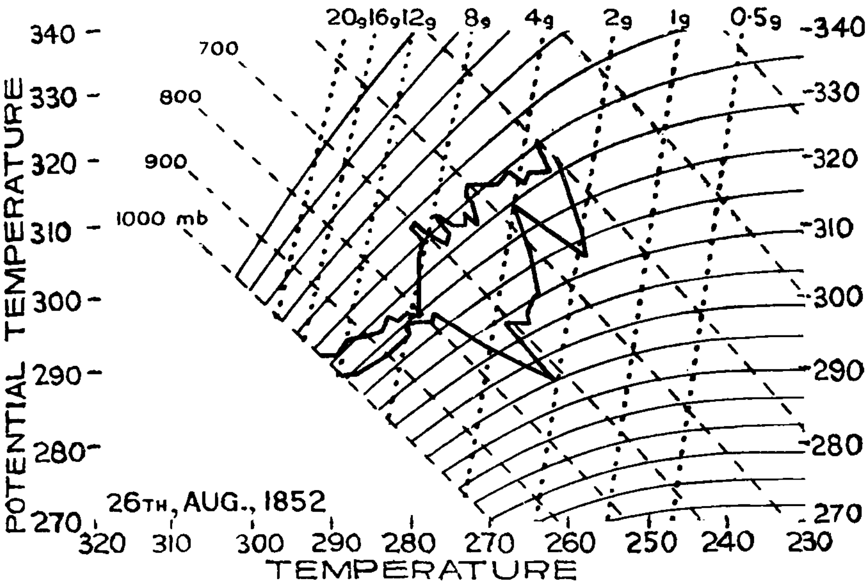

FIG. 1.

November 10th. The results are represented in engraved diagrams in the paper referred to. With the knowledge that is based upon recent experience, they must be pronounced remarkably good for records three-quarters of a century old; the provision for ventilation must have been quite efficient. The greatest height reached was 22,000 feet. On each occasion there was an inversion of lapse-rate of temperature below ten thousand feet. Welsh himself divided the graph of each ascent into two portions, nearly parallel in direction, but separated by a " discontinuity." The individual readings are very numerous and somewhat irregular, as one would expect, but the general run of the graphs is undeniable.

It is worth while to bring these results to remembrance. Two years ago I translated them into the language of the twentieth century and deposited a lantern-slide which expressed the results with the Royal Meteorological Society. In order to show the general character of the ascents, I have set out here that of August 26th (Fig. 1) as showing the most notable changes in humidity, and that of November 10th (Fig. 2), the highest ascent of the four, on forms which have been recently prepared for exhibiting the energy of dry or saturated air in relation to the conditions of the atmosphere disclosed by soundings. The lines of reference are temperature, measured along the horizontal from right to left, and entropy (or the logarithm of potential temperature) measured along the vertical from below upward: whence it follows that area on the diagram represents thermal energy.

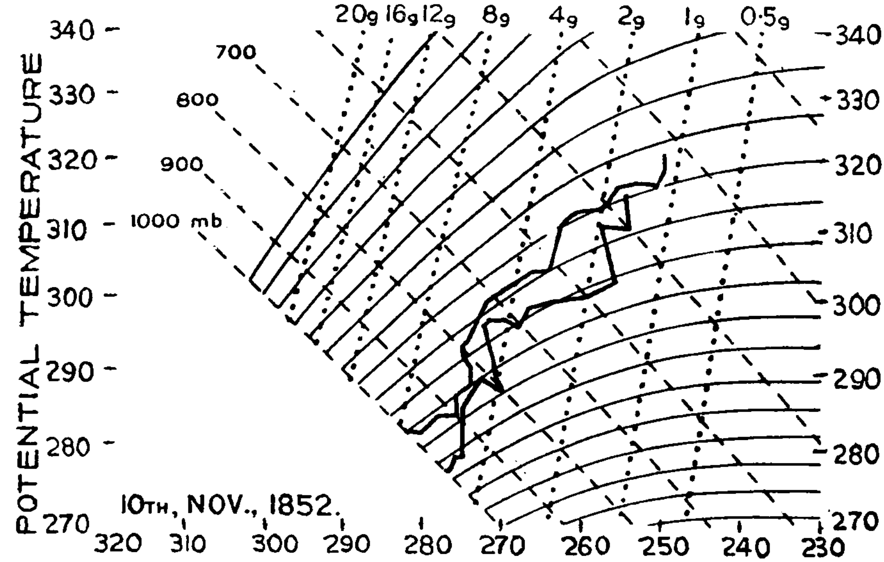

FIG. 2.

In the ground-work are lines of equal pressure, lines of equal vapour-content, and adiabatic lines, all for a saturated atmosphere. But whether the air be saturated or not, the conditions at each point of the ascent are represented with sufficient accuracy by the point on the graph which gives the appropriate temperature and potential temperature. The condition as regards humidity is indicated by marking the temperature of the dewpoint arrived at by moving parallel to a line of equal pressure. The dewpoint curve, called the depegram, is dotted.* Where it coincides with the full line, the tephigram, the air is saturated; where the two curves are widely separated the air is dry.

The graph for August 26th shows two main portions of notable

*The dotting of the original has disappeared in the reproduction. The dewpoint curve (depegram) is on the right of the temperature—entropy curve in each of the figures 1 and 2.

lapse-rate, the first from 1,000 mb. to 800 mb., and the second running very irregularly from 700 mb. to 500 mb. These are separated by an "isothermal layer" in which the humidity becomes very small, the dewpoint being as much as 18° C. (32° F.) below the air-temperature though it is nearly saturated on the 800 mb. line. Above the inversion, which is complete at 700 mb., humidity, after fluctuations, is shown increased until something near saturation is reached at 500 mb. The graph for November 10th is smoother and more regular: the tephigram resolves itself into three portions with considerable lapse-rate; 1,000 mb. to 850 mb., 750 mb. to 620 mb., and 550 mb. to 440 mb. Between these are the discontinuities of isothermal layer or inversion.

Apart from the irregularities which occur in readings, either of pressure or temperature, the curves are eloquent of the state of the atmosphere. We can look back on the period of Welsh's superintendence of the Observatory as one of much activity and infinite promise.

The Problem of Atmospherics

By E. G. Bilham, B.Sc., D.I.C.

Readers of the *Meteorological Magazine* will be familiar with the important and interesting work which Mr. Watson Watt has been engaged on under the auspices of the Radio Research Board. Apart from their practical importance to the radio engineer, atmospherics—those irritating extraneous noises which often seriously interfere with our efforts to hear broadcasting from distant stations—are clearly phenomena of direct meteorological interest, since there is a manifest, though not very simple, connection between their degree of activity and the weather. Early in the history of radio communication it was recognised that atmospherics were unusually numerous and violent when thundery conditions prevailed. Subsequent investigation has shown that atmospherics are not produced exclusively in regions where lightning is actually occurring, and the phenomenon is, in short, far more complex than at first seemed probable. The Meteorological Office initiated an enquiry into the possibility of locating distant thunderstorms by observing the apparent direction of arrival of atmospherics, as long ago as 1915. Work on this and cognate problems has engaged the attention of Mr. Watson Watt continuously since that date, with very conspicuous success.

The paper* now under notice deals with a form of recorder in

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* The Directional Recording of Atmospherics, by R. A. Watson Watt, *London, J.Inst. Electr. Engin.* 64 (1926), pp. 596-610.

which the direction of each disturbance affecting the apparatus is registered automatically. Briefly, the instrument consists of a large frame aerial rotated continuously about a vertical axis by clockwork. The recording drum is rotated at the same speed as the frame, and is also given a vertical movement by means of a lead-screw. A fixed pen would therefore inscribe upon it a helical trace which, when developed by spreading the paper out flat would appear as a series of parallel straight lines. The recording pen is actuated by an instrument known as the Abraham-Block oscillograph, and makes a short vertical excursion when the aerial picks up a disturbance. The record therefore takes the form of a series of parallel lines crossed by short transverse marks whose length is a rough measure of the intensity of the disturbance. On account of the directional properties of the frame aerial the response to disturbances originating in a given azimuth is a maximum when the plane of the aerial is in that azimuth, and a minimum when the aerial is at right angles. An inspection of the trace, therefore, permits of the azimuth of the main streams of atmospherics being identified. The ordinary ambiguity of 180° in the sense of the direction is present, but some determinations have been made simultaneously with an unambiguous recorder as a result of which it has been possible to discriminate, to some extent, between the two alternative directions indicated by the traces.

The records obtained in this way have been reduced in considerable detail, and the resulting data have yielded much interesting information. In the paper the results relating to the diurnal variation of intensity and direction are given in full. During the months September to February, the diurnal curve of intensity at Aldershot takes a fairly simple form, high values prevailing during the night and low values during the day, the principal minimum occurring before noon. The remaining months show the development of another maximum during the afternoon. There is a close correlation between the time of incidence of the stationary points on the curves and the times of sunrise and sunset. The principal maximum occurs six hours after sunset, and the principal minimum four hours after sunrise. The curves also indicate the existence of a small secondary maximum one hour before sunset.

It should have been mentioned that similar recorders were running during 1924 at Lerwick, Aboukir and Bangalore, as well as in the south of England. As might be expected, perhaps, the diurnal curve of direction of arrival of the principal stream of atmospherics shows considerable variation from station to station, but it is possible to draw some general conclusion which the author expresses as follows : " Early in the morning—sometimes in fact, before midnight—atmospherics arriving from the far east, where the sun has already attained some considerable altitude, begin to show themselves. Towards 9 h. or 10 h. G.M.T. they have become the dominant stream, and arrive from a direction a few degrees south of east at the time of the autumnal equinox, and from nearly due south at the time of the winter solstice. In the equinoctial season the cum-solar swing of the hourly direction of arrival is very strongly marked, and in all cases the direction of arrival swings through south to a relatively constant south-west by west or west-south-west near midnight. This stream from the west usually remains the dominant stream until about 9 h., presumably because the American Continent produces atmospherics until late in its evening, while the Pacific is not an important atmospheric producing centre."

The location of atmospheric-producing centres by considering simultaneous records from two or more stations, is illustrated by two examples, from one of which, November 7th, 1924, a chart of isobars is reproduced. On this occasion the directions of arrival of atmospherics at Lerwick, Ditton Park, and Aboukir when plotted on a terrestrial globe intersected to indicate a source just east of Tunis. The successive hourly bearings over a period of 12 hours lay almost all along the meridian of 10° E., which coincided on the day in question with the trough of a shallow depression, in which, presumably, thunderstorms were occurring. On another occasion, records from Ditton Park and Lerwick were used to trace a thunderstorm all the way from Norway to the Black Sea. It is clear that Mr. Watson Watt has in his hands material which may be of very great value to meteorology, and we await with interest the further discussion of the data which he promises.

Official Publications

The following publications have recently been issued :—

A Short Course in Elementary Meteorology. By W. H. Pick, B.Sc. (M.O. 247).

This is the second edition of the earlier volume published in 1921, and represents a complete revision of the material, together with additional matter. For a review of the first edition, see the *Meteorological Magazine*, 57 (1922), p. 39.

PROFESSIONAL NOTES—

No. 44. *The Velocity Equivalents of the Beaufort Scale.* By G. C. Simpson, C.B.E., D.Sc., F.R.S. (M.O. 273*d*).

At their meeting in London in 1921 the International Meteorological Committee resolved " that Dr. Simpson should be asked to look into the matter of proposing a definite scale of equivalents between the Beaufort numbers and wind velocity in miles per hour and metres per second." The results of Dr. Simpson's investigation are set out in this *Professional Note.*

The necessity for such an investigation arises from the fact that at many telegraphic stations the wind velocity is obtained from an anemometer, but is converted into a Beaufort number before being telegraphed, and in the absence of a universally accepted scale of equivalents, different services report the same anemometer readings as different forces.

The two chief determinations of the velocity equivalents to the Beaufort Scale were made by the Deutsche Seewarte in 1898 and 1916, and the London Meteorological Office in 1906. These determinations, however, show considerable discrepancies, especially in the higher numbers. Above velocities of 12 metres per second the difference is always a whole Beaufort number, and at velocities higher than 16 metres per second it is often two whole numbers, the Meteorological Office scale giving the higher velocity equivalents.

The author points out that when a sailor makes an estimate on the Beaufort Scale he bases his estimate on the waves formed on the surface of the sea, on the amount of broken water, on the sound produced as the wind blows through the rigging and on the way his ship stands up to it. None of these effects depends on the position of the observer, therefore an observer on the bridge makes the same estimate as the man at the mast-head. The case is quite different when the velocity is measured, for the velocity of the wind depends on the position where it is measured. A careful examination of the observations employed in the two determinations leads to the conclusion that the differences are entirely due to the difference in the exposures of the anemometers. The instruments used in the Meteorological Office determination had unusually free exposures, whereas those employed in the Seewarte observations were much less free, hence the British anemometers would record a higher wind velocity for a given Beaufort number than the Seewarte anemometers. The two sets of equivalents, therefore, are appropriate to different types of exposure, and they probably represent the extremes likely to be met with in practice.

The conclusion is that " there is no unique relationship between wind velocity as recorded by anemometers and estimates made on the Beaufort Scale." A telegraphic code is recommended, in which the groups of velocities are so chosen that " the group corresponding with a given code number would be between the limits of the velocity equivalents found by the Meteorological Office and the Seewarte for the Beaufort number equal to the code number." The equivalents of the code numbers are not to be regarded as velocity equivalents of the Beaufort Scale, and in order to make allowances for the exposure of the different anemometers descriptions of the stations should be published.

Royal Meteorological Society

THE last monthly meeting of this Society for the present session was held on Wednesday, June 16th, at 49, Cromwell Road, South Kensington, Sir Gilbert T. Walker, C.S.I., F.R.S., President, in the Chair.

J. E. Clark, I. D. Margary and R. Marshall—Report on the phenological observations in the British Isles, 1925.

The phenological year December, 1924, to November, 1925, provided a striking illustration of the way in which a series of twelve months, including some extreme abnormalities, may be shown by the annual means as a normal year. December, 1924, and November, 1925, stand out as the mildest December and the coldest November for many years. The wetness of May was balanced by the drought of June. The year was exactly normal, both in temperature and in the mean date of flowering. Migrants were only a day late. The tree fruit was doubly hit. Early blooming after the warm winter exposed it to the inclemency of late April and May. Then June drought was fatal to young fruit set badly, and so also to later sown crops. Hay, early sown grain, roots, including potatoes, did pretty well where weather permitted fair harvesting, but sunshine after mid-July was lacking. Normal plant progress was uneven in various districts, the lines of equal departure from the phenological normals (" lines of equal unseasonableness ") showing that some districts were very early, others very late. The cuckoo was two days behind the swallow in south-east England, but ten days behind the swallow in Ireland; on the other hand, in passing northward, the cuckoo made up its arrears, and reached the north of Scotland a day early. As the result of articles in *Nature* a very gratifying response has been made to an appeal for closer international phenological collaboration, especially over Europe, where twelve organizations are concerned, extending north to Scandinavia, south to Italy, and east to Russia.

S. Morris Bower.—Report on Winter Thunderstorms in the British Islands from January 1st to March 31st, 1925.

The results of the thunderstorm census show that in 1925 February was the stormiest month in England and Wales, while January was most disturbed in Scotland and Ireland. The maps of winter thunderstorm distribution for England and Wales show that the stormiest areas were mainly on or near the south coast, especially the southern parts of Sussex and Surrey

Tables and maps are given in the report, showing the dates on which storms were observed and the areas visited, together with a map of the distribution during each of the months.

Edward Kidson, O.B.E., D.Sc.—Abnormal rates of ascent of pilot balloons in the lower levels of the atmosphere at Melbourne.

Observations extending from 1922-25 are discussed, and tables given showing respectively (1) rapid ascending currents in the atmosphere, and (2) low rates of ascent. These tables show that both rapid ascending currents and low rates of ascent most frequently occur in the months of September to February inclusive, that is, in the months when the land is warmer than the air and sea. The rapid ascending currents are encountered with the greatest relative frequency at 11h., and the least at 9h 30m. With the low rates of ascent the greatest and least relative frequency are at the same hours. It is suggested that the low rates of ascent are very largely the product of turbulence, the balloon being caught in the descending portions of eddy currents.

Correspondence

To the Editor, *The Meteorological Magazine*

The Green Flash

HAVING seen this to-night in greater perfection than ever before, it seems worth while describing the conditions.

At about 9.15 p.m. (summer time) the sky was very clear except for four or five narrow bands of stratus above the setting sun, which seemed half set behind the ridge two miles or so distant. Going up the hill caused the sun to rise above the ridge and showed it just touching a lower line of stratus. It was deep orange and decidedly bright for so low a position. Returning and facing the sun it was bright enough to be rather dazzling as one's eyes were kept on it.

As I reached the point where the stratus cloud and ridge nearly coincided, the chord visibly narrowed towards the vanishing point, became yellower for a brief instant before turning to an almost dazzling emerald green, which seemed to emit rays downwards in a semi-circle from the last fraction of the sun's disc. Not only was its brilliance greater than it has been my fortune to see it before, even at sea in the tropics, but, instead of being an instantaneous phenomenon, it lasted at least two seconds or even longer, almost as if it were disappearing behind two edges. Its duration was not quite so long as on the occasion reported to you a few years ago, when it was seen in a cleft between trees on the same ridge, but its brilliance was incomparably greater. This seems to me to have been due to the exceptionally clear night. The previous afternoon Epping

Forest, up to 14 miles distance, was visible from our office roof near Finsbury Square. The number of times we have previously seen so far in the five years we have been there is under five. The unusual visibility seems to have been widespread.

J. E. CLARK.

41, *Downscourt Road, Purley, Surrey. June 22nd*, 1926.

The Abnormal Spring of 1926

The following records taken in the screen at Ro Wen (4 miles south of Conway) show the warmth of April and the chill of May.

Mean Max. Temp. of the 7 days, April 1st to 7th ...	63·2°F.
Mean Min. Temp. ,, ,, ,, ,, ,, ,, ,, ,, ...	46·4°F.
Average of Max. and Min. ...	54·8°F.
Mean Max. Temp. of the 7 days, May 11th to 17th ...	52·7°F.
Mean Min. Temp. ,, ,, ,, ,, ,, ,, ,, ,, ...	38·7°F.
Average of Max. and Min. ...	45·7°F.
Mean Temp. of the whole of April	49·8°F.
,, ,, ,, ,, ,, ,, May	49·6°F.

The severe frost of May 16th, when the screen temperature fell to 28·8° F., caused great damage to potatoes, apples, pears, gooseberries, &c., and destroyed the young fronds of ferns and the leaves of oak, ivy, brambles and other plants.

A. WILSON.

Tiry-Coed, Ro Wen, Near Conway. June 5th, 1926.

	April.	May.
[Mean Temperature at Rhyl is ..	46·2	51·2
,, ,, ,, Llandudno is ..	46·8	51·8

Ed. *M.M.*]

The Cold Nights at Garforth

Miss Geake† has most unfortunately failed to observe a striking south-country parallel to Garforth in the matter of cold nights with respect to surrounding stations, viz., Wokingham, with a mean annual minimum of 38·4, or only +0·3 above that of Garforth.*

A couple of years or so ago, I made enquiries about this station at the Meteorological Office, but in consequence of its cessation, a really satisfactory solution could not be obtained. I suspected, however, that the cold nights at Wokingham were due partly to the fact that this town is in the heart of the sandy pine and heath country along the borders of Berks, Surrey and Hants, and also partly, perhaps, to the situation of the observing station in a hollow. To try and test these assumptions I made a special visit to Wokingham, and found that the town itself is in the midst of green pasture-land for the most part undulating

* *See Book of Normals*, Section I., p. 15.
† *See Meteorological Magazine* 61 (1926), p. 77.

with some deep wooded hollows. I had no idea where the former station was, and so could not proceed any further with the matter.

I think it is very likely, however, that radiation-cold, favoured by the abundance of semi-naked sand around Wokingham, would lower the minima near the town itself, even though the immediate surroundings are more fertile, whilst the deep hollows in question would provide for the other possibility which I mention. It is well known that, of all soils sand is the most favourable to extremes of temperature, and the maxima at Wokingham are quite high, comparatively.

The case of Wokingham is far more outstanding than that of Salisbury, to which Miss Geake refers, and if you can investigate the case more closely, I should be very glad. These local peculiarities never appear on generalized isothermal charts as determined by major geographical factors, but their existence should always be borne in mind.

L. C. W. Bonacina.

27, Tanza Road, London, N.W. 3. June 12th, 1926.

[The report of the inspector who visited the station at Wokingham in 1910 contains the following remark: "The low temperatures sometimes recorded at this station are probably right, as the idiosyncrasies of the minimum thermometers are clearly recognised and guarded against." The station was on Bagshot sands (the same formation as that which constitutes Hampstead Heath). It apparently lay on the southern slope of a coombe which opens to the westward and has a steep slope up to high ground, exceeding 300 ft., to the eastward. This exposure offers the possibility of accounting for the low minimum temperatures by the accumulation of cold air drainage in a hollow, but our correspondent's explanation of the cooling due to radiation from "semi-naked" sand is not excluded.—Ed. *M.M.*]

NOTES AND QUERIES

Comfort

One of the reproaches most frequently levelled against meteorologists is concerned with their treatment of statistics, especially in the domain of climatology. The climatological table in its standard form, with its columns of mean and extreme temperature, mean humidity, rainfall, days of weather, and wind direction gives a large amount of useful information in a small space, but it is stated—and with some truth—that it does not give a real picture of the "climate" of a place. The late J. von Hann was fully alive to this and he supplemented his statistical matter wherever possible with word-pictures of the weather quoted from residents of the regions described, but this is not a complete solution. One can at least compare the statistics from one place with those from another place and say that " A " is sunnier than " B " but has more north winds, but descriptions cannot be compared directly. What we require is some numerical index which will express the general climate of a place as a single figure on a scale, and various attempts at such a scale have been made from time to time. One of the difficulties is, of course, that different people look at climate from different points of view. The doctor regards the health value, either as a whole or from the point of view of various maladies, and he considers the needs of the individual. At the other extreme we have students of geographical history, such as Ellsworth Huntington, seeking for general causes and finding them in the different effects of various climates on the physical and mental energy of whole races of men and drawing charts of the distribution of " climatic energy " over the globe based on a simple formula. But the ordinary man, who is not ill and not addicted to self-analysis, requires something different, which may be termed the " comfort value " of a climate. " Comfort value," however, is hard to define and harder still to assess, as is shown by a symposium of " Papers on the Relation of the Atmosphere to Human Comfort," which was published in the *Monthly Weather Review* of the U.S. Weather Bureau for October, 1925.* Two quite different lines of attack are developed ; the first, in papers by C. F. Brooks and E. C. Donnelly, regards the cooling power of the climate as the main consideration, and the second, in papers by G. F. Howe, E. S. Nichols and J. Elmer Switzer, seeks a solution in the narrower definition of daily weather types.

In some early work on the subject, the human body was regarded as cooling by evaporation like a wet-bulb thermometer, and the readings of the latter instrument were employed as a test of the fitness of a climate for occupation by white men. Thus Griffith Taylor employed a " climagraph," in which the wet-bulb temperature for each month was plotted as the ordinate and the relative humidity as the abscissa. The effect is more complicated than this, however. Dr. Brooks describes the rate of cooling as a complex of the air temperature, wind velocity, rate of evaporation, intensity of radiation and clothing. The first two factors have been well studied by Dr. Leonard Hill with his katathermometer, but the others are largely unknown. Brooks gives a complicated formula representing the effects of temperature and wind, and Donnelly adds rather arbitrary terms for the evaporation and radiation, but the application of the latter's formula to the daily weather records at Los Angeles appears to give excellent results. The curves show that for most of the year

*Washington D.C., U.S.A. Dept. Agric. *M. W. Rev.* 53 (1925), pp. 423-437.

the cooling power "is just a little more than sufficient to compensate for the heat evolved by metabolism (of a man seated in the shade), thereby insuring comfort." The increased cooling power due to the evaporation of sweat would suffice to keep comfortable a tailor or shoemaker, but not a man sawing wood in the shade. A man in the sun, even if he be idle, would be uncomfortable during most of the year. These examples show very clearly the practical value of the formula, when it has been confirmed or improved by experience and further research.

The second line of attack has not yet got so far. The idea is to classify each day as one of a number of types, such as hot and rainy, or cool, fair and windy, according to its temperature, humidity, wind velocity and sunshine, but the number of proposed types varies enormously, G. F. Howe having 13 and E. S. Nichols as many as 720. The results can be expressed in tabular form, the more readily the fewer the types, and the tables provide ready answers to many questions about which the standard climatological table is blank, such as "Are the cold days always dry?" while the frequency of different types of weather can be charted to show variations from place to place. The next step would be to assign comfort values to the various weather types, but this is very difficult; in fact Donnelly tried to do so and abandoned the method in favour of direct calculation from a formula. Hence it seems that the further development of this interesting practical application of climatology is most likely to result from the statistical investigation of further experimental data. It may be found necessary to bring in other elements, such as atmospheric pollution, thunderstorm activity, the day-to-day variation, and even such elusive variables as the "comfort value" of different out-looks under various meteorological conditions. The final formula for the "comfort value" of a climate may present a fearsome appearance, but this will not detract from its value provided that the idea for which it stands is clearly understood.

An Early Meteorologist*

At the present time when French dynamical meteorology is advancing along new lines owing to the development of aeronautics, the Office National Météorologique de France has thought it right to bring before her modern meteorologists the important contributions made to their work by the French *savants*. A series of extracts from their memoirs dealing especially with meteorology and its relationship with aeronautics is to be published, of which those of Lavoisier (just issued) forms the first number. Other *savants* to whom French meteorologists are

* *Extraits des mémoires de Lavoisier concernant la météorologie et l'aéronautique.* L'Office National Métérologique de France, Paris 1926.

much indebted, whose memoirs are to be published are: Le Verrier, de Tastes, Teisserenc de Bort, Durand-Gréville. Lavoisier's memoirs, which are written in a very clear and easy manner, are not confined to one or two aspects of meteorology; they range from observations of the Aurora Borealis and reports on the construction of instruments, to theories on the formation and constitution of the atmosphere and rules for forecasting weather changes. In the last mentioned essay, written in 1790, he gives eight main rules for forecasting with the help of the barometer. After discussing the general movements of the air he adds that, with the help also of observations of the humidity of the air and the force and direction of winds at different heights, forecasts for one or two days in advance could almost always be made and that it would be possible to publish every day a forecast of much use to the general public. Three of his longest essays are devoted to a study of extreme cold experienced in the winter of 1776.

Rankin's Halo observed on May 16th

We have received from Mr. C. J. P. Cave a photograph of the double halo which was seen over a wide area of south-east England on May 16th. According to the particulars given in Mr. Cave's letter to *Nature* (June 5th, 1926, p. 791), the radius of the inner halo was $17\frac{1}{2}°$ to the inner edge and 21° to the outer edge; it is evidently Rankin's Halo, which is excessively rare, and has never been photographed before. It was hoped that it would be possible to reproduce this unique photograph in the *Meteorological Magazine*, but, unfortunately, it would not stand reproduction. It has been included in the Meteorological Office Album of photographs.

Some measurements were also made by Mr. F. Addey, at Lee, Kent, who found the radius of the inner halo to be 18° to the inner edge, and 21° to the middle of the dark band separating the two halos. He noted that the inner edge of each halo was red and the remainder colourless, and that they were not visible below the level of the sun.

This double halo was referred to on page 111 of the *Meteorological Magazine* for June, in which the date was inadvertently given as April 16th.

The Uppermost Regions of the Earth's Atmosphere

The 1926 Halley lecture, which was delivered at Oxford on May 5th by Dr. G. M. B. Dobson, constituted a brief survey of present day knowledge of the atmosphere at extreme altitudes. Our knowledge comes from a variety of sources. Observations of the aurora and of meteors occurring in these regions are used to give some indication of the actual state of the atmosphere at these heights. The aurora is most frequent at a height of about 100 km. (60 miles), and is considered to be due to an electrical discharge produced by ionisation of the atmosphere by charged particles shot from the sun. The spectrum of the aurora is a line spectrum which includes the lines of nitrogen, argon, neon, but the most intense line observed, of wave length 5,578 A° (green) cannot be attributed to any element. It is possibly due to a mixture of hydrogen and helium. No hydrogen lines have been observed in the aurora spectrum.

Observations of meteors have been used to calculate the temperature and density of these upper layers. Calculations tend to show that from 10 to 55 km. in temperate latitudes, the temperature continues at about 220° a, (—63° F.) but above 60 km. the air appears to be much warmer, and comparable with that at the earth's surface. This increased temperature is attributed to the formation of ozone by the action of the sun's ultraviolet radiation on oxygen. Ozone absorbs ultraviolet radiation strongly, but visible radiation only slightly, so that the higher layers containing oxygen will be warmed considerably. This increase of temperature above 60 km. may possibly be responsible for the bending downwards of sound waves which have reached these heights, and thus cause the " silent zones " associated with the propagation of sound waves from explosions.

Harmonies of Tone and Colour in Scenery

In the *Geographical Journal* for June, 1926, there appears from the pen of Dr. Vaughan Cornish an extremely interesting paper on " Harmonies of tone and colour in scenery determined by light and atmosphere." The paper is the result of an attempt, during a period of six years, to provide a scientific foundation for the æsthetic study of scenery. Examples are drawn from various parts of the world. The author considers that the scientific result exceeded his most sanguine hopes ; appearances which it was thought could only be described, can also be explained, and impressions supposed to be merely due to intellectual association, which is personal, can in many cases be traced to a more permanent and general origin in the habits and sensations of the eye. The paper is divided into five sections : 1. the relief of the land ; 2. vegetation ; 3. hoar frost and snow, with remarks on wind-blown sand ; 4. water ; 5. fog, aurora, cloud and clear sky.

Much of the material in the first section treats of the Swiss Alps, their changes in tone and colour under varying atmospheric effects, and at different hours of the day. Three varieties of atmospheric conditions are considered when treating of English plain scenery: the fine day with the air of polar origin; the misty day; and the anticyclonic type of fine summer weather.

Dealing with vegetation, the plane, birch, pine and palm trees are of singular merit from the author's point of view. The transparent lattice effects of the bare boughs of the plane tree in a foreground are noted as increasing the apparent magnitude of a background of buildings, the action being partly a stereoscopic one, and partly a tone contrast. Against the saffron or orange band of a fine-weather sunset the tracery of the bare birch gives one of the most charming effects of our open English winter. For a bolder silhouette of the evening sky, the pine is pre-eminent, at any rate, in northern latitudes, but there is no tree to equal the palm in the boldness of its silhouette, the most distinctive feature of sunset in the Tropics. The change of vegetation with change of season in the south of England is dealt with at some length.

Dr. Vaughan Cornish considers that the full beauty of hoar frost is admirably displayed by the climate of southern England, and we again find commendation of the birch and pine, the former under hoar frost conditions, and the latter under snowfall. A large measure of attention is directed to the variations in tone and colour to be found in the Swiss Alps in association with snow. Only at sunrise can desert scenery be said to be attractive, one of the cases in which the beauty of a landscape is not dependent upon an atmospheric veil, but upon the unveiling effect of clear air.

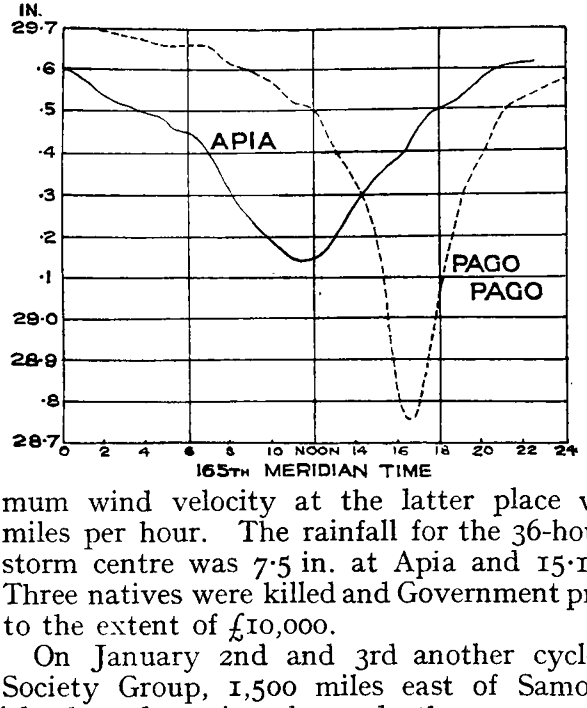
The enhancement of a scenic view when reflected in a lake is attributed to the fact that the whole of the reflection has the effect of being in one pictorial plane. No account is taken, here, of the possible effect of the light being polarized under such conditions. The rarity of the reflection of the sunset colours on the ocean is remarked upon. The sky is best mirrored when there is no ripple, and when there is sufficient sediment in suspense to make reflection mainly superficial. This effect is also to be noticed in certain rivers: personal experience brings to mind the contrast between the Thames and the Shannon, the former frequently reflects the sunset colours perfectly, the latter seldom.

Dr. Vaughan Cornish maintains that to appreciate the colours of an unclouded sunrise or sunset it is necessary to assume a recumbent attitude. The colour bands then appear longer, narrower, and more distinct, and new transitional tints are also revealed. This mode of viewing not only enables the effects of refraction to be seen in greater detail, but discloses more clearly the layered structure of the air.

S.C.R.

Tropical Cyclones

Two disastrous tropical cyclones visited Central Polynesia during the first week of the year 1926. On December 31st a cyclone developed north of the Samoan Islands (14° S. 172° W.) and travelled through the Group in a southeasterly direction, the centre moving at a rate of about 10 miles per hour. The lowest barometer reading at Apia Observatory was 29·14 in. (986·8 mb.), but at Pago Pago (Tutuila), 70 miles east-southeast from Apia, during the calm at the centre of the storm, it fell to 28·75 in. (973·6 mb.). The maximum wind velocity at the latter place was estimated at 80 miles per hour. The rainfall for the 36-hour period about the storm centre was 7·5 in. at Apia and 15·1 in. at Pago Pago. Three natives were killed and Government property was damaged to the extent of £10,000.



On January 2nd and 3rd another cyclone occurred in the Society Group, 1,500 miles east of Samoa, devastating four islands and causing eleven deaths.

ANDREW THOMSON.

Thunderstorms at Aguilas

The following summary of his study of the thunderstorms which have occurred at Aguilas, Murcia, Spain, during the last seventeen years (1909-1925) has been contributed by Mr. G. L. Boag.

TABLE I.—MONTHLY FREQUENCY OF THUNDERSTORMS.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Total (17 yrs.)	3	1	3	4	14	7	4	4	18	13	5	2	78
Mean ...	0·2	0·1	0·2	0·2	0·8	0·4	0·2	0·2	1·1	0.8	0·3	0·1	4.6
Percentage on year ...	4	1	4	5	18	9	5	5	23	17	6	3	100
Number with rain	3	1	3	3	10	3	3	2	16	13	5	2	64

It will be noticed that at Aguilas there are two yearly maxima of thunderstorms, the chief maximum in September and a secondary maximum in May. Of the years under consideration, 1914 and 1925 were those during which the most thunderstorms occurred, 9 in each, while in 1920 there were 8. The data are also tabulated according to the time of day at which they occurred (Table II.). In summer there is a well-marked maximum frequency in the late afternoon (16h–18h.), due to convectional thunderstorms. In winter the diurnal variation is less marked, the convectional maximum in the late afternoon persists, but there are also indications of a second maximum near midnight.

TABLE II.—HOURLY VARIATION IN RELATION TO MONTHS.

	1h-3h	4h-6h	7h-9h	10-12-h	13h-15h	16-18h	19-21h	22-24h	Total
Summer ...	3	3	1	8	5	17	7	7	51
Winter ...	3	2	0	3	3	9	2	5	27

Usually the thunderstorms were accompanied by slight rainfall, less than half an inch, but on fourteen occasions there was no rain at all, and on nine, more than an inch, the heavier rain occurring, with two exceptions, during the winter storms. Only on two occasions was the rainfall greater than two inches. On October 22nd, 1918, 2·47 in. was measured, and on October 30th, 1923, 3·83 in. Both these thunderstorms occurred at 17h. It is stated that " these storms invariably come drifting rapidly from the south-west direction and to seaward of mountain ranges running parallel to the coast." The record is of thunderstorms actually occurring, and does not include distant thunder.

Low Humidities in Northern Provinces of Nigeria

In summarising the meteorological returns received regularly from stations in the Northern Provinces of Nigeria, some very low humidities are found from time to time. The apparent dryness is rendered more remarkable by the fact that the hour of observation is 9h., and therefore not in the hottest part of the day. A selection of these low humidities recorded during the year 1925, and the early part of 1926, is given in the table, from which it will be seen that at Sokoto on March 1st, 1925, the difference between the dry and wet bulb readings was as much as 36° F. The relative humidities have been calculated from the *Tables for the Reduction of Meteorological Observations in India*, and on two occasions the calculated figures are as low as 2 per cent. It may perhaps be doubted if the formula which was employed in preparing the humidity tables is accurate for such very great differences between dry and wet bulb readings, but the fact that there are six values of two or three per cent.

and yet not a single observation which would give a negative relative humidity tends rather to support the accuracy both of the readings and of the humidity tables.

The stations at which these low humidities occur are in the north and east of the country, where the climate is semi-arid.

Date	Station	9 h. temperature		Relative Humidity	Max. Temp.	Wind	
		Dry Bulb	Wet Bulb			Direction	Force
		° F.	° F.	%	° F.		
1925, Feb. 11th	Kaduna Capital	74	49	5	88	NE	2
1925, Feb. 18th	Sokoto..	80	52	3	93	NE	6
1925, Mar. 1st ..	Sokoto..	95	59	2	104	NE	5
1926, Feb. 3rd ..	Kaduna Capital	74	48	2	86	E	2
1926, Feb. 7th ..	Yola ..	78	51	3	98	SE	2
1926, Feb. 22nd	Yola ..	80	52	3	100	SE	5
1926, Feb. 26th	Hadeija	83	53	3	95	E	2

The average annual rainfall is 25 inches at Sokoto and 39 inches at Yola, but it falls entirely between the middle of March and the end of October. The "winter" months are quite rainless, the sky is almost free from clouds, and the winds blow continuously from north-east, east or occasionally south-east, that is, out of the dry interior of Africa, and mainly from the Sahara. The north-east wind is the well-known dust-laden "Harmattan" which is analogous to the "Khamsin" of Egypt. Hence the air is very dry throughout the "winter," and when the country begins to warm up in February owing to the increasing altitude of the sun, the dryness becomes accentuated. The average relative humidity at Sokoto is as low as 26 per cent. in February and 28 per cent. in March, after which it increases rapidly to a maximum of 74 per cent. in August.

Reviews

Hygrometertafeln. Tafeln zur Bestimmung des Wasserdampfgehaltes der Luft, by Dr. J. N. Dörr, and Anleitung zur Behandlung eines Haarhygrometers und zur Verwertung für die lokale Wettervorhersage, by Dr. A. Schlein. Size 10×7, pp. 32, Vienna, 1925.

The last issue of hygrometric tables by the Austrian Central Institute for Meteorology and Geodynamics was the sixth edition of Jelinek's psychrometer tables, in which was included a set of tables by Pernter for the determination of vapour pressure from the indications of a dry bulb thermometer and a hair hygrometer. That issue, which was dated 1911, is now out of print, and the present work is published as the official hygrometric tables for use at the meteorological stations of the Central Institute, and for other purposes. The work contains no psychrometer tables, or tables for the reduction of dry and wet bulb readings; but it is assumed that humidity determinations will be made by means of the hair hygrometer. It is however understood that a new edition of tables for the determination of humidity from readings of the dry and wet bulbs is in preparation, so that it appears that both methods of humidity determination are officially recognised in Austria for use at climatological stations.

In the introduction to the tables the disadvantages of the psychrometer are referred to under three headings: (1) the unreliability of the wet bulb at temperatures below the freezing point; (2) the disturbing effect of wind; and (3) the effect of change of pressure, which is considerable in the case of high level stations. A remark made in 1783 by de Saussure is quoted: "After all other possible hygrometers have been tried, we shall always come back again to the hair hygrometer."

The advantages claimed for the hair hygrometer are that it remains unaffected by change of pressure, wind velocity and temperature. The well-known disadvantages of the instrument are described, and instructions for adjusting Lambrecht's polymeter, which is apparently the type of hygrometer in general use at the Austrian stations, are given in some detail.

The main table has two arguments:

(1) Values of relative humidity from 5 per cent. to 100 per cent., in steps of 5 per cent.; and (2) values of dry bulb temperature from $-35°$ C. ($-31°$ F.) to $+50°$ C. ($122°$ F.) in steps of whole degrees, half-degrees, fifths or tenths, according to the temperature.

The values for these two arguments are obtained by direct observation from the hair hygrometer and the dry bulb respectively. The body of the table is entered with the corresponding values of vapour pressure, expressed in millimetres of mercury. For the benefit of those who require vapour pressure to be expressed in millibars, a subsidiary conversion table is given. The values of saturation vapour pressure which have been used are those published by the Reichsanstalt in 1919. They extend from $+50°$ C. ($122°$ F.) to $-16°$ C. ($3°$ F.), but a further extension to $-35°$ C. ($-31°$ F.) was specially made for use in this publication by Dr. K. Scheel of Berlin. The vapour pressures at temperatures below the freezing point are, as is customary, those appropriate to a water, not an ice surface.

The tables are convenient in form, and are excellently printed on paper of good quality.

There are many who will wish to follow with interest the outcome of the decision to accept humidity determinations by hair hygrometer from ordinary meteorological stations. While wishing the venture all success, we hope that, in due course, a report on the matter will be published for the benefit of other meteorological services.

R.C.

Het Klimaat Van Nederlandsch-Indie. Sumatra. By C. Braak K. Magn. Meteor. Obs., Batavia, Verh. No. 8, Vol. II., Part 1. Size 11×7½, pp. v. +156 (Dutch) + 67 (English Summary). *Illus.* Batavia. 1925.

The first volume of *The Climate of the Netherlands Indies*, various parts of which have been reviewed from time to time in the *Meteorological Magazine*, forms a model of the general treatment of the climatology of an extensive area. According to the plan of the work, the second volume is to contain a detailed account of the local climatology, and the first part of this volume, dealing with the climate of Sumatra, which has now appeared, maintains the high standard which the author has set himself. The East Indies have a large output of agricultural produce, and climatological studies of this nature have a great economic value in guiding the cultivation of the land to the best advantage, but in addition there is abundant material which will be of service in studying the more purely scientific problems of the tropics, though, in these days of the study of world weather, no man can say where practical meteorology ends and academic meteorology begins. It may be remarked that this book would have been of great value a year ago, when the chances of the various sites in Sumatra for successful observation of the total eclipse of January 14th, 1926, were under consideration.

The variation of the different climatological elements is mainly related to the winds, which themselves present an interesting study. Sumatra is a long rather narrow island extending in a north-west—south-east direction, a mountain ridge near the western coast forming a backbone. This ridge interrupts the general flow of the monsoon winds, and at low levels the only important air movement is that due to the land and sea breezes or, in the interior, the mountain and valley winds. From May to September there is a powerful westerly air current between the levels of about 1,000 and 5,000 metres, while at greater heights there is a strong easterly current. Many of the mountain summits project into this westerly current. During these months pressure at sea level is generally higher to the west of the ridge than to the east, and at times the difference becomes accentuated, usually owing to a fall of the barometer on the eastern side. At these times the westerly current is apt to descend from 1,000 metres to the surface of the ground; on the western side this results in an increased rainfall, but in the east the air, descending the mountain slopes, forms a warm dry föhn-like wind, termed the "bohorok," very injurious to the tobacco plantations. When this wind sets in in the morning, it sometimes drives before it a layer of cold air from the mountain slopes, and the onset of the "bohorok" is marked by a cold gust.

Observations at high levels are surprisingly frequent, especially when we consider that the plateau climate of Sumatra is bleak and chilly, in fact, quite untropical, with a thin drizzle in place of the usual tropical showers, but the data are none the less welcome. The enterprise of the Netherlands Meteorological Service is shown by the fact that autographic instruments were maintained on the summit of Mount Singgalang, 9,440 feet high, and some specimen thermograms and hygrograms are reproduced. The summit of the mountain is often shrouded in mist for days at a time, and some of the hygrograms are of great interest, showing how the depression of relative humidity at midday gets smaller and smaller day after day as the misty weather sets in, until the hygrogram shows merely a straight line at the level of saturation. We shall welcome the later parts of this second volume, dealing with other islands of the East Indies.

Books Received

Nautisk-Meteorologish Aarbog, 1925. The Danish Meteorological Institute, Copenhagen, 1926.

Deutsches Meteorologisches Jahrbuch for 1914 *to* 1918 *and* 1924. Sächsische Landeswetterwarte, Dresden, 1925 and 1926.

News in Brief

It was announced in the list of Honours awarded on the occasion of the King's Birthday that a knighthood had been conferred on Col. H. G. Lyons, F.R.S., Director and Secretary of the Science Museum and Acting-Director of the Meteorological Office, May, 1918, to April, 1919; and that Dr. G. C. Simpson, C.B.E., F.R.S., Director of the Meteorological Office, had been made a Companion of the Order of the Bath.

Staff News.—Mr. Michael Sugrue, assistant at Valencia Observatory, retired on June 30th. Mr. Sugrue joined the Observatory staff on June 18th, 1874, so that his service with the Meteorological Office reached the remarkable length of 52 years. During this period he has served with every superintendent who has held office at the Observatory since its foundation, and from all of them he received praise for the quality of his work and his devotion to duty. The whole staff join in wishing him many years of well merited rest.

Mr. F. H. West, Observer at Weymouth, sends us word that a small tornado, a few yards wide, was experienced there at 10h. 55m. (G.M.T.) on Thursday, June 24th. Two tents on the beach were lifted up and the woodwork smashed, and people had to cling to the wall. The barograph at the observing station, however, was not affected.

The Weather of June, 1926

Unlike June, 1925, which was so remarkably dry and sunny, the weather during the greater part of June, 1926, was of an unsettled character, with much rain during the first three weeks, occasional thunderstorms, and day temperature more often below normal than above it. On the 1st a secondary depression began to develop off southwest England causing heavy rain that night in Devon and Cornwall, a gale near the Channel Islands on the following day, and much rain generally in southern England; 49 mm. (1·93 in.) were measured at Holne, Devon, on the 1st, and 37 mm. (1·45 in.) at Burgh Heath, Surrey, on the 2nd. The improvement in the rear of this depression lasted some days, and temperature rose well above 70° F. in many places on the 7th, 77° F. being reached at London (Camden Square). From the 8th to the 13th pressure was generally low over Ireland, while secondaries passed across England. Strong southwesterly winds were experienced on several parts of the coast, and attained gale force in northern Ireland and south Wales. Thunderstorms developed locally, and rainfall measurements exceeded 30 mm. at times in Ireland and northwest England, 76 mm. (3·00 in.) were measured at Delphi Lodge, Mayo, and 40 mm. (1·57 in.) at St. Michael's on Wyre, Lancs., on the 10th. Heavy rain fell again in northern England on the 14th and 15th, and in the southern part of the country about the 17th. At Norwich 13 mm. (0.52 in.) of rain and hail fell in about 5 minutes during a thunderstorm about noon on the 17th—many of the hailstones measured ½ to ¾ inch in diameter.

A marked improvement followed at the third week-end, temperature rising again above 70° at most places on the 19th, 20th and 21st (79° F. at Worksop, Nottingham and Kilkenny on the 20th). Subsequently high pressure extended from the Azores towards Iceland, giving cooler northerly winds for some days until near the end of the month, when the anticyclone moved east across the British Isles to the continent, causing a renewal of fine warm weather about the 27th. The total sunshine for the month was below normal in many parts, but the total rainfall varied considerably, being as much as 201 per cent. of the normal at Patching Farm, Sussex, and only 58 per cent. of the normal at Ledbury, Hereford.

Pressure was below normal in a belt extending over western and central Europe, the Azores, Newfoundland and southwest Greenland, and above normal over Iceland, east Greenland, Spitsbergen, northern Scandinavia, most of Spain and in the Bermudas, the greatest excess being 6·9 mb. at Jan Mayen. Temperature was generally below normal and rainfall above normal over Europe, except that there was a deficit of rain in north Sweden and Spitsbergen. Snow fell heavily in Switzerland and the Chambéry and Cantal regions during the first days of the month, and torrential rains caused serious floods in the northern part of Bohemia and much damage at Pantchevo (Yugoslavia) and Odessa. On the 13th a violent thunderstorm swept over southwest Switzerland for a distance of about 15 miles and a width of 1 to 2 miles. Three woods were destroyed, and many people injured by falling roofs and trees. Another bad thunderstorm was reported from central Switzerland on the 22nd. Reports on the 18th and 21st showed that the Rhine, Moselle and Elbe were rising and overflowing their banks. About the middle of the month the Volga floods, which, since April, have devastated great tracts all along the river, began to subside. Floods have also occurred in the Caucasus, and the floods of the river Euphrates have not abated much, large areas near Samawah being still under water. On the other hand drought prevails in the Kliva and Bokhara Oases. The irrigating canals are dry as the river Oxus is changing its course, and the crops are therefore suffering.

Early in the month a heat wave occurred in Egypt, a temperature of 115° F. being reported from Cairo on the 9th.

As a result of snowstorms in the Andes, railway traffic between Argentina and Chile was interrupted about the 13th. Owing to the bursting of the Coecillo Dam flood water from the San Luisite River swept through the valley, destroying half the town of Leon (Mexico) on the 23rd.

Violent earthquakes and many minor shocks occurred in many parts of the world during the month.

The special message from Brazil states that the rainfall over the whole country was rather scarce, being 43 mm., 26 mm. and 30 mm. below normal in the northern, central and southern districts respectively. The anticyclones followed the normal tracks for this month, while depressions were very active. The coffee, cane, tobacco, cocoa and vegetable crops in the centre and south were generally in good condition. At Rio de Janeiro pressure was 0·6 mb. below normal, and temperature 1·1° F. above normal.

Rainfall, June, 1926—General Distribution

England and Wales ..	125	per cent. of the average 1881-1915.
Scotland	122	
Ireland	114	
British Isles	122	

Rainfall: June, 1926: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square	3·27	83	162
Sur .	Reigate, Hartswood	3·51	89	180
Kent.	Tenterden, Ashenden	2·20	56	115
,, .	Folkestone, Boro. San.	2·84	72	...
,, .	Margate, Cliftonville	2·97	75	170
,, .	Sevenoaks, Speldhurst.	3·11	79	...
Sus .	Patching Farm	4·06	103	201
,, .	Brighton, Old Steyne	3·15	80	175
,, .	Tottingworth Park	3·93	100	187
Hants	Ventnor, Roy. Nat. Hos.	3·16	80	173
,, .	Fordingbridge, Oaklnds	2·91	74	157
,, .	Ovington Rectory	2·34	59	101
,, .	Sherborne St. John Rec.	...	..	...
Berks	Wellington College	2·63	67	121
,, .	Newbury, Greenham	2·62	67	121
Herts.	Benington House	3·66	93	178
Bucks	High Wycombe	2·84	72	146
Oxf. .	Oxford, Mag. College	2·49	63	117
Nor .	Pitsford, Sedgebrook	1·79	45	93
,, .	Eye, Northolm	...	..	...
Beds.	Woburn, Crawley Mill	2·47	63	126
Cam.	Cambridge, Bot. Gdns.	...	..	...
Essex	Chelmsford, County Lab	2·84	72	149
,, .	Lexden, Hill House	3·29	84	...
Suff .	Hawkedon Rectory	2·76	70	133
,, .	Haughley House	2·58	66	...
Norf.	Beccles, Geldeston	3·15	80	175
,, .	Norwich, Eaton	2·71	69	140
,, .	Blakeney	2·31	59	124
,, .	Swaffham	2·56	65	120
Wilts.	Devizes, Highclere	3·23	82	143
,, .	Bishops Cannings	2·52	64	104
Dor .	Evershot, Melbury Ho.	2·50	64	110
,, .	Creech Grange	3·41	87	...
,, .	Shaftesbury, Abbey Ho.	2·54	64	110
Devon	Plymouth, The Hoe	3·39	86	157
,, .	Polapit Tamar	2·80	71	130
,, .	Ashburton, Druid Ho.	4·85	123	190
,, .	Cullompton	3·04	77	143
,, .	Sidmouth, Sidmount	3·43	87	163
,, .	Filleigh, Castle Hill	2·34	59	...
,, .	Barnstaple, N. Dev. Ath.	2·19	56	98
Corn.	Redruth, Trewirgie	3·30	84	133
,, .	Penzance, Morrab Gdn.	2·73	69	123
,, .	St. Austell, Trevarna	3·57	91	137
Soms	Chewton Mendip	3·38	86	114
,, .	Street, Hind Hayes	3·22	82	...
Glos. .	Clifton College	1·63	41	66
,, .	Cirencester, Gwynfa	2·08	53	84
Here.	Ross, Birchlea	1·42	36	65
,, .	Ledbury, Underdown	1·31	33	58
Salop	Church Stretton	2·34	59	97
,, .	Shifnal, Hatton Grange	1·52	39	68
Staff.	Tean, The Heath Ho.	2·01	51	78
Worc.	Ombersley, Holt Lock	1·42	36	63
,, .	Blockley, Upton Wold	2·48	63	93
War.	Farnborough	2·77	70	116
War.	Birminghm, Edgbaston	1·39	35	60
Leics	Thornton Reservoir	1·93	49	89
,, .	Belvoir Castle	2·21	56	116
Rut .	Ridlington	2·14	54	...
Linc.	Boston, Skirbeck	3·36	85	185
,, .	Lincoln, Sessions House	2·70	69	133
,, .	Skegness, Marine Gdns.	2·67	68	148
,, .	Louth, Westgate	3·55	90	164
,, .	Brigg	3·77	96	180
Notts.	Worksop, Hodsock	2·50	63	126
Derby	Mickleover, Clyde Ho.	3·11	79	130
,, .	Buxton, Devon. Hos.	3·52	89	109
Ches.	Runcorn, Weston Pt.	1·73	44	67
,, .	Nantwich, Dorfold Hall	1·70	43	...
Lancs	Manchester, Whit. Pk.	2·04	52	77
,, .	Stonyhurst College	2·25	57	73
,, .	Southport, Hesketh	1·77	45	82
,, .	Lancaster, Strathspey.	3·10	79	...
Yorks	Sedbergh, Akay	3·39	86	102
,, .	Wath-upon-Dearne	3·26	83	147
,, .	Bradford, Lister Pk.	2·98	76	127
,, .	Wetherby, Ribston H.	3·61	92	172
,, .	Hull, Pearson Park	4·02	102	195
,, .	Holme-on-Spalding	6·47	164	...
,, .	West Witton, Ivy Ho.	2·40	61	...
,, .	Felixkirk, Mt. St. John	4·60	117	210
,, .	Pickering, Hungate	3·42	87	...
,, .	Scarborough	3·26	83	177
,, .	Middlesbrough	2·45	62	130
,, .	Baldersdale, Hury Res.	2·82	72	120
Durh.	Ushaw College	3·52	89	163
Nor .	Newcastle, Town Moor.	3·52	89	162
,, .	Bellingham, Highgreen	3·92	100	...
,, .	Lilburn Tower Gdns.	5·73	146	...
Cumb	Geltsdale	4·43	113	...
,, .	Carlisle, Scaleby Hall	3·50	89	139
,, .	Seathwaite M.	9·15	232	140
Glam.	Cardiff, Ely P. Stn.	1·80	46	72
,, .	Treherbert, Tynywaun	3·54	90	...
Carm	Carmarthen Friary	1·91	49	67
,, .	Llanwrda, Dolaucothy.	3·14	80	92
Pemb	Haverfordwest, School	2·44	62	90
Card.	Gogerddan	2·54	65	82
,, .	Cardigan, County Sch.	2·16	55	...
Brec .	Crickhowell, Talymaes	2·80	71	...
Rad .	Birm. W. W. Tyrmynydd	2·81	71	86
Mont.	Lake Vyrnwy	2·43	62	77
Denb.	Llangynhafal	1·64	42	...
Mer .	Dolgelly, Bryntirion	4·53	115	130
Carn.	Llandudno	1·47	37	72
,, .	Snowdon, L. Llydaw 9	...	..	...
Ang .	Holyhead, Salt Island.	1·38	35	64
,, .	Lligwy	2·21	56	...
Isle of Man				
	Douglas, Boro' Cem.	2·20	56	91
Guernsey				
	St. Peter P't, Grange Rd	3·98	101	215

Rainfall: June, 1926: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	1·59	40	65	*Suth.*	Loch More, Achfary	3·65	93	99
„	Pt. William, Monreith	2·24	57	...	*Caith*	Wick	1·54	39	86
Kirk.	Carsphairn, Shiel.	4·31	109	...	*Ork.*	Pomona, Deerness	2·21	56	120
„	Dumfries, Cargen	4·47	114	161	*Shet.*	Lerwick	1·41	36	79
Roxb	Branxholme	3·45	88	153		———			
Selk.	Ettrick Manse	5·45	139	...	*Cork.*	Caheragh Rectory	5·07	129	...
Berk.	Marchmont House	3·83	97	166	„	Dunmanway Rectory	4·23	107	121
Hadd	North Berwick Res.	2·86	73	172	„	Ballinacurra	2·73	69	105
Midl	Edinburgh, Roy. Obs.	2·95	75	160	„	Glanmire, Lota Lo.	3·67	93	136
Lan.	Biggar	3·03	77	147	*Kerry*	Valencia Obsy.	...	..	...
„	Leadhills	5·53	140	...	„	Gearahameen	3·30	84	...
Ayr.	Kilmarnock, Agric. C.	1·76	45	80	„	Killarney Asylum	3·92	100	135
„	Girvan, Pinmore	2·21	56	76	„	Darrynane Abbey	4·15	105	132
Renf.	Glasgow, Queen's Pk.	2·02	51	87	*Wat.*	Waterford, Brook Lo.	2·09	53	78
„	Greenock, Prospect H.	3·62	92	110	*Tip.*	Nenagh, Cas. Lough	2·75	70	112
Bute.	Rothesay, Ardencraig.	3·09	78	101	„	Tipperary	2·73	69	...
„	Dougarie Lodge	2·72	69	...	„	Cashel, Ballinamona	2·45	62	107
Arg.	Ardgour House	3·79	96	...	*Lim.*	Foynes, Coolnanes	3·93	100	152
„	Manse of Glenorchy	4·74	120	...	„	Castleconnell Rec.	3·53	90	...
„	Oban	3·08	78	...	*Clare*	Inagh, Mount Callan	...	..	...
„	Poltalloch	3·07	78	101	„	Broadford, Hurdlest'n.	3·57	91	...
„	Inveraray Castle	4·25	108	107	*Wexf*	Newtownbarry	...	..	...
„	Islay, Eallabus	3·30	84	126	„	Gorey, Courtown Ho.	...	..	...
„	Mull, Benmore	7·90	201	...	*Kilk.*	Kilkenny Castle	2·17	55	89
Kinr.	Loch Leven Sluice	3·50	89	160	*Wic.*	Rathnew, Clonmannon	1·72	44	...
Perth	Loch Dhu	4·95	126	119	*Carl.*	Hacketstown Rectory	2·89	73	103
„	Balquhidder, Stronvar.	4·52	115	118	*QCo.*	Blandsfort House	...	..	...
„	Crieff, Strathearn Hyd.	2·62	67	99	„	Mountmellick	3·07	78	...
„	Blair Castle Gardens	2·45	62	124	*KCo.*	Birr Castle	2·61	66	113
„	Coupar Angus School	2·60	66	139	*Dubl.*	Dublin, FitzWm. Sq.	2·34	59	120
Forf.	Dundee, E. Necropolis	3·05	77	169	„	Balbriggan, Ardgillan	2·30	58	114
„	Pearsie House	4·01	102	...	*Me'th*	Drogheda, Mornington	...	..	...
„	Montrose, Sunnyside	2·34	59	141	„	Kells, Headfort	2·70	69	102
Aber.	Braemar, Bank	3·41	87	174	*W.M*	Mullingar, Belvedere	3·43	87	132
„	Logie Coldstone Sch.	3·52	89	180	*Long*	Castle Forbes Gdns.	3·54	90	137
„	Aberdeen, King's Coll.	1·60	41	94	*Gal.*	Ballynahinch Castle	5·90	150	167
„	Fyvie Castle	2·84	72	...	„	Galway, Grammar Sch.	4·58	116	...
Mor.	Gordon Castle	2·78	71	136	*Mayo*	Mallaranny	4·69	119	...
„	Grantown-on-Spey	2·44	62	108	„	Westport House	4·11	104	152
Na.	Nairn, Delnies	2·22	57	126	„	Delphi Lodge	8·30	211	...
Inv.	Ben Alder Lodge	3·33	85	...	*Sligo*	Markree Obsy.	3·55	90	118
„	Kingussie, The Birches	1·91	49	...	*Cav'n*	Belturbet, Cloverhill	3·09	78	127
„	Loch Quoich, Loan	6·00	152	...	*Ferm*	Enniskillen, Portora	2·98	76	...
„	Glenquoich	...	..	...	*Arm.*	Armagh Obsy.	2·64	67	105
„	Inverness, Culduthel R.	1·88	48	...	*Down*	Warrenpoint	2·38	60	...
„	Arisaig, Faire-na-Squir	...	..	...	„	Seaforde	2·89	73	105
„	Fort William	3·29	84	92	„	Donaghadee, C. Stn.	1·64	42	70
„	Skye, Dunvegan	1·91	49	...	„	Banbridge, Milltown	1·96	50	77
„	Barra, Castlebay	1·20	31	...	*Antr.*	Belfast, Cavehill Rd.	2·34	59	...
R&C	Alness, Ardross Cas.	3·16	80	140	„	Glenarm Castle	2·29	58	...
„	Ullapool	2·26	57	...	„	Ballymena, Harryville	2·50	64	86
„	Torridon, Bendamph.	3·35	85	82	*Lon.*	Londonderry, Creggan	3·42	87	121
„	Achnashellach	4·58	116	...	*Tyr.*	Donaghmore	2·68	68	...
„	Stornoway	2·05	52	88	„	Omagh, Edenfel	2·83	72	100
Suth.	Lairg	2·66	68	...	*Don.*	Malin Head	2·34	59	109
„	Tongue Manse	3·36	85	164	„	Dunfanaghy	...	..	...
„	Melvich School	1·81	46	93	„	Killybegs, Rockmount	3·42	87	90

Climatological Table for the British Empire, January, 1926

STATIONS	PRESSURE: Mean of Day M.S.L.	PRESSURE: Diff. from Normal	TEMPERATURE: Absolute: Max.	TEMPERATURE: Absolute: Min.	TEMPERATURE: Mean Values: Max.	TEMPERATURE: Mean Values: Min.	TEMPERATURE: Mean Values: ½ max. and min.	TEMPERATURE: Mean Values: Diff. from Normal	TEMPERATURE: Mean: Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION: Am'nt	PRECIPITATION: Diff. from Normal	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	mm.	mm.			
London, Kew Obsy.	1012·1	− 5·5	53	18	45·5	35·7	40·6	+ 1·7	38·4	90	7·9	59	+ 14	18	1·4	16
Gibraltar	1022·0	+ 0·8	67	45	62·4	51·8	57·1	+ 2·3	51·8	84	5·5	109	− 20	8	...	...
Malta	1017·0	− 0·6	67	46	59·4	52·2	55·8	+ 0·5	52·0	81	6·5	68	− 14	13	5·3	54
St. Helena	1013·1	+ 3·4	72	58	67·1	59·9	63·5	− 1·0	61·3	88	4·3	56	− 19	21	...	...
Sierra Leone	1012·5	+ 1·3	90	70	86·8	73·2	80·0	− 1·5	72·1	77	3·4	0	− 10	0	...	...
Lagos, Nigeria	1008·9	− 1·0	92	68	89·7	75·0	82·3	+ 1·4	73·7	77	6·7	0	− 27	0	...	...
Kaduna, Nigeria	1014·9	+ 3·3	94	...	86·8	...	...	...	?54·9	? 19	4·0	0	0	0	...	...
Zomba, Nyasaland	1012·8	− 0·9	87	64	81·1	66·3	73·7	+ 0·9	...	88	9·5	711	+445	28	...	...
Salisbury, Rhodesia	1006·7	− 1·9	85	53	79·0	61·3	70·1	+ 0·6	63·8	77	6·8	143	− 58	19	6·2	47
Cape Town	1014·3	+ 1·1	94	50	81·7	60·6	71·1	+ 1·3	63·9	71	2·7	8	− 10	4	...	...
Johannesburg	1010·3	+ 0·7	88	50	80·6	57·7	69·1	+ 2·9	60·0	67	3·1	192	+ 33	16	8·8	65
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	101	51	93·2	61·9	77·5	+ 4·3	66·7	59	3·0	76	− 26	3	...	...
Calcutta, Alipore Obsy.	1016·4	+ 1·2	82	49	77·1	55·3	66·2	− 0·2	56·3	86	2·2	14	+ 5	3*	...	...
Bombay	1013·6	0·0	89	63	83·6	69·7	76·7	+ 1·4	66·2	73	2·0	76	+ 73	4*	...	...
Madras	1014·6	+ 0·5	86	63	84·2	69·7	76·9	+ 0·8	72·8	88	4·3	28	− 7	3*	...	...
Colombo, Ceylon	1011·6	+ 0·1	92	66	87·7	71·1	79·4	+ 0·3	73·9	73	4·6	64	− 25	9	4·6	39
Hong Kong	1021·6	+ 1·8	76	52	66·0	57·6	61·8	+ 1·6	56·2	72	5·5	5	− 30	2	5·6	51
Sandakan	...	...	86	72	83·2	75·0	79·1	− 0·7	75·7	82	...	753	+284	17	...	...
Sydney	1010·7	− 1·8	104	58	79·2	64·6	71·9	+ 0·3	66·1	63	6·1	90	− 3	13	7·6	54
Melbourne	1013·4	+ 0·5	104	51	73·8	55·5	64·7	− 2·8	57·4	60	5·5	89	+ 42	11	7·5	52
Adelaide	1014·5	+ 1·5	102	51	83·6	58·0	70·8	− 3·3	58·3	36	3·2	1	− 17	1	11·2	79
Perth, W. Australia	1012·8	+ 0·3	106	56	88·9	65·8	77·3	+ 3·4	63·9	41	3·0	1	− 7	2	10·8	78
Coolgardie	1011·9	+ 0·5	103	54	94·2	64·3	79·3	+ 1·9	61·9	39	1·3	0	− 12	0	...	...
Brisbane	1010·9	− 0·5	97	65	86·4	69·3	77·9	+ 0·7	70·8	66	5·6	77	− 86	12	7·5	55
Hobart, Tasmania	1010·5	+ 0·2	82	43	68·3	51·3	59·8	− 2·5	53·7	59	6·5	38	− 7	9	8·2	55
Wellington, N.Z.	1011·5	− 1·3	81	46	70·7	57·3	64·0	+ 1·6	58·2	69	6·8	78	− 6	13	7·4	50
Suva, Fiji	1007·9	+ 0·2	89	69	86·1	74·5	80·3	+ 0·4	75·9	81	5·1	129	−143	15	7·3	56
Apia, Samoa	1007·7	− 0·2	91	71	85·8	76·2	81·0	+ 2·0	77·7	77	6·3	278	−149	19	6·3	49
Kingston, Jamaica	1014·9	− 0·2	91	64	85·9	69·1	77·5	+ 0·7	66·2	80	2·8	11	− 13	3	3·1	28
Grenada, W.I.	1014·9	+ 2·3	84	70	82·3	72·1	77·2	+ 0·2	72·6	78	4·6	88	− 25	22	...	...
Toronto	1014·8	− 2·6	46	− 5	30·8	18·7	24·7	+ 2·6	22·4	80	8·1	58	− 15	18	1·8	19
Winnipeg	1016·2	− 3·6	34	−29	14·5	−2·5	6·0	+10·4	...	...	5·7	10	− 11	8	3·1	36
St. John, N.B.	1011·0	− 4·7	44	−13	25·8	10·7	18·3	− 0·9	15·9	77	6·0	155	+ 33	16	3·0	33
Victoria, B.C.	1020·4	+ 5·1	52	34	45·2	39·4	42·3	+ 2·2	39·9	93	9·1	89	− 26	15	1·3	15

*For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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On Some Summer Depressions

By. C. K. M. DOUGLAS, B.A.

The unsettled weather of the present summer has provided a number of interesting features for the meteorologist, and it is proposed to give some details of a few special cases. Figs. 1 and 2 illustrate the development of the depression responsible for the third wet Derby day in succession. Fig. 1 shows the chart on the evening of Monday, May 31st, with the depresssion in its early stage of development far out on the Atlantic, the dotted line marking the approximate position of the warm and cold fronts. It was known that polar air had penetrated right down to Spain, and that a warm southwest current had prevailed at the Azores for about 12 hours. It was also known that there was another anticyclone to the northwest of the new depression, both from the strong northwest wind observed by the "Montclare," and from a Norwegian ship reporting from further west five hours previously. The presence of this anticyclone meant that there would be a strong polar current striking down behind the advancing depression, a factor very favourable for its development. The essential factor for the development of a depresssion is that masses of air originating in widely different latitudes should be brought together, but their relative position and movements are also important. The case under discussion was one of the very few when all the factors were known to be favourable before the issue of the forecast, so that the deepening of the system could be predicted with confidence. Another satisfactory feature from

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the point of view of the forecaster was the pronounced westerly current over the British Isles, which made it certain that the depression would pass over or near southern England. The "further outlook" issued that evening therefore predicted rain for southern England on Wednesday. On the following evening there was a falling barometer and backing wind at the mouth of the English Channel, accompanied by rain, but it was only because of the chart of Monday evening that a definitely rainy day could be forecasted.

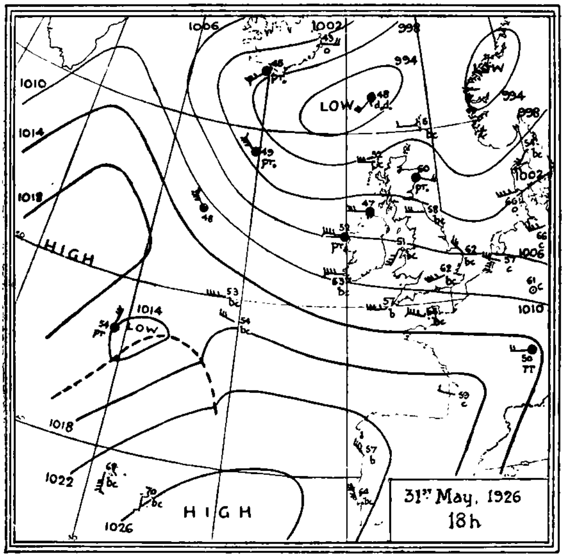

FIG. 1.

Fig. 2 shows the chart for 7h. on June 2nd, and it can be seen that the depression had greatly deepened, pressure at the centre having dropped about 22 mb. There were no ships' reports received from suitable positions to show the intermediate stages, but from the fact that the wind at Valencia remained westerly, veering to north-northwest, on the morning of the 2nd, we may infer that most of the deepening took place during the night of the 1st. The single dotted line on fig. 2 shows the occlusion, or line of intersection of the two cold currents, after the disappearance of the warm sector from the earth's surface. During the next 24 hours the system partly filled up (pressure rising 12 mb. at the centre), and advanced only 300 miles, compared with 1,200 miles during the preceding 36 hours. During the night of the 1st there were nearly two inches of rain in parts of South Devon, but at Pembroke there was none. In the 12 hours commencing 7h. on the 2nd the rain area spread up as far as Harrogate, and in southeast England there was about three-quarters of an inch in places, but no very large falls. From the expansion, but decreased intensity of the rain area we may infer that the angle of inclination of the surface of discontinuity decreased.

Depressions in their early stages, of which an example is seen in fig. 1, are commonly known as "secondaries." Various types of systems, differing entirely in their physical structure, are included under that much overworked term. One of these small developing cyclones crossed southeast England on November 3rd, 1925, and a valuable aeroplane ascent was made at Duxford in the warm sector, near the centre, showing a temperature at 15,000 feet about 20° F. warmer than those observed at that level on the preceding or the following days.

Another important depression began to develop south-southwest of Ireland on the morning of June 9th, 1926, and moved north-northeast, at the same time rapidly deepening, with a fall of about 14 mb. in the pressure at the centre in 24 hours. By next morning the polar air had curved round and swept across England from southwest, with very low upper air temperatures, and numerous thunderstorms in spite of strong winds, which reached gale force locally, and force 7 Beaufort, even in the southeast. The centre of the cyclone was then occluded, but a secondary formed about 200 miles further east, swung round the main centre and became absorbed into it. In consequence the system became still deeper, the barometer at Malin Head falling to 978·3 mb. at 7h. on the 11th, the lowest sea level reading recorded in the British Isles in June for at least half a century. Subsequently the centre moved a little west and began to fill up. The depression which caused continuous rain at Nottingham on June 14th and 15th, thus finally spoiling the first Test Match, began to develop over the upper Rhine valley on the night of 12th, at a well-marked polar front, the same front which caused a tornado near Geneva and the Jura mountains. This depression moved northwest, bringing with it a new rain area. The original primary, in which the rain had for some days been of the showery type, filled up rapidly and swung southeast as a dying "secondary" to the new system. When complex developments of this type take place out in the Atlantic, with only scattered ships' observations, the details cannot be followed. It may be regarded as certain that all long irregular cyclone tracks represent

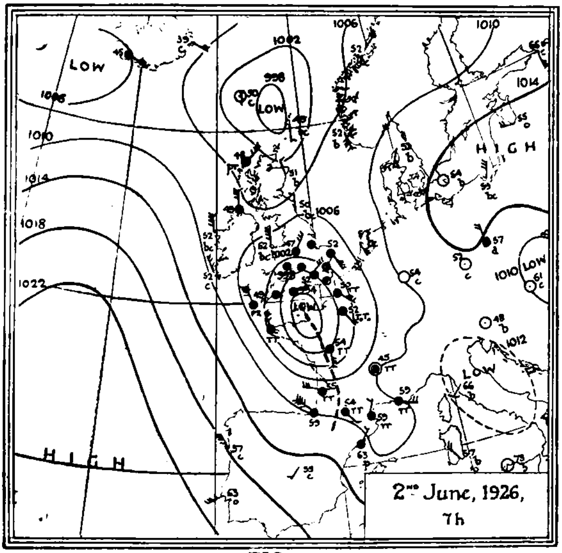

FIG. 2.

complex developments of new centres and not ordinary movements. Between July 3rd and 6th, 1926, another depression moved northwest, in this case from southeast Europe, and brought heavy rain to northeast England, amounting to well over an inch in places. On the 3rd and 4th violent thunderstorms developed in Germany and France in the middle of an easterly to northeasterly current, which in eastern England, and probably also on the continent, extended right up to the cirrus. At Säntis, an Alpine Observatory on a summit at 8,200 feet, the wind was northeast on the 3rd. It is by no means rare to find continental air with enough moisture for thunderstorms, or for prolonged rains if the air should act as a "warm sector." The historic rains early in August, 1917, were supplied by a very warm easterly current over Germany and Denmark. The exceptionally wet period in June, 1903, was started by a depression from the east on the 9th. From the 13th to the 15th there was a 58 hours downpour in London and the surrounding area, with 3·44 inches at Camden Square. During this period there was no supply of Atlantic air, but a vast anticyclone extending from north of Iceland to Madeira. A depression developed over southern England as the result of a cold northerly current cutting into warmer air which originally came from the east, and then only moved slightly and irregularly for 48 hours.

Extremes of Temperature

A type of question which is frequently asked is: What is the highest or lowest temperature which can be anticipated under given conditions, in the sun, in the shade, or on the ground, in England or in the tropics or in any part of the world? The following notes have been collected, mainly by Miss R. E. Smith, from a great variety of sources in order to provide material for a ready answer to many of these questions. They have been classified under the geographical headings, World, Tropics, United Kingdom, England and London.

The highest temperatures are those recorded by the "black bulb in vacuo." These temperatures do not correspond with anything which occurs in a state of nature, and their physical meaning is obscure, while their value is still further decreased by the difficulty of getting two instruments which read alike. They have not been systematically collected, but a brief search has revealed the following maxima: for the world, 184° F. at Coolgardie (West Australia) in January, 1914, and for London, 173° F. at Greenwich on July 2nd and 15th, 1925. For the tropics, the search has not been very complete and the highest which was found, 169° F. at Lagos (Nigeria) in March, 1908, may have been exceeded in drier localities. If any black-bulb temperatures have been recorded on high mountains, they probably show very much higher values. In the Antarctic a maximum of 154° F. was recorded by the National Antarctic Expedition on December 21st, 1902, the corresponding shade maximum being only 24° F., and this difference of 130° F. between the shade and "sun" temperatures would be very hard to match.

Of much greater practical importance are the highest temperatures recorded by objects exposed to both sun and air. Dr. Helene Wiszwianski* gives the following surface temperatures in the sun: in the Sahara, recorded by Foureau, 159° F. at Iferouan on May 12th, 1899; in the central Asiatic desert, recorded by Obrutschev, 140-158° F. (60-70° C.). H. G. Cornthwaite† gives the temperatures of iron or steel painted different colours and exposed to the sun's rays at Balbao Heights, Panama. The observations were made in the last half of April with the mid-day sun directly overhead; a half-inch hole was drilled into the centre of each block and filled with mercury, in which a thermometer was inserted. The highest temperature recorded was 133°F. in steel painted black, and it is estimated that under the most favourable conditions possible in the Canal Zone the maximum temperature of exposed steel is not likely to exceed 140° F. With steel painted other colours, lower temperatures were recorded, green being nearly as hot as black, red much cooler, and white slightly cooler than red, but the difference between black and white averaged less than 20° F. at mid-day.

The highest shade temperature on record is 136° F. at Azizia (Uzzizia) in Tripoli, on September 13th, 1922, which is 2° F. higher than the maximum of 134° F. recorded at the famous station of Death Valley, California. Temperatures of 130° F. or over have also been recorded at Insalah in the Sahara, at Mammoth Tank in the Colorado Desert, and in the interior of New South Wales. It must be remarked that G. Hellmann‡ queries the maximum at Azizia, as being about 10° C. higher than those of the neighbouring stations in Tripoli. The minima at Azizia are lower than those of surrounding stations, and suggest incomplete protection against radiation, or a position in a hollow. Similarly, Hellmann believes that the American screen in use at Death Valley gives maxima 1° C. or more too high. All these high temperatures occur in the sub-tropical

* Wiszwianski H., Die Faktoren der Wüstenbildung, *Berlin, Veröff. Inst. Meeres.* Heft. 9, 1906.

† Cornthwaite, H. G. Exposed steel temperatures in the tropics. *Washington, D.C., M. W. Rev.* 48 (1920), p. 403.

‡ Hellmann, G., Grenzwerte der Klimaelemente auf der Erde. *Berlin, SitzBer Ak. Wiss.* 11 (1925), p. 200.

desert zone. Between the tropics, although the temperature remains steadily at a high level, very high maxima are rare. A brief search gave a maximum of 132° F. at Tokar (18° 25' N., 37° 40' E.) in the Sudan, on June 28th, 1915. This figure is somewhat doubtful, and it would perhaps be better to accept the figure of 129° F. at the same station three days later. In England a temperature of 100·5° F., registered at Tunbridge Wells in 1868, is recorded by Marriott* ; it is closely approached by the well-known Greenwich maximum of 100° F. on August 9th, 1911, recorded in a Glaisher stand. On the same day a temperature of 98° F. was recorded at Raunds (Northamptonshire). A temperature of 101·5° F. at Alton, Hants, on July 15th, 1881, was obtained in a screen which differed from the standard pattern, and this record cannot be accepted.

Death Valley has the distinction of recording the hottest summers, the mean July temperature being 102° F., which is approached by Jacobabad, in north-west India, with 98° F. Within the tropics is the August mean of 96° F. at Suakin. The place with the highest mean annual temperature is apparently Massaua, on the Red Sea, with 86° F. ; this high temperature is due as much to the high minima as to remarkable maxima. Thirteen months' observations at Juba, in Italian Somaliland, gave an annual mean of 87° F. Both of these stations are within the tropics. The places with the highest annual mean temperature in the British Isles are Scilly, Jersey and Guernsey with 52·2 °F.

The highest wet bulb temperature on record is 100° F. observed at Kamaran Island, in the Red Sea, on September 23rd, 1923, and also at Berbera, Somaliland, on June 21st, 1924 ; Kamaran also gave the highest dry-bulb temperature with a saturated atmosphere discovered by a brief search, namely 94° F. at 9h. on August 14th, 1924. The highest temperature of the sea surface is not known ; a mean monthly temperature exceeding 90° F. has been found in the Red Sea in September. It may be of interest to note that the chemical composition of some deposits from a Permian lake in central Europe indicates that the temperature in summer rose to 95° F.

The absolute minimum temperature on record at the earth's surface comes from Verkhoïansk, in the well-known " cold pole " of Siberia, and is as low as −94° F., recorded by a spirit thermometer on January 3rd, 1885 (mercury freezes at −38° F.). No polar expedition has recorded temperatures nearly so low as this, the nearest approaches being −76° F. on a sledge journey between Cape Evans and Cape Crozier, in 76° S., on July 5th-6th, 1911, and −74° F. at Floeberg Beach, in Lady Franklin Bay, 82° N. These surface temperatures, however, pale into insignificance compared with that of −133° F. (182 a) found

* MARRIOTT, W. Some facts about the weather. 2nd edition. London, 1909.

at 17 km. over Batavia, Java. In the British Isles a temperature of −98° F. (201 a) occurred at 12·5 km. over Pyrton Hill on October 13th, 1913, but without a thorough scrutiny of all the records it is impossible to say if that is the lowest in this country.

The lowest shade temperature at a low level within the tropics revealed by a brief search is 25° F. at Wellington, Madras, but at high levels much lower temperatures are recorded. Of interest, though it is actually outside the tropics, is the minimum of −24° F. recorded at a height of 21,000 feet on Mount Everest in 1924. In the United Kingdom the record is held by Blackadder with a minimum of −23° F. on December 4th, 1879 (Marriott); in England, −11° F. occurred at Buxton on February 11th, 1895; and at Greenwich, 7° F. on February 8th, 1895. The lowest grass minimum at Greenwich is 2° F. on December 30th, 1908. A grass minimum of −9° F. was recorded at Hodsock Priory, Worksop, in February, 1895, but lower minima would probably be revealed by a systematic search.

Turning to low mean temperatures, we find the January mean at Verkhoïansk to be −59° F. As the July mean at this station is +60° F., the mean annual range is as much as 119° F. The lowest mean annual temperature probably occurs in the Antarctic. Observations have not been maintained for a year in the interior, but at Framheim, the winter quarters of Amundsen's expedition, the annual mean was −14·4° F. The interior of Greenland is also very cold, and in 75° N, at a height of about 10,000 feet, A. Wegener supposes the mean temperature to be about −26° F., but this is not based on actual observations. The lowest mean annual temperature for the British Isles given in the *Book of Normals*, is 43·3 °F. at Braemar, but the mean temperature at the top of Ben Nevis is 31·4° F.

It may be of interest to close this summary of temperature extremes with three tables compiled from nine annual volumes of the Meteorological Office publication entitled the *Réseau Mondial*. This publication gives data of pressure, mean and extreme temperature, and rainfall, based on land stations, generally two for each ten degree "square" of latitude and longitude. The stations are arranged in ten-degree zones, and Miss F. A. Shields has taken out the absolute maximum and minimum in each zone during each of the nine years, with the results shown in Tables 1 and 2. The absolute extremes of the whole period in each zone, with the station and date, are shown in Table 3. One of the most remarkable points shown by Table 1 is that the highest temperature in the zone 0°−10° S was actually lower than the highest temperature in the zone 60°−50° N in seven years out of nine, the same in one year and lower in only one year. The maximum in this equatorial zone was lower than the maximum in the zone 40°−50° S in four years out of nine.

C. E. P. B.

TABLE I. ABSOLUTE MAXIMUM TEMPERATURES.

Zone	Latitude	1910	1911	1912	1913	1914	1915	1916	1917	1918
		° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.
1	80°—70°N.	74.7	76.6	75.2	83.3	82.6	85.5	77.4	81.5	73.9
2	70°—60°	91.0	95.0	91.4	93.0	93.2	97.0	97.0	91.8	96.1
3	60°—50°	103.5	102.9	100.9	98.8	102.2	98.1	100.0	102.0	102.0
4	50°—40°	107.1	104.4	108.7	109.0	105.8	107.6	109.6	107.1	108.9
5	40°—30°	117.3	117.0	118.4	117.0	120.6	119.1	118.4	122.7	120.6
6	30°—20°	124.9	122.0	123.6	122.0	133.3	125.8	123.8	122.7	124.2
7	20°—10°	119.1	114.8	118.4	120.6	116.2	116.1	118.9	115.7	115.0
8	10°N —0°	115.0	105.1	107.1	108.0	110.5	110.5	108.7	109.4	108.0
9	0°—10°S.	97.3	100.0	100.4	97.7	101.5	102.9	100.0	98.6	100.4
10	10°—20°	111.6	109.8	111.7	111.0	108.0	111.9	108.5	107.1	109.0
11	20°—30°	115.0	114.6	115.0	116.1	115.0	118.9	115.0	118.6	114.8
12	30°—40°	116.1	109.9	120.7	117.5	115.0	117.0	114.1	115.0	115.0
13	40°—50°	96.1	89.8	105.4	106.2	93.2	92.8	98.1	101.5	101.5
14	50°—60°	73.4	74.1	72.3	79.5	73.0	73.8	92.7	91.4	87.6
15	60°—70°	45.5	47.3	41.4	49.3	47.7	41.0	46.8	48.6	52.3
16	70°—80°S.	...	34.7	39.9	...	...	37.0	...	...	...

TABLE II. ABSOLUTE MINIMUM TEMPERATURES.

Zone	Latitude	1910	1911	1912	1913	1914	1915	1916	1917	1918
		° F	° F	° F.	° F.	° F.	° F.	° F.	° F.	° F.
1	80°—70°N.	−34.2	−38.6	−47.7	−48.6	−42.3	−39.3	−50.3	−56.6	−45.6
2	70°—60°	−68.1	−82.8	−79.6	−76.5	−67.7	−79.1	−78.0	−80.7	−75.8
3	60°—50°	−56.6	−60.3	−61.2	−57.6	−58.4	−70.4	−68.8	−60.0	−60.9
4	50°—40°	−42.0	−45.0	−41.3	−36.9	−39.5	−37.3	−45.0	−47.0	−41.1
5	40°—30°	−18.9	−17 0	−16.1	−20.9	−15.0	−13.0	−24.0	−16.8	−17.0
6	30°—20°	24.1	19.0	19.9	27.0	13.5	3.0	21.2	19.0	16.0
7	20°—10°	27.0	36.0	29.5	36.3	38.3	31.8	34.9	29.8	27.7
8	10°N.—0°	50.0	44.1	44.6	44.6	27.1	33.6	30.4	31.8	27.5
9	0°—10°S.	39.0	37.9	40.8	36.5	42.1	39.0	34.0	39.9	37.9
10	10°—20°	29.8	30.0	28.6	32.0	30.4	29.3	24.8	28.8	25.7
11	20°—30°	25.0	19.0	26.1	23.4	25.0	24.1	19.6	23.0	19.9
12	30°—40°	23.7	12.6	11.7	24.8	25.9	17.1	16.7	21.2	13.5
13	40°—50°	24.1	24.6	22.3	21.2	23.0	22.6	10.4	15.8	2.8
14	50°—60°	14.0	9.3	8.2	9.3	11.8	9.3	9.7	9.3	8.8
15	60°—70°	−25.1	−18.4	−30.1	−32.8	−26.7	−25.4	−24.3	−26.7	−27.8
16	70°—80°S.	...	−73.3	−37.5	...	...	−34.1	...	...	...

TABLE III. EXTREME TEMPERATURES.

Zone	Latitude	Abs. Max.	Station	Date	Abs. Min.	Station	Date
		° F.			° F.		
1	80°—70°N.	85.5	Gjesvaer ...	July 28, 1915	—56.6	Spitsbergen ...	Mar. 28, 1917
2	70°—60°	97.0	Rampart	July 21, 1915 / June 26, 1916	—82.8	Verkhoïansk ...	Jan. 28, 1911
3	60°—50°	103.5	Minnedosa ...	July 14, 1910	—70.4	Eniseisk ...	Jan. 10, 1915
4	50°—40°	109.6	Krasnovodsk	July 20, 1916	—47.0	Macleod ...	Jan. 31, 1917
5	40°—30°	122.7	Baghdad ...	July 21, 1917	—24.0	Modena	Dec. 27, 1916
6	30°—20°	133.3	Insalah ...	July 19, 1914	3.0	Cañadas del Teide	Feb. 2, 1915
7	20°—10°	120.6	Timbouctoo...	June 13, 1913	27.0	Mexico	Jan. 22, 1910
8	10°N.—0°	115.0	Wau ...	April 16, 1910	27.1	Nuwara Eliya ...	Feb. 8, 1914
9	0°—10°S.	102.9	Barra do Corda	Oct. 8, 1915	34.0	Nairobi	July 23, 1916
10	10°—20°	111.9	Daly Waters	Jan. 4, 1915	24.8	Sucre	July 1, 1916
11	20°—30°	118.9	Boulia ...	Feb. 7, 1915	19.0	Mitchell... ...	June 23, 1911
12	30°—40°	120.7	Eucla ...	Dec. 17, 1912	11.7	Heidelberg ...	June 26, 1912
13	40°—50°	106.2	Bahia Blanca	Jan. 13, 1913	2.8	Sarmiento ...	July 7, 1918
14	50°—60°	92.7	Santa Cruz ...	Feb. 17, 1916	8.2	South Georgia ...	Aug. 13, 1912
15	60°—70°	52.3	South Orkneys	Jan. 25, 1918	—32.8	South Orkneys ...	June, 1913
16	70°—80°S.	39.9	Cape Evans (McMurdo Sd.)	Jan., 1912	—73.3	Framheim ...	Aug. 13, 1911

Correspondence

To the Editor, *The Meteorological Magazine*

The Relative Sunniness of the south-western and south-eastern Counties

In the recent discussion in *Nature* and the June number of the *Meteorological Magazine*, on the claims of England, south-west or south-east, to the most sunshine, it strikes one that there is some danger of haggling about insignificant differences, and thus of losing sight of the real climatic picture, viz., that there is sensible equality between the two districts. The quarterly differences made much of, both by Mr. Harding and Mr. Phillips, are in most cases of a trivial order, and, even supposing they are real, as based on a limited number of stations in a period of thirty-five years, an excess of 2 minutes per day on the average of the year (4·53-4·49 hours, according to figures quoted in the June *Meteorological Magazine*) cannot surely be credited with any medical or other practical importance. The fact which makes Mr. Phillips object to the inclusion of south Wales in the south-west district, on the ground that it lowers the sunshine values for that district, tells, in my opinion, rather in favour of the south-east district, since it is an expression of the fact that, as may be verified by the sunshine maps in Section III. of the *Book of Normals*, the characteristic sunniness of the south coast of England as a whole extends considerably further up the east coast than the west. This means that the south-east lies more centrally in the sunny belt than the south-west, which may at least have some significance.

L. C. W. BONACINA.

27, Tanza Road, London, N.W. 3. June 26th, 1926.

Waterspouts observed at Paull

I saw two water spouts or whirls or vortices of cloud on Monday, June 28th, at about 12 noon from Paull Pt., Paull, near Hedon, near Hull. They were both to eastward. The first one was at a great distance and in the duration of 5 or 10 minutes extended downwards from a dark cumulus cloud which might have been over Spurn or east of Sunk Island. The view was in each case across land. The first extended downwards until its lower part looked like a thin thread. The whole swayed gently from side to side.

When it had gone a long finger of white cloud was seen comparatively close, perhaps ½ mile away, subtending about 2°, in which the spin and upward spiral in a clockwise direction could be observed, but whether water or cloud or dust I could not say, it was quite white. Where I was, the water was still.

M. R. C. NANSON.

Rosemarkie, Goxhill, Barrow on Humber, Lincs. July 1st, 1926.

NOTES AND QUERIES

The Thunderstorms of July 18th, 1926

For the fourth year in succession July has provided a notable day of thunderstorms. The storms which began on Saturday night, July 17th, and continued on the Sunday, were the most widespread for many years past, affecting practically the whole of the British Isles, and in some western districts they were very severe and prolonged. There was a little local thunder in the southwest on the 17th, but the first really severe storm appears to have reached the south coast about the borders of Devon and Dorset shortly before midnight, after much lightning over the English Channel. At Seaton the storm broke at 10.30 p.m. (probably summer time) and lasted for 12 hours, with 1·78 in. of rain (*Times*, June 19th). Mr. B. D. Kilburne, writing in the *Times* of June 23rd, reports that at Sidmouth 2·66 in. fell in about 5 hours, commencing 2 a.m. Several houses were struck by lightning in Lyme Regis and the vicinity, and there was some flooding.

Thunderstorms also commenced during Saturday night in Wales and Ireland, and in the Channel Islands, and throughout Sunday they were very general in western England, Wales, Ireland, and parts of Scotland, continuing far into the night in places. At Birr Castle, in Central Ireland, thunderstorms recurred at intervals for over 24 hours, and the total rainfall was 2·52 in., of which 1·65 in. fell during the Sunday night. Mr. Hansford, the observer at Woolacombe climatological station (Devonshire), reports a severe hailstorm at 1.30 p.m. on Sunday afternoon, with hailstones 4 to 5 inches in circumference and weighing 2 to 3 ozs., much glass being broken. Hailstones 3¼ inches in circumference were observed at Braunton (N. Devon), at 2.20 p.m., by Mr. Longfield (*Times*, June 23rd).

During the Sunday night thunderstorms extended over eastern England, but they were neither so severe nor so prolonged as they had been in the west. Mr. Henry Newby sends in an account of the storm at Hove, where it broke at about 8.30 p.m., preceded by distant thunder, and by a dark sky over the sea since 6 p.m. It was probably the same storm which crossed the southeast suburbs of London a little over an hour later, doing some damage by lightning. A more general but less severe storm crossed the London area soon after midnight, at the passage of a " cold front."

A study of the synoptic charts shows that on the 17th there was an anticyclone over the North Sea, covering most of the British Isles, but off our western coasts there was an indefinite trough of low pressure, which had only just developed, and which extended down to an old " dying " depression between the Azores and Spain. During the 18th a rather deep depression developed quickly near Brittany and moved north, causing an unusual combination of severe thunderstorms and persistently strong winds later in the day. On the following night a " cold front " or " squall line," swept quickly across the southeast half of England, but the severe storms in the west were certainly not due to a cold front. Like many of our severe storms, they drifted from the south over surface winds mainly between east and southeast, and the upper southerly current probably brought abundant warmth and moisture from low latitudes at the level of the cloud base.

For the ordinary observer, one of the most valuable of all cloud signs is the turret cloud, or alto-cumulus castellatus, which is usually followed by thunder, especially if the wind is easterly and the clouds are moving from south or southwest.

Good examples of this cloud were visible in southeast England on the afternoon of 17th, and also on the 18th.

C.K.M.D.

Lieut.-Col. W. A. Bentley, of Broadford, Co. Clare, reports that during the storm 1·24 in. of rain fell on July 17th and 1·50 in. on the 18th, the total of 2·74 in. in 48 hours not having been exceeded since 2·77 in. fell on 2nd and 3rd April, 1909. The storm came from the southeast; two cows and some goats were killed and a small cock of hay burned by the lightning. The rivers rose rapidly but soon subsided.

Abnormal Audibility of Gunfire. The Time of Passage of the Sound

The study of the "abnormal" audibility of the sounds from explosions suffers from the drawback that as large explosions are usually unforeseen, persons who happen to hear them are not prepared to time with any precision the arrival of the sound. On the other hand, the deliberate detonation of large quantities of explosive can only be arranged on the rare occasions when superfluous stores have to be disposed of. It occurred to me recently that it might be possible to utilise the comparatively small air disturbances produced by gunfire, and, to give the method a trial, I ascertained when heavy guns were likely to be tested at Shoeburyness. For my listening post, I selected Grantham, in Lincolnshire, as being at an appropriate distance for abnormal audibility and in a likely direction. It may be recalled that the Silvertown explosion was audible in Lincolnshire, and also that during the war, firing on the western front was heard in London in the summer months, the bearing being about the same in each case.

On Monday, June 28th, 1926, I was at Grantham and received a telegram to say that firing would commence at about 2 o'clock (13h. G.M.T.) and last for an hour. The spot I selected for listening was on the hill about a mile east of Grantham and half a mile northwest by north from Spittlegate Aerodrome. I sat under a hedge with a clump of trees behind it. The view to the south and southeast from this position was quite open.

It was not until 13h. 48m. that I heard any noise which could be identified with gunfire. After that I heard six more booms at intervals. The noises were all so faint that they would have been unnoticed by anyone who was not on the alert. There were considerable differences between the noises, and it is therefore worth while to copy my notes. The times have been corrected to G.M.T.

13h 48m 25s	Definite boom, short.	13h 55m 48s	Boo oo m.
14h 9m 6s	Ahaa haa.	14h 15m 56s	Ahaa ha.
14h 22m 31s	Up up.	14h 28m 23s	Doubtful (Adventitious noises).
14h 34m 45s	Single boom, faint.		

The meteorological conditions were the same throughout ; little wind, overcast sky (small cumulus below stratus), poor visibility.*

On receipt of information from Shoeburyness, I was gratified to find that exactly seven rounds had been fired, so that I had heard all of them. The times are shewn in the following table :—

JUNE, 28th, 1926.

Round.	Fired. h. m. s.	Heard. h. m. s.	Time of Passage. m. s. s.	Apparent Speed. km/s.
1 ..	13 37 37	13 48 25	10 48 = 648	·285
2 ..	44 56	55 48	10 52 = 652	·283
3 ..	58 2	14 9 6	11 4 = 664	·278
4 ..	14 4 44	15 56	11 12 = 672	·275
5 ..	11 14	22 31	11 17 = 677	·273
6 ..	17 8	28 23	11 15 = 675	·274
7 ..	23 44	34 45	11 1 = 661	·280

It will be seen that there were considerable differences in the time of passage of the sound over the range, which is 115 miles or 185 kilometres. For the first round, it was 10 minutes 48 seconds, for the fifth, 11 minutes 17 seconds. If the sound had travelled near the ground at the speed 341 metres per second appropriate for the temperature, the time of passage would have been just 9 minutes. The single booms were observed when the time of passage was short, the double ones when it was longer. The interpretation may be that in the former case, my station was almost on the inner boundary of the zone of abnormal audibility, in the latter case the station was well beyond the boundary. According to theory, the fore and aft section of the wave front as it approaches the ground is γ-shaped. The arrival of the cusp might be heard as a single crack, whereas the arrival of the two branches of the γ would be heard as two booms in quick succession. However, I do not attach much importance to this aspect of the observations. It is recognised that even at short distances from a gun, the quality of the sound differs from round to round. In the present instance, Mr. Britton reports that at Shoeburyness 8,500 yards from the gun, rounds 3, 6 and 7, were clearly less sharp than the remainder,

* The *Daily Weather Report* shews that pressure was high, 1,029 mb., and temperature moderate (64° F, at Cranwell at 13h.). An aeroplane flight at S. Farnboro' at 9h 30m the same morning gave a regular temperature gradient up to 8·6 km. above sea level, where temperature was −38° F.

and that another observer about 9,200 yards from the gun, but much nearer the trajectory, found that rounds 1, 2, 3 and 5, were accompanied by more reverberation than rounds 4, 6 and 7. The firing conditions for the seven rounds were identical, the charge being the same every time.

That the time of passage of the sound should change so much in the course of half-an-hour implies rapid variation in the upper air conditions.

If we accept the theory that abnormal audibility depends on the fact that at heights from 30 kilometres upwards the atmosphere is comparatively warm, and at 50 kilometres at least as warm as at ground level, variations in the time of passage of the sound imply variations in the temperature and height of this warm layer. These may be casual; on the other hand it is possible that they are systematic, with a large daily range. It is even within the bounds of possibility that it is the daily fluctuation in the density of the air in these high regions that is responsible for the familiar regular oscillation of barometric pressure.

My thanks are due to Lt.-Col. J. V. Hope, Superintendent of Experiments, Shoeburyness, and to Mr. C. Britton, the Meteorological Officer, without whose assistance the investigation could not have been undertaken.

F. J. W. WHIPPLE.

The Breathing of the Continents

Herr Otto Myrbach has developed some ideas on the succession of weather types in temperate regions which are of exceptional interest.* His theory depends on the fact that land has a smaller specific heat than water and therefore warms or cools more rapidly. Starting from a winter period with slight barometric and thermal gradients, he sets out the theoretical succession of events as follows :—

(A) Over the continents the temperature falls more rapidly than over the sea. The air over the land is cooled by conduction and radiation and contracts, drawing in air from the oceans; "*the continents breathe in.*" The vertical contraction causes a lack of air at great heights, producing a barometric depression in the upper air.

(B) To fill this high depression over the land air streams in from the sea. Pressure rises over the land and falls over the sea; this land-sea gradient prevents the further influx of air at low levels. The temperature over the land reaches its minimum.

(C) The cold air in the anticyclones over the continents breaks out as cold waves over the sea, especially in low latitudes.

* O. MYRBACH, Das Atmen der Atmosphäre unter kosmischen Einflüssen. Ann. Hydrogr., Berlin 54 (1926) pp. 94-105 and pp. 145-168.

Over the land air descends, warming adiabatically and bringing about a rise of temperature and fall of pressure. "*The continents breathe out.*"

(D) The cold waves spread further over the sea and displace the warm air (stage of winter sea rainfall). Pressure rises over the sea and the original stage of uniformity of pressure and temperature is re-established.

The author investigates these winter stages by examining the charts of the northern hemisphere for the first half of 1914, published by the United States Weather Bureau. An analogous succession during the summer months could not be investigated directly because of the lack of suitable charts. In order to eliminate the "small weather changes" due to the passage of depressions he forms overlapping ten-day charts and also forms the "isallobar" charts from one ten-day period to the next. He considers that the charts confirm his theoretical succession and reproduces a number of them showing typical stages. His starting point is January 10th, when there were small pressure gradients over the whole northern hemisphere and relatively high pressure over the polar basin. Stage (B) is reached by February 1st, when a depression over the Arctic Ocean is surrounded by a ring of very high pressure. Stage (C) is reached by February 11th, and (D) by February 21st. The outbreak of cold air from the Arctic basin is very clearly pictured by the isallobar chart representing the change of pressure from February 21st to March 9th, which shows three tongues in which pressure was rising over the oceans, separated by areas of falling pressure over the continents. On March 9th the original stage of uniform distribution has been reproduced and the cycle begins again.

The average interval between the corresponding stages of the two cycles is 58 days. The obvious course would be to regard this as the natural length of the cycle under the existing conditions of solar constant, size of continents, etc., and if he had been able to leave it at that, the author would have presented us with a clear-cut theory of the sequence of pressure types, requiring only to be proved or disproved by the examination of further series of weather charts for different years. But in addition to this simple succession, he finds on his charts evidence of various series of pressure waves, both progressive waves moving from west to east, and stationary meridional waves, and in his investigation of these waves he become rather involved. He finally postulates a very complex series of "rhythms" depending on the rotation of the sun, the conjunctions of the planets, the moon, all fitting neatly into a grand period of 432 days in which the position of the pole oscillates about its mean. The term "rhythms" is used instead of "periods" because they are of variable length, being shortened in years of many sunspots, and lengthened in years of few sunspots. Altogether we have about 22 "rhythms" ranging in length from 45 to 432 days, few of which are likely to prove worthy of serious consideration.

The conception of the "breathing of the continents" is simpler and may explain some examples of the succession of weather types which have emerged from the study of monthly charts of pressure. For example in the spring of many years there is an occasion when a large anticyclone moves north-eastward from the Azores across the British Isles.* Good examples occurred in April, 1912, and March, 1926. It was supposed that these are "warm" anticyclones composed of equatorial air with a high cold stratosphere; Myrbach's charts show that in 1914 a similar phenomenon occurred between March 9th and April 15th, and he attributes the anticylcone to a mass of cold polar air, breaking out from the Arctic Ocean southwards across the western North Atlantic and curving round the Icelandic minimum. Aeroplane ascents in the middle of March, 1926, showed a very marked inversion at a height of 5,000-6,000 feet, above which the air was abnormally warm for the season, so that it was presumably equatorial air. On the other hand, in the anticyclone of April, 1912, the average height of the tropopause was only a little over 10 km., and the temperature from 5 to 9 km. was abnormally low, presumably indicating polar air, so that neither view is definitely excluded.

Chinese Boy Scouts as Observers

The Hankow Weather Guide, by Stanley V. Boxer, which has recently been published by the Griffith John College, Hankow, forms a welcome addition to our knowledge of the meteorology of Central China. The well-known compilations of the Zi Ka Wei Observatory, *La pluie en Chine*, and *La temperature en Chine*, deal with the regional distribution of special elements ; here we have a comprehensive account of the variations of all elements of climate at one station over a period of ten years, 1916 to 1925. The observations were commenced by Mr. Boxer as a result of the enthusiasm of the late Mr. W. W. Lindsay, of Kuling, and by far the greater number of the observations have been taken by the 1st Hankow Troop of the Chinese Boy Scouts, assisted by the staff of the Griffith John College. Every effort has been made to preserve continuity and accuracy. The analysis of the data is very complete, including numerous frequency tables, and there are many excellent diagrams. There is, in fact, something to record at this station : "From the hot breathless nights of August (would that we had a Recording Katathermo-

* See *Meteorological Magazine*, 61, (1926), p. 59.

meter for these), through the delightful clear days of autumn to shrivelling, dry northerly winds of January . . . . . we undergo an annual oscillation between Goa and Gobi ! "

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1926.

Unit : one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays)

Averages for Readings

		April	May	June
Cloudless days :—				
Number of readings	n	5	4	10
Radiation from sky in zenith ...	π I	468	504	532
Total radiation from sky ...	J	502	536	568
Total radiation from horizontal black surface on earth ...	X	749	758	769
Net radiation from earth ...	X—J	247	222	201

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

		April	May	June
Cloudless days :—				
Number of readings	n_0	2	1	2
Radiation from sky in zenith ...	πI_0	67	85	60
Total radiation from sky ...	J_0	69	108	73
Cloudy days :—				
Number of readings	n_1	1	3	5
Radiation from sky in zenith ...	πI_1	*20	190	173
Total radiation from sky ...	J_1	*17	172	154

* The low values were caused by an usually dense cloud stratum.

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

Modern Sunlight

WE have received a copy of Vol. I., No. 3 of *Modern Sunlight*, published monthly by the Sunlight Bureau, price 2s. The health-giving power of sunlight is believed to be largely, if not mainly due to the ultra-violet radiation, and for curative purposes such radiation can be provided with great steadiness and reliability by artificial means. Instead of the patient often having to make an expensive journey in quest of the sun, the curative essence of sunlight is brought to the patient.

Man and Weather*

" 'The time has come,' the walrus said,
'To talk of many things.' "

The impression which this little book makes on the reader may be summed up in these lines. There are six chapters, representing a series of popular lectures on "aerography" (meteorology), and the author jumps from subject to subject in a delightfully chatty and informal way. "The Strategy of Weather in War" recalls some occasions on which a gale or fog has perhaps changed the course of history. Many of the instances are drawn from the late war, and it appears that, but for south-west gales in the Mediterranean in February, 1915, the war would have been shortened by three years. "Weather in peace" ranges over many topics, from weather forecasts, long and short, to Professor McAdie's own units and nomenclature. It seems that the forecaster in America plays many parts, and may on occasion be called in to restore the health of a crêche after the doctors have confessed themselves baffled.

"The Structure of the Atmosphere" is a lively account of the six floors of the atmospheric skyscraper—troposphere, stratosphere, the region of meteors, the Kennelly-Heaviside layer, the auroral layer and the Empyrean, from 500 to 1,000 kilometres. The Fahrenheit scale is regarded as obsolete, and readings are given in kilograds. The chapter is marred by a few examples of loose writing, as in the reference to density on page 43. The same applies to the next chapter, where we read (page 62) that it would seem that "the total rainfall for the globe is much less than the evaporation," a meaningless statement as it stands. The definition of entropy on page 65 as "the running-down of heat" might perhaps be improved upon.

The truth about Franklin forms the main theme of the chapter on "Lightning": apparently the usual story of the famous kite-flying experiment is inaccurate; in fact, "if Franklin had really flown his kite during a lively thunder-storm, there might have been a coroner's jury next day holding an inquest on the remains." The last part of this chapter, dealing with the auroral spectrum, is rather technical, and is out of keeping with the remainder of the book. The final chapter deals with "Droughts, floods and forecasts," and we read that in order to produce the Noachian flood which submerged Mount Ararat in forty days and forty nights, it must have rained steadily at the

* McAdie, A. Man and Weather, 8vo, $7\frac{1}{2} \times 5$. pp 99, *illus.* published by Humphrey Milford, at the Harvard University Press, Cambridge, Massachusetts, U.S.A. and the Oxford University Press, London. Price 8s. 6d. net.

rate of 100 mm. a minute. The author might have made this figure even more impressive if he had adopted the Indian version of the tradition, in which the ark lands on the top of Mount Everest.

The book is excellently printed, and contains a number of fine plates, mostly of cloud forms. It is well calculated to appeal to the layman, for whom it would while away the idle hour or so of a train journey with great interest and some profit. The price seems rather high for the size, but this is probably accounted for by the illustrations. There is a misprint on page 39, and on page 67 Luke Howard's domicile is given as "Tottingham," this may be the archaic form, but the modern spelling would be preferable.

Reviews

Gerland's "Beiträge zur Geophysik." Edited by V. Conrad, Vienna. Band XV., Heft I., Leipsig, Akademische Verlags-gesellschaft M.B.H., 1926.

The first part of a new volume (Volume XV.) of Gerland's "Beiträge zur Geophysik" has been published recently. According to the preface to this volume, the last previous issue appeared in 1918. The magazine, which began in 1887 with the publication of theses by Gerland's students at Strassburg, had attained before the war an international character. Angot, Darwin, Galitzin, Helmert and Trabert were numbered amongst the contributors. It is hoped that the international character will be preserved in the revived magazine. The editor might have thought that there was hardly room for his paper as well as for the Zeitschrift für Geophysik, but he contends that whilst that journal meets the need for rapid publication of new ideas his will contain more detailed developments.

For this first number the editor has been successful in securing the co-operation of experts from several countries and in covering many branches of geophysics—magnetism, atmospheric electricity, seismology, gravitation, meteorology and geochemistry. The paper on geochemistry is by V. M. Goldschmidt, of Oslo. He sets out the aims and methods of this new subject. It is concerned with such questions as the frequency of the elements: how much oxygen is there on the earth and how much iron? what rules govern their distribution?

Of the two meteorological papers, one by A. Ångstrom is of outstanding importance. It deals with the flux of heat to and from the earth and with the distribution of temperature. One valuable generalisation is that the outflow of heat by radiation through the top of the atmosphere is the same in all latitudes; the greater radiation from the earth's surface in the hotter regions is balanced by the greater absorption in the moister air.

Within 35° of the equator, the heat received from the sun more than compensates for the loss by radiation; the polar zones on the other hand do not receive from beyond the atmosphere as much as they lose. Reconciliation is effected by atmospheric and oceanic currents; the flow of heat parallel to the earth's surface is analogous to conduction but eddy conductivity on this scale is very large compared with the conductivity of metals; Ångstrom finds that it is greater in the ratio 10,000,000 : 1. The paper is in harmony with earlier work by Defant and Exner but the subject gains by treatment by a writer who is *the* authority on terrestrial radiation.

The other meteorological paper is by J. W. Sandstrom on what he calls a peculiar ambiguity in the meteorological influence of the Gulf Stream. He demonstrates that winter temperature in northern Europe is associated closely with the direction of the local wind as observed in the Lofoten Islands. His view is that for long range forecasting it will prove profitable to study the winds at the Lofoten Islands rather than the difference between the pressure at the Azores and Iceland, hitherto the favourite criterion of the strength of the Gulf Stream influence.

Jahresberichte (28-33) *des Sonnblick-Vereines für die Jahre* 1919 *bis* 1924. Sonnblick-Vereines XIX, Hohe Warte 38, Vienna 1924 and 1925.

The Sonnblick (lat. 47° 1 N, long. 12° 6 E, height 10,190 ft.) is a peak in the Austrian Central Alps, well known to all alpinists as a neighbour of Grossglockner. In 1886 a meteorological observatory was built on its summit by Simon Rojacher, the native owner of a neighbouring gold mine. Due to the initiative of this experienced man, the house may be called a model piece of architecture for mountain regions. It has braved the inclemencies of alpine climate for 40 years, enabling the observers to keep meteorological records running throughout the year, in the region of everlasting snows.

The observations, combined with those taken at base-stations, have been of great importance for the advancement of meteorology. The Alps are, so to say, a laboratory for the meteorologist where he can study the phenomena in and above the cloud-region and the dynamic effects in air flowing up or down the slopes. The Austrian meteorologists, under the leadership of the late Hann and Trabert, have used the data for many investigations, throwing new light on the vertical distribution of temperature in cyclones and anticyclones, the relations between the daily variations of pressure, wind and temperature in the free atmosphere, the amount of water in clouds, etc. The work of Elster and Geitel on atmospheric electricity must also be mentioned.

It has often been thought that modern aerological research work by means of kites, sounding balloons and aeroplanes has reduced the comparative value of mountain observations. These show indeed local influences causing small differences in the conditions of the air on the summit compared with that in the free atmosphere ; but this slight drawback is more than compensated by the high advantage of continuous records for investigational and prognostic work.

The costs for running the observatory have been defrayed by private people united in the Sonnblick-Verein. The bad financial conditions in post-war time nearly crushed the institution, but since 1924 several scientific societies in Austria and Germany have lent support. The present reports deal with this reorganization. They also contain obituaries for Hann and Trabert, several papers of meteorological and alpinistic interest, abstracts of the observations and two splendid photographs of the Sonnblick crowned with snow. During the six years 1919-1924 the highest temperature recorded was +11·9°C (53°F), the lowest −31·6° C (−25°F). The coldest month was February, 1924, with a mean of −15·3° C (4°F), the mildest month was July, 1921, +2·6°C (37°F). The number of days with snowfall per year varies between 119 (1921) and 229 (1919), while the annual precipitation lies between 1,046 and 1,558 mm. The frequency of stormy days (31 % in the year, 41 % in winter) is characteristic for the climate of the peak.

J. BARTELS.

Obituary

Colonel Francisco S. Chaves. It is with much regret that we learn of the death, on July 23rd, of Colonel Chaves, the Director of the Meteorological Service of the Azores. Col. Chaves entered the observatory at Ponta Delgada in 1893, and his association with International meteorology began in 1900 when he was invited to attend a meeting of the Meteorological Committee held in Paris. He was shortly afterwards elected a member of that Committee in place of Admiral de Brito Capello. Realising the importance of meteorological observations in the Azores for the meteorology of Europe and America, Col. Chaves had put forward proposals at Paris for the establishment of an International Meteorological Service in the Azores and had secured the patronage and support of the Prince of Monaco for his project. Subsequently the King of Portugal decided to establish the service at the sole expense of Portugal, and Col. Chaves was charged with the duty of organising the service. This was begun in October, 1901, and the King and Queen of Portugal went to the Azores to lay the first stone of the Meteorological Observatory at Horta. Observatories were established in four of the islands—St. Michael (Ponta Delgada); Fayal (Horta); Terceira (Angra); and Flores (Santa Cruz). Col. Chaves secured a concession from the Eastern Telegraph Company, under which the meteorological telegrams reporting the observations at these stations were transmitted free of all cable charges up to 40 words per day. The first report from the new observatory at Horta was published in the *Daily Weather Report* for December 6th, 1902.

Col. Chaves' achievement was a notable one, but perhaps even more noteworthy than the achievement was the spirit in which it was effected. It is not unusual in International meetings for members either to seek for something which is of value to their own country or to offer services in exchange for services rendered or in anticipation of services to be rendered. Colonel Chaves, when he offered reports from the Azores, attached no conditions to his offer nor did he seek for anything in return. This same spirit in which he began, continued throughout his life, and at all the meetings of the Meteorological Committee or Commissions his sole endeavour was to make the service which he had inaugurated at the Azores more completely useful for European (and American) meteorology.

In 1923 and 1924 he was unable to come to International meetings or to Europe on account of illness, and although he had recovered appreciably early in 1925 he was still not well enough to attend the meeting of the Upper Air Commission in London, in April, 1925. Later, however, he recovered sufficiently to pay another visit to Europe.

He was very desirous that European meteorologists should see the service of the Azores and he had a guest room for them in the Observatory. I remember vividly our last conversation when he was describing the view of an island mountain 7,000 feet high, which I should see from the guest chamber window when I went to see him at the Azores, and how the cloud motion over the top of the mountain was one of the local weather prognostics.

To those who knew the earnestness of this desire of Col. Chaves, the sorrowful news of his death is made the more poignant by the fact that he passed away while Sir Napier Shaw was on his way to the Azores to pay just such a visit to his old friend.

E.G.

The Rev. Herbert Arnold Boys, F.R. Met. Soc. The death of the Rev. H. A. Boys, which took place at St. Mary Bourne, Hants, on July 31st, removes another of the band of voluntary observers who have been associated with the British Rainfall Association almost from its foundation. Mr. Boys was born at Wing Rectory, Rutland, in 1844, and educated at Uppingham and Emmanuel

College, Cambridge, where he was Johnson and Thorpe scholar. He took honours in mathematics, classics and theology, and was ordained in 1869. It was in 1868 that he first came into touch with the late G. J. Symons' Rainfall Association, and at Wing that year he set up a Negretti and Zambra raingauge, which he still had in use at St. Mary Bourne at the time of his death. In 1870 weakness of the lungs forced him to leave England and he became the first English chaplain at Patras, Greece. Here he took regular observations of pressure, temperature and rainfall, and an account of these observations formed his first contribution to *Symons Meteorological Magazine*. This was published in July, 1871, and thereafter for over 50 years he continued a frequent and valued contributor. As late as 1924 he entered with keenness into the discussion on "The Reform of the Calendar," and less than a month before his death he wrote a description of the storms of July 5th, 1926. From 1870 onwards throughout his life he took accurate meteorological observations wherever he was. He wrote a summary of the climate of Algiers, where he was chaplain from 1875 to 1889, and at North Cadbury, Somerset, where he held the living from 1896 to 1921, he started the Mid-Wessex Rainfall Association in 1906 on the lines of the one he had helped Major C. A. Markham with, when he was at Easton Mauduit (1890-1896). He had a fine library and he was an ardent cyclist, continuing to ride until past his 80th birthday. At Cadbury he restored the tower of the magnificent Perpendicular Church at his own expense, and acted for some time as secretary of the Wells and Glastonbury branch of the English Church Union. He married twice.

News in Brief

The Council of the Royal Meteorological Society has awarded the Howard Prize for 1926 to Cadet B. W. Harman, of H.M.S. "Worcester," for the best essay on "The Causes and Distribution of Fog in the North Atlantic."

The Weather of July, 1926

The weather was mainly fair and warm with many thunderstorms during the first part of the month, and unsettled, but with many fine periods during the later part. The first three or four days were fine with high night temperatures especially on the night of the 2nd to 3rd when minima of 55° to 60° were recorded at most stations. On the 4th, low pressure systems began to spread over southern England and Ireland causing unsettled mainly cooler weather with much rain at times and local thunderstorms in the south, while warm cloudy weather continued in Scotland. Rainfall measurements exceeded 30 mm. in several southern places, *e.g.*, 42 mm. (1·67 in.) were recorded at Haughley, Suffolk, on the 5th. On the 8th a general improvement took place and maximum temperatures of over 80° F. occurred in many parts, but on the 9th thunderstorms accompanied in some instances by heavy rain occurred over a wide area. About the 10th an anticyclone passed across France towards Denmark and was associated with a short spell of hot weather in our islands. Each day the temperature rose higher, until on the 14th 89° F. was registered at London (Camden Square) and at Calshot. Meanwhile pressure was rising on the Atlantic, south of Iceland, bringing a supply of air from a more northerly source to Great Britain. This caused cloudier skies and a marked drop in temperature on the 15th, the maximum readings in some cases being more than 20 ° F. lower than on the 14th, *e.g.*, at West Witton the maximum temperature on the 14th was 85° F., on the 15th, 63° F. Temperature rose again, however, during the next few days as the anticyclone moved southeast to the continent, but at the same time a depression was spreading up from the Bay of Biscay. This caused numerous thunderstorms and torrential rain and hail in many places as well as high winds and gales locally. 97 mm. (3·80 in.) fell at Ballycumber (King's Co.), and 91 mm. (3·58 in.) at Lyme Regis (Dorset) on the night of the 17th to 18th, 103 mm. (4·06 in.) at Rhayader on the 18th, and 57 mm. (2·26 in.) at Ilderton (Northumberland) on the 19th. Serious floods occurred in several places as a result of this heavy precipitation. A report from Ross-on-Wye states that the river rose rapidly to 11 feet above its normal. Somewhat unsettled rather cool weather with, however, many fair periods when day temperatures reached 80° F. locally, then prevailed until about the 27th when an anticyclone passed northeastwards to Scotland giving fine warm weather over the whole kingdom. In districts visited by heavy thunderstorms the total rainfall was much above the average, but in others the month was dry, *e.g.*, at Braemar only 28 per cent. of the normal occurred.

Pressure was slightly above normal over the British Isles and western Europe, the excess reaching 3·1 mb. at Wick. Pressure was below normal over the Arctic Ocean, Iceland and the greater part of the North Atlantic and also over central Europe, but the deficit nowhere reached 5 mb. Temperature did not depart greatly from its normal value but the month was generally dry in the centre and west of Europe, the deficit amounting to about 40 per cent. of the normal in parts of Sweden. Heavy rain and the melting of the snow in the mountains caused floods throughout Yugoslavia early in the month. On the 4th and 5th, after a respite of about a week, severe thunderstorms again broke over Germany, northern France and Switzerland. Floods occurred in several parts and several lives were lost. On the 16th a hailstorm devastated the village of Rugovo (Montenegro) and 40 people were killed. During the following days fresh floods occurred in Yugoslavia, and also in Rumania on the 29th.

Heavy rain was experienced in Calcutta on the 21st and 22nd when nearly 12 in. are reported to have fallen in two days. Large areas of the city were flooded. Part of a large building in Bombay collapsed on the 27th as a result of the heavy rain. The monsoon was reported as generally active towards the end of the month. Heavy storms followed by landslides caused much destruction and loss of life in southern Japan about the 7th. On the 25th floods occurred in northern Korea and on the 26th a landslide in southern Korea, 53 people being killed. Nearly 200 people were reported to have been drowned during the severe floods near Tokyo on the 29th.

The total rainfall for the month in Australia was generally slightly below normal, except in the central parts of Western Australia where it was nearly twice the normal and caused floods of unusual magnitude about the 22nd. On the 22nd a tornado passed across Melbourne doing much damage.

The long spell of cool weather which the eastern states of America enjoyed during the spring and early summer was broken on July 9th by a heat wave, lasting two days. This ended in a terrific thunderstorm when the naval ammunition depot at Dover was struck by lightning and many lives were lost. Between the 15th and 20th the Middle West was suffering from a heat wave which passed to the eastern States about the 20th. Temperatures of over 100° F. were registered in many places. At Washington 104° F. was recorded on the 21st, 1° F. higher than the record for July. Windstorms on the 23rd brought an end to the heat wave. A hurricane from the Caribbean Sea swept across the Leeward Islands on the 24th and then over the Bahamas and the east coast of Florida on the 26th. Nassau, Porto Rico and San Domingo suffered the most, and 150 people are believed to be missing from Nassau. Great damage was done to shipping.

The special message from Brazil states that the rainfall in the northern and central regions was scanty, being 70 mm. and 20 mm. below normal respectively, and that the distribution in the southern region was irregular with an average 74 mm. above normal. The atmospheric circulation was normal. The coffee, cane and tobacco crops were suffering from lack of rain. At Rio de Janeiro pressure was 1·1 mb. above normal and temperature 0·7° F. below normal.

Rainfall, July, 1926—General Distribution

England and Wales ..	96	per cent. of the average 1881-1915.
Scotland	90	
Ireland	102	
British Isles	96	

Rainfall: July, 1926: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square	2·08	53	87	*War.*	Birminghm, Edgbaston	1·82	46	78
Sur.	Reigate, Hartswood	1·64	42	78	*Leics*	Thornton Reservoir	2·54	65	102
Kent.	Tenterden, Ashenden	1·93	49	92	,,	Belvoir Castle	2·13	54	88
,,	Folkestone, Boro. San.	1·43	36	...	*Rut.*	Ridlington	2·20	56	...
,,	Margate, Cliftonville	1·33	34	67	*Linc.*	Boston, Skirbeck	1·37	35	62
,,	Sevenoaks, Speldhurst	1·91	49	...	,,	Lincoln, Sessions House	1·45	37	65
Sus.	Patching Farm	2·31	59	96	,,	Skegness, Marine Gdns.	1·37	35	63
,,	Brighton, Old Steyne	1·81	46	83	,,	Louth, Westgate	1·95	50	78
,,	Tottingworth Park	2·60	66	104	,,	Brigg	1·99	51	85
Hants	Ventnor, Roy.Nat.Hos.	1·69	43	84	*Notts.*	Worksop, Hodsock	1·50	38	66
,,	Fordingbridge, Oaklnds	1·32	34	66	*Derby*	Mickleover, Clyde Ho.	1·59	40	65
,,	Ovington Rectory	2·27	58	88	,,	Buxton, Devon. Hos.	3·20	81	81
,,	Sherborne St.JohnRec.	...	..	...	*Ches.*	Runcorn, Weston Pt.	3·97	101	144
Berks	Wellington College	1·99	51	96	,,	Nantwich, Dorfold Hall	3·49	89	...
,,	Newbury, Greenham	2·36	60	106	*Lancs*	Manchester, Whit. Pk.	3·13	79	95
Herts.	Benington House	2·76	70	113	,,	Stonyhurst College	3·34	85	86
Bucks	High Wycombe	2·45	62	124	,,	Southport, Hesketh Pk	3·32	84	116
Oxf.	Oxford, Mag. College	2·64	67	116	,,	Lancaster, Strathspey	4·01	102	...
Nor.	Pitsford, Sedgebrook	2·00	51	85	*Yorks*	Sedbergh, Akay	4·92	125	109
,,	Eye, Northolm	2·14	54	...	,,	Wath-upon-Dearne	1·61	41	64
Beds.	Woburn, Crawley Mill	1·99	51	89	,,	Bradford, Lister Pk.	2·13	54	77
Cam.	Cambridge, Bot. Gdns.	2·28	58	106	,,	Wetherby, Ribston H.	2·01	51	80
Essex	Chelmsford, CountyLab	2·19	56	103	,,	Hull, Pearson Park	1·89	48	81
,,	Lexden, Hill House	2·12	54	...	,,	Holme-on-Spalding	2·02	51	...
Suff.	Hawkedon Rectory	3·30	84	135	,,	West Witton, Ivy Ho.	2·62	67	...
,,	Haughley House	2·94	75	...	,,	Felixkirk, Mt. St. John	1·90	48	70
Norf.	Beccles, Geldeston	1·93	49	83	,,	Pickering, Hungate	2·43	62	...
,,	Norwich, Eaton	1·67	42	65	,,	Scarborough	2·67	68	110
,,	Blakeney	2·13	54	94	,,	Middlesbrough	4·70	119	184
,,	Swaffham	1 38	35	54	,,	Baldersdale, Hury Res.	3·29	84	106
Wilts.	Devizes, Highclere	2·25	57	97	*Durh.*	Ushaw College	...	..	...
,,	Bishops Cannings	2·28	58	92	*Nor.*	Newcastle, Town Moor.	3·75	95	142
Dor.	Evershot, Melbury Ho.	1·82	46	72	,,	Bellingham, Highgreen	3·59	91	...
,,	Creech Grange	1·66	42	...	,,	Lilburn Tower Gdns.	5·25	133	...
,,	Shaftesbury, Abbey Ho.	1·77	45	69	*Cumb*	Geltsdale	3·08	78	...
Devon	Plymouth, The Hoe	·54	14	20	,,	Carlisle, Scaleby Hall	3·54	90	108
,,	Polapit Tamar	2·76	70	103	,,	Seathwaite M.	11·08	281	131
,,	Ashburton, Druid Ho.	1·15	29	38	*Glam.*	Cardiff, Ely P. Stn.	2·27	58	73
,,	Cullompton	1·21	31	45	,,	Treherbert, Tynywaun	4·73	120	...
,,	Sidmouth, Sidmount	3·65	93	145	*Carm*	Carmarthen Friary	3·23	82	92
,,	Filleigh, Castle Hill	2·36	60	...	,,	Llanwrda, Dolaucothy	6·81	173	157
,,	Barnstaple, N.Dev.Ath.	2·63	67	97	*Pemb*	Haverfordwest, School	5·61	142	175
Corn.	Redruth, Trewirgie	1·62	41	53	*Card.*	Gogerddan	6·04	153	156
,,	Penzance, Morrab Gdn.	1·40	35	51	,,	Cardigan, County Sch.	3·08	78	...
,,	St. Austell, Trevarna	1·04	26	31	*Brec.*	Crickhowell, Talymaes	3·20	81	...
Soms	Chewton Mendip	6·24	158	179	*Rad.*	Birm.W.W.Tyrmynydd	6·96	177	169
,,	Street, Hind Hayes	4·36	111	...	*Mont.*	Lake Vyrnwy	6·36	162	185
Glos.	Clifton College	2·48	63	88	*Denb.*	Llangynhafal	6·24	158	...
,,	Cirencester, Gwynfa	2·08	53	79	*Mer.*	Dolgelly, Bryntirion	7·24	184	170
Here.	Ross, Birchlea	2·29	58	101	*Carn.*	Llandudno	3 49	89	146
,,	Ledbury, Underdown	2·25	57	100	,,	Snowdon, L. Llydaw 9	14·55	370	...
Salop	Church Stretton	2·65	67	108	*Ang.*	Holyhead, Salt Island	2·56	65	98
,,	Shifnal, Hatton Grange	...	..	...	,,	Lligwy	2·35	60	...
Staff.	Tean, The Heath Ho.	2·16	55	75	*Isle of Man*				
Worc.	Ombersley, Holt Lock	2·08	53	97		Douglas, Boro' Cem.	2·98	76	97
,,	Blockley, Upton Wold	2·25	57	93	*Guernsey*				
War.	Farnborough	2·38	60	93		St. Peter P't, Grange Rd	1·20	31	59

Rainfall: July, 1926: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	3·16	80	109	*Suth.*	Loch More, Achfary	3·00	76	56
,,	Pt. William, Monreith	3·03	77	...	*Caith*	Wick	1·56	40	59
Kirk.	Carsphairn, Shiel	4·44	113	...	*Ork.*	Pomona, Deerness	1·63	41	63
,,	Dumfries, Cargen	...	..	...	*Shet.*	Lerwick	1·12	28	49
Roxb	Branxholme	2·84	72	94					
Selk.	Ettrick Manse	4·73	120	...	*Cork.*	Caheragh Rectory	2·42	61	...
Berk.	Marchmont House	3·50	89	115	,,	Dunmanway Rectory	3·75	95	96
Hadd	North Berwick Res.	3·61	92	140	,,	Ballinacurra	3·23	82	116
Midl	Edinburgh, Roy. Obs.	2·76	70	105	,,	Glanmire, Lota Lo.	1·94	49	67
Lan.	Biggar	3·45	88	119	*Kerry*	Valencia Obsy.	...	..	...
,,	Leadhills	5·59	142	...	,,	Gearahameen	3·00	76	...
Ayr.	Kilmarnock, Agric. C.	3·90	99	125	,,	Killarney Asylum	2·57	65	77
,,	Girvan, Pinmore	4·17	106	114	,,	Darrynane Abbey	2·24	57	59
Renf.	Glasgow, Queen's Pk.	3·35	85	115	*Wat.*	Waterford, Brook Lo.	3·60	91	111
,,	Greenock, Prospect H.	3·21	82	82	*Tip.*	Nenagh, Cas. Lough	4·91	125	156
Bute.	Rothesay, Ardencraig	3.50	89	88	,,	Tipperary	3·68	93	...
,,	Dougarie Lodge	3·45	88	...	,,	Cashel, Ballinamona	2·11	54	73
Arg.	Ardgour House	7·61	193	...	*Lim.*	Foynes, Coolnanes	2·65	67	86
,,	Manse of Glenorchy	6·40	163	...	,,	Castleconnell Rec.	3·90	99	...
,,	Oban	3·73	95	...	*Clare*	Inagh, Mount Callan	3·64	92	...
,,	Poltalloch	4·10	104	99	,,	Broadford, Hurdlest'n.	5·05	128	...
,,	Inveraray Castle	6·29	160	126	*Wexf*	Newtownbarry	...	..	...
,,	Islay, Eallabus	3·65	93	107	,,	Gorey, Courtown Ho.	3·84	98	131
,,	Mull, Benmore	11·60	295	...	*Kilk.*	Kilkenny Castle	2·97	75	105
Kinr.	Loch Leven Sluice	4·77	121	166	*Wic.*	Rathnew, Clonmannon	1·96	50	...
Perth	Loch Dhu	3·70	94	77	*Carl.*	Hacketstown Rectory	2·80	71	81
,,	Balquhidder, Stronvar	2·64	67	61	*QCo.*	Blandsfort House	3·05	77	97
,,	Crieff, Strathearn Hyd.	2·49	63	84	,,	Mountmellick	2·55	65	...
,,	Blair Castle Gardens	2·10	53	82	*KCo.*	Birr Castle	5·00	127	169
,,	Coupar Angus School	2·79	71	118	*Dubl.*	Dublin, FitzWm. Sq.	2·30	58	90
Forf.	Dundee, E. Necropolis	3·18	81	116	,,	Balbriggan, Ardgillan	2·86	73	106
,,	Pearsie House	2·18	55	...	*Me'th*	Drogheda, Mornington	...	..	...
,,	Montrose, Sunnyside	2·23	57	85	,,	Kells, Headfort	4·07	103	128
Aber.	Braemar, Bank	·72	18	28	*W.M*	Mullingar, Belvedere	4·68	119	147
,,	Logie Coldstone Sch.	1·80	46	61	*Long*	Castle Forbes Gdns.	2·58	65	83
,,	Aberdeen, King's Coll.	2·40	61	85	*Gal.*	Ballynahinch Castle	3·04	77	73
,,	Fyvie Castle	2·18	55	...	,,	Galway, Grammar Sch.	2·39	61	...
Mor.	Gordon Castle	1·74	44	54	*Mayo*	Mallaranny	4·01	102	...
,,	Grantown-on-Spey	2·63	67	86	,,	Westport House	2·31	59	75
Na.	Nairn, Delnies	1·70	43	63	,,	Delphi Lodge	4·82	122	...
Inv.	Ben Alder Lodge	3·37	86	...	*Sligo*	Markree Obsy.	2·59	66	75
,,	Kingussie, The Birches	2·11	54	...	*Cav'n*	Belturbet, Cloverhill	4·02	102	129
,,	Loch Quoich, Loan	7·40	188	...	*Ferm*	Enniskillen, Portora	...	..	...
,,	Glenquoich	...	..	...	*Arm.*	Armagh Obsy.	3·13	79	108
,,	Inverness, Culduthel R.	1·67	43	...	*Down*	Warrenpoint	2·82	72	...
,,	Arisaig, Faire-na-Squir	3·63	92	...	,,	Seaforde	2·81	71	88
,,	Fort William	5·12	130	106	,,	Donaghadee, C. Stn.	2·65	67	95
,,	Skye, Dunvegan	3·07	78	...	,,	Banbridge, Milltown	3·72	94	114
,,	Barra, Castlebay	1·86	47	...	*Antr.*	Belfast, Cavehill Rd.	4·22	107	...
R&C	Alness, Ardross Cas.	1·92	49	63	,,	Glenarm Castle	3·77	96	...
,,	Ullapool	2·83	72	...	,,	Ballymena, Harryville	4·94	125	144
,,	Torridon, Bendamph.	5·87	149	108	*Lon.*	Londonderry, Creggan	3·31	84	90
,,	Achnashellach	3·46	88	...	*Tyr.*	Donaghmore	5·58	142	...
,,	Stornoway	1·86	47	61	,,	Omagh, Edenfel	3·49	89	103
Suth.	Lairg	2·06	52	...	*Don.*	Malin Head	3·17	81	112
,,	Tongue Manse	2·32	59	76	,,	Dunfanaghy	2·47	63	72
,,	Melvich School	1·65	42	59	,,	Killybegs, Rockmount	5·26	134	120

Climatological Table for the British Empire, February, 1926

STATIONS	PRESSURE: Mean of Day M.S.L. mb.	PRESSURE: Diff. from Normal mb.	TEMPERATURE Absolute: Max. °F.	TEMPERATURE Absolute: Min. °F.	TEMPERATURE Mean Values: Max. °F.	TEMPERATURE Mean Values: Min. °F.	TEMPERATURE Mean Values: ½ max. and min. °F.	TEMPERATURE Mean Values: Diff. from Normal °F.	TEMPERATURE Mean: Wet Bulb °F.	Relative Humidity %	Mean Cloud Am'nt 0—10	PRECIPITATION: Am'nt mm.	PRECIPITATION: Diff. from Normal mm.	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible
London, Kew Obsy.	1011·4	− 4·6	57	27	50·4	40·9	45·7	+ 5·6	42·6	91	8·3	58	+ 19	18	1·6	17
Gibraltar	1020·3	+ 0·3	68	50	62·8	54·3	58·5	+ 2·6	53·2	81	7·1	95	− 12	8	...	...
Malta	1018·0	+ 1·3	66	52	60·5	54·0	57·3	+ 2·0	54·1	88	6·6	23	− 33	7	5·3	49
St. Helena	1012·0	+ 2·7	73	60	71·6	61·7	66·7	+ 0·3	63·4	91	4·6	82	− 15	18	...	...
Sierra Leone	1011·4	+ 0·6	93	71	89·3	74·0	81·7	− 0·6	73·3	76	2·3	0	− 8	0	...	...
Lagos, Nigeria	1008·4	− 1·7	93	72	90·7	78·0	84·3	+ 2·1	78·7	85	7·9	76	+ 23	5	...	...
Kaduna, Nigeria	1013·2	+ 1·2	95	54	91·0	61·9	76·5	− 0·4	54·0	14	3·5	5	+ 4	1	...	...
Zomba, Nyasaland	1014·4	+ 0·4	88	61	82·0	66·1	74·1	+ 2·2	...	88	8·6	326	+ 57	24	...	...
Salisbury, Rhodesia	1008·0	− 0·5	84	56	79·6	61·9	70·7	+ 1·9	65·2	77	7·8	141	− 47	22	6·0	47
Cape Town	1014·6	+ 1·3	86	49	78·5	58·5	68·5	− 2·0	60·6	74	4·4	21	+ 8	5	...	...
Johannesburg	1010·5	+ 0·2	86	54	80·0	58·1	69·1	+ 3·7	60·4	71	3·6	72	− 61	11	8·8	68
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	97	49	82·8	58·9	70·9	− 1·0	61·7	53	2·3	83	− 5	6	...	...
Calcutta, Alipore Obsy.	1013·7	+ 0·4	92	56	84·7	62·7	73·7	+ 2·7	63·9	85	3·6	20	− 8	2*	...	...
Bombay	1012·8	+ 0·1	89	68	84·3	71·4	77·9	+ 2·3	68·2	74	2·0	0	− 1	0*	...	...
Madras	1013·9	+ 1·0	93	64	87·3	68·3	77·8	+ 0·1	73·0	87	1·2	0	− 8	0*	...	...
Colombo, Ceylon	1011·3	+ 0·2	93	68	89·2	71·9	80·5	+ 0·8	74·5	69	3·5	4	− 41	2	9·5	80
Hong Kong	1019·8	+ 1·1	74	49	63·9	57·3	60·6	+ 1·5	56·9	81	9·3	61	+ 20	6	2·4	21
Sandakan	...	...	89	73	86·1	74·7	80·4	+ 0·3	76·4	81	...	209	− 35	5	...	...
Sydney	1012·9	− 1·2	108	61	83·7	68·0	75·9	+ 4·6	69·2	62	4·5	27	− 81	6	7·8	58
Melbourne	1013·0	− 1·5	104	46	82·3	57·5	69·9	+ 2·5	59·3	49	4·5	1	− 43	1	8·4	62
Adelaide	1013·5	− 0·8	104	51	88·0	61·8	74·9	+ 0·8	60·0	35	4·5	26	+ 9	4	9·3	70
Perth, W. Australia	1015·2	+ 2·2	101	54	79·7	61·2	70·5	− 3·6	63·2	58	4·2	15	+ 3	5	9·3	70
Coolgardie	1012·3	− 0·2	110	50	92·5	63·4	77·9	+ 1·9	61·9	42	1·9	41	+ 22	2	...	...
Brisbane	1014·7	+ 2·2	94	67	87·3	71·0	79·1	+ 2·6	72·1	67	4·4	30	−127	3	9·1	70
Hobart, Tasmania	1007·7	− 5·8	91	45	73·2	53·5	63·3	+ 0·9	53·9	54	6·3	36	− 1	11	8·4	61
Wellington, N.Z.	1008·8	− 7·0	72	46	66·9	53·6	60·3	− 2·2	55·9	71	6·4	67	− 13	9	7·2	53
Suva, Fiji	1008·0	+ 0·3	85	70	80·0	73·8	76·9	− 3·6	75·0	93	9·5	429	+172	26	1·3	10
Apia, Samoa	1007·4	− 1·0	89	75	86·0	77·1	81·5	+ 2·5	79·0	81	6·8	250	−149	19	4·6	37
Kingston, Jamaica	1015·1	− 0·2	90	65	85·4	68·7	77·1	+ 0·6	66·8	84	4·3	25	+ 10	7	1·8	16
Grenada, W.I.	1014·8	+ 1·5	86	70	83·7	72·4	78·1	+ 1·0	72·3	76	3·9	36	− 35	15	...	...
Toronto	1013·5	− 4·5	40	1	27·7	14·3	21·0	− 0·7	17·3	72	7·7	75	+ 9	18	3·0	29
Winni[illegible]	1015·6	− 6·2	39	−20	21·1	4·5	12·8	+13·4	...	...	7·0	15	− 6	12	3·6	36
St. [illegible]n, N.B.	1006·8	− 7·3	39	− 3	25·0	10·8	17·9	− 2·0	13·7	69	6·0	114	+ 15	14	4·6	45
[illegible]ia, B.C.	1013·4	− 2·5	57	37	50·4	41·5	45·9	+ 5·6	42·2	88	8·0	61	− 29	19	2·6	26

*For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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British Association for the Advancement of Science

OXFORD MEETING, AUGUST 4TH TO 11TH, 1926

IT is generally agreed that the Oxford Meeting of the British Association was one of the most successful in its long history. To that very satisfactory result many people both within and without the Association contributed. The fact that the Presidential Chair was occupied by H.R.H. The Prince of Wales, and that the University and City of Oxford were the hosts for the meeting undoubtedly helped considerably to augment the numbers attending. It was, however, not so much the presence of some three thousand five hundred people which made the occasion memorable, as the enthusiasm and scholarship of the contributors of papers, and the co-operation of many active workers in planning and carrying out the various social functions; both the scientific side and the social side of the meeting were unqualified successes. A not unimportant contributor to this desirable result was the weather.

Throughout the period the weather was remarkably good. On only two mornings did it rain with any intensity, and on each of these occasions the sky cleared in time for the afternoon outdoor programmes to be completed in brilliant sunshine. In this respect therefore meteorology was a prominent favourite, but as a science amongst its sisters it took but a very poor place.

Wt 69—P 1 1000 9/26 M & C

At Southampton in 1925 meteorology was well to the fore, partly owing to the fact that the Director of the Meteorological Office was President of Section A (Mathematics and Physics), but this year there was not a single paper on meteorology read in Section A, neither did the subject find a place in the programmes of any other Section as it has done in past years.

In spite, however, of this regrettable absence of papers on the subject, meteorology was not allowed to be forgotten, for the Meteorological Office, at the request of the Council of the Association, staged a large exhibit and demonstration in a commodious room in the University Museum. The exhibition comprised a comprehensive selection of meteorological instruments, including those used in the investigation of atmospheric pollution and upper air conditions, together with the usual climatological ones, such as wind, temperature and rainfall instruments. With these were shown numerous photographs, of which some splendid cloud studies were prime favourites with visitors; and many diagrams and maps, some illustrating the various sides of the activities of the Office, and others showing the special lines on which private investigators are working, prominent in their topical appeal being some seismograms from Kew recording the recent earthquake in the Channel Islands.

The demonstration of forecasting was equally popular. With the collaboration of the Signals Branch of the Air Ministry, who erected a wireless receiving station, synoptic charts for north-western Europe were drawn twice daily, those for 0700 and 1300, entirely from broadcast data, thus demonstrating the possibilities made general by the use of wireless in meteorology. On the 0700 chart a forecast was prepared for the Oxford district, which was made available to all members by its issue on a "Local Daily Weather Report" prepared and duplicated complete with weather map and other data in the exhibition. This Report was circulated daily by means of scouts to the Reception Room of the Association, to all meeting places of the various Sections, and to all the Colleges which were housing members of the Association. By 11 a.m. each morning the whole of Oxford was posted with its own weather report.

From the great interest evinced by the many visitors both in the display of equipment and in the demonstration it was evident that the policy of the Meteorological Office in this matter was amply justified.

The great day of Meteorology was the Tuesday before the Association broke up its meeting. On that day the annual Meteorological Luncheon was held, and both in venue and the numbers who attended it proved to be the most memorable of the series. It was found possible to hold the function in the Hall of a College, the Warden of Keble College being kind enough to place his resources at our disposal. The suitable atmosphere thus immediately created ensured the success of the Luncheon, and when it is mentioned that the large number of 69 sat down in the beautiful Hall under the Chairmanship of Dr. G. C. Simpson it can be realized that the scene was a notable one. The following were present :—

Dr. G. C. Simpson, C.B., F.R.S. (in the Chair) ; Colonel Sir Henry Lyons, F.R.S., Lady Lyons and Miss Lyons ; Professor A. S. Eddington ; Dr. Annie J. Cannon ; Sir Richard Gregory ; Professor A. Fowler, F.R.S., and Mrs. Fowler ; Lady Lockyer ; Sir Frank Dyson, K.B.E., F.R.S., Astronomer Royal ; Sir Gilbert Walker, F.R.S., President of the Royal Meteorological Society ; Professor H. H. Turner, F.R.S., and Mrs. Turner ; Professor Louis Vessot King, F.R.S. ; Dr. Vaughan Cornish ; Dr. Harold Jeffreys, F.R.S. ; Major G. M. B. Dobson ; Mr. R. S. Whipple ; Mr. H. Knox Shaw ; Professor E. A. Milne, F.R.S. ; Professor Herbert Dingle ; Professor H. C. Plummer, F.R.S., and Mrs. Plummer ; Dr. W. J. S. Lockyer and Mrs. Lockyer ; Professor R. S. Troup, F.R.S. ; Dr. J. S. Owens and Mrs. Owens ; Professor Carroll M. Sparrow ; Professor A. M. Tyndall, Recorder of Section A ; Mr. M. A. Giblett and Mr. W. M. H. Greaves, Secretaries of Section A, and Mrs. Greaves ; Professor H. Stansfield ; Dr. J. K. Fotheringham and Mrs. Fotheringham ; Mr. A. Stevens ; Professor Albert Gilligan ; Dr. H. Borns ; Mrs. A. M. E. Neville ; Dr. A. D. Gardner and Mrs. Gardner ; Mr. F. Debenham and Mrs. Debenham ; Dr. Sturrock and Mrs. Sturrock ; The Reverend Father Lynch, S.J. ; Mr. M. J. B. Davy and Mrs. Davy ; Miss Gertrude Bacon ; Mr. J. J. Shaw and Mrs. Shaw ; Mr. L. H. G. Dines ; Miss E. E. Austin ; Mr. J. D. Fry ; Mr. N. K. Johnson ; Mr. J. Wadsworth ; Mr. J. Hughes ; Mr. W. W. Jervis ; Mr. Joseph Lunt ; Dr. R. Madwar ; Mr. W. M. Witchell ; Mr. E. W. Bliss ; Mr. E. W. Shurlock ; Mr. A. P. Hollis ; Mr. M. F. Budden ; Mr. A. Pearse Jenkins ; and Mr. R. H. Mathews.

During the course of the Luncheon the Chairman first called for the customary loyal toast, and then the company proceeded with the subjoined toast list :—

1. The Success of the Sister Sciences : Meteorology, Astronomy and Seismology.
   Proposer : Sir R. Gregory.
   Seconder : Dr. Vaughan Cornish.
   Reply : Astronomy—Professor A. S. Eddington.
   Meteorology—Sir G. Walker.
   Seismology—Professor H. H. Turner.

2. The Continued Success of the British Association, especially in Section A.
   Proposer : Sir F. Dyson.
   Seconder : Sir H. Lyons.
   Reply : Professor A. Fowler.

During the speeches reference was made to the recent honours conferred by the King on Sir Frank Dyson, Sir Henry Lyons and Dr. G. C. Simpson. Professor Turner added to our merriment by singing, to the tune of "The British Grenadiers," the following song, which was introduced by Australians at the beginning of the Great War. It was an event to hear the whole company made to join in a repetition of the last line of each stanza as a chorus.

Meteorology *

Some talk of Astrophysics, and some of Educa-
Tion, while shells and bullets whizz, sixteen thousand miles away.
No disrespect is meant to them, nor yet to Botany,
If we sing just now, with a tow-row-row, of Meteorology.

Some use the millimetre, and some the millibar,
And for the thermometer, there's Réaumur, Cent., and Fahr.
But we'll sink all these distinctions, and all united be
When we sing right now, with a tow-row-row, of Meteorology.

Some praise the dirigible, and some the aeroplane,
We need not stop to quibble, the points of both are plain.
But let me make confession, the dream of bliss for me,
Is to go to the Moon, with a "sounding-balloon," for Meteorology.

Some folk are fond of roses, in gardens or in rooms,
And some of country posies, and some of hothouse blooms.
Let each one have his fancy, the "rose of the winds" for me!
This lovely flower I draw by the hour, for Meteorology.

We toast "our wives and sweethearts," and also "absent friends,"
Both these will cause to beat hearts, till human nature ends,
But I hope you'll drink in bumpers the toast that appeals to me
'Tis Hip, Hip, Hooray! for Australia, and Meteorology.

After the Luncheon a registering balloon was released by Mr. L. H. G. Dines from the Quadrangle of the College in the presence of the assembled company, who then dispersed, some to visit the exhibit in the Museum opposite.

That evening meteorology was again prominent, for during the course of a Conversazione held in the Museum, Dr. G. C. Simpson gave a short lecture on "Weather Forecasting," accompanied by the projection of some excellent slides, and the Meteorological Office Exhibition was kept open and the 1800 chart drawn. On this occasion there was a continual stream of visitors through the exhibition room, and the lecture room was filled to overflowing. Undoubtedly interest in meteorology is growing apace.

R. H. MATHEWS.

Erratum

With reference to the statement on page 159 of the *Meteorological Magazine* that a minimum temperature of − 24° F. was recorded at a height of 21,000 feet on Mount Everest, Mr. F. J. W. Whipple points out that this reading was obtained from a thermometer with its bulb freely exposed, about one foot above the surface of the snow, and is not a shade minimum.

*From *The Observatory*, Vol. XXXVII. (1914), p. 430.

OFFICIAL NOTICES

A Course of Training for Observers

The Fourth course of training for Meteorological observers provisionally arranged for the week April 19th to April 24th, as intimated in the February issue of this Magazine, but unavoidably postponed will now be held during the week September 27th to October 2nd at Kew Observatory, Richmond.

The subjects to be dealt with include the following :—

Meteorological instruments and methods of observation.

Recording of observations and their transmission to the Meteorological Office.

The Weather Map : charting of observations distributed by wireless telegraph.

Climatology.

The course is addressed primarily to observers at stations which report regularly to the Meteorological Office. Others will, however, be admitted, at the discretion of the Director, as far as the accommodation permits. Applications for tickets of admission should be made to the Director, Meteorological Office, Air Ministry, Kingsway, London, W.C. 2. There will be no fee for the course, but travelling and other incidental expenses incurred by observers attending the course will in no case be paid by the Meteorological Office.

Meteorological Ground Signals at Lympne Aerodrome

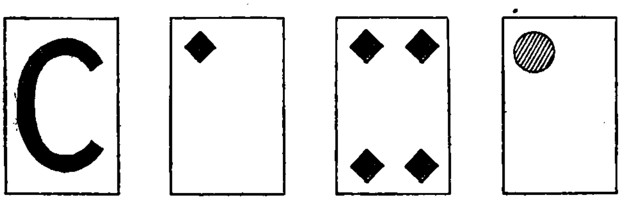
In the *Meteorological Magazine* for November, 1920, reference was made to a system of cloud and visibility signals which had been installed at Lympne Aerodrome to indicate to pilots flying on the air routes between Croydon and the Continent, the height of cloud and the visibility at neighbouring aerodromes.

A revised system of ground signals has been recommended recently by the International Commission for Air Navigation and is being introduced on the London—Paris—Brussels routes. The new system was brought into operation at Lympne on 15th August. For each station for which information is displayed, there are four large white rectangular panels arranged in a line. On the first panel, reading from left to right is a single capital letter, permanently fixed, which indicates the station to which the information refers. The second and third panels bear red diamond-shaped marks, arranged as on a playing card. The diamonds are hinged along one diagonal and when closed are indistinguishable from their white background. In this way, any number of diamonds from 1 to 9 can be exposed, the number indicating, according to fixed scales, the height of the lowest cloud and the visibility respectively.

A variation from the normal arrangement of diamonds in a playing card is made in the case of the lowest cloud height in the cloud height scale and the lowest distance of visibility in the visibility scale, each of which is indicated by one diamond in the top left-hand corner of the appropriate panel. Also the second lowest cloud height or distance of visibility is indicated by one diamond exposed in the centre of the panel. For values higher in the scale of cloud height or visibility the diamonds are arranged from 2 to 9 in the usual way.

The fourth panel is only utilised when one of four adverse weather phenomena is reported, namely, rain or drizzle ; snow, hail or sleet ; thunderstorm or line-squall ; gale. Each of the four groups is represented by an appropriate symbol which can be exposed or shielded at will.

A typical ground signal would be :—



indicating

Croydon.	Lowest cloud below 150 feet.	Visibility between 1,000 and 2,000 yards.	Rain or drizzle.

By the simple arrangement described above, a pilot flying over Lympne can see at a glance from the air the weather conditions prevailing at Biggin Hill and Croydon, if he is flying towards London, or at St. Inglevert, near the French coast, if he is proceeding across the Channel. The information is kept up to date, reports being received at Lympne from each of the three stations every hour during the period that flying is in progress and even more frequently if important changes in the weather conditions occur between two regular hours of observation.

Official Publications

Annual Report of the Meteorological Committee to the Air Council for the year ended 31st March, 1926 (M.O. 288).

PROFESSIONAL NOTES—

No. 45. *The Comparison of Sunshine Recorders of the Campbell-Stokes Type.* A report prepared in the Meteorological Office, London, at the request of the International Meteorological Committee. (M.O. 273*e*).

This paper gives the results of a comparison carried out at Kew Observatory between three sunshine recorders of Campbell-Stokes pattern, exposed side by side under identical conditions. Causes likely to produce slight variations in the records are discussed, and the general conclusion is reached that the maximum duration is likely to be recorded by an instrument in close agreement with the Meteorological Office specification.

Correspondence

To the Editor, *The Meteorological Magazine*

A Proposal for a Meteorological Cruise in the Atlantic in 1927

The lamented death of Colonel Chaves on 23rd July, which was the subject of a sympathetic notice in the *Meteorological Magazine* for August, brought to a close a career of devotion to the science of meteorology which deserves exceptional recognition.

Towards the close of the nineteenth century when the islands of the Azores were connected by cables with both the eastern and the western shores of the Atlantic, Colonel Chaves extended the meteorological organisation of the archipelago from Ponta Delgada to include stations at Horta, Angra do Heroismo and Flores. The ideas with which the new stations were established are set out in a brochure, published at Monaco in the year 1900, under the auspices of the late Prince Albert, who was himself much interested in the islands from the point of view of meteorology and oceanography. The prospective stations mentioned in the volume include one on the island of Pico, a volcanic cone which reaches to a height of 7,500 feet and is a commanding figure in the group, but that part of the scheme is attended by special difficulties. The observations at the other stations were sent to Europe and to America free of any charge.

It is customary for observations to be transmitted between the meteorological services of different countries by way of exchange; those of the Azores were offered without any reciprocal contribution on the part of the continental services. Indeed the provision for transmission of the observations was incorporated by the Portuguese Government in the concessions for the cables. In this respect Colonel Chaves's contribution to the study of the meteorology of the globe may be described as unique.

The islands from which the observations are derived form parts of a volcanic archipelago on about the same latitude as Lisbon, 38° to 40° north, and are in themselves well worth visiting ; they are however seldom visited because the steamship lines crossing the Atlantic, with few exceptions, do not touch there ; apart from the boats which bring the season's pineapples to Europe, the ordinary facilities for getting from one of the islands to the others are limited to the boats of the Empresa Insulana of Portugal, which make the voyage from Lisbon to Madeira and thence to the Azores and back, but only one of the two extends the voyage to Flores the most western of the Islands.

The geology of these mid-Atlantic islands is of much interest as well as their meteorology, and the services which Colonel Chaves has rendered are so exceptional that meteorologists may be disposed to avail themselves of an opportunity for a special visit to the Islands, and to use the occasion to pay a tribute to the memory of the founder of the Meteorological Service of the Azores.

The best time of the year for the visit would be mid-summer when the days are long, the weather fine, the often vexed Atlantic smooth enough for a pleasure cruise, and the temperature at sea in those latitudes neither too warm nor too cold for comfort. There is an eclipse of the sun on the 29th June next year, of which the line of totality crosses the Irish Sea, and this might be taken as a starting point.

If a sufficient number of readers of the Magazine and their friends would join in a cruise of about 25 days, beginning with 28th June, to see the eclipse at sea and thereafter visit the Azores, we would endeavour to make the necessary arrangements, either with a British Company or with the Empresa Insulana.

It will be remembered that a conference of meteorologists, at which there would be time to discuss papers as well as read them, has often been projected, and was in prospect for the autumn of 1914. The present occasion invites a revival of that idea under the exceptionally favourable conditions of life at sea. The co-operation of meteorologists from other countries would, of course, be welcomed, and is not difficult to arrange, because some of the lines of steamers between the United States and the Mediterranean call at Ponta Delgada in the Island of San Miguel and at Madeira, and could bring friends from the South or West.

We write this note to ask those who would be disposed to join in such a cruise to communicate with one of us as speedily as possible.

(Sgd.) C. J. P. Cave.
Napier Shaw.

2nd September, 1926.

Fishing Weather

The following paragraph occurs as a footnote to a paper "On Barometer Indicators," published in the *Report of the Council of the British Meteorological Society for the 11th Annual General Meeting*, 1861, June 12, pp. 35-48 (p. 47) :—

> "Attention has of late been directed to the influence of temperature with the adventures of the fisherman. Sir Francis Chantry, the well-known eminent sculptor, who was fond of fishing, always carried a thermometer, and based his anticipations of success on the relative temperature of the air and water. Important and practical deductions have been formed in the herring fishery from the varying temperature of the sea, by attention to which a sort of geometrical scale has been formed as to the greater or less probabilities of the take of fish."

In recent years meteorologists have been paying much attention to the difference of temperature between sea and air, but I do not think they have taken its influence on the behaviour of fish into consideration. Is there any record of Chantry's experience ?

F. J. W. WHIPPLE.

Kew Observatory, Surrey. August 3rd, 1926.

[We cannot trace any record of Chantry's experience, but the general opinion of anglers, as quoted by F. G. Aflalo (*Fishermen's Weather*, London, 1906), is that the most favourable conditions are experienced when the water is warmer than the air. It seems probable, however, that this refers mainly to fish which feed on fly : warm water and cold air would mean that the fish would be active, but their natural food supply would be scanty, so that the attractiveness of the bait would be enhanced. The relation of the herring fishery to temperature is a different problem, depending on the strength and direction of the warm currents which bring their food supply.

In looking up references, a curiosity was found in *Nature*, Vol. 25, 1882, p. 229, to the effect that the temperature can be estimated very closely from the rate of the cricket's chirp :— "Take 72 as the number of strokes per minute at 60° F., and for every four strokes more add 1° ; for every four strokes less deduct the same." Ed. *M.M.*]

Anti-Crepuscular Rays

A very good reflection of the sunset from an eastern part of the horizon was visible here on Sunday last, August 22nd, between 7.35 and 7.50 p.m. The sun was shining brightly at the time, and near the western horizon, whilst in the opposite direction several "rays" were seen, in fan-shaped formation and of a bright pink hue, as if emanating from one source. I noticed that when a bank of alto-stratus cloud passed in the vicinity that the rays were visible under the cloud and not above it. I may add that the air was remarkably clear, the Houses of Parliament, St. Paul's and the Tower being clearly observed, as well as the Crystal Palace.

The place of observation was Richmond Park, near Penn Ponds.

A. HARRISON.

36, *Rosemont Road, Richmond. August 24th*, 1926.

NOTES AND QUERIES

Variations in the Atmospheric Pressure at the 20-kilometre Level

It has been established by more than one investigator* that at a height of 20 km. above sea level the variations in the atmospheric pressure are insignificant as between cyclonic and anticyclonic areas, but there is sometimes a tendency to go further than this and to imply that in this region the pressure is not subject to any appreciable variation.†

An endeavour has been made to discover what variations actually exist, and to that end the British observations by means of registering balloons between the years 1909 and 1925 inclusive have been examined, and about 60 of them found to have reached a height of 19 km. or more. The data are fairly well distributed over the four seasons of the year, but have a tendency to be grouped around certain epochs in a manner which somewhat spoils their independence. When, as happened once or twice, several soundings were available on the same day, selection was made to avoid the inclusion of two or more in close proximity of place and time.

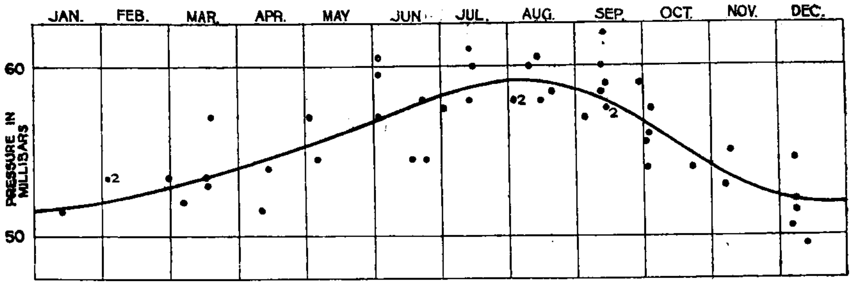
Finally 48 were selected, which occurred in the two distinct periods 1909-1913 and 1924-1925; the winter season is less well represented than the other three. When a height of not more than 19 km. was attained the pressure at 20 km. was computed from that at 19 by assuming that the temperature of the layer 19-20 was the same as that recorded at 19; since the vertical temperature gradient at this height is always very small, such a

* See, The vertical temperature distribution in the atmosphere over England. By W. H. Dines. *London. Phil. Trans. A.* Vol. 211; and "Winds and temperature gradients in the stratosphere." By G. M. B. Dobson. *London. Q. J. R. Met. Soc.* Vol. XLVI. No. 193.

† See, Meteorology. By A. E. M. Geddes, pp. 232 and 276.

procedure is justifiable and not likely to introduce an error exceeding 0·1 mb.

It was found that the pressure at 20 km. was subject to a well marked seasonal variation about an annual mean of 55·2 mb. The individual data are shown plotted in the figure, with a smoothed curve drawn through them. Owing to the fewness of the observations the latter must be regarded as to some extent a provisional estimate of the true curve of annual variation, but it is probable that it represents the main features, and denotes



the magnitude to within a millibar or two. This conclusion is supported by the fact that when further selection of the data was made by including only such soundings as were made under nocturnal or twilight conditions (29 in all), a curve of the same shape was obtained with an annual range of about 1 millibar less.

The departures of the individual observations shown in the figure from the mean curve were tabulated, and their standard value found to be 1·7 mb. How far this is due to real variations of pressure it is not at present possible to say ; so many small sources of error in measurement exist that until more observations are available, or the accuracy of observation is increased, it will not be possible to settle the point with certainty.

L. H. G. Dines.

Memoirs of The Royal Meteorological Society

The volumes of the Quarterly Journal of the Royal Meteorological Society for the past few years have contained a number of papers devoted to the theoretical aspects of meteorology, contributed by specialists in the different branches of the subject. Papers of this nature are of very great scientific value, but their treatment frequently necessitates the use of advanced mathematical methods, such as are beyond the equipment of many of the Fellows. Moreover, their publication was a heavy drain on the Society's limited resources, and the Council found itself unable to provide space in the Journal for many matters which, though of wider interest, were of less scientific importance.

In 1925, as announced in the Report of the Council, the Royal Society acceded to an application from the Council for the allocation of a sum of £150 from the Government Publication Grant, and the Council decided to utilise this sum in the publication of a series of " Memoirs."

The object of this series, which is to be independent of the Quarterly Journal, is to provide " for the publication of papers involving highly technical methods of presentation." Three " Memoirs " have now been published, and their titles give an indication of the scope which the series is likely to attain. They are :—

" Diffusion over Distances ranging from 3 km. to 86 km.," by Lewis F. Richardson, B.A., F.Inst.P., and Denis Proctor.

" The Single-Layer Problem in the Atmosphere and the Height-Integral of Pressure," by Lewis F. Richardson, D.Sc., and Russell E. Munday (Exhibitioner of Jesus College, Oxford).

" The Six-hourly Variations of Atmospheric Pressure and Temperature," by S. K. Pramanik, M.Sc., D.I.C. (U.P. Government Scholar, Imperial College of Science and Technology, London). Communicated by Prof. S. Chapman, F.R.S.

Abstracts of the Memoirs are being published in the Quarterly Journal for reference, but the Memoirs will not necessarily be read before meetings of the Society.

The first Memoir is intended to link up the work of Taylor and others on diffusion over distances of a few hundred metres, with that by Defant on diffusion over distances of the order of 1,000 km. For this purpose two sets of records are available—the scattering of pilot balloons loosed from the same place within a short interval of time, and the scattering of volcanic ash erupted from Asama, Japan, in December, 1920. The balloon records employed were mainly those resulting from the toy balloon " races " organised by Major J. M. MacLulich at Brighton. The results show a scattering from the mean track of 10 km. to 86 km. for the volcanic ash, and of 3 km. to 49 km. for the balloons, and confirms the suggestion obtained from previous work that the diffusivity increases with the scale of the phenomena studied.

In the second Memoir a number of theorems on the " single layer " are propounded and established theoretically, and from the published records of registering balloons certain conclusions are drawn. Nothing was found in the observations to justify the hope that the atmosphere could be treated as a single dynamical layer, while it is concluded that " Laplace's equations for *free* tidal oscillations in an ocean of uniform depth are a very bad description of ordinary disturbances of the European atmosphere."

In the third Memoir on the six-hourly variations of pressure and temperature, observational data for a large number of stations were utilized. Tables are given with stations arranged in order of increasing latitude in 10° zones from 0°—60° latitude, no distinction being made between places in the northern and southern hemispheres. The annual mean amplitude of the pressure variation does not vary much with latitude between 50° north and south latitude: it is slightly greater at coast stations than at inland stations, the mean between these latitudes being 0·018 mm. at the former, and 0·015 mm. at the latter. The seasonal variation of amplitude is large, the values being greater in winter than in summer, particularly at inland stations.

The annual mean amplitude of the six-hourly temperature variation has its maximum value (0·23° C.) at about 25° latitude, decreasing towards the equator, and more rapidly towards higher latitudes; it is greater at inland than at coast situations. The mean amplitude is much greater in winter than in summer.

The Millibar in France

The Director of the Office National Météorologique de France has decided to adopt the millibar as the unit of pressure in all publications of that Office from the 1st January, 1927.

The millibar was first adopted in the French Daily Weather Reports in January, 1917, and continued in use until March, 1921, when it was decided that, for the daily reports, it would be more convenient to go back to the millimetre. The reversion to millibars is especially welcome, since it means that all nations along the eastern seaboard of the Atlantic from Spitsbergen to the west coast of Africa will now use the millibar as their unit of pressure.

Upper Air Turbulence in Western Australia

An interesting extract from an Australian pilot's log relating to disturbed conditions in the upper air following a "willy-willy" has been forwarded by Mr. H. A. Hunt, Commonwealth Meteorologist. The extract runs as follows:—

> "At a height of 4,000 feet the air was bumpy but not exceptionally so; I was strapped in, but my passenger found the trip decidedly uncomfortable. I then noticed that the machine was rising rapidly and I pulled the throttle half-shut but still the machine went up. At a height of

6,000 feet the air was so terribly bumpy that I was obliged to wedge myself under the side cowling for additional support, the passenger having a very rough time and actually bumping his head severely on the cabin roof. In order to regain the lower altitude where the air was not so rough, I closed the throttle but the machine hung at the higher altitude for quite an appreciable time before descending. I then continued at a height of about 4,000 feet but had very little throttle opening, as there was a continual tendency for the machine to gain height."

A "willy-willy" is the local name given to the hurricanes which sometimes visit the northwest coast of Australia during the summer months, the greatest frequency occurring in January. These storms appear to originate in the Cambridge Gulf or in the Arafura Sea and move southwestward at first, subsequently curving and approaching the Australian coast from westnorthwest. They consist of atmospheric whirls with spirally inflowing winds which attain a destructive speed of from 60 to 120 miles per hour. Their destructive section is frequently less than 100 miles wide, while 150 miles may be taken as an extreme diameter.

The particular "willy-willy" which was followed by the conditions referred to in the above extract developed off Broome on Friday, January 22nd, 1926. On the morning of Saturday, the 23rd, the storm centre was still near Broome but was just beginning to move inland. During Saturday it moved inland and filled up rapidly. While the "willy-willy" was raging at Broome, the pilots of the Western Australia Airways, Ltd., were instructed not to enter the danger zone but to house their machines and await instructions. It was not until midnight on Saturday that the "all clear" message was received and flying was not resumed until Sunday. It was on the Sunday and the following day or so that the pilots reported the very rough air conditions to which the above extract referred.

When forwarding the extract from the pilot's log, the Western Australia Airways, Ltd., in their covering letter assume on the above evidence that the effects of the "willy-willy" persist in the upper air for some two or three days after the storm has moved away. It is very improbable, however, that the turbulent effects would survive so long in the upper air after the moving away of the whirl. A more probable explanation is that the disturbed upper air conditions reported were not due to the whirl as such but resulted from the effect of the southerly wind in the rear of the disturbance. Such a wind drawn from the warm desert interior would probably be warm and dry and the temperature lapse rate might thus approach or even exceed the dry adiabatic and cause great turbulence up to considerable heights. Analogous conditions are encountered in Egypt and Iraq where the turbulence sometimes extends up to 8,000 to 10,000 feet.

W. C. K.

Speed of Depressions near the Falkland Islands

The Governor of the Falkland Islands maintains a station at Stanley, on the east coast, the records from which include a good series of barograms. He has now kindly sent for our information, another good series of barograms, extending from December, 1924, to August, 1925, and obtained by Mr. J. Robertson at Port Stephens, at the western extremity of the islands. A comparison of the two records yields the results given below for the speed at which depressions travel in this area. The two stations are approximately 125 miles apart and very nearly on the same parallel of latitude (52° S approx.). Depressions are assumed to move approximately from west to east. The barograms have no time marks, but in most cases it was possible to estimate the speed of the clocks from an examination of the times at which the weekly records commenced and finished, the new sheets being nearly always put on the instrument at a definite hour and adjusted to read correctly at the start.

The following table of frequencies was obtained in relation to the passage of a minimum of pressure in the neighbourhood of the two stations :—

FREQUENCIES OF SPEEDS OF DEPRESSIONS WITHIN SPECIFIED LIMITS.

	11–20 m.p.h.	21–30 m.p.h.	31–40 m.p.h.	41–50 m.p.h.	51–60 m.p.h.	61–70 m.p.h.	71–80 m.p.h.	Mean Speed.
Dec.-Mar.	1	4	2	1	—	—	—	29 m.p.h.
April-Aug.	1	3	5	5	1	2	1	41 m.p.h.

The mean speed at which depressions travel is thus 29 m.p.h. during the summer (southern hemisphere) and 41 m.p.h. during the winter.

J. W.

Brush for Stevenson Screen

Observers in dusty localities must have felt the need for a convenient brush for the purpose of removing dust and wind blown débris of various kinds from the louvres and interior of the Stevenson screen. To be suitable for the purpose, the brush should be capable of getting well into the corners and have fairly long bristles so that the spaces between the louvres may be well swept out. For use at official stations, the Meteorological Office has had a number of suitable brushes made and observers who feel the need for such a brush and find difficulty in obtaining anything suitable are invited to communicate with the Director. The cost of the brush is 8½d.

Reviews

Meteorological Conditions along Airways. By W. R. Gregg. Report No. 245 of the United States National Advisory Committee for Aeronautics.

The report was prepared in an endeavour to show the meteorological requirements necessary for determining the operating conditions along airways. The service that meteorology can render aviation may be treated under two headings: (1) furnishing in convenient form statistical information based upon many years' records of the principal meteorological elements in different parts of the country; and (2) making quickly available current data and forecasts for specified airways based upon detailed observations at points on or near those airways. As aviation in the United States of America is in a large measure in the organization stage, only the first of these headings is dealt with, and in order to bring out clearly the nature of the data available, a definite route is chosen, viz., the Chicago-Fort Worth Airway, on which regular flying begins this year.

The principal factors, from a meteorological point of view, on which the ground organization depends—in particular the selection and orientation of aerodromes—are the direction and velocity of the prevailing surface winds, the frequency of occurrence of fog and low cloud, thunderstorms, and excessive precipitation, including snow-fall. The adoption of satisfactory flight schedules is primarily dependent on the direction and velocity of the wind at flying levels, and also on the frequency of occurrence of fog, low cloud, etc., along the airway. Both in the selection of aerodromes, and in the preparation of flight schedules, topographical irregularities play an important part, owing to the influence these irregularities have on the variation in wind gustiness and on the frequency of occurrence of fog or very low cloud.

In the report, stations along the airway for which meteorological data are available have been selected, and useful summaries of the seasonal and annual frequency of low visibilities and of clouds below selected heights are given. Upper wind data for heights up to 4,000 metres are treated separately for three sections of the route, viz., Chicago to Davenport, Davenport to St. Joseph, and St. Joseph to Fort Worth, and valuable tables supplemented by diagrams showing the average frequency of winds of different directions and velocities, and the resultant wind velocities along these different sections of the airway, should be a very useful aid in the fixing of flight schedules. It is shown that on the average throughout the year, assuming a cruising speed of 100 mi/hr. and flight at an altitude of 1,600 ft., the actual ground speed of an aeroplane northward would be faster than that southward by the following amounts :—

Chicago to Davenport, 14 mi/hr. ; Davenport to St. Joseph, 8 mi/hr. ; St. Joseph to Fort Worth, 13 mi/hr. The value of information of this nature to an operating company is obvious.

The fact that it is not stated to which years the observations refer, nor the number of observations given, detracts to a certain extent from the value of the paper, as most of the tables are percentage frequencies. It would appear that the visibility observations, for example, cannot cover a very long period, as the international visibility scale is used. The fact, however, that the available information is for a definite airway, and that it is discussed in a straightforward manner, will be useful when similar information has to be compiled and discussed for other areas. It is also realized that the data are far from being complete, and future reports of a similar character will undoubtedly improve, as new material becomes available.

The importance of meteorology in relation to the selection of aerodrome sites in the British Isles is discussed very fully by F. Entwistle in a paper (No. 413) read at the Third International Air Congress at Brussels in 1925, while the more general problem of the relationship between meteorology and aviation is dealt with by E. Gold in the *Journal of the Scottish Meteorological Society* (Vol. XVIII.). Both these papers should be read in conjunction with this report.

G. R. H.

Onweders, optische Verschijnselen, enz. in Nederland. Naar Vrijwillige Waarnemingen in 1922. Deel XLIII. K. Ned. Meteor. Inst. No. 81. Amsterdam 1924.

The publication of this series of volumes was inaugurated by the Institute in 1882 but up to 1895 the contents were confined to a discussion of thunderstorms and their accompanying phenomena, noted annually by voluntary observers. Since 1896 the series has also contained details of the optical phenomena observed.

The present volume is based on observations received from 184 stations, which are distributed with fair regularity over Holland. In Section I. frequency data for thunder and hail are given, followed by a discussion of the state of the atmosphere on thundery days or periods during the year. The illustrations show cyclone tracks and records of autographic instruments. Paragraphs on lightning, hail, ball-lightning, St. Elmo's fire and waterspouts complete this section. It is noted that the word "fireballs" (Vuurbollen) heads the paragraph on ball-lightning, though a literal translation of the latter term (Bolbliksem) is also used in the text. The use of the word "fireball" in this connection seems to be established in Holland and it is not uncommon in our own country. The astronomical application of the term to a certain class of cosmic meteor certainly antedated the comparatively recent time at which ball-lighting was recognised as a definite electrical phenomenon, and it is unfortunate that the confusion of nomenclature should be perpetuated. Tables showing for each month the daily and hourly frequencies of thunder and hail are given at the end of the book.

The chief optical phenomena considered in Section II. are halos, coronæ, rainbows and mirage. Detailed accounts of the more interesting observations are given. A striking halo complex was seen at De Bilt on March 10th, 1922 (Fig. 19). Tables follow in which the monthly frequency of solar halos, lunar halos and lunar coronæ at a number of individual stations are presented. Perhaps the most striking feature of the book is a further table (VIII.) in which daily frequencies of halos and coronæ, without distinction as to sun or moon, are shown. Separate frequencies are given for no less than eight different kinds of halo or coronal phenomena.

The Dutch Meteorological Institute is certainly to be congratulated upon the regular publication of this series. Both descriptively and statistically the phenomena included are dealt with much more thoroughly than is the case with most other countries.

E. W. B.

The Weather of August, 1926

August, 1926, was unusually fine and warm. At Kew Observatory, for example, the mean temperature for the month was 2·5° F. above the average for August, the duration of sunshine was 20 hours above and the rainfall was 40 mm. (1·57 in.) below the average. The total fall of 17 mm. (0·67 in.) for the month was the lowest since 1899.

After mainly fine warm weather at the beginning of the month, conditions deteriorated somewhat towards the end of the first week, a trough of low presssure which extended from a depression near Iceland causing rain in a few districts that night and local thunderstorms on the 6th. The persistence of low pressure systems southward of Iceland caused rather unsettled weather with bright intervals during the next two weeks. There were occasional thunderstorms and local heavy falls of rain, notably on the 9th 49 mm. (1·91 in.) at Rhayader, 48 mm. (1·88 in.) at Llyn Fawr (Glamorgan), 46 mm. (1·81 in.) at Malvern and 42 mm. (1·65 in.) at Llandrindod Wells; on the 16th 43 mm. (1·71 in.) at Tenterden in Kent and 39 mm. (1·54 in.) at Ramsgate; on the 20th, 37 mm. (1·46 in.) at Eskdalemuir. Temperature, however, remained fairly high, many places recording maximum temperatures of 75° F. and above. 79° F. was registered at Greenwich on the 9th and 81° F. at Jersey on the 16th. Warm nights were also experienced, several stations recording minimum temperatures between 60° F. and 64° F. Good sunshine records were obtained on various days especially on the 12th, when many stations in south and south-east England registered between 12 and 14 hours, and on the 17th when Colwyn Bay registered 13 hours and Hoylake and Sheffield more than 12 hours.

The falls of rain on the 16th at Tenterden and Ramsgate occurred during a severe thunderstorm which visited south-eastern England during the night of the 16th-17th. Damage by lightning and heavy rain was reported from most places along the south and south-east coasts from Carisbrooke in the Isle of Wight to Margate. Ramsgate suffered particularly, the damage there being estimated at several thousands of pounds. At Dover, after a calm night, the wind sprang up suddenly and reached a velocity of 46 miles per hour, 11·2 mm. (0·44 in.) of rain was registered in 12 minutes and 18·8 mm. (0·74 in.) in three hours. At Margate, 16·5 mm. (0·65 in.) fell between 12.30 and 1.30 G.M.T., and 13 mm. (0.51 in.) fell in less than 20 minutes. At Hellingly, in Sussex, the storm lasted 50 minutes, during which time 30·8 mm. (1·21 in.) of rain fell, 18·5 mm. (0·73 in.) falling in 12 minutes. At Upper Hardres and Bossingham, in Kent, there was very heavy hail accompanied by a high wind, and a great deal of damage was done to fruit and crops; on the 19th there was still a large quantity of ice remaining outside Upper Hardres church. The chief feature of the storm was the vividness and continuity of the lightning, an observer near Tunbridge Wells frequently counted as many as four flashes per second.

During the last ten days of the month high pressure systems spread over England from the south giving drier weather in many parts (at Kew there was no appreciable rain after the 21st), and an anticyclone which passed across the British Isles on the 27th and 28th caused a few days of very fine warm weather. About 12 hours of sunshine were enjoyed daily in south-east England from the 26th to the 29th and day temperatures were high, on the 30th 83° F. and 84° F. were recorded in

London. Some high night temperatures were again recorded especially on the night of the 24th-25th, when the thermometer remained well above 60° F. in many places and did not fall below 65° F. in several parts of London.

At the end of the month a trough of low pressure which approached from the Atlantic brought a renewal of unsettled weather and cooler winds in its rear.

Pressure was above normal over the whole of Europe, with the exception of Finland and the north of Sweden, and also at Jan Mayen, the excess reaching 4.3 mb. at Scilly. Pressure was slightly below normal over the North Atlantic between Newfoundland, the Azores and Iceland.

Temperature was above normal except in Switzerland and northern Norway. Rainfall was below normal over the whole of western Europe, the deficit amounting to 79 mm. at Zurich.

The special message from Sweden states that temperature was above normal, the excess reaching 4° F. in the north. Rainfall was normal in the north, but only slightly exceeded half the normal fall in the centre and south. Thunderstorms were rather frequent in central Sweden.

At the beginning of the month further rain in Yugoslavia following on the floods of July caused a landslip which derailed an express train from Vienna to Zagreb. Four lives were lost on the Italian Alps above the Fassa valley as the result of a severe storm which raged along the whole chain of higher mountains.

A heavy rainstorm broke in Barcelona on the night of the 13th and continued throughout the morning of the 14th. A large part of the city and its suburbs was flooded and it is believed that several persons were drowned.

Very hot weather was experienced in the south of France in the middle and end of the month. Forest fires broke out in several districts, the most serious being at Mont-de-Marsan in the district of Landes. In the district round Montpellier vines and fruit trees were reported to be dying from the heat and drought; several places recorded temperatures above 95° F., on the 19th the temperature reached 102° F. at Toulouse, on the 21st 100° F. at Montélimar and on the 22nd 98·6° F. at Nimes. Very hot weather also occurred in Spain, particularly on the 22nd and 23rd, when the highest temperatures for the last five years were recorded. The temperature is reported to have reached over 100° F. at many places and 109° F. at Cordova. Rain fell in Madrid on the 28th for the first time for 55 days.

The Indian monsoon was generally active throughout the month. At the beginning of the month heavy floods on the

Tista river breached the railway at Barnes Ghat, cutting off communication with an important tea district. Floods in Lower Burma breached the entire railway system, some bridges being washed away, others damaged. Rangoon was isolated from the rest of Burma. Large areas of rice and other crops were destroyed. In Upper Burma, on the other hand, various crops are reported to have failed for want of sufficient rain. The Yangtse river was in heavy flood, its depth near Hankow was 48 feet, this is more than has been recorded for 25 years. The floods are reported to have covered two thousand square miles of country and to have caused the loss of three thousand lives.

A gale blowing along the North Atlantic coast of America during the week-end of the 7th and 8th took a heavy toll of shipping, two fishing schooners were wrecked off Nova Scotia. On the 12th a thunderstorm of great intensity swept over New York, $4\frac{1}{2}$ in. of rain was recorded in the 24 hours, of which $3\frac{1}{4}$ in. is reported to have fallen in less than 75 minutes. Considerable damage was done by lightning and water. On the evening of the 16th a small cyclone coming in from the sea during a thunderstorm wrought damage at Glencove, Long Island. Hundreds of trees were blown down and more than a dozen houses demolished. In the centre and west of the Continent hot weather was experienced. High temperatures were recorded in South Dakota and Utah, especially towards the end of the month. In the southern interior of British Columbia there were many forest fires.

Lake Chapala in Mexico overflowed, twenty-five persons were drowned, and railway communication between Guadalajara and Mexico city was cut off.

The special message from Brazil states that the rainfall was scanty in the north, being 30 mm. below normal, in the central region it was 7 mm. above normal, and in the south the distribution was irregular with an average of 5 mm. above normal. The atmospheric circulation was less active, the Atlantic anticyclone probably being in a normal position. At Rio de Janeiro the pressure was 3 mb. above normal and the temperature 0·3° F. above normal.

Rainfall, August, 1926—General Distribution

England and Wales ..	79	per cent. of the average 1881-1915.
Scotland	86	
Ireland	86	
British Isles	82	

Rainfall: August, 1926: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION	In.	mm.	Per-cent of Av.
Lond.	Camden Square.......	1·55	39	70	*War.*	Birminghm, Edgbaston	2·07	53	76
Sur .	Reigate, Hartswood...	2·10	53	91	*Leics*	Thornton Reservoir ..	2·63	67	94
Kent.	Tenterden, Ashenden..	2·42	61	106	,, .	Belvoir Castle........	2·59	66	99
,, .	Folkestone, Boro. San.	1·24	31	...	*Rut* .	Ridlington............	1·40	36	...
,, .	Margate, Cliftonville..	2·04	52	64	*Linc*.	Boston, Skirbeck	1·40	36	59
,, .	Sevenoaks, Speldhurst.	1·77	45	...	,, .	Lincoln, Sessions House	2·09	53	85
Sus .	Patching Farm........	2·31	59	92	,, .	Skegness, Marine Gdns.	1·46	37	60
,, .	Brighton, Old Steyne .	3·31	84	152	,, .	Louth, Westgate	1·64	42	59
,, .	Tottingworth Park....	2·52	64	93	,, .	Brigg	2·87	73	103
Hants	Ventnor, Roy. Nat. Hos.	1·36	35	68	*Notts*.	Worksop, Hodsock....	3·14	80	128
,, .	Fordingbridge, Oaklnds	1·09	28	42	*Derby*	Mickleover, Clyde Ho..	2·27	58	83
,, .	Ovington Rectory	1·85	47	68	,, .	Buxton, Devon. Hos...	3·95	100	90
,, .	Sherborne St. John Rec.	...	..	...	*Ches*.	Runcorn, Weston Pt...	2·97	75	83
Berks	Wellington College...	...	..	...	,, ..	Nantwich, Dorfold Hall	3·14	80	...
,, .	Newbury, Greenham..	1·03	26	39	*Lancs*	Manchester, Whit. Pk.	3·74	95	108
Herts.	Benington House	1·29	33	53	,, ..	Stonyhurst College....	4·96	126	98
Bucks	High Wycombe	1·17	30	50	,, ..	Southport, Hesketh Pk	3·12	79	90
Oxf..	Oxford, Mag. College..	1·18	30	53	,, ..	Lancaster, Strathspey.	3·61	92	...
Nor .	Pitsford, Sedgebrook..	1·41	36	58	*Yorks*	Sedbergh, Akay	4·82	122	86
,, .	Eye, Northolm.......	...	..	...	,, .	Wath-upon-Dearne ...	2·67	68	111
Beds.	Woburn, Crawley Mill.	1·19	30	52	,, .	Bradford, Lister Pk...	3·30	77	122
Cam.	Cambridge, Bot. Gdns.	1·10	28	47	,, .	Wetherby, Ribston H..	4·26	108	156
Essex	Chelmsford, County Lab	·90	23	41	,, .	Hull, Pearson Park ...	2·40	61	82
,, .	Lexden, Hill House...	1·14	29	...	,, .	Holme-on-Spalding ...	3·20	81	...
Suff .	Hawkedon Rectory ...	1·61	41	62	,, .	West Witton, Ivy Ho..	3·14	80	...
,, .	Haughley House......	1·19	30	...	,, .	Felixkirk, Mt. St. John	3·01	76	106
Norf.	Beccles, Geldeston....	1·33	34	62	,, .	Pickering, Hungate ...	3·90	99	...
,, .	Norwich, Eaton	2·54	65	107	,, .	Scarborough.........	2·61	66	94
,, .	Blakeney	1·49	38	66	,, .	Middlesbrough	2·02	51	74
,, .	Swaffham	1·25	32	48	,, .	Baldersdale, Hury Res.	2·97	75	84
Wilts.	Devizes, Highclere....	1·30	33	45	*Durh*.	Ushaw College	2·71	69	93
,, .	Bishops Cannings	1·52	39	49	*Nor* .	Newcastle, Town Moor.	2·27	58	78
Dor .	Evershot, Melbury Ho.	1·27	32	40	,, .	Bellingham, Highgreen	4·34	110	...
,, .	Creech Grange	·94	24	...	,, .	Lilburn Tower Gdns...	2·71	69	...
,, .	Shaftesbury, Abbey Ho.	1·04	26	36	*Cumb*	Geltsdale............	4·14	105	...
Devon	Plymouth, The Hoe...	1·53	39	50	,, .	Carlisle, Scaleby Hall .	4·09	104	100
,, .	Polapit Tamar	2·08	53	65	,, .	Seathwaite M.	8·10	206	70
,, .	Ashburton, Druid Ho..	2·25	57	60	*Glam*.	Cardiff, Ely P. Stn.....	3·90	99	90
,, .	Cullompton	3·02	77	99	,, .	Treherbert, Tynywaun	9·32	237	...
,, .	Sidmouth, Sidmount ..	1·09	28	39	*Carm*	Carmarthen Friary....	4·70	119	101
,, .	Filleigh, Castle Hill ...	4·28	109	...	,, .	Llanwrda, Dolaucothy.	6·12	155	111
,, .	Barnstaple, N. Dev. Ath.	2·59	66	78	*Pemb*	Haverfordwest, School	3·70	94	89
Corn.	Redruth, Trewirgie ...	2·61	66	76	*Card*.	Gogerddan...........	5·52	140	113
,, .	Penzance, Morrab Gdn.	2·10	53	66	,, .	Cardigan, County Sch. .	4·35	110	...
,, .	St. Austell, Trevarna..	2·23	57	62	*Brec*.	Crickhowell, Talymaes	4·20	107	...
Soms	Chewton Mendip	3·44	87	77	*Rad* .	Birm. W. W. Tyrmynydd	5·45	138	101
,, .	Street, Hind Hayes ...	2·18	55	...	*Mont*.	Lake Vyrnwy	5·77	147	112
Glos..	Clifton College	2·74	70	78	*Denb*.	Llangynhafal	2·89	73	...
,, .	Cirencester, Gwynfa..	2·02	51	66	*Mer* .	Dolgelly, Bryntirion..	5·75	146	102
Here.	Ross, Birchlea	...	..	...	*Carn*.	Llandudno	3·52	89	117
,, .	Ledbury, Underdown.	2·88	73	110	,, .	Snowdon, L. Llydaw 9	13·20	335	...
Salop	Church Stretton	2·54	65	78	*Ang* .	Holyhead, Salt Island.	3·22	82	101
,, .	Shifnal, Hatton Grange	2·09	53	74	,, .	Lligwy	2·67	68	...
Staff.	Tean, The Heath Ho...	...	..	...	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	1·95	50	73		Douglas, Boro' Cem...	3·68	93	97
,, .	Blockley, Upton Wold.	1·76	45	60	*Guernsey*				
War.	Farnborough	1·81	46	66		St. Peter P't, Grange Rd	1·41	36	60

Rainfall: August, 1926: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	3·62	92	97	*Suth.*	Loch More, Achfary	8·94	227	153
,,	Pt. William, Monreith	3·14	80	...	*Caith*	Wick	2·02	51	73
Kirk.	Carsphairn, Shiel.	5·25	133	...	*Ork.*	Pomona, Deerness	2·87	73	100
,,	Dumfries, Cargen	4·95	126	113	*Shet.*	Lerwick	3·70	94	123
Roxb	Branxholme	3·73	95	116		———			
Selk.	Ettrick Manse	5·55	141	...	*Cork.*	Caheragh Rectory	3·28	83	...
Berk.	Marchmont House	3·04	77	92	,,	Dunmanway Rectory	3·34	85	71
Hadd	North Berwick Res.	1·95	50	62	,,	Ballinacurra	2·57	65	69
Midl	Edinburgh, Roy. Obs.	1·95	50	63	,,	Glanmire, Lota Lo.	2·90	74	80
Lan.	Biggar	2·95	75	89	*Kerry*	Valencia Obsy.	4·37	111	91
,,	Leadhills	5·90	150	...	,,	Gearahameen	3·00	76	...
Ayr	Kilmarnock, Agric. C.	3·51	89	90	,,	Killarney Asylum	3·39	86	77
,,	Girvan, Pinmore	3·21	82	72	,,	Darrynane Abbey	2·89	73	66
Renf.	Glasgow, Queen's Pk.	3·03	77	86	*Wat.*	Waterford, Brook Lo.	2·47	63	65
,,	Greenock, Prospect H.	5·09	129	94	*Tip.*	Nenagh, Cas. Lough	3·31	84	84
Bute.	Rothesay, Ardencraig.	5·23	133	107	,,	Tipperary	3·07	78	...
,,	Dougarie Lodge	4·57	116	...	,,	Cashel, Ballinamona	2·46	62	69
Arg.	Ardgour House	10·11	257	...	*Lim.*	Foynes, Coolnanes	2·56	65	66
,,	Manse of Glenorchy	7·95	202	...	,,	Castleconnell Rec.	2·79	71	...
,,	Oban	5·05	128	...	*Clare*	Inagh, Mount Callan	5·00	127	...
,,	Poltalloch	6·09	155	124	,,	Broadford, Hurdlest'n.	3·81	97	...
,,	Inveraray Castle	7·74	197	118	*Wexf*	Newtownbarry	2·54	65	...
,,	Islay, Eallabus	5·21	132	120	,,	Gorey, Courtown Ho.	2·34	59	70
,,	Mull, Benmore	12·80	325	...	*Kilk.*	Kilkenny Castle	3·71	94	107
Kinr.	Loch Leven Sluice	2·24	57	58	*Wic.*	Rathnew, Clonmannon	2·73	69	...
Perth	Loch Dhu	6·75	171	100	*Carl.*	Hacketstown Rectory	3·49	89	86
,,	Balquhidder, Stronvar	4·87	124	80	*QCo.*	Blandsfort House	3·08	78	78
,,	Crieff, Strathearn Hyd.	2·81	71	67	,,	Mountmellick	2·89	73	...
,,	Blair Castle Gardens	2·73	69	81	*KCo.*	Birr Castle	2·93	74	77
,,	Coupar Angus School	2·63	67	79	*Dubl.*	Dublin, FitzWm. Sq.	2·29	58	75
Forf.	Dundee, E. Necropolis	2·29	58	68	,,	Balbriggan, Ardgillan	3·79	96	111
,,	Pearsie House	2·54	65	...	*Me'th*	Drogheda, Mornington	...	..	...
,,	Montrose, Sunnyside	1·70	43	61	,,	Kells, Headfort	5·13	130	124
Aber.	Braemar, Bank	1·73	44	51	*W.M*	Mullingar, Belvedere	4·73	120	114
,,	Logie Coldstone Sch.	1·13	29	36	*Long*	Castle Forbes Gdns.	3·34	85	82
,,	Aberdeen, King's Coll.	1·32	34	48	*Gal.*	Ballynahinch Castle	6·00	152	109
,,	Fyvie Castle	1·49	38	...	,,	Galway, Grammar Sch.	2·89	73	...
Mor.	Gordon Castle	1·63	41	51	*Mayo*	Mallaranny	6·02	153	...
,,	Grantown-on-Spey	2·24	57	70	,,	Westport House	3·62	92	89
Na.	Nairn, Delnies	1·56	40	65	,,	Delphi Lodge	7·51	191	...
Inv.	Ben Alder Lodge	3·69	94	...	*Sligo*	Markree Obsy.	4·28	109	99
,,	Kingussie, The Birches	2·28	58	...	*Cav'n*	Belturbet, Cloverhill	2·93	74	79
,,	Loch Quoich, Loan	10·75	273	...	*Ferm*	Enniskillen, Portora	...	..	...
,,	Glenquoich	...	..	...	*Arm.*	Armagh Obsy.	3·24	82	89
,,	Inverness, Culduthel R.	1·69	43	...	*Down*	Warrenpoint	3·66	93	...
,,	Arisaig, Faire-na-Squir	4·58	116	...	,,	Seaforde	3·56	90	95
,,	Fort William	7·25	184	118	,,	Donaghadee, C. Stn.	3·11	79	93
,,	Skye, Dunvegan	5·81	148	...	,,	Banbridge, Milltown	3·66	93	105
,,	Barra, Castlebay	3·04	77	...	*Antr.*	Belfast, Cavehill Rd.	4·14	105	...
R&C	Alness, Ardross Cas.	2·01	51	68	,,	Glenarm Castle	4·18	106	...
,,	Ullapool	2·93	74	...	,,	Ballymena, Harryville	4·44	113	104
,,	Torridon, Bendamph	4·94	125	75	*Lon.*	Londonderry, Creggan	4·06	103	87
,,	Achnashellach	6·02	153	...	*Tyr.*	Donaghmore	3·76	96	...
,,	Stornoway	4·06	103	102	,,	Omagh, Edenfel	4·04	103	95
Suth.	Lairg	2·61	66	...	*Don.*	Malin Head	3·09	79	88
,,	Tongue Manse	2·55	65	80	,,	Dunfanaghy	3·40	86	77
,,	Melvich School	3·05	77	102	,,	Killybegs, Rockmount	3·56	90	64

Climatological Table for the British Empire, March, 1926

STATIONS	PRESSURE: Mean of Day M.S.L. (mb.)	PRESSURE: Diff. from Normal (mb.)	TEMPERATURE: Absolute Max. (°F.)	TEMPERATURE: Absolute Min. (°F.)	TEMPERATURE: Mean Values Max. (°F.)	TEMPERATURE: Mean Values Min. (°F.)	TEMPERATURE: Mean Values ½ max. and min. (°F.)	TEMPERATURE: Mean Values Diff. from Normal (°F.)	TEMPERATURE: Mean Wet Bulb (°F.)	Relative Humidity (%)	Mean Cloud Am'nt (0—10)	PRECIPITATION: Am'nt (mm.)	PRECIPITATION: Diff. from Normal (mm.)	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible
London, Kew Obsy.	1018·5	+ 5·1	60	31	50·4	38·8	44·6	+ 2·2	39·6	82	7·4	5	− 38	4	3·3	28
Gibraltar	1019·4	+ 2·4	74	46	65·5	54·2	59·9	+ 2·4	53·1	79	6·0	42	− 80	11	...	...
Malta	1014·5	− 0·3	72	45	62·1	53·0	57·5	+ 0·4	53·9	83	5·6	37	− 1	8	6·6	55
St. Helena	1012·5	+ 3·3	71	60	68·1	62·2	65·1	− 1·7	63·9	91	4·0	94	− 31	21	...	...
Sierra Leone	1011·8	+ 1·1	93	73	90·5	76·7	83·6	+ 1·2	76·2	77	4·3	3	− 26	1	...	...
Lagos, Nigeria	1008·4	− 1·0	93	73	91·4	79·2	85·3	+ 2·0	79·8	81	8·6	70	− 25	8	...	...
Kaduna, Nigeria	1012·0	+ 0·9	103	60	95·6	66·7	81·1	0·0	59·3	20	3·0	0	− 11	0	...	...
Zomba, Nyasaland	1016·7	+ 1·1	85	61	81·5	65·1	73·3	+ 2·1	...	87	8·2	367	+143	21	...	...
Salisbury, Rhodesia	1010·7	+ 0·1	81	53	77·7	59·9	68·8	+ 0·6	62·9	79	5·0	304	+190	19	6·7	55
Cape Town	1017·1	+ 2·6	98	51	77·8	59·8	68·8	+ 0·7	60·5	79	3·4	6	− 17	4	...	...
Johannesburg	1015·3	+ 1·6	81	46	74·0	54·3	64·1	+ 0·8	56·9	71	3·2	70	− 43	12	7·7	63
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	92	49	78·7	55·5	67·1	− 0·3	60·0	78	4·5	97	− 4	13	...	...
Calcutta, Alipore Obsy.	1011·7	+ 1·8	95	63	88·2	69·1	78·7	− 1·4	70·4	83	4·3	113	+ 76	10*	...	...
Bombay	1011·8	+ 0·9	89	72	86·5	74·7	80·6	+ 1·1	71·9	76	1·9	0	− 1	0*	...	...
Madras	1012·1	+ 1·2	95	71	90·6	75·4	83·0	+ 1·9	77·1	79	2·5	0	− 5	0*	...	...
Colombo, Ceylon	1010·9	+ 0·5	93	72	90·3	74·4	82·3	+ 1·0	77·7	69	4·9	146	+ 31	13	9·5	79
Hong Kong	1017·9	+ 1·8	82	55	68·0	60·8	64·4	+ 1·1	60·5	82	9·4	123	+ 52	15	3·1	25
Sandakan	...	...	92	74	88·0	75·1	81·5	+ 0·4	76·9	77	...	26	−178	2	...	...
Sydney	1018·5	+ 2·3	100	58	75·9	63·3	69·6	+ 0·3	65·2	71	7·1	310	+188	14	4·7	38
Melbourne	1019·1	+ 2·1	101	46	77·8	57·0	67·4	+ 2·9	59·0	58	6·2	35	− 22	5	6·2	50
Adelaide	1018·9	+ 1·8	101	50	81·5	60·7	71·1	+ 1·3	58·8	44	4·7	0·3	− 27	1	8·4	69
Perth, W. Australia	1017·5	+ 2·2	98	53	79·3	60·5	69·9	− 1·2	61·7	61	4·5	49	+ 30	7	8·4	68
Coolgardie	1017·3	+ 2·5	101	50	80·4	58·8	69·6	− 2·1	59·6	60	2·7	38	+ 19	7	...	...
Brisbane	1017·5	+ 3·1	94	62	84·5	67·2	75·9	+ 1·6	69·6	69	5·0	49	− 92	11	7·6	62
Hobart, Tasmania	1018·6	+ 4·6	84	35	69·5	51·6	60·5	+ 1·1	53·2	64	6·9	20	− 23	10	6·7	54
Wellington, N.Z.	1022·0	+ 4·8	74	40	65·9	51·0	58·5	− 2·0	55·3	71	6·2	113	+ 28	7	6·7	54
Suva, Fiji	1009·5	+ 1·0	90	68	82·7	74·5	78·6	− 1·5	75·5	88	7·6	235	−138	20	5·4	44
Apia, Samoa	1009·0	− 0·2	89	72	85·2	75·9	80·5	+ 1·2	78·6	81	7·5	400	+ 56	24	4·5	37
Kingston, Jamaica	1014·8	− 0·1	91	68	87·6	70·0	78·8	+ 1·7	68·5	86	1·6	3	− 23	2	2·2	18
Grenada, W.I.	1015·0	+ 2·3	87	71	84·7	73·2	78·9	+ 1·2	72·7	73	5·8	21	− 49	11	...	...
Toronto	1014·8	− 2·2	48	− 1	32·0	20·1	26·1	− 2·8	20·8	70	5·5	74	+ 7	11	5·5	46
Winnipeg	1021·4	+ 2·6	57	− 18	26·7	8·1	17·4	+ 3·0	...	...	5·5	16	− 12	9	5·4	46
St. John, N.B.	1009·5	− 4·7	45	− 2	32·1	16·4	24·3	− 4·1	19·3	71	5·1	123	+ 8	10	5·5	46
Victoria, B.C.	1021·9	+ 6·1	63	38	55·9	42·8	49·3	+ 6·1	45·0	78	5·6	14	− 51	9	6·5	55

*For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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A remarkable Stereoscopic Effect produced by motion at right angles to the Direction of View

By G. A. CLARKE

Most meteorological observers are familar with photo-stereograms of clouds, wherein, by the employment of similar cameras at the two ends of a fairly long base line, simultaneous photographs of the clouds can be taken, which, when suitably mounted and viewed in an ordinary stereoscope, give very effective three-dimensional pictures of the arrangement of clouds in space.

It may not, however, be so widely known that a similar stereographic effect may be visually observed in the clouds themselves in certain circumstances, provided that the observer is moving fairly rapidly in a direction at right angles to the direction in which he is looking. Even from the top of a tramcar, moving at about 12 miles an hour, cumulus clouds, if their altitude is fairly low, may be seen to stand out beautifully in stereoscopic relief.

But the effect is much more dramatic when the observer is in a moving train. The writer was travelling on the express train from Aberdeen to London, on the evening of August 10th, the speed of the train being about 45 miles an hour. Between 8 and 8.30 p.m. (B.S.T.) the train was in the neighbourhood of Laurencekirk, proceeding south-westwards along the low-lying valley known as the Strath More. To the north-west there lay the mass of hills, about 1,500 feet high, which forms the eastern

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end of the southern spur of the Grampians, the hills being about 10 miles distant. The afternoon had been cloudy and showery but a partial clearing had taken place, leaving a wide-extended mass of cloud over the mountain area. This cloud mass had a horizontal depth of perhaps 10 miles and culminated on its further side in a fairly well-developed cumulo-nimbus head about 8,000 feet high. In front of the line of hills and about level with their tops lay a long line of low cumuliform cloud (A—B in the diagram, Fig. 1). As the train sped onwards this line of cloud appeared to stand out clearly separated from the

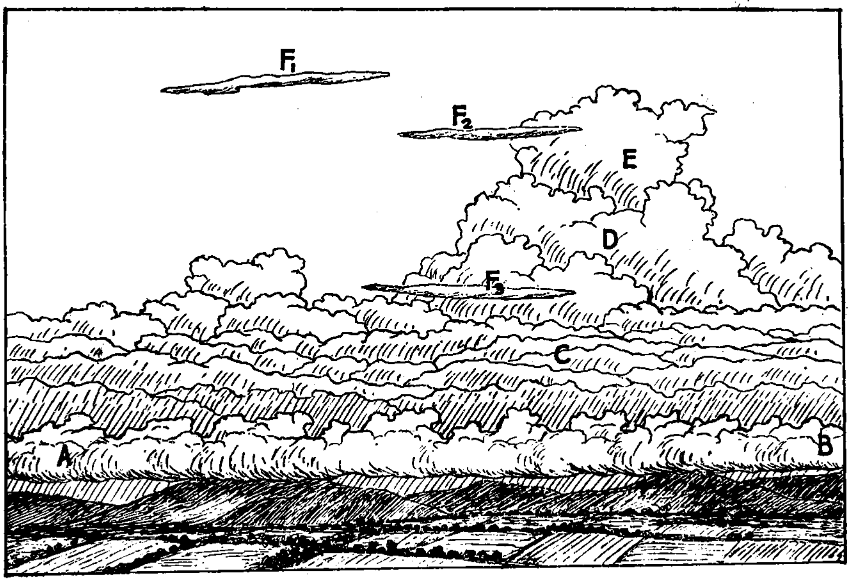

FIG. 1. VIEW OF CLOUD BANK LOOKING NORTHWEST.

general mass behind it. The main cloud-mass appeared to be built up of a series of ridges (C, D, in Fig. 1), one behind the other, rising successively higher upwards to the cumulo-nimbus head (E in Fig. 1). The whole cloud-mass looked exactly like a huge mountain with its slopes and ridges, and it was a comparatively easy matter to deduce, from the three-dimensional view thus presented to the observer, the actual structure of the cloud-mass in a plane at right angles to the view shown in Fig. 1. This structure was approximately as shown in the diagram Fig. 2, wherein the letters indicate the same portions of the cloud as those indicated in Fig. 1. From Fig. 2 it will be seen that the line of cloud A B was detached and in front of the hills while the main cloud-mass rose upwards in a concave slope to the lofty cumulo-nimbus head. The spatial arrangement of the detached fragments of intermediate cloud (F 1, F 2 and F 3), was also clearly apparent.

This stereoscopic appearance was due, of course, to the fact that the velocity of the train was sufficient, when taken in conjunction with the scale of the subject viewed, to give to each

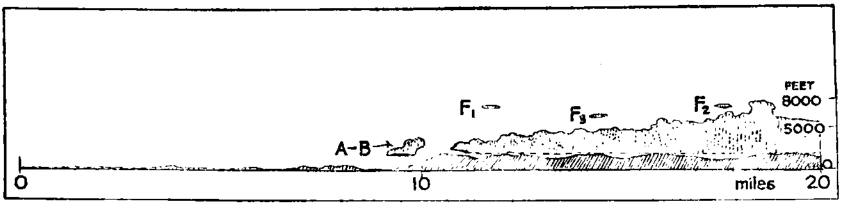

FIG. 2. PROBABLE SECTION OF CLOUD AT RIGHT ANGLES TO VIEW SHOWN IN FIG. 1. (Drawn to scale).

part of the cloud a relative velocity *across* the field of view proportionate to the distance away of such part, and these differing velocities, when viewed all together, produced on the retina the three-dimensional impression just described.

A similar sense of " mass-solidity " is produced by a regiment marching past in " companies."

The Florida Hurricane

Early on Saturday, September 18th, the south-eastern coast of Florida from Miami to Palm Beach was struck by a hurricane, which on the preceding day had ravaged the Turks and Caicos Islands. The visitation appears to have been one of the most severe of the dreaded West Indian hurricanes, but it is not yet possible to give full details of its origin and development. The Daily Weather Charts of the United States Weather Bureau show that a disturbance appeared in about latitude 25° N, longitude 65° W, on the evening of the 9th, and increased to hurricane intensity while it moved very slowly north-westward. It passed west of Bermuda, but at too great a distance to affect the mainland. On the evening of the 11th a shallow disturbance appeared in the Caribbean Sea and moved north-eastward, increasing somewhat in intensity. On the morning of the 14th another disturbance of some depth was reported north-east of St. Kitts and moved directly westward. On the 16th it lay between Porto Rico and Turks Island, moving rapidly west-north-west, and on the 17th it was already attended by hurricane winds near its centre. The forecast for Florida for Friday, September 17th, mentioned, winds " reaching gale force late to-night or Saturday night, especially on the south-east coast." At noon on this day it was realised that the centre was moving directly towards Miami, and warnings were posted. On the morning of the 18th the storm centre lay about 20 miles south of Miami, and hurricane warnings were displayed over the coast of the southern half of Florida. The centre passed practically over Miami; the official barometer fell to 27·65 in. (936 mb.), and a correspondent of *The Times* reports that two private barometers dropped below 27 inches. The storm then curved to the north-west, striking the coast between Mobile and Pensacola on the morning of the 20th, the wind velocity at the latter place being 100 miles per hour at 8 a.m., when the centre was still some distance from the coast. The hurricane dissipated over eastern Texas on the 22nd.

The hurricane appears to have reached its greatest intensity at Miami and on the coast immediately to the north, which was in the dangerous sector. The first phase lasted for nine hours, and the wind is estimated to have reached a velocity of 130 miles an hour. Then, as the centre passed over, there was a lull, and large numbers of people who did not realise that a second phase was coming ventured out to be caught when the wind rose again to hurricane force in the rear of the centre. The strength of the wind is shown by the nature of the damage done. An 18-storey skyscraper at Miami, recently finished, was twisted so badly that it will have to be demolished. Another tall building was bent over twenty degrees from the vertical. Yachts and small ships were lifted bodily on to the land. At Palm Beach the damage was much less serious, and the loss of life was due chiefly to the collapse of the dam holding back Lake Okeechobee. The first messages gave the loss of life in south-eastern Florida as 1,000 dead and 3,000 injured; later messages reduced the number to 365 dead and 1,100 injured, while 25,000 persons were rendered homeless, and the damage to property is estimated at £33,000,000.

The Florida hurricane, while the most terrible in its consequences, has not been the only disaster of this nature. On September 20th a tornado swept a wide path through the town of Encarnacion in Paraguay, wrecking most of the buildings and resulting in at least 200 deaths, and injuries to another 400 persons. It is stated that trees were uprooted and roofs were carried miles away. About the same time a typhoon in the neighbourhood of Kagoshima, Japan, destroyed 1,200 houses. On September 25th a hurricane traversed the province of San Pablo, Brazil, and the town of Itambe was completely destroyed, over 200 bodies having been recovered. On the 28th a hurricane struck Vera Cruz in Mexico. The wind velocity was estimated at 125 miles an hour; the roofs of houses were blown off and several ships were sunk. The damage was accentuated by torrential rains and a "hurricane wave" at high tide, flooding about 25 square miles of low-lying ground with two to five feet of water. The loss of life however does not seem to have been very great.

It is too soon yet to venture any opinion as to the underlying cause of all these disasters, except to say that they were probably related. The air over the Atlantic Ocean seems to have been in a very disturbed state during the last half of September. It is possible that the small disturbance which moved north-eastward from the Caribbean Sea, while in itself of no importance, caused the main hurricane of the 14th to 21st to follow a more westerly track than it would otherwise have done and thus strike the land instead of keeping to the ocean like its predecessor.

Abnormal Wind Velocities

The wind velocity of 130 miles an hour reported as occurring during the Florida hurricane is not by any means unusual in the hurricane and typhoon regions, though in this country we are fortunately free from such winds. The highest velocity hitherto recorded in the British Isles was one of 110 miles per hour or over at Quilty, on 27th January, 1920, but this is open to doubt.* On 8th March, 1922, a velocity of 108 miles per hour was recorded at Scilly, but the true figure was probably two or three miles less. On the same day the anemometer at Pendennis Castle recorded 103 miles per hour.

There are obvious difficulties in the way of obtaining records of the very high winds sometimes experienced in hurricanes or tornadoes. In the first place an apparatus suitable for the accurate recording of moderate winds may become unreliable when the speed rises to 100 miles an hour or more ; secondly, and more serious, the strength of the instruments and their supports is not unlimited. When it is remembered that the pressure exerted by the wind is proportional to the square of the wind velocity, so that a wind of 120 miles an hour is more than nine times as powerful as a wind of gale force (39 miles per hour), it will be seen that a very solidly built and, therefore, very expensive instrument would be required to stand up to hurricane winds.

An experience during the Jamaica hurricane of November, 1912,† is of interest in this connexion. "As the mid-day hurricane came on, the pressure plate (of the Osler anemoneter at Kempshot) was seen to be jerked back continually as far as it could go ; the registering part had been arranged to register only 30 lbs. . . . However a violent gust caught the massive vane sideways and broke it in two ; the wind then took advantage of this wreckage on top of the wooden structure and hurled the whole out of the ground."

"The evening hurricane was much more violent but lasted a

* *Meteorological Magazine*, 57 (1922), p. 102.

† "A report on the storms and hurricanes in Jamaica, November, 1912." By Maxwell Hall. Report No. 411, Jamaica, 1913.

very short time ; at the side of an exposed terrace there were a large number of cubical flower pots placed on the grass . . . full of wet soil . . . they might have exposed as much as six-tenths of a foot of surface to the wind. They weighed on an average 25 lbs. These flower pots were blown . . . here and there ; some were upside down, some were far removed from the terrace . . . It required a force of 30 lbs. to move them from their position on the grass . . . so that the wind must have had a greater force than 30 lbs. on the six-tenths of a square foot, or a greater force than 50 lbs. on a square foot, and this would give more than 118 miles per hour." At Black River, Jamaica, during the same hurricane the anemometer had two cups wrenched off at 2 a.m. The wind velocity continued to increase and the velocity was estimated at 150 miles per hour.

In a hurricane at Wilmington, North Carolina, the anemometer registered 138 miles per hour before the cups were carried away, and it was estimated that the greatest velocity reached was 165 miles per hour. Better fortune attended the anemometer at Burrwood, La., at the mouth of the Mississippi during the hurricane of September 29th, 1915, where with practically a free water surface exposure a maximum velocity of 140 miles per hour was recorded. " This is the highest wind velocity ever recorded on the Gulf coast."*

Further north, at Mount Washington, New Hampshire (41° 20′ N, 71° 20′ W), on February 20th, 1884, during a hurricane the anemometer was broken at 2.30 a.m., but it is estimated that the wind velocity exceeded 160 miles per hour during the greater part of the forenoon.

In the hurricane areas of the old world the highest velocity ever recorded autographically appears to be 127 miles per hour, at Hongkong, on 18th August, 1923,† but the damage sustained during some of the great cyclones and typhoons points to much greater speeds which have escaped direct observation, " when the most solid and substantial buildings crack and sway under the impulse of the hurricane ; when roofs are carried off and torn to pieces ; when heavy sheets of metal whirl through the air like feathers and mighty trees fly great distances as if hurled from a gigantic invisible catapult."‡

The characteristic tornadoes of the United States are associated with wind velocities greater than those of any tropical cyclone. The building which can withstand the direct force of the centre of a fully developed tornado has yet to be constructed. Certainly no anemometer could register the appalling velocity of the wind, and our information has to be obtained by indirect means

* U.S. Weather Bureau. *Monthly Weather Bureau Supplement, No.* 24.
† *Meteorological Magazine* 60 (1925), p. 11.
‡ ALGUÉ, J. *The Cyclones of the Far East.* Manila, 1904 p. 205.

similar to the movement of the flower-pots described above. In a group of tornadoes in Iowa and Nebraska, on March 23rd, 1913, soft objects had struck harder objects with such force as to penetrate them, and engineering tests gave velocities of 200 to 400 miles per hour. Trees, beams, horses, cattle and other heavy objects can be whirled up in the air. On one occasion a cart weighing six hundred pounds was carried up into the air, and R. de C. Ward* estimates that velocities may exceed 400 miles per hour. Fortunately the path of destruction is extremely narrow, sometimes only a few yards. Tornadoes are not actually unknown in this country, though they are fortunately rare; a notable example occurred in South Wales on October 27th, 1913,† in which a sheet of corrugated iron was carried nearly a mile and was found "so firmly wrapped around a fallen telegraph pole that it could not be removed," while "several pieces of slate were found buried to a depth of 1½ inches across the grain of trees."

These notes would not be complete without some reference to the abnormal wind velocities experienced at Adelie Land, "the home of the blizzard," in the Antarctic."‡ On May 15th, 1912, the average velocity for the whole 24 hours was 90 miles per hour, and for the whole month of May 60·7 miles per hour. During individual hours the run of the wind reached or exceeded 100 miles, and the momentary velocity of some of the gusts "doubtless approached two hundred miles per hour." Fuller details will be available when the publication of the scientific report of the expedition is completed.

OFFICIAL NOTICES

Discussions at the Meteorological Office

The series of meetings for the discussion of recent contributions to meteorological literature, especially in foreign and colonial journals, were resumed at South Kensington on Monday, October 11th. The subject for this meeting was a paper by G. M. B. Dobson and D. N. Harrison, entitled *Measurements of the amount of ozone in the earth's atmosphere and its relation to other geophysical conditions.* (London, Proc. R. Soc. A. 110, 1926, pp. 660-93.) The discussion was opened by Mr. J. S. Dines, M.A.

The meetings are held on alternate Mondays at 5 p.m. The subjects for the next two meetings are:

October 25th, 1926. *The measurement of humidity in closed spaces.* Food Investigation Board Special Report No. 8. *Opener*—Mr. E. G. Bilham, B.Sc., D.I.C.

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* "The Climates of the United States," Ginn & Co., 1925, p. 344.

† London Meteorological Office. *Geophysical Memoirs*, No 11.

‡ *The Home of the Blizzard*, by Sir Douglas Mawson, London, Heineman, Ltd. Vol. 1, pp. 111-134.

November 8th, 1926. *Uber Temperaturschwankungen in der Stratosphäre und die hochreichenden Antizyklonen.* By R. Mugge (Met. Zs. XLII., 1925, pp. 389-94.) *Opener*—Mr. E. Taylor, M.A., B.Sc.

The dates for subsequent meetings are as follows :—

November 22nd, December 6th, 1926, January 17th and 31st, February 14th and 28th, and March 14th, 1927.

The Director of the Meteorological Office wishes it to be known that visitors are welcomed at these meetings.

Courses of Training for Observers

About two years ago a scheme for obtaining data suitable for the correlation of weather and crops was instituted by the Ministry of Agriculture and Fisheries and the Board of Agriculture for Scotland, acting in co-operation with the Meteorological Office. In connexion with this scheme a course of meteorological instruction was held this year at Kew Observatory from September 27th to 29th. Ten observers from "crop-weather" stations attended the course; two members of the staff of the Ministry of Agriculture and Fisheries were present.

Observers from six stations reporting regularly to the Meteorological Office, but not observing in connexion with the "Crop-weather" scheme, were also present, and continued in attendance at Kew Observatory until October 2nd. These observers had instruction in the following subjects, in addition to those dealt with in the "crop-weather" course:

The routine of observations at health resort stations whose reports are issued daily to the press.

The Weather Map: charting of observations distributed by wireless telegraphy.

Climatology.

The course of instruction at Kew for "crop-weather" observers was followed by a Conference held on September 30th and October 1st at the Meteorological Office in connexion with the same scheme, at which Sir Napier Shaw took the chair. The following papers were read: "The influence of summer rainfall on the fruiting of apples," by Mr. A. H. Lees, of the Agricultural and Horticultural Research Station at Long Ashton; "Meteorological conditions and the growth of barley," by Dr. S. G. Gregory, of the Plant Physiology Research Institute, Imperial College of Science; "The essentials of theory and points of practice in crop-weather work," by Mr. F. L. Engledow, of the Plant Breeding Institute, Cambridge University; "Technique of crop observations," by Mr. T. Eden, of the Rothamsted Experimental Station; "Solar radiation," by Mr. R. Corless, of the Meteorological Office; "The effect of solar radiation on plant growth," by Prof. V. H. Blackman, of the Plant Physiology Research Institute, Imperial College of Science; "The value of co-ordination in phenological work," by Mr. J. E. Clark; and "The value of phenological observations in practical agriculture," by Mr. A. Roebuck, of the Midlands Agricultural College.

The Conference was well attended and many speakers took part in the discussions.

Correspondence

To the Editor, *The Meteorological Magazine*

Extremes of Temperature

Returning late from my holiday, I have only just seen your August issue. The author of the interesting article on "Extremes of Temperature" has evidently overlooked the figures published by Dr. and Mrs. Workman in "Ice-bound Heights of the Mustagh" (Constable, 1908). On page 270 is given a list of maxima obtained with the black bulb thermometer on the ten available clear days between July 18th and August 17th, 1903, at heights above 14,000 feet on the Chogo-Lungma Glacier, Karakoram Mountains. On each of these ten days the figure exceeded 183° F., while on July 28th, 204° was reached at a height of 17,322 feet. With a corresponding shade temperature of 56° F. (the screen used is not stated) there is a difference of 148°. No doubt the reflecting power of the snow has a great influence over the temperatures recorded.

HUGH GARDNER.

Oakhurst, Harrow-on-the-Hill. September 23rd, 1926.

Photograph of a Meteor Train

May I call your attention to the article by W. J. Fisher, in the Journal of the R. Astronomical Society of Canada (September, 1926), on the fireballs of November and December, 1925. The author places on record the success of Mr. D. O. Woodbury of Schenectady, New York, in taking a photograph of the "train" left by a meteor on December 29th, 1925. His moral may be quoted :—

> "It is surprising and unfortunate that in these days of unlimited amateur photography only one person had the initiative to get a photograph of this train. Mr. Woodbury's photograph was got under entirely untried conditions as to light and exposure; the writer does not know that a measurable photograph of a meteor train was ever made before. With another as good as this, made anywhere north or south of the train, measurement would have given by far the best determination of a meteor train ever made."

Of course, it would have been still better if each of the alert photographers had had the initiative to take two or three photographs, then a good determination of the air currents at the height of the "train" would have been possible.

It is worth noting that from the available observations, Fisher concludes that the air currents on this particular occasion were from the west. In 1921, Dr. S. Kahlke published a collection of reports on meteor trails.* Eighteen daylight trails were included; the majority indicated east wind at great heights, but one of the two instances in December gave a west wind and the one in January a north-west wind.

F. J. W WHIPPLE.

Kew Observatory, Surrey. September 21st, 1926.

Green Flash in London

On Monday, September 13th, from the White Stone Pond, Hampstead, the sun was observed to set over a long building some miles off and at a slightly lower level, giving a very sharp horizon. The sun was a deep orange colour, but its intersection with this artificial horizon was very clear. As the upper rim disappeared the orange colour was replaced—for a fraction of a second only—by a colour which can best be described as a smoky white with a faint tinge of green. The change of colour was abrupt, and the "flash" contained no trace of red.

C. E. P. BROOKS.

NOTES AND QUERIES

Isonotides

Under the heading "Die Isonotiden" Dr. P. Wirth gives in Petermann's Mitteilungen for 1926, p. 145, a description of the distribution of the "rain-factor" over the globe. The rain-factor was devised by R. Lang (Verwitterung und Bodenbildung als Einführung in die Bodenkunde, Stuttgart 1920) as an indication of the state of the ground, and is found by simply dividing the annual rainfall in millimetres by the mean annual temperature in Centigrade degrees. The advantages of the use of such a formula are obvious; desert formations are limited by a much higher annual rainfall in hot areas than in cold, and as Dr. Wirth points out, if the limits are taken simply from the isohyets, the desert areas include regions of permanent inland ice. The chart prepared by the author on the basis of Lang's formula to show the distribution of isonotides over the globe presents a much more natural appearance, the areas with a rain-factor less than 20 being limited to just those regions which are regarded as deserts from the biological point of view.

The formula is however by no means perfect for the purpose.

* *Meteorological Magazine*, London. 56 (1921), p. 293.

With a mean annual temperature of 0° C. the rain-factor becomes infinite, and still nearer the poles it is negative. Moreover, the formula does not differentiate between regions in which the greater part of the rainfall occurs in winter and those of the monsoon type with their rainfall in summer, but it is well known that desert areas are limited by a much lower rainfall in the former than in the latter. To meet these points it would be necessary to devise some formula in which the rain-factors of the individual months are calculated separately and then combined to give the general factor for the year, but there would be many difficulties in such a calculation and the amount of labour involved would be very considerable. Over the greater part of the world the result would probably not differ greatly from that presented by Dr. Wirth, and his chart should prove of great assistance in the application of climatic data to biological researches.

The Fluctuating Rainfall of the Sudan

An article by G. T. Renner, Jr., entitled " A famine zone in Africa: the Sudan," in the *Geographical Review* for October, 1926, raises once again the " vexed question " of desiccation during recent years. The evidence of human geography seems to point to a gradually decreasing rainfall, at least during the present century. There seems to be in progress a gradual southward movement of peoples throughout the Sudan, from the border of grass land and desert to the moist regions of the Guinea coast, and every year the Tuaregs of the desert's edge penetrate a little further south. By 1917 conditions at Sokoto in the north of Nigeria had become so threatening that the British Resident considered abandoning the post. H. Hubert concluded that desiccation has been in progress for at least 60 years, and has been greatly aggravated during the present century, but the late R. Chudeau regarded the variation as cyclical in periods of 20 to 50 years and not progressive. G. T. Renner analyses the rainfall records from a number of stations in the Sudan during the present century and fails to find evidence of a secular change; rather he favours the occurrence of very pronounced irregular variations from year to year which render living exceedingly precarious, with perhaps an eleven year cycle giving heaviest rainfall at sunspot maxima.

During the present century the various European governments have penetrated the Sudan, bringing law and order. The population, formerly kept down by inter-tribal warfare, increases beyond the capacity of the country and as the peoples of the desert edge can only expand southwards, a southward migration is introduced which may be entirely unrelated to climatic changes. Thus the question is still open.

Sunspots and Thunderstorms

Dr. Evald Septer, of the Magnetical and Meteorological Observatory, Irkutsk, calls attention in the *Meteorologische Zeitschrift* for June, 1926, to a remarkable parallelism between the relative number of sunspots and the frequency of thunderstorms in Siberia. The thunderstorm data utilised are the annual averages of the number of days with thunder at 229 stations between latitudes 71° and 43° N, longitudes 59½° and 149½° E, *i.e.*, practically the whole of Siberia. The period covers the 37 years, 1888 to 1924, and includes three maxima and four minima of the eleven year sunspot cycle, all of which are faithfully reproduced on the curve of thunderstorm activity, except that the double sunspot maximum of 1905 and 1907 is represented by a single thunderstorm maximum in 1906. The means of nine years grouped about the three maxima, and of twelve years grouped about the four minima, give :

	Sunspot maxima.	Sunspot minima.
Sunspots	73·0	7·1
Thunderstorms ..	18·4	10·6

The author does not give the correlation coefficient, but from his figures it is found to have the remarkably high value of +·88. The regression equation gives :

No. of Thunderstorms = 10·4 + 0·11 (Relative Sunspot Number).

This is curious ; in each year there appear to be about ten thunderstorms independent of sunspots, and a further number from 0 to 9 associated with sunspots. The manner of their occurrence is also curious, since thunderstorms appear to have a maximum frequency when large groups of spots are directly opposite the earth, but on the side of the sun which is turned away from us, and the author asks the question, at present unanswerable, as to how sunspots in such a position can affect terrestrial weather.

Thunder in Siam

Mr. R. Stanley Breton, B.A., has sent a summary of his observations of the frequency of thunder at Tung Song, Siam (8° 20′ N, 99° 60′ E), about the middle of the Malay Peninsula. The observations cover three to five years between 1921 and 1926, and the average frequency of thunder heard is as follows (days per month) :

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
2	2	14	22	25	17	14	17	15	19	15	5

The annual average frequency is 168 days, but in 1923 the total was 190. The data thus indicate a northward extension of the area of maximum thunder frequency over the East Indies centred at Buitenzorg (Java), which with ·322 days a year is so far as is known the most thundery region of the globe.

Winter Thunderstorms

Mr. S. Morris Bower informs us that it is hoped to continue this investigation* during the following winter, and he would be glad to receive reports of thunderstorms in any part of the British Isles, especially in Scotland or Ireland, between October 1st, 1926, and March 31st, 1927. It is to be noted that the period has been extended to include the whole of the six winter months. A note on a postcard of the date and time of the occurrence of thunder or lightning, with the direction in which the lightning was seen, especially at night, will be valuable. Any additional information of the following character will be extremely welcome :—

1. The time when the storm passed overhead or was nearest, with its direction ; and how long it lasted.
2. Severity of the storm ; much or little thunder, or lightning, or both.
3. Whether it was accompanied by rain, hail or snow.
4. Direction and strength of wind ; change of wind (if any).
5. Whether there was a change in temperature during the storm.
6. Any other observation which may be of particular moment.

It is particularly asked that the position of the place of observation should be indicated by mentioning the estimated distance and direction from the nearest town. A note that no thunder or lightning has been observed will be useful. Notes should be sent by postcard or letter to S. Morris Bower, Esq., 10, Langley Terrace, Oakes, Huddersfield.

American Studies of Tropical Meteorology

We have received from Dr. S. S. Visher, of Indiana University, whose book *Climatic Laws* was reviewed in the *Meteorological Magazine* for 1925, p. 22, a number of papers dealing mainly with various points in the meteorology of the tropics, especially in the Pacific Ocean. These papers embody the results of Dr. Visher's investigations into the " Variations in weather due to variations in the frequency, intensity and tracks of storms, and the possible causes and effects of such variations," and are

* See *Meteorological Magazine*, 60 (1925), p. 260.

largely based on field work in the Pacific area during 1921 and 1922. The main results are embodied in a memoir—" Tropical cyclones of the Pacific "—which appeared as *Bulletin* 20 of the Bernice P. Bishop Museum, Honolulu, Hawaii, in 1925. This memoir deals first with the structure, causes, places of origin, frequencies, tracks, &c., of Pacific cyclones, including useful lists of the hurricanes which have visited the various islands or groups during the past century. It has been generally understood that hurricanes are rare within eight or ten degrees of the equator, but on pp. 63-64 a list is given of 68 which have been recorded in latitudes 5° to 8° since 1880 (and mainly during the present century), while one storm is located in latitude 4°; whether north or south is not stated. One would like to have further details in order to make sure that this abnormal occurrence was really a cyclone.

The author is not happy in dealing with the immediate causes of tropical cyclones; for example, on p. 93 we read: " The force of gravity draws air in toward the centre, where a partial vacuum exists. This is the agency which produces the wind." He is on much surer ground in dealing with the effects of tropical cyclones on Pacific Islands, and many of his descriptions bear the stamp of the eye-witness. The " laziness " of tropical islanders, usually attributed to the enervating climate, is here related also to the uncertainty which hurricanes introduce into the reward for toil, and it is suggested that " the occasional destruction by a hurricane of most of the personal property of a village has undoubtedly played at least a small part in the development of communism . . . . . among the natives of the tropics." The harmful effects are due not only to the destructive winds and hurricane waves, but also to the excessive rainfall.

Other points which are dealt with briefly in this memoir are elaborated in special papers. They include " Tropical cyclones and the dispersal of life from island to island in the Pacific " (*American Naturalist,* 59, 1925, p. 70), in which the transporting power of the wind and of abnormal temporary ocean currents is suggested as an explanation of the widespread occurrence of plants and animals; and " Effects of tropical cyclones upon the weather of mid-latitudes " (*Geographical Review,* 15, 1920, p. 107), in which it is suggested that the irregular variations of weather in temperate latitudes result from the irregular occurrence of tropical cyclones. The handicap offered by the irregular rainfall to the development of tropical countries is discussed in the *Geographical Review* for 1925, p. 457.

A Comparison of Hydrological and Meteorological Data

A report has recently been published of the lecture given by

Professor V. I. Pettersson* at the reunion of the International Council for the Exploration of the Sea, in September, 1925, at Copenhagen. The hydrographical statistics of the surface temperature of the sea for the fourteen years 1900 to 1913, are taken from the *Hydrographic Bulletin* of the International Council. It is demonstrated that there exists a fair relation between the mean annual air temperature of oceanic islands, such as Madeira, and the surface temperature of the surrounding ocean, a correlation coefficient of +0·86 being obtained for the values for Madeira and the sea some 35 miles to the north east. By considering the surface temperature of adjacent sea areas, the path of the Gulf Stream and the effect of the encounter with the Labrador Current is studied. The Gulf Stream Drift divides south of Newfoundland into two portions, one going to the north towards Greenland, and the other to the east (south of latitude 40°), to the west coasts of Europe. It is shown that the northerly branch has a seasonal flow, the surplus temperature over the surrounding areas ceasing in January. The Gulf Stream proper shows variations of temperature from one year to another, but the correlation of these variations with the temperature changes of western Europe is nil. Prof. Pettersson estimates the annual variation of the amount of melting ice, by comparing the average departure of the water temperature from the mean temperature in the summer months to the east of Newfoundland. The warmer or colder surface water spreads eastward from this zone of melting ice, as part of the Atlantic drift current to the shores of Europe. It is estimated that this water will arrive 12 or 14 months later. The correlation coefficient between the surface temperature in summer of the area in which the ice melts and the mean annual temperature of the water in the ocean midway between Newfoundland and Ireland in the following year (*i.e.*, 6-8 months later) is found to be +0·45. The variations of this mid-Atlantic temperature are reproduced in the variations of the rainfall of Ireland in the following year, a correlation coefficient of +0·64 being obtained from the data for the years 1900 to 1913. It is shown that the general rainfall values for Ireland, Great Britain, Spain and Sweden are very similar. Thus there is some evidence for suggesting that the rainfall of western Europe is determined by the temperature of the sea on the other side of the Atlantic one or two years earlier.

The author points out that this is a preliminary discussion, and that a larger series of observations and more accurate measurements of the water temperature by automatic recording

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* Etude de la Statistique Hydrographique du Bulletin Atlantique du Conseil International pour l'Exploration de la Mer. By Vilhelm I. Pettersson. *Svenska Hydrog.-Biol. Komm. Skri.* New Series. *No.* 1 *Göteborg* 1926.

instruments are required. The results are both interesting and suggestive, and it is very satisfactory that the hydrological data, in which the name of Professor Otto Pettersson is associated, should be correlated by his son with the meteorological data. This marks a beginning in the carrying out of one part of the programme for the hydrographical and biological work in the northern parts of the Atlantic Ocean, the North Sea, the Baltic and adjoining seas. "The hydrological researches shall have for their object the distinction of the different water-strata, according to their geographical distribution, their depths, temperature, salinity, gas contents, plankton and currents, in order to find the fundamental principles not only for the determination of the external conditions of the useful marine animals, but also for weather forecasts for extended periods in the interest of agriculture."

J.G.

Reviews

The Present Status of Long-Range Weather Forecasting. By R. de C. Ward. Philadelphia, Pa. Proc. Amer. Phil. Soc. XV. 1926.

Professor R. de C. Ward in a paper presented to the American Philosophical Society (*Proceedings,* Vol. XV., 1926) reviews the present status of the problem of forecasting the weather weeks or months in advance. He sets aside as unworthy of serious consideration forecasts based on the behaviour of animals and plants and also the efforts of the almanac makers. He pays little attention to cycles and he also leaves out of consideration the "weather outlook" for a few days or a week, issued from time to time by the British or American meteorological services, on the ground that it is not a forecast. This statement seems rather sweeping; the "further outlook" and the "fine spell" forecast are often of greater value to the general public than the day-to-day forecast, and many meteorologists would support the view that the development of successful "medium-range" forecasting is most likely to result from the extension, both in area and detail, of synoptic charts, with perhaps the addition of regular upper air data. The way in which Professor Ward looks at the problem is briefly this: The "atmospheric machine" which governs our weather does not always "run true," so that "in temperate latitudes abnormal weather is normal." The solution of the problem depends on finding out the cause of these irregularities in the running of the machine, but so far the attempts in this direction have for the most part been little more than experiments, based on hopes and intuitions rather than on sure knowledge.

There are various "schools" of thought; H. H. Clayton looks to the sun, Sir Gilbert Walker to the state of the machine as shown by conditions in the action centres, F. McEwen to the variations of the great ocean currents, W. Wiese to Arctic Ice. The present writer would suggest that *a priori* all four factors are likely to be of importance, which is already a reason why no very obvious relations should exist between any one of them and the weather of temperate latitudes. Further, each of these causes is in itself complex. Variations of solar radiation act differently under different atmospheric conditions. There are many action centres, interrelated in many diverse ways. Ocean currents are complex entities, subject to outside influences along the whole of their course. We are not likely to overstate the case if we say that the future weather of Great Britain is controlled by twenty-five different and more or less independent factors. It is usual nowadays to investigate these relationships by the method of correlation.

Now if the variations of one element, say pressure, are controlled to an equal extent by the variations of twenty-five factors, all of which are independent of each other, pressure will have a correlation coefficient with each of these factors of about 0·2. An investigator seizes on one of these factors and concludes from theoretical reasoning that it should be of value for forecasting the pressure. He calculates the correlation, obtains a coefficient of 0·2, and unless he is gifted with unusual persistence, he abandons the investigation. His difficulty is that coefficient of 0·2 may readily arise by chance, without indicating any real relationship at all, hence every such coefficient has to be laboriously checked by other methods. But the outlook is not hopeless; every factor identified and tracked to its lair is so much gained, and in time we shall have laid our hands on the whole twenty-five.

C.E.P.B.

Zum Klima der Turkei. Ergebnisse dreijähriger Beobachtungen 1915-1918, edited by Dr. Ludwig Weickmann. Part II. Die Temperaturverhältnisse der Türkei; Der Scirocco. By Dr. Peregrin Zistler. 8vo., $9\frac{1}{4} \times 6\frac{1}{4}$, pp. 181, *illus.* Bayerische Landeswetterwarte, München and Geophysikalisches Institut der Universität Leipzig, Leipzig, 1926.

The mind adjusts itself so quickly to actualities, that nowadays the name of Turkey brings to the mind a small patch of land in Asia Minor, and one wonders where in this barren region the author has found the wherewithal to fill nearly 200 pages with information about the temperature and the scirocco. The region dealt with in the first paper, on the temperature conditions, is, however, the old Turkish Empire, and incidentally includes also the south of Russia and the eastern Mediterranean, and the discussion is the most thorough conceivable. Numerous barograms and thermograms are reproduced to illustrate such special points as the onset of cold waves, land and sea breezes, or the types of diurnal variation, while the number of tables of wind frequency would warrant a reference to wind in a sub-title. The tables belonging to this section are extraordinarily complete—mean monthly temperatures for 60 stations, with the amount of precipitation in the year, and the extreme months and the "climatic formula" according to Koppen; mean daily maximum and minimum, mean daily range, mean monthly extremes and range, mean and absolute annual extremes. Charts of isotherms for the Mediterranean region and the Turkish Empire are given for the year, and for January, April, July and October.

The second section, dealing with the scirocco, is equally complete, occupying 65 pages. The usual classification into dry and moist scirocco is adopted, but the author is not content with generalisations; he investigates individual examples by means of daily weather charts and the records of autographic instruments. He concludes that it is essentially a desert wind, and is not limited to the Mediterranean region, but can blow from any great desert. Its immediate cause is a depression passing along the edge of the desert and drawing air from it. The scirocco is initially a hot dry wind, but after crossing a stretch of ocean it may arrive on the opposite shore as a moist wind. It carries much fine sand, but the sandstorms which are sometimes experienced are incidental phenemona due to the upsetting of air in unstable equilibrium.

The scirocco is shallow: in Syria and Palestine it usually entends to a height of 700-900 metres above the ground. Above this is a transition layer to a height of 2,400 to 2,600 metres above the sea, where a layer of winds from west or north-west is met with. The scirocco generally ends suddenly when, with the passing away of the depression, cool moist winds from the sea break in and replace the hot desert winds.

Books Received

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Ergebnisse Aerologischer Beobachtungen. K. Ned. Meteor. Inst. (No. 106A). Utrecht, 1924.

Falmouth Observatory. Meteorological Notes and Tables for the year 1925. Falmouth, 1926.

Records of the Survey of New Zealand. Vol. II.

Meteorology. Extracts from statistics of New Zealand for the year 1925. Wellington, 1926.

Monthly Rainfall of India for 1924. Calcutta, 1926.

Obituary

John Louis Emil Dreyer, Ph.D., D.Sc.—The death was announced on September 14th, at Oxford, of Dr. J. L. E. Dreyer, the distinguished astronomer, at the age of 74. Dr. Dreyer was born at Copenhagen. He came to Ireland in 1874 to Lord Rosse's Observatory at Birr Castle. While there he began the study of nebulæ, with which his name is so closely connected. In 1882 he was appointed to the charge of Armagh Observatory, which appointment he held until 1916. The observatory was mainly concerned with astronomical work, but at that time it was also one of the seven observatories of the Meteorological Office which had been started in 1868 to obtain continuous records of the meteorological elements, with a view to the discovery of the laws which regulated the changes in the weather. The full programme of observatory work at Armagh, which involved the preparation from the autographic records of hourly readings of pressure, temperature, humidity, wind, rain and sunshine, was discontinued in 1884, from which date Armagh has acted as a second order climatological station. Dr. Dreyer was President of the Royal Astronomical Society from 1923-5.

News in Brief

Tiree.—The need has long been felt for an anemograph station representative of coastal conditions in the west of Scotland, no anemometer having been maintained in the past on the coast between the Orkneys and the west of Ireland. This gap has been filled by the opening last month of an anemograph and telegraphic reporting station at Cornaigmore in Tiree, an island some 25 miles westward of Mull with an open exposure to the Atlantic on the west. The island is for the most part low-lying and flat and thus provides an ideal site for obtaining wind records. Mr. D. O. Maclean, M.C., M.A., Headmaster of the Secondary School at Cornaigmore, has undertaken to act as observer and the first telegraphic report was received in the Forecast Division on the afternoon of September 16th.

The Weather of September, 1926

September opened with severe local thunderstorms, accompanied by heavy rain in south-east England in the early hours of the 1st. Floods occurred in several parts of London, 34 mm. (1·34 in.) of rain were recorded at Greenwich, and 31 mm. (1·22 in.) at Lewisham; 35 mm. (1·38 in.) fell at Brighton. Letters in the *Times* give for this storm 46 mm. (1·80 in.) between 6.30 and 8 a.m. at East Grinstead, and 54 mm. (2·14 in.) at Oxted, mainly between 7 and 8.45 a.m. These storms were caused by a depression over France. Shallow lows over the Channel caused further heavy rain on the

2nd, including 35 mm. (1·39 in.) at Standon, Herts. The weather continued rather unsettled during the first half of the month. Temperature was generally above normal, except in the north of Scotland; the night temperatures were particularly high, many screen minima being between 60° and 66° F. The sunshine was generally below normal, but good records were obtained in southern England on the 10th. During the third week an anticyclone moved eastward over France from the Azores, southerly winds and bright sunshine causing a short spell of very hot weather. On the 18th many stations recorded maximum temperatures of 80° F. and over, 85° F. was recorded at Camden Square, and the 19th was still hotter; the highest temperatures recorded this year occurred on that day, namely: 85° F. at Kew Observatory, 87° F. at St. James' Park, 88° F. at Greenwich and Kensington Palace, and 91° F. at Camden Square. There was a marked fall of temperature generally on the 20th; nevertheless, values of 80° F. were again registered. The supply of cooler air was brought by northerly winds in the rear of a trough of low pressure, which crossed our islands on the 19-20th causing thunderstorms and heavy rain locally in northern England and southern Scotland. During the last ten days of the month, temperatures were considerably lower, a marked drop occurring on the 25th, when a depression passed across the north of Scotland to the North Sea. The 26th was generally the coldest day, the maximum readings in London being 30°-39° F. lower than on the previous Sunday.

Rainfall was below normal except at some stations in the north and west. Some southern districts had remarkably little rain, the total fall at Calshot being only 6 mm.

Pressure was above normal over Bermuda and over the whole of Europe, with the exception of the northwest coast of Norway, and below normal over Spitsbergen, Iceland, Greenland, Newfoundland and the Azores. Temperature was above normal except along the shores of the Baltic, and rainfall was generally above normal in northern Europe and below normal in the south and central regions, including England. In Sweden the rainfall was on the whole about 10 per cent. below normal though there was an excess of 20 per cent. in the central regions. Owing to a landslide caused by heavy rains many people were killed or injured in a railway accident near Tortosa, Spain, on the 1st. During the early part of the month bad weather continued in Catalonia and round Valencia, and much of the wheat, maize and other crops were destroyed by floods in Toledo. Severe storms swept across the south of France on the 3rd doing much damage. In Portugal the crops are suffering owing to the long hot summer, and the Patriarch of Lisbon has asked that prayers for rain should be said. On the 10th a great landslip occurred on the Dent du Midi, which blocked up a torrent. This, however, soon broke through and carried down with it masses of rock which obstructed the Rhone Valley, near Bains de Lavey. On the 26th further masses of mud and rock were brought down by the Saint Barthelemy torrent and the river began encroaching on its right bank. The level of the river fell considerably after the 27th and the protective measures could be proceeded with quickly. After nearly two months of beautiful dry weather in Italy stormy weather prevailed there from the 25th to the 30th and considerable damage was done by the heavy rain and hail.

Serious floods were reported from Upper Burma on the 7th, and a typhoon swept across eastern Japan on the 4th causing extensive damage to houses and crops. Renewed floods in the neighbourhood of Hiroshima on the 11th caused many deaths and much damage. Owing to a sudden storm in the Bay of Bengal a country boat capsized on the 17th and 170 people were drowned. Unusually heavy rainfall occurred in the Bombay Presidency during the first half of the month causing damage to the crops. In the Central Provinces and Berar the recent rains are reported to have had a generally beneficial effect.

Fairly general rain fell in the drought-stricken areas of Queensland during the first week of the month.

Unfavourable weather for harvesting has occurred generally in Canada. During the first few days there was much rain, and later snow fell in many parts of Saskatchewan, Alberta and Manitoba. Threshing operations were stopped and the quality of the grain is seriously reduced. Heavy rain occurred in New York on the 6th, and rainstorms in southeastern Kansas brought about flood conditions there on the 12th. On the 18th a disastrous hurricane swept across Florida. For an account of this and other disasters which occurred over a wide region at about the same time, see page 207.

The special message from Brazil states that the rainfall in the northern and central regions was scarce, being 15 mm. and 35 mm. below normal respectively, while the distribution in the southern regions was irregular with an average 45 mm. above normal. Pressure changes were frequent. The cotton, grain and vegetable crops are suffering from lack of rain. At Rio de Janeiro pressure was 3·6 mb. above normal and temperature 4·5° F. above normal.

Rainfall, September, 1926—General Distribution

England and Wales ..	69	per cent. of the average 1881-1915.
Scotland	138	
Ireland	80	
British Isles	88	

Rainfall; September, 1926: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square	1·52	39	84	*War.*	Birminghm, Edgbaston	·95	24	53
Sur.	Reigate, Hartswood	·76	19	39	*Leics*	Thornton Reservoir	1·52	39	86
Kent.	Tenterden, Ashenden	·60	15	28	,,	Belvoir Castle	1·29	33	69
,,	Folkestone, Boro. San.	·48	12	...	*Rut.*	Ridlington	1·36	35	...
,,	Margate, Cliftonville	·47	12	24	*Linc.*	Boston, Skirbeck	1·85	47	105
,,	Sevenoaks, Speldhurst.	1·11	28	...	,,	Lincoln, Sessions House	·98	25	64
Sus.	Patching Farm	·41	10	17	,,	Skegness, Marine Gdns.	·97	25	54
,,	Brighton, Old Steyne	·41	10	20	,,	Louth, Westgate	·65	17	32
,,	Tottingworth Park	·93	24	38	,,	Brigg	·91	23	54
Hants	Ventnor, Roy.Nat.Hos.	·83	21	33	*Notts.*	Worksop, Hodsock	·98	25	65
,,	Fordingbridge, Oaklnds	·95	24	44	*Derby*	Mickleover, Clyde Ho.	1·05	27	59
,,	Ovington Rectory	1·43	36	63	,,	Buxton, Devon. Hos.	3·54	90	109
,,	Sherborne St.JohnRec.	...	..	...	*Ches.*	Runcorn, Weston Pt.	3·69	94	138
Berks	Wellington College	1·34	34	73	,,	Nantwich, Dorfold Hall	2·38	60	...
,,	Newbury, Greenham	·77	20	38	*Lancs*	Manchester, Whit. Pk.	2·88	73	21
Herts.	Benington House	...	..	...	,,	Stonyhurst College	5·44	138	142
Bucks	High Wycombe	1·66	42	88	,,	Southport, Hesketh Pk	4·61	117	168
Oxf.	Oxford, Mag. College	1·34	34	80	,,	Lancaster, Strathspey	4·58	116	...
Nor.	Pitsford, Sedgebrook	1 83	46	102	*Yorks*	Sedbergh, Akay	6·47	164	154
,,	*Eye, Northolm	...	..	...	,,	Wath-upon-Dearne	·79	20	50
Beds.	Woburn, Crawley Mill	...	..	...	,,	Bradford, Lister Pk.	1·82	46	88
Cam.	Cambridge, Bot. Gdns.	2·44	62	152	,,	Wetherby, Ribston H.	1·88	48	104
Essex	Chelmsford, CountyLab	·91	23	53	,,	Hull, Pearson Park	·62	16	36
,,	Lexden, Hill House	1·50	38	...	,,	Holme-on-Spalding	·76	19	...
Suff.	Hawkedon Rectory	1·38	35	72	,,	West Witton, Ivy Ho.	2·92	74	...
,,	Haughley House	1·08	27	...	,,	Felixkirk, Mt. St. John	1·83	46	100
Norf.	Beccles, Geldeston	·44	11	23	,,	Pickering, Hungate	1·16	29	...
,,	Norwich, Eaton	...	..	...	,,	Scarborough	1·53	39	85
,,	Blakeney	·78	20	42	,,	Middlesbrough	2·25	57	136
,,	Swaffham	1·15	29	54	,,	Baldersdale, Hury Res.	4·94	125	71
Wilts.	Devizes, Highclere	1·05	27	51	*Durh.*	Ushaw College	2·50	63	124
,,	Bishops Cannings	·99	25	45	*Nor.*	Newcastle, Town Moor.	2·40	61	118
Dor.	Evershot, Melbury Ho.	·47	12	18	,,	Bellingham, Highgreen	3·91	99	...
,,	Creech Grange	·76	19	...	,,	Lilburn Tower Gdns.	3·80	97	...
,,	Shaftesbury, Abbey Ho.	·76	19	31	*Cumb*	Geltsdale	4·99	127	...
Devon	Plymouth, The Hoe	·36	9	14	,,	Carlisle, Scaleby Hall	5·64	143	208
,,	Polapit Tamar	·97	25	35	,,	Seathwaite M.	12·30	312	124
,,	Ashburton, Druid Ho.	1·35	34	43	*Glam.*	Cardiff, Ely P. Stn.	2·02	51	65
,,	Cullompton	1·71	43	76	,,	Treherbert, Tynywaun	3·77	96	...
,,	Sidmouth, Sidmount	1·27	32	55	*Carm*	Carmarthen Friary	1·07	27	31
,,	Filleigh, Castle Hill	3·15	80	...	,,	Llanwrda, Dolaucothy	2·83	72	70
,,	Barnstaple, N.Dev.Ath.	2·53	64	94	*Pemb*	Haverfordwest, School	1·62	41	46
Corn.	Redruth, Trewirgie	1·00	25	32	*Card.*	Gogerddan	3·48	88	96
,,	Penzance, Morrab Gdn.	·79	20	27	,,	Cardigan, County Sch.	1·87	47	...
,,	St. Austell, Trevarna	·95	24	30	*Brec.*	Crickhowell, Talymaes	2·50	64	...
Soms	Chewton Mendip	2·75	70	90	*Rad.*	Birm.W.W.Tyrmynydd	3·43	87	89
,,	Street, Hind Hayes	1·55	39	...	*Mont.*	Lake Vyrnwy	4·09	104	116
Glos.	Clifton College	1·40	35	60	*Denb.*	Llangynhafal	4·00	102	...
,,	Cirencester, Gwynfa	1·01	26	45	*Mer.*	Dolgelly, Bryntirion	3·37	86	79
Here.	Ross, Birchlea	·68	17	35	*Carn.*	Llandudno	2·60	66	114
,,	Ledbury, Underdown	·83	21	43	,,	Snowdon, L. Llydaw 9	9·95	253	...
Salop	Church Stretton	1·84	47	91	*Ang.*	Holyhead, Salt Island	1·54	39	57
,,	Shifnal, Hatton Grange	·94	24	49	,,	Lligwy	2·15	55	...
Staff.	Tean, The Heath Ho.	...	..	...	*Isle of Man*				
Worc.	Ombersley, Holt Lock	·47	12	27		Douglas, Boro' Cem.	...	..	...
,,	Blockley, Upton Wold	1·54	39	73	*Guernsey*				
War.	Farnborough	1·52	39	71		St. Peter P't, Grange Rd	·47	12	18

Rainfall: September, 1926: Scotland and Ireland

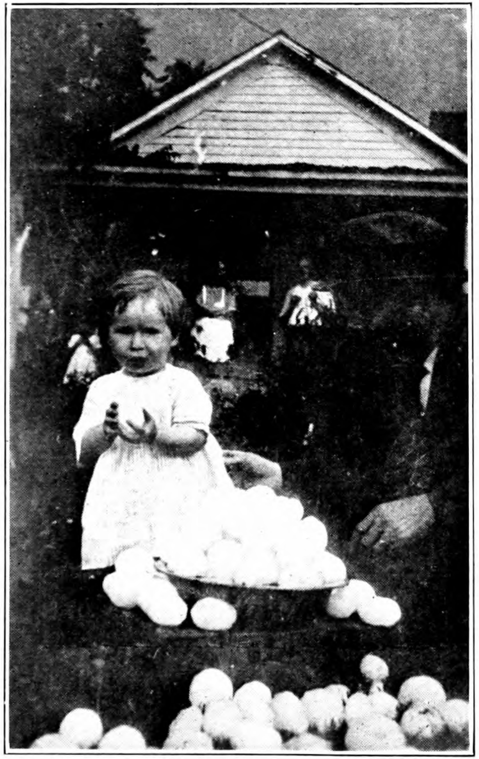
CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Wigt.	Stoneykirk, Ardwell Ho	...	..	...	*Suth.*	Loch More, Achfary	8·27	210	144
,,	Pt. William, Monreith	2·97	75	...	*Caith*	Wick	2·99	76	120
Kirk.	Carsphairn, Shiel.	4·60	117	...	*Ork*	Pomona, Deerness	4·76	121	164
,,	Dumfries, Cargen	4·62	117	157	*Shet*	Lerwick	4·81	122	160
Roxb	Branxholme	3·36	85	150		———			
Selk	Ettrick Manse	4·07	103	...	*Cork*	Caheragh Rectory	1·04	26	...
Berk	Marchmont House	4·55	116	188	,,	Dunmanway Rectory	1·26	32	31
Hadd	North Berwick Res.	4·25	108	204	,,	Ballinacurra	·51	13	20
Midl	Edinburgh, Roy. Obs.	4·11	104	218	,,	Glanmire, Lota Lo.	·69	18	25
Lan	Biggar	4·07	103	178	*Kerry*	Valencia Obsy.	...	..	...
,,	Leadhills	5·58	142	...	,,	Gearahameen	3·30	84	...
Ayr	Kilmarnock, Agric. C.	3·85	98	126	,,	Killarney Asylum	2·34	59	65
,,	Girvan, Pinmore	4·60	117	120	,,	Darrynane Abbey	1·91	49	54
Renf.	Glasgow, Queen's Pk.	2·96	75	107	*Wat.*	Waterford, Brook Lo.	·93	24	34
,,	Greenock, Prospect H.	4·84	123	102	*Tip*	Nenagh, Cas. Lough	2·10	53	75
Bute.	Rothesay, Ardencraig	4·63	118	114	,,	Tipperary	1·67	42	...
,,	Dougarie Lodge	3·29	84	...	,,	Cashel, Ballinamona	1·14	29	47
Arg	Ardgour House	9·79	249	...	*Lim*	Foynes, Coolnanes	2·67	68	93
,,	Manse of Glenorchy	6·90	175	...	,,	Castleconnell Rec.	1·82	46	...
,,	Oban	6·05	154	...	*Clare*	Inagh, Mount Callan	5·85	149	...
,,	Poltalloch	4·85	123	106	,,	Broadford, Hurdlest'n.	2·65	67	...
,,	Inveraray Castle	8·32	211	130	*Wexf*	Newtownbarry	·94	24	...
,,	Islay, Eallabus	4·60	117	110	,,	Gorey, Courtown Ho.	1·03	26	42
,,	Mull, Benmore	15·20	386	...	*Kilk.*	Kilkenny Castle	·79	20	34
Kinr.	Loch Leven Sluice	3·69	94	144	*Wic*	Rathnew, Clonmannon	1·02	26	...
Perth	Loch Dhu	5·10	130	89	*Carl*	Hacketstown Rectory	1·58	40	56
,,	Balquhidder, Stronvar	2·94	75	55	*QCo.*	Blandsfort House	1·29	33	47
,,	Crieff, Strathearn Hyd.	3·44	87	120	,,	Mountmellick	1·60	41	...
,,	Blair Castle Gardens	2·64	67	111	*KCo.*	Birr Castle	2·07	53	90
,,	Coupar Angus School	4·03	102	203	*Dubl.*	Dublin, FitzWm. Sq.	1·51	38	79
Forf.	Dundee, E. Necropolis	4·04	103	194	,,	Balbriggan, Ardgillan	1·76	45	86
,,	Pearsie House	2·92	74	...	*Me'th*	Drogheda, Mornington	...	..	...
,,	Montrose, Sunnyside	4·39	112	220	,,	Kells, Headfort	2·24	57	84
Aber.	Braemar, Bank	2·88	73	115	*W.M*	Mullingar, Belvedere	2·23	57	84
,,	Logie Coldstone Sch.	3·40	86	146	*Long*	Castle Forbes Gdns.	2·94	75	102
,,	Aberdeen, King's Coll.	4·57	116	206	*Gal*	Ballynahinch Castle	5·02	128	105
,,	Fyvie Castle	4·27	108	...	,,	Galway, Grammar Sch.	3·64	92	...
Mor	Gordon Castle	2·59	66	104	*Mayo*	Mallaranny	6·44	164	...
,,	Grantown-on-Spey	2·77	70	112	,,	Westport House	3·06	78	86
Na	Nairn, Delnies	2·50	63	114	,,	Delphi Lodge	8·78	223	...
Inv.	Ben Alder Lodge	...	..	...	*Sligo*	Markree Obsy.	3·66	93	109
,,	Kingussie, The Birches	3·10	79	...	*Cav'n*	Belturbet, Cloverhill	2·75	70	111
,,	Loch Quoich, Loan	14·10	358	...	*Ferm*	Enniskillen, Portora	2·66	68	...
,,	Glenquoich	...	..	...	*Arm.*	Armagh Obsy.	1·98	50	81
,,	Inverness, Culduthel R.	2·34	59	...	*Down*	Warrenpoint	1·51	38	...
,,	Arisaig, Faire-na-Squir	5·81	148	...	,,	Seaforde	1·95	50	71
,,	Fort William	8·05	204	127	,,	Donaghadee, C. Stn.	1·85	47	77
,,	Skye, Dunvegan	7·81	198	...	,,	Banbridge, Milltown	1·83	46	74
,,	Barra, Castlebay	3·44	87	...	*Antr.*	Belfast, Cavehill Rd.	2·76	70	...
R&C	Alness, Ardross Cas.	2·60	66	89	,,	Glenarm Castle	3·71	94	...
,,	Ullapool	5·95	151	...	,,	Ballymena, Harryville	3·50	89	113
,,	Torridon, Bendamph	7·05	179	101	*Lon*	Londonderry, Creggan	4·35	110	132
,,	Achnashellach	8·93	227	...	*Tyr*	Donaghmore	2·41	61	...
,,	Stornoway	6·62	168	168	,,	Omagh, Edenfel	2·43	62	80
Suth.	Lairg	2·98	76	...	*Don*	Malin Head	4·52	115	172
,,	Tongue Manse	3·50	89	111	,,	Dunfanaghy	5·02	128	146
,,	Melvich School	3·15	80	113	,,	Killybegs, Rockmount	6·67	169	145

Climatological Table for the British Empire, April, 1926

STATIONS	PRESSURE: Mean of Day M.S.L.	PRESSURE: Diff. from Normal	TEMPERATURE: Absolute Max.	TEMPERATURE: Absolute Min.	TEMPERATURE: Mean Values Max.	TEMPERATURE: Mean Values Min.	TEMPERATURE: Mean Values ½ max. and min.	TEMPERATURE: Mean Values Diff. from Normal	TEMPERATURE: Mean Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION: Am'nt	PRECIPITATION: Diff. from Normal	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1011·8	− 2·6	71	33	57·2	41·9	49·5	+ 2·2	44·3	90	7·5	67	+ 30	16	3·7	26
Gibraltar	1017·8	+ 1·3	73	48	67·4	54·7	61·1	+ 0·1	53·8	79	4·7	25	− 43	10	...	...
Malta	1015·8	+ 1·8	72	50	65·8	56·2	61·0	+ 0·1	57·8	86	5·2	25	+ 3	4	7·4	57
St. Helena	1014·1	+ 4·1	72	60	67·9	61·3	64·6	− 1·2	62·9	90	3·7	51	− 47	19	...	...
Sierra Leone	1011·6	+ 0·8	93	71	90·4	77·0	83·7	+ 1·3	76·9	77	4·7	128	+ 25	6	...	...
Lagos, Nigeria	1009·5	− 0·3	93	73	90·8	77·7	84·3	+ 1·8	79·2	81	7·5	324	+178	13	...	...
Kaduna, Nigeria	1012·0	+ 1·3	98	63	94·8	70·8	82·8	+ 1·3	68·8	47	2·7	101	+ 17	7	...	...
Zomba, Nyasaland	1020·4	+ 1·9	84	55	78·1	60·8	69·5	+ 0·3	...	85	7·6	69	− 23	13	...	...
Salisbury, Rhodesia	1014·7	+ 0·6	83	45	77·1	53·6	65·3	− 0·4	58·9	67	3·3	44	+ 19	3	8·7	74
Cape Town	1018·7	+ 2·4	93	44	74·2	54·7	64·5	+ 1·3	56·7	86	3·5	18	− 31	5	...	...
Johannesburg	1018·4	+ 2·1	79	44	73·6	51·1	62·3	+ 2·5	52·0	55	1·5	5	− 39	4	8·9	78
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	83	32	75·2	46·9	61·1	+ 0·3	54·4	78	2·0	45	− 9	4	...	...
Calcutta, Alipore Obsy.	1007·8	+ 1·5	100	68	94·6	75·0	84·8	− 0·9	76·1	81	4·9	40	− 8	4*	...	...
Bombay	1010·2	+ 1·4	92	73	88·1	76·5	82·3	− 0·8	73·0	69	3·3	0	− 1	0*	...	...
Madras	1009·8	+ 1·4	102	74	94·8	79·5	87·1	+ 1·8	78·6	71	4·2	3	− 10	1*	...	...
Colombo, Ceylon	1009·9	+ 0·8	93	74	90·5	76·4	83·5	+ 0·9	79·5	72	6·1	64	−135	12	9·2	75
Hong kong	1011·5	− 1·2	83	62	72·9	66·1	69·5	− 1·3	66·6	97	9·2	436	+301	18	2·0	16
Sandakan	...	...	92	75	89·9	76·5	83·2	+ 0·9	77·6	73	...	66	− 37	8	...	...
Sydney	1014·2	− 4·3	85	50	74·3	58·2	66·3	+ 1·6	60·3	67	4·8	80	− 61	11	6·5	58
Melbourne	1014·2	− 5·2	86	41	69·5	53·2	61·3	+ 1·8	55·8	72	6·0	50	− 7	13	4·8	43
Adelaide	1015·2	− 4·8	85	49	74·0	56·0	65·0	+ 1·1	56·3	55	6·7	52	+ 7	12	6·2	55
Perth, W. Australia	1016·0	− 2·5	90	42	72·7	57·3	65·0	− 1·6	59·7	73	7·9	149	+109	19	4·4	34
Coolgardie	1015·1	− 3·4	97	37	76·2	53·8	65·0	− 0·1	56·3	58	3·8	14	− 10	4	...	...
Brisbane	1016·1	− 1·5	90	51	81·4	61·8	71·6	+ 1·3	64·5	70	3·5	60	− 31	10	8·5	74
Hobart, Tasmania	1011·1	− 3·4	75	38	63·8	49·1	56·5	+ 1·4	50·2	68	6·6	50	+ 2	17	5·4	50
Wellington, N.Z.	1020·7	+ 2·6	71	42	64·8	53·6	59·2	+ 2·3	56·2	77	6·5	37	− 62	7	5·4	50
Suva, Fiji	1013·1	+ 2·5	85	68	80·9	72·2	76·5	− 2·2	73·1	85	7·1	257	− 30	21	4·6	39
Apia, Samoa	1011·3	+ 1·4	88	70	85·4	74·8	80·1	+ 1·2	77·2	78	6·1	135	−125	11	5·8	49
Kingston, Jamaica	1014·6	+ 0·5	93	68	88·1	70·8	79·5	+ 1·1	70·0	78	1·8	3	− 28	2	1·9	15
Grenada, W.I.	1015·4	+ 3·0	88	73	85·4	74·4	79·9	+ 1·0	73·0	70	4·7	15	− 43	8	...	...
Toronto	1014·0	− 1·5	72	16	45·3	29·4	37·3	− 4·1	32·1	70	5·1	73	+ 12	14	6·3	47
Winnipeg	1017·0	0·0	80	12	49·8	26·4	38·1	+ 0·3	...	...	4·6	4	− 34	5	7·5	55
St. John, N.B.	1009·2	− 4·4	58	15	41·3	28·0	34·7	− 4·3	31·1	75	5·4	91	+ 2	9	5·9	44
Victoria, B.C.	1015·9	− 1·4	72	40	60·5	46·4	53·5	+ 5·8	48·5	70	6·0	15	− 29	8	8·3	61

*For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

To face p. 229.



Hailstones at Dallas, Texas, May 8th, 1926.

Waterspout in Northern Nigeria.

M.O. 284.

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International Meteorology

No science, especially in its practical application, depends more on international co-operation than does meteorology. There are now two international organizations which deal with meteorology: the International Union of Geodesy and Geophysics, and the International Conference of Directors. By mutual arrangement it has been decided that the former should concern itself only with the scientific side of meteorology, while the practical application should be left entirely to the latter. In conformity with this arrangement it was decided at Utrecht in 1923 that only directors of State meteorological services should be members of the Conference of Directors. The Conferences are held every six years, and at each Conference a number of Commissions are appointed to deal with various aspects of practical meteorology. In the nature of the case, these commissions have to consider a number of scientific problems, and, therefore, membership of commissions is not limited to members of meteorological services, but any man of science whose help would be valuable to the work of any commission is elected a member. During the interval between the meetings of the Conference the authority of the Conference is vested in the International Meteorological Committee, which meets whenever required, and, in any case, once in each three years.

During the eight days September 13th to September 20th, eight Commissions met in Zürich. The attendance was high,

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no less than 45 members of the various Commissions attending the meetings, in which the following British representatives took part: Dr. G. C. Simpson, president of the Commission for the Réseau Mondial; Lt.-Col. E. Gold, president of the Commission for Synoptic Weather Information; Dr. C. Chree, president of the Commission for Terrestrial Magnetism and Atmospheric Electricity; Sir Gilbert Walker; Sir Frederic Stupart (Toronto); Mr. C. J. P. Cave; Mr. C. Stewart (Pretoria); and Mr. R. A. Fisher.

After the meetings of the Commissions in Zürich, the International Meteorological Committee met in Vienna from September 23rd to September 28th, under the presidency of Professor van Everdingen (Holland). The Committee held eight meetings, at which the reports of the Commissions were considered, and about 70 resolutions submitted by the Commissions were adopted and a large number of other resolutions approved. As most of these resolutions deal with practical questions of the collection and distribution of meteorological information, uniformity of observational methods and the fixing of hours of observations, it will be seen that a large amount of international co-ordination of meteorological work was effected. It is impossible here to summarise the resolutions, but the following are amongst the chief decisions reached:

A system of visual gale warning signals, for day and night, was adopted as the system to be used as far as possible in all national services. The vexed question of the velocity equivalents of the Beaufort scale was considered, and at last, after many years of effort, agreement was obtained as to the method to be used in converting velocities read on anemometers into Beaufort Numbers for use in weather telegrams.

The International Cloud Atlas—prepared in 1895 by Messrs. Hildebrandsson, Riggenbach and Teisserenc de Bort—has for some time been out of print. The Cloud Commission under the presidency of General Delcambre (Director of the French Meteorological Service) has considered the question of a new atlas and of the changes in nomenclature and arrangement which experience has shown to be desirable. It was decided to prepare a new atlas, which will contain a new set of photographs and the proposed changes, for the consideration of the Conference of Directors which will meet in 1929. An anonymous donor has generously provided funds for the purpose.

Throughout its history the International Meteorological Committee has had no permanent staff and no funds. All secretarial work and the publication of the reports of the meetings have been undertaken by one or more of the national meteorological offices. The work of the international organization has now grown so large that this is no longer a practical method, and, in addition, the need for an organization for the interchange of information about changes in codes, times of issue of wireless messages, and other similar matters of general concern, is now acutely felt. It was therefore decided that the time has come to establish a secretariat to look after the records of the Conference, Committees and Commissions, to arrange the meetings, and to publish the records. Only a small staff of two or three persons is contemplated, and a small Committee of three was appointed to work out the details of the proposal.

The Weather of the Past Summer

During the summer half-year, April to September, 1926, the weather as a whole over the British Isles was not strikingly abnormal. The rainfall was above the average for April, May and June, but this excess was partly compensated by a deficit in July, August and September. Similarly, April, July, August and September were warm, but May and June were cold, and the mean temperature for the whole period was only slightly above normal. Perhaps the most general impression of the summer half-year of 1926 concerns the frequency of severe thunderstorms. It is true that at Kew Observatory the total number in the months of April to August was 14, compared with a normal total in these months of 11·6, while in the months of June to August only six storms were recorded, compared with an average of 8·3, but the year 1926 included several storms of considerable severity, notably those of July 18th, August 17th and September 1st.* The heavy storms of July were particularly unfortunate for the wheat crops, which otherwise would have stood a good chance of recovering from the cool, wet and sunless June. The general tendency during the half-year was for warm moist thundery weather.

This type of weather is similar to that associated with the south-eastern quadrant of large shallow depressions, or with the col between two anticyclones. The average distribution of pressure appears to have been favourable on the whole for the frequent establishment of such conditions. The map (Fig. 1) shows the distribution of deviations of pressure from normal during the five months, April to August. Pressure was above normal over the northern part of the North Atlantic Ocean from the north coast of Iceland to beyond Spitsbergen, and also over the northern half of Scandinavia, while another area of pressure above normal included Spain, Portugal and the south of France. Between these two areas of excess a col of relatively low pressure

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* See *Meteorological Magazine*, 1926; August, p. 162; September, p. 199, and October, p. 223.

extended across the British Isles and central Europe, expanding westwards into a large area of pressure deficit which covered the greater part of the North Atlantic. Pressure averaged 3·5 mb. below normal at St. John's, Newfoundland, 2·4 mb. below normal at Horta, Azores, and 2·8 mb. below normal at the point 50° N 30° W. This deficit over the North Atlantic persisted in all the individual months, though the details of the distribution over western Europe varied from month to month. In April pressure was 8·9 mb. below normal in 50°N 30° W, and the deficit extended eastwards across central Europe as in the average map. In May the maximum deficit was 4·5 mb. at St. John's, and in June 4·4 mb. at Horta, but the col across the British Isles persisted throughout these three months and numerous depressions crossed these islands unusually far to the southward, often following slow and irregular tracks. In July, however, there was a definite change in the pressure distribution; while the deficit over the Atlantic persisted, the two areas with pressure above normal over Scandinavia and the Iberian peninsula united across the British Isles, giving us a relatively fine month in England and Scotland, though the rainfall was still slightly above normal in Ireland. In August the area of high pressure over these islands strengthened, and the deviation from normal reached +4·3 mb. at Scilly; this month was definitely dry, rainfall averaging only 82 per cent. of normal, and, in England and Wales, only 79 per cent. In September the pressure distribution over western Europe was very similar to that in August, the maximum deviation being +4·4 mb. at Brest, but the area of pressure above normal extended out into the Atlantic some distance to the westward of Ireland, while pressure was more than 5 mb. below normal over the Azores. In this month also, pressure gave way over Iceland and the Arctic Ocean. The rainfall was well below normal over England and Ireland but above normal over Scotland.

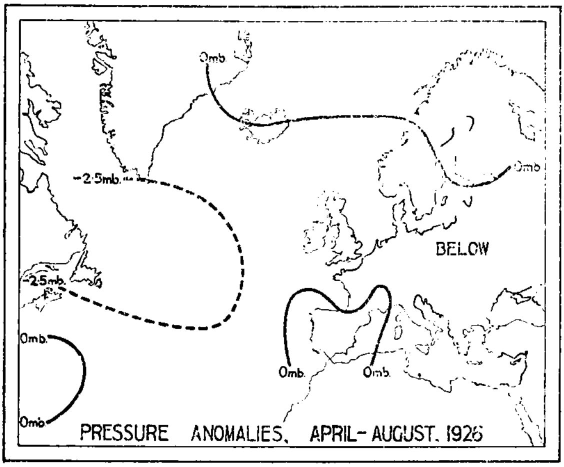

Fig. 1.

The information available about the general meteorological conditions over the world during the past two years is not yet sufficient to throw much light on the causes of the pressure distribution shown in Fig. 1. The outstanding feature, so far as is known at present, was the abnormal weakness of the south-east trade wind at St. Helena during the last seven months of 1924 when the velocity was the lowest on record during the whole period of 33 years since anemometer records began. Unfortunately, no records are yet available for the early months of 1925. The strength of the north-east trade wind, as indicated by the mean pressures at Horta, Gibraltar and Sierra Leone, was also below normal from June, 1925, until July, 1926, which is the latest month for which information is available. There is evidence that weak trade-winds in the Atlantic result in a weakening of the Gulf Stream, and adversely affect the surface temperature of the North Atlantic one to two years later, and the surface temperature of the North Atlantic is one of the numerous factors which affect the distribution of pressure over the North Atlantic and western Europe. The relation found is that when the surface temperature of the North Atlantic is below normal, pressure tends to be below normal between the Azores and Bergen, but above normal in Iceland and Greenland. Thus the deviations of pressure from normal shown in Fig. 1 are roughly what we should expect from the preceding variations of the Atlantic trade winds. There are, however, so many other factors, the variations of which are not yet known, and especially the amount and distribution of Arctic ice during the spring and summer of 1926, that it would be rash to assume that the pressure deviations of April to August are entirely accounted for by the trade-wind conditions.

In discussing the weather of the winter 1925-26 over the Atlantic and western Europe*, it was remarked that the succession of events during the period December, 1925, to March, 1926, presented a remarkable similarity to the succession during the period January to April, 1912. The abrupt change in 1926 from a rainy February to a dry March, closely resembled the change in 1912 from a wet March to a very dry April. The resemblance persisted for another two months; the pressure distribution during April, 1926, resembled that of May, 1912, and the distribution during May, 1926, resembled that of June, 1912, but after that the parallelism began to break down. August, 1912, was a very wet month, including the famous Norwich floods, and from the holiday point of view it was fortunate that the parallelism between 1912 and 1926 did not persist for eight months instead of six.

C.E.P.B.

* *Meteorological Magazine*, April, 1926, p. 56.

Discussions at the Meteorological Office

October 11th, 1926. *Measurements of the amount of ozone in the earth's atmosphere and its relation to other geophysical conditions.* By G. M. B. Dobson and D. N. Harrison (London, Proc. R. Soc., A. 110, 1926, pp. 660-93). *Opener*—Mr. J. S. Dines, M.A.

Attempts to determine the amount of ozone in the atmosphere by chemical analysis have not been successful. In 1920 Fabry and Buisson used a spectroscopic method, and it is this method which has been adopted and developed at Oxford by the authors of the present paper. Ozone has strong absorption bands in the ultra-violet between 3,300 A° and 2,000 A°. Owing to this absorption no light reaches the earth's surface of wave length less than about 2900 A° and the more ozone there is in the atmosphere the less light is received between this wave length and 3300 A°.

A spectrograph is used to separate out the wave lengths, a very effective light filter of a type devised by the authors being placed in front of the spectrograph to cut out light of longer wave length than 3300 A°, which if allowed to enter would by reason of its intensity and by scattering through the optical system tend to fog the photographic plate. By means of a photometer the intensity of the light received on certain wave lengths in the ozone absorption region is measured from the plate.

On a cloudless day a series of observations can be taken at different solar altitudes and the absorption of light on various wave lengths in the ozone absorption band determined. From these readings the amount of ozone can be deduced but it is necessary to assume that the constitution of the atmosphere remains constant throughout the series of observations.

As cloudless days are rare in this country a short method was worked out by which the amount of ozone can be determined from a single exposure taken at any solar altitude above a certain limiting value. Certain assumptions are necessary but the results obtained are probably of no less accuracy than those given by the series method described above, and readings can be obtained on many days when a series would be impracticable owing to cloud.

The results obtained during 1925 are given in the paper.

The most notable deductions are that the amount of ozone in the atmosphere has an annual variation from the equivalent of a layer 0·3 cm. thick at normal temperature and pressure in the spring to 0·2 cm. thick in late autumn. There is a close connexion with surface pressure in the sense that ozone above the normal is associated with pressure below normal and *vice versa*.

The correlation with pressure at 9 and 12 km. height is also found to be very close. Further observations are proposed for 1926, not only at Oxford but also at various places in Europe, so that the distribution of ozone round various types of pressure systems can be determined.

October 25th, 1926. *The measurement of humidity in closed spaces.* Food Investigation Board, Special Report, No. 8. *Opener*—Mr. E. G. Bilham, B.Sc., D.I.C.

The paper summarises the results of an extensive investigation on the measurement of humidity with special reference to problems relating to storage of food. After a brief summary of the existing methods of humidity control, including a useful account of a chamber in which the humidity can be kept at any required value for testing purposes, the various commercial types of psychrometer and hygrometer are considered in detail. The general conclusions arrived at are :—

(1) That the dew point hygrometer, when carefully designed, is the most accurate and convenient method of determining the atmospheric moisture content.

(2) That ventilated psychrometers of the Assmann type give results normally agreeing to within one per cent. with the dew point apparatus, provided precautions are taken to prevent errors due to the presence of the observer.

(3) That hair hygrometers are normally reliable to within about four per cent., provided that the tension on the hairs is reduced to a minimum and that the zero adjustment is checked at frequent intervals. In instruments in which the hairs are under considerable tension, serious changes of zero are found to occur after the instrument has been exposed either to very low humidity or low temperature.

Certain lesser known methods of measuring humidity, such as the hot wire method, are briefly considered.

The paper forms a convenient and useful summary of existing knowledge on the subject of humidity and its measurement.

The subjects for discussion for the next meetings will be :—

November 22nd. *Atmospheric diffusion shown on a distance—neighbour graph.* By L. F. Richardson (London, Proc. R. Soc., A. 110, pp. 709-37). *Opener*—Mr. N. K. Johnson, M.Sc.

December 6th. *On the theory of monsoon rainfalls in the Far East.* By D. Nukiyama (Tokio, Jap. J. Astron. Geophys. II., pp. 75-90). *Opener*—Mr. R. H. Mathews, B.A.

Royal Meteorological Society

An informal meeting of this Society was held on Wednesday, October 20th, at 49, Cromwell Road, South Kensington, to welcome Dr. T. Okada, Honorary Member, 1925, and Symons Medallist, 1924, Director of the Central Meteorological Observatory, Tokyo, who was paying a short visit to England with Dr. S. F. Fujiwhara, of Tokyo.

A set of lantern slides of cloud forms which have recently been presented to the Society by Mr. G. A. Clarke, of Aberdeen Observatory, were shown, together with slides from the Society's collection.

The meeting was followed by an informal dinner at the Rembrandt Hotel.

Correspondence

To the Editor, *The Meteorological Magazine*

Black Bulb Temperatures

With reference to the article entitled "Extremes of Temperature," in the August number of the *Meteorological Magazine*, it may be of interest to note the following maxima recorded by "black bulb in vacuo" in this country :—

Station.	Latitude North.		Longitude East.		Height above M.S.L.	Highest Temperature.	Date.	Period Examined.
	°	′	°	′	Feet	F°		
Allahabad	25	28	81	54	309	180	24.5.'08	Feb. 1904 to Aug. 1914
Pachpadra	25	55	72	18	380	196.5	8.6.'82	1882 to 1886
Jacobabad	28	17	68	29	186	182	20.5.'83	1878 to 1887
Sirsa ..	29	10	75	46	725	183	29.5.'84	Ditto
Lahore ..	31	34	74	21	702	183	28.4.'86	Ditto
Srinagar	34	6	74	51	5,204	168	6.8.'26	Mar. 1904 to Aug. 1926

It is rather curious that the solar radiation thermometer at Srinagar has hitherto never recorded a temperature higher than 168° F., which is often exceeded at the low level stations. The effect of stronger wind at high levels on imperfect vacuum is a probable explanation.

S. N. SEN.

Assam House, Boileauganj, Simla. October 5th, 1926.

Stereoscopic Effect produced by Motion at Right Angles to the Direction of View

Mr. Clarke's article in the *Meteorological Magazine* for October on the stereoscopic effect of motion at right angles to the direction of view, prompts me to state what I saw off the south-west coast of Spain at sunset in September. The conditions were almost identical, and produced such an effect that officers and passengers both agreed they had never before seen a sunset like it.

A mass of black cumulus apparently rested on the ocean to the west about 4 miles away, and, extending along whole west horizon, far beyond, was the furnace glow of sunset ; the sea in the foreground looked like a river with a shore of mountains, say, about 3,000 ft. high. We were steaming north, *i.e.*, at right angles, at about 15 knots.

The picture in the *Meteorological Magazine* is identical with what we saw, except that water was the foreground, and we were looking from a steamer, not a train.

S. SINGLE.

17, Kensington Palace Mansions, W. 8. October 21st, 1926.

Land Waterspout in Northern Nigeria

Whilst trekking across the Bauchi Plateau in December last, I witnessed the very peculiar phenomenon of a waterspout at the beginning of the dry season.

At about 10 a.m. (local mean time) a storm suddenly came up from the south-east, and, soon afterwards, heavy rain began to fall. The wind was blowing very strongly from the west at the time, but gradually backed round to south, then east. A huge vertical column, approximately 200 feet in height, could be seen a few miles away—descending vertically in the centre, and rising in a counter clockwise direction on the outside ; at the same time the whole column was moving across the plateau with a velocity estimated at 40 miles per hour.

The local inhabitants informed me that these phenomena are very frequent in this district (Kaleri, Bauchi Province), and occur generally at the end of the tornado season.

The snapshot* shows the break-up of the waterspout.

T. H. FALLOWS.

Survey Department, Nigeria. March 15th, 1926.

Winter Thunderstorms

In December last an appeal was made to readers of the *Meteorological Magazine* for reports of any thunder or lightning they might observe during the first three months of 1926. Efforts were made to secure the co-operation of observers in all parts of the British Islands, and the British Broadcasting Co. kindly broadcasted requests for information on several occasions.

Nearly 2,500 reports were sent in, showing that thunder or lightning occurred somewhere in the British Isles on 49 out of

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* See page 229.

the 90 days from January 1st to March 31st, which is eight days less than during the same period in 1925. The number of days for each country is shown in the following table.

1926.	England and Wales.	Scotland.	Ireland.	British Isles.
January	17	4	15	21
February	11	6	5	13
March	9	11	6	15
Totals (3 months)	37	21	26	49

The figures for Scotland and Ireland are very probably still too low on account of the small number of observers in those parts.

The thunderstorm distribution map for England and Wales shows that there were four main districts in which four or more storms were experienced during the three months. One of these was a large area round the Severn Estuary, and another was a smaller district in south-west Yorkshire and south Lancashire. The prominent belt free from storms which in 1925 ran approximately north-east and south-west through the midland counties, appears this year to run east and west. The outstanding storms of the season were those of February 15th to 17th, when almost every place south of a line drawn from Pembroke to King's Lynn and north of one joining Barnstaple and Colchester experienced at least one storm.

In thanking all those who supplied information last winter, it is hoped that many readers will be good enough to assist in the continuation of the storm census during the present season. The investigation was re-commenced on October 1st last. I shall, therefore, be very grateful for records of any storms before April 1st, 1927. Details of the observations needed were published in the *Meteorological Magazine* for October, 1926.

S. MORRIS BOWER.

10, *Langley Terrace, Oakes, Huddersfield. October* 30*th*, 1926.

The Term "Fireball"

With pleasure I read a note in the September issue of your magazine on the yearly Dutch publication with relation to Thunderstorms and Optical Phenomena, of which another part has been published after the number under review.

I hope you will allow me a short remark with regard to the objection which is made there against the use of the word "fireball" as a heading for a chapter on ball-lightning.

Admitting that the name "fireball" has been given to a certain class of cosmical meteors, one could say that the character of an electrical discharge has been recognised in a number of cases which present themselves as fireballs.

Now ball-lightnings are so rare, that most people never happen to see one, and, therefore, the average observer cannot be expected to be able to make out in all cases whether what impresses him as a fireball is a ball-lightning or not. In the greater part of the communications on fireballs which the Dutch Meteorological Institute receives, the phenomenon is evidently of a cosmical nature, but by keeping the word fireball, which has been chosen as a heading for the chapter in which those communications are discussed, it is avoided that the observer should decide that the object of his observation has been of a meteoritic character, whereas it could be under certain circumstances a form of an electrical discharge as well.

C. SCHOUTE.

Koninklijk Nederlandsch Meteorologisch Instituut, De Bilt, Holland.

October 7th, 1926.

Iceballs

Dr. Mill's talk by wireless on rain this evening was peculiarly interesting to me because of the phenomenal storm experienced here on Sunday evening, July 18th. Details of this storm* as observed by myself and a friend, are as follows.

At 7 p.m. the south and south-west sky darkened.

At 7.5 a sprinkle of large raindrops fell, followed by heavy rain a few moments after.

At 7.10 ordinary sized hailstones fell. These were quickly followed by iceballs, some of which we measured. They were $1\frac{1}{4}$ in. in diameter. They flew past the window as if from machine guns. At 7.20, to our amazement, we saw the direction of the hail had reversed to the opposite from the north-west.

The hail was succeeded by dense rain, which lasted a long time during the evening. The floods tore deep courses in the hard road. After the hail ceased, lightning and thunder became incessant, and continued far into the night ; the flashes seemed to last two or three seconds, and the zigzags were more arrestingly vivid than any pictures I have seen.

The temperature of the iceballs was such that they lay in shady places till I removed the drifts on the Tuesday following, but some were still lying in a garden a short distance from mine on Wednesday. Apples were shot to pieces, as were leaves of trees. Bark of trees was split and torn into hanging ribbons, and thick twigs split and shattered.

The composition of the iceball resembled a dead eyeball.

* For an account of the general conditions during this storm see *Meteorological Magazine*, 61 (1926), p. 162.

The centre was an ordinary sized hailstone, which was surrounded by half an inch of clearest ice ; the rest appeared to be congealed snow or sleet. The appearance suggested to me three different degrees of freezing temperatures.

JOHN D. CATHRALL.

The Cottage, Pantybuarth, Mold, Flintshire. September 29th, 1926.

NOTES AND QUERIES

Large Hailstones

Mr. George F. Lewis, Deputy Fire Marshal of Ontario, has kindly forwarded a photograph of some abnormally large hailstones, which is reproduced in the frontispiece.* The photograph was originally published in the " Factory Mutual Record " for July, 1926, issued by the Associated Factory Mutual Fire Insurance Companies, Boston, Mass., together with a brief description of the storm, from which the following particulars are taken. The hailstones fell at Dallas, Texas, in the early evening of May 8th, immediately after a thunderstorm ; it is stated that some of them were as large as baseballs, and weighed over twenty ounces. [The diameter of a baseball is just under three inches, while a sphere of ice weighing twenty ounces would have a diameter of slightly over four inches.] Driven by the wind, which blew with a velocity of 45 miles per hour, these missiles struck with great force, and caused considerable damage throughout the city. At the new Ford assembling works nearly 5,000 panes of glass were broken or cracked. Many of these were wired and were more nearly vertical than horizontal. Some of the wired glass was broken into small pieces, and holes two inches in diameter were formed.†

A peculiar thermal effect was noticed in connexion with this storm. The hailstones piled up a foot deep on the roofs of the Main Building and the Power House. This lowered the temperature so rapidly that the roof covering on the Power House contracted faster then the cement tile beneath, with the result that the roofing was pulled out of place, forming " blisters " several feet long, which were punctured by the hailstones.

Note on a Bora at Trieste

According to an account recently received, a bora, violent but of short duration, was experienced at Trieste on the afternoon of July 22nd, 1926.

* See photograph facing p. 229.

† Readers will recall the experience of Mr. G. A. Livett at Plumstead on July 22nd, 1925, described in the *Meteorological Magazine* for August, when the hailstones were " as large as a man's fist," and weighed over eight ounces.

The morning was fine and calm with clear blue sky. About noon alto-cumulus clouds appeared, coming from eastward, and an hour later covered half the sky. There were light airs from an easterly direction.

About 13h. 15m. the north horizon became dark, and, soon after, a heavy dark rain cloud was seen approaching from that direction. At the same time, fresh easterly squalls, about force 5, were experienced, causing dust to rise in clouds on shore. Three-quarters of the sky was covered with alto-cumulus cloud. At 14h. the heavy cloud was close and approaching rapidly. The easterly squalls had ceased.

Suddenly just after 14h. the storm broke in a violent squall (estimated variously at force 10 to 12), from north-north-east. Visibility at once fell to about 200 yards, both ashore and afloat, and very heavy rain fell. The storm was very violent for about twenty minutes when the wind decreased to force 8, visibility increased very rapidly, rain decreased, and blue sky began to appear to the northward. In another twenty minutes the sun was shining, the wind had gone round to east-north-eastward and had fallen to force 6 or 7. The sky cleared rapidly and by 23h. the wind had entirely died away.

The barograph record showed a slight rise for about two hours before, and a sudden rise of 2·5 millibars when the storm broke, after which it was steady for four hours, rising fairly rapidly thereafter until next forenoon when it became steady. The thermograph record showed a fall of temperature of 7 degrees between noon and 16h. and a decrease of humidity from nearly 100 % to 77 % in the same period, whereas in the preceding and following undisturbed weather the temperature was several (about 5) degrees higher at 16h. than at noon and the humidity remained approximately constant.

On the morning of the 22nd there was a depression over Finland, which had moved eastwards from the Atlantic, and a shallow depression in the north Adriatic. The cold front of the Finland depression ran down in the neighbourhood of Danzig through Germany to the region of Zürich and was moving eastwards at about 25 miles per hour. Surface temperatures were not noticeably lower behind the front than before it, the surface cold air behind the front having been warmed by the ground; but the mountain station on Säntis showed a temperature fall of 7 degrees from noon of the 21st to noon of the 22nd, and that on Sonnblick a fall of 6 degrees from the morning to the evening of the 22nd. Pressure rose rapidly behind the front, corresponding with this fall of temperature, and when the cold air reached the eastern end of the Alps in the early afternoon of the 22nd, the pressure gradient between the Alps and the north Adriatic increased greatly. The cold air consequently flowed southwards forming a cold front with a bora squall as it penetrated under the warm air of the Adriatic.

Bora in the Adriatic is normally a winter wind because the conditions producing it, namely a rapid increase in the difference of pressure and temperature between the hinterland and the sea, are most frequent in winter owing to the more frequent occurrence of depressions over Europe and associated depressions in the north Adriatic, while the seasonal difference of temperature between the hinterland and the sea is at its greatest. This instance of bora in the middle of summer is therefore of special interest.

W. A. HARWOOD.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1926.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays)

Averages for Readings

		July	August	Sept.
Cloudless days :—				
Number of readings	n	5	8	9
Radiation from sky in zenith ...	π I	599	556	580
Total radiation from sky ...	J	620	580	624
Total radiation from horizontal black surface on earth ...	X	800	782	818
Net radiation from earth ...	X—J	180	202	194

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

		July	August	Sept.
Cloudless days :—				
Number of readings	n_0	1	1	2
Radiation from sky in zenith ...	πI_0	45	40	39
Total radiation from sky ...	J_0	42	60	61
Cloudy days :—				
Number of readings	n_1	2	2	4
Radiation from sky in zenith ...	πI_1	150	230	140
Total radiation from sky ...	J_1	141	178	126

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

The Aurora of October 14th and 15th, 1926

The week October 10th to 16th was characterised by the existence of five spot groups of considerable size, fairly evenly spaced in an almost straight line across the sun's disc. These spots were just large enough to be visible, four at a time, to keen sight without optical aid, a most unusual occurrence.

In connection with this activity there were fine displays of the aurora borealis on the nights of the 14th and 15th of October. Several accounts of the phenomena have been received from stations in Scotland, northern England and northern Ireland, but in the south the sky was generally overcast.

Mr. H. W. L. Absalom, at Eskdalemuir Observatory, Dumfriesshire, observed a good auroral display at 23h. 20m. on the 14th, glows having been noted earlier in the evening. Streamers reached an elevation of about 55° and transient patches of luminosity were noticed at altitudes of 60° to 70°. The interval of greatest brightness was from 23h. 27m. to 23h. 38m., the chief features then appearing between north and northeast. A distinct red colour was noted in the upper portion of a sheaf of streamers about this time. Soon after midnight the display was fainter. At 4h. 30m. on October the 15th a glow was seen between clouds to north. The aurora of the evening of the 15th was considered to be one of the most prolonged, most extensive and, in certain respects, most remarkable that have been witnessed at Eskdalemuir. Outstanding features were the occurrence of a great arch extending from the north-north-east horizon to the west by south horizon through the zenith, and of approximately east-west bands or streaks to the south, sometimes at an elevation of only about 40°. Mr. Absalom watched the aurora from 19h. to 0h. 30m. on October 16th. Edinburgh observers state that it lasted a further two hours. At Eskdalemuir a coronal effect near the zenith was prominent between 19h. 20m. and 19h. 50m., and after 23h. 30m. the combination of the corona and the main arch, which was then directed more to the north, suggested a water cascade. After midnight the display was fainter. One of the most severe magnetic disturbances of the present sunspot cycle began abruptly at 19h. 23m. on October 13th and continued until the 16th, the intensity being greatest between 15h. on the 15th and 4h. on the 16th.

The following account of the aurora on the 14th has been received from Mr. J. S. Kingdom, of Stockton-on-Tees.

" At 10 p.m. a bright light was showing through banks of clouds near the horizon throughout the north-west sector. The remainder of the sky was totally overcast, but clearing. The appearance was that of a full moon (hidden) setting behind banks of clouds. The intensity of the light at this time was probably as great as, or greater than, at any time later on, as the bulk of the light was hidden behind the clouds.

At 1 a.m. the sky was perfectly clear, and the air cold and fresh. Movements of the aurora were very plain throughout the whole of the north-west sector. The light took the form of a continuous horizontal band just above the horizon, with vertical beams rising from it. These beams were comparatively short, not generally rising to more than 30° or 45° elevation, but occasionally a very bright one would reach to the zenith for a second. One of the most conspicuous features was the rapid rising of nearly horizontal flickering bands of brighter light. Frequently two or more of these bands were visible at once, and three or four would follow each other in rapid succession. The west end of these bands was rather higher than the north end, so that they appeared to commence to rise at a point almost due west, and to rise upwards with an inclination towards north.

This continued until about 3 a.m., when the brilliance commenced to die off: at 3.30 a.m. the light was much diminished. At 4 a.m. and 4.30 a.m. distinct auroral light was still visible, although very weak, but at 5 a.m. it had entirely disappeared, and dawn was beginning to break further round in the north-east.

The colour of the light throughout was from white to a creamy yellow, very much the same as that frequently shown by the moon when low down in the sky."

The description below is quoted from a letter written by Mr. W. J. Gibson, of Waringstown, Co. Down.

" The display as observed by me, on the night of the 15th in particular, has not been rivalled since that singularly splendid aurora on March 9th last, and the following are some of the salient features which characterized the phenomena of October 15th. At 7.35 p.m. (local time) the north quadrant of the sky was lightly covered with mackerel clouds, through which the stars shone occasionally, except when a streak of cirro-stratus crept in from the west. From the eastern extremity of the constellation Auriga, then just clear of the north-east horizon, passing underneath the bright star Capella, rising with a graceful curve towards Ursa Major, and finally resting beneath Arcturus, there stretched a beautiful arc of pearly green light. Emanating from the arc, and from the horizon itself, there streamed and danced the weird beautiful flames of the Aurora or Northern Morning. About 8 p.m. the display became more tranquil, and the streamers grew fainter, but this lull was only temporary, for the phenomenon was soon afterwards repeated in all its beauty, lasting into the small hours of the 16th. A magnetic storm raged over the earth on October 14th and 15th, dislocating Trans-Atlantic cable services."

Mr. A. J. Crockatt, of Roundhay, Leeds, observed the aurora of the 15th at 23h. when a broad glow extended from west-north-west to north-north-east, being brightest about the north-north-west point. He states that "When first observed it appeared uniform, but soon there appeared dark parallel markings which fluctuated in intensity, sloping up to the left at something over 60° with the horizon. A very bright streak stretched up at the same angle right past Vega and well into Cygnus, and perhaps lasted a couple of minutes. There were next ripplings of light upwards from the horizon and moving areas of brightness. The light was nearly white, but distinctly green tinted."

Aurora was observed on one or both of the above nights at most of the Scottish climatological stations and at Armagh and Aspatria (Cumberland). The observer at Aspatria sent the following note: "23h. 30m., 14th and 15th. Quite distinctly green arch reaching to almost overhead, with red and purple peak reaching out far to south of green arch. Broad green rays like searchlights shooting out beyond the arch."

An unusually fine auroral display was reported from practically the whole of Sweden on the 15th.

E.W.B.

Eastbourne Science Exhibition

A popular science exhibition was held at Eastbourne on October 12th, 13th and 14th. The idea of presenting science on popular lines, illustrated by modern apparatus, proved interesting and instructive to both old and young, and the exhibition was a great success. The sections included, amongst others, astronomy, bacteriology, chemistry, electricity, entomology, geology, mechanics and engineering, meteorology, photography and X-ray.

The loan of instruments by the Meteorological Office and self recording instruments by Messrs. Casella, Negretti & Zambra, and Short & Mason, greatly assisted in making meteorology a very popular section. The collections of cloud photographs lent by the Meteorological Office and Royal Meteorological Society were greatly admired and proved very attractive, and the local annual coloured charts from 1894 showing the principal meteorological observations recalled to the minds of many some outstanding meteorological features. The instruments, charts and diagrams with the constant series of explanations given by those in attendance not only gave much instruction but removed also many erroneous ideas. In addition to demonstrations in the respective sections, several lecturettes were given during each session in a separate lecture room and were very popular.

Pupils of the private schools visited the exhibition in large numbers during the afternoon sessions, but the visitors to the evening sessions, with the exception of a very few, were adults. A special morning session was open free to about 400 children selected from the elementary schools. The exhibition was a complete success and it was felt that no one visited it without gaining some knowledge. From the receipts small sums were given to two local charities, and a sum of £20 was also given to the local general hospital towards the purchase of some scientific instrument.

A. H. HOOKHAM.

Short Period Oscillations of Pilot Balloons

No one who has observed the ascent of pilot balloons can have failed to note the lack of smoothness in the motion of the balloon in the field of view of the theodolite. When the balloon is not rapidly traversing the field of view, it is possible to estimate with a high degree of accuracy its period of "oscillation." Attention was redirected to the phenomenon of oscillation of pilot balloons, by M. Fontséré, of Barcelona, at the meeting of the International Commission for the exploration of the upper air held in London in April, 1925.* Fontséré's observations at Barcelona showed that the period of the oscillations was apparently independent of the wind velocity, and was not appreciably affected by the height of observation. He found a mean period of about 2·8 seconds and a maximum range of 2½ to 3 diameters of the balloon.

During the month of September of this year several stations in England carried out observations of these oscillations. These observations show that the oscillations are practically always present, but with varying amplitudes. Observers refer to "undulating motion," "an almost circular movement," and "a push-like velocity." It is not clear that any real physical difference enters into these apparent differentiations of type. Probably it is merely a question of whether the general movement of the balloon and the oscillation are in the same direction or not.

Observations at Croydon, Calshot, and Shoeburyness, all show that the mean period of oscillation is usually between 2·0 and 2·6 seconds, and that the average amplitude of the oscillation is about equal to the diameter of the balloon. The Shoeburyness observations show a definite tendency towards an increase of the period with height, but this is not borne out by the other two stations.

The data already accumulated show that the oscillations are not associated with large changes of wind with height. It is hoped, however, that future observations will give sufficient detail to make it possible eventually to determine the cause of the oscillations. At the moment one would be inclined to

* See Report of the meeting, M.O., 281, p. 49.

ascribe the oscillations to oscillations in the form of the balloon, causing alterations in the rate of ascent, and so leading to the jerky motion observed in the theodolite. This suggestion is strengthened by the fact that the periods of oscillation show such slight variability from time to time and from place to place. If the oscillations depended upon the changes of wind or temperature with height, we should anticipate considerable variations in period from day to day, and even from one level to another during the same ascent. The relative constancy of the period of oscillation suggests that the phenomenon depends upon the balloon itself. In view of this it is desirable that future observations should be made with balloons of varying sizes. Fontséré states that the phenomena are independent of the rate of ascent of the balloon.

D. BRUNT.

Review

Deutsches Meteorologisches Jahrbuch, 1925, Freie Hansestadt Bremen. Edited by Prof. Dr. W. Grosse. $12\frac{1}{2} \times 9\frac{1}{2}$, pp. xi. + 75 Bremen 1926

In addition to the bi-hourly data for 1925, this volume contains a full discussion of the records obtained during the lustrum 1921 to 1925, and normals for longer periods. Among the latter may be mentioned monthly normals of all elements for the fifty-year period 1876 to 1925, and monthly averages for each hour of wind velocity (1896 to 1925), and of temperature, pressure, vapour pressure and relative humidity for the two periods 1891 to 1920, and 1921 to 1925. The volume concludes with some results of regular measurements of atmospheric polarisation.

Obituary

We regret to learn of the death on November 3rd, at the age of fifty-seven, of Lord Clonbrock of Clonbrock, Ahascragh, Co. Galway. A rainfall station was started at Clonbrock by his father the fourth baron in 1874 and has been maintained up to the present time.

The Weather of October, 1926.

The first part of the month was generally warm and unsettled but with considerable fair periods whereas the latter part was cold and wintry. After the passage of a secondary depression which caused some heavy rain in Scotland, *e.g.*, 48 mm. (1·89 in.) at Ford on the 1st, an anticyclone became centred over our islands for a few days and though associated with early morning fog locally, it gave good sunshine records in many places. Temperature was high for the time of year, maxima of over 70° F.

being recorded, while 75° F. occurred at Killarney on the 3rd, and 74° F. at Worksop on the 2nd. Thunderstorms occurred in many parts of England on the 5th and 6th, by which time the anticyclone was withdrawing eastwards and low pressure systems spread gradually over the British Isles. Rain fell in most districts on the 8th and 9th and was heavy in the north and west (*e.g.*, 60 mm. (2·35 in.) at Snowdon on the 8th), a comparatively shallow secondary developing rapidly into a deep depression as it moved across Scotland. Widespread gales were experienced on the 9th, gusts of over 70 m.p.h. occurring in parts of Scotland and northern England. Northerly winds in the rear of this disturbance caused a temporary drop in temperature on the 10th, but the quick renewal of southwesterly winds gave further mild weather in the south, with much rain at times in most districts and occasional high winds or gales on exposed parts of the coasts. 51 mm. (2·01 in.) of rain fell at Stonyhurst on the 12th, 50 mm. (1·98 in.) at Montgomery on the 13th, and 45 mm. (1·77 in.) at Achnashellach on the 14th. By the 14th a colder current was spreading southwards and after the passage of a few shallow depressions near the English Channel, an anticyclone south of Iceland extended over the British Isles for a few days. Day temperature remained mostly below 50° F., sharp frost occurred at night and local fog in the morning ; showers of snow, sleet or hail were also experienced in the north. On the 21st depressions were developing over France and near the Hebrides and conditions became generally unsettled with much rain at times and some hail, sleet and snow even as far south as Kent and the Isle of Wight. The passage of a deep depression on the 25th caused heavy rain and high winds and gales in many places; 83 mm. (3·27 in.) fell at Snowdon. "Snow lying" was recorded repeatedly from many parts of Scotland and north-west England between the 22nd and 30th, at Dalnaspidal in Perthshire the depth was reported to be 12 inches on the 28th. At the end of the month an anticyclone approached from the Atlantic giving bright weather in the north and west.

Pressure was above normal over most of the North Atlantic, Iceland, Greenland, Spitsbergen and the western British Isles, the excess being as much as 12·3 mb. at Isafjord, and below normal over most of Europe and the Azores. This distribution favoured north-easterly winds in north-west Europe. Temperature and rainfall were below normal in northern and western Europe, but above normal in the centre and south. In Sweden temperature was about 5° F. below normal at most stations, while rainfall, except in Norrland, was slightly in excess.

During the first days snow fell on the mountains in south-east France and in the eastern Pyrenees and on the 10th another series of landslips occurred on the Dent du Midi owing to heavy rain in the preceding few days. Gales occurred on the southern North Sea on the 10th and 12th and several trawlers were sunk. During the storms the island of Marken in the Zuider Zee was flooded. It was reported on the 16th that Touraine was enjoying a second spring, the fruit trees on the banks of the Cere and the chestnuts in Tours being in blossom again. Rain fell in Lisbon on the 21st putting an end to the drought during which, since May, only 2 mm. of rain have fallen. Severe gales and heavy rain occurred generally from the 20th to 26th in Switzerland and northern Italy doing considerable material damage, and a sudden drop in the temperature about the 24th injured the wine harvest which was not complete. Heavy snow occurred generally in central Europe and in the region of the Puy de Dôme after the 24th.

Ten vessels were wrecked and twenty people drowned in the vicinity of Yeterofu Island in the Kuriles in a severe storm on the 13th. A hurricane is said to have occurred to the south of Australia on the same day, but no damage was reported.

Owing to heavy rains at the beginning of the month, floods extending over a wide area in Oklahoma, Kansas, Missouri and Illinois, have done considerable damage to the crops. Three people were drowned. A passenger and freight steamer was sunk at the mouth of the St. Lawrence on the 15th, owing to bad weather. On the 20th a hurricane swept across Cuba attaining its greatest force just before noon. Over 600 people were killed, and ten or more towns and villages destroyed, the material damage being estimated at £20,000,000. On the 22nd a hurricane, said to be the worst for years, struck Bermuda at 9 a.m. and lasted until 3 p.m. During the storm the H.M.S. Valerian foundered 18 miles south of Bermuda.

Heavy gales occurred repeatedly on the North Atlantic from the 17th to 28th. The "Minnedosa" experienced a wind of force 10 (59 m.p.h.) at 18h. on the 27th in 52° N, 20° W.

The special message from Brazil states that the rainfall in the southern regions was 30 mm. below normal, while in the central regions it was irregular in distribution with 26 mm. below normal. Many depressions passed across the southern part of the country. The coffee, cane and vegetable crops suffered from lack of rain but not the cotton. At Rio de Janeiro pressure was 1·6 mb. below normal and temperature 1·4° F. above normal.

Rainfall, October, 1926—General Distribution

England and Wales ..	86	per cent. of the average 1881-1915.
Scotland	151	
Ireland	96	
British Isles	104	

Rainfall: October, 1926: England and Wales

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square	2·21	56	84	*War.*	Birminghm, Edgbaston	2·37	60	85
Sur.	Reigate, The Knowle	2·39	61	76	*Leics*	Thornton Reservoir	2·72	69	97
Kent.	Tenterden, Ashenden	2·61	66	75	,,	Belvoir Castle	2·74	70	101
,,	Folkestone, Boro. San.	4·23	107	...	*Rut.*	Ridlington	1·98	50	...
,,	Margate, Cliftonville	3·10	79	106	*Linc.*	Boston, Skirbeck	1·95	50	71
,,	Sevenoaks, Speldhurst.	2·64	67	...	,,	Lincoln, Sessions House	1·93	49	76
Sus.	Patching Farm	2·57	65	65	,,	Skegness, Marine Gdns.	...	..	...
,,	Brighton, Old Steyne	2·42	61	63	,,	Louth, Westgate	2·88	73	89
,,	Tottingworth Park	2·75	70	66	,,	Brigg	2·60	66	87
Hants	Ventnor, Roy.Nat.Hos.	4·50	114	115	*Notts.*	Worksop, Hodsock	1·74	44	66
,,	Fordingbridge, Oaklnds	3·60	91	87	*Derby*	Mickleover, Clyde Ho.	2·78	71	103
,,	Ovington Rectory	...	..	...	,,	Buxton, Devon. Hos.	4·05	103	83
,,	Sherborne St.JohnRec.	...	..	...	*Ches.*	Runcorn, Weston Pt.	3·81	97	111
Berks	Wellington College	2·45	62	75	,,	Nantwich, Dorfold Hall	2·75	70	...
,,	Newbury, Greenham	2·54	65	73	*Lancs*	Manchester, Whit. Pk.	3·40	86	103
Herts.	Benington House	...	..	...	,,	Stonyhurst College	5·37	136	119
Bucks	High Wycombe	2·58	66	82	,,	Southport, Hesketh Pk	3·18	81	90
Oxf.	Oxford, Mag. College	2·10	53	75	,,	Lancaster, Strathspey.	3·56	90	...
Nor.	Pitsford, Sedgebrook	2·46	62	92	*Yorks*	Sedbergh, Akay	4·45	113	89
,,	Eye, Northolm	...	..	...	,,	Wath-upon-Dearne	2·24	57	81
Beds.	Woburn, Crawley Mill.	2·66	67	100	,,	Bradford, Lister Pk.	3·66	93	105
Cam.	Cambridge, Bot. Gdns.	2·37	60	100	,,	Wetherby, Ribston H.	3·05	77	102
Essex	Chelmsford, CountyLab	2·61	66	107	,,	Hull, Pearson Park	3·81	97	128
,,	Lexden, Hill House	2·47	63	...	,,	Holme-on-Spalding	2·20	56	...
Suff.	Hawkedon Rectory	3·02	77	112	,,	West Witton, Ivy Ho.	...	..	...
,,	Haughley House	2·78	71	...	,,	Felixkirk, Mt. St. John	2·54	65	88
Norf.	Beccles, Geldeston	2·74	70	97	,,	Pickering, Hungate	3·51	89	...
,,	Norwich, Eaton	2·78	71	89	,,	Scarborough	3·18	81	102
,,	Blakeney	2·85	72	109	,,	Middlesbrough	2·70	69	90
,,	Swaffham	2·16	55	75	,,	Baldersdale, Hury Res.	3·81	97	...
Wilts.	Devizes, Highclere	3·42	87	110	*Durh.*	Ushaw College	3·48	89	101
,,	Bishops Cannings	2·80	71	84	*Nor.*	Newcastle, Town Moor.	2·73	69	85
Dor.	Evershot, Melbury Ho.	2·96	75	64	,,	Bellingham, Highgreen	3·25	83	...
,,	Creech Grange	5·09	129	...	,,	Lilburn Tower Gdns.	4·76	121	...
,,	Shaftesbury, Abbey Ho.	2·54	65	65	*Cumb*	Geltsdale	3·07	78	...
Devon	Plymouth, The Hoe	2·73	69	69	,,	Carlisle, Scaleby Hall	3·48	88	104
,,	Polapit Tamar	3·39	86	71	,,	Seathwaite M.	8·25	210	69
,,	Ashburton, Druid Ho.	3·93	100	65	*Glam.*	Cardiff, Ely P. Stn.	4·31	109	90
,,	Cullompton	2·89	73	70	,,	Treherbert, Tynywaun	8·80	224	...
,,	Sidmouth, Sidmount	2·48	63	67	*Carm*	Carmarthen Friary	3·72	94	65
,,	Filleigh, Castle Hill	3·75	95	...	,,	Llanwrda, Dolaucothy.	4·87	124	77
,,	Barnstaple, N.Dev.Ath.	2·97	75	65	*Pemb*	Haverfordwest, School	3·72	94	69
Corn.	Redruth, Trewirgie	3·47	88	66	*Card.*	Gogerddan	4·01	102	76
,,	Penzance, Morrab Gdn.	3·26	83	70	,,	Cardigan, County Sch.	4·72	120	...
,,	St. Austell, Trevarna	3·50	89	66	*Brec.*	Crickhowell, Talymaes	4·00	102	...
Soms	Chewton Mendip	6·11	155	127	*Rad.*	Birm.W.W.Tyrmynydd	6·07	154	92
,,	Street, Hind Hayes	4·37	111	...	*Mont.*	Lake Vyrnwy	6·34	161	111
Glos.	Clifton College	4·54	115	120	*Denb.*	Llangynhafal	3·09	78	...
,,	Cirencester, Gwynfa	2·62	67	77	*Mer.*	Dolgelly, Bryntirion	4·97	126	82
Here.	Ross, Birchlea	2·77	70	84	*Carn.*	Llandudno	3·23	82	90
,,	Ledbury, Underdown.	2·60	66	84	,,	Snowdon, L. Llydaw 9	10·45	265	...
Salop	Church Stretton	2·89	73	80	*Ang.*	Holyhead, Salt Island.	3·43	87	86
,,	Shifnal, Hatton Grange	2·21	56	78	,,	Lligwy	4·63	118	...
Staff.	Tean, The Heath Ho.	2·48	63	77	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	2·62	67	98		Douglas, Boro' Cem.	3·93	100	87
,,	Blockley, Upton Wold.	2·55	65	78	*Guernsey*				
War.	Farnborough	2·27	58	72		St. Peter P't, Grange Rd	3·57	91	79

Rainfall: October, 1926: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.
Wigt.	Stoneykirk, Ardwell Ho	4·76	121	131
,,	Pt. William, Monreith	5·02	128	...
Kirk.	Carsphairn, Shiel.	8·51	216	...
,,	Dumfries. Cargen	...	..	...
Roxb	Branxholme	3·06	78	94
Selk.	Ettrick Manse	5·82	148	...
Berk.	Marchmont House	4·54	115	119
Hadd	North Berwick Res.	3·65	93	123
Midl	Edinburgh, Roy. Obs.	3·35	85	129
Lan.	Biggar	3·88	99	129
,,	Leadhills	6·23	158	...
Ayr	Kilmarnock, Agric. C.	4·86	124	138
,,	Girvan, Pinmore	6·25	159	125
Renf.	Glasgow, Queen's Pk.	4·83	123	149
,,	Greenock, Prospect H.	9·20	234	171
Bute.	Rothesay, Ardencraig.	9·17	233	208
,,	Dougarie Lodge	6·30	160	...
Arg.	Ardgour House	7·88	200	...
,,	Manse of Glenorchy	8·89	226	...
,,	Oban	7·01	178	...
,,	Poltalloch	9·54	242	193
,,	Inveraray Castle	10·15	258	144
,,	Islay, Eallabus	8·43	214	177
,,	Mull, Benmore	...	..	...
Kinr.	Loch Leven Sluice	5·01	127	146
Perth	Loch Dhu	9·50	241	133
,,	Balquhidder, Stronvar.	4·73	120	...
,,	Crieff, Strathearn Hyd.	6·74	171	172
,,	Blair Castle Gardens	5·54	141	179
,,	Coupar Angus School	4·97	126	174
Forf.	Dundee, E. Necropolis.	5·12	130	192
,,	Pearsie House	6·23	158	...
,,	Montrose, Sunnyside	...	..	...
Aber.	Braemar, Bank	5·93	151	158
,,	Logie Coldstone Sch.	5·52	140	170
,,	Aberdeen, King's Coll.	5·23	133	174
,,	Fyvie Castle	6·18	157	...
Mor.	Gordon Castle	4·13	105	131
,,	Grantown-on-Spey	5·06	129	170
Na.	Nairn, Delnies	3·28	83	140
Inv.	Ben Alder Lodge	6·56	167	...
,,	Kingussie, The Birches	5·17	131	...
,,	Loch Quoich, Loan	9·00	229	...
,,	Glenquoich	...	..	...
,,	Inverness, Culduthel R.	3·00	76	...
,,	Arisaig, Faire-na-Squir	5·51	140	...
,,	Fort William	5·70	145	80
,,	Skye, Dunvegan	6·52	166	...
,,	Barra, Castlebay	5·74	146	...
R&C	Alness, Ardross Cas.	6·76	172	176
,,	Ullapool	5·55	141	...
,,	Torridon, Bendamph	9·58	243	120
,,	Achnashellach	8·24	209	...
,,	Stornoway	5·75	146	111
Suth.	Lairg	4·61	117	...
,,	Tongue Manse	7·14	181	170
,,	Melvich School	6·71	170	183

CO.	STATION.	In.	mm.	Per-cent of Av.
Suth.	Loch More, Achfary	10·18	259	131
Caith	Wick	6·24	159	211
Ork.	Pomona, Deerness	8·62	219	228
Shet.	Lerwick	2·68	68	68
Cork.	Caheragh Rectory	4·85	123	...
,,	Dunmanway Rectory.	4·94	125	82
,,	Ballinacurra	2·54	65	63
,,	Glanmire, Lota Lo.	2·88	73	69
Kerry	Valencia Obsy.	3·21	81	58
,,	Gearahameen	2·70	69	...
,,	Killarney Asylum	2·96	75	55
,,	Darrynane Abbey	4·07	103	81
Wat.	Waterford, Brook Lo.	2·71	69	69
Tip.	Nenagh, Cas. Lough	2·65	67	78
,,	Tipperary	...	..	...
,,	Cashel, Ballinamona	2·21	56	61
Lim.	Foynes, Coolnanes	3·53	90	93
,,	Castleconnell Rec.	3·41	87	...
Clare	Inagh, Mount Callan	5·70	145	...
,,	Broadford, Hurdlest'n.	3·47	88	...
Wexf	Newtownbarry	3·51	89	...
,,	Gorey, Courtown Ho.	4·39	112	124
Kilk.	Kilkenny Castle	2·20	56	70
Wic.	Rathnew, Clonmannon	3·01	76	...
Carl.	Hacketstown Rectory	3·06	78	81
QCo.	Blandsfort House	2·24	57	64
,,	Mountmellick	2·69	68	...
KCo.	Birr Castle	2·19	56	75
Dubl.	Dublin, FitzWm. Sq.	2·89	73	108
,,	Balbriggan, Ardgillan	2·28	58	84
Me'th	Drogheda, Mornington	...	..	...
,,	Kells, Headfort	2·68	68	80
W.M	Mullingar, Belvedere	3·40	86	109
Long	Castle Forbes Gdns.	2·68	68	82
Gal.	Ballynahinch Castle	5·69	145	95
,,	Galway, Grammar Sch.	3·22	82	...
Mayo	Mallaranny	7·67	195	...
,,	Westport House	4·94	125	110
,,	Delphi Lodge	8 20	208	...
Sligo	Markree Obsy.	4·00	102	97
Cav'n	Belturbet, Cloverhill	2·77	70	95
Ferm	Enniskillen, Portora	3·29	84	...
Arm.	Armagh Obsy.	2·84	72	104
Down	Warrenpoint	...	..	...
,,	Seaforde	3·56	90	100
,,	Donaghadee, C. Stn.	3·61	92	125
,,	Banbridge, Milltown	2·53	64	99
Antr.	Belfast, Cavehill Rd.	4·34	110	...
,,	Glenarm Castle	4·60	117	...
,,	Ballymena, Harryville	5·10	130	138
Lon.	Londonderry, Creggan	5·55	141	151
Tyr.	Donaghmore	3·76	96	...
,,	Omagh, Edenfel	3·21	82	87
Don.	Malin Head	6·24	158	212
,,	Dunfanaghy	5·68	144	129
,,	Killybegs, Rockmount	8·27	210	148

Climatological Table for the British Empire, May, 1926

STATIONS	PRESSURE: Mean of Day M.S.L.	PRESSURE: Diff. from Normal	TEMPERATURE: Absolute Max.	TEMPERATURE: Absolute Min.	TEMPERATURE: Mean Values Max.	TEMPERATURE: Mean Values Min.	TEMPERATURE: Mean Values ½ max. and min.	TEMPERATURE: Mean Values Diff. from Normal	TEMPERATURE: Mean Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION: Am'nt	PRECIPITATION: Diff. from Normal	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible.
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1012·4	− 3·5	75	35	59·2	45·3	52·3	− 1·1	46·8	82	7·1	44	0	16	4·7	31
Gibraltar	1015·4	− 0·7	85	50	72·5	55·9	64·2	− 1·3	55·1	79	3·3	37	− 7	6	...	...
Malta	1012·4	− 2·6	79	57	70·0	60·3	65·1	− 0·8	61·0	82	5·0	21	+ 11	2	8·7	62
St. Helena	1014·6	+ 3·5	74	57	66·0	58·5	62·3	− 1·3	60·0	86	3·5	64	− 41	17	...	...
Sierra Leone	1011·5	+ 0·3	95	70	91·3	75·0	83·1	+ 1·6	77·1	78	5·4	178	−113	13	...	...
Lagos, Nigeria	1009·5	− 1·5	92	73	87·9	76·7	82·3	+ 0·5	78·3	82	8·5	348	+ 82	22	...	...
Kaduna, Nigeria	1012·0	− 1·1	98	66	89·6	70·1	79·9	+ 0·5	73·3	72	2·3	94	− 57	17	...	...
Zomba, Nyasaland	1021·8	+ 0·7	86	51	76·4	56·6	66·5	+ 0·8	...	79	4·8	3	− 24	3	...	...
Salisbury, Rhodesia	1015·6	− 0·8	82	39	75·7	48·4	62·1	+ 1·5	55·0	60	2·3	9	− 5	2	9·7	86
Cape Town	1017·9	− 0·1	87	39	69·2	51·4	60·3	+ 1·4	52·6	85	6·3	92	− 5	10	...	...
Johannesburg	1018·9	− 0·1	73	34	65·1	46·6	55·9	+ 1·5	46·8	53	1·4	43	+ 24	6	8·4	78
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	77	30	71·8	36·7	54·3	+ 1·6	44·1	69	3·0	6	− 24	1	...	...
Calcutta, Alipore Obsy.	1004·7	+ 1·2	102	72	96·5	76·7	86·6	+ 0·6	79·0	79	5·8	129	− 17	6*	...	...
Bombay	1008·0	+ 0·6	93	78	91·1	80·6	85·9	0·0	77·4	74	3·7	3	− 11	1*	...	...
Madras	1006·1	+ 0·7	108	73	98·5	81·8	90·1	+ 0·2	79·7	65	6·7	3	− 24	1*	...	...
Colombo, Ceylon	1008·5	− 0·1	91	74	87·9	76·9	82·4	− 0·1	79·0	80	9·0	659	+330	29	5·5	44
Hong kong	1008·9	− 0·5	89	67	80·9	72·7	76·8	− 0·6	72·9	81	8·1	146	−149	9	5·0	37
Sandakan	...	...	93	76	90·7	77·1	83·9	+ 1·3	77·8	77	...	115	− 35	10	...	...
Sydney	1015·5	− 3·1	75	47	65·5	51·9	58·7	− 0·1	52·6	71	5·2	75	− 55	15	5·8	56
Melbourne	1016·9	− 2·6	64	37	58·9	47·3	53·1	− 1·0	48·8	79	7·6	62	+ 7	17	3·1	33
Adelaide	1018·6	− 1·5	70	42	62·7	48·9	55·8	− 2·1	50·5	72	6·2	110	+ 40	17	4·5	44
Perth, W. Australia	1016·5	− 2·0	75	44	68·2	52·6	60·4	− 0·2	54·5	65	6·6	162	+ 38	16	5·2	50
Coolgardie	1018·6	− 1·2	80	37	66·3	45·0	55·7	− 1·9	48·9	60	4·0	64	+ 29	6	...	...
Brisbane	1015·2	− 3·6	87	47	74·2	56·6	65·4	+ 0·9	57·7	67	5·0	32	− 40	9	6·1	57
Hobart, Tasmania	1014·1	− 1·5	64	34	54·8	42·8	48·8	− 1·6	44·2	77	6·5	67	+ 20	15	4·6	47
Wellington, N.Z.	1008·5	− 7·1	71	35	59·7	48·8	54·3	+ 1·6	51·0	77	6·4	121	+ 2	20	4·3	44
Suva, Fiji	1012·7	− 0·1	87	66	81·5	70·9	76·2	− 0·3	73·7	85	5·7	212	− 46	14	6·5	58
Apia, Samoa	1009·6	− 1·5	89	71	86·8	74·0	80·4	+ 2·0	76·5	77	4·6	31	−109	8	8·2	71
Kingston, Jamaica	1012·9	− 0·2	92	69	89·0	72·7	80·9	+ 1·2	72·4	78	4·7	24	− 86	6	...	...
Grenada, W.I.	1013·7	+ 1·2	90	73	86·6	75·9	81·3	+ 1·7	75·5	74	6·1	31	− 86	7	...	...
Toronto	1013·2	− 1·6	80	29	62·9	42·6	52·7	0·0	45·2	62	3·5	33	− 43	8	9·2	63
Winnipeg	1011·6	− 2·7	90	22	76·4	45·2	60·8	+ 9·2	...	...	3·8	21	− 37	10	8·9	58
St. John, N.B.	1009·2	− 4·8	68	31	53·9	38·8	46·3	− 1·4	42·8	75	6·3	85	− 9	15	5·9	40
Victoria, B.C.	1016·5	+ 0·1	82	42	60·8	48·0	54·4	+ 1·3	50·6	72	7·0	47	+ 14	19	6·9	45

*For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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The Detonating Meteor of October 2nd, 1926

By F. J. W. Whipple, M.A., F.Inst.P

I have taken an interest in detonating meteors since the beginning of 1923, when it occurred to me that one way of learning about the temperature of the air at great heights would be to study the records of such meteors. The idea was that the time that elapsed between the explosion of a meteor and the arrival of the sound would depend on the temperature of the air traversed by the sound-wave. I was able, however, to find no observations that looked sufficiently precise. Detonating meteors are not infrequent, however, there are some nearly every year in this country, so it was clear that if attention was given to the matter suitable observations should be forthcoming.

The brilliant meteor of September 6th, 1926, which produced considerable excitement in south Yorkshire gave an opportunity, and several newspapers published my request for information. Unfortunately the greater part of the course of this meteor was over cloud. Moreover it did not happen that any observers made on the spot close estimates of the time that elapsed before they heard the sound after they saw the illumination in the sky. The discussion of the observations has not led at present to results which serve for my special object.

The attention which had been drawn to the subject served a good purpose however. On October 2nd Mr. H. E. Brooking, of Kew Observatory, saw a fine meteor from Richmond Park and

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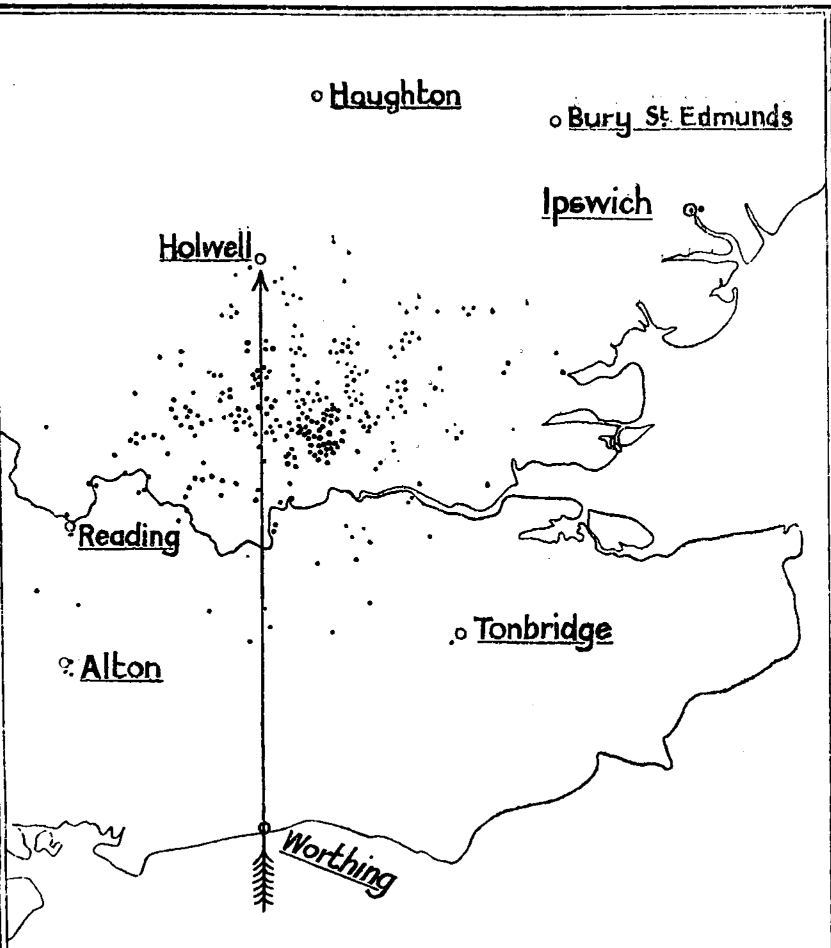
heard the detonation. I received his report at the same time as one from Mr. A. C. Armitage, of Letchworth. On the strength of these two reports an appeal for observations was issued through the Air Ministry. About 700 replies to this appeal have been received at Kew Observatory. The correspondence shows that the meteor, which appeared at 8.27 p.m., B.S.T., was seen over a very large area, stretching from Boulogne to Pontypool, from Corfe to Barnsley. The path, which crossed the west of London from south to north, has been determined with great care by Mr. A. King, who has utilised all the available observations. The meteor became visible when it was about 60 km. south of Hove and 106 km. up. It did not attract much attention in the early part of its course but from a boat at anchor, near Worthing pier, it was seen to pass nearly overhead, slightly to the east. By the time the meteor passed over London it had become very conspicuous. It seems to have been most brilliant in the neighbourhood of Hatfield where it was bright enough to throw sharp shadows. Mr. King places the point where the meteor broke up as 2 km. north of the centre of Hitchin and 22½ km. up. This point is a little south of the village of Holwell, which is shown on our map. The colour of the meteor when overhead was bluish green ; it looked more yellow when seen at a low elevation. When the meteor broke up the fragments appeared to be projected forwards. No trail of glowing matter was left to show where the meteor had passed.

Any expectation that the sound of the meteor was due to a great explosion at the end of its path was dissipated directly the observations were plotted on a map. No sound was heard to the north of the end point and indeed people right beneath that point heard nothing. The area of audibility spread out fanwise, the boundary being almost straight from Reading to Hitchin and from Braintree to Hitchin. In many places the sound was very strong right up to the boundary. South of the Thames the sound was heard at Richmond and at various places in south-east London. There was a group of observations near Dorking beneath the track of the meteor, more isolated observations were at Nutfield and Tonbridge to the east of the track. Well to the west were three good observations at Alton, in Hampshire, and, on the line between Alton and Reading, the sound was heard at Winchfield and Bramley.

The character of the sound varied considerably. At some places, including the southernmost,* there was a single boom or crack. Places with a double or triple report, boom-oom-boom, were common. Three accounts from Reading agree in mentioning a double report. Other places south of the Thames in the same category were on the roads from Leatherhead to

* A rumble as of distant thunder was heard by a motor cyclist between Uckfield and East Grinstead, but the short interval after the passage of the meteor (1 min.) makes the relevance of the observation doubtful.

Dorking and from Sevenoaks to Tonbridge. In Middlesex the sound was comparable to a short peal of thunder gradually falling off in intensity. One report speaks of the sound of a beaten drum rolling over the sky. Such a prolonged sound was noticed, however, as far south as Titsey Hill on the North Downs



THE METEOR OF OCT. 2, 1926, 19H. 27M. G.M.T.
∴ The track is shown by the Arrow: audibility by dots.

" a distant roar like a train going over a bridge." Observers near the end of the track compared the noise with machine-gun fire.

In some places, at any rate, there was an "infra-sound" wave. Disturbances such as the rattling of windows were noticed even by people who did not perceive any direct sound. Animals and especially pheasants were disturbed. The pheasants were affected at Bury St. Edmunds, well outside the region of audibility.

It is curious that on the north-west the boundary of the area over which the meteor was heard runs the length of the Chiltern Hills. Some light on this phenomenon, the sharp boundary of the area of audibility, may be thrown by the report from Mr. A. Jelley, who was at Aldbury, in a valley near Tring, and heard a noise which lasted at least two minutes. "There was a rumbling noise like thunder in the distance, it seemed to start in the south-east of the village, rumbling along the hills, then a pause for a second, then it seemed to rumble back again from where it started, then a faint rumbling northward again, each time fainter. It seemed to be just behind the hills."

When I undertook this enquiry I had not considered closely how the sound of a detonating meteor was likely to be produced. I accepted the idea that the noise came from an explosion. The reports about the Yorkshire meteor convinced me that the thunder-like noise was produced by the mere passage of the meteor through the air; the reports of the meteor of October 2nd suggested that the sharp detonation itself had a similar origin. I find that in both these conclusions I had been anticipated by Dr. Alfred Wegener who investigated* very fully the case of a daylight meteor which fell in Germany on April 3rd, 1916. Wegener points out the analogy with the noise produced by the passage of a shell fired from a big gun. It is well known that a projectile moving through the air with a velocity exceeding that of sound makes a wave like the bow-wave from a ship. This wave when it reaches an observer is heard as a sharp crack. The crack is followed by a rumbling noise which may be attributed to the irregularities in the aerial disturbance. The nature of these ballistic waves is expounded at length in a recent work† by Professor Ernest Esclangon, the pioneer in sound-ranging, the art of locating hostile guns by timing the arrival of the sound at different points. Esclangon attributes the sound of meteors to ballistic waves, though it appears that he has not studied any accounts of observers. One remark†† of his is worth quoting. If the bolide is very small a single detonation should be perceived; otherwise two or three detonations might be heard, as happens with projectiles.

In the case which Wegener investigated the meteor's path was inclined to the vertical at a comparatively small angle, about 35°, and the sound was heard on all sides. In our case the path was much less steep. It seems clear that as the meteor approached

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* Schriften der Gesellschaft zur Beförderung der gesamten Naturwissenschaften zu Marburg, 14 (1917).

† L'acoustique des canons et des projectiles, Paris, 1925.

†† loc. cit., p. 82.

the end of the path the intensity of the noise fell off rapidly. The accounts of a sound like machine guns suggests the possibility that when the meteor broke up into bits each produced its own little ballistic wave. In that connexion Professor Lindemann tells me that he explains the fracture as due to centrifugal force. The meteor is bound to get up a spin as it goes through the air and this spin may be accelerated until the relative velocity of the opposite sides is comparable with the velocity of translation. No material could stand the enormous stresses set up by the centrifugal force and the meteor would burst. Probably in most cases the meteor is melted or evaporated before this can take place. Ours seems to have lost a great deal of its mass before the end. It will be noticed that the fracture is not like an explosion in which a quantity of gas is suddenly generated; the fracture can not produce a great sound wave.

As to the original object of the enquiry I have to thank numerous correspondents for the trouble they took to make good estimates of the time that elapsed between sight and sound. In several cases observers retraced their steps, watch in hand. The results obtained in this way are not very consistent however. Fortunately, there were two observers who were able to give within a few seconds the times of the two observations.

Dr. H. B. Heywood, who was at Headstone Lane, Harrow, made the times 8h. 27m. 0s. and 8h. 29m. 15s. Thus the time the sound took to reach his position was approximately 135 seconds. Dr. Heywood gives 10 seconds as a liberal estimate of the possible error in timing the interval. Utilising Mr. King's data and finding from the map that Headstone Lane is 43 km. from the end of the meteor's path we can compute the distance of the meteor track from Dr. Heywood's position. This turns out to be 38 km., and the nearest point of the track was 35 km. above ground. Thus it appears that the average speed of the sound, if it went the nearest way from the track to the observer, was 282 metres per second. The velocity of sound at the freezing-point is 331 metres per second, so Dr. Heywood's observation implies very cold air aloft. In fact, if we take likely values for the temperature up to 20 km. we find for the average temperature between 20 and 35 km. 136°A., *i.e.*, −215° F. This is hardly acceptable, but we note that if Dr. Heywood's estimate of the time is reduced by 10 seconds the mean speed of the sound becomes 304 metres per second and the average temperature between 20 and 35 km. becomes 215° A., *i.e.*, −72° F., and this is quite plausible.

Another observer, Mr. A. Colebrook, gives the times he noted at Reading, 8h. 27m. 4s. and 8h. 32m. 2s. The interval in this case was 298 seconds. If the sound came from the nearest point of the track the speed averaged only 218 metres per second. Reading is a long way to the west of the track and the only likely explanation of this very low apparent velocity of the sound is a strong adverse wind in the upper regions.

The first point on its course at which the meteor was heard was near Leith Hill. The height of the nearest point of the path was about 50 km. This is interesting as Mr. Denning has recently announced* that by examination of the records of the last 70 years he has found from 90 good instances of detonating meteors, that the average end-height was 33 km. and that there were only four above 55 km. The sound-limit for audible detonations seems to be about 55 km. If we adopt Wegener's theory, we can hardly suppose that there is no ballistic wave at greater heights. Possibly there is a discontinuity which reflects sound waves at that level. The fact that sounds can reach the earth from the height of 55 km. has a bearing on the theory of the transmission to great distances of the sound of explosions. If a sound originating at that height can be heard on the ground, the air at the same height must be dense enough to transmit waves originating on the earth. Further, we note that Dr. Heywood's observation will not allow us to bring much below 35 km. the upper region in which a high velocity of sound prevails. This result is consistent with deductions from the study of the audibility of explosions.

In conclusion, I wish to thank very warmly the numerous correspondents who were so good as to write to me with regard to one or other of the two meteors of September 6th and October 2nd. I regret that it has not been possible for me to reply personally to all the letters. I am especially grateful to Mr. A. C. Armitage, of Letchworth, and Mr. B. Tayor, of Pirton, as well as to Mr. A. C. Denning and Mr. A. King for their co-operation.

Official Publications

The following publications have recently been issued :—

British Rainfall, 1925.

The volume is a summary of the rainfall observations made during 1925 by some 5,000 observers throughout the country.

The rainfall of the year 1925 over the British Isles taken as a unit, was very slightly above the average and from this point of view the year's rainfall can be described as normal. When smaller areas or shorter intervals of time are considered, however, abnormalities become apparent. The most remarkable features of the year were (1) the exceptionally dry June which was absolutely rainless in many localities and one of the driest months on record for the British Isles as a whole ; (2) the cold and cheerless summer, being the fourth summer in succession

* *The Observatory*, October, 1926, p. 314.

of that nature ; (3) the small number of days with heavy falls of rain in spite of the large number of thunderstorms, especially in May and June ; and (4) the wintry conditions which were experienced in the north of Scotland in the early and late months.

Three articles on various branches of recent rainfall research are also included in the volume.

GEOPHYSICAL MEMOIRS.

No. 31. *Classification of monthly charts of pressure anomaly over the northern hemisphere.* By C. E. P. Brooks, M.Sc., and Winifred A. Quennell. (M.O. 286*a*).

In order to have available material for the study of variations of the pressure distribution from month to month, charts were drawn showing the distribution of pressure (deviations from normal) over the northern hemisphere for each month of the years 1873 to 1900 inclusive, which with the addition of the charts for the years 1910 to 1918 previously constructed from the " Réseau Mondial " data, gave a collection of 444 monthly charts. For convenient reference some form of index was desirable, and the classification described in this memoir was devised for that purpose. The classification refers mainly to the conditions over north-western Europe and the north-eastern Atlantic, and especially the area Greenland-Scandinavia-Azores. The pressure at Thorshavn (Faeroes) in the centre of this triangle is taken as the main basis of classification, two groups being defined, in which this pressure is respectively above and below normal. The further classification depends upon the positions of the centres of excess and deficit of pressure. Each of the types and sub-types is illustrated by charts representing an impressionist synthesis of the various examples classified as belonging to that type.

A table showing the classification of each monthly chart is given and from this table the frequency and sequence of types are calculated. The greatest number of charts fall into the types where the excess or deficit is centred over Iceland. There is very little indication of any regular sequence of types ; the most noteworthy is that type IIC (centre of deficit over British Isles) in winter tends to be followed by type I. (pressure above normal at Thorshavn).

Discussions at the Meteorological Office

November 8th. *Temperature Variations in the Stratosphere.* By R. Mügge (Met. Zs. XLII., 1925, pp. 389-394). *Opener*—Mr. E. Taylor, M.A., B.Sc.

To account for the relatively low temperatures found in the upper troposphere and stratosphere over warm high pressure areas occurring in our latitudes, the author considers three points of view, viz., advection, dynamic causes, and radiation.

The temperatures of the stratosphere and substratosphere decrease as the temperature of the lower strata increases, whether we consider variations at one and the same place in our latitudes or variations of temperature gradient with latitude. Pressure gradient and its fluctations with altitude and latitude follow a similar law. Just as in the lower strata, fluctuations of temperature and pressure are often causatively connected and can then be traced to simple advection phenomena, and in particular to incursions of the polar front, so the low temperatures associated with the upper strata of warm high pressure areas may be due to inrushes of the upper cold equatorial front. This is supported by evidence of frequently occurring inversions at the stratosphere boundary which may be attributed to under-running of the stratosphere layers by a cold current from the south.

The author's chief objection to this explanation is that warm high pressure areas exhibit a persistence more marked than that of any other weather phenomena in our latitudes, a persistence which would entail a continuous inflow of cold equatorial air to replace the air which sinks for days at a time over such regions.

In 1921 he and Peppler separately decided from upper air soundings that the upper strata of at least some high pressure areas have a single divergence point about which wind and pressure is distributed; therefore some of these areas at least must be regarded as "Islands of Cold," and the cause of their maintenance must be sought elsewhere than in the equatorial front. A high pressure area established by a limited inrush of equatorial air would have a mobility comparable to that of the cold polar front anticyclone.

The possibility of a dynamic cause for low temperatures prevailing locally in high reaching anticyclones is dismissed very briefly. The theory which Bjerknes and Sandström have advanced for a warm anticyclone is not in good agreement with observations. Though a discontinuity probably exists at the base of the sinking air mass the latter cannot be considered as a symmetrical rotating eddy. Purely dynamical elevation of the troposphere due to heating of the lower strata is a possible cause in tropical regions but not in middle latitudes; and in tropical regions it would involve the presence of an extraordinarily strong inversion.

Turning to radiation theory for an explanation, the author refers briefly to the work of Gold and Humphreys, and remarks that for high altitudes where the dependence of temperature on altitude disappears, it leads to the simple formula

$$T = \sqrt[4]{\frac{J}{2\sigma}(1+q)}$$

in which T is the temperature of radiative equilibrium, J is the effective intensity of radiation, a function of solar radiation and the earth's albedo, σ is the constant of the Stefan-Boltzmann law and q a value expressing the ratio of the two coefficients of absorption for short and long waves.

When the variation of J with latitude is taken into account, this equation gives values of T low at the poles and high at the equator; for example T becomes —40° C. (approx.) at the equator. Actually it is observed to be nearer —80° C. This difference between theory and observation is due to the assumption in the theory that incoming and outgoing radiation are equal over any one region of the earth's surface, whereas in fact such equality is seldom found. For the polar and equatorial regions and likewise for warm high pressure areas with their marked thermal characteristics such equality is never to be expected. On these grounds the author has distinguished between regions of incoming and regions of outflowing radiation ("incoming" and "outflowing" denoting the sense of preponderating radiation). The former are important potential energy accumulation centres which yield up heat to the latter. Warm anticyclones are classed among the regions of incoming radiation. This classification has also been adopted by Defant.

The next step is to adapt the equation given above to fit the argument by writing

$$T = \sqrt[4]{\frac{J}{2}(1+q) - \frac{R}{2\sigma}}$$

where R denotes the proportion of radiation energy acquired or dissipated as the result of thermal processes in the troposphere in the two types of region. The temperature corresponding to R = 0 is called the normal stratosphere temperature.

As a rough example of the way this modification would operate, it is shown that a quantity of energy R = +0·08 calories per square centimetre per minute would have to be withdrawn from the region between the equator and latitude 40° to account for observed mean values of T in that region. Differentiating broadly between this region as one of incoming radiation and the remainder of the hemisphere as one of outflowing radiation and assuming that the heat withdrawn from lower latitudes is transferred to the latitudes above 40° across a wall of the troposphere extending vertically to 4 kilometres, the author finds that the heat transference would be at the rate of 100 calories per square centimetre per minute, a quantity whose order is in agreement with Defant's work.

The paper includes a graph showing in parameter form the relation between the three quantities T, J and R.

The title of the paper suggests a wider range of investigation than is covered by the text but a more detailed analysis of heat transference from warm anticyclonic regions is to appear later.

In view of the hypothetical nature of the present paper and the fundamental question raised, it will be interesting to see the result of applying the suggested modification of the radiation theory to particular areas for which actual values of J and T can be stated with some measure of accuracy.

E.T.

The next meeting will be held on January 17th, when Dr. B. A. Keen, of Rothamsted, will open the discussion on some subject relating to agriculture and meteorology.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, November 17th, at 49, Cromwell Road, South Kensington, Sir Gilbert Walker, C.S.I., F.R.S., President, in the Chair.

E. W. Bliss, M.A.—The Nile Flood and World Weather.

See page 268.

D. Brunt, M.A., B.Sc.—An Investigation of Periodicities in Rainfall, Pressure and Temperature at certain European stations.

This paper gives a discussion of twelve periodograms ; those of rainfall at Milan, Padua, London and Edinburgh, of pressure at Edinburgh and Paris, and temperature at Edinburgh, Stockholm, London, Paris, Berlin and Vienna, which were published in *Phil. Trans. R. Society*, Vol. 225, 1925. The author does not advocate their use for forecasting future weather.

D. Brunt, M.A., B.Sc.—A simple period of vertical oscillation in the atmosphere.

This paper shows that when an element of air is displaced vertically it oscillates harmonically about its equilibrium position with a period of the same order as those found in microbarograph records.

Correspondence

To the Editor, *The Meteorological Magazine*

The Last British Glacier

I do not suppose there is anybody who thinks that ice is still scratching the rocks in the British Isles, but I am by no means sure that such is not the case. The site in question is usually snow covered all the year. Thinking that in 1918 the snowbeds would be smaller than usual, I went to explore some that I know of. The rocks then seen may not have been exposed to the light for ten years, perhaps 50, I have no means of knowing. They were worn absolutely smooth and were brown or yellow in colour, totally different to any other rock. The snow bed had got so small that it had split into four isolated pieces, about 4 feet thick, the under surface practically pure ice. Below the bed is a heap of scree pushed down by the bed or falling from its extremity. As the bed in April or May must be 50-100 feet in thickness and lying on steep rock there must be some downward pressure after the nature of a glacier. It is probably the remains of the last glacier in Britain.

I believe the snow beds were very small this year but I was not able to go and see them; anyhow the coldness of October must have quickly increased them as Ben Nevis was snow clad to 2,000 feet at the end of September.

These beds are not on Ben Nevis but on Aonach Mt. some three miles or so east and are due to Aonach Mt. having a flat top so that all the snow (practically) blows off it and down the cliffs. Much the same thing happens on Brae Riach (Cairngorms) only far more so, as the plateau at the summit is far more extensive, but against this is the smaller precipitation in Cairngorms. Nevertheless, the Brae Riach bed has never been known to melt, the drifting area and height of same (4,000 feet) being so enormous. I have never been to this bed though I saw it in 1918 from the cliffs above. It was my first visit there. I looked for it in the many corries, then went to the summit of the plateau and only saw it from there. There was no time to descend to it. Mr. Seton Gordon paid a visit to it in mid-September last and wrote me that it was smaller than he had ever seen it and thought it might disappear, but as cold weather supervened at the end of September I don't think it did.

In addition to the two beds on Aonach Mt. there is a third about a mile from the two I have spoken about; I had found this before 1918 but it looked rather small and I thought it might not be permanent, so that in 1918 when I found one of the beds gone and the other reduced to four slabs I was surprised to find this third one still existing. It is under Aonach Beas.

R. P. DANSEY.

Kentchurch Rectory, Hereford. November 4th, 1926.

[The photograph is not reproduced, as it is doubtful if a reproduction would show the details of the original with sufficient clearness. There is a typical smoothed glacial surface, ending in a loose moraine of the kind formed by small mountain glaciers. Some light and dark bands on the smoothed surface may represent either flutings and striations or colour bands in the rock itself.

It does not seem probable that the extensive planation of the rock surface can have been effected by the small masses of ice which are able to survive the summer at present. The smoothed surface seems to extend beneath the scree and probably dates back to the maximum glaciation of Great Britain, when the whole mountain was submerged beneath an inland ice-sheet which reached to the sea on the east, west and north, and on the south extended into England. During the retreat of the ice-sheet the Scottish mountains formed nunataks and the glaciated surfaces were probably covered by screes. In subsequent cold periods mountain glaciers were formed which cleared away this scree in places and exposed the underlying glaciated surface, and the "moraine" shown in the photograph presumably represents the last and least intense of these minor glaciations. It is quite possible that it originated as late as the eleventh to fourteenth centuries A.D. The snow and ice bed which is formed at present each winter and generally persists through the summer would be quite capable of keeping this smoothed surface clean and unweathered.—ED. *M.M.*]

The "Sticking" of Pressure Tube Anemometers at Low Wind Velocities

In the *Meteorological Magazine* for July, 1924 (p. 132) a suggestion is given for preventing the "sticking" of the float rod in the pressure tube anemometer. This "sticking" is caused by the condensation upon the float stem of the water vapour given off from the water surface around the float. The extent to which this evaporation and condensation go on can be judged by removing the lid of the recorder, when it will nearly always be found that the underside of the lid is covered with large pendulous drops of water, and the walls of the container are literally running with water.

It occurred to me about a year ago that the most effective way of preventing the condensation would be to prevent the evaporation. The most obvious way of achieving this appeared to be by covering the water surface with a thin layer of non-volatile oil. One of our pressure tube recorders was treated in this way, the annular water surface between the float and the walls of the container being covered with a thin coating of a high boiling point paraffin. The oil in question is a pure (B.P.) paraffin of the type used medicinally. This instrument has been working for over a year since being treated in this manner, and it has been found that the "sticking" of the float stem has been reduced to vanishing point. Incidently it has also been found that it is best to keep the float stem highly polished.

It subsequently occurred to me that covering the water surface inside the float with oil would prevent the distilling over of this water and its gradual collection at the lowest point of the pipe which transmits the pressure from the head. Our instruments are now erected by covering the entire water surface with oil before the float is put into the container. The addition of the oil necessitates, of course, running off some of the water so as to bring the level down to the top of the style in the gauge glass on the side of the instrument. It may be noted, incidentally, that the presence of the oil prevents the change in level of the water surface which normally occurs in these instruments.

The effect of the addition of this oil upon the calibration of the instrument has been investigated, and I am indebted to Mr. R. F. Budden for the following figures. The recorder was calibrated in the usual manner by means of a tilting manometer of the National Physical Laboratory type, which showed the pressure necessary to raise the float to ten, twenty, thirty, etc., feet per second on the chart. This was done for three cases, as shown in the following table :—

Recorded Wind Speed in ft./sec.	Observed Pressure Differences in millimetres of Water.		
	No Oil.	Oil in Suction Chamber only.	Oil in both Chambers.
10	0.7	0.7	0.7
20	2.9	2.7	2.5
30	6.7	6.7	6.5
40	13.2	12.3	11.9
50	20.4	19.5	19.5
60	29.6	28.5	28.5
70	40.8	39.8	39.5

It will be observed that the addition of the oil makes a small, but appreciable, difference in the calibration. For a given pressure difference the recorder reads about one foot per second higher if the entire water surface is covered with oil. When only the water outside the float is covered, the increase in the reading appears to be rather less. These differences are smaller than the variations which are found to exist between individual pressure heads. It may, therefore, be concluded, that the addition of the oil does not affect the reading of the instrument for ordinary purposes, but that if a high degree of accuracy is required the recorder should be calibrated after the oil has been added.

The treatment described above does not, of course, prevent "sticking" in those cases in which it is due to condensation from the atmosphere upon the protruding part of the stem. But these occasions are rare compared with those which arise from evaporation and condensation inside the instrument.

N. K. JOHNSON.

Experimental Station, Porton, Salisbury. October 19th, 1926.

NOTES AND QUERIES

Early Experiments in Measuring the Upper Wind by means of Shell-Bursts

The method of obtaining the wind at high altitudes by observations of smoke clouds produced by the bursting of shells fired from high angle guns was used extensively during the war. It is the best method known for getting the wind at high altitudes in a broken sky or windy weather. Although I do not know of any specific claim being put forward that the method was a new one, I myself had always regarded it as a natural war-time development of the observation of cloud motion and I had not been aware of any earlier use of the method. I was therefore very interested to come across a reference to experiments on this method in the *Minutes of the Proceedings of the Meteorological Council* 45 years ago. I thought it would probably be of interest to many others also and I therefore obtained authority to make use of the information contained in the Minutes.

The story of the experiments as given in the *Proceedings of the Council* for the year 1881-5 is briefly as follows:—

At the meeting on July 20th, 1881, Mr. Galton (Sir Francis Galton) mentioned that he had made enquiries of Captain A. Noble, C.B., F.R.S. (Sir Andrew Noble) "on the possibility of forming a smoke cloud at a considerable altitude for the observation of upper air currents by firing a small shell, with a bursting charge, from a seaside station, that the plan seemed to be feasible, but that preparative experiments were needful to determine the best method of forming a dense and durable smoke cloud."

The Council decided to authorise Mr. Galton, in conjunction with Captain Noble, to expend a sum not exceeding £20 on the experiments.

In February, 1882, Captain Noble reported that he had made experiments with a light 7-pounder gun of 400 lb. weight, mounted at an angle of 75°, which was the highest angle considered safe, from the point of view of those using the gun, in the event of a premature explosion. In the first experiment, the shell burst after 2¼ seconds, the height of the burst being roughly estimated at about 2,500 feet. The second round burst at 5·35 seconds, but the third, fourth, fifth and sixth rounds, although they burst and their bursts were seen, were not observed at the moment of burst.

An attempt was made to obtain the height of the bursts by means of two observers taking the angle at the moment of the burst, but the great difficulty of making the two observations simultaneously caused this attempt to be a failure.

Further experiments were made on January 5th, 1882, but no attempt was made on this occasion to measure the height by observation of two angles. The height was determined by noting the time between the burst and the sound of the report and taking the angle of elevation of the burst observed from the gun. Three very good observations were made of the time taken by the sound to return to the gun. They were 9·7, 9·8 and 9·8 seconds. The angle of the elevation of the burst was 62° in all three cases and these data gave for the height of the burst approximately 9,500 feet. Captain Noble remarks " the day was exceedingly windy but the sky very clear. A cloud of smoke could be seen without difficulty for a considerable time but I should anticipate great difficulty in seeing it in a dull leaden sky. There would be no difficulty with a larger gun in sending the shell very much higher, but the expense would be very much greater."

On receipt of Captain Noble's report, the Meteorological Council instructed the Secretary to enquire whether it would be possible to have a series of observations made with the gun at Shoeburyness (the experiments of Captain Noble had been made at Elswick Works, Newcastle), and if so whether an attempt could be made to determine, at the time when each round is fired, the direction and the velocity of the upper wind by observation of the bursting of the shell and of the subsequent course of the smoke.

The Council at the same time indicated that they were prepared to increase the amount of the grant for the experiments.

In reply to the Council's enquiry, Captain Noble stated that he was satisfied there would be no difficulty in having a series of observations made at Shoeburyness, that his firm would be happy to lend the gun and carriage for the purpose and that he himself in concert with Mr. Galton, would be happy to assist at the experiments. The sanction of the War Office to the experiments was duly obtained but so far as I can ascertain, they were never actually made at Shoeburyness.

Some further experiments do however appear to have been made, for Captain Noble reported in March, 1884, on further observations apparently with the same gun on August 23rd, 1883. The bursts appear to have been visible for several minutes, and in his report he gives two sketches showing the direction of travel of the smoke puff in relation to the direction of the wind, but no actual observations of the speed of the bursts. The height of the bursts appear to have been between 8,000 and 10,000 feet.

The Council considered this report and instructed the Secretary to write to Captain Noble asking him if he could arrange for a three months' course of observations carried out at Elswick or elsewhere under his general superintendence by competent men, the Council bearing the cost and allotting a grant beforehand to cover it. The observations were to be made within half-an-hour of 8 a.m. and to give the angular elevation of the burst of the shell, the direction of the drift of the smoke cloud, the interval in time between the burst and the sound of it and the angular velocity of the smoke cloud. If the results of such a trial proved to be favourable they would wish to be informed of the cost of purchasing the gun, carriage and gear and the cost of the shells, etc., connected with firing, say, per 100 shots.

There is no evidence of any reply having been received to this communication and the matter appears to have been dropped. As it depended mainly, I think, on the initiative of Sir Francis Galton, the fact that nothing more was done may have been due to his energies having been diverted into other channels.

E. G.

Two Memoirs on World Weather: The Nile Flood, and British Winters*

The first memoir is an application to the Nile of the methods which have been used in India by Sir Gilbert T. Walker. The series of values for the Nile flood are based on the discharges at Aswan and the total for the four months July to October is taken to represent the flood. A considerable amount of secular change is apparent in the series, but as far as I know it cannot be ascribed to the presence of the Dam which is fully open during flood, or to erosion of the river bed.

The following conclusions are drawn from the correlation coefficients. First, the Nile behaves as a strongly marked member of the first group of the southern oscillation, *i.e.*, it has positive correlations with South America and Pacific Ocean pressures and negative with pressures over the Indian Ocean. Second, low equatorial temperatures are associated with a high Nile, and third, the North Atlantic circulation in winter is weak after a high Nile. For prediction of the flood, Port Darwin pressure, Samoa and Dutch Harbour temperatures may be used and from its coefficient of ·72 the formula may be expected to give useful indications in 40 per cent. of the years: in the other years when the indicated departure is small no forecast would be attempted.

It was mentioned that the Nile shows a secular change and as some of the other factors undergo similar changes, it is of interest to examine the effect of this on the coefficients. Taking Port Darwin pressure in which there is a marked rise I found on eliminating secular changes that instead of −·54 the coefficient became −·45.

It may be of interest to note that the probable deviation of the

* *London, Mem. R. Meteor. Soc.*, Vol. I. Nos. 5 & 6.

Nile flood is 10,000 million cubic metres ; departures are as likely to exceed as to be less than this amount.

The second memoir deals with the winter temperature of Greenwich. In view of its connection with the Nile further correlations were worked out with the Greenwich temperature of December to February. It appears that during the previous June to August conditions in the tropics and the southern hemisphere exert a considerable control on the subsequent winter temperature in the British Isles. Within the northern hemisphere, however, the relationships are mainly contemporary ones but an interesting point is that while winter and spring in the British Isles are interrelated, there is no connexion between autumn and winter temperatures. This bears out a result of W. Wiese, who shows that with October a new "meteorological year" begins.*

Although there are not so many large coefficients as were found in the former memoir there are as many as seven between ·42 and ·54 which relate to prior conditions ; and it would appear that some advance has been made towards the solution of the problem of forecasting in September or October the mean temperature of the winter months in England.

E. W. BLISS.

The Wet November of 1926

The distribution of the rainfall of November, 1926, presented some features of unusual interest.

The total for the month was above the average everywhere over the British Isles except along the north-west, north and north-east coasts of Scotland. The excesses were largest in the south-west of England and Wales and in Connemara. More than twice the average was recorded in these areas as well as at Wetherby in Yorkshire and at Dundee. Falls of more than 250 per cent. of the average occurred in parts of Dorset, Hampshire and Hereford, while at Ross, the fall of 7·87 in. was as much as 311 per cent. of the average. It appears to be a feature of the climate of Herefordshire that the variability of monthly and of annual rainfall, when considered as a percentage of the average falls, is generally larger than that experienced elsewhere in the British Isles.

There were large areas with over 10 inches of rain for the month in Dartmoor, Exmoor, the English Lake District, Wales, the Western Highlands of Scotland and also in Connemara. The largest monthly totals were those reported from Llyn Llydaw on Snowdon of 19·50 in., and from Delphi in Connemara of 18·30 in. Over five inches of rain was recorded in one day in Snowdonia on the 4th and in Connemara on the 18th.

* *Met. Zs.*, June, 1926, p. 215.

Many observers reported the wettest November on record. At stations as widely distributed as Camden Square (London), Polapit Tamar, near Launceston, to the west of Dartmoor, and at St. Michael's on Wyre in the north of Lancashire, the total for the month was the largest for November in over 50 years' records. At Camden Square the number of days of rain, *viz.*, 25, and the duration of rainfall of 85·0 hours were the largest in November since records became available in 1858 and 1881 respectively.

So far as can be ascertained at the moment, November, 1926, was the wettest November since 1870 over England and Wales, and also the wettest November over the British Isles as a whole. The rainfall of Scotland and Ireland was less remarkable. A comparison of the general rainfall over the British Isles for November, 1926, with the three wettest Novembers back to 1870 is set out below. The rainfall is expressed as a percentage of the average amounts for the period 1881 to 1915.

November of	1926	1888	1877	1872
	%	%	%	%
England and Wales	188	175	162	162
Scotland	130	139	153	144
Ireland	137	121	143	145
British Isles	163	153	155	153

For the eleven months, January to November, 1926, the rainfall at Camden Square has amounted to 26·80 in. This is 4·72 in. above the average of the eleven months and already 2.33 in. above the average for the whole year. For the British Isles as a whole, the general rainfall for the eleven months is estimated as 41 in. This is 4 in. above the average for that period and only about half an inch below the average for the whole year. It is clear therefore that while the rainfall of the whole year over the British Isles generally may not rank as very heavy it will almost certainly exceed the average.

J.G.

The Rainfall of Novembers

With the wet November of 1926, it is of interest to consider extremely wet and dry Novembers in comparison with the extremes experienced in other months. A marked feature of the rainfall of Novembers in these islands is the smaller variability than that of other months, the variability being considered not in actual inches but as a percentage of the average. This can be illustrated by reference to the table below giving the wettest and driest months for the British Isles as a whole from 1870 to

1925. The values for each month have been obtained by taking the mean of the percentages for some 50 stations distributed uniformly over the British Isles.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Per cent.	192	204	171	172	187	196	176	183	242	193	155	189
Date ..	1877	1923	1903	1882	1924	1879	1888	1917	1918	1903	1877	1876
Per cent.	37	18	34	35	26	21	39	38	33	44	43	41
Date ..	1880	1891	1893	1893	1896	1925	1913	1880	1910	{1879 1922}	1896	1890
Range ..	155	186	137	137	161	175	137	145	209	149	112	148

In the last row the range is obtained from the percentage fall in the wettest month and the percentage fall in the driest month. It will be seen that the months of greatest range are February and September. Both these months have been conspicuous for long runs of rainless days and also for consecutive wet days over large areas in these islands. November on the other hand stands out as the month of most reliable rains, the wettest and driest Novembers in the series being considerably nearer the average fall for November than is the case with the other months. The months of 1926 have so far not changed the table of extremes above, except in the case of November. Even with this modification the range for November is still considerably below that of the other months.

J.G.

News in Brief

The degree of D.Sc. (Physics) has been conferred by the University of London on Mr. C. E. P. Brooks.

Further information is now available as to the course of the hurricane during which the H.M.S. *Valerian* foundered off Bermuda. The Government meteorologist states that it appeared to the north of Colon on the 17th, and followed a north-west track across western Cuba, causing great loss of life round Havana on the 20th.

The Weather of November, 1926

Mild unsettled conditions with southwesterly winds and a rainfall abnormally heavy were the main characteristics of the weather of November. At the beginning of the month fine weather and low temperatures prevailed generally over the eastern part of the British Isles, the lowest minimum for the month occurring on the morning of the 1st when 9° F. was recorded in the screen at Balmoral and 1° F. on the grass. On the 2nd, however, the depression in the west spread eastwards and from then until the end of the month pressure continued low. The mean pressure for the month was considerably below normal at most places, and at Valentia it was about 2 mb. lower than the previous record in November, 1877. Temperature rose generally about the 5th when a deep depression passed across the Hebrides causing southwesterly gales in many places. Gusts of over 80 m.p.h. were recorded at Edinburgh and Quilty, and rainfall for the 24 hours ended 7h. that morning was heavy, 137 mm. (5·40 in.) being measured at Snowdon, 83 mm. (3·28 in.) at Dungeon Ghyll (Westmoreland), and 73 mm. (2·87 in.) at Eskdalemuir. Floods occurred in many parts of Scotland and Wales, and "snow lying" was reported from the extreme north. From the 8th to the 22nd unsettled conditions prevailed with rain on most days and high winds or gales frequently. At Plymouth a gust of 80 m.p.h. was registered on the 10th. The heaviest rain occurred on the 18th when 129 mm. (5·06 in.) fell at Delphi (Mayo), and 105 mm. (4·12 in.) at Aasleagh (Mayo), but measurements of over 50 mm. were recorded on other days at many places. Floods occurred in several districts. Thunderstorms and hail showers were also experienced fairly frequently throughout this period. During the last week a deep depression which had passed across our islands filled up over the North Sea and pressure became temporarily high over England on the 24th and 25th. Widespread fog occurred in southern Scotland on the 24th and in England on the 25th. Temperature did not rise above 32° F. at Renfrew on the 24th and 33° F. at Croydon on the 25th. There was a return to generally unsettled rainy conditions on the 26th, and on the 29th a depression centred over the English Channel caused heavy rain in the south. Meanwhile a belt of high pressure extending from Norway to the Azores was moving southeast and fair weather prevailed in Scotland and north Ireland on the 29th and 30th.

The total rainfall for the month is discussed on p. 269.

Pressure was below normal over a large area, stretching from central Europe and the Baltic across the North Atlantic to Greenland and Labrador, the greatest deficit being 13·7 mb. at Valentia, and above normal at the Azores, south Italy, Spitsbergen, and the extreme north of Norway. At Horta pressure was 6·7 mb. above normal. This distribution was associated with the frequent passage of depressions across these islands and with generally southwesterly winds over western Europe. Temperature and rainfall were both above normal, except in central Europe and the south eastern coastal districts of Sweden, where the rainfall was somewhat below normal. In Norrland

and northern Svealand the precipitation was about double the normal.

During the first days of the month heavy rain accompanied by floods occurred in many parts of Italy and Westphalia, and a severe hailstorm was experienced in Corsica. On the 9th a thunderstorm swept over western Switzerland causing much damage to forests and orchards, and later in the month several lives were lost in Murcia (Spain) owing to the heavy rains and floods. In the meantime a sudden thaw in the mountains south of the Tyrolese Alps, caused much damage, and the weather in the Austrian lower Alps was so warm that strawberries were gathered in the open on the 16th. In Greece the prolonged drought gave rise to much anxiety with regard to the crops. During the later part of the month very stormy weather was again experienced in France, Italy and Switzerland, and floods occurred in many parts. An avalanche of mud and rock caused by the heavy rains overwhelmed the village of Roquebillière, near Nice, on the 24th, and nineteen people were killed. In consequence of a drop in temperature and the heavy snowfalls winter sports began in the higher resorts at the end of the month.

Heavy rain occurred in the Transvaal about the 20th to 27th putting an end to the bad drought, during which the farmers have lost many cattle and sheep through the drying up of the veld.

Unusually heavy and early rain fell in Iraq' about the middle of the month promising a good season but causing much damage to the railway lines. Three hundred people are reported to have been drowned as a result of a typhoon which crossed the province of Batangas (Philippines) on the 6th.

In the United States a tornado struck a schoolhouse in Laplata, Maryland, on the 9th, killing thirteen children. Storms or blizzards were experienced in many States and on the North Atlantic between the 14th and 17th and again about the 25th, when over 50 people were killed by a tornado which swept across central Arkansas into Missouri.

The special message from Brazil states that the rainfall was very scarce in the central regions, being 56 mm. below normal, and irregular in distribution in the southern regions, with an average 8 mm. below normal. Many depressions passed across the country. The cane, cotton and tobacco crops are suffering from lack of rain, but the coffee crop is in good condition. Pressure at Rio de Janeiro was 0·3 mb. above normal, and the temperature 1·3° F. above normal.

Rainfall, November, 1926—General Distribution

England and Wales ..	188	per cent. of the average 1881-1915.
Scotland	130	
Ireland	137	
British Isles	163	

Rainfall: November, 1926: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square	4·71	120	200	*War.*	Birminghm, Edgbaston	5·64	143	237
Sur .	Reigate, The Knowle ..	6·20	157	214	*Leics*	Thornton Reservoir ..	4·02	102	178
Kent.	Tenterden, Ashenden. .	7·11	181	236	,, .	Belvoir Castle........	3·27	83	147
,, .	Folkestone, Boro. San.	5·80	147	...	*Rut* .	Ridlington...........	3·36	85	...
,, .	Margate, Cliftonville . .	4·41	112	183	*Linc.*	Boston, Skirbeck	2·87	73	144
,, .	Sevenoaks, Speldhurst.	7·00	178	...	,, .	Lincoln, Sessions House	2·23	57	119
Sus .	Patching Farm.......	8·04	204	225	,, .	Skegness, Marine Gdns.	2·43	62	113
,, .	Brighton, Old Steyne .	6·76	171	211	,, .	Louth, Westgate	2·87	73	111
,, .	Tottingworth Park....	8·42	214	228	,, .	Brigg	2·45	62	107
Hants	Ventnor,Roy.Nat.Hos.	7·72	196	240	*Notts.*	Worksop, Hodsock....	2·88	73	147
,, .	Fordingbridge, Oaklnds	10·38	264	303	*Derby*	Mickleover, Clyde Ho. .	3·68	93	165
,, .	Ovington Rectory	8·40	213	253	,, .	Buxton, Devon. Hos. . .	5·80	147	124
,, .	Sherborne St.JohnRec.	...	..	...	*Ches.*	Runcorn, Weston Pt. . .	5·27	134	190
Berks	Wellington College...	4·94	125	193	,, ..	Nantwich, Dorfold Hall	5·08	129	...
,, .	Newbury, Greenham . .	7·13	181	255	*Lancs*	Manchester, Whit. Pk.	4·84	123	183
Herts.	Benington House	4·62	117	195	,, ..	Stonyhurst College....	5·63	143	125
Bucks	High Wycombe	5·41	137	217	,, ..	Southport, Hesketh Pk	5·92	150	188
Oxf. .	Oxford, Mag. College . .	4·29	109	194	,, ..	Lancaster, Strathspey.	6·70	170	...
Nor .	Pitsford, Sedgebrook . .	3·62	92	165	*Yorks*	Sedbergh, Akay	...	..	...
,, .	Eye, Northolm........	...	..	...	,, .	Wath-upon-Dearne ...	2·64	67	129
Beds.	Woburn, Crawley Mill.	3·39	86	152	,, .	Bradford, Lister Pk. . .	5·82	148	199
Cam.	Cambridge, Bot. Gdns.	2·88	73	149	,, .	Wetherby, Ribston H. .	5·09	129	218
Essex	Chelmsford, CountyLab	4·30	109	191	,, .	Hull, Pearson Park ...	2·80	71	128
,, .	Lexden, Hill House . . .	3·87	98	...	,, .	Holme-on-Spalding ...	2·92	74	...
Suff .	Hawkedon Rectory ...	3·29	84	145	,, .	West Witton, Ivy Ho. .	6·16	157	...
,, .	Haughley House......	2·99	76	...	,, .	Felixkirk, Mt. St. John	4·47	114	182
Norf.	Beccles, Geldeston....	2·68	68	115	,, .	Pickering, Hungate ...	3·40	86	...
,, .	Norwich, Eaton	3·09	79	120	,, .	Scarborough.........	2·82	72	114
,, .	Blakeney	4·03	102	182	,, .	Middlesbrough	3·37	86	159
,, .	Swaffham	3·81	97	157	,, .	Baldersdale, Hury Res.	5·43	138	...
Wilts.	Devizes, Highclere....	6·14	156	231	*Durh.*	Ushaw College	4·18	106	165
,, .	Bishops Cannings	6·34	161	222	*Nor* .	Newcastle, Town Moor.	3·58	91	148
Dor .	Evershot, Melbury Ho.	11·06	281	259	,, .	Bellingham, Highgreen	5·66	144	...
,, .	Creech Grange	10·76	273	...	,, .	Lilburn Tower Gdns. . .	4·20	107	...
,, .	Shaftesbury, Abbey Ho.	7·12	181	220	*Cumb*	Geltsdale............	5·47	139	...
Devon	Plymouth, The Hoe . . .	7·67	195	210	,, .	Carlisle, Scaleby Hall .	4·32	110	144
,, .	Polapit Tamar	9·11	231	215	,, .	Seathwaite M.	19·03	483	140
,, .	Ashburton, Druid Ho. .	12·66	321	223	*Glam.*	Cardiff, Ely P. Stn.....	8·84	225	212
,, .	Cullompton	8·32	211	242	,, .	Treherbert, Tynywaun	18·58	472	...
,, .	Sidmouth, Sidmount . .	8·64	219	277	*Carm*	Carmarthen Friary....	11·06	281	222
,, .	Filleigh, Castle Hill ...	7·98	203	...	,, .	Llanwrda, Dolaucothy.	11·56	294	196
,, .	Barnstaple,N.Dev.Ath.	7·21	183	183	*Pemb*	Haverfordwest, School	11·94	303	238
Corn.	Redruth, Trewirgie ...	8·90	226	183	*Card.*	Gogerddan...........	8·71	221	184
,, .	Penzance, Morrab Gdn.	6·41	163	140	,, .	Cardigan,County Sch. .	8·25	210	...
,, .	St. Austell, Trevarna . .	8·58	218	174	*Brec.*	Crickhowell, Talymaes	11·80	300	...
Soms	Chewton Mendip	8·79	223	205	*Rad* .	Birm.W.W.Tyrmynydd	11·07	281	166
,, .	Street, Hind Hayes ...	6·23	158	...	*Mont.*	Lake Vyrnwy	9·84	250	177
Glos. .	Clifton College	7·62	193	242	*Denb.*	Llangynhafal	4·39	112	...
,, .	Cirencester, Gwynfa . .	7·17	182	234	*Mer* .	Dolgelly, Bryntirion . .	8·80	224	142
Here.	Ross, Birchlea	7·87	200	311	*Carn.*	Llandudno	4·21	107	136
,, .	Ledbury, Underdown.	6·55	166	268	,, .	Snowdon, L. Llydaw 9	19·50	495	...
Salop	Church Stretton	6·68	170	227	*Ang* .	Holyhead, Salt Island.	6·88	175	166
,, .	Shifnal, Hatton Grange	4·97	126	208	,, .	Lligwy	6·21	158	...
Staff.	Tean, The Heath Ho. . .	5·17	131	176	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	5·66	144	248		Douglas, Boro' Cem. . .	5·63	143	120
,, .	Blockley, Upton Wold.	6·21	158	210	*Guernsey*				
War.	Farnborough	4·81	122	176		St. Peter P't, Grange Rd	8·63	219	205

Rainfall: November, 1926: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	6·20	157	156	*Suth.*	Loch More, Achfary...	7·06	179	83
„	Pt. William, Monreith.	6·16	156	...	*Caith*	Wick	2·45	62	78
Kirk.	Carsphairn, Shiel.	8·89	226	...	*Ork*	Pomona, Deerness	3·87	99	98
„	Dumfries, Cargen.....	8·08	205	179	*Shet*	Lerwick	4·81	122	113
Roxb	Branxholme	4·35	110	131					
Selk	Ettrick Manse........	9·17	233	...	*Cork*	Caheragh Rectory	7·46	189	...
Berk.	Marchmont House	3·94	100	131	„	Dunmanway Rectory.	8·36	212	135
Hadd	North Berwick Res....	2·69	68	120	„	Ballinacurra	5·27	134	132
Midl	Edinburgh, Roy. Obs..	3·05	77	142	„	Glanmire, Lota Lo. ...	6·26	159	145
Lan	Biggar	3·91	99	137	*Kerry*	Valentia Obsy........	8·34	212	153
„	Leadhills............	9·25	235	...	„	Gearahameen	...	..	...
Ayr	Kilmarnock, Agric. C..	4·94	126	131	„	Killarney Asylum.....	7·25	184	129
„	Girvan, Pinmore......	5·96	151	112	„	Darrynane Abbey	7·64	194	150
Renf.	Glasgow, Queen's Pk..	6·33	161	170	*Wat.*	Waterford, Brook Lo..	5·61	142	148
„	Greenock, Prospect H..	8·36	212	130	*Tip*	Nenagh, Cas. Lough...	5·74	146	143
Bute.	Rothesay, Ardencraig.	6·87	175	135	„	Tipperary	...	..	...
„	Dougarie Lodge	7·32	186	...	„	Cashel, Ballinamona ..	4·34	110	124
Arg	Ardgour House	10·11	257	...	*Lim*	Foynes, Coolnanes	5·34	136	131
„	Manse of Glenorchy..	9·78	248	...	„	Castleconnell Rec.	4·24	108	...
„	Oban	6·95	177	...	*Clare*	Inagh, Mount Callan ..	9·77	248	...
„	Poltalloch	5·10	130	91	„	Broadford, Hurdlest'n.	5·75	146	...
„	Inveraray Castle......	8·89	226	105	*Wexf*	Newtownbarry	5·69	145	...
„	Islay, Eallabus.......	10·21	259	190	„	Gorey, Courtown Ho...	5·36	136	154
„	Mull, Benmore	17·40	442	...	*Kilk.*	Kilkenny Castle	4·20	107	136
Kinr.	Loch Leven Sluice	6·04	153	168	*Wic*	Rathnew, Clonmannon	4·62	117	...
Perth	Loch Dhu	12·85	326	148	*Carl.*	Hacketstown Rectory.	5·62	143	144
„	Balquhidder, Stronvar.	10·61	269	...	*QCo.*	Blandsfort House.....	4·77	121	143
„	Crieff, Strathearn Hyd.	8·47	215	195	„	Mountmellick	4·39	111	...
„	Blair Castle Gardens ..	5·64	143	161	*KCo.*	Birr Castle...........	3·34	85	108
„	Coupar Angus School..	4·99	127	179	*Dubl.*	Dublin, FitzWm. Sq...	3·64	93	136
Forf.	Dundee, E. Necropolis.	5·09	129	209	„	Balbriggan, Ardgillan.	3·63	92	126
„	Pearsie House........	6·30	160	...	*Me'th*	Drogheda, Mornington	...	..	...
„	Montrose, Sunnyside..	4·38	111	165	„	Kells, Headfort......	3·96	101	116
Aber.	Braemar, Bank	5·99	152	156	*W.M*	Mullingar, Belvedere.	4·18	106	123
„	Logie Coldstone Sch. ..	3·94	100	128	*Long*	Castle Forbes Gdns....	4·61	117	128
„	Aberdeen, King's Coll..	4·23	107	143	*Gal*	Ballynahinch Castle..	11·16	283	187
„	Fyvie Castle	3·95	100	...	„	Galway, Grammar Sch.	5·31	135	...
Mor	Gordon Castle........	2·78	71	97	*Mayo*	Mallaranny..........	12·86	327	...
„	Grantown-on-Spey....	2·63	67	88	„	Westport House......	10·02	255	204
Na	Nairn, Delnies........	2·26	57	96	„	Delphi Lodge	18·30	465	...
Inv.	Ben Alder Lodge	7·58	193	...	*Sligo*	Markree Obsy.	5·71	145	137
„	Kingussie, The Birches	3·59	91	...	*Cav'n*	Belturbet, Cloverhill..	3·17	81	102
„	Loch Quoich, Loan....	12·00	305	...	*Ferm*	Enniskillen, Portora ..	3·41	87	...
„	Glenquoich	...	..	...	*Arm.*	Armagh Obsy.	3·09	78	109
„	Inverness, Culduthel R.	3·28	83	...	*Down*	Warrenpoint	...	..	...
„	Arisaig, Faire-na-Squir	5·24	133	...	„	Seaforde	7·18	182	189
„	Fort William.........	8·73	222	107	„	Donaghadee, C. Stn...	4·13	105	135
„	Skye, Dunvegan......	6·82	173	...	„	Banbridge, Milltown.	3·27	83	119
„	Barra, Castlebay	4·44	113	...	*Antr.*	Belfast, Cavehill Rd. .	3·87	98	...
R&C	Alness, Ardross Cas....	5·33	135	133	„	Glenarm Castle.......	6·51	165	...
„	Ullapool.............	4·40	112	...	„	Ballymena, Harryville	5·23	133	129
„	Torridon, Bendamph..	8·40	213	91	*Lon*	Londonderry, Creggan	4·97	126	121
„	Achnashellach	6·89	175	...	*Tyr*	Donaghmore	4·52	115	...
„	Stornoway	5·04	128	86	„	Omagh, Edenfel......	3·78	96	100
Suth.	Lairg	4·15	105	...	*Don*	Malin Head	5·19	132	158
„	Tongue Manse........	3·04	77	66	„	Dunfanaghy	5·70	145	121
„	Melvich School.......	2·67	68	67	„	Killybegs, Rockmount.	8·39	213	133

Climatological Table for the British Empire, June, 1926

STATIONS	PRESSURE: Mean of Day M.S.L. (mb.)	PRESSURE: Diff. from Normal (mb.)	TEMPERATURE: Absolute Max. (° F.)	TEMPERATURE: Absolute Min. (° F.)	TEMPERATURE: Mean Values Max. (° F.)	TEMPERATURE: Mean Values Min. (° F.)	TEMPERATURE: Mean Values ½ max. and min. (° F.)	TEMPERATURE: Mean Values Diff. from Normal (° F.)	TEMPERATURE: Mean Wet Bulb (° F.)	Relative Humidity (%)	Mean Cloud Am'nt (0—10)	PRECIPITATION: Am'nt (mm.)	PRECIPITATION: Diff. from Normal (mm.)	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible.
London, Kew Obsy.	1013·6	− 3·1	75	43	66·0	50·0	58·0	− 1·2	52·2	85	6·4	86	+ 31	12	6·3	38
Gibraltar	1016·2	− 1·2	85	58	76·8	62·7	69·7	− 0·8	60·7	76	3·4	0	− 12	0	...	...
Malta	1013·9	− 1·7	89	60	76·3	65·1	70·7	− 2·0	66·0	81	4·0	2	0	2	9·8	68
St. Helena	1016·6	+ 3·7	69	54	62·3	56·3	59·3	− 1·7	58·6	93	3·7	70	− 33	17	...	...
Sierra Leone	1013·0	+ 1·0	92	70	87·0	73·6	80·3	0·0	76·2	84	7·2	547	+ 38	25	...	...
Lagos, Nigeria	1011·3	− 1·6	87	72	84·5	74·5	79·5	+ 0·2	75·7	87	8·1	332	−142	23	...	...
Kaduna, Nigeria	1014·3	+ 0·5	89	62	86·2	67·9	77·1	+ 0·6	72·1	83	2·3	219	+ 20	17	...	...
Zomba, Nyasaland	1024·9	+ 1·4	81	47	72·4	53·2	62·8	− 0·1	...	81	6·4	4	− 9	3	...	...
Salisbury, Rhodesia	1019·8	+ 0·1	81	37	70·4	43·9	57·1	+ 0·2	50·5	58	2·0	0	− 1	0	8·9	80
Cape Town	1022·0	+ 1·9	76	36	64·5	47·1	55·8	+ 0·1	49·0	91	5·0	44	− 71	5	...	...
Johannesburg	1024·5	+ 1·8	72	30	61·7	41·9	51·8	+ 1·1	43·5	61	1·6	3	− 1	2	8·9	85
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	75	22	64·4	31·0	47·7	+ 0·1	36·2	68	3·0	1	− 11	1	...	...
Calcutta, Alipore Obsy.	999·4	− 0·3	107	75	96·6	81·7	89·1	+ 4.0	81·4	81	7·4	160	−142	5*	...	...
Bombay	1004·8	+ 0·8	94	78	91·0	81·8	86·4	+ 2·5	79·1	79	5·8	157	−348	11*	...	...
Madras	1003·6	− 0·2	110	77	103·3	83·9	93·6	+ 3·5	76·9	56	6·8	10	− 38	1*	...	...
Colombo, Ceylon	1008·8	+ 0·1	89	73	86·3	77·7	82·0	+ 0·3	78·7	83	9·2	337	+141	28	5·3	42
Hong kong	1006·5	+ 0·4	89	67	81·3	75·3	78·3	− 3·1	74·1	81	9·6	169	−240	18	3·1	23
Sandakan	...	...	91	74	89·1	75·8	82·5	+ 0·8	76·8	83	...	221	+ 36	15	...	...
Sydney	1020·2	+ 2·4	70	44	64·3	49·6	56·9	+ 2·3	51·8	84	4·6	36	− 85	13	5·8	59
Melbourne	1021·1	+ 2·6	66	34	58·0	45·3	51·7	+ 1·3	48·0	86	7·6	72	+ 19	12	3·8	40
Adelaide	1021·7	+ 2·7	70	41	61·6	47·3	54·5	+ 1·0	48·9	75	6·7	42	− 38	12	4·7	48
Perth, W. Australia	1019·7	+ 1·8	71	41	64·2	49·4	56·8	0·0	52·6	77	6·1	174	0	17	4·3	43
Coolgardie	1020·8	+ 1·7	75	34	64·4	42·7	53·5	+ 0·8	47·4	66	3·6	7	− 24	6	...	...
Brisbane	1019·9	+ 1·8	75	45	69·9	53·2	61·5	+ 1·3	55·9	71	3·8	135	+ 68	12	7·3	70
Hobart, Tasmania	1018·1	+ 3·8	61	37	55·7	45·7	50·7	+ 3·9	46·1	80	7·7	115	+ 59	16	3·0	33
Wellington, N.Z.	1020·3	+ 5·4	60	34	55·7	42·2	48·9	− 0·5	47·0	84	5·7	73	− 48	12	4·3	47
Suva, Fiji	1014·4	+ 0·8	86	62	78·9	70·0	74·5	− 0·4	71·8	86	7·5	424	+268	23	3·7	34
Apia, Samoa	1012·4	+ 0·8	89	67	85·5	73·9	79·7	+ 1·9	75·6	77	6·1	148	+ 17	8	7·4	65
Kingston, Jamaica	1013·5	− 0·3	92	72	90·1	73·6	81·9	+ 0·6	72·5	78	3·1	7	− 98	3	...	...
Grenada, W.I.	1014·3	+ 1·2	88	70	84·9	75·0	79·9	+ 1·0	75·7	79	6·7	227	+ 16	17	...	...
Toronto	1011·6	− 2·7	83	38	70·2	49·3	59·7	− 2·9	53·4	66	3·7	88	+ 18	12	9·2	60
Winnipeg	1012·3	− 0·2	84	36	68·5	49·1	58·8	− 3·4	50·2	66	5·0	90	+ 7	11	6·6	41
St. John, N.B.	1011·3	− 2·7	75	41	62·4	47·0	54·7	− 1·8	51·6	77	7·0	146	+ 63	16	7·3	47
Victoria, B.C.	1018·2	+ 1·3	85	47	66·7	51·7	59·2	+ 2·2	54·2	91	5·0	4	− 20	3	11·4	71

*For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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Climatic Variation

By HAROLD JEFFREYS, D.Sc., F.R.S.

The explanation of the variation of climate that has taken place on the earth's surface during geological time has long been one of the thorniest problems of geophysics. Few questions have received so many attempted answers, yet the record is one of almost continuous failure. That Mr. C. E. P. Brooks has already gone a long way towards a solution is well known to readers of his previous book, *The Evolution of Climate,* and of his papers in recent numbers of the *Quarterly Journal of the Royal Meteorological Society.* In the present work* he has advanced several further stages. His fundamental method is to investigate statistically the present relations between temperature and the quantities of water, land, and ice in the neighbourhood of the place considered. Having expressed these relations in quantitative form, he can then apply the results to find what distribution of temperature would correspond to distributions of land and sea different from the present one. The results have hitherto seemed very promising. Brooks's chief recent advance has been in the extension he has made in the theory of the effects of ice, and an account of this forms the subject of the first chapter of his new book. Mere changes in the amount of land in high latitudes, he has found, would alter the mean annual temperature by a few degrees. For some of the

* "Climate through the ages." By C. E. P. Brooks, size $8\frac{1}{2} \times 5\frac{1}{2}$, pp. 439. *Illus.* London. E. Benn Ltd. 1926. 15s. net.

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phenomena to be explained this would be quite adequate, but the full change of temperature in middle latitudes from a warm period, such as the Eocene, to a glacial period appears from the evidence of fossils to have been about 30° F.; also the presence of ice complicates the matter. Suppose that the conditions were such that the temperature at the North Pole was just above the freezing point of sea water, say 28° F., and that the land area was then reduced to such an extent that the mean annual temperature in high latitudes was raised by 2°. Then that would be the end of the matter. But suppose instead that the land was increased so as to lower the mean temperature by 2°. This would be only the immediate effect. The ocean would then proceed to freeze at the pole ; this would be a slow affair, because water cooled at the poles sinks and flows away as a bottom current, so that the whole ocean would have to be cooled before ice could form at the surface. But in time an ice sheet would form. Now the cooling effect of ice is much greater than that of unglaciated land ; there are numerous theoretical reasons why this should be so, and Brooks's previous work has given an estimate of the amount. Hence an ice sheet once started would cool the ocean around it further, and freezing would extend. A simple calculation with reasonable data shows that a uniform ocean in such circumstances would freeze down to latitude 65°, and that the temperature at the pole would ultimately be lowered by 45°. Conversely, if such a state had been attained, and the general temperature rose a little, melting would begin on the southern edge of the ice sheet. The reduction in the area of the ice would reduce its cooling effect, and melting would gradually proceed till the whole ocean was again ice-free. Thus quite a slight change in the external factors governing the temperatures in high latitudes may make all the difference between a mild climate and an intense glaciation.

Brooks sums up the external factors by means of a hypothetical "non-glacial" temperature. This is the temperature that would exist if the ocean had just the same physical properties as it actually has, except that its freezing point was sufficiently low for freezing never to take place, so that the influence of ice would not arise. This can be calculated more directly than the actual temperature, and forms an intermediate stage in finding the latter. If the non-glacial temperature is above 28° F., it is of course equal to the actual temperature ; but if it is lower, the ultimate actual temperature will be much lower still. The present non-glacial temperature at the North Pole in January is estimated as about 26° F. Consequently quite a small rise of temperature would suffice to clear the Arctic Ocean of ice completely. It is, therefore, inferred that during the warm periods, which constitute much the largest part of geological time, the poles were free from ice. Glacial periods occur when the non-glacial temperature at the poles falls enough to form ice-sheets at the poles, and if this condition persists the ultimate result is extensive glaciation ; the actual temperature falls far more than the non-glacial temperature. At present we are in a glacial period, but not at its height ; the extensive low-lying continents around the North Pole become hot in the summer and reduce the glaciated area, and the ice is slowly retreating.

On these lines Brooks has little difficulty in accounting for the last glaciation. A barrier in the North Atlantic shut out the Gulf Stream from the Arctic Ocean, and led to the formation of an extensive ice-cap, which then lowered the temperatures all over the Northern Hemisphere. A surprising fact that arises in the course of his discussion is that the Arctic was probably free from ice from about 500 to 1000 A.D. ; the Scandinavian settlement of Greenland at this time would certainly have been impossible in present conditions.

The Permo-Carboniferous glaciation presents greater difficulties. At this period there was ice in comparatively low southern latitudes, combined with an extensive development of coal and glaciation almost side by side in North America. A reconstruction of the distribution of land and sea at that time, already inferred by geologists on purely geological grounds, leads Brooks to a very plausible explanation. An extensive continent called Gondwanaland connected South America, Africa and Australia. North of it the trade winds drove a warm central Pacific current into an extended Mediterranean, a broad arm of which went up into the Arctic by way of a Volga Sea. Thus warm conditions were maintained in Europe and Central Asia. At the same time an arm from the Arctic extended into the North Atlantic by way of Baffin Bay. This was blocked at the southern end, and explains the local glaciations in America at the time. The southern glaciations are attributed to glaciers from an extensive plateau in the interior of Gondwanaland.

The main lines of Brooks's theory seem extremely plausible. In places, however, his statements do not agree with what we know of the theory of the atmospheric circulation. It is quite certain that if the sun radiated as at present, but there were no atmosphere, the tropics would be much hotter than they are, and the temperature at the poles would be near the absolute zero. If the atmosphere were present, but did not move so as to redistribute the heat, the results would be qualitatively the same. The reason why the mean difference of temperature between poles and equator is only 60° F. is that north and south displacements of air redistribute the heat (partly indirectly, by driving ocean currents with them). A warm period arises when wide seas admit warm currents to the Arctic Ocean in such quantities as to melt its ice. Brooks considers that in these conditions the difference of temperature between the poles and the equator would be small, and the atmospheric circulation much reduced in intensity. But if so the main factor that maintains the ocean currents and keeps the temperature differences down would be reduced, and these differences would become greater than ever. It seems more probable that the differences of temperature from place to place in a warm period were much the same as at present, and that the intensity of the atmospheric circulation also was only slightly less than it is now. Also it seems to be suggested (p. 225) that the atmospheric circulation would be easterly up to latitude 70°. As the area of the surface in higher latitudes is only about 6 per cent. of the whole, the friction of the air over the surface would in these conditions push the air systematically westwards, and convert the circulation into one involving east and west winds over comparable areas, in about a week. An absence of the ordinary temperate region cyclones is also implied ; but these cyclones are necessary to maintain the circulation against friction. It seems to me that the number and intensity of cyclones were probably much the same as at present, and that the dryness of the ground shown by deserts and salt beds was really due to special local conditions, the atmospheric movements and the rainfall remaining in their main outlines much as at present.

The experiment of F. Ahlborn, described on p. 58, has nothing to do with the explanation of the atmospheric circulation. In this experiment a sphere was rotated in a vessel filled with water, and produced an outward current in its equatorial plane, an inward one approaching the sphere again in middle latitudes. This is merely an instance of the well-known fact* that rotatory motion in a fluid is unstable if the angular momentum per unit mass increases inwards. G. I. Taylor's† experiment with fluid between two rotating cylinders is another instance. The fixed containing vessel is an essential part of the conditions of Ahlborn's experiment, and has no analogue in the atmospheric problem. It can be shown easily that the atmosphere would rotate with the earth like a rigid body if it were not for differences of temperature over level surfaces within it.

The idea of a star radiating energy at the expense of its mass, attributed to Prof. Eddington, on p. 112, was originally due to Dr. J. H. Jeans ; and the giant and dwarf theory of stellar evolution, described as if it was created by Eddington in 1924, really received a most damaging blow from him then. With

* Lord Rayleigh, *London Proc. R. Soc. A.*, 1916, pp. 148-154.

† *London Phil. Trans. R. Soc. A.*, 223, 1923, 289-343.

regard to the passage on p. 115 on the change of the obliquity of the ecliptic, Sir G. H. Darwin's work on tidal friction showed that a secular increase in the obliquity has probably proceeded ever since the moon was formed. On p. 140 it is said that cloudiness would lower the mean temperature even if solar and terrestrial radiation were reflected equally. This is not the case; a "grey body," that is, a body with surface composed partly of black regions and partly of perfectly reflecting regions, would take up the same temperature as a black body; the only difference is that it would take longer to do it. The estimate of 30 to 180 miles, given on p. 253, for the thickness of the sial or granite layer is probably excessive; 10 miles would probably be nearer the mark. It might be inferred from p. 256 that Prof. Joly's theory is the only modern form of the thermal contraction theory of mountain formation, which is not the case.

A curious result is obtained in an Appendix, with reference to the geological time scale. Taking some geological determinations of the mean height of the land during the various periods, Brooks assumes that the rate of denudation was proportional to this height, and infers the lengths of the periods from the thicknesses of the sediments deposited. The results are in surprisingly good agreement with those obtained from the Uranium-Lead ratio. This fact suggests, incidentally, that the rate of denudation requires no great corrections for variations in rainfall, which would support the view expressed above that cyclonic disturbances in the warm periods were about as plentiful as at present.

Though Brooks's theory seems to require modification in some points, its fundamental ideas are highly plausible and well supported by the facts. There is a creditable dearth of misprints in his book, and the illustrations and maps are clear and abundant.

"Old Fashioned" Winters.

By M. T. Spence, B.Sc.

An "old fashioned" winter may be defined as a winter in which frost and snow are prevalent; this implies that cold winters occur less frequently now than they have done; temperature records might, therefore, be expected to afford the necessary evidence in support of a conclusion which is so generally accepted. The difficulty immediately presents itself, however, of determining exactly when frost and snow first became "old fashioned." It is not improbable that what is "old fashioned" now, was "old fashioned" many years ago and, if so, it may be inferred that there has ever been a popular delusion with regard to winter weather. If that is the case, can an explanation of the delusion be found?

The longest homogeneous series of temperature records in the British Isles is the Greenwich series from 1841. There was, however, a change in the site of the thermometers in January, 1899, when they were moved to a more open site in the Magnetic Pavilion enclosure. There is the further point, that the expansion of London during the past 85 years may possibly have had its influence on the temperature at Greenwich. The frequency with which winter months in the Greenwich series in each five year-period have been above or below the average for the whole period, is shown in the following table (months which are exactly normal are given alternatively to "above average" and "below average;" there are, however, only 3 such months in the whole period):—

	December		January		February		3 Winter Months	
	Above average	Below average	Above average	Below average	Above average	Below average	Above average	Below average
1841-45 ..	3	2	2	3	1	4	6	9
1846-50 ..	3	2	2	3	4	1	9	6
1851-55 ..	3	2	4	1	2	3	9	6
1856-60 ..	2	3	3	2	2	3	7	8
1861-65 ..	4	1	2	3	3	2	9	6
1866-70 ..	2	3	2	3	4	1	8	7
1871-75 ..	2	3	4	1	2	3	8	7
1876-80 ..	3	2	2	3	4	1	9	6
1881-85 ..	2	3	3	2	4	1	9	6
1886-90 ..	0	5	1	4	0	5	1	14
1891-95 ..	3	2	0	5	2	3	5	10
1896-1900 ..	3	2	4	1	4	1	11	4
1901-05 ..	3	2	3	2	2	3	8	7
1906-10 ..	3	2	2	3	2	3	7	8
1911-15 ..	5	0	3	2	5	0	13	2
1916-20 ..	3	2	3	2	2	3	8	7
1921-25 ..	3	2	5	0	4	1	12	3
	47	38	45	40	47	38	139	116

There is here no indication of a progressive change in the frequency of cold or mild winters, the highest frequency of mild winters does occur towards the end of the period but the highest frequency of cold winters occurs about the middle of the period. The further analysis of the series as given below is, however, instructive and may, it is thought, explain the popular conception of a cold winter as "old fashioned."

Taking the winter months in sequence, *i.e.*, December, January, February, December, January, etc., and basing the mathematical probability of a run of mild or cold months on the fact that 139 are above average and 116 below average, and noting that the ratio of mild Decembers to cold Decembers is approximately the same as the ratio of mild Januaries to cold Januaries and also of mild Februaries to cold Februaries, we have :—

No. of months in run.	Mathematical probabilities of runs of winter months which are mild or cold.		Actual frequency of occurrence of runs of winter months which are mild or cold.	
	Mild.	Cold.	Mild.	Cold.
2	1 in 3	1 in 5	1 in 3	1 in 4
3	,, 6	,, 11	,, 5	,, 7
4	,, 11	,, 23	,, 8	,, 13
5	,, 20	,, 51	,, 14	,, 21
6	,, 37	,, 113	,, 23	,, 31

This analysis shows that there are two factors operating to give runs of mild winter months without assuming any change of climate ; firstly, the mathematical probability based on pure chance of a run of mild winter months is greater than the mathematical probability of a run of cold winter months (a run of 6 mild winter months might be expected to occur approximately 3 times as often as a run of 6 cold winter months) ; secondly, the observed frequency of those runs compared with the mathematical probability of them indicates that a month is predisposed to be mild or cold according as the preceding months have been mild or cold. It may be deduced from these considerations that a series of mild winters such as has occurred since 1911 is no indication of a change of climate and that similar runs have probably occurred in the past. Furthermore, it is not difficult to understand how such runs when they occur give rise to the impression that cold winters are " old fashioned."

Another series of data which is of interest in this connexion and which deals more specifically with frost is the record of days of skating in Regent's Park kept by the National Skating Club from 1830 to 1904, given in Sir Richard Gregory's *British Climate in Historic Times*, as follows :—

Mean Annual number of days of Skating.		Mean Annual number of days of Skating.	
1830-35	7.6	1865-70	7.2
1835-40	12.8	1870-75	11.6
1840-45	18.8	1875-80	21.4
1845-50	12.2	1880-85	4.2
1850-55	10.0	1885-90	16.0
1855-60	7.0	1890-95	31.2
1860-65	10.0	1895-1900	2.4

1900-4 (4 years), mean, 7.7 days.

It is unfortunate that this series does not extend beyond 1904, but so far as it goes there is no indication in it of a progressive change in the number of days of skating.

Luke Howard in his *Climate of London* (2nd edition), gives

the following values of mean monthly temperature for London for the period 1797 to 1816 :—
December, 38·7° F. ; January, 36·3° F. ; February, 39·6° F.
The normal at Greenwich for the period 1881-1915 is :—
December, 40.2° F. ; January, 38·5° F. and February, 39·8° F.

The exposures of the thermometers, however, used for Howard's values make his records quite incomparable with later records, for instance, the height of the thermometers above ground varied from 3 feet to 10 feet, and almost any position which was not exposed to direct sunlight appears to have been regarded as satisfactory for registering air temperatures. In the same publication there appears the following description of winter weather :—

> " Continued frost in winter is always an exception to the general rule of the climate. The winter even passes, occasionally, almost without frost ; in return for which we have, at uncertain intervals, a rigorous season of many weeks' duration, attended with deep snows and clear atmosphere common to more northern latitudes. Our seasons of frost go off, like those of great heat, with a wind from the Atlantic."

The second edition of the *Climate of London* was published in 1833, and the author states that he was about 60 years of age at the time of preparing it for press. The remarks of so conscientous an observer as Luke Howard who had devoted so many years to observational work may be taken as accurate and suggest that winters during the first half of the nineteenth century were much the same as they now are.

The frequent references to severe winters and to a frozen Thames appearing in Lowe's *Chronology of the Seasons*, and in Sir Richard Gregory's *British Climate in Historic Times*, and the comparative absence of reference to mild winters might possibly be regarded as an indication of change, but it is not improbable that mild winters might pass unrecorded whereas severe frosts would be generally noted. There is, however, one reference in *British Climate in Historic Times* to a mild winter which is not without significance : " 1775, April 11th. From November till a fortnight ago we had warmth that I should often be glad of in summer." With regard to the freezing of the Thames Sir Richard Gregory points out that in former times the arches of London Bridge impeded the flow of the river and were easily blocked with ice.

The question as to whether winters with frost and snow are " old fashioned " is one to which the available observations give no conclusive answer, but an analysis of the Greenwich series makes it clear that a run of mild winter months is no evidence that cold winters are becoming " old fashioned " and the comparative frequence of runs of mild winter months may possibly explain the title given to the less frequently occurring cold, but often impressively cold, winter months. The records outside the Greenwich series do not afford satisfactory evidence on which to base conclusions of a change within, say, the last two centuries.

The Detonating Meteor of October 2nd, 1926

ADDITIONAL NOTES

The following notes, which are supplementary to my article in the December number of the *Meteorological Magazine*, should, I think, be placed on record.

The position of the radiant of the meteor is given by Mr. King as defined by Right Ascension 303°, Declination 14° S. Mr. Denning gives 305°, 13° S and remarks (The *Observatory*, November, 1926, p. 344) that this is a centre from which numerous meteors diverge during the months of July and August.

The track shewn on the map is not quite correct ; the line should have been drawn to pass to the east of Worthing and to cross the Thames nearer London.

It is probable that the meteor began to break up a little south of Hitchin and that some of the fragments retained their luminosity as far as Holwell. Mr. B. Taylor, who saw the phenomenon from near Pegsdon about 5 km. southwest of Holwell, gives a sketch of a ball of fire followed by numerous stars. The ball which was yellow " burst open and disappeared almost at once." " The noise was like a clatter of machine guns two or three miles away and quite terrifying." To Mr. Arthur Moody, who saw the phenomenon from Coventry, the meteor was " of a bluish incandescent tint." It burst into a number of pieces, about a dozen, " which immediately turned red like coal cinders and died away."

The speed of the meteor as determined by Messrs. Denning and King was 20 km. per sec.

As the meteor was moving about 70 times as fast as sound, the ballistic wave must have taken the form of a very sharp cone, nearly a cylinder. That the sound was not heard beyond the end of the meteor's track may be analagous to the fact that the ballistic wave from a shell is not heard behind the gun.

The west wind at great heights, which was postulated to account for the time the sound took to reach Reading, may be the explanation of the greater extension of the region of audibility to the east.

Houghton appears on the map as the position of an observer who gave a good estimate of the elevation of the end point of the track. At Ipswich, which is also shewn on the map, there were two observers who heard noises. Mr. Hodson's report is circumstantial—" I saw the meteor burst but do not remember hearing an explosion ; soon after it had vanished, however, I heard a sound as if somebody had clapped." May we regard this as evidence that it was a single ballistic wave that reached Ipswich ?

The hypothesis, which was new to me, that the bursting of a meteor is due to centrifugal force was current as long ago as 1809. In the abridged *Philosophical Transactions of the Royal Society*, Vol. 6, there is a summary of a paper written by Edmund Halley, in 1714. To this paper one of the editors, probably Charles Hutton, adds a long footnote which includes the following paragraph :

> " That they commonly burst and fly in pieces in their rapid flight, is a circumstance exceeding likely to happen, both from the violent state of fusion on their surface, and from the extreme rapidity of their motion through the air. If a grinding stone, from its quick rotation, be sometimes burst and fly in pieces ; and if the same thing happens to cannon balls, when made of stone, and discharged with considerable velocity, merely by the friction and resistance of the air ; how much more is the same to be expected to happen to the atmospheric stones, moving with more than 50 times the velocity, and when their surface may well be supposed to be partly loosened or dissolved by the extremity of the heat there."

F.J.W.W.

Official Publications

The following publication has recently been issued :—

Advisory Committee on Atmospheric Pollution. Twelfth Annual Report ; for the year ending March 31st, 1926.

The report is divided into four sections. In the first section which deals with the deposit of impurity at 61 gauges, an increase of twelve over the previous year, it is shown that the deposit of impurity was less than the average for the previous five years at about two-thirds of the stations. Section 2 deals with the impurity suspended in the air as measured by the automatic filter. In London the percentage of hazy days as determined by the filter was definitely higher than in the previous year but at Blackburn and Stoke-on-Trent it was lower. An account of observations made with the jet dust counter is given under Section 3. Section 4 describes various researches carried out including an attempt to correlate the obstruction of ultra-violet radiation with the quantity of suspended impurity in the atmosphere.

An appendix to this report written by Dr. J. R. Ashworth, of Rochdale, describes an instrument designed by himself for measuring the amount of deposit from the atmosphere day by day or hour by hour. The results obtained with the instrument are described, including a discussion of the effects of wind and rain on the quantity of matter deposited.

Discussions at the Meteorological Office

December 6th. *On the theory of monsoon rainfalls in the Far East.* By D. Nukiyama, (National Research Council of Japan, Tokyo, Jap. J. Astron. Geoph., II., 1924, pp. 75—90). *Opener*—Mr. R. H. Mathews, B.A.

This paper is concerned, not with the rainfall, which is small, but with the excessive cloudiness during the period of the winter north-north-west monsoon over the East China Sea, between Formosa and the Luchu Islands. The area is traversed by a warm south-west current, while northern China, the source of the wind, is very cold and has clear skies. The northerly monsoon winds have a velocity of 8-18 m/s ; the winds associated with cyclonic disturbances are generally weaker. The difference between the air temperature and dew point, and hence the height of cloud formation with a normal vertical temperature gradient, are greater with northerly winds than with those from other directions, but in spite of this the amount of cloud is greatest with northerly winds, averaging between eight and nine tenths of the sky at Nafa.

Since there is no question of forced ascent of air by mountains, and the loss of heat by radiation is also unable to account for the cloud formation, the author investigates the effect of warming of the lower layers from below by the sea surface, and obtains a mathematical expression from which he deduces that this cause is sufficient.

The subjects for discussion for the next meetings will be :—

January 31st, 1927. *The way of the wind.* By W. J. Humphreys (Philadelphia, Pa., J. Franklin Inst. 200, 1925, pp. 279-304). *Opener*—Mr. M. J. Thomas, B.Sc.

February 14th, 1927. *The cup anemometer.* By J. Patterson (Ottawa, Trans. R. Soc., Canada, Sec. 3, 20, 1926, pp. 1-54). *Opener*—Mr. T. W. Vernon-Jones, B.Sc.

A paper on " The forecasting and control of cholera epidemics in India " will be read before the Royal Society of Arts, by Lieut.-Col. Sir Leonard Rogers, C.I.E., M.D., F.R.S., on Friday, January 28th, at 4.30 p.m. Tickets may be obtained upon application to the Secretary, Royal Society of Arts, John Street, Adelphi, W.C. 2.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, December 15th, at 49, Cromwell Road, South Kensington, Sir Gilbert Walker, C.S.I., F.R.S., President, in the Chair.

N. K. Johnson, M.Sc.—Some meteorological observations at sea.

This paper gives a brief account of some meteorological readings which were taken over a period of 24 hours on a ship steaming eastwards in the Mediterranean Sea. The observations include measurements of wind velocity and direction, air temperature and humidity, sea temperature and the vertical distribution of temperature in the air up to a height of 22 m. The last quantity was measured by means of a specially designed apparatus, and precautions were taken to determine all the other quantities as accurately as possible. The observations were made on May 12th-13th, 1926, and the sky was practically clear throughout the 24 hours. The readings of air temperature show a diurnal variation of 1·9° F. There are also indications of a small diurnal variation in the sea temperature. The vertical temperature gradient between heights of 5 m. and 22 m. was found to possess the dry adiabatic value throughout the day but exceeded this value during the night. This result, which is exactly the reverse of what occurs on land, is discussed and reasoning is given to show that it probably represents the normal occurrence at sea.

N. K. Johnson, M.Sc., and E. L. Davies, M.Sc.—Some measurements of temperature near the surface in various kinds of soil.

This paper contains an account of a series of measurements made throughout the year 1925 of the maximum and minimum temperatures recorded at a depth of about 1 cm. below the surface of six kinds of "soil." It is found that in summer the maximum soil temperatures are considerably in excess of the maximum air temperatures recorded in a Stevenson screen. This excess is 37° F. in the case of tarmac, and 14° F. in the case of grass covered soil. In mid-winter the soil maxima are all practically equal to the screen maximum. The minimum temperatures recorded in the "soils" agree closely throughout the year with the minimum air temperature in the screen. The only exception is in the case of the grass covered soil in which the minimum averages about 5° F. higher than the air minimum. A pair of recording thermometer bulbs buried in undisturbed chalky soil enabled the conductivity of the soil to be calculated, firstly from the decrease with depth of the diurnal temperature wave, and secondly from its change of phase with depth. The values deduced by the two methods are in good agreement. By employing this value it then becomes possible to extrapolate the temperature observations up to the actual surface of the soil.

In this way it is found that the average summer maximum for the surface of tarmac is about 115° F., and for earth and sand about 100° F. The extreme maxima for these "soils" are calculated as about 140° F. and 130° F. respectively. It is also concluded that in the tropics an extreme maximum surface temperature for ordinary soils may be estimated as about 180° F.

A. N. Puri, Ph.D.—Investigation on the behaviour of hair hygrometers.

A study has been made of four types of hair hygrometers in which the total load on the hairs consists of a weight. These were taken through a series of humidity changes controlled by sulphuric-acid water mixtures. It is shown that, when the hair is loaded with a weight of two grams, or more, it undergoes a slow extension which extends over a period of several weeks. Hair under a smaller load shows no such effect and the readings at various humidities can be reproduced with sufficient accuracy to measure humidity within two per cent. Alterations in the length of the hair due to changes in humidity show a hysteresis effect which is apparently in the reverse direction to that when measurements are taken in terms of change in weight. A simple form of weight hair hygrometer has been described, which can be used for measuring the vapour pressure of moist substances.

The Buchan Prize of the Royal Meteorological Society for 1927 has been awarded to Mr. C. K. M. Douglas, B.A., for the following papers, contributed to the *Quarterly Journal* of the Society during the years 1922-25 :—" Observations of upper cloud drift as an aid to research and to weather forecasting" ; " Further researches into the European upper air data, with special reference to the life history of cyclones" ; " On the relation between the source of the air and the upper air temperature up to the base of the atmosphere."

Correspondence

To the Editor, *The Meteorological Magazine*

Land Waterspouts

I was much interested in Mr. Fallows' letter in your November issue and should like to add an observation of mine to his. I also feel that it is time that someone with scientific experience took up the cudgels on behalf of the many sea captains who write both to the *Meteorological Magazine* and to *Nature* iterating that water spouts are tubular. Their stories are generally followed by an editorial comment to the effect that water spouts are formed by the condensation of water vapour by rapid expansion in a vortex, and as such cannot be tubular, but consist of "solid" (if the term can be applied) mist.

The waterspout illustrated here occurred on the land, 150 miles from the nearest sea, at Naft-i-Safid, Bakhtiari Country, in Persia, on Monday, December 27th, 1915. Its distance from myself as observer was about two miles, and it was viewed through a pair of Zeiss glasses with a magnification of eight. As the pendant gradually dropped from the cloud, a hollow column of dust from the plain rose to meet it. The pendant and column eventually joined, the whole swaying about in a particularly beautiful manner. The height of column from the plain to the

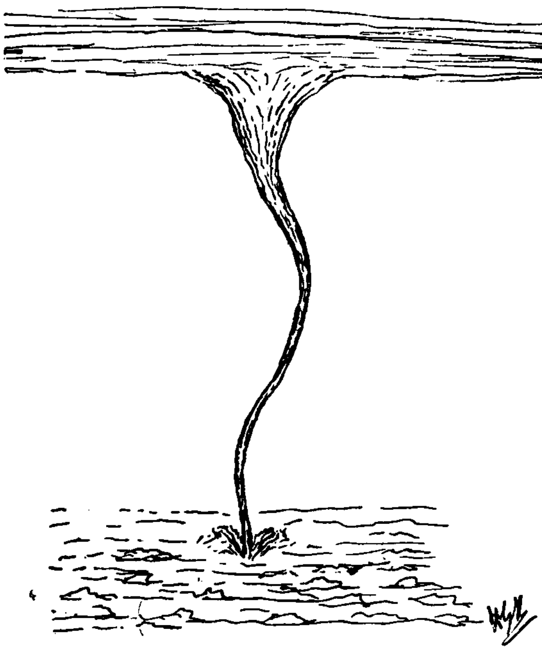

FIG. 1. GENERAL VIEW.

FIG. 2. PORTION OF COLUMN AS SEEN THROUGH GLASSES.

cloud was about 2,000 feet (surely Mr. Fallows' column was more than 200 feet ?), and the motion of the column about fifteen miles per hour, but very irregular. I have no note on the direction of rotation of the column. The whole phenomenon lasted about fifteen minutes, and the pendant portion withdrew into the cloud first, leaving the lower portion rotating at the bottom. At the base of the column there was a fountain of large fragments thrown out, stones, sticks and anything that was loose. The whole column appeared like a translucent glass tube, but flexible, that is, there was a dark edge and a brighter middle, just as I have drawn it. A solid column of mist would have given an exactly opposite effect, namely, a dark middle and a bright edge. There is no doubt in my mind at any rate that the column was hollow, and that the lower part of it was composed of dust, which was of a browner colour than the cloud above it.

Such a "landspout" is, of course, not to be confused with the ordinary dust devil, which is quite common in any desert on a bright day.

I have frequently seen waterspouts at sea, and the tubular effect is always there.

H. G. BUSK.

Old Vicarage House, Milford-on-Sea, Hants. November 22nd, 1926.

Short Period Oscillations of Pilot Balloons

Captain Brunt in his interesting note on this subject in your last issue comes to the conclusion that the oscillations must be ascribed to oscillations in the form of the balloon and not to changes of wind or temperature in the surrounding atmosphere. The conclusion that the cause is inherent in the balloon is borne out by some observations on the rate of ascent of balloons made by the writer in an airship shed at South Farnborough and in the Albert Hall some years ago.

The balloons liberated in these enclosed buildings always went up in a series of "waggles." The period of the oscillations was not noted but from memory I should say that it did not differ greatly from the 2-2½ seconds mentioned by Captain Brunt. It would be interesting to know whether the period depends upon the size of the balloon, a point that could easily be investigated. It has always seemed to me that the irregular movements were due to instability in the wake of the air behind the balloon and that there was no need to look for irregularities of shape as their cause.

J. S. DINES.

November 30th, 1926.

NOTES AND QUERIES

Remarkable Temperature Inversion, December 30th, 1926

A remarkable temperature inversion was observed by aeroplane at Duxford on December 30th, 1926, the temperature readings being 34° F. at 890 mb. (3,700 ft.), 51° F. at 850 mb. (4,900 ft.), and 52° F. at 830 mb. (5,500 ft.) giving a total rise of 18° F. The temperature at the upper level appears to be the highest yet recorded in the British Isles for the period December to April inclusive. The high readings were confirmed by another aeroplane ascent from Stag Lane Aerodrome, Hendon. Next day the inversion had vanished, the temperature having fallen 18° F. at 850 mb., and on the average 15° F. from 850 to 650 mb. (about 5,000 to 12,000 ft.). This change was surprising considering that there was a stationary anticyclone off southwest Ireland, with no change either in the general conditions, in the source of the lower air, or in the surface pressure. It was amply confirmed by a large fall of upper air temperature observed at Utrecht, in Holland. Similar phenomena on a smaller scale are, however, fairly frequent, provided there is a considerable upper wind.

It is worthy of note that the pilot reported "altitude of inversion unreliable owing to its variation with cloud undulations." It is important to keep these small scale variations in mind when comparing the heights of inversions at different stations or on successive days. Though the undulations of large winter inversions only amount to a few hundred feet, there may be local variations up to 2,000 ft. in the height of smaller summer inversions when there are irregular convectional clouds below. There may also be great local variations in the sharpness of inversions, due to changes just below or just above them.

C.K.M.D.

First Greenland Expedition of the University of Michigan

We learn from *Science* for October 8th that Professor W. H. Hobbs with a party of scientists has successfully carried out a nine-weeks exploration of south-west Greenland, a preliminary to the more prolonged expedition which is planned to commence in 1927. A base was established on July 7th on the shores of Maligiak Fiord, about fifty miles east of Holstensborg, and a journey was undertaken to the margin of the inland ice, where a depot of equipment was laid down. Pilot balloon ascents were made both from the base camp and by the exploring party, some of the balloons being followed over the surface of the ice itself ; in all some ninety ascents were made, the greatest height reached being 14,000 metres. In addition ballon-sondes were sent up and one of the meteorographs was recovered after reaching a height of 8,000 metres.

Tornadoes Started by an Oil Fire.

The *Scientific American* for December, 1926, contains a vivid description of the effects of a fire which destroyed nearly six million barrels of oil at San Luis Obispo, California. An account of the event was given by Mr. J. E. Hissong, of the local weather bureau of California city. He states that the fire was started by lightning and that initially four tanks, each containing 750,000 barrels of oil, "boiled over." An immense quantity of burning oil was spread over an area which was estimated at about 900 acres or nearly 4 sq. km. Flames seemingly leaped up to a height of 1,000 feet, and at the same time violent whirlwinds formed over the fire. During the period when the large reservoirs were burning, and the convection was probably at its strongest, the whirls were numerous and violent. Some hundreds of whirls were observed simultaneously, many of them presenting the features of true tornadoes, with gyrating funnel shaped clouds, the condensation of vapour in the central portions showing up clearly against the dark background of smoke. It is reported that some of the central funnels were not more than about a foot in diameter.

One of the whirls travelling downwind to a cottage about a thousand yards away, picked up the cottage, and carried it a distance of 150 feet, where it was dropped, a complete wreck, the two occupants being killed.

Mr. Hissong reports that strong southerly winds prevailed initially, shifting later to west, and eventually to northwest. He attributes the formation of the whirls to the veering of the wind, which coincided more or less with the formation of the whirls. It is difficult to see how this in itself could account for the whirls, and the present writer suggests that the whirls were such as might have occurred, independently of any wind, by the convection currents removing large masses of air, which would be replaced by the convergence of air from all sides. The converging air by retaining its original moment of momentum about the centre of the rising column, would after convergence, have acquired a large velocity of rotation about the centre, and would give rise to whirls of the nature observed.

A rough estimate of the energy liberated by the fire can be readily made. A given weight of oil will raise the temperature of 1,000 times its own weight of water through 10° C. The fire of six million barrels, assuming a barrel to be half a cubic metre, is equivalent to the burning of $3 \cdot 10^9$ kg. and would produce $3 \cdot 10^{18}$ kg. calories; taking the specific heat of air to be 1/4, we find that this would heat $12 \cdot 10^{12}$ kg. of air through 10° C. This amount of air is about 10^{13} c.m., or 10^4 c.km.

If there were no wind initially, then if we assume that 10^4 c. km. of air is removed through a funnel vertically over the fire, this amount of air must drift in sideways to the zone of the fire, and be replaced by air pushing in from further distances. Taking the zone of fire to be a circle of 1 km. radius, this involves the convergence to the edge of the zone of fire of air from 50 km. away. The angular momentum of this air remains constant, in space, and if the velocity in the whirl about the fire be v at the edge of the fire (at 1 km. from the centre) we then have

$$(50)^2\ \omega \sin\phi = 1.\ (v + \omega \sin\phi).$$

$$\text{Thus } v = \text{approximately } (50)^2\ \omega \sin\phi$$
$$= 2500 \times 5 \cdot 7\ 10^{-5} \text{ km. per sec.}$$
$$\doteq 142 \text{ metres per sec.}$$

Thus the whirl formed in still air would have a whirling velocity of 142 metres per sec. at 1 km. from its centre, with velocity decreasing outward in inverse proportion to distance from the centre.

In the case in question, the air was not initially still, and so the ascending cylinder of air was replaced by a sheet of air, and the one whirl was replaced by a number of smaller whirls. Enough has been said, however, to show that the supply of energy available from the fire was ample to account for the formation of violent tornadoes without assuming any special properties of the wind distribution. Moreover, it has been assumed above that only air heated through 10° C. will ascend, whereas it is certain that in the region of such a fire as this air heated through a much smaller range of temperature would ascend readily. If we decrease the necessary range of temperature we increase the volume of air removed by convection in inverse proportion, and increase the intensity of the whirl in proportion to the mass of air removed.

It may be recalled that during the fires which completed the destruction of Tokyo after the earthquake of September 2nd, 1923, Dr. Fujiwhara reported the formation of a number of whirls.*

D. BRUNT.

The Last British Glacier

With reference to his letter of November 4th,† Mr. R. P. Dansey points out that Aonach Mt. should be Aonach Mor, and Aonach Beas should be Aonach Beag. He also writes: "Personally I am of the opinion that the scree mound below the bed has been pushed up there by the bed, against your deduction that the rock face has been bare for hundreds of years and has been preserved in its clean state by the bed. The other bed under Aonach Mor which in most years never melts but which had gone in 1918 ought, I think, if your deduction is right, also to have shown smooth clear rocks, but it did not."

The Rainfall of 1926

The rainfall of the year 1926 was similar to that of 1925 in being slightly in excess of the average. Since the dry year 1921 the rainfall of each year has reached or exceeded the average, the percentage values for the British Isles for the years 1921 to 1926 being 82, 100, 114, 117, 104 and 103 respectively. Excesses predominated over England and Wales and in Scotland, but in Ireland excesses were confined to considerably less than half the country. In England and Wales there were two large areas with excess, one to the south-east of a line from the mouth of the Severn to the Wash, and the other covering the north of England

*Vide *Meteorological Magazine*, December, 1923, p. 247.

† See *Meteorological Magazine*, 61 (1926), p. 262.

and northern and central Wales. Practically everywhere the fall was within 85 and 115 per cent. of the average. In Scotland the fall exceeded 120 per cent. over the west of the Southern Uplands, to the south of the Grampians from Crieff to Dundee and to the north of Bute from Rothesay to Inveraray. The fall was below the average along the greater part of the west and north coasts and over the Valley of the River Spey. In Ireland falls of more than the average were confined to the north-east, from Galway to Belfast, while in the neighbourhood of Londonderry more than 110 per cent. was recorded.

While the rainfall of the whole year over the British Isles was close to the normal, the distribution in time was very erratic. Apart from the very wet January and dry March, the year includes the wettest November and the driest December in 57 years of comparable statistics. While separately November and December gave extreme values, together the fall was very close to the average for the two months.

The rainfall of December is worthy of special comment. The map showing the rainfall of the month as a percentage of the average presents a fairly uniform gradient from the south to the north in each of the three countries. Over England and Wales the percentage varied from less than 10 per cent. along the south coast of Dorset and Devon to 75 per cent. in the Lake District ; in Scotland from less than 25 per cent. in the south-east to more than 100 per cent. in the north-west, and in Ireland from less than 10 per cent. in Co. Cork to over 50 per cent. in Londonderry. Many observers reported the driest December on record. At stations as widely distributed as Slough in Buckinghamshire, Lyme Regis in Dorset, Church Stretton in Shropshire and Darrynane Abbey in Kerry, the total was the smallest recorded in December in over 50 years' records. At Kew Observatory it was the smallest total since records began there in 1866 and at Ross-on-Wye since 1818.

Obituary

We regret to learn of the death of Mr. Charles Harding, at Eastbourne, on January 9th, at the age of 80.

News in Brief

The past and present members of the Staff of the Meteorological Office, Edinburgh, and their friends, together with members from Eskdalemuir Observatory and Leuchars Aerodrome, to a total number of 25, held a most successful social gathering in Edinburgh, on December 4th. As on the first occasion, a year ago, the party met for dinner at Ferguson and Forrester's Restaurant, and the remainder of the evening was spent in dancing at the *Palais de Danse.*

The Weather of December, 1926

In striking contrast to November the rainfall of December was unusually low and pressure unusually high. Westerly winds prevailed during more than half the month, but after the 21st the winds were mainly easterly. Cold anticyclonic misty weather occurred on the 1st, but the passage of a depression south-eastwards across the North Sea caused strong north-westerly winds and hail, sleet and thunder locally in the north and west on the 3rd. Subsequently an anticyclone spread north-eastward from the Azores and was associated with fog at times; day temperatures, however, rose frequently above normal between the 6th and the 11th. By the 12th the anticyclone was withdrawing towards Switzerland and a shallow depression was approaching from Iceland. Northerly winds in the rear of the latter were associated with a temporary drop in temperature about the 15th, when the lowest grass minimum temperature for the month, 11° F., was recorded at Dumfries. Snow and sleet were reported from most districts and " snow lying " from a few places in the north. Further depressions travelling south of Iceland in an east-south-east direction caused a renewal of generally mild conditions on the 16th with freshening westerly winds. After the 20th pressure became high across Scotland to Scandinavia giving cold north-easterly winds and snow or sleet locally. The winds freshened considerably at times, rising to gale force in the western part of the English Channel, and temperature readings were low, the lowest screen minimum for the month, 14° F., being recorded at Balmoral on Christmas Day. On the 24th the barometer rose unusually high in Scotland, readings exceeding 1,050 mb. in several places, but during the next few days the anticyclone moved south-westwards and became less intense. A comparatively warm current from the Atlantic caused a marked rise in temperature in Scotland on the 27th, the maximum at Aberdeen that day being 53° F., 17° F. higher than at Kew. Milder conditions spread to the southern counties also on the 28th and 29th.

The rainfall for the month and year is discussed on p. 294.

Pressure was above normal over western and central Europe and the North Atlantic, the excess being as much as 17·6 mb. at Donaghadee, and below normal over Spitsbergen, northern Scandinavia and Nova Scotia. Rainfall was generally below normal except in northern Norway and temperature below normal in Scandinavia except Jämtland, Ireland and Spain, but above normal elsewhere. In Svealand, Sweden, the rainfall was only 66 per cent. of the normal.

Extensive floods occurred in the south of France during the first days of the month owing to the previous heavy rains. By the 4th the rain had turned to snow and abundant falls were reported from the Auvergne, Pyrenees and Puy de Dôme. Heavy snow also occurred in Asturias, the neighbourhood of Madrid, and as far south as Almeria. Ten monks from the Great St. Bernard Hospice were overtaken by an avalanche coming from the Col de Fenêtre on the 7th, and landslides occurred in Oviedo (Spain) and the Pyrenees owing to torrential rains. An unusually black high fog occurred in Paris on the 10th. Mild weather prevailed in Lorraine to about the 18th, and fine sunny weather in Switzerland from the 8th to 18th, when a severe snowstorm occurred there. Later, heavy snow also fell in the Black Forest and severe cold and snow were reported from Switzerland, France, Spain and Portugal for the rest of the month.

On the 10th a thunderstorm ended the drought which was being experienced in Jerusalem. Following on a week's rain, floods occurred in Malaya on the 27th causing much damage to the mines and railways. Floods also occurred along the Beira-Mashonaland railway (Portuguese East Africa) on the 29th.

Disastrous bush fires raged intermittently in New South Wales from the 4th to 14th. Steady soaking rains, however, fell after the 18th in Queensland and after the 27th in New South Wales, where floods were reported in low lying parts.

On the 4th more than 100 steamers were held up in the St. Lawrence at Sault Ste. Marie by an ice blockade said to be the worst ever experienced. It was broken up on the 9th. Heavy snow occurred in New York on Christmas night and at the same time almost tropical rains swelled the rivers of Tennessee, Arkansas, Mississippi and Kentucky, till they overflowed their banks. Twelve people were drowned. Unusually severe weather was experienced in the Rocky Mountain States towards the end of the month.

A violent storm passed over Funchal, Madeira, on the 15th. The wind at first was SE, but later veered to W, and large seas dashed against the island, doing much damage to shipping, several vessels being sunk.

The special message from Brazil that the rainfall in the central districts was 48 mm. above normal and in the southern districts very abundant with 109 mm. above normal. The weather was generally favourable to crops and vegetables. Many depressions passed across the southern part of the country. At Rio de Janeiro pressure was 1·3 mb. below normal and temperature 1·1° F. below normal.

Rainfall, 1926—General Distribution

	Dec.	Year	
England and Wales	26	102	per cent. of the average 1881-1915.
Scotland	57	109	
Ireland	30	99	
British Isles	34	103	

Rainfall: December, 1926: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square	·43	11	18	*War.*	Birminghm, Edgbaston	·41	11	15
Sur .	Reigate, The Knowle	·48	12	16	*Leics*	Thornton Reservoir	1·00	25	37
Kent.	Tenterden, Ashenden	·74	19	24	,, .	Belvoir Castle	·91	23	37
,, .	Folkestone, Boro. San.	·96	24	...	*Rut* .	Ridlington	·64	16	...
,, .	Margate, Cliftonville	·44	11	19	*Linc.*	Boston, Skirbeck	·76	19	35
,, .	Sevenoaks, Speldhurst.	·75	19	...	,, .	Lincoln, Sessions House	·64	16	29
Sus .	Patching Farm	·33	8	10	,, .	Skegness, Marine Gdns.	·58	15	26
,, .	Brighton, Old Steyne	·46	12	15	,, .	Louth, Westgate	·79	20	28
,, .	Tottingworth Park	·53	13	14	,, .	Brigg	·85	22	35
Hants	Ventnor, Roy. Nat. Hos.	·43	11	13	*Notts.*	Worksop, Hodsock	·85	22	36
,, .	Fordingbridge, Oaklnds	·45	11	11	*Derby*	Mickleover, Clyde Ho.	·81	21	31
,, .	Ovington Rectory	·53	13	13	,, .	Buxton, Devon. Hos.	1·96	50	35
,, .	Sherborne St. John Rec.	...	..	...	*Ches.*	Runcorn, Weston Pt.	1·09	28	34
Berks	Wellington College	39	10	14	,, ..	Nantwich, Dorfold Hall	1·00	25	...
,, .	Newbury, Greenham	·44	11	14	*Lancs*	Manchester, Whit. Pk.	1·46	37	45
Herts.	Benington House	·31	8	12	,, ..	Stonyhurst College	2·92	74	60
Bucks	High Wycombe	·50	13	17	,, ..	Southport, Hesketh Pk	1·16	29	36
Oxf. .	Oxford, Mag. College	·51	13	22	,, ..	Lancaster, Strathspey.	1·39	35	...
Nor .	Pitsford, Sedgebrook	·56	14	23	*Yorks*	Sedbergh, Akay	...	..	...
,, .	Eye, Northolm	...	..	...	,, .	Wath-upon-Dearne	·83	21	35
Beds.	Woburn, Crawley Mill.	·40	10	17	,, .	Bradford, Lister Pk.	1·06	27	32
Cam.	Cambridge, Bot. Gdns.	·27	7	14	,, .	Wetherby, Ribston H.	·89	23	36
Essex	Chelmsford, County Lab	·43	11	19	,, .	Hull, Pearson Park	·79	20	33
,, .	Lexden, Hill House	·49	12	...	,, .	Holme-on-Spalding	·64	16	...
Suff .	Hawkedon Rectory	·84	21	35	,, .	West Witton, Ivy Ho.	1·08	27	...
,, .	Haughley House	·67	17	...	,, .	Felixkirk, Mt. St. John	1·14	29	47
Norf.	Beccles, Geldeston	·78	20	34	,, .	Pickering, Hungate	1·21	31	...
,, .	Norwich, Eaton	1·30	33	50	,, .	Scarborough	1·08	27	45
,, .	Blakeney	1·06	27	48	,, .	Middlesbrough	1·12	28	58
,, .	Swaffham	·89	23	37	,, .	Baldersdale, Hury Res.	1·30	33	...
Wilts.	Devizes, Highclere	·69	18	23	*Durh.*	Ushaw College	·70	18	28
,, .	Bishops Cannings	·62	16	19	*Nor* .	Newcastle, Town Moor.	·69	18	29
Dor .	Evershot, Melbury Ho.	·40	10	8	,, .	Bellingham, Highgreen	·49	13	...
,, .	Creech Grange	·52	13	50	,, .	Lilburn Tower Gdns.	·75	19	...
,, .	Shaftesbury, Abbey Ho.	·39	10	11	*Cumb*	Geltsdale	1·20	30	...
Devon	Plymouth, The Hoe	·57	15	11	,, .	Carlisle, Scaleby Hall .	·85	21	26
,, .	Polapit Tamar	1·52	39	30	,, .	Seathwaite M.	14·01	356	86
,, .	Ashburton, Druid Ho.	·65	17	9	*Glam.*	Cardiff, Ely P. Stn.	·46	12	9
,, .	Cullompton	·52	13	12	,, .	Treherbert, Tynywaun	·53	13	...
,, .	Sidmouth, Sidmount	·59	15	15	*Carm*	Carmarthen Friary	·60	15	10
,, .	Filleigh, Castle Hill	1·12	28	...	,, .	Llanwrda, Dolaucothy.	1·94	49	28
,, .	Barnstaple, N. Dev. Ath.	·96	24	22	*Pemb*	Haverfordwest, School	...	..	...
Corn.	Redruth, Trewirgie	1·24	31	20	*Card.*	Gogerddan	1·89	48	38
,, .	Penzance, Morrab Gdn.	1·20	31	21	,, .	Cardigan, County Sch. .	1·06	27	...
,, .	St. Austell, Trevarna	1·09	28	18	*Brec.*	Crickhowell, Talymaes	1·00	25	...
Soms	Chewton Mendip	·66	17	12	*Rad* .	Birm. W. W. Tyrmynydd	1·89	48	23
,, .	Street, Hind Hayes	·51	13	...	*Mont.*	Lake Vyrnwy	1·03	26	15
Glos. .	Clifton College	·65	17	17	*Denb.*	Llangynhafal	1·49	38	...
,, .	Cirencester, Gwynfa	·43	11	12	*Mer* .	Dolgelly, Bryntirion	2·38	60	35
Here.	Ross, Birchlea	·47	12	16	*Carn.*	Llandudno	·97	25	31
,, .	Ledbury, Underdown.	·57	14	20	,, .	Snowdon, L. Llydaw 9	3·97	101	...
Salop	Church Stretton	·70	18	21	*Ang* .	Holyhead, Salt Island.	·81	21	19
,, .	Shifnal, Hatton Grange	·55	14	21	,, .	Lligwy	·81	21	...
Staff.	Tean, The Heath Ho.	·98	25	30	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	·39	10	15		Douglas, Boro' Cem.	1·24	32	25
,, .	Blockley, Upton Wold.	·57	14	18	*Guernsey*				
War.	Farnborough	·82	21	28		St. Peter P't, Grange Rd	1·61	41	39

Rainfall: December, 1926: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	1·86	47	45	*Suth.*	Loch More, Achfary	16·12	409	174
,,	Pt. William, Monreith	1·65	42	...	*Caith*	Wick	3·53	90	115
Kirk.	Carsphairn, Shiel.	4·84	123	...	*Ork.*	Pomona, Deerness	5·46	139	130
,,	Dumfries, Cargen	1·28	33	24	*Shet.*	Lerwick	4·61	117	96
Roxb	Branxholme	·51	13	14					
Selk.	Ettrick Manse	1·67	43	...	*Cork.*	Caheragh Rectory	·40	10	...
Berk.	Marchmont House	·61	15	22	,,	Dunmanway Rectory	·37	9	5
Hadd	North Berwick Res.	·38	10	18	,,	Ballinacurra	·39	10	8
Midl	Edinburgh, Roy. Obs.	·62	16	29	,,	Glanmire, Lota Lo.	·72	18	13
Lan.	Biggar	1·16	29	34	*Kerry*	Valentia Obsy.	1·43	36	22
,,	Leadhills	2·79	71	...	,,	Gearahameen	...	..	...
Ayr.	Kilmarnock, Agric. C.	2·44	62	57	,,	Killarney Asylum	1·55	39	21
,,	Girvan, Pinmore	2·54	65	42	,,	Darrynane Abbey	1·78	45	30
Renf.	Glasgow, Queen's Pk.	1·61	41	38	*Wat.*	Waterford, Brook Lo.	·90	23	19
,,	Greenock, Prospect H.	3·63	92	57	*Tip.*	Nenagh, Cas. Lough	·88	22	19
Bute.	Rothesay, Ardencraig.	4·13	105	82	,,	Tipperary	...	..	...
,,	Dougarie Lodge	2·63	67	...	,,	Cashel, Ballinamona	·79	20	18
Arg.	Ardgour House	10·89	277	...	*Lim.*	Foynes, Coolnanes	1·27	32	27
,,	Manse of Glenorchy	10·84	275	...	,,	Castleconnell Rec.	1·20	30	...
,,	Oban	4·12	105	...	*Clare*	Inagh, Mount Callan	2·35	60	...
,,	Poltalloch	4·85	123	86	,,	Broadford, Hurdlest'n.	1·68	43	...
,,	Inveraray Castle	6·83	173	81	*Wexf*	Newtownbarry	·60	15	...
,,	Islay, Eallabus	4·41	112	82	,,	Gorey, Courtown Ho.	·73	19	19
,,	Mull, Benmore	15·80	401	...	*Kilk.*	Kilkenny Castle	·86	22	25
Kinr.	Loch Leven Sluice	·38	10	11	*Wic.*	Rathnew, Clonmannon	·53	13	...
Perth	Loch Dhu	5·30	135	61	*Carl.*	Hacketstown Rectory	1·41	36	34
,,	Balquhidder, Stronvar.	2·51	64	...	*QCo.*	Blandsfort House	1·26	32	34
,,	Crieff, Strathearn Hyd.	·59	15	14	,,	Mountmellick	2·72	69	...
,,	Blair Castle Gardens	...	..	...	*KCo.*	Birr Castle	·98	25	30
,,	Coupar Angus School	1·86	47	67	*Dubl.*	Dublin, FitzWm. Sq.	·84	21	34
Forf.	Dundee, E. Necropolis	·31	8	12	,,	Balbriggan, Ardgillan	·71	18	25
,,	Pearsie House	·71	18	...	*Me'th*	Drogheda, Mornington	...	..	...
,,	Montrose, Sunnyside	...	..	...	,,	Kells, Headfort	·95	24	25
Aber.	Braemar, Bank	·36	9	10	*W.M*	Mullingar, Belvedere	1·05	27	29
,,	Logie Coldstone Sch.	1·13	29	40	*Long*	Castle Forbes Gdns.	·94	24	24
,,	Aberdeen, King's Coll.	·96	24	30	*Gal.*	Ballynahinch Castle	2·56	65	34
,,	Fyvie Castle	1·87	47	...	,,	Galway, Grammar Sch.	·86	22	...
Mor.	Gordon Castle	1·82	46	68	*Mayo*	Mallaranny	2·72	69	...
,,	Grantown-on-Spey	1·60	41	59	,,	Westport House	1·68	43	29
Na.	Nairn, Delnies	1·66	42	75	,,	Delphi Lodge	4·10	104	...
Inv.	Ben Alder Lodge	4·00	102	...	*Sligo*	Markree Obsy.	2·15	55	45
,,	Kingussie, The Birches	2·26	57	...	*Cav'n*	Belturbet, Cloverhill	1·26	32	34
,,	Loch Quoich, Loan	16·00	406	...	*Ferm*	Enniskillen, Portora	...	..	...
,,	Glenquoich	...	..	...	*Arm.*	Armagh Obsy.	1·22	31	39
,,	Inverness, Culduthel R.	2·38	61	...	*Down*	Warrenpoint	...	..	...
,,	Arisaig, Faire-na-Squir	5·47	139	...	,,	Seaforde	·94	24	23
,,	Fort William	6·29	160	62	,,	Donaghadee, C. Stn.	1·04	27	33
,,	Skye, Dunvegan	...	..	...	,,	Banbridge, Milltown	·85	22	29
,,	Barra, Castlebay	1·66	42	...	*Antr.*	Belfast, Cavehill Rd.	1·36	35	...
R&C	Alness, Ardross Cas.	2·78	71	67	,,	Glenarm Castle	2·58	66	...
,,	Ullapool	5·26	133	...	,,	Ballymena, Harryville	2·05	52	46
,,	Torridon, Bendamph.	6·35	161	62	*Lon.*	Londonderry, Creggan	2·69	68	61
,,	Achnashellach	11·53	293	...	*Tyr.*	Donaghmore	1·56	40	...
,,	Stornoway	5·27	134	84	,,	Omagh, Edenfel	1·75	44	41
Suth.	Lairg	5·71	145	...	*Don.*	Malin Head	1·80	46	54
,,	Tongue Manse	4·67	119	94	,,	Dunfanaghy	2·04	52	39
,,	Melvich School	4·20	107	98	,,	Killybegs, Rockmount	3·06	78	42

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Climatological Table for the British Empire, July, 1926

STATIONS	PRESSURE: Mean of Day M.S.L. (mb.)	PRESSURE: Diff. from Normal (mb.)	TEMPERATURE: Absolute Max. (°F.)	TEMPERATURE: Absolute Min. (°F.)	TEMPERATURE: Mean Values Max. (°F.)	TEMPERATURE: Mean Values Min. (°F.)	TEMPERATURE: Mean Values ½ max. and min. (°F.)	TEMPERATURE: Mean Values Diff. from Normal (°F.)	TEMPERATURE: Mean Wet Bulb (°F.)	Relative Humidity (%)	Mean Cloud Am'nt (0—10)	PRECIPITATION: Am'nt (mm.)	PRECIPITATION: Diff. from Normal (mm.)	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible
London, Kew Obsy.	1016·8	+ 1·0	85	51	71·6	56·1	63·9	+ 1·2	57·3	83	7·0	44	− 11	16	5·4	33
Gibraltar	1015·7	− 1·1	90	62	81·3	67·5	74·4	− 0·4	65·1	76	3·9	0	− 1	0	...	...
Malta	1014·4	− 0·9	87	65	80·3	69·3	74·8	− 3·5	69·4	82	2·5	0	− 1	0	11·3	79
St. Helena	1016·7	+ 3·2	66	52	60·8	54·2	57·5	− 1·5	56·1	89	3·5	68	− 34	17	...	...
Sierra Leone	1013·7	+ 1·0	87	70	83·9	72·8	78·3	− 0·3	74·8	87	7·8	548	−356	30	...	...
Lagos, Nigeria	1011·8	− 2·0	85	69	81·7	74·1	77·9	− 0·1	74·2	83	7·6	256	− 15	13	...	...
Kaduna, Nigeria	1014·3	+ 0·3	90	62	83·0	66·7	74·9	+ 1·3	70·6	85	2·2	344	+136	22	...	...
Zomba, Nyasaland	1024·5	0·0	80	47	71·5	53·1	62·3	+ 0·3	...	78	5·8	18	+ 10	6	...	...
Salisbury, Rhodesia	1019·6	− 0·9	79	37	69·5	42·9	56·2	+ 0·1	48·6	57	3·1	0	− 1	0	8·2	74
Cape Town	1023·6	+ 2·3	79	35	61·8	45·0	53·4	− 1·3	47·3	85	4·5	112	+ 19	16	...	...
Johannesburg	1025·7	− 0·1	65	21	56·8	36·2	46·5	− 4·0	38·3	58	1·4	22	+ 14	1	9·2	87
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	67	12	59·3	25·2	42·3	− 5·0	33·5	69	1·5	4	− 6	1	...	...
Calcutta, Alipore Obsy.	998·9	− 0·3	97	75	89·0	78·9	83·9	+ 0·4	79·6	90	9·3	644	+326	20*	...	...
Bombay	1002·4	− 1·5	89	74	86·2	78·7	82·5	+ 1·2	78·5	86	8·0	784	+168	27*	...	...
Madras	1004·2	− 0·3	101	74	96·5	78·7	87·6	+ 0·2	76·9	70	8·3	69	− 31	7*	...	...
Colombo, Ceylon	1008·3	− 0·9	87	73	85·8	76·6	81·2	+ 0·1	77·9	82	9·1	301	+137	26	4·7	38
Hongkong	1005·8	+ 1·0	91	73	86·9	78·4	82·7	+ 0·2	78·2	80	7·6	757	+417	21	7·2	54
Sandakan	...	...	92	74	88·3	75·7	82·0	+ 0·2	76·4	83	...	149	− 17	8	...	...
Sydney	1016·5	− 2·0	78	42	64·0	47·0	55·5	+ 2·8	48·8	75	4·3	60	− 63	11	6·4	63
Melbourne	1015·7	− 3·4	69	36	57·5	45·4	51·5	+ 2·9	47·1	83	6·6	37	− 9	18	4·6	47
Adelaide	1016·6	− 3·8	73	37	61·8	46·7	54·3	+ 2·6	48·0	72	5·5	50	− 17	16	5·5	55
Perth, W. Australia	1013·3	− 5·7	67	40	61·4	50·1	55·7	+ 0·5	52·9	80	8·0	312	+146	27	3·2	31
Coolgardie	1015·3	− 4·6	71	31	61·8	42·9	52·3	+ 1·1	46·9	72	4·4	22	− 1	12	...	...
Brisbane	1018·1	− 0·4	81	42	69·5	47·9	58·7	+ 0·2	51·7	70	3·3	22	− 37	5	8·0	76
Hobart, Tasmania	1011·0	− 2·8	65	36	54·3	42·7	48·5	+ 3·1	42·8	76	6·9	41	− 13	16	4·2	45
Wellington, N.Z.	1014·9	+ 1·0	60	32	54·5	42·7	48·6	+ 0·9	46·2	79	6·4	73	− 70	17	4·1	44
Suva, Fiji	1013·3	− 0·9	83	62	78·0	67·5	72·7	− 0·9	68·5	83	7·0	233	+116	17	4·3	39
Apia, Samoa	1012·1	+ 0·1	87	67	84·1	73·0	78·5	+ 1·3	75·0	78	4·9	116	+ 49	11	8·0	70
Kingston, Jamaica	1013·7	− 1·0	93	71	90·3	74·1	82·2	+ 0·5	72·7	78	3·4	47	+ 5	6	5·2	40
Grenada, W.I.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Toronto	1014·3	+ 0·2	91	46	77·8	57·8	67·8	− 0·4	60·0	65	4·1	45	− 32	8	9·8	65
Winnipeg	1013·6	+ 0·9	98	37	80·1	55·8	67·9	+ 1·7	...	...	3·6	51	− 29	5	10·0	63
St. John, N.B.	1013·8	+ 0·1	79	48	68·8	52·7	60·7	+ 0·3	57·6	81	5·6	76	− 16	15	7·7	50
Victoria, B.C.	1016·9	+ 0·2	85	50	70·0	53·0	61·5	+ 1·2	56·0	67	5·0	0	− 9	0	11·2	71

*For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.