M.O. 284.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 61

Mar. 1926

No. 722

LONDON : PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE.

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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*).

† 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 $\bar{P}$ 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_0 the radiation received on a perfectly clear day at that time of year, then $Q_s = Q_0 (0{\cdot}25 + 0{\cdot}75S)$. 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 $R_m = R_0 (0{\cdot}25 + 0{\cdot}75S)$, 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.

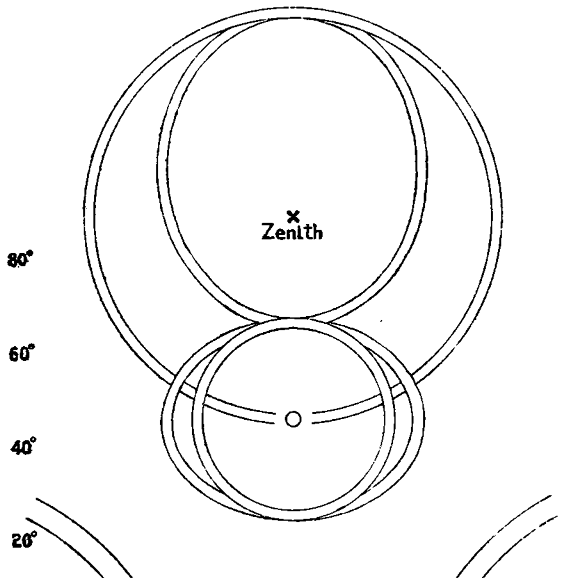
A method is described for obtaining the best possible values for amplitude and phase of a periodicity of given length, if the period is hidden by comparatively large irregular fluctuations. The method is applied to the determination of the lunar diurnal variation of atmospheric pressure in higher latitudes.

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.

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* 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

* 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	Hours before Low Tide 3	2	1	Hours after Low Tide 1	2	3	Hours before High Tide 3	2	1	Hours after High Tide 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

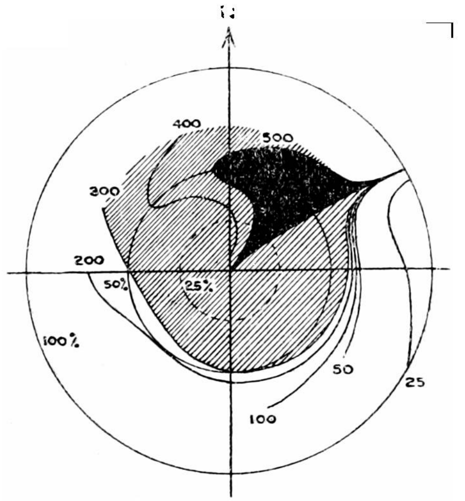
The Edge of the Doldrums

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