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Growth of Trees in the Forest of Dean in relation to Rainfall.

Mr. E. G. Burtt has kindly supplied several series of measurements of the annual rings of growth of trees in the Forest of Dean. The best and longest series was given by a yew, which grew on a south-west slope overlooking Lower Sondley. The tree was cut in the winter of 1922-23, and proved to be 200 years old. The individual measurements are given in Table I., and smoothed values constructed by taking overlapping five-yearly totals are shown in the uppermost curve of Fig. 1. It will be seen that the tree grew very slowly at the beginning and end of its existence and more rapidly in middle age. There are four periods of most rapid growth; the first and most important occurred from about 1780 to 1800, with a maximum from 1786 to 1792, and the second reached its maximum in 1829 to 1830. The third maximum extended from about 1861 to 1878, but is not very striking; on the other hand, the fourth maximum, which comes at 1899 to 1900, is remarkably sharp and definite. It will be noticed that the lengths of the intervals between these maxima, about 40, 40 and 30 years respectively, give an average of 36-37 years, which is very near that assigned to the Brückner cycle.

Measurements of two oak trees are given, both of which grew on Staple Edge Hill and were cut about 1921. The individual

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measurements are not reproduced here, but the figures smoothed by forming five-yearly totals are shown in Fig. 1. Curves 9A and 9B are from measurements taken at right angles on the same tree—an exceptionally well formed root—9A being along a line due west from the centre and 9B along a line due north. An attempt had been made at some time to burn the stump, and the outer 40 mm., representing about 42 years' growth, were charred. It will be noticed that from 1830 to 1864 the tree grew somewhat more rapidly on the west than on the north side, but that from 1864 to 1883 this condition was reversed, growth being more rapid on the north side of the trunk. The curve labelled 10 represents the second oak tree, which showed no signs of burning. The two curves 9A and 9B are obviously closely related; No. 10 is fairly similar, but the pronounced maximum just before 1840

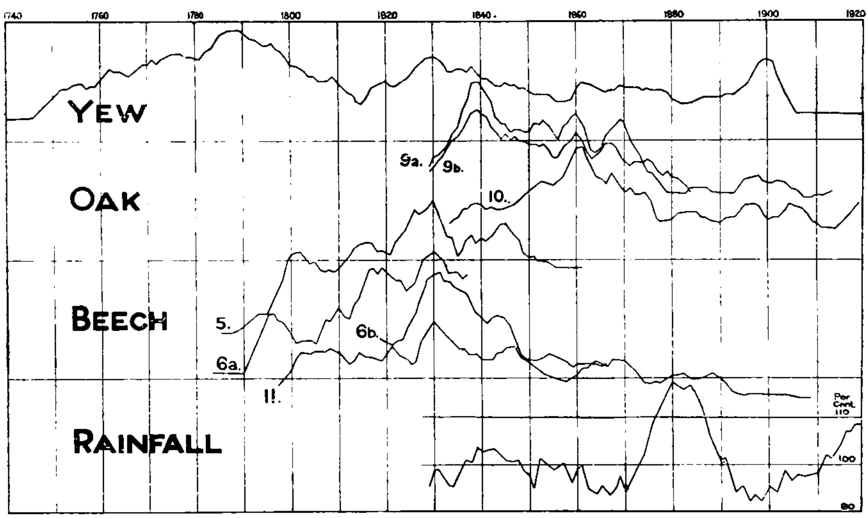


FIG. 1.

is barely represented, and the period of most rapid growth occurred instead about 1860. The most curious point is that these records of oak trees show very little similarity with that of the yew which grew only a short distance away. This is partly due to the much lesser age of the oaks, not one of which was 100 years old, so that the period of slow growth at the beginning of their existence coincides with the full maturity of the yew, and in fact with one of its periods of maximum. It is only when we examine the curves in detail that we can see points of resemblance, in particular the rapid increase of growth-rate about 1860 and the general slow growth from 1880 to 1893. There is a distinct suggestion that the oaks responded more rapidly to changes of weather than the yew, for the curves 9 and 10 are far more irregular than the uppermost curve. The pronounced maximum at 1900 on the latter shows itself as a double maximum on both oak trees, and similarly the small minimum of 1865 on the curve for the yew becomes much more important in the oaks.

Of the beech trees numbers 5 and 6 grew on the Blaize Bailey ridge and No. 11 grew near the yew tree ; the dates of felling are not known, but were probably between 1900 and 1910. The two records 6A and 6B are from measurements along two lines at right angles on the same tree, but the actual directions are not specified. Since the dates of felling were not known exactly, it was necessary to fit the curves together from intrinsic evidence only. This was not difficult so long as only the three beech trees were considered ; the correlation actually adopted seems to be the only possible one. When it came to fixing the age of the trees absolutely, by reference to the yew and oaks of which

TABLE I.—GROWTH OF YEW TREE IN MILLIMETRES.

Years.	0	1	2	3	4	5	6	7	8	9
1740				1·0	1·0	1·0	1·0	1·0	2·0	2·0
1750	2·0	2·0	2·0	3·0	2·0	2·5	2·5	2·0	2·0	2·5
1760	2·5	3·5	3·5	3·0	2·0	2·5	3·0	3·0	4·0	3·0
1770	3·0	3·0	4·0	3·0	4·0	3·5	3·5	4·0	3·0	3·5
1780	3·5	3·0	4·0	4·5	4·0	4·5	5·0	4·5	5·0	4·0
1790	4·5	4·5	3·5	4·5	3·5	4·0	4·5	4·0	3·0	3·0
1800	3·0	3·0	3·5	2·5	2·5	2·0	3·0	2·5	2·5	2·5
1810	3·0	2·0	1·5	1·0	2·0	1·5	1·5	3·0	3·0	2·5
1820	2·0	2·0	2·0	3·0	3·0	2·5	3·0	3·5	4·0	4·0
1830	3·0	3·0	3·0	3·0	2·5	3·0	3·5	3·0	2·5	3·5
1840	2·0	2·0	3·0	2·0	2·5	2·0	2·5	2·5	2·0	2·0
1850	2·0	2·0	2·0	2·0	2·0	2·0	1·0	1·5	2·0	2·0
1860	2·5	3·0	3·0	1·5	2·0	2·0	2·5	2·5	2·0	2·0
1870	3·0	2·0	2·5	2·0	2·0	2·5	2·5	2·0	2·0	2·0
1880	2·0	1·5	1·5	1·5	2·0	2·0	2·0	2·0	2·0	2·0
1890	2·0	2·0	2·5	2·0	2·0	2·5	3·0	3·5	4·0	4·0
1900	3·5	3·0	3·0							

Total growth 1723—32, 8 mm., 1733—42, 9 mm.
,, ,, 1903—12, 14 mm., 1913—22, 14 mm.

the dates of felling are known, it was a different matter, and the dating adopted in drawing Fig. 1 is to be regarded as something of a guess. Like the oaks and the yew, the beech trees grew slowly at the beginning and end of their existence, while the response to changes of climate seems to have been more rapid than that of the yew, but perhaps not quite so rapid as that of the oaks.

For comparison between the rate of tree-growth and the amount of rainfall, Dr. J. Glasspoole has been good enough to calculate a series of rainfall values for the Forest of Dean extending from 1820 to 1920, expressed as a percentage of the normal for the 35 years 1881 to 1915. A comparison of these figures with the annual growths of the yew in Table I. shows that there is little if any relation between the growth in any one year and the rainfall in that year. When we smooth the data over a number of years, there are some indications that heavy rainfall is inimical to the growth of the yew, but with the oak and the beech the relation is still indefinite. The rainfall data, smoothed by forming overlapping ten-year means, are shown in the lowest curve of Fig. 1; following the model of the well-known American investigations into the relation between tree-growth and rainfall the curve has been shifted to the left, in order to compare the tree-growth in any year with the rainfall during the previous ten years. Thus the point where the rainfall curve crosses the vertical line for 1830 shows the rainfall of the years 1821 to 1830, which was 98 per cent. of normal.

The period of rather rapid growth of the yew about 1830 comes at a time when the rainfall curve is low, but the minimum from 1851 to 1859 follows the maximum of the rainfall curve by about ten years. The poorly developed period of maximum growth from 1861 to 1870 fits in fairly well with the minimum of the same years on the rainfall curve, but the outstanding maximum shown by the latter about 1880 to 1883 is only represented by a slight minimum on the curve of tree-growth. On the other hand the pronounced maximum growth about 1900 agrees very well with the minimum on the rainfall curve. The opposition is also shown in Table II., where the total growth of

TABLE II.—COMPARISON OF GROWTH OF YEW TREE WITH RAINFALL

	1826–35	1836–45	1846–55	1856–65	1866–75	1876–85	1886–95	1896–1905	1906–15
Tree growth mm. ...	32	26	21	20·5	23	19	21	28	(14)
	1820–29	1830–39	1840–49	1850–59	1860–69	1870–79	1880–89	1890–99	1900–09
Rainfall per cent. ...	95	104	98	96	98	114	102·5	92·5	98

the yew in successive periods of ten years is compared with the rainfall six years earlier. The most notable feature of this table is that, excluding the years 1906 to 1915, when the slow growth of the tree may be attributed to old age, the slowest growth, 19 mm. in 1876 to 1885, corresponds with the decade 1870-79, which was by far the rainiest, while the two periods of most rapid growth, 1826 to 1835 and 1896 to 1905, correspond with the two decades of least rainfall. There are no available records for the Forest of Dean previous to 1820, and a comparison of the growth of the yew from 1750 to 1820 with Dr. Glasspoole's figures for the whole of England, published in the *Meteorological Magazine* for February, failed to show any definite relationship. If the hypothesis that the yew grew best in dry weather is correct, we should infer that in the Forest of Dean the years 1803 to 1813 were rainy and the years 1780 to 1790 dry; it would be interesting to know if local non-instrumental records confirm or disprove this. The general results of the comparison are not very convincing, however, and do not make it probable that we shall ever be able to write the history of our rainfall from the annual rings of our trees, as has been done so successfully in the west of America, even if we can find any trees of sufficient age.

Winds in the Forth Valley

The south of Scotland is bisected by a valley which joins the Forth and Clyde Estuaries at a level little above that of the sea. Both to the south and north considerable mountain areas exist. The valley runs in a general east to west direction and at its western end bifurcates near Renfrew, one branch running northwest to Greenock and the other southwest to Ardrossan. Those who work with daily weather maps have long noticed peculiarities in the surface winds reported from Renfrew and from Inchkeith which lie near the western and the eastern ends of the valley respectively, and it has been difficult to ascribe these effects to any cause other than the local topography. At Renfrew the effect most commonly shown is a deflection of winds in the direction of the valley so that ENE or WSW winds are frequently found when the pressure gradient suggests quite other conditions. At Inchkeith the effect is more pronounced on the velocity of the winds than on their direction. The station is at the top of a rocky islet in the middle of the Forth Estuary, some three to four miles from Leith in the south and from the Fifeshire coast in the north.

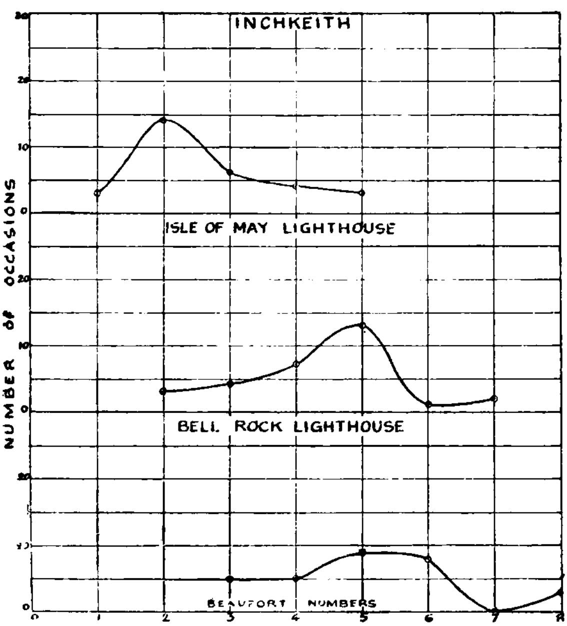


FIG 1

Frequency curves showing the number of occasions on which each Beaufort Number occurred at Inchkeith, Isle of May and Bell Rock respectively during the six months. November, 1926—April, 1927, when the gradient at Inchkeith was from a southerly point and equal to 30 m.p.h. or more.

An inquiry has lately been carried out into the local winds at Inchkeith and the results obtained seemed of sufficient general interest to be put on record. During the winter of 1926-7 the gradient wind in that neighbourhood was noted on all occasions where it equalled or exceeded 30 m.p.h. from the southward. The observations of wind reported from Inchkeith at these times were also noted together with those from the lighthouses at Isle of May and Bell Rock, which were kindly supplied by the Commissioners of Northern Lights. The Isle of May is situated in the entrance to the Firth of Forth, 25 miles eastnortheast of Inchkeith, while Bell Rock is a further 20 miles to the northeast and lies well out in the North Sea.

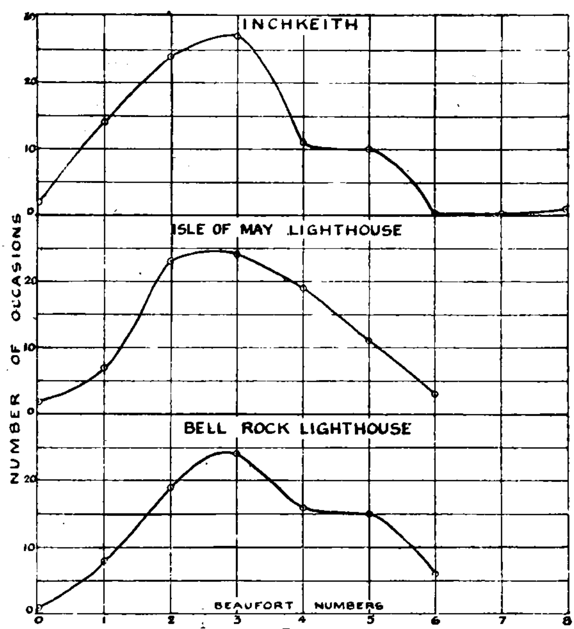


FIG. 2

Frequency curves showing the number of occasions on which each Beaufort Number occurred at the three stations for all wind directions at 3 p.m. during the three months, February, March and April, 1927.

The frequency with which different surface wind forces were reported at the three stations under these conditions of strong southerly gradient (30 m.p.h. or over) is shown in Fig. 1. A gradient of 30 m.p.h. corresponds at a normal fairly well exposed station with a surface wind of about force 4 and stronger gradients would naturally be associated with higher surface winds. It will be seen that at Bell Rock winds of forces 5 and 6 were most frequent, while at the Isle of May there was a marked preponderance of force 5. At Inchkeith, on the other hand, winds were almost always light, force 2 being reported 14 times against 6 reports of force 3 and even less frequent records of forces 4 and 5. It has been stated that the station at Inchkeith is on the top of a rocky islet and the exposure is certainly not ideal for wind observations, but there are reasons for thinking that this peculiarity of light winds with southerly gradients is a feature of stations in the Forth valley and is not confined to Inchkeith.

It seemed desirable to compare the winds reported from

Inchkeith, Isle of May and Bell Rock for all wind directions in order to test whether the effect found for southerly winds was peculiar to that direction or persisted more generally. Frequency curves similar to those given in Fig. 1 were therefore drawn for all winds reported during the three months February to April, 1927, observations at 3 p.m. daily being used. These curves are plotted in Fig. 2 and show good agreement between the three stations.

J. S. DINES.

Royal Meteorological Society

The monthly meeting of the Society was held on Wednesday, February 15th, at 49, Cromwell Road, South Kensington, Sir Richard Gregory, D.Sc., LL.D. President, in the Chair.

Dr. L. F. Richardson described two of the Society's *Memoirs* by himself and other authors :

No. 2. "The single-layer problem in the atmosphere and the height-integral of pressure."

No. 4. "The variance of upper wind and the accumulation of mass."

Both *Memoirs* were published in 1926 ; an account of No. 2 will be found in the *Meteorological Magazine* for September, 1926, p. 191. No. 4 is a study of simultaneous pilot balloon ascents at two stations a short distance apart, or at one station at short intervals. The mathematical study of smooth functions suggests that the closer two ascents approach in space or time, the more nearly similar should be their results, but the observations do not always support this, perhaps because the wind does not possess the required kind of smoothness.

Dr. J. Glasspoole then read a paper on "The distribution over the British Isles of the average number of days with rain during each month of the year." He pointed out that one naturally associates a large frequency of rain-days with a large average rainfall, but the frequency of rain-days was also affected by geographical factors. While rainfall decreases from west to east, the decrease in the number of rain-days is rather from north-west to south-east—from 270 in the Outer Hebrides to 150 along the Thames Valley. In the present paper maps are given showing the distribution of the average number of days with rain in each month as well as for the year as a whole. There are only 10 days with rain on the average along the Thames Estuary in June, July and September, and 26 in December in the north-west of Scotland and in the mountains of Kerry, Connemara and Donegal. June is the month of fewest days with rain over the British Isles generally, averaging 14, while December has most with 20. May also has less days with rain than either July or August, so that the popular call for early holidays is well supported by rainfall statistics. It is also shown that the amount of rain per rain-day is greater during the last six months of the year than the first six months, another factor which makes May and June more favourable for holiday makers than July and August.

Correspondence

To the Editor, *The Meteorological Magazine*

The Storm of February 10th

Probably you will receive many reports of the storm of the 10th instant. This appears to have been in the nature of a line squall of exceptional kind, remarkable for its severity, for the great length of country affected, for its accompanying winter thunderstorm almost everywhere, and for the striking variations of wind force and temperature in many places.

Here the morning was overcast with gusty southerly wind, rain setting in at noon. Switching on my wireless set at 1.30 p.m., I was surprised to hear atmospherics of a frequency and vigour usually associated with heavy summer thunderstorms. At 1.50 p.m. the sky rapidly darkened and thunder was heard. Sleet began to fall followed immediately by blinding snow, accompanied by vivid lightning and heavy thunder, the wind veering west at no great strength. The snow was wet, temperature being about 35°, and it continued thickly for half an hour, lying to a depth of half an inch. Clear sky spread in from westnorthwest at 3 p.m. behind a very fine cirrified edge, extending in an almost unbroken straight line from north to south, the sky shading to a deep black on the eastern horizon and forming a magnificent spectacle. The wind was not notably strong at any time, but later in the evening furious squalls of wet snow preceded the hurricane which rose to 104 m.p.h. at Liverpool.

E. C. Rutherford.

Red Holm, Macclesfield Road, Buxton. February 13th, 1928.

Return of Balloons in Ceylon

In connexion with the upper air work here, it is the practice to pay a reward of one rupee for the return of balloons, and a notice to that effect in English, Sinhalese and Tamil is attached to the tail of the balloon and produces a fair response, though of course many are lost in the jungle or at sea.

It is not unusual for letters returning the slip, and claiming the rupee, to contain irrelevant information regarding the finder's circumstances and character, leading up to a request for a further cash payment or a post in the Observatory, but I think a letter in Sinhalese received to-day may possibly be of amusement to your readers. I may add that tail No. 720 had already been returned and the reward duly paid.

Translation of letter received.

A piece of black paper bearing No. 720 to which is pasted a printed notice in English, Sinhalese and Tamil, another paper attached by a wire and a rubber balloon have been found by us.

A reward of one rupee is not sufficient. If the Superintendent of the Observatory will advertise in the Dinamina newspaper in rather large letters an offer of a hundred pounds, we will inform him where and when these were found.

A. J. BAMFORD.

Colombo Observatory, Ceylon, November 11th, 1927.

NOTES AND QUERIES

Commission for Synoptic Weather Information

Arrangements have been made for a meeting of the Commission for Synoptic Weather Information to be held in London during the period May 29th to June 2nd next. The last meeting of the Commission was at Zürich in September, 1926.

British members of the Commission are Lt.-Col. E. Gold, D.S.O., F.R.S., and Air Commodore L. F. Blandy, C.B., D.S.O.

Under the Rules of the International Meteorological Organisation any question which is to form the subject of discussion at a meeting of the Commission must be communicated by a member of the Commission to the President and a report on it distributed at least two months before the meeting.

Meteorological Service of Madagascar

On June 15th, 1927, a Meteorological Service was established for the Colony of Madagascar and its Dependencies. The new Service is under the control of the Director of the Observatory of Antananarivo, and its duties will be forecasting, climatology and aerology. The forecasting service is concerned with the issue of cyclone warnings by wireless ; for this purpose a network of 25 telegraphic reporting stations is established, and it is hoped that weather reports will be received from ships. The climatological service includes 40 stations reporting monthly, and the data will be published monthly in the *Journal Officiel*, and quarterly in greater detail in the *Bulletin Economique.*

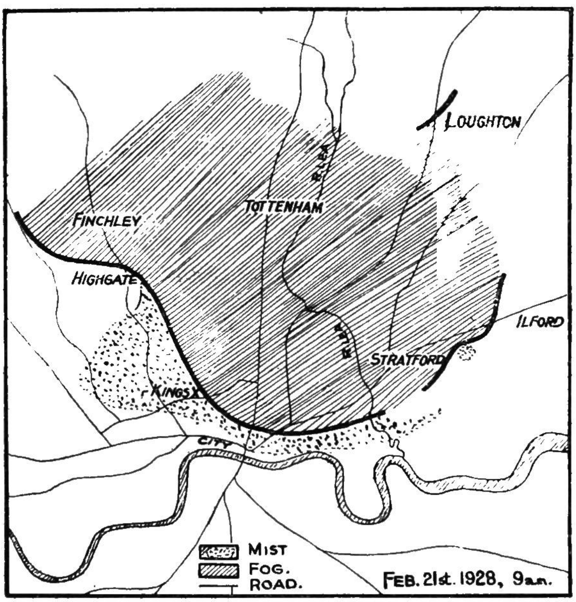
A New Observatory for Yugoslavia

The new City Meteorological Observatory which has been established by the City of Split, Yugoslavia, with the help of a subsidy from the Government, was formally opened on December 1st, 1927. The Observatory has been built at a height of 128 metres above sea level on Mount Marjan, which is just outside the city in 40° 21′ N., 16° 26′ E.

Besides all the usual instruments for observations at fixed intervals it is equipped with numerous self-recording instruments. There is also a wireless receiving station in the building and a seismic station will shortly be established. Work at the Observatory has been going on during the whole of 1927, and it is hoped that in the near future the Observatory will become the Headquarters of the meteorological service which is to be organised along the Adriatic coast of Yugoslavia.

London Fog, February 21st, 1928

In the March number for 1927 there appeared a map showing the movements of fog over London on the previous January 29th. The occurrence of fog in the third week of February, 1928, gave an opportunity to investigate its distribution on another occasion. Unfortunately fog occurred on several successive days and to avoid the possibility of mistakes it was not considered safe to accept statements with regard to observations later than the day after that on which the fog distribution was investigated. The accompanying map is thus not so detailed as that drawn last year. Information was however obtained from districts considerably farther east, and this, together with its curious similarity to its predecessor, which may or may not be significant, makes it worth while to put it on record. The map speaks for itself, the noticeable fact being that it is again the Lea valley which appears to be the fog reservoir, the Roding valley being also affected, but Epping forest apparently stood out above the fog. Whether fog extended to the river in the Silvertown area is doubtful, but the evidence is against it. A misty belt of varying width surrounded the fog, but elsewhere London was bathed in sunshine.



It may perhaps be noted that (1) there had been fog over somewhat the same area the previous morning; (2) shortly after 9 a.m. the fog moved slightly westward, but that was all the movement that took place; (3) over most of the area the fog had disappeared by 12.30 p.m., but in the central portion of the valley it remained to some extent all day ; (4) the fog appeared over very much the same area at night ; (5) next morning, fog lay over many parts of London, east, west and south, but whether these were continuous with the northern area is not known.

J. FAIRGRIEVE.

Mock Moons

Mr. F. Sargent of Durham University Observatory reports that he observed " mock moons " on the evening of Sunday, January 8th, from the Observatory. At a few minutes before 9 o'clock a small patch of the prevailing thin cirrus cloud situated some distance to the right of the nearly full moon was seen to be illuminated as though by a bright light behind it. A little later a similar patch of light, a second mock-moon, developed at a similar distance to the left. With the increased altitude of the moon one hour later a similar mock moon was visible vertically below and a fourth appeared faintly above. Occasionally, the familiar lunar halo would develop, when it could be seen that the mock moons were situated on the outer edge of it, the appearance then being of the usual halo with four small circular illuminated patches dividing it equally in the vertical and horizontal places. The phenomenon was observed for two hours.

The only other local record of this phenomenon known to Mr. Sargent is one from the Newcastle district, where it was seen on January 18th, 1902.

Wind at the Level of a Rain Gauge

Owing to difficulties arising from the effects of blown sand upon the rainfall record at Spurn Head, arrangements were made in 1925 for a rain gauge to be erected in the enclosed yard of the lighthouse station. This yard is circular and measures 36 yards in diameter. It is surrounded by low buildings, the approximate height of these being 16 feet. As the yard was paved it was considered necessary that the rain gauge should be at a height greater than 1 foot, so that the effects of insplashing should be avoided. It was actually installed at a height of 4 feet. It is well known that the rainfall collected by a gauge with the rim at a height of 4 feet exposed in an ordinary situation would be less than the rainfall collected with a gauge with the rim at a height of 1 foot. This difference arises from the eddies caused by the wind and is naturally dependent upon the strength of the wind, though not solely upon the strength.

With a view to getting some idea as to whether the exposure of the new rain gauge at Spurn Head could be considered normal so far as the strength of the wind at the height of the rim of the gauge is concerned, it was decided to make some measurements with an anemometer in the yard with the cups placed at the same level as the rim of the rain gauge. From these measurements it was found that the wind at the level of the rim ot the rain gauge was about 25 per cent. of the wind recorded by the pressure tube anemometer at a height of 42 feet above ground. The highest value recorded at the level of the rain gauge was 11 miles per hour at a time when the pressure tube anemometer recorded a wind of 39 miles per hour : in each case the value refers to the mean velocity over a period of 60 minutes. When the results came to be examined it was found that there were no records available of the strength of the wind at a height of 1 foot above the ground in a situation which would be considered normally satisfactory for a rain gauge exposure. It was therefore arranged that some measurements of the strength of the wind should be made at a height of 1 foot above the ground in the neighbourhood of the rain gauge at Kew Observatory. From these measurements it was found that the strength of the wind at rain gauge level at Kew Observatory was between 25 per cent. and 40 per cent. of the strength of the wind recorded by the pressure tube anemometer on the top of the Observatory, the value depending naturally upon the direction of the wind. The highest value recorded at a height of 1 foot was 10 miles per hour at a time when the pressure tube anemometer recorded a wind of 28 miles per hour.

It appears from this that the exposure of the rain gauge at Spurn Head is sufficiently near the normal so far as strength of the wind at the level of the rim of the gauge is concerned for no artificial screening of the gauge to be necessary, and it appears from the further observations at Kew Observatory that the exposure of a rain gauge may be considered as sufficiently near the normal to require no artificial screening if the wind at the level of the rim of the gauge does not exceed 10 to 15 miles per hour. This must not be taken to imply that a wind of 10-15 m.p.h. has no effect upon the catch of a rain gauge—all that it means is that the effect is not great enough to render the records useless for comparison with the records from other gauges.

E. Gold.

Rainfall and Farming in the Transvaal

In this bulletin of the Transvaal University College, Pretoria,* there are two parts. The first, by F. E. Plummer, Professor of Geography, is a preliminary investigation into the variability of the rainfall, and the second, by H. D. Leppan, Professor of Agronomy, is entitled " Rainfall in relation to agriculture in the Transvaal."

The outstanding feature of the rainfall in the Transvaal is the

* *Transvaal University Bulletin No.* 12, pp. 63+17 maps, Pretoria, 1927.

fact that from 80 to 90 per cent. of it falls in the summer months, October to March. As the processes of farming depend directly upon the summer rains, Professor Plummer takes for the "hyetal year" the twelve months commencing July, instead of the twelve months of the calendar year. With the scanty material at his disposal he deduces that the mean annual rainfall varies from rather less than 15 in. in the extreme west to over 30 in. over the mountains in the east, where, in general conformity with the contours, the average rainfall shows various small areas of maxima exceeding 50 in., with an extreme average of 72 in. at Woodbush Forest. The "dispersion" (computed by the ordinary formula for probable error of a set of observations) of the deviations of the serial annual values at a station is worked out in as many cases as possible, in order to obtain a measure of the "reliability" of the rainfall from year to year. The dispersions for all the stations, when expressed as percentages of the respective annual average values of rainfall and plotted on a map, show values of less than 7·5 per cent. towards the south-east of the province, west of the mountains, increasing to over 25 per cent. in the east, over 20 per cent. in the extreme west, and over 25 per cent. in the north-west. Pretoria, at a height of 4,350 feet, has an average rainfall of about 29 in. and a percentage dispersion of 16 per cent., *i.e.*, the actual dispersion is about 4½ in. By the theory of probability, and under a certain (false) assumption which will presently be referred to, it can, therefore, be concluded that the chances are even that the rainfall at Pretoria in any year will lie between 33½ and 24½ in. The chances are also even that it will be outside these limits. The author also works out by the theory of probability, and shows cartographically (1) the minimum amount of rainfall which may reasonably be expected to occur in seventy-five years out of one hundred; (2) the number of years per century in each of which a minimum of (A) 20 in. and (B) 24 in. may be expected to occur; (3) the duration of the rainy period with an average of (A) 1 in., (B) 3 in., and (C) 4 in. per month; (4) the month of maximum rainfall irrespective of amount; and (5) the percentage of the mean annual rainfall which is recorded in each of the two three-monthly periods comprising the six months of summer. He also classifies the Transvaal into hyetal regions, and sets out diagrammatically various types of average monthly distribution.

The paper is a valuable addition to our knowledge of the rainfall of the Transvaal, and as such is very welcome.

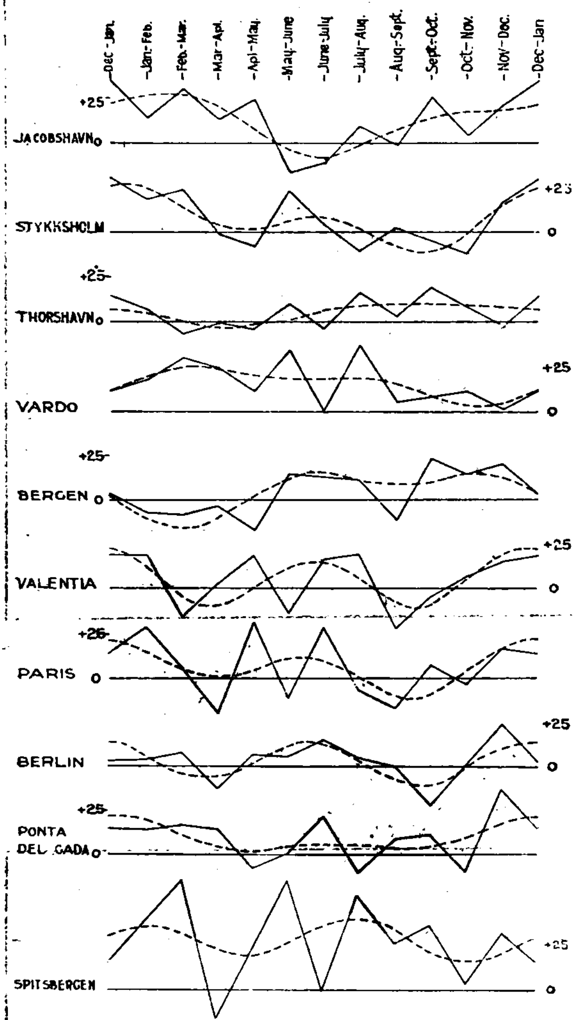
Exception must, however, be taken to the author's use of the theory of probability in his treatment of the rainfall data, by means of which he obtains certain results which are manifestly improbable. For example, he shows a diagram of serial annual values of rainfall at Johannesburg on which the annual average value 33·39 in. is marked. The diagram extends from 1889 to 1925, 37 years. It shows one year (1908-9) of markedly excessive rainfall (50 in.), and another (1917-8) of even greater excess (63·92 in.). Yet the author goes on to state : " According to the law of probability this amount " (*i.e.*, 50 in. in 1908-9) " cannot reasonably be expected to occur more often than 23 times in 10,000 years " (*i.e.*, twice in 1,000 years approximately) ! He also concludes that the value of 63·92 registered in 1917-8 cannot be expected to occur more than five times in 100,000 years. The key to the error is found on p. 10, where it is stated that " there appears to be no reason why the law of probability of error should not be applicable to the analysis of rainfall data, as equal positive and negative deviations from the mean are equally probable, if the series of observations is sufficiently extensive." The author thus regards annual rainfall totals in the same way statistically as he would regard successive annual attempts of some Jupiter Pluvius to deal out the exact average rainfall by means of a huge graduated watering can. It is, however, known that the deviations of annual rainfall do not follow the normal frequency curve of error, but are distributed in a skew manner about the average annual value. Accordingly, the assumed law of error, and the criterion of rejection of outstandingly high annual values which is used, are invalid, and the computations based on them are subject to consequential errors. Judging from data printed in the tables, these errors should not, however, affect seriously the main conclusions of the paper.

Professor Leppan gives a very clear and interesting account of the manner in which farm crops are affected by the seasonal distribution of the rainfall, by the variations in annual rainfall, and by effects of percolation and evaporation. He discusses the question of the most suitable crops for cultivation in the different rainfall zones, and warns new settlers in the Transvaal against certain pitfalls into which they may not improbably fall, such as the temptation to acquire land in regions where the rainfall is very uncertain, in view of the low price at which it is offered for sale.

R. Corless.

Persistence of Pressure Deviations in Western Europe

One of the features which distinguishes the temperate regions from almost all other parts of the world is the extreme smallness of the tendency for deviations of pressure from normal to persist with the same sign over more than one month. This characteristic feature is brought out by the results in Table 1, obtained by correlating the pressures of every month at each of a number of stations in the eastern North Atlantic and north-western Europe, with the pressures at the same station in the following month. The results are shown graphically in Fig. 1. The upper line for each station in the table, and the full curves in Fig. 1, represent the coefficients actually obtained; the lower lines in the table, and the broken lines in the figure, represent the results after smoothing by means of the first two terms of a Fourier series. The figures in brackets in the last column represent the largest of the twelve monthly coefficients which would be expected if there were no real connexion between the pressure in succeeding months.



Considering first the mean values, and omitting for the moment consideration of Spitsbergen, we find that although all are positive, only the two northern stations, Jacobshavn and Vardö, exceed +·10. The mean values are smallest at the intermediate stations, Thorshavn, Bergen, Valentia and Berlin, and increase slightly southwards as well as northwards. At these four stations not one of the monthly values exceeds the highest value which would be expected if there were no real connexion, so that there is no real evidence of an appreciable connexion between the pressure in successive months at any season of the year.

At Vardö all twelve coefficients are positive, though that for June to July is very small, and it is here that the evidence for persistence is strongest. Coefficients were accordingly calculated for Spitsbergen, and although, owing to the short record (only 15 years), the monthly values are very irregular, the annual average of +·27 evidently indicates a real tendency for persistence from one month to the next, which appears to be strongest

TABLE 1.

CORRELATION COEFFICIENTS BETWEEN PRESSURES IN SUCCESSIVE MONTHS.

	Dec.-Jan.	Jan.-Feb.	Feb.-Mar.	Mar.-Apr.	Apr.-May	May-June	June-July	July-Aug.	Aug.-Sept.	Sept.-Oct.	Oct.-Nov.	Nov.-Dec.	Mean
Jacobshavn ...	+·**35**	+·14	+·30	+·13	+·24	−·16	−·11	+·08	−·01	+·25	+·04	+·20	+·12
1873-1923	+·22	+·26	+·27	+·20	+·07	−·04	−·08	−·02	+·07	+·14	+·17	+·18	(·27)
Stykkisholm...	+·**31**	+·18	+·24	−·01	−·07	+·23	+·04	−·10	+·02	−·04	−·11	+·17	+·07
1846-1926	+·26	+·25	+·14	+·04	+·02	+·06	+·08	+·02	−·07	−·10	−·01	+·15	(·21)
Thorshavn ...	+·15	+·07	−·07	−·01	−·04	+·10	−·04	+·16	+·03	+·**19**	+·08	−·02	+·05
1872-1922	+·07	+·04	·00	−·03	−·02	+·01	+·06	+·09	+·10	+·10	+·09	+·08	(·27)
Vardo ...	+·12	+·18	+·30	+·25	+·12	+·34	+·01	+·**37**	+·06	+·08	+·11	+·02	+·16
1874-1924	+·12	+·20	+·25	+·24	+·21	+·19	+·19	+·19	+·16	+·09	+·04	+·05	(·27)
Bergen ...	+·04	−·07	−·08	−·03	−·17	+·15	+·13	+·12	−·11	+·**24**	+·15	+·21	+·05
1868-1924	+·03	−·10	−·16	−·10	+·02	+·13	+·16	+·12	+·09	+·11	+·15	+·13	(·25)
Valentia ...	+·18	+·18	−·15	+·02	+·18	−·13	+·16	+·18	−·**22**	−·04	+·06	+·15	+·05
1866-1926	+·22	+·12	−·04	−·09	−·01	+·11	+·14	+·05	−·07	−·08	+·04	+·19	(·24)
Paris	+·14	+·29	+·06	−·19	+·**32**	−·11	+·28	−·06	−·17	+·07	−·03	+·17	+·06
1874-1920	+·22	+·15	+·05	+·01	+·04	+·11	+·10	+·01	−·09	−·09	+·03	+·17	(·28)
Berlin ...	+·03	+·04	+·08	−·13	+·07	+·06	+·15	+·05	·00	−·**22**	+·01	+·24	+·03
1848-1923	+·14	+·07	−·03	−·06	+·02	+·12	+·13	+·04	−·07	−·10	−·01	+·10	(·22)
Ponta Delgada	+·15	+·14	+·17	+·14	−·07	+·01	+·21	−·09	+·08	+·11	−·08	+·**37**	+·09
1865-1926	+·22	+·20	+·12	+·05	+·02	+·04	+·05	+·05	+·03	+·04	+·09	+·17	(·24)
Spitsbergen ...	+·15	+·37	+·**61**	−·17	+·24	+·60	−·01	+·52	+·26	+·35	+·03	+·31	+·27
1911-1925	+·29	+·35	+·31	+·23	+·19	+·25	+·35	+·39	+·33	+·22	+·16	+·20	(·49)

in late winter and at midsummer. At Jacobshavn and Stykkisholm, and again at Ponta Delgada, the coefficients appear to indicate a real, though small, persistence in winter, but almost complete independence in summer.

TABLE 2.

PERSISTENCE OF PRESSURE DEVIATIONS FROM ONE QUARTER TO THE NEXT.

	Jan.-Mar. to Apr.-June.	Apr.-June to July-Sept.	July-Sept. to Oct.-Dec.	Oct.-Dec. to Jan.-Mar.	Mean.
Jacobshavn ...	+·18	+·01	+·04	+·27	+·13
Stykkisholm...	+·13	+·02	+·03	+·17	+·09
Thorshavn ...	+·25	−·19	−·06	−·07	−·02
Vardö ...	+·06	−·03	−·19	+·04	−·03
Bergen ...	+·06	−·13	−·06	−·17	−·07
Valentia ...	−·02	+·16	−·19	+·11	+·01
Paris	+·02	+·15	−·02	+·13	+·07
Berlin ...	+·01	+·18	+·06	+·16	+·10
Ponta Delgada	+·14	+·19	+·16	+·05	+·13

Table 2 shows the correlation between the means of pressure during successive quarters. The greatest persistence is shown at Jacobshavn and Stykkisholm in winter and by Ponta Delgada in summer; at the remaining stations the figures are all small and irregular.

C. E. P. BROOKS.
WINIFRED A. QUENNELL.

An Unusual Cyclone Track *

In a recent publication of the Royal Alfred Observatory, Mauritius, appears a short note by Mr. M. Koenig on a cyclone which is said to be unique in being " the first case on record, in this region of the Indian Ocean, of a cyclone actually moving towards the equator." From examination of observations made at Rodriguez, Mauritius and Madagascar, as well as on several ships, it is deduced that this cyclone, which passed north of Mauritius on February 27th, 1927, moved over a track of the usual " parabolic " shape to a position about 100 miles north of Réunion on March 2nd, but then, instead of continuing south or south-east after recurving, took a WNW course towards Madagascar. At the same time the intensity and rate of travel of the cyclone increased considerably. The centre passed over Tamatave (Madagascar) on March 3rd, pressure falling to 940 mb. in the central calm area and winds reaching an estimated speed of 125 miles per hour, and was traced inland across Madagascar for some distance, but up to the time of the writing of the note, the subsequent history of the cyclone was unknown.

S. T. A. MIRRLEES.

High Temperatures in Iraq

Maximum temperatures ranging from 110° to 121° F. in the shade were registered in Iraq during July in the years 1922-24. The stations considered were Mosul in the north, Baghdad and Ramadi in central Iraq and Shaibah near the head of the Persian Gulf. There is a great preponderance of north-westerly winds in Iraq in July and practically no southerly winds, so that nearly

HINAIDI (NEAR BAGHDAD).
Percentage frequencies of winds in July at 3,000 ft.

Period	Hour	No. of Obs.	N	NE	E	SE	S	SW	W	NW	Velocity 3 mph or less
1922 –26	0h 30m to 5h	141	28	1	1	1	0	2	7	59	1

all these high temperatures occurred on days when the wind was northerly. These hot northerly winds were often quite strong

*The cyclone of February 24th to March 3rd, 1927. By M. Koenig, A.Inst.P. (Misc. Pub. Royal Alfred Observatory, No. 6, pp. 5.) Port Lewis, Mauritius, 1927.

and attained their maximum velocity at about 1,500 feet above ground level where the velocity in a few cases exceeded 50 miles per hour. On July 11th, 1923, for example, the temperature at Hinaidi rose to 114° F. in the shade, while the surface wind at 10h. G.M.T. (*i.e.*, about 13h. local time) was reported as 35 miles per hour from north; on July 12th, 1924, also at Hinaidi, the maximum temperature was 115° F. and the surface wind at 10h. G.M.T. 28 miles per hour from north-west. An extreme temperature of 121° F. was recorded at Hinaidi on July 21st, 1922. On this date the wind was blowing from north-west with a velocity of 16 miles per hour at 5h. G.M.T., but had fallen to calm at 10h. G.M.T.; while on July 13th, 1924, when 121° F. was again recorded at Hinaidi the wind was moderate or fresh from north-west. A general survey of the observations therefore shows that high temperatures in Iraq are usually associated with northerly winds which may be quite strong.

The mean maximum temperature for July at Hinaidi during the five years 1922-26 was 110° F. During the three-year period 1922-24 there were six days on which the wind at 3,000 feet at Hinaidi was southerly and on four of these days the maximum temperatures were all above normal, the highest being 119° F. On the remaining two days the maxima were 108° and 110° F. Hence the temperature in Iraq is also likely to be high when the wind is southerly.

The occurrence of high temperatures in Iraq when the wind is northerly suggests the existence of a föhn effect because this region is flanked on the north and east by ranges of mountains. If the existing air over Iraq is withdrawn at any time and replaced by air from the mountains the dynamical warming which occurs will give a föhn effect provided that the initial distribution of temperature in the vertical in the descending air is suitable, and it is not difficult to imagine that suitable initial temperatures will at times occur in summer.

The pressures observed in Iraq on the three hottest days in each of the years 1922-24 were all below normal for the time of year and indicate an extension or intensification of the low pressure centre which normally exists at this season over north-west India. Since the wind at Hinaidi at 3,000 feet was southerly on only one of these nine days the observations in Iraq suggest an association between föhn effects and pressure changes similar to that observed in Switzerland and elsewhere. The preponderance of northerly winds is lost at a height of 6,000 feet at Mosul, so that the vertical thickness of the air flowing in from the mountains on the north may be taken to lie between 3,000 and 6,000 feet.

The observations in Iraq therefore indicate that the heat of this region in summer is supplemented at times by a föhn effect.

A Thermometric Chart

A new Thermometric Conversion Chart designed by P. L. Markes, L.R.I., B.A., has been published by Crosby Lockwood and Son. With this chart the conversion, to the nearest whole degree, from one thermometer scale to another can be seen at a glance, and constants are given at the foot of the chart for use when greater accuracy is desired. Five thermometric scales are charted, including the De l'Isle scale, which is now only of historical interest, and in the introduction a brief account of the history of the invention of each of the scales is given. The book is well got up, and should prove an acceptable addition to the literature of thermometry.

Reviews

Physical Factors of the Historical Process. By A. Tchijevsky. Size $9\frac{1}{4} \times 7\frac{1}{2}$, pp. 72. Russian with English summary. *Illus.* Kaluga, 1924.

There is a well-known theory, due to W. S. Jevons, that commercial crises have an eleven-year cycle corresponding with that of sunspots, but the relation is generally considered to be an indirect one, resulting from the effect of a sunspot periodicity in rainfall on the yield of crops. Equally well known is the relation between weather conditions and crime, including suicide, and here again there is the possibility of an indirect relation with sunspots. The author of the present paper postulates a close relation between sunspots and the collective activity of the mob, as expressed in rebellions, revolutions, riots, religious movements and other "mass-historical" events. As the result of "a minute scrutiny of the history of all the peoples and states known to science, beginning with the V. century B.C.," he finds that "as soon as the sunspot activity approaches its maximum, the number of the important mass-historical events, taken as a whole, increases," and he calculates that 60 per cent. of these events occur in the three years of spot maximum, compared with only five per cent. in the three years of spot minimum. During the latter period there is, instead, a time of peaceful creative work. A curious individual instance is a curve showing the parallelism between outbursts of revolutionary activity in Russia and outbursts of sunspots day by day from October, 1905, to April, 1906. This seems to indicate that the supposed relation does not take effect through the ordinary weather channels such as rainfall, but acts far more quickly. The author does not venture an explanation, but one immediately thinks of the nervous effects of variations of atmospheric potential gradient.

The author's results are certainly striking, and we may yet hear an anarchist accused of bomb-throwing plead in defence the influence of sunspots, but there must be difficulty in avoiding bias in the selection of the "mass-historical" events, and for the present it would be as well to keep an open mind.

C. E. P. Brooks.

Sur la Distribution de la Pluie en Belgique. By Emile Vanderlinden. Inst. Roy. Météor. de Belgique, Mémoires Vol. II. Size $12\frac{1}{2} \times 9\frac{1}{2}$, pp. 50. *Illus.* Brussels, 1927.

It is not surprising that with the difficult war and post-war conditions in Belgium, the number of rainfall stations should have decreased considerably. In fact, it is very satisfactory to note that as many as 100, out of the 311 stations recording in 1913, still survived in 1918. Subsequently the number of new records has kept pace with those which have ceased. A detailed study had to be limited to the 17 years commencing 1910 when standard gauges were introduced.

Mean monthly and annual amounts are set out for each station, those from incomplete records being computed in the usual way by reference to the nearest stations with complete records. Except in the case of the record at Uccle, the means have been increased by 3·2 per cent. This factor has been determined experimentally as the difference between the catch of the standard gauge and that of a "normal rain gauge" set up on the bottom of a cylindrical tub 28 in. in diameter with its rim and that of the gauge level with the ground. Finally the corrected annual means have been reduced in the ratio 108·5 : 100, since this is the ratio of the annual catch at Uccle for the years 1910 to 1926 and that for 1887 to 1926. The final values are taken as the normals for the 40 years' period. The defects of the gauges in use prior to 1910 were the large surface of the collecting funnel, leading to losses by evaporation, the lack of adequate precautions for the measurement of snow and the exposure with the rim 5 feet above the ground. The gauges caught from 10 to 20 per cent. less than a gauge exposed with the rim level with the ground. The standard gauge is of the Howard pattern, *i.e.*, a shallow funnel and bottle. The gauge rests on the ground with the mouth 30 cm. (11·8 in.) above the level of the ground, and is prevented from being blown over by a cylinder projecting just above the ground and soldered to a horizontal sheet buried about 5 cm. Each gauge is supplied with a spare funnel about 9 in. deep, for use in time of frost and snow. Like the other funnel, it is of zinc and 10 cm. (3·9 in.) in diameter. The method employed of increasing the recorded values by 3·2 per cent. seems open to serious objections, and more direct observations are desirable. In the first place there is probably some insplashing from the ground only 1 foot away and level with the mouth of the normal rain gauge. Furthermore, any correction is likely to vary with the seasons and with the different exposures of the gauge, *i.e.*, any loss is likely to be greater in the winter months and with gauges in more open sites, owing to the increased amount of wind-eddy set up round the gauge in both cases with the stronger winds. The decrease in the ratio of 108·5 to 100 is probably reasonable, since recent years were generally wet and since Uccle is in the central portion of Belgium. If reliable data were, however, available, most probably the factor would have varied appreciably in the outlying districts.

The publication includes a map showing the distribution of the average annual rainfall as computed for the period 1887 to 1926. The fall varies from about 25 in. along part of the coast to about 50 in. on the higher ground to the south-east. This is a much smaller range than in the British Isles, where the average annual rainfall varies from about 20 in. in the neighbourhood of the Thames Estuary to over 150 in. in the English Lake District, Snowdonia and the Western Highlands of Scotland. Details are given of the maximum recorded intensity of rainfall. For durations less than 10 minutes, the greatest rates are generally smaller than those for the British Isles, probably owing to our larger number of highly sensitive recording gauges. The greatest rates on record for rains of from 10 to 45 minutes' duration are similar for the two countries, varying from about 7 in. to 3·5 in. per hour. A fall of 7·9 in. in 3 hours 15 minutes at Louvain on May 14th, 1906, is comparable with that at Cannington, near Bridgwater, Somersetshire, on August 18th, 1924, when, during an intense and remarkable local thunderstorm, a conservative estimate is that 8 in. of rain and hail fell in 5 hours.

There is a detailed discussion of the abnormally dry weather from August, 1920, to October, 1921, a drought apparently without precedent in Belgium in historic times. The drought was most intense during the six months May to October, 1921, when deficiencies occurred of from 60 to 75 per cent. at a number of stations. The drought seems to have been even more severe than in the British Isles, since in the corresponding driest six months period, February to July, 1921, deficiencies in this country only just exceeded 65 per cent. of the average. It is interesting to note that the Lac de la Gileppe, which usually contains 13 million cubic metres, was reduced to little over one million cubic metres by December 8th, 1921, and striking photos are given of a nearly empty lake. In this connexion references are given to earlier droughts, from the author's work on *Chronique des événements météorologique en Belgique jusqu'en 1834*, together with details of more recent droughts in Belgium.

J. GLASSPOOLE.

Weather Observations and Aids to Forecasting. By Donald W. Horner. Size $7\frac{1}{4} \times 5$, pp. 64. *Illus.* London, G. Allen & Unwin, 1927. 2s. 6d. *net.*

This little volume has been written, according to the Preface, with the intention of being used as an elementary text book for schools and colleges, and on this account "great care has been taken to verify every fact, and the information given will be found completely up to date and quite reliable throughout."

The book, however, contains only a few instructions on how weather observations are made, and some of these are rather misleading. For example, on page 36, in describing the setting of the grass minimum thermometer, the following occurs :—

"The 'grass thermometer' is 'set' in a similar way to the ordinary minimum thermometer, *i.e.*, by tipping it up gently so that the index . . . impinges upon the indicating medium, which, however, in this case is mercury." The grass minimum thermometer is, of course, a spirit thermometer. Again, regarding rainfall measurement, page 44 : "rainfall measurements are taken in inches or millimetres. We can use which we prefer, but once having adopted a particular system we must adhere to it, and no conversion from inches to millimetres or *vice versa* should be attempted. Exact conversion is impossible, . . ." On page 43 it states : "The actual cause of rain—apart from rain brought about by electric influence—is dust-motes collecting water vapour until, becoming sufficiently heavy, they fall by gravitation to the earth as rain."

Distributed throughout the book are instructions on how to forecast coming weather. Such instructions often involve the making of assertions which cannot be readily proved. On page 28 there is a typical case, here the author assumes that rain is falling in south-east England with a north-east wind and a rising barometer : "The probabilities are ten to one that the persistent rain with a north-easterly wind and steadily rising barometer will be followed by a spell of from seven to ten days' fine weather."

On page 41 a peculiar explanation is given of the formation of fog : "The origin of the dense fogs prevalent in London, Liverpool and other large towns or cities situated on the banks of rivers in winter is similar. The cold, damp air rises from the surface of the rivers and mixes with the warmer and drier air of the town." Later, on the same page : "It does not seem generally understood that the same 'visible moisture' which causes the 'objectionable fog' is also responsible for those magnificent cumulus (thunder) clouds which we all admire."

Perhaps rigid accuracy has after all been occasionally sacrificed to simplicity, for the book is written in simple language and makes easy and interesting reading.

J. CRICHTON.

Books Received

Memorias y Revista de la Sociedad Cientifica " Antonio Alzate." Tomo 45 and 46, Nums. 3-6 and 7-12. Mexico, 1926.

The article in Tomo 46, pp. 237-77, on " Geological phenomena in the Valley of Mexico and their influence on the production of Dust Devils," is of special interest to meteorologists.

Bollettino Meteorologico della Cirenaica, 1925 (*Riassunto annuale, della osservazioni*). R. Ufficio Meteorologico, No. 5. Tripoli, 1927.

Bollettino, 1925 (*Riassunto annuale della osservazioni*). R. Ufficio Meteorologico della Tripolitania, No. 7. Tripoli, 1927.

Nautisk-Meteorologisk Aarbog, 1926. The Danish Meteorological Institute. Copenhagen, 1927.

Obituary

Prof. Willis L. Moore.—We regret to learn of the death of Prof. Willis L. Moore, on December 18th, 1927, aged seventy-one years. Prof. Moore was Chief of the Weather Bureau from 1895 to 1913 and was succeeded by the present Chief, Prof. C. F. Marvin. After his retirement from the Official Service he became professor of applied meteorology at George Washington University. He was elected an Honorary Member of the Royal Meteorological Society in 1902 and is chiefly known to English meteorologists for his textbook *Descriptive Meteorology.*

M. Spas Watzof.—We regret to learn of the death, on February 2nd, of the Bulgarian meteorologist, M. Spas Watzof, in his 72nd year. Although he published little himself, M. Watzof was keenly interested in science, and in 1894 he organised the formation of the Meteorological and Seismological Service of Bulgaria, of which be became the first Director, a post which he held until his death.

News in Brief

Sir John Moore reports that on Saturday afternoon, February 25th, he observed two beautiful parhelia followed by a sun pillar in the neighbourhood of Bletchley, Buckinghamshire.

The degree of Doctor of Science has been awarded by the University of Cambridge to Mr. F. J. W. Whipple, Superintendent of Kew Observatory and Assistant Director of the Meteorological Office.

The Ninth Annual Soirée of the Meteorological Office Staff was held on Thursday, February 23rd, at Anderton's Hotel, Fleet Street. An excellent Cabaret Concert and a Dance, each held in separate rooms throughout the evening were enjoyed by a record number of past and present members of the Staff and their friends.

The Weather of February, 1928

During the first half of the month the weather continued mild and unsettled as in January with strong westerly winds or gales and heavy rain at times, but towards the end fine warm dry conditions prevailed with an unusually large number of hours of bright sunshine. Hail and sleet showers were general in the north during the first days and "snow lying" was reported from a few places, especially in Scotland where measurements of 6 to 7½ in. were recorded at West Linton on the 2nd, 3rd and 4th. The lowest screen minimum temperature for the month was 19° F. at West Linton on the 4th and at Balmoral on the 23rd and the lowest grass minimum, 12° F. at Balmoral on the 4th. Strong winds and gales were often reported from most parts of the country between the 1st and 17th, the strongest winds occurring on the 10th and 11th. During the afternoon of the 10th a line squall passed over England, a sudden drop of about 10° F. in temperature being recorded in London and elsewhere while thunderstorms with hail, sleet or snow occurred in many places. In the evening a secondary depression developed off northwest Ireland and moved eastward causing strong gales over England. Mean velocities between 55 and 60 m.p.h. were measured at Fleetwood, Southport, Holyhead and Scilly with gusts of over 80 m.p.h. at Valentia, Holyhead and Southport. A gust of 104 m.p.h. was recorded by the Osler swinging plate anemometer at Bidston Observatory. During this period minimum temperatures were unusually high for the time of year; minima of 52° F. were registered at Valentia, Gorleston and Kew on the 16th. Among the heaviest amounts of rain recorded were 4·65 in. at Cwm Dyli, Snowdon, on the 4th, 3·02 in. at Treherbert (Glamorgan) on the 15th, 2·83 in. at Mourne Mountains (Co. Down) on the 29th. After the 17th an anticyclone began to spread over the British Isles causing a change to quiet, almost rainless, sunny conditions. A good deal of fog developed locally and some frost occurred at night, but day temperatures continued generally above the average for the time of year, though there were some low readings mainly due to the presence of fog. In many parts, however, the weather was remarkably fine, sunshine records of over nine hours a day occurring repeatedly. The highest values were recorded on the 27th, when 9·9 hrs. occurred at Eastbourne and 9·8 hrs. at Bath, Cheltenham and Jersey. The total sunshine for the month was above the normal in most parts, being 26 hrs. above normal at Kew Observatory, 19 hrs. at Dublin, 13 hrs. at Aberdeen and 10 hrs. at Falmouth. In southwest Ireland however there was a deficiency of 4 hrs. at Valentia. At Kew Observatory, the total of 86 hrs. has only twice been exceeded in February during the past 48 years.

Pressure was below normal in Spitsbergen, Iceland, Newfoundland, Scotland, northeast England, Norway and Sweden, the greatest deficit being 10·6 mb. at Reykjavik, and above normal over an area extending from Denmark, Germany and Italy across the North Atlantic to Bermuda, the greatest excess being 7·5 mb. at Madrid. Temperature was above normal generally and rainfall was above normal except in northern Norway, eastern Gothaland and Svealand (Sweden) and eastern British Isles.

Several heavy snowfalls between the 1st and 6th made the conditions for ski-ing excellent in Switzerland during those days, but the heavy rainfall which fell in France at the same time caused the Seine to rise dangerously. Storms and floods occurred in southwest and west Norway on the 8th to 10th and caused loss of life and much material damage, nine bridges on the Bergen railway being destroyed. Flooding also occurred in Leningrad owing to the storms in the eastern Baltic on the 8th and 9th. On the 11th severe gales and thunderstorms were reported from western Germany while the continued bad weather in France caused flooding on all the main rivers until about the 17th when there was a general improvement in the weather in Europe. The ice broke up on the Vistula at Warsaw on the 13th but floods were prevented by bombing any ice dams that formed. Many avalanches fell and floods occurred in Switzerland and in the Austrian Alps round about the 15th owing to the rapid melting of the snow under the influence of the föhn wind. Owing to strong northwest winds in Transjordan swarms of locusts which attacked Wady Musa near Petra on the 2nd were driven back to the desert.

Welcome rains fell in most of New South Wales and southwestern Queensland during the first half of the month but by the 16th the rainfall was excessive and resulted in severe floods. On the 17th the drought in South Australia was broken and here, too, the rains were so heavy that extensive flooding occurred. Unusually dry weather prevailed in New Zealand early in the month.

The special message from Brazil states that the rainfall in the northern and central regions was scarce, being 2·6 in. and 3·1 in. below normal respectively, while in the southern regions it was plentiful with 1·8 in. above normal. Eight anticyclones passed across the country and gales were frequent in the south and along the coasts of the central regions. The sugar cane was in good condition. At Rio de Janeiro pressure was 0·2 mb. below normal and temperature 1·1° F. above normal.

Rainfall, February, 1928—General Distribution

England and Wales ..	119	per cent. of the average 1881-1915.
Scotland	115	
Ireland	128	
British Isles	120	

Rainfall: February, 1928: England and Wales

CO.	STATION.	In.	Per-cent. of Av.	CO.	STATION.	In.	Per-cent of Av.
Lond.	Camden Square	1·66	99	*Leics*	Thornton Reservoir	2·24	134
Sur .	Reigate, The Knowle	1·77	86	,, .	Belvoir Castle	1·58	95
Kent.	Tenterden, Ashenden	1·33	68	*Rut* .	Ridlington	1·74	...
,, .	Folkestone, Boro. San.	1·19	...	*Linc.*	Boston, Skirbeck	1·34	92
,, .	Margate, Cliftonville	·88	64	,, .	Lincoln, Sessions House	1·03	71
,, .	Sevenoaks, Speldhurst.	1·63	...	,, .	Skegness, Marine Gdns.	1·57	103
Sus .	Patching Farm	1·66	75	,, .	Louth, Westgate	1·78	93
,, .	Brighton, Old Steyne	1·76	87	,, .	Brigg	...	...
,, .	Tottingworth Park	2·01	86	*Notts.*	Worksop, Hodsock	2·11	137
Hants	Ventnor, Roy. Nat. Hos.	2·03	97	*Derby*	Derby	2·52	156
,, .	Fordingbridge, Oaklnds	2·85	114	,, .	Buxton, Devon. Hos.	5·10	136
,, .	Ovington Rectory	2·46	95	*Ches.*	Runcorn, Weston Pt.	2·48	133
,, .	Sherborne St. John	2·25	103	,, ..	Nantwich, Dorfold Hall	2·48	...
Berks	Wellington College	1·42	76	*Lancs*	Manchester, Whit. Pk.	3·43	179
,, .	Newbury, Greenham	2·11	96	,, ..	Stonyhurst College	6·26	187
Herts.	Benington House	1·54	97	,, ..	Southport, Hesketh Pk	3·31	158
Bucks	High Wycombe	2·35	127	,, ..	Lancaster, Strathspey.	5·22	...
Oxf. .	Oxford, Mag. College	1·68	106	*Yorks*	Wath-upon-Dearne	2·30	140
Nor .	Pitsford, Sedgebrook	1·91	114	,, .	Bradford, Lister Pk.	4·43	189
,, .	Oundle	1·16	...	,, .	Oughtershaw Hall	10·18	...
Beds.	Woburn, Crawley Mill.	1·45	98	,, .	Wetherby, Ribston H.	2·38	138
Cam.	Cambridge, Bot. Gdns.	...	...	,, .	Hull, Pearson Park	1·53	92
Essex	Chelmsford, County Lab	1·25	84	,, .	Holme-on-Spalding	1·70	...
,, .	Lexden, Hill House	1·08	...	,, .	West Witton, Ivy Ho.	3·86	...
Suff .	Hawkedon Rectory	1·32	87	,, .	Felixkirk, Mt. St. John	1·31	78
,, .	Haughley House	·92	...	,, .	Pickering, Hungate	1·60	...
Norf.	Beccles, Geldeston	·98	72	,, .	Scarborough	1·78	106
,, .	Norwich, Eaton	1·49	91	,, .	Middlesbrough	·99	76
,, .	Blakeney	1·53	103	,, .	Baldersdale, Hury Res.	4·18	...
,, .	Little Dunham	1·43	88	*Durh.*	Ushaw College	1·41	89
Wilts.	Devizes, Highclere	2·22	112	*Nor* .	Newcastle, Town Moor.	1·26	79
,, .	Bishops Cannings	...	...	,, .	Bellingham, Highgreen	2·48	...
Dor .	Evershot, Melbury Ho.	3·07	98	,, .	Lilburn Tower Gdns.	1·84	...
,, .	Creech Grange	3·20	...	*Cumb*	Geltsdale	3·36	...
,, .	Shaftesbury, Abbey Ho.	1·98	86	,, .	Carlisle, Scaleby Hall	3·61	162
Devon	Plymouth, The Hoe	3·31	111	,, .	Borrowdale, Rosthwaite	12·26	...
,, .	Polapit Tamar	3·80	118	,, .	Keswick, High Hill	5·95	...
,, .	Ashburton, Druid Ho.	4·97	105	*Glam.*	Cardiff, Ely P. Stn.	5·27	176
,, .	Cullompton	3·50	125	,, .	Treherbert, Tynywaun	14·33	...
,, .	Sidmouth, Sidmount	2·81	112	*Carm*	Carmarthen Friary	5·23	141
,, .	Filleigh, Castle Hill	4·39	...	,, .	Llanwrda, Dolaucothy.	5·62	129
,, .	Barnstaple, N. Dev. Ath.	3·36	124	*Pemb*	Haverfordwest, School	4·69	135
Corn.	Redruth, Trewirgie	4·04	107	*Card.*	Gogerddan	6·67	210
,, .	Penzance, Morrab Gdn.	4·33	130	,, .	Cardigan, County Sch.	3·50	...
,, .	St. Austell, Trevarna	4·83	126	*Brec.*	Crickhowell, Talymaes	4·00	...
Soms	Chewton Mendip	4·67	139	*Rad* .	Birm. W. W. Tyrmynydd	6·42	122
,, .	Street, Hind Hayes	2·30	...	*Mont.*	Lake Vyrnwy	10·68	235
Glos. .	Clifton College	4·13	175	*Denb.*	Llangynhafal	2·61	...
,, .	Cirencester, Gwynfa	3·02	134	*Mer* .	Dolgelly, Bryntirion	7·43	167
Here.	Ross, Birchlea	2·14	106	*Carn.*	Llandudno	3·33	160
,, .	Ledbury, Underdown.	2·11	116	,, .	Snowdon, L. Llydaw 9	17·56	...
Salop	Church Stretton	3·43	156	*Ang* .	Holyhead, Salt Island.	3·58	147
,, .	Shifnal, Hatton Grange	1·94	120	,, .	Lligwy	4·31	...
Worc.	Ombersley, Holt Lock.	1·87	114	*Isle of Man*			
,, .	Blockley, Upton Wold.	1·99	88		Douglas, Boro' Cem.	3·70	116
War.	Farnborough	2·51	122	*Guernsey*			
,, .	Birminghm, Edgbaston	2·26	134		St. Peter P't. Grange Rd	3·90	159

Rainfall: February, 1928: Scotland and Ireland

CO	STATION.	In.	Per-cent. of Av.	CO.	STATION.	In.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	3·34	128	*Suth.*	Loch More, Achiary ...	9·38	142
,, .	Pt. William, Monreith .	3·33	...	*Caith*	Wick	1·69	74
Kirk.	Carsphairn, Shiel.	6·99	...	*Ork* .	Pomona, Deerness	3·40	113
,, .	Dumfries, Cargen	5·17	133	*Shet* .	Lerwick	5·37	170
Dumf	Eskdalemuir Obs......	...	...	*Cork.*	Caheragh Rectory	6·62	...
Roxb	Branxholm	4·19	159	,, ..	Dunmanway Rectory.	6·81	116
Selk .	Ettrick Manse	7·40	...	,, ..	Ballinacurra	2·92	78
Peeb.	Castlecraig	...	...	,, ..	Glanmire, Lota Lo. ...	3·54	90
Berk.	Marchmont House	2·56	123	*Kerry*	Valentia Obsy.	4·69	90
Hadd	North Berwick Res....	1·31	84	,, .	Gearahameen	11·90	...
Midl	Edinburgh, Roy. Obs..	2·57	162	,, .	Killarney Asylum.....	4·85	[illegible]
Ayr .	Kilmarnock, Agric. C..	3·38	118	,, .	Darrynane Abbey	5·60	121
,, .	Girvan, Pinmore	4·08	96	*Wat.*	Waterford, Brook Lo..	2·52	77
Renf.	Glasgow, Queen's Pk..	3·98	135	*Tip* .	Nenagh, Cas. Lough...	5·61	180
,, .	Greenock, Prospect H..	6·41	114	,, .	Roscrea, Timoney Park	4·34	...
Bute.	Rothesay, Ardencraig.	5·46	137	,, .	Cashel, Ballinamona ..	3·69	115
,, .	Dougarie Lodge	4·72	...	*Lim* .	Foynes, Coolnanes ...,	4·83	151
Arg .	Ardgour House	11·49	...	,, .	Castleconnell Rec.	5·42	...
,, .	Manse of Glenorchy..	10·45	...	*Clare*	Inagh, Mount Callan ..	7·65	...
,, .	Oban	5·20	...	,, .	Broadford, Hurdlest'n.	4·64	...
,, .	Poltalloch	4·51	105	*Wexf*	Newtownbarry	3·90	...
,, .	Inveraray Castle	10·32	152	,, .	Gorey, Courtown Ho...	2·95	105
,, .	Islay, Eallabus	5·20	124	*Kilk.*	Kilkenny Castle	3·11	122
,, .	Mull, Benmore	12·80	...	*Wic* .	Rathnew, Clonmannon	3·20	...
,, .	Tiree	...	...	*Carl.*	Hacketstown Rectory .	3·40	113
Kinr.	Loch Leven Sluice	3·24	115	*QCo..*	Blandsfort House.....	3·57	133
Perth	Loch Dhu	10·05	135	,,	Mountmellick	4·81	...
,, ..	Balquhidder, Stronvar.	8·33	...	*KCo.*	Birr Castle	3·89	170
,, ..	Crieff, Strathearn Hyd.	3·54	101	*Dubl.*	Dublin, FitzWm. Sq...	2·46	130
,, ..	Blair Castle Gardens ..	3·55	127	,, .	Balbriggan, Ardgillan .	2·90	148
Forf.	Kettins School	2·10	99	*Me'th*	Beauparc, St. Cloud ..	3·18	...
,, .	Dundee, E. Necropolis.	1·83	97	,, .	Kells, Headfort......	4·13	153
,, .	Pearsie House	2·48	...	*W.M*	Moate, Coolatore	3·18	...
,, .	Montrose, Sunnyside ..	1·24	67	,, .	Mullingar, Belvedere .	3·75	135
Aber.	Braemar, Bank	1·42	50	*Long*	Castle Forbes Gdns....	3·23	114
,, .	Logie Coldstone Sch. ..	1·16	56	*Gal* .	Ballynahinch Castle ..	4·67	91
,, .	Aberdeen, King's Coll..	·64	31	,, .	Galway, Grammar Sch.	4·08	...
,, .	Fyvie Castle	·77	...	*Mayo*	Mallaranny	6·21	...
Mor .	Gordon Castle	·91	47	,, .	Westport House	3·03	77
,,	Grantown-on-Spey	...	...	,, .	Delphi Lodge	6·54	...
Na .	Nairn, Delnies	2·26	126	*Sligo*	Markree Obsy.	3·93	112
Inv..	Ben Alder Lodge	...	...	*Cav'n*	Belturbet, Cloverhill..	3·13	120
,, .	Kingussie, The Birches	4·96	...	*Ferm*	Enniskillen, Portora ..	4·51	...
,, .	Loch Quoich, Loan ...	17·30	...	*Arm.*	Armagh Obsy.	3·57	161
,, .	Glenquoich	17·46	169	*Down*	Fofanny Reservoir ...	8·67	...
,, .	Inverness, Culduthel R.	2·60	...	,, .	Seaforde	4·98	163
,, .	Arisaig, Faire-na-Squir	3·83	...	,, .	Donaghadee, C. Stn...	3·11	135
,, .	Fort William	10·40	138	,, .	Banbridge, Milltown .	3·23	155
,, .	Skye, Dunvegan	5·59	...	*Antr.*	Belfast, Cavehill Rd. .	4·63	...
R&C	Alness, Ardross Cas. ..	4·53	137	,, .	Glenarm Castle	5·29	...
,, .	Ullapool	6·20	...	,, .	Ballymena, Harryville	3·99	123
,, .	Torridon, Bendamph..	9·60	122	*Lon* .	Londonderry, Creggan	4·72	148
,, .	Achnashellach	9·20	...	*Tyr* .	Donaghmore	5·65	...
,, .	Stornoway	5·48	123	,, .	Omagh, Edenfel	5·56	187
Suth.	Lairg	5·16	...	*Don* .	Malin Head	4·61	191
,, .	Tongue	4·39	126	,, .	Dunfanaghy	4·35	123
,, .	Melvich	3·43	115	,, .	Killybegs, Rockmount.	6·93	139

Climatological Table for the British Empire, September, 1927

STATIONS	PRESSURE: Mean of Day M.S.L.	PRESSURE: Diff. from Normal	TEMPERATURE: Absolute Max.	TEMPERATURE: Absolute Min.	TEMPERATURE: Mean Values Max.	TEMPERATURE: Mean Values Min.	TEMPERATURE: Mean Values ½ max. and min.	TEMPERATURE: Mean Values Diff. from Normal	TEMPERATURE: Mean Wet Bulb	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION: Am'nt	PRECIPITATION: Diff. from Normal	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	in.	in.			
London, Kew Obsy.	1009·5	− 7·9	71	35	61·9	49·8	55·9	− 1·2	51·4	92	7·5	4·49	+ 2·62	15	3·4	27
Gibraltar	1015·8	− 1·5	85	56	79·2	65·4	72·3	− 0·2	63·4	80	4·4	0·29	− 1·10	2	...	...
Malta	1015·1	− 1·8	90	66	81·4	72·1	76·7	+ 0·7	72·2	84	3·5	0·37	− 0·90	4	8·9	72
St. Helena	1013·9	+ 0·8	65	52	59·7	54·2	56·9	− 1·0	55·6	97	9·9	1·48	− 1·54	17	...	...
Sierra Leone	1012·4	+ 0·2	89	69	84·8	71·9	78·3	− 0·8	75·3	85	7·2	24·50	− 3·98	28	...	...
Lagos, Nigeria	1011·9	− 0·9	85	71	82·3	74·0	78·1	− 0·3	74·4	85	2·5	3·04	− 2·22	14	...	...
Kaduna, Nigeria	1015·0	+ 2·2	89	...	84·7	...	...	...	71·4	83	...	11·31	− 0·18	20	...	...
Zomba, Nyasaland	1014·6	+ 0·9	86	51	81·0	56·8	68·9	− 0·6	...	76	3·6	0·00	− 0·34	0	...	...
Salisbury, Rhodesia	1014·5	0·0	87	42	79·8	50·8	65·3	− 1·1	...	50	0·7	0·00	− 0·26	0	10·1	84
Cape Town	1019·3	+ 0·2	86	41	67·1	50·9	59·0	+ 1·1	53·1	83	4·4	0·73	− 1·54	3	...	...
Johannesburg	1017·8	+ 1·3	86	44	75·4	50·9	63·1	+ 3·7	49·0	39	0·9	0·05	− 0·91	2	9·7	82
Mauritius	1019·8	− 0·4	79	56	75·6	62·1	66·8	− 1·3	64·8	66	6·3	1·18	− 0·12	17	7·9	66
Bloemfontein	...	...	89	33	81·8	46·0	63·9	+ 4·8	49·1	44	2·1	0·10	− 0·80	2	...	...
Calcutta, Alipore Obsy.	1005·3	+ 0·8	93	76	90·1	78·6	84·3	+ 1·3	79·7	90	7·9	7·04	− 2·83	12*	...	...
Bombay	1007·0	− 1·0	89	74	86·1	77·9	82·0	+ 1·2	77·0	87	6·9	5·33	− 5·35	11*	...	...
Madras	1006·2	− 0·3	101	72	93·0	77·7	85·3	+ 0·2	76·9	77	6·4	2·88	− 2·11	8*	...	...
Colombo, Ceylon	1009·5	− 0·5	90	72	86·8	75·3	81·1	+ 0·2	77·6	76	8·4	9·18	+ 2·96	19	4·8	39
Hongkong	1009·8	+ 1·4	89	70	83·6	76·1	79·9	− 1·1	75·3	79	8·0	6·17	− 3·82	17	4·9	40
Sandakan	...	...	91	73	88·6	75·4	82·0	+ 0·3	77·3	84	...	9·72	+ 0·33	12	...	...
Sydney	1020·9	+ 4·9	81	42	64·7	49·4	57·1	− 2·1	52·2	67	5·9	3·06	+ 0·17	11	5·7	48
Melbourne	1021·9	+ 6·1	77	35	62·7	44·3	53·5	− 0·6	49·2	66	5·3	1·74	− 0·67	11	5·9	50
Adelaide	1022·3	+ 5·0	83	37	68·4	47·5	57·9	+ 0·8	50·4	49	4·1	0·91	− 1·13	7	7·5	64
Perth, W. Australia	1018·8	+ 0·9	80	44	68·5	52·2	60·3	+ 2·0	54·9	66	5·6	3·93	+ 0·53	15	6·8	58
Coolgardie	1019·9	+ 2·8	85	38	69·9	45·9	57·9	− 0·7	50·7	55	4·0	1·84	+ 1·23	9	...	...
Brisbane	1020·2	+ 2·9	89	46	74·9	54·8	64·9	− 0·4	57·0	59	4·2	1·77	− 0·28	9	7·8	66
Hobart, Tasmania	1019·1	+ 8·4	71	34	58·9	42·8	50·9	+ 0·1	45·4	66	6·0	1·09	− 1·04	14	5·7	49
Wellington, N.Z.	1018·0	+ 3·4	66	37	58·4	45·5	51·9	+ 0·3	49·6	75	7·2	3·07	− 0·90	16	5·3	45
Suva, Fiji	1014·5	+ 0·2	84	64	81·2	71·3	76·3	+ 1·8	71·8	80	7·4	7·13	+ 0·15	21	5·2	43
Apia, Samoa	1013·0	+ 0·9	86	72	84·2	75·4	79·8	+ 1·6	75·9	74	4·5	4·20	− 0·92	12	7·9	66
Kingston, Jamaica	1011·6	− 0·6	92	70	89·2	73·6	81·4	− 0·1	72·8	87	4·8	1·82	− 2·21	7	7·8	64
Grenada, W.I.	1007·2	− 4·5	92	75	88·2	76·6	82·4	+ 2·2	77·4	76	4·8	3·15	− 5·11	11	...	...
Toronto	1015·5	− 2·3	88	39	73·0	53·7	63·3	+ 4·1	55·5	79	4·0	1·11	− 2·07	9	7·2	58
Winnipeg	1012·9	− 1·9	89	28	67·4	47·2	57·3	+ 3·9	48·3	87	4·7	2·54	+ 0·26	11	5·7	45
St. John, N.B.	1013·6	− 3·9	74	34	63·4	49·2	56·3	+ 0·4	52·1	81	5·6	5·52	+ 1·78	8	...	...
Victoria, B.C.	1014·4	− 2·1	77	47	62·8	51·0	56·9	+ 1·3	53·2	80	6·7	1·95	− 0·06	11	5·8	46

*For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.