

M.O. 294.

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The Meteorology of Solar Eclipses

By E. W. BARLOW, B.Sc.

A most important astronomical event, so far as our country is concerned, will occur on June 29th next, when a total eclipse of the sun will be visible over limited areas in northern England and north Wales. A total eclipse is an event of great rarity in any circumscribed region, although, if the earth be taken as a whole, there are normally about ten such eclipses in every eighteen years. The last total eclipse visible within the British Isles took place on May 22nd, 1724; the next, after that of the present year, will be on August 11th, 1999. The interval between successive occurrences in any definite place is variable, but averages 360 years.

The purpose of this article is to give a very brief outline of the effects of solar eclipses on meteorological conditions. There is quite an extensive literature on the subject, and it has been found necessary to exclude the influence of the eclipse shadow upon atmospheric electricity and terrestrial magnetism. Eclipse meteorology is unique; the conditions which are superimposed upon the momentary atmospheric state cannot be produced by any other event or combination of events. The conical shadow thrown by the moon, from which all direct solar radiation is cut off, surrounded by the penumbral shadow, traverses the atmosphere with a velocity depending on the circumstances of

the eclipse and the latitude of the place of observation ; it usually lies between 1,100 and 6,000 miles per hour, but is greater in extreme cases. The broader meteorological effects, such as the fall of temperature, are obvious, but a detailed study of observations made at past eclipses reveals many interesting facts and some inconsistencies.

On June 29th the sun will rise totally eclipsed at a point in the Atlantic Ocean southwest of Ireland. The belt of totality first touches land at Bardsey Island, and its central line passes over Criccieth, nearly over Snowdon and Colwyn Bay, over Southport, thence crossing northern England to Hartlepool. The width of the belt is about 28 miles in north Wales and 31 miles at Hartlepool. The shadow subsequently crosses the North Sea and enters Norway. The speed of the shadow is 5,400 miles per hour, and the time at which totality occurs is about 5h. 24m. G.M.T. The maximum possible duration of totality is less than 6 minutes for the latitudes of the British Isles and nearly 8 minutes at the equator, but such durations are of the most extreme rarity. The duration this year is only 22 seconds in Wales, and 24 seconds on the east coast. For stations not in the centre of the belt the duration is decreased. The partial phase extends from about 4h. 30m. to 6h. 20m. G.M.T., and the sun's altitude at totality is approximately 10° at the western and 13° at the eastern end of the belt. In London 96 per cent of the sun's disc will be covered.

The influence which the eclipse exercises on solar radiation received depends on a number of factors, but broadly speaking the radiation at any time is proportional to the extent of the unobscured sun. During totality the radiation is negative, i.e., the outgoing radiation from the earth is of measurable amount, having on some occasions exceeded 0.1 gram-calorie per square centimetre per minute. The diffuse sky radiation during totality was estimated on June 8th, 1918, to be of the order of 0.0001 gram-calorie. Light diminution is very gradual in the early partial phases, and very rapid just before totality. During the total phase light is received from two sources, the solar appendages, chiefly the corona, and the partially illuminated atmosphere lying at the moment just outside the umbral shadow. Of these the former is by far the largest contributor, but the illumination from both causes varies with the circumstances of individual eclipses. During a short totality it is in general greater, and on June 29th may be expected to be three or even four times that of the full moon.

The fall of temperature is one of the most clearly defined phenomena, but is influenced by many factors. A table compiled by H. H. Clayton of 12 total eclipses from 1878 to 1905,

after correction for diurnal variation, shows maximum falls varying from 1.5° F. to 8.1° F. The amount of fall varies with the character of the station, being for the eclipses cited 1.5° F. over the open ocean, 3.2° F. on a small tropical island, and 5.5° to 8.1° F. over large land areas. Over land areas the fall shows a latitude effect with a minimum in high latitudes and a maximum at the equator. The recovery of normal values appears to take place simultaneously with the end of the eclipse, in the upper air, over the ocean and on small islands, but is delayed from 1 to $2\frac{1}{2}$ hours after the end of the eclipse in continental situations. The temperature normally begins to fall 20 minutes after first contact, and the minimum occurs from 2 to 20 minutes after totality. Kite meteorograph observations from the "Otaria" in 1905 gave a fall of only 1° F. at 300m. above the Atlantic Ocean. Temperature variation is therefore probably confined to a very shallow layer not exceeding 300m. or 400m. above the earth's surface. At hill stations the fall is usually less than at low level stations, but comparisons are not always consistent.

Changes of vapour pressure are more difficult to distinguish, but there appears to be an increase of vapour pressure up to a time 30 to 50 minutes preceding totality, a minimum pressure at totality, and a second maximum about 30 minutes afterwards. This is characteristic only of stations in or near the total belt, but applies both on the ground and at 300m. The decrease is as large over the ocean as over large land areas. Relative humidity is acted on by opposing factors, the decrease in vapour pressure and the decrease in temperature. Over land areas the relative humidity usually rises to a maximum at the time of minimum temperature through preponderance of the second factor. Dew is often formed on the ground near the time of mid-eclipse. Cloud changes which appear to be definitely associated with the eclipse and also the formation of fog have been noted.

The variation of atmospheric pressure is not conspicuous with ordinary instruments, but observations with these and with microbarographs have produced considerable but not conclusive evidence to show that the eclipse curve has two minima and three chief maxima, the latter occurring at totality and about 75 minutes before and after it. The fluctuation is of the order of 0.2mb.

A diminution in wind velocity is a feature almost as marked as the temperature fall. The minimum usually agrees closely with the time of minimum temperature. There are also strong evidences of maxima represented by gusts of increased velocity occurring 30 to 50 minutes before and 40 to 60 minutes after

totality. The production of winds with definite cyclonic circulation has been observed on some occasions but not on others. The resultant eclipse wind, however, frequently shows a definite succession of changes, with a reversal of direction before and after totality ; it can never be large as the temperature gradient produced by the shadow is comparatively small.

The optical phenomena are of considerable interest ; the colours of sky, clouds and landscape are usually very striking and subject to rapid changes about the time of totality. While the sun is completely obscured the light is of very peculiar quality, and appears to justify adjectives such as "livid" and "unnatural," by which it is usually described. Vitiating of distance estimates is a noticeable feature at this time. The approaching umbral shadow is indigo or blackish, and may be seen, from an elevated position, to pass points at known distances. As it reaches the observer definite pulsations, probably diffraction phenomena, may be observed. The best known of eclipse optical phenomena are the "shadow-bands" These are observed about 5 minutes before totality, and therefore definitely before the umbral shadow has reached the observer, and again after it has left him. The shadow-bands thus have no connexion with the pulsation of the shadow edge. The phenomenon consists of undulating dark bands, separated by light spaces, following one another in a direction usually normal to the tangent to the crests. The bands are visible on the ground, but are best seen if a sheet is laid down, or on snow, or on the walls of white houses. The bands appear to flicker and, while sometimes of considerable regularity, are often very vague and confused. Their speed is also inconstant, varying from about 3 to 25 m.p.h., and, therefore, very much slower than the speed of the moon's shadow. This is one of several facts which have disproved the theory that the bands are diffraction fringes bordering the moon's shadow. The bands were photographed for the first time in 1925 in the United States, and they have been observed up to a height of 3,800m. on sheets hung below manned balloons. The general inference is that they are caused by the diminishing crescent of light penetrating air strata differing in their thermal and hygrometrical conditions, and, therefore, in their refractive power. Other optical phenomena have been observed, and possibly some remain to be discovered.

There are four points which should be noted by intending observers. (1) An open site, free from interference by people, should be selected. (2) It is advisable to secure the services of a friend, as the time is too short to see and do everything oneself. (3) A programme should be planned and adequately rehearsed beforehand. (4) The sun should not be looked at without coloured or smoked glass until totality has actually begun.

For the total phase field glasses without any protection will enhance the spectacle.

In conclusion, may I emphasise the fact that the opportunity afforded next June of seeing a total solar eclipse is literally that of a lifetime. Even if a journey abroad be possible, there will be no such favourable European eclipse as the Spanish one of 1905 for many years to come. Quite apart from the interest of possible meteorological work, the occasion is one of extraordinary beauty, and many people are of opinion that it constitutes the most sublime and awe-inspiring phenomenon that Nature has to offer. The chief of the great solar appendages revealed by a total eclipse is the brilliant greenish or pearly-white corona, which has never been seen or photographed at any other time, and the structure of which varies with the 11-year solar cycle. The scarlet hydrogen prominences are also likely to be well seen in the present state of solar activity. The impressiveness of an eclipse is, however, by no means confined to its astronomical features. The onrush of the great shadow, the fall of temperature, the vivid sky colouration, the effect on birds, animals and flowers, and the strange all-pervading stillness—each of these contributes to form an experience which is both unique and unforgettable. The first ray of returning sunlight strikes the earth like a flash of lightning, and life is re-established. In the words of Professor H. H. Turner, "We have seen a vision and are awake again."

Rainfall Atlas of the British Isles*

By J. FAIRGRIEVE, M.A.

This long-expected atlas has at last appeared. There is probably no subject in which co-operation is so necessary in order that results of even moderate value should be obtained as meteorology, and there is probably no section of meteorology in which co-operation is so vital as is the study of rainfall. If we add that there is no country where that co-operation has been so ungrudgingly given as Great Britain and that this atlas embodies the results of this co-operative work we have the reason for the high value that must be placed on it. It is a summary of the labours of some 10,000 persons in carefully recording observations day by day, and it has a most illuminating introduction by Dr. Mill, a fitting tribute to the carrying out of the work by the man to whom the work owes most. This introduction by the greatest authority on British rainfall is a model of exposition of a most difficult subject.

* See advertisement p. vi.

The complicated circumstances under which the atlas has been issued are all clearly explained in the introduction. Here it is enough to say that the Royal Meteorological Society undertook the preparation of this atlas as the first contribution of the endowment fund to rainfall research, this fund coming to it from the British Rainfall Organization when the latter, with its records, was taken over by the Meteorological Office. The atlas was planned by a committee of the Society and executed under the direction of the late M. de Carle Salter by Dr. John Glasspoole.

In effect the atlas consists of three parts: (1) Three full page maps, on the scale of 60 miles to an inch, showing the rainfall distribution in the average year based on the thirty-five year period, 1881-1915, in the very wet year 1872, and in the very dry year 1887; (2) A series of fifty-six half-page maps showing for each year from 1868 to 1923 the distribution of rainfall expressed as a percentage of the average; (3) Twelve full-page maps showing the distribution of average rainfall for each month of the year for the period 1881-1915. Sections (1) and (3) are really the work of Dr. Mill and Mr. Salter, while the preparation of the maps in section (2) was carried out by Dr. Glasspoole.

The average rainfall map is the pivot on which all the others turn. As has been said it is the average for the thirty-five years 1881-1915, but this is merely the period to which all observations have been reduced. Practically every available piece of evidence has been included in the construction of what is surely the most accurate rainfall map in existence, though on a larger scale parts at least could have been shown more accurately still. About half of the area has been mapped at one time or another by Dr. Mill and Mr. Salter on a scale of two miles to an inch. As one who was privileged to see the methods by which this work was carried on, the reviewer would like to bear testimony to its extraordinary brilliancy and accuracy. A short but extremely interesting paper by Mr. Salter on "the preparation of a rainfall map of the British Isles," published by the Institute of Water Engineers, gives a little insight into the care which was taken and indicates also something of the brilliant intuition which was lost to rainfall research with Mr. Salter's death. Naturally, these large scale maps were utilised in the construction of the average map here produced.

The maps of the wettest and driest years are reproduced as samples of the yearly maps which have been constructed every year since 1868 by the British Rainfall Organization, and as giving an indication of the extremes to which the British Isles are subject, but it is pointed out that 1872 was the wettest year over only half of the area and 1887 the driest year over only two-fifths of the area.

The full-page maps of average rainfall for the months on the scale of 60 miles to an inch "constitute," as Dr. Mill says, "perhaps the most interesting as well as the most beautiful feature of the atlas. They present for the first time a satisfactory picture of the progress of rainfall from month to month in a normal year." It may be doubted, perhaps, whether "normal" is quite the right word. The average annual map is normal in the sense that it cannot differ appreciably from that constructed from observations taken day by day through any other consecutive thirty-five years in the last, or next, few centuries, but it is not so certain that the average rainfall for the months would remain the same; the average map for September is the average for 1881-1915, but probably not for another thirty-five year period. The maps are not only new but they have been constructed on a new principle; isomeric maps for the months were made, and the monthly maps were produced by a very ingenious combination of each isomeric map in turn with the average annual map. The result is that now for the first time accurate monthly maps of rainfall in Britain are available for reference on a scale never before attempted. One cannot easily compare them as one can the smaller maps on one page in the Atlas of Meteorology, and of course the varying lengths of the months make accurate comparison impossible, but these maps state the facts simply, and one cannot have everything.

The second section of fifty-six half-page maps is historical and gives the first accurate presentation of the fluctuation of rainfall over our island for a long period. Like the monthly maps these are based on the average annual map and each shows the variation from the average of the rainfall for a particular year. The jazziness of these comes rather as a shock after the solidity and respectability of the annual and monthly maps. The latter are excellent pieces of work from the cartographic point of view. While retaining the convention that blue stands for water another principle is acted on which is scarcely yet recognised as such, i.e., that in many maps the practical point of departure for measurement is not zero. It is recognised in orographical maps by the use of green and brown to stand for low and high respectively, where the psychological standpoint is somewhere between the two. Here the principle is recognised by giving a touch of purple to the blue shades which represent rainfall above 40 in., or 1,000 mm., on the annual map, and 4 in., or 100 mm., on the monthly maps. The effect is entirely good, strong and simple. The series of annual maps also very naturally recognises the average as the point of departure and uses blue for above and yellow for below the average, but this does not give sufficient range, and the jazz effect is enhanced by using red for departures much below the average and green for departures much above.

Though not unpleasing the effect is startling and distracts attention from the story which the maps tell except in one important point, i.e., that the jazziness when translated into terms of rainfall emphasises the remarkable fact that in such a small area as Great Britain the rainfall has never in 56 years had the same percentage variation all over the country. There are never fewer than five tints of colour, each indicating a 10 per cent variation, and seven or more occur in 60 per cent of the maps. There are two maps which require ten grades and these are almost the inverse of each other, 1880 when the north-west was dry and the southeast wet, and 1921 when the southeast was dry and the northwest wet. But jazz or no jazz these maps are fascinating. There is a curious run of maps with many tints from 1870 till 1883, and another from 1916 onwards; one speculates, too, on the differences which would have been made if the year had run from July to June.

It seems greedy when so much is given to ask for more but it may be suggested that the complement of the historical series of annual maps would be the isomeric series of monthly maps; no doubt they are to be found in the files of the Journal, but there they are rather buried, and in a future edition of the Rainfall Atlas of the British Isles they should certainly find a place even if they are reproduced four on a page. But this is for the future. At present we are delighted with what we have and we do not know which we admire most, the accuracy of the annual map, the cleverness and freshness of the monthly maps, or the march of these delightfully jazzy historical maps. They are all good.

Official Publications

GEOPHYSICAL MEMOIRS—

No. 32. *Hourly Character Figures of Magnetic Disturbance at Kew Observatory, Richmond, 1913-23.* By J. M. Stagg, M.A., B.Sc. (M.O. 286b).

Magnetic character figures (0, 1 and 2) have been assigned to every hour of the eleven years 1913-23, and the figures have been tabulated to show the daily distribution of total and component characters (1's and 2's) in the different months and seasons and for the year. From the hourly figures mean monthly character figures have also been derived, and their annual variation examined. The influence of the sunspot cycle on the diurnal and annual variations of the magnetic characters is investigated.

From the monthly character figures mean annual figures have been derived, which are compared with those derived from the whole-day characters at Kew and Fskdalemuir Observatories,

as well as with those published by the authorities at de Bilt as being internationally representative. The similarity between the last mentioned and the annual means of the Kew hourly characters is very pronounced.

No. 34. *The effect of fluctuations of the Gulf Stream on the distribution of pressure over the eastern North Atlantic and western Europe.* By C. E. P. Brooks, D.Sc. (M.O. 286d).

Tradition ascribes the favourable climate of western Europe to the waters of the Gulf Stream ; that being granted, we may reasonably suppose that fluctuations in the strength of the Gulf Stream play some part in the variations of European weather from year to year and from season to season. This effect is investigated in detail, and is found to be real and appreciable, but complex.

The origin of the Gulf Stream is the warm surface water driven into the Equatorial Current by the north-east and south-east trade winds ; passing through the West Indies or round the Gulf of Mexico, this warm water travels along the American coast to Newfoundland, whence it is driven eastwards by the prevailing westerly winds. From the eastern tropical Atlantic to the west coast of Europe the journey takes a year or fifteen months, and strong trade winds are reflected after this interval in the surface temperatures of the North Atlantic west of Ireland. The effects of the north-east trade differ from those of the south-east trade however, in a way which may be clear by an example. If the north-east trade is unusually strong in January to March of one year, the surface temperature west of Ireland will be high in January to March of the following year, but this effect is transitory, and is succeeded by a rapid fall, so that from April to December the temperature will be below normal. On the other hand, suppose the south-east trade to be above normal from January to March of one year. No effect will be noticed until April of the following year, when the surface temperature will rise, and will remain above normal until December. These differences are due to the shape of the Atlantic, and particularly to the great bulge of West Africa.

It was found that when the North Atlantic is warm, pressure tends to be low near Iceland and Greenland but high over the Azores and western Europe. The relations between the strength of the trade winds and the subsequent pressure over western Europe and the eastern Atlantic were then examined directly, and it was found that a period of strong north-east trade winds tends to be followed twelve months later by high pressure over the Azores and western Europe and by low pressure over Iceland, a combination favourable to westerly winds and mild rather fine weather over Britain. This lasts only for three months, and for the next nine months the opposite effect holds—a tendency for

low pressure and rainy weather over the British Isles. A period of strong south-east trade winds tends to be followed fifteen months later by high pressure over the Azores and western Europe and low pressure over Iceland, and this fine-weather tendency lasts for nine months. The opposite conditions—periods of weak trade winds, have the reverse effects.

The Gulf Stream is modified by conditions in other parts of the Atlantic—in the Gulf of Mexico, the neighbourhood of Bermuda, the Newfoundland Banks, and the mid-Atlantic between Iceland and the Azores, but these modifications are less important than the original impulses due to the trade winds, which are thus shown to be numbered among the makers of British weather.

PROFESSIONAL NOTES—

No. 46. *A Note on Bumpiness at Cranwell, Lincolnshire, during the period 1st December, 1925, to 30th April, 1926.*
By W. H. Pick, B.Sc., and G. A. Bull, B.Sc. (M.O. 273f).

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, April 20th, at 49, Cromwell Road, South Kensington, Sir Gilbert Walker, C.S.I., F.R.S., President, in the chair. A Report of the Committee on Atmospheric and Weather, entitled "The Range of Atmospheric," was introduced by Mr. R. A. Watson Watt, convener of the Committee. The report deals with the distances over which an atmospheric may produce disturbance of broadcast reception. The Committee organised experiments in which observers in the British Isles, Norway, Germany, France, Spain, Morocco and Madeira, recorded disturbance of broadcast talks, while the sources of the atmospheric were identified by wireless position-finding by the organisation set up by the Department of Scientific and Industrial Research on the advice of its Radio Research Board.

Many of the sources were found to lie in regions of meteorological disturbance, and a subsequent report on these meteorological relations is promised. Meanwhile examples are cited of cases in which atmospheric from beyond the Azores disturbed the reception of Daventry's signals in Paris and of London's signals in Aberdeen, and of the disturbance of reception in Spain, France, Madeira, the British Isles and Norway by atmospheric from a thunderstorm at Rome.

The Committee concludes that very many atmospheric are heard at distances exceeding 1,800 miles from their sources, and that the distances may reach at least 4,500 miles.

They find no evidence of the presence of many atmospheric with a short range of disturbing effect.

The presentation of the report was followed by a discussion of great interest, in which the principal speakers were :—Mr. O. F. Brown, Capt. Brunt, Dr. Chree, Mr. D. L. Eckersley, Mr. J. F. Herd, Sir Henry Jackson, Col. Leigh, Sir N. Shaw, Dr. Simpson, Capt. Slee, R.N., and Capt. A. D. G. West.

A special meeting of the Society was held on Thursday, April 28th, when the Rt. Hon. Sir Samuel Hoare, Bart., C.M.G., M.P., the Secretary of State for Air, gave an account of his recent flight to India to a large and appreciative audience.

Correspondence

To the Editor, *The Meteorological Magazine*

Explosion at Butaritari.

The following letter from the Acting District Officer at Butaritari has been received by the courtesy of the Secretary of State for the Colonies.

"I have the honour to inform you that on Friday October 8th, 1926 at about 10.55 a.m. a large explosion followed by vibrating rumbles was heard to the northwest of the Government Station, Butaritari. At the time the sky was clear and the wind slight from the south. It was certainly not thunder and no lightning was seen or reported.

During Friday reports came in from Kuma, Keusa, Tainimaika and Ukiana and on Saturday from Pikati and Makin, of having heard the same explosion and from the same direction.

The cause of this loud explosion aroused great speculation amongst the Europeans and natives and personally I attribute it to a falling meteorite. No peculiar atmospheric disturbances have been witnessed since then.

PHILIP C. SPAIN."

Gilbert and Ellice Islands Colony, Butaritari. October 9th, 1926.

Mammato-Cumulus Cloud at Cranwell, Lincolnshire

The occurrence of mammato-cumulus cloud at Cranwell, Lincs., during the period stretching from January 1st, 1920, to October 12th, 1926, has been analysed, and in view of the rarity of the cloud in question, it is thought that the results of that analysis may not be without interest.

In the period considered there were 35 days upon which the cloud form in question occurred. Taking winter to include the months December to February; spring, March to May; summer,

June to August; and autumn, September to November, the seasonal distribution is shown in the following table:—

Season.	Number of days examined.	Number of days M-cu occurred.	Percentage.
Winter	601	3	0.5
Spring	644	12	1.9
Summer	644	18	2.8
Autumn	588	2	0.3

The table reveals that summer and spring in the order named are the seasons most marked by the occurrence of mammato-cumulus, and that autumn and winter seldom have the cloud.

Of the 35 days upon which mammato-cumulus was observed precipitation occurred at Cranwell on 27, but on only 14 of these days did precipitation occur at the actual time of observation of the cloud. On one of the 14 precipitation days hail occurred, accompanying the cloud, and in one other case within the hour following the occurrence.

On five of the 35 days of occurrence thunder occurred actually at Cranwell, but the *Daily Weather Reports* issued by the Meteorological Office, Air Ministry, show that on 12 of the days storms occurred in either the Midland or Eastern Districts of England, these including the five cases of occurrence at Cranwell.

On 23 of the 35 days of occurrence of mammato-cumulus, cumulo-nimbus was observed at some time or another, and on 15 occasions it both preceded and followed the occurrence of the mammato-cumulus; on five it preceded only, and on three it followed only.

In three cases line-squalls occurred at Cranwell within the hour preceding the noting of the mammato-cumulus cloud. In no other case did line-squalls occur at any time during the day of the appearance of mammato-cumulus.

With regard to the map conditions prevailing, 25 of the 35 cases could be definitely associated with the rears of depressions, eight with the fronts of depressions, one with a col, and one with an anticyclone, occurring right in the centre of the system.

WILLIAM H. PICK.

G. A. WRIGHT.

R.A.F. Cadet College, Cranwell, Sleaford, Lincs. October 19th, 1926.

Errata

April, 1927, page 72, line 33. For "27th," read "28th," and for "29th," read "30th."

Millibar Barograph Charts

To those who use charts reading in millibars on the recording barometers, it may be of interest to know that I have this week received from a well-known foreign firm of instrument makers a sample of a "millibar" chart in which approximately 25.4 "millibars" are made to correspond to a pressure of "one inch of mercury." The chart appears to be a millimetre chart which has been re-numbered so that the 1,000 "millibar" line is almost in the correct position. If these charts have been supplied to anyone and used with the common type of barograph, for which instruments the charts are apparently intended, large errors may result. It may be noted that if we take 750 millimetres to correspond to 1 bar, which is a fairly close approximation, millimetres may easily be converted into millibars by multiplying the former by four-thirds.

S. MORRIS BOWER.

Langley Terrace, Huddersfield. January 6th, 1927.

NOTES AND QUERIES

The Mississippi Floods

The flood danger, present every spring in the valley of the Mississippi, has at last materialised into a disaster of the first magnitude. The stage for such a disaster was set many years ago, when the great river, which for ages had wandered at large over a level plain more than a hundred miles across, was confined within bounds by a system of levees. It bears great quantities of silt, and this, formerly spread over a wide area, was now deposited on the actual river bed, raising it gradually. The levees were raised in turn and finally the river became a sort of elevated aqueduct, the upper surface of the water in time of flood being many feet above the surrounding country. The pressure of this mass of water is enormous, and, should a levee break beneath it, the low country would be quickly flooded.

Over the greater part of the enormous Mississippi drainage, the rains of September, 1926, were excessive; in the central valleys the amount of rain was the greatest ever measured in September and in some places the greatest ever measured in any one month. Many rivers were consequently in flood. October again had rainfall above normal though not to the marked extent of September. In November the precipitation was above normal in the northern and eastern States, but not in the southern.

The *Monthly Weather Review* for December, 1926, published by the U.S. Weather Bureau, mentions the "general and disastrous floods in the southern streams tributary to the Ohio

River, an unprecedented occurrence within the last 54 years." The chief rivers affected in December were the Cumberland and the Tennessee. The immediate causes of the floods were two periods of excessive rainfall, December 20th—21st and December 24th—25th, following on moderate to heavy rain from December 8th—13th. Over the drainage area of the Cumberland River an average of 4.25 inches fell on December 20th—21st, and of 3.5 inches on December 24th—25th. The area most affected was from Carthage to Nashville, Tenn., the crest of the flood was 19 feet above flood stage at Carthage and 16 feet at Nashville. Much of the city of Nashville was under water. Corresponding rises occurred in the Ohio River and by the end of December part of it was in flood.

Although over most of the United States January, 1927, was an exceptionally dry month, the Ohio valley again had a rainfall in excess of the normal, and towards the end of the month the river was in flood as far up as Pittsburg. The effect of the rain was aggravated by the prevailing high temperatures melting the snow and ice. The Cumberland and Tennessee rivers had receded, but the northern tributaries of the Ohio were generally in flood though not seriously.

During February and March rain fell in part (or the whole) of the affected area—the valleys of the Lower Mississippi and Ohio—on 14 and 17 days respectively. On February 12th and 13th rain fell over a large area in association with a series of small depressions. On the 13th some local falls were very heavy, 4.32 inches being recorded at New Orleans. Again on the 18th a deep depression, centred over the south-west corner of Kansas, caused general rainfall including a local very heavy fall of 6.88 inches at Vicksburg, Miss. A depression moving in a north-easterly direction across the centre of the United States on March 11th—12th caused moderate to heavy rain over a large area. On the 11th 4.86 inches fell at Nashville and on the 12th 3.76 inches fell at Vicksburg and 3.16 inches at Nashville.

At the end of March the tables of River Stages given in the U.S. Daily Weather Reports show that the Ohio was in flood from Evansville, Ind., to Cairo, Ill., and the Lower Mississippi was in flood from Memphis, Tenn., to New Orleans.

Rain was plentiful in April, moderate falls occurring nearly every day. Very heavy rain fell locally from 13th—15th; 3.34 inches fell on the two days 13th and 14th at Fort Smith, Ark., 3.10 inches fell at Little Rock, Ark., and 6.41 inches were reported from Alexandria, La., on the 14th. On the 15th 3.80 inches fell at Memphis, and on the same day New Orleans was flooded by a fall of 14 inches. During the eight weeks ending April 26th Memphis had had 25.5 inches of rain, Little Rock 21.4 inches, and New Orleans 20.7 inches.

The tables of River Stages during April show the Mississippi from Cairo to New Orleans rising steadily. Levees were breached at Dorena on the 17th and at St. John's Bayou, near New Madrid, on the 19th, and a levee near Greenville gave way on the 21st. The Missouri reached flood stage at St. Louis on the 4th and at Kansas City on the 19th. The Arkansas River reached flood stage at Fort Smith on the 14th and on the 15th it had risen another 14 feet. Probably the heavy rains of the 13th-15th were partly responsible for this sudden large rise. Flood stage at Little Rock was reached on the 15th and on the 20th a levee near Little Rock was breached. At the time of writing the crest of the flood is approaching New Orleans, and a wide breach has been dynamited in the levees below that town in hopes of saving it, but with what success remains to be seen.

The Great Storm of 1703

Mr. H. Harries, in a communication which is too long to print in full, takes exception to some of the suggestions made in the article on "The Great Storm of 1703," which appeared in the *Meteorological Magazine* for March. Unfortunately Mr. Harries' article to which I referred briefly did not come to my notice until my own was in proof, and in my attempt to reconstruct the meteorological situation of the day I was unable to give adequate consideration to all the facts which Mr. Harries had extracted from Admiralty logs preserved in the Public Record Office and other sources. In the light of these facts some of the suggestions made require to be modified. Incidentally, it is gratifying to find that De Foe's remark that the "sea was swept clear of shipping" need not be taken literally in so far as the King's ships are concerned. The winds off the Yorkshire coast appear to have been westerly on November 27th and not easterly as suggested by the closed isobars on the map which accompanied my article. Readers who are interested should refer to Mr. Harries' article which appeared in the *Cornhill Magazine* for November, 1897.

C.E.P.B.

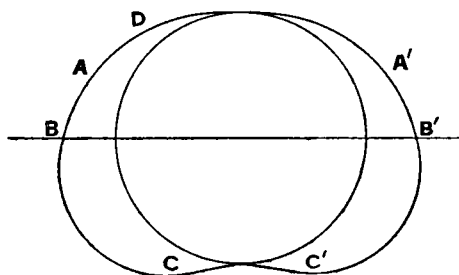
A halo with brilliant arcs of contact, April 2nd, 1927

On the morning of April 2nd, 1927, a halo of 22° with both upper and lower arcs of contact was observed at South Farnborough and at Croydon, as well as at Kew Observatory.

Mr. C. C. Newman reports that at South Farnborough the halo was first observed at 10h. 30m. G.M.T. and the phenomenon continued until 11h. om., when the sun was obscured from view by low clouds. At Croydon the commencement of the halo was

observed by Mr. J. G. Goodyear at 10h. 45m. and was visible at that time only as bright patches of colour above and below the sun. By 11h. the complete halo and two arcs were visible, all brightly coloured. A similar development was observed at Kew Observatory a few minutes later, and here also the phenomenon was soon obscured by low cloud. The height of the sun at 10h. 30m. was about 39° , at 11h. about 41° , so that it is of interest to compare the observations with Pernter's diagram for the circumscribing halo computed for the case in which the sun is 40° above the horizon. The computation is based on the assumptions that the phenomenon is due to the refraction of light through ice crystals in the form of hexagonal prisms, and that the crystals tend to settle down with their axes horizontal.

The diagram (Pernter-Exner, 2nd Edition, Fig. 154, p. 391) is reproduced herewith. The letters are not in the original.



The South Farnborough observer says "the upper arc of contact appeared to be a portion of an ellipse. The semi-major axis of the ellipse was about 30° . The lower arc of contact appeared to be a portion of a circle of diameter 22° ."

The observer's sketch shews that the arcs AA', CC' of Pernter's diagram were seen.

At Croydon "the top arc was visible on either side down to points level with the sun's disc, but the lower, though definitely an arc bent away from the halo, was visible on either side for only a short distance. The semi-major axis of the ellipse of which the top arc of contact formed a part was about 29° ." In this case the arcs seen were apparently BB' and CC'.

At Kew the upper arc was clearer on the west than on the east, so that we saw DA' and CC'. I tried to see some faint illumination connecting the upper and lower arcs, but I could not detect any. On theoretical grounds, the illumination should be very weak indeed. The upper and lower arcs were so well developed on this occasion that I should doubt whether conditions could have been much more favourable. It seems unlikely that the complete heart-shaped circumscribing halo computed for the solar elevation 40° can ever be observed.

F. J. W. WHIPPLE.

Catalogue of Scientific Instruments published by Short & Mason, Ltd.

Messrs. Short & Mason's new catalogue which came to hand

recently contains numerous features of interest to the meteorologist. The first section deals with aneroids and opens with a useful article on the construction of aneroids, followed by a table of equivalents of altitudes and pressures, assuming a mean temperature of 50° F. In future editions this table will presumably be replaced or supplemented by the new International table in which account is taken of the normal lapse rate of temperature.

The numerous types of aneroid barometers and barographs made by this well-known firm are well described and illustrated. Frankly, we do not care for the word "stormograph" as a generic name for an aneroid barograph, while the use of the name "micro-barograph" for the improved, open-scale barograph is likely to give rise to confusion with the well-known instrument of that name designed by Shaw and Dines.

The Meteorological Office pattern thermograph is listed on p. 25, where details will also be found of a combined wet and dry bulb instrument on similar lines. In the section on rain-gauges and measures, we welcome the inclusion of the taper-pattern measure now adopted by the Office as the official pattern. Two rain-gauges of the tilting-bucket type, one indicating and the other recording, are listed. We should like to have seen a continuously-recording gauge included, for although bucket gauges may give a considerable amount of interesting information regarding the intensity of rainfall, they do not permit of the tabulation of rainfall duration with accuracy.

Other sections of meteorological interest are those dealing with anemometers (p. 46), airmeters (p. 47), the Campbell-Stokes sunshine recorder (p. 51), meteorological thermometers (p. 60), and charts (p. 68).

'Comparison of Grass Minimum Thermometer Readings at South Farnborough

The following results obtained with grass minimum thermometers at South Farnborough are interesting as an illustration of the variations in grass minimum temperature which can result from a slight difference in exposure. The thermometers were in good agreement when exposed side by side, but when separated in the positions shown on the diagram, they differed appreciably, the difference being always in the same direction, and amounting on occasions to 6° F

It has been suspected for some time that considerable local variation in the ground temperature occurs in the neighbourhood of the station at South Farnborough, due to the amount and disposition of trees, shrubs, &c., and to the patchy nature of the very prevalent fog, but such differences as these now

recorded were hardly expected from exposures only fourteen feet apart, and apparently not differing greatly in character.

The season at which the observations were made, however, would certainly accentuate any difference due to exposure, for surrounding trees were still in full leaf although ground frosts were being recorded.

Date.	Position A.	Position B.	A—B.	Date.	Position A.	Position B.	A—B.
	°F	°F	°F		°F	°F	°F
Oct. 1st	34	28	6	Oct. 20th	31	25	6
2nd	44	40	4	21st	33	28	5
3rd	42	37	5	22nd	35	32	3
4th	46	42	4	23rd	25	20	5
5th	53	51	2	24th	24	19	5
6th	47	42	5	25th	33	31	2
7th	46	42	4	26th	32	29	3
8th	44	39	5	27th	26	24	2
9th	41	35	6	28th	37	34	3
10th	39	37	2	29th	39	39	0
11th	34	28	6	30th	36	35	1
12th	41	37	4	31st	31	29	2
13th	49	48	1				
14th	51	48	3	Nov. 1st	23	19	4
15th	45	43	2	2nd	38	37	1
16th	42	41	1	3rd	32	29	3
17th	41	39	2	4th	33	29	4
18th	24	22	2	5th	45	45	0
19th	22	17	5	6th	38	36	2

If the difference column (A—B) is plotted against temperatures in position B, a very irregular sequence of points is obtained. If the mean values of the difference are used, where the same temperature occurs more than once in column B, a more regular sequence is obtained, which indicates roughly that the difference increases the lower the ground temperature becomes. But the irregularity of the single observation points suggests that other factors, such as local eddies in the immediate vicinity of the thermometers, play a part in determining the temperature recorded.

E.T.

Review

Nature Notes for Ocean Voyagers. By Captain A. Carpenter, A.M., D.S.O., R.N. ; and Captain Sir David Wilson Barker, R.D., R.N.R. Size 9×6 pp. xi.+212, *illus.* London : C. Griffin & Co., Ltd., 1926, 10s. 6d. *net.*

This, the second edition of *Nature Notes for Ocean Voyagers*,

will be welcomed by all those who go down to the sea in ships. Many of the chapters in this new edition have been completely revised and others have been added together with many new illustrations. The authors are careful to point out that the book has been written particularly for ocean voyagers who have no knowledge of the "wonders of the deep," and not for those who wish to do some work for science and already have some knowledge of the ocean and the plants and animals living therein. In the opinion of the writer of this review, who has himself spent 25 years at sea, the authors are too modest, for the book contains a mass of information of interest not only to those who have little knowledge of the sea but to sailors and others of a more scientific bent.

It is written in a popular form and delightfully illustrated and gives a comprehensive survey of the phenomena and conditions of life in the ocean's depths and on the surface of the sea.

The authors have both spent a great part of their lives afloat and have been in intimate association with the life about which they write and many of the notes are based on personal observation. They describe the general conditions of the sea, its circulation and temperature, and the methods by which the ocean depths have been explored. Life in the ocean is fully discussed and some interesting notes given on the habits and development of fish and of birds and reptiles frequently seen on an ocean voyage. Some remarkable photographs illustrate these chapters. The chapter on whales and other mammals has been completely revised and an endeavour made to describe them correctly under the many names they have—thrilling stories are related of the power and ferocity occasionally displayed by these monsters of the deep.

No book written particularly for ocean voyagers would be complete without a chapter on weather, for their comfort, if not safety, depends on it. We find here a description of pressure and winds over the different oceans of the world, a table of seasons of tropical storms; a diagram showing a variety of weather types, and some interesting cloud studies. An excellent photograph of a cloud shadow and a remarkable illustration of a waterspout are also given.

A chapter on waves follows, with some exceedingly good illustrations of rough seas. Sir David W. Barker has made a study of the subject and he can therefore speak with some authority. Other subjects dealt with in the book are: Plant Life and Seaweed, Boring and Surface destructive animals, Light and phosphorescence and Coral.

The volume ends with descriptions of mythical sea monsters and old sea customs, a chapter on the mysteries of the deep in which is recalled the story of the "Marie Celeste," a ship found

at sea under full sail without a soul on board. With the many additional notes and chapters and a full and complete index, the second edition of this book is undoubtedly an advance on the former edition and is altogether a most fascinating little volume.

L. G. G.

News in Brief

Group Captain P. F. M. Fellowes, Director of Airship Development, accompanied by Mr. M. A. Giblett, Superintendent of Airship Meteorology, left England this month for South Africa, Australia and New Zealand, to discuss the erection of mooring masts for the use of the new Empire airships.

We learn from *The Times* that the Council of the Royal Aeronautical Society has decided to award the Society's gold medal to Dr. L. Prandtl, of Gottingen University, in recognition of his work on aerodynamics. The medal will be presented on May 16th when Dr. Prandtl will deliver the fifteenth Wilbur Wright memorial lecture.

The Weather of April, 1927

The weather of April, 1927, can be divided into three definite periods—unsettled, then fine and warm, and lastly fair but cold.

On the 9th thunderstorms accompanied by heavy hail occurred in London. At Hampstead hail lay 1 inch thick on the ground and in drifts the depth was 3 inches. Northerly winds with lower temperatures prevailed for a few days, but by the 12th the southern districts came under the influence of an anticyclone to the south-west of the British Isles and temperatures rose to 60°F. and over. In the northern districts however the weather was changeable and showery. Rain fell generally in the south of England on the night of the 14—15th, and on the 15th and 16th day temperatures failed to rise above 55° F. Conditions gradually improved over the week-end and fair warm weather was experienced in England during most of the next week. The highest temperatures occurred on the 21st when 70° F. was recorded at some stations. In the rear of a depression which passed north-eastwards towards Scandinavia however the winds became northerly and temperatures fell considerably on the 23rd. Showers of hail and snow fell in Scotland and northern England. The weather continued cold though sunny until the end of the month.

The total rainfall for the month varied considerably ; Storno-

way had 164 mm. (6·5 in.) or 87 mm. (3·4 in.) more than the average, Valentia had only 35 mm. (1·38 in.) being 58 mm. (2·3 in.) less than the average. At Kew the total for the first nine days amounted to rather more than the average for April, but the following three weeks were so dry that the whole month only showed an excess of 6 mm. (.24 in.).

Pressure was below normal over northern Europe and the North Atlantic north of 52° N., the greatest deficit being 15·1 mb. at Rost in Norway; the deficit of 8 mb. in southern Sweden is the greatest on record in April. Pressure was above normal over Europe and the North Atlantic south of this latitude, the excess reaching 5 mb. between Corunna and Madrid. Temperature was about normal except at Spitsbergen where it was 8° F. below. Rainfall was generally near normal, but was 50 per cent. above in parts of Sweden (Gothland and eastern Svealand).

Towards the end of the month floods occurred in northern Germany, the Oder, the Elbe and the Havel all being over their banks. On the 12th and 13th the worst "levanter" storm for many years raged in the western Mediterranean. In the harbour of Melilla four ships were wrecked, and in the town several houses collapsed; at Malaga torrents of red rain fell, and the east coast of Spain suffered damage from the waves.

Thousands of acres were reported to be flooded in Manitoba, and the floods in the Mississippi area reached disastrous proportions before the end of the month (see p. 89). On the night of the 12th-13th a tornado wrecked the town of Rock Springs, Texas, and on the night of the 18th-19th tornadoes passed over Kansas, Oklahoma, Texas and Missouri.

On the 15th and 16th very heavy rains fell in the coastal districts of Australia from Sydney to Newcastle. At some of the resorts in the Blue Mountains the falls exceeded 11 in. in 48 hours.

The special message from Brazil states that the rainfall in the northern districts was 64 mm. above normal, and that it was below normal in the central and southern districts by 77 mm. and 36 mm. respectively. Crops were generally in good condition, except the vegetables in the central and southern regions. Pressure changes were frequent. At Rio de Janeiro the pressure was 0·8 mb., and the temperature 0·9° F. above normal.

Rainfall, April, 1927—General Distribution

England and Wales	..	107	} per cent. of the average 1881-1915.
Scotland	.. ..	145
Ireland	.. ..	69
British Isles	.. ..	107

Rainfall: April, 1927: England and Wales

CO.	STATION.	In.	mm.	Per- cent. of Av.	CO.	STATION.	In.	mm.	Per- cent. of Av.
<i>Lond.</i>	Camden Square	2.02	51	131	<i>War.</i>	Birmingham, Edgbaston	1.50	38	86
<i>Sur.</i>	Reigate, The Knowle ..	2.13	54	137	<i>Leics.</i>	Thornton Reservoir ..	1.74	44	102
<i>Kent.</i>	Tenterden, Ashenden ..	1.64	42	101	"	Belvoir Castle	1.94	49	127
"	Folkestone, Boro. San.	...	...	...	<i>Rut.</i>	Ridlington	1.95	50	...
"	Margate, Cliftonville ..	1.42	36	105	<i>Linc.</i>	Boston, Skirbeck	2.37	60	176
"	Sevenoaks, Speldhurst ..	2.04	52	...	"	Lincoln, Sessions House	1.61	41	116
<i>Sus.</i>	Patching Farm	2.19	56	125	"	Skegness, Marine Gdns.	1.61	41	120
"	Brighton, Old Steyne ..	1.72	44	106	"	Louth, Westgate	2.01	51	120
"	Tottingworth Park	2.18	55	118	"	Brigg	2.25	57	143
<i>Hants.</i>	Ventnor, Roy. Nat. Hos.	1.79	45	107	<i>Notts.</i>	Workshop, Hodsock	1.76	45	120
"	Fordingbridge, Oaklands	2.29	58	125	<i>Derby</i>	Mickleover, Clyde Ho.	2.46	62	142
"	Ovington Rectory	2.24	57	119	"	Buxton, Devon. Hos. ..	4.16	106	141
"	Sherborne St. John	1.93	49	109	<i>Ches.</i>	Runcorn, Weston Pt. ..	2.57	65	148
<i>Berks.</i>	Wellington College	1.59	40	99	"	Nantwich, Dorfold Hall	2.41	61	...
"	Newbury, Greenham	2.14	54	118	<i>Lancs.</i>	Manchester, Whit. Pk.	2.05	52	107
<i>Herts.</i>	Benington House	1.71	43	112	"	Stonyhurst College	3.79	96	140
<i>Bucks.</i>	High Wycombe	1.66	42	106	"	Southport, Hesketh Pk	1.07	27	58
<i>Oxf.</i>	Oxford, Mag. College ..	1.73	44	112	"	Lancaster, Strathspey ..	1.92	49	...
<i>Nor.</i>	Pitsford, Sedgebrook ..	1.55	39	101	<i>Yorks.</i>	Wath-upon-Deerne	1.96	50	124
"	Oundle	1.31	33	...	"	Bradford, Lister Pk. ...	2.69	68	134
<i>Beds.</i>	Woburn, Crawley Mill ..	1.35	34	90	"	Oughtershaw Hall	5.87	149	...
<i>Cam.</i>	Cambridge, Bot. Gdns. ...	...	...	...	"	Wetherby, Ribston H. ...	1.51	38	86
<i>Essex.</i>	Chelmsford, County Lab	1.47	37	115	"	Hull, Pearson Park	2.74	70	176
"	Lexden, Hill House	1.99	51	...	"	Holme-on-Spalding	1.99	51	...
<i>Suff.</i>	Hawkedon Rectory	2.49	63	162	"	West Witton, Ivy Ho. ...	2.41	61	...
"	Haughley House	2.01	51	...	"	Felixkirk, Mt. St. John	1.56	40	...
<i>Norfol.</i>	Beccles, Geldeston	1.46	37	99	"	Pickering, Hungate	2.15	55	...
"	Norwich, Eaton	1.55	39	91	"	Scarborough	2.20	56	141
"	Blakeney	1.66	42	130	"	Middlesbrough	1.41	36	103
"	Swaffham .....	...	...	...	"	Baldersdale, Hury Res.	2.27	58	...
<i>Wilts.</i>	Devizes, Highclere	1.60	41	84	<i>Durh.</i>	Ushaw College	1.60	41	85
"	Bishops Cannings	1.93	49	96	<i>Nor.</i>	Newcastle, Town Moor.	2.05	52	125
<i>Dor.</i>	Evershot, Melbury Ho. ...	2.03	52	86	"	Bellingham, Highgreen	2.23	57	...
"	Crech Grange	2.63	67	...	"	Lilburn Tower Gdns. ...	1.36	35	...
"	Shaftesbury, Abbey Ho. ...	1.70	43	80	<i>Cumb.</i>	Geltsdale	2.54	65	...
<i>Devon.</i>	Plymouth, The Hoe	2.29	58	101	"	Carlisle, Scaleby Hall ..	...	...	...
"	Polapit Tamar	2.20	56	94	"	Seathwaite M.	13.01	330	175
"	Ashburton, Druid Ho. ...	2.81	71	92	<i>Glam.</i>	Cardiff, Ely P. Stn.	1.95	50	77
"	Cullompton	2.12	54	93	"	Treherbert, Tynywaun	3.87	98	...
"	Sidmouth, Sidmount	1.98	50	93	<i>Carm.</i>	Carmarthen Friary	2.09	53	76
"	Filleigh, Castle Hill	2.83	72	...	"	Llanwrda, Dolaucothy.	3.31	84	100
"	Barnstaple, N. Dev. Ath.	1.92	49	91	<i>Pemb.</i>	Haverfordwest, School	1.98	50	76
<i>Corn.</i>	Redruth, Trewirgie	2.49	63	86	<i>Card.</i>	Gogerddan	2.88	73	110
"	Penzance, Morrab Gdn.	3.09	79	127	"	Cardigan, County Sch. ...	2.02	51	...
"	St. Austell, Trevarna ..	3.32	84	118	<i>Brec.</i>	Crickhowell, Talymaes	2.00	51	...
<i>Soms.</i>	Chewton Mendip	2.45	62	82	<i>Rad.</i>	Birm. W. W. Tyrmynydd	3.86	98	105
"	Street, Hind Hayes	1.50	38	...	<i>Mont.</i>	Lake Vyrnwy	3.46	88	115
<i>Glos.</i>	Clifton College	1.28	33	60	<i>Denb.</i>	Langynhafal	1.83	46	...
"	Cirencester, Gwynfa ..	1.63	41	87	<i>Mer.</i>	Dolgelly, Bryntirion ..	4.30	109	118
<i>Here.</i>	Ross, Birchlea	1.17	30	62	<i>Carn.</i>	Llandudno	1.13	29	62
"	Ledbury, Underdown	1.29	33	71	"	Snowdon, L. Llydaw 9	8.37	213	...
<i>Salop.</i>	Church Stretton	1.99	51	92	<i>Ang.</i>	Holyhead, Salt Island.	.81	21	39
"	Shifnal, Hatton Grange	1.27	32	76	"	Lligwy	1.07	27	...
<i>Staff.</i>	Tea, The Heath Ho. ....	...	...	...	<i>Isle of Man</i>				
<i>Worc.</i>	Ombersley, Holt Lock ..	1.17	30	77		Douglas, Boro' Cem. ...	1.76	45	72
"	Blockley, Upton Wold ..	1.94	49	100	<i>Guernsey</i>				
<i>War.</i>	Farnborough	2.25	57	115		St. Peter P't. Grange Rd	2.45	62	122

Rainfall: April, 1927: Scotland and Ireland

CO.	STATION	In.	mm.	Per- cent. of Av.	CO.	STATION.	In.	mm.	Per- cent. of Av.
<i>Wigt.</i>	Stoneykirk, Ardwell Ho	1.98	50	94	<i>Suth.</i>	Loch More, Achfary...	15.37	390	317
<i>"</i>	Pt. William, Monreith.	1.94	49	...	<i>Caith.</i>	Wick	4.21	107	212
<i>Kirk.</i>	Carsphairn, Shiel.	5.90	150	...	<i>Ork.</i>	Pomona, Deerness	6.10	155	295
<i>"</i>	Dumfries, Cargen	2.58	66	97	<i>Shet.</i>	Lerwick	6.03	153	264
<i>Roxb.</i>	Bransholme	1.57	40	83					
<i>Selk.</i>	Ettrick Manse	3.24	82	...	<i>Cork.</i>	Caheragh Rectory	2.07	53	...
<i>Berk.</i>	Marchmont House	1.82	46	90	<i>"</i>	Dunmanway Rectory.	1.60	41	39
<i>Hadd.</i>	North Berwick Res. ....	.70	18	50	<i>"</i>	Ballinacurra	1.52	39	59
<i>Midl.</i>	Edinburgh, Roy. Obs. ...	1.60	41	116	<i>"</i>	Glanmire, Lota Lo. ...	1.29	33	46
<i>Lan.</i>	Biggar .....	...	...	...	<i>"</i>	Glanmire, Lota Lo. ...	1.29	33	46
<i>"</i>	Leadhills	5.13	130	...	<i>Kerry</i>	Valentia Obsy.	1.37	35	37
<i>Ayr.</i>	Kilmarnock, Agric. C. ...	3.31	84	161	<i>"</i>	Killarney Asylum.	1.29	33	39
<i>"</i>	Girvan, Pinmore	3.27	83	110	<i>"</i>	Darrynane Abbey	1.75	44	51
<i>Renf.</i>	Glasgow, Queen's Pk. ...	2.27	58	115	<i>Wat.</i>	Waterford, Brook Lo. ...	1.25	32	49
<i>"</i>	Greenock, Prospect H. ...	4.10	104	113	<i>Tip.</i>	Nenagh, Cas. Lough. ...	1.95	50	78
<i>Bute.</i>	Rothsay, Ardenraig.	4.76	121	160	<i>"</i>	Roscrea, Timoney Park	1.61	41	...
<i>"</i>	Dougarie Lodge	2.91	74	...	<i>"</i>	Cashel, Ballinamona ..	1.24	31	50
<i>Arg.</i>	Ardgour House	13.08	332	...	<i>Lim.</i>	Foynes, Coolnanes	1.98	50	81
<i>"</i>	Manse of Glenorchy. ...	...	...	...	<i>"</i>	Castleconnell Rec.	1.53	39	...
<i>"</i>	Oban	4.95	126	...	<i>Clare</i>	Inagh, Mount Callan ..	3.12	79	...
<i>"</i>	Poltalloch	4.94	125	164	<i>"</i>	Broadford, Hurdlest'n.	1.55	39	...
<i>"</i>	Inveraray Castle	7.26	184	158	<i>Wexf.</i>	Newtownbarry	1.42	36	...
<i>"</i>	Islay, Eallabus	4.14	105	144	<i>"</i>	Gorey, Courtown Ho. ...	1.87	47	85
<i>"</i>	Mull, Benmore	15.00	381	...	<i>Kilk.</i>	Kilkenny Castle .....	.85	21	39
<i>Kinr.</i>	Loch Leven Sluice ....	.99	25	52	<i>Wic.</i>	Rathnew, Clonmannon	1.16	29	...
<i>Perth</i>	Loch Dhu	5.10	130	108	<i>Carl.</i>	Hacketstown Rectory .	1.34	34	51
<i>"</i>	Balquhadder, Stronvar. ...	3.94	100	...	<i>QCo.</i>	Blandsfort House	1.25	32	48
<i>"</i>	Crieff, Strathearn Hyd. ...	1.42	36	65	<i>"</i>	Mountmellick	1.79	45	...
<i>"</i>	Blair Castle Gardens ..	2.01	51	95	<i>KCo.</i>	Birr Castle	1.54	39	72
<i>Forf.</i>	Kettins School	1.41	36	85	<i>Dubl.</i>	Dublin, FitzWm. Sq. ...	1.23	31	65
<i>"</i>	Dundee, E. Necropolis. ...	.96	24	56	<i>"</i>	Baibriggan, Ardgillan .	1.12	28	57
<i>"</i>	Pearsie House	1.24	31	...	<i>Me'th</i>	Beauparc, St. Cloud ..	1.10	28	...
<i>"</i>	Montrose, Sunnyside ..	1.47	37	81	<i>"</i>	Kells, Headfort	1.16	29	46
<i>Abcr.</i>	Braemar, Bank	1.85	47	78	<i>W.M.</i>	Moate, Coolatore	1.48	38	...
<i>"</i>	Logie Coldstone Sch.	2.38	60	118	<i>"</i>	Mullingar, Belvedere .	1.54	39	65
<i>"</i>	Aberdeen, King's Coll. ...	2.35	60	126	<i>Long</i>	Castle Forbes Gdns. ...	1.39	35	58
<i>"</i>	Fyvie Castle	3.87	98	...	<i>Gal.</i>	Ballynahinch Castle ...	3.33	85	94
<i>Mor.</i>	Gordon Castle	2.80	71	160	<i>"</i>	Galway, Grammar Sch.	1.84	47	...
<i>"</i>	Grantown-on-Spey	3.83	97	194	<i>Mayo</i>	Mallaranny	4.05	103	...
<i>Na.</i>	Nairn, Delnies	2.10	53	140	<i>"</i>	Westport House	2.07	53	77
<i>Inv.</i>	Ben Alder Lodge	3.88	99	...	<i>"</i>	Delphi Lodge	5.60	142	...
<i>"</i>	Kingussie, The Birches	3.52	89	...	<i>Sligo</i>	Markree Obsy.	1.89	48	71
<i>"</i>	Loch Quoich, Loan ....	...	...	...	<i>Cav'n</i>	Belturbet, Cloverhill. .	1.48	38	65
<i>"</i>	Glenquoich	13.68	347	210	<i>Ferm</i>	Enniskillen, Portora ..	1.82	46	...
<i>"</i>	Inverness, Culduthel R. ...	1.97	50	...	<i>Arm.</i>	Armagh Obsy.	1.32	33	63
<i>"</i>	Arisaig, Faire-na-Squir	...	...	...	<i>Down</i>	Fofanny Reservoir ...	3.05	77	...
<i>"</i>	Fort William	9.43	240	211	<i>"</i>	Seaforde	1.88	48	72
<i>"</i>	Skye, Dunvegan	6.11	155	...	<i>"</i>	Donaghadee, C. Stn. ...	1.26	32	63
<i>"</i>	Barra, Castlebay	3.31	84	...	<i>"</i>	Banbridge, Milltown .	1.31	33	64
<i>R&C</i>	Alness, Ardross Cas. ...	3.27	83	135	<i>Antr.</i>	Belfast, Cavehill Rd. .	1.68	43	...
<i>"</i>	Ullapool	8.02	203	...	<i>"</i>	Glenarm Castle	2.68	68	...
<i>"</i>	Torricon, Bendamph. ...	11.43	290	219	<i>"</i>	Ballymena, Harryville	2.54	65	96
<i>"</i>	Achnashellach	12.82	325	...	<i>Lon.</i>	Londonderry, Creggan	2.47	63	96
<i>"</i>	Stornoway	6.47	164	213	<i>Tyr.</i>	Donaghmore	1.78	45	...
<i>Suth.</i>	Lairg	5.23	133	...	<i>"</i>	Omagh, Edenfel	1.75	44	67
<i>"</i>	Tongue Manse	4.97	126	190	<i>Don.</i>	Malin Head	2.94	75	149
<i>"</i>	Melvich School	3.61	92	155	<i>"</i>	Dunfanaghy	3.19	81	118
					<i>"</i>	Killybegs, Rockmount.	4.69	119	130

Climatological Table for the British Empire, November, 1926

STATIONS	PRESSURE		TEMPERATURE							Rela- tive Humi- dity	Mean Cloud Am't	PRECIPITATION		BRIGHT SUNSHINE		
	Mean of Day M.S.L.	Diff. from Normal	Absolute	Mean Values					Days			Diff. from Normal	Am't	Days	Hours per day	Per- cent- age of possi- ble.
				Max.	Min.	1 max. and 1/2 min.	Diff. from Normal	Mean								
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	%	0-10	mm.	mm.				
London, Kew Obsy.	1003.6	-11.0	56	29	50.0	40.3	45.1	+1.1	89	8.1	130	74	20	1.4	15	
Gibraltar	1016.0	-2.0	70	46	64.1	52.1	58.1	-2.4	82	5.0	153	9	17	6.3	62	
Malta	1017.2	+0.7	77	56	72.1	65.2	68.7	+4.8	85	5.4	94	3	7			
St. Helena	1013.1	+1.7	65	53	60.2	54.3	57.3	-2.8	92	4.2	49	6	20			
Sierra Leone	1011.2	+0.3	90	69	86.5	73.6	80.1	-1.1	83	6.3	151	21	15			
Lagos, Nigeria	1008.5	-2.3	89	70	86.9	74.4	80.7	-0.7	81	7.7	139	73	8			
Kaduna, Nigeria	1013.8	+2.5	94	50	90.4	60.8	75.6	-0.6	45	2.0	1	2	1			
Zomba, Nyasaland	1016.1	+1.1	94	47	87.0	56.8	71.9	-3.6	62	5.8	70	60	9			
Salisbury, Rhodesia	1009.2	-0.6	92	52	84.7	59.0	71.9	+1.2	50	4.4	33	61	9	7.3	57	
Cape Town	1016.9	+1.1	93	46	73.9	55.6	64.7	+0.3	66	3.3	12	15	4			
Johannesburg	1016.9	...	84	45	74.6	52.2	63.4	-0.1	62	4.4	120	6	14	8.3	62	
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	88	39	78.4	57.1	67.7	-0.7	68	4.0	83	25	10			
Calcutta, Alipore Obsy.	1013.4	+0.1	87	56	81.9	62.6	72.3	-0.8	76	3.1	0	17	0*			
Bombay	1011.4	-0.6	94	68	87.3	72.5	79.9	-0.6	71	1.4	0	11	0*			
Madras	1011.6	+0.3	89	60	84.9	70.0	77.5	-1.4	73.7	6.5	310	52	6*			
Colombo, Ceylon	1009.7	-0.4	92	67	86.6	73.0	79.8	-0.1	76.4	6.0	260	19	15	7.2	61	
Hongkong	1017.7	+0.1	83	61	73.4	65.0	69.2	-0.4	63.4	6.9	126	83	3	6.8	62	
Sandakan	...	...	90	73	87.4	75.2	81.3	+0.5	77.0	8.2	310	62	16			
Sydney	1014.3	+0.6	96	52	77.5	59.0	68.3	+1.2	61.3	4.8	3	68	4	9.4	68	
Melbourne	1015.2	+1.0	101	43	72.4	51.7	62.1	+0.8	54.5	6.8	28	28	12	7.1	51	
Adelaide	1017.6	+2.5	100	43	78.6	55.4	67.0	+0.1	56.1	3.8	20	9	7	9.7	70	
Perth, W. Australia	1015.7	+0.4	96	48	76.7	58.0	67.3	+1.3	60.6	5.7	40	20	12	8.4	61	
Ooogardie	1014.1	+1.0	102	48	87.6	59.0	73.3	+2.5	57.4	3.3	7	10	4			
Brisbane	1016.2	+1.7	96	56	82.9	63.7	73.3	-0.3	65.4	3.5	44	49	3	10.2	76	
Hobart, Tasmania	1007.9	-1.5	89	39	66.0	47.5	56.7	-0.5	50.3	6.6	23	41	15	8.8	61	
Wellington, N.Z.	1008.7	-3.4	65	41	61.4	50.7	56.1	-0.8	52.4	5.4	123	34	20	6.7	47	
Suva, Fiji	1011.4	+0.3	87	69	83.4	73.2	78.3	+1.1	74.0	7.8	164	78	19	5.4	42	
Apia, Samoa	1009.9	+0.4	88	72	85.3	75.0	80.1	+1.4	77.5	8.0	361	125	24	5.9	46	
Kingston, Jamaica	1011.9	-0.5	89	69	86.7	71.9	79.3	0.0	70.8	6.4	51	29	7	8.4	74	
Grenada, W.I.	1011.3	+1.0	87	71	84.7	74.8	79.7	+0.4	77.5	8.3	266	53	18			
Toronto	1015.9	-0.9	63	15	43.2	31.6	37.4	+1.1	33.5	5.7	97	22	14			
Winnipeg	1020.4	+3.7	40	-18	22.3	12.2	17.3	-3.5	15.5	8.1	0	24	0	2.1	23	
St. John, N.B.	1018.3	+4.4	57	13	44.9	30.6	37.7	-1.0	34.6	6.3	100	12	16	3.3	35	
Victoria, B.C.	1012.7	-2.8	60	38	51.8	44.2	48.0	+3.6	45.8	7.7	80	84	18	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.