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## An analysis of Warm Spells in London from 1900-33, with special reference to the prevailing conditions of Humidity

By F. H. DIGHT, B.Sc.

Marked extremes of temperature when they occur in this country excite much popular interest. Thus the "Great Frost" of February, 1929 will long be remembered and the same is true of the more noteworthy spells of very warm weather popularly known as "Heat Waves." As far as these "Heat Waves" are concerned it is not generally understood that the degree of comfort or otherwise experienced by the human body depends on the prevailing "wet bulb" temperature\* and much less so on the reading of the ordinary "dry bulb" thermometer. Several references to the subject are to be found in British meteorological literature, but more attention has been paid to it in countries where greater extremes of temperature are experienced, notably in America and by C. W. B. Normand† in India. F. C. Houghton‡ gives a scale of "Effective Temperatures" which combines the effect of the three variables into a series of single comparative temperatures as indices of the degree of human comfort. The reading of the wet bulb thermometer depends on the rate of evaporation of water from the bulb

\* The Observers' Handbook.

† London, *Q.J.R., Meteor. Soc.*, 46, 1920, p. 1.

‡ *J. Amer. Soc. Heat. and Vent. Engineers, New York*, 1926, p. 737.

surface and on the wind velocity and is thus controlled by the prevailing conditions of humidity and wind in the air. The human body when perspiring has thus been compared to a wet bulb thermometer.

There is an increasing demand in recent years for data of humidity and its variations which is not conveniently met by the published observations of this element. The engineers in particular, faced with the design of conditioning plants with which are being equipped many of the large and varied modern buildings now being erected in London and in other large cities at home and abroad, are finding it essential to have greater detail in humidity data.

The original purpose of this note was to provide more critical data concerning the humidity of the air, in an effort to meet some of the demands of the engineers and others. Much useful information of the mean value of the relative humidity at each hour of the day and for each month is given in a Meteorological Office publication\* for five observatories and a few other stations in the British Isles. But the mean figures do not indicate the degree of humidity to be expected on a warm summer day, and although it is known to vary considerably, it is difficult to estimate the maximum value likely to be experienced with dry bulb temperatures ranging up to 90°F. or above. Practically saturated air is sometimes found in summer with temperatures of from 65°-70°F., but it is not true that in the British Isles a very hot day is also a very humid day.

The data used in this investigation were extracted from the published values of the hourly readings from the autographic records of the instruments at Kew Observatory, Richmond, for the period 1900-1933. For every occasion during the 34 years that the hourly reading of the dry bulb thermometer reached or exceeded 85.0°F. the corresponding value of the wet bulb (or relative humidity) was tabulated; the maximum temperature was also noted for each of the days concerned. On a few days a maximum temperature of 85°F. or more was shown without a corresponding entry in the hourly value column and in these instances hourly readings of the dry and wet bulb slightly below 85°F. were noted.

For any sample of air the three variables, the wet bulb temperature, the relative humidity and the dew point are all so dependent on the dry bulb temperature as to be almost meaningless without its specification, and a change in temperature of the air is accompanied by a marked change in the variables. Within limits, however, the absolute humidity or actual water content of the air sample must remain constant with temperature changes, at least so long as the temperature change is insufficient to cause

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\* "Book of Normals of Meteorological Elements for the British Isles," Sect. VI., H.M.S.O.

condensation and while evaporation into the sample is prevented.

For most practical purposes the absolute humidity in grams per cubic metre is equivalent to the vapour pressure, the actual relation being—

$$\text{Absolute Humidity in grm./m}^3 = \frac{1.060}{(1 - \alpha t)} e$$

where  $e$  = vapour pressure in mm.

$t$  = temperature in °C.

$$\alpha = \frac{1}{273}$$

For this reason the available index of humidity for each hourly reading was used in conjunction with the Hygrometric tables and the International Meteorological tables to obtain the actual weight of water vapour in unit volume of air (grammes/cubic metre). This was sufficient to permit of an interpolation of the water content at the time of occurrence of the maximum temperature, and then by the reverse process for the determination of the relative humidity or wet bulb temperature at the same time. There appeared to be in general no very marked change in water content over the hourly interval embracing the time of maximum dry bulb. When a decided change was noticed, almost invariably the water content increased during and after the rise to the maximum dry bulb, presumably as a result of evaporation from the ground, etc. This necessitated a certain measure of discretion in the interpolation, but a reference to the actual records in one or two very difficult cases of recent date showed that the interpolated reading of the wet bulb corresponding to the occurrence of the maximum did not differ from the actual reading by more than a degree or so.

#### *Warm Weather Spells*

An analysis of the figures showed that London (Kew) has experienced a day temperature of 85.0°F. or more for a total duration of 232 hours embracing 61 days in 34 years, the extreme value being 93.9°F. This occurred on 9th August, 1911, the warmest day on record in London; at Greenwich a reading of 100°F. on this date is the highest in the records dating back to 1841. Notable warm spells were those of July, 1900; July, 1901; August 31st-September 2nd, 1906; July and August, 1911; July, 1921; July, 1923; August, 1930, and August, 1932. The summer of 1911 was easily the most outstanding period of prolonged heat, and 13 of the 61 very warm days occurred between July 8th and September 8th of that year. On five days in 1911 the temperature rose to 88°F. or above. For the 34 years maxima were between the limits 85°F.-87.5°F. on 30 days, between 87.5°F.-90°F. on 24 days, and 90°F. or above on 7 days. Temperature for the individual days are given in Table I, where every occurrence of a maximum temperature of 85°F. or above

TABLE I

DATES OF OCCURRENCE OF MAXIMUM TEMPERATURES  
OF 85°F. OR ABOVE AT KEW OBSERVATORY, 1900-33

Date	Max- imum °F	Wet Bulb °F	Rel. Hum. %	Water Content grm/m <sup>3</sup>	Date	Max- imum °F	Wet Bulb °F	Rel. Hum. %	Water Content grm/m <sup>3</sup>
		1900					1921		
June 11	86·5	67·9	35	10·7	July 10	89·2	66·6	26	8·6
July 16	89·4	73·0	44	14·5	„ 11	89·1	63·1	18	5·8
„ 19	89·4	71·7	40	13·2	„ 12	85·6	64·9	28	8·3
„ 20	89·4	75·4	51	16·9	„ 19	87·8	64·8	24	7·6
„ 24	86·0	71·8	48	14·4			1922		
„ 25	89·3	72·1	41	13·5	May 22	86·0	68·6	38	11·3
		1901			„ 23	86·4	69·1	39	11·8
July 18	85·6	69·2	41	12·2	„ 24	86·5	70·1	41	12·5
„ 19	87·6	69·1	36	11·4			1923		
„ 20	85·2	66·2	33	9·5	July 6	86·4	70·1	42	12·7
„ 21	86·9	69·4	38	11·4	„ 7	88·3	71·1	40	12·8
		1904			„ 11	88·5	73·4	47	15·1
Aug. 3	85·1	68·9	41	12·0	„ 12	90·1	73·2	42	14·3
„ 4	86·4	70·6	43	13·1	„ 13	89·6	71·6	39	13·0
		1906					1924		
Aug. 22	86·0	70·7	44	13·3	July 12	85·8	68·6	39	11·5
„ 31	90·9	70·7	34	11·8			1925		
Sept. 1	91·8	70·4	31	11·1	July 22	86·5	71·6	45	13·7
„ 2	91·7	69·5	29	10·4			1926		
		1911			July 14	85·3	70·1	44	13·1
July 8	85·1	70·7	47	13·7			1928		
„ 21	87·4	68·3	34	10·6	July 15	86·9	65·4	27	8·4
„ 22	88·3	68·6	33	10·5			1929		
„ 28	85·8	70·3	44	13·1	July 16	87·3	66·1	28	8·7
„ 29	87·8	70·9	41	13·0	„ 20	85·6	71·4	48	14·3
Aug. 8	88·0	69·4	36	11·5			1930		
„ 9	93·9	71·4	30	11·3	Aug. 27	88·0	75·0	52	16·5
„ 11	85·1	68·7	41	11·9	„ 28	88·0	73·4	48	15·3
„ 12	88·2	69·6	36	11·5	„ 29	89·1	75·7	52	17·1
„ 13	90·0	67·5	27	9·2			1932		
„ 14	85·6	67·0	35	10·4	Aug. 11	86·7	70·1	41	12·7
Se. t. 7	87·3	69·7	39	12·0	„ 18	88·3	73·2	47	15·1
„ 8	87·8	68·6	34	10·9	„ 19	91·6	75·4	45	15·9
		1912			„ 20	86·4	74·1	54	16·4
July 12	86·7	71·2	45	13·7			1933		
		1914			June 5	85·5	66·2	32	9·5
July 1	89·0	70·8	38	12·4	July 26	88·3	70·8	39	12·6
		1917			„ 27	87·3	70·3	40	12·5
June 17	87·8	70·9	41	12·9	Aug. 6	89·4	72·1	41	13·7

No maximum temperatures of 85°F. or above were recorded at Kew Observatory in the years 1902-03, 1905, 1907-10, 1913, 1915-16, 1918-20, 1927, 1931.

is tabulated together with the corresponding wet bulb reading, the relative humidity and the water vapour content.

Passing now to the humidity conditions prevailing during these warm spells, at one end of the scale there is the outstanding remarkably dry heat which prevailed from July 10th-12th, 1921, and again on July 19th of the same year. On none of these days was the relative humidity above 33 per cent. during the warmest hours of the day, and it was for the most part below 30 per cent. On July 11th it fell below 20 per cent., reaching a minimum value (interpolated) of 17.7 per cent. at the time of maximum temperature (89.1°F.). Possibly this figure, low as it is, is still too high; evaporation from the wet bulb was so rapid that it was difficult to maintain it in efficient operation. The range of

TABLE II.  
HOURLY READINGS OF THE HYGROMETER.

(a) Warm Humid Days.

(b) Warm Dry Day.

Hour	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	Max.
Date 20th July, 1900 (a)									
Dry Bulb	88.2	86.6	85.4	85.3	*	*	*	*	89.4
Wet Bulb	74.4	75.5	74.0	74.3	—	—	—	—	75.4
Rel. Hum.	50	58	57	57	—	—	—	—	51
Date 29th August, 1930 (a)									
Dry Bulb	86.2	87.6	88.0	88.7	88.2	87.8	85.1	*	89.1
Wet Bulb	73.3	72.5	73.5	75.2	75.3	72.2	74.2	—	75.7
Rel. Hum.	52	46	48	52	53	51	58	—	52
Date 11th July, 1921 (b)									
Dry Bulb	*	*	86.2	87.4	88.5	88.3	87.8	86.2	89.1
Wet Bulb	—	—	61.9	†	62.8	†	†	66.0	63.1
Rel. Hum.	—	—	20	—	18	—	—	30	18

\* Dry Bulb below 85°F.

† Wet Bulb unreliable.

hourly readings of the wet bulb during the period was from 68°F. with a dry bulb reading of 88°F. down to 62°F. with a dry bulb of 86°F. The outstanding periods of humid heat occurred in July, 1900, 30 years later in August, 1930, and a third in August, 1932. The recent spells, both of 3 days duration, as compared with only one very humid day on July 20th, 1900, are of greatest importance. The hourly readings in August, 1930, revealed a maximum relative humidity of 59 per cent. with temperatures of 86.4°F. and 85.5°F. on August 27th and 28th, with corresponding wet bulb readings of 75.6°F. and 74.8°F. A relative humidity of 58 per cent. was noted on August 29th, 1930 with dry and wet bulb temperatures of 85.1°F. and 74.2°F. respectively, and on July 20th, 1900, with

thermometer readings of  $86.6^{\circ}\text{F.}$  and  $75.5^{\circ}\text{F.}$  At the time of maximum heat on these dates in turn, the figures were 52 per cent. at  $88^{\circ}\text{F.}$ , 48 per cent. at  $88^{\circ}\text{F.}$ , 52 per cent. at  $89.1^{\circ}\text{F.}$  and 51 per cent. at  $89.4^{\circ}\text{F.}$  August 20th, 1932 is also noteworthy; the temperature only rose above  $85^{\circ}\text{F.}$  for a short time between 1 p.m. and 2 p.m., and the interpolated reading for the relative humidity at the time is the highest in the series in Table I, *i.e.*, 54 per cent., although higher wet bulb temperatures and larger water contents are shown.

The highest wet bulb readings for the 34 years were  $75.7^{\circ}\text{F.}$  with a dry bulb reading of  $89.1^{\circ}\text{F.}$  on August 29th, 1930, and

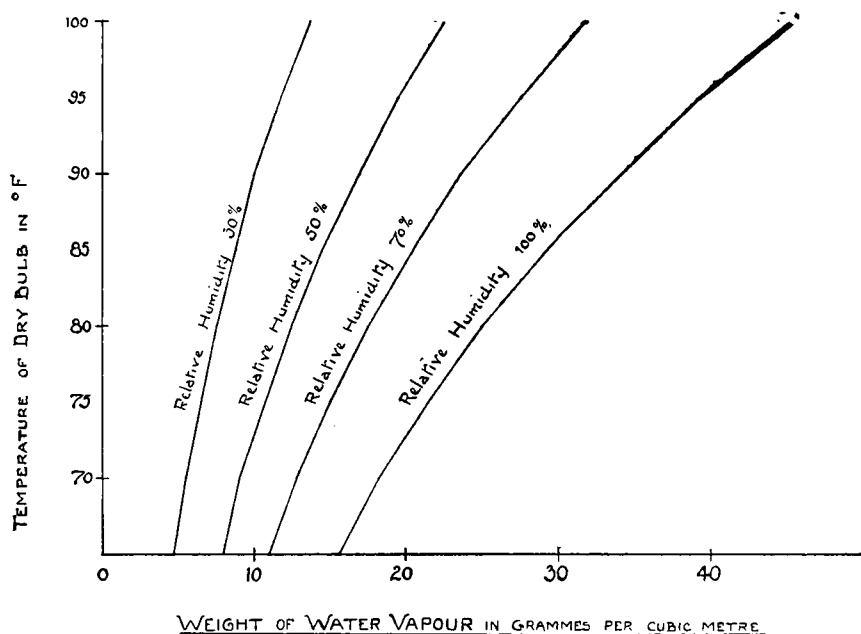


Fig 1

one of  $75.4^{\circ}\text{F.}$  with a dry bulb of  $91.6^{\circ}\text{F.}$  on August 19th, 1932. The figures indicate that the "heat wave" at the end of August, 1930 was the most uncomfortable spell of warm weather experienced in London during the present century, although again in 1932 the heat in August was only slightly less trying.

Judged from the point of view of comfort of the human body there is a strong argument for the extended use of the wet bulb temperatures, but to the engineer the exact water content of the air is probably most useful. The hourly readings of the dry and wet bulb thermometers for the two humid warm days and the warm dry spell have been set out in Table II as an indication of the limiting conditions. The relative humidity figures have also been included, and used in conjunction with the curves in Fig. 1 give an approximate figure of the actual water content of the

### FREQUENCIES OF RELATIVE HUMIDITY.

BASED ON HOURLY VALUES OF TEMPERATURE ABOVE 85°F  
AT KEW OBSERVATORY. 1900 ~ 1933.

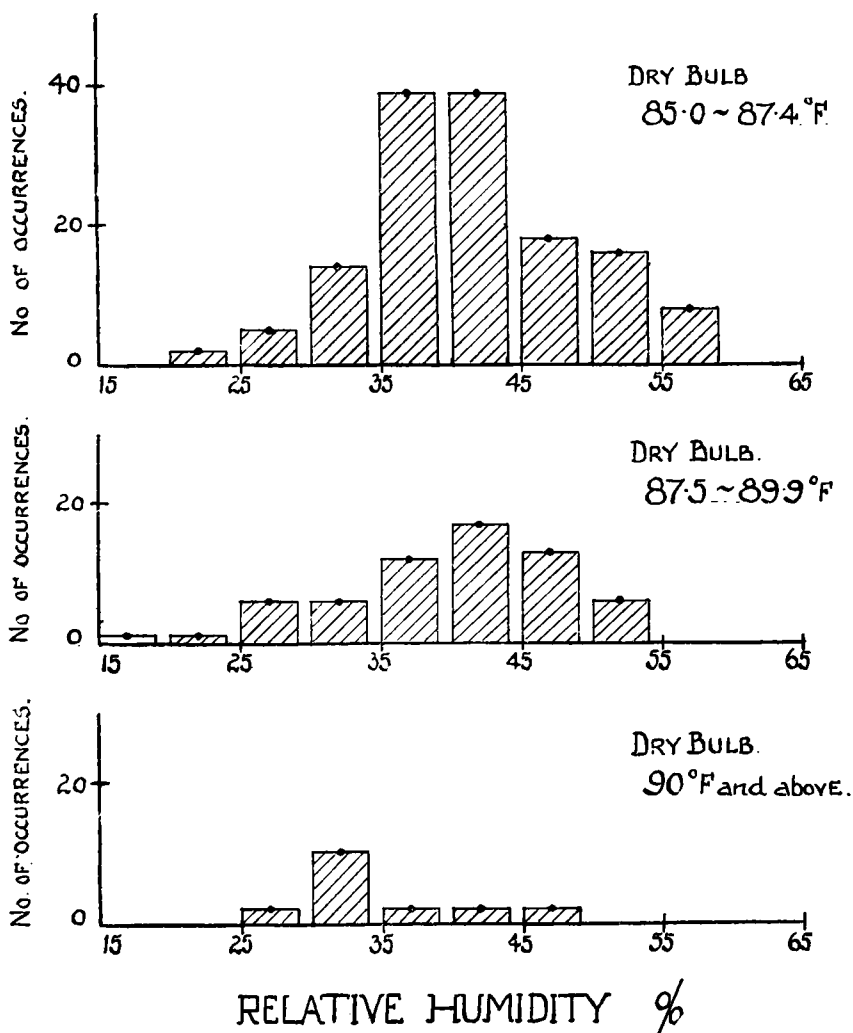


FIG. 2

air. Fig. 2 shows the frequency of occurrence of hourly values of the relative humidity for three ranges of temperature.

Generally with temperatures in excess of 85°F. the prevailing humidity ranges between 35 per cent. and 45 per cent. at the warmest part of the day. The maximum amount of water vapour contained in the air has been noted to rise to between 17.5 gm./cubic metre and 17.9 gm./cubic metre in a few of the hourly readings during the most humid spells. This is the amount

necessary to produce saturation at a temperature of  $69^{\circ}\text{F}$ . Any cooling below this figure must therefore result in condensation.

As we know it is not unusual for a period of warm weather to culminate in an outbreak of thunderstorms which frequently result in a break-up of the "heat wave". In these circumstances the humidity of the air often rises rapidly almost to saturation point, and this paper would be incomplete if it did not indicate the magnitude of the rapid change in general conditions. A severe thunderstorm which broke over London in the late afternoon on July 22nd, 1925 provides one of the best examples for this purpose. At Kew the storm lasted from 5 p.m. G.M.T. until 2.30 a.m. on the following morning and gave a total rainfall of 42.6 mm. (1.68 in.). The high degree of humidity prevailing in conjunction with the high temperature has been commented on in the official records, and it is thus sufficient justification for dealing here more fully with the temperature changes that occurred. Before the diurnal fall in temperature set in soon after 2 p.m. the dry bulb had climbed to  $86.5^{\circ}\text{F}$ . with a wet bulb reading of  $71.4^{\circ}\text{F}$ . (rel. hum. 45 per cent.; moisture content 13.72 grm./m.<sup>3</sup>). At 4.30 p.m. the dry and wet bulb readings were  $79.7^{\circ}\text{F}$ . and  $69.8^{\circ}\text{F}$ . respectively. With the onset of the storm rain fell heavily, and as is usual in such cases, the temperature fell rapidly. In this case a drop of  $10^{\circ}\text{F}$ . in the dry bulb to  $69.3^{\circ}\text{F}$ . occurred in less than half an hour, although the wet bulb fell only from  $69.8^{\circ}\text{F}$ . to  $67.0^{\circ}\text{F}$ . The relative humidity, which had risen slowly to 58 per cent. by 5 p.m., then rose quickly to 90 per cent. before 6 p.m. It practically reached saturation point 45 minutes later, remaining there until 6.30 a.m. on the following morning. The dry and wet bulbs also remained nearly constant at about  $66^{\circ}\text{F}$ . throughout the night, the difference between the two thermometers being not more than  $0.5^{\circ}\text{F}$ ., indicating a water vapour content in the air of approximately 16 grm./m.<sup>3</sup>, considerably greater than that prevailing in the period before the storm.

In conclusion mention should be made of two published notes which contain some interesting data bearing on the general subject of high temperatures. Dry and wet bulb temperatures together with the relative humidity, taken at Greenwich during the hot summer of 1900 are given in the *Q.J. R. Meteor. Soc.*, Vol. 27, p. 99, and provide a useful comparison with the figures for Kew shown in Table I. The second paper is a note by Marriott in the same journal, Vol. 37, p. 359, describing experiments made to determine the temperature of various objects exposed to the sunshine during the hot weather of August, 1911, when a temperature of  $112^{\circ}\text{F}$ . was recorded on a bar of iron railings exposed to the sunshine. Values of the "mean wet bulb" for a number of stations in different parts of the Empire have been published regularly in this magazine since March, 1921.

## Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, May 16th, at 49, Cromwell Road, South Kensington, Professor S. Chapman, F.R.S., Vice-President, in the Chair.

*H. J. Bigelstone.—Sixty Years Rainfall at Liverpool Observatory.*

The average rainfall over the 60-year period, 1871-1930, is 28.97 in., and when the rainfall in each of the six decades is examined it is seen that the range of fluctuation is comparatively small. In three out of six decades the average fall is within two per cent of the long-period mean. The first and last decade are the only wet ones of the series, and the overall percentage of range between any two decades is only from 95 to 107 per cent of the mean. General examination of the various tables prepared stresses the abnormality of the heavy rainfall of 1872, in which year 45.66 in. were registered. This year of unparalleled wetness was followed by one of the driest years of the series, and in fact, 1872 exerts very little influence on the grouping of consecutive wet years. Grouping of the rainfall in monthly, quarterly, and half-yearly periods exhibits a marked increase in the third or autumn quarter of the year, and in the half-yearly grouping the last six months have an appreciably larger average fall than the first. A seasonal grouping—that is from April to September and from October to the following March—gives a much more uniform distribution of annual rainfall, and in so far as the development of crops and so on is affected, this seasonal grouping is a much more reasonable one. In the sixty years, August and October have the unenviable distinction of having been most frequently the wettest months of the year. April in spite of its showery reputation has never been the wettest month in any one year.

*A. T. Doodson, F.R.S., and H. J. Bigelstone.—The Frequency Distribution of Rainfall at Liverpool Observatory.*

The distribution of rainfall at Bidston has been examined by statistical methods and the frequency curves have been deduced for various periods. These curves have been compared with those derived from similar periods of observation at Southport (Lancs.), and North Craig (Ayrshire). In all cases it is found that the frequency distribution is skew, there being a tendency for the more frequent rainfalls to be less than the mean.

The frequency curve representing rainfall on a 59 years' basis has been tabulated, and from it conclusions can be drawn with regard to the probability of rainfall.

*W. A. L. Marshall.—The mean frequency of thunder over the British Isles and surrounding areas.*

The paper gives a chart showing the average annual frequency of thunder over the British Isles and neighbouring parts of the

continent over a period of years, and also a series of smaller charts showing the average frequency in the individual months. The charts are briefly described.

*Dr. G. C. Simpson, C.B., F.R.S.—World Climate during the Quaternary Period.*

If the solar radiation were to increase from its present value there would be a general rise of temperature, increased winds, cloud and precipitation. At first the increased precipitation would result in greater accumulation of snow and the increased cloud would prevent summer melting. The polar ice caps and the ice fields on mountains would extend, spreading into lower latitudes in one case and to lower heights in the other. The steady increase of temperature, however, would soon prevent further advance of the ice and would finally lead to a disappearance of the ice owing to melting. On a subsequent reduction of solar radiation the reverse sequence would be followed: appearance and advance of ice, then a retreat of the ice due to decreasing precipitation and so back to present conditions with small ice fields both at the poles and on the mountains. Thus such an oscillation of solar radiation would give rise in high latitudes to two glacial epochs, and to two interglacial epochs, one of which would be warm and wet and the other cold and dry; while in low latitudes there would be a single pluvial period with its maximum synchronous with the maximum of the solar radiation and with the warm and wet interglacial.

Two such cycles of solar radiation have occurred during the Pleistocene Period. In high latitudes the first cycle gave rise to the Günz glacial epoch; the Günz-Mindel interglacial, which was warm and wet; the Mindel glacial; and the Mindel-Riss interglacial, which was cold and dry. The following cycle gave rise to the Riss glacial; the warm and wet Riss-Würm interglacial; the Würm glacial, and finally the present cold and dry interglacial.

The polar ice sheet in the glacial epochs was not symmetrical about the North Pole, but extended much further south in the Atlantic than the Pacific segment. This was due to the fact that the vast accumulations of ice in the Arctic Ocean were discharged into the Atlantic through the gap between Greenland and Norway with the consequence that the Atlantic became full of floating ice. There was no such discharge into the Pacific, where owing to the increased solar radiation the temperature was higher than at present. The geological record gives evidence of this sequence of climate. The four glacial epochs are well marked in the Alps and can be recognised in many other localities. That the Günz-Mindel and the Riss-Würm interglacial epochs were warmer than the Mindel-Riss and the present interglacials is clearly shown by the occurrence in both the former of fauna and flora which now live in much lower latitudes

and did not exist in the same localities in the Mindel-Riss interglacial epoch. The increase in the precipitation during the Riss-Würm interglacial is shown by the great spreads of gravel in the terraces of the Thames and continental rivers associated with the "warm" fauna and flora and the Acheulean artifacts which are characteristics of this interglacial.

In low latitudes each oscillation of solar radiation gave rise to a pluvial period, so that there were two pluvial periods associated with the four glacial epochs. The first pluvial period corresponded with the Günz and Mindel glacial epochs and the intermediate Günz-Mindel warm and wet interglacial; the second pluvial period corresponded with the Riss and Würm glacial epochs and their intermediate interglacial. The minimum of solar radiation between the two oscillations corresponded with the long cold and dry Mindel-Riss interglacial epoch, and we are at present approaching a minimum and our climate is again cold and dry.

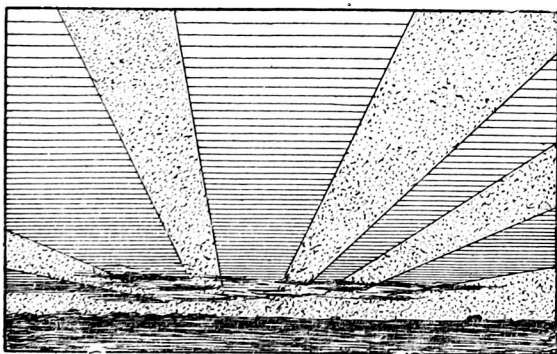
From the geological record it is estimated that at the maximum of the solar radiation the temperature was between  $5^{\circ}\text{C}$ . and  $10^{\circ}\text{C}$ . warmer than at present, and that the cloud amount was increased from the present .5 to between .7 or .8. From these data it is calculated that the sun is a variable star with an amplitude of 20 per cent (range 40 per cent) in the intensity of the radiation and a period of the order of 100,000 years.

## Correspondence

To the Editor, *The Meteorological Magazine*.

### Strange Sunset Effect

On October 11th, 1933, a strange sunset effect was observed at 17h. 35m. G.M.T. Shafts of pale-rose light alternating with



blue shadow-beams, radiated from a point on the eastern horizon diametrically opposite the sun (now set some 20 minutes). The light was registered on what appeared to be a nebula of false-cirrus homogeneously diffused over the

sky. The effect did not extend beyond the zenith and there was no comparable phenomenon in the west. The radial spacing of the beams in the diagram taken from a sketch made at the time is accurate.

W. L. BAXTER.

R.A.E., South Farnborough, Hants. March 17th, 1934.

### Optical Phenomena seen from Birmingham

Below is a description of optical phenomena which I observed yesterday, May 7th. I think the display justifies mention on account of the extreme brilliance. Observations were made from the ground of the Cymric Tennis Club at Handsworth Wood, on the outskirts of Birmingham and due north of it. After midday the halo of  $22^\circ$  was almost continuously visible, and at 16h. 36m. G.M.T. the left parhelion shone out and lasted for four minutes. At this time there was a gentle W. wind and the sky was nearly covered with cirro-stratus, below which was a little low cloud.

At 17h. 10m. the halo of  $46^\circ$  showed faintly outside the  $22^\circ$  halo, and a slight trace of what I took to be the circumzenithal arc appeared. This last soon faded out. The clouds were now getting thinner, and at 17h. 35m. in a patch of sky apparently quite free of cloud the circumzenithal arc made its appearance. It was brighter than any halo I have ever seen, even the  $22^\circ$  halo (I should mention that my experience of chionisms only began in 1926). The angle subtended at the zenith must have been fully a radian, and the colours were of the extreme purity associated with this arc. The violet showed up particularly well, even against the deep blue background of the sky.

Besson states that the length of time the arc is observed is about 5 minutes. On this occasion it lasted about 19 minutes. From 17h. 35m. to 17h. 45m. it was visible alone, the halos having disappeared; at 17h. 45m. parts of the  $46^\circ$  halo were seen, and at 17h. 55m. the  $22^\circ$  halo. After 18h. only the  $22^\circ$  halo remained, as is usual after a display of the more unusual optical phenomena. Throughout there was the added beauty of a continually varying display of iridescence on the lower clouds.

S. E. ASHMORE.

22, *Soho Road, Handsworth, Birmingham*, 21. *May 8th, 1934.*

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### Halo Phenomena, Whit Sunday

On May 19th at 14h. the  $22^\circ$  halo with upper contact arc was noted.

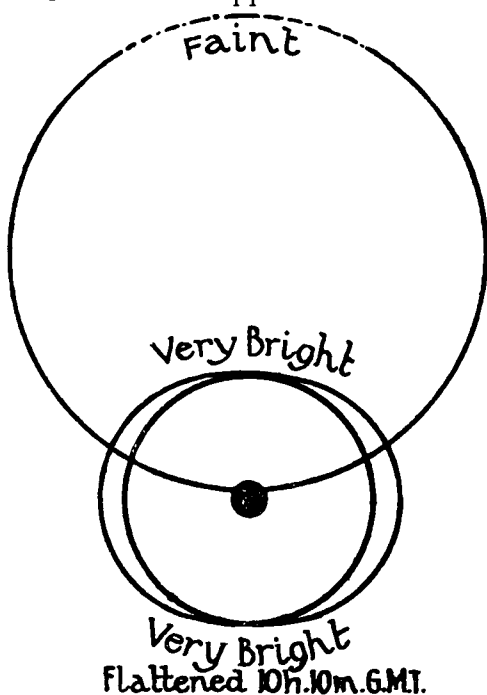
On May 20th, Whit Sunday, at 8h., the  $22^\circ$  halo with upper contact arc was seen again. There was a faint right parhelion. About 9h. 30m. the lower arc began to appear, and by 10h. the circumscribed halo was fully developed and bright especially at the points of contact with the  $22^\circ$  halo. In addition a large portion of the parhelic circle was to be seen. Lack of time prevented exact measurements, but the circle could be traced on both sides right up to the glare surrounding the sun, and also for some considerable distance outside the halo, especially on the

right side. At 11h. 40m. the  $22^\circ$  halo was still visible but lower clouds intervened.

CICELY M. BOTLEY.

*Guildables, 17, Holmesdale Gardens, Hastings. May 20th, 1934.*

At 10h. 10m. G.M.T. on the morning of May 20th, the following phenomenon was observed here. It consisted of the ordinary halo with the upper and lower tangent arcs which formed an elliptical halo outside the ordinary circular one. The whole was very distinct, and the upper and lower junctions of the arcs with the halo were very brilliant and prismatic; the lower one was decidedly flattened where it joined the halo. In addition to this a more or less complete parhelic circle was visible at the same time; this was very faint, and was only discovered to be present with the aid of the black mirror, as the sun was shining rather brightly through a film of cirro-nebula. It was particularly noted that the parhelic circle passed inside the halos towards the sun, as indicated in the accompanying drawing. Indeed, this section of the parhelic circle was more readily discernible than that outside the halos. The phenomenon was visible until just before 10h. 55m. when cloud rapidly thickened and only an ordinary halo was visible. A solar halo was first observed as early as 7h. 40m.



ing drawing. Indeed, this section of the parhelic circle was more readily discernible than that outside the halos. The phenomenon was visible until just before 10h. 55m. when cloud rapidly thickened and only an ordinary halo was visible. A solar halo was first observed as early as 7h. 40m.

At 14h. 40m., in a sheet of smooth altostratus, a very fine and brilliant solar corona was observed, consisting of two rings of colours, red being outermost. This corona extended for several degrees outwards from, and formed a complete circle round, the sun. It was quite distinct, however, from the extensive patches of colour occasionally seen on the edges of certain forms of cirrocumulus, or a high type of alto-cloud (usually observed

during the summer months), frequently referred to as iridescence.

A. E. MOON.

39, Clive Avenue, Clive Vale, Hastings. May 26th, 1934.

A very beautiful halo with mock suns and partial mock sun ring was witnessed at Lympne on Whit Sunday, May 20th, 1934. A partial faint ring was observed at 6h. 30m. G.M.T., which persisted until 13h. 15m. and increased in intensity as the sun rose, reaching maximum brilliance at 10h. 45m., when the halo was completed. Its radius was  $22^\circ$  of a great circle and the colours red, orange, and yellow were very clear and easily recognisable, with a dazzling white on the edge furthest from the sun. An unusual feature of the colours was the fact that they appeared only in the north-west quadrant of the halo, the remainder of the ring being a dazzling white.

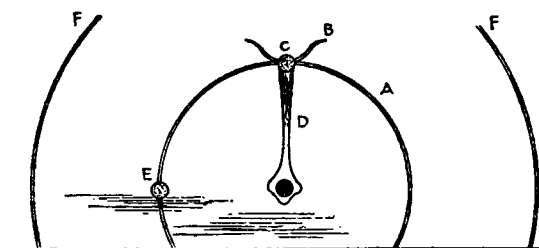
The mock sun ring also appeared only in the north-west quadrant, and was distinctly visible passing through the sun and forming a mock sun at the point of its intersection with the halo. This ring did not continue to pass beyond the sun's centre. A further mock sun, with less intensity, appeared for a short while on the opposite side of the sun but, strange to say, this one definitely appeared to be a good way "off" the mock sun ring. Was this due to an optical illusion or to the effect of cirrus cloud, of which the sky was nine-tenths covered?

D. F. BOWERING.

Lympne Airport, Hythe, Kent. May 31st, 1934.

### Halo Complex in Holland, May 26th

A remarkable halo complex was visible near Nijmegen, Holland, on the evening of May 26th. About 7.45 p.m. B.S.T. a well-



developed halo of  $22^\circ$  appeared; the left-hand side especially was brightly coloured and showed a mock sun at the point E of the sketch. At the same time there was a rudimentary cross of

light about the sun, the vertical arm having a length of five or six degrees.

Towards 8 p.m. the left-hand mock sun faded, but the  $22^\circ$  halo remained well developed A with the upper tangent arc B and another mock sun at the point of contact C. At the same time the vertical arm of the solar cross extended upwards to this mock sun; it had a striking shape as shown by D in the

figure. On each side of the  $22^\circ$  halo appeared a large arc of the  $46^\circ$  halo F also brilliantly developed.

The display was also watched by Dr. C. Braak of the Netherlands Meteorological Institute, who was with me on the train at the time.

C. E. P. Brooks.

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## NOTES AND QUERIES

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### German Meteorological Service

According to the German Press, a Government Order, dated April 6th, 1934, organises the whole work of the meteorological service of Germany (excluding the educational and research work of colleges and schools) under the administration of the Air Minister. The Air Minister will be responsible for all "applied meteorology," including aviation, agriculture, marine, upper air and climatic services. The marine service was formerly maintained by the Deutsche Seewarte at Hamburg, while the agricultural and climatic services were maintained in various ways by the governments of the constituent states or even individual towns. The new decree establishes the basis for a uniform meteorological service for the whole of Germany.

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### Geophysical Observatory on the Pamir

We learn from a note by L. Breiffuss in *Petermann's Mitteilungen* that with a view to studying the water supply of the Amu Daria, which is supplied by the glaciers of the Pamir and is important for the cotton, fruit, and vine plantations of Turkestan, an observatory has been erected on the Fedtschenko Glacier, in Russian Turkestan,  $38^\circ 50' N.$ ,  $72^\circ 20' E.$ , at a height of 4,700 m. The work was commenced in October, 1933, and in spite of the bitter cold the building was completed by the end of December. Observations have already begun.

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### Whirlwind at Ilford on May 26th

On the afternoon of Saturday, May 26th, a small whirlwind developed at Ilford. It first appeared in Valentines Park as a column of dust and pieces of paper about 100 feet high, travelling southwards. It passed through a group of children, whipping off the girls' hats and drawing them high into the air, while some of the children were blown over. The track then turned towards the south-west, and crossing the tennis courts, the whirl lifted boxes of tennis balls over the wire netting into the cricket ground, where a match was in progress. Here chairs were overturned and a fielder was thrown to the ground. The whirlwind then turned sharply to the left, regaining its original southerly direction. It caught a heavy wooden sight-

screen, which requires two men to push it, and lifted it bodily, throwing it into an iron-rail fence, which was broken by the impact. The whirlwind then passed away across the car park and over the lake.

The *Daily Weather Report* for May 26th shows a well-developed anticyclone centred west of Ireland, where pressure exceeded 1032 mb. The winds over south-east England were between north and north-east, so that the track of the whirl followed the general drift of the air. Temperatures on the ground were moderate, and upper air temperatures showed no particularly abnormal conditions. At South Farnborough and Hamburg the lapse rate in the lowest 1,000 feet was rather steep, but this was not the case at Duxford.

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## Obituary

*Heer Peter Helbert Gallé.*—We regret to learn of the death on May 9th, 1934, of Heer P. H. Gallé, well known for his work on the climatology of the sea. Gallé was born in 1874 and after four years' training at the K. Instituut voor de Marine at The Helder, at the age of twenty he was appointed to the Royal Navy of Holland, serving with distinction both in Holland and the East Indies. In 1906 he was appointed Assistant-Director of the Koninklijk Nederlandsch Meteorologisch Instituut at De Bilt, his duties being especially concerned with marine meteorology, and in this capacity he attended the conference on Safety of Life at Sea in London in 1913 and 1914. He published a number of monographs on temperatures, winds and currents in the Indian and Atlantic Oceans, based on the rich store of material accumulated at De Bilt, and his paper "On the relation between fluctuations in the strength of the trade winds in the North Atlantic in summer and departures from the normal of the winter temperature in Europe," published in 1916, caused some discussion. In 1919 Gallé was appointed Director of the Oceanographical Branch of the Meteorological Institute, which has its office at Amsterdam, where he brought out his book on the "Climatology of the Indian Ocean," published in seven sections between 1924 and 1930. He received many distinctions including the Gold de Ruyter medal. His relations with his colleagues were always pleasant and his loss will be deeply regretted.

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*Professor William Morris Davis.*—We regret to learn of the death of Professor W. M. Davis at the age of nearly 84 at Pasadena, California, on February 6th. Professor Davis was a physical geographer who for about ten years, 1884 to 1894, devoted himself to the subject of meteorology. At first his chief interest was the study of winds and storms, particularly

thunderstorms, and he wrote many papers on this subject, but later he turned to other aspects of meteorology. In 1894 his book of *Elementary Meteorology*, which is still used as a text book in United States colleges, was published. He was a stimulating teacher and was active as a founder and member of the New England Meteorological Society. In recognition of his services to meteorology and his help in the founding of the American Meteorological Society, Professor Davis was elected in 1928 an honorary life member of this society—the only man to hold this distinction.

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### News in Brief

Dr. G. C. Simpson, C.B., F.R.S., has been elected a Corresponding Member of the Academy of Science, Vienna.

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The Royal Aeronautical Society has awarded the Simms Gold Medal to Sir Gilbert Walker for his paper on cloud formation.

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The Birthday Honours List includes the name of Mr. G. W. E. Loder, J.P., M.A., who since 1915 has regularly forwarded observations from his climatological station at Ardingley, Sussex. Mr. Loder is raised to the peerage with the title of Baron.

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We learn that Dr. J. Maurer has retired from the directorship of the Schweizerische Meteorologische Zentralstalt. He is succeeded as Director by Dr. P. L. Mercanton, Professor at the University of Lausanne.

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Mr. T. Schumann has been appointed Chief Meteorologist, Dept. of Irrigation, Pretoria, S. Africa, as from November, 1933.

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Mr. Alfred Westley, of Blisworth, Northamptonshire, has 27 copies of *British Rainfall*, 1894 to 1920, which he desires to sell. Anyone interested should communicate direct with Mr. Westley.

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### Errata

May, 1934, photograph facing p. 93. Title under the photograph *should read* "Refraction at sea on the way to Nain, Labrador" and *for* "facing p. 9" *read* "facing p. 93."

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## The Weather of May, 1934

Pressure was below normal over western and southern United States, Alaska, eastern Canada, Greenland, Spitsbergen, Iceland, northern Europe and Madeira, the greatest deficits being 8.7 mb. at Point Barrow and 8.3 mb. at Reykjavik. Pressure was above normal in a small area in western Canada, Mexico, north-east United States, Newfoundland, and across the North Atlantic to western, central, southern and eastern Europe and

northern Africa, the greatest excess being 4.6 mb. at Valentia. Temperature was above normal generally but below normal in south-west Europe. Rainfall was in excess in Spitsbergen and northern Norway and southern Sweden but deficient in central Europe and only about 20-40 per cent in Norrland, Sweden.

The weather of May over the British Isles was mainly dry in the south and unsettled in the north, the outstanding features being the high temperatures experienced on the 11th and in south and south-east England also on the 12th, and the absolute drought in places in eastern and south-eastern England and the Midlands from the 16th or 17th onwards. On the 1st rain fell in Scotland, but on the 2nd and 3rd mainly dry fine conditions prevailed, except locally in the south-east, over the whole country, though fog occurred at many places on the 1st and 2nd. At Spurn Head the temperature did not rise above 46°F. on the 1st owing to fog, while 70° was recorded at South Farnborough and Ross-on-Wye. Thunderstorms occurred on the 2nd and 4th. From the 4th to 9th depressions passing across the country gave unsettled weather but with bright intervals. On the 6th the southerly winds reached gale force in parts of Scotland, Ireland, and north England, a gust of 77 m.p.h. being recorded at Valentia. The rainfall was generally slight during this period, though heavy rain fell locally on the 4th and 6th, 2.11 in. at Watendlath, Cumberland, and 1.43 in. at Tairbull, Brecon, on the 6th. After the 8th the depressions passed further north and high pressure spread northwards over the country so that from the 10th to 13th fine dry warm weather prevailed over England, but cloudy mild conditions occurred in Scotland and Ireland becoming unsettled there on the 12th. Temperatures were high generally, 84°F. was recorded at Cambridge on the 11th, 82°F. at South Farnborough and 81°F. at Tottenham and Southampton on the 12th. A trough of low pressure brought cooler conditions locally early on the 12th in the north and later in the Midlands where it was accompanied by thunder. The sunniest day of this period was the 11th when 14.5 hrs. were recorded at Eastbourne and 14.4 hrs. at Torquay. From the 13th to 21st depressions passing across the country, first south-eastwards and then north-eastwards, caused cool unsettled weather with bright periods. Hardly any rain fell in the south, but heavy rain occurred locally in the north and west; 2.08 in. fell at Snowdon (Carnarvon) and 1.82 in. at Borrowdale (Cumberland) on the 15th. Snow and sleet occurred generally, and gales locally in Scotland, sleet and hail fell in the Midlands, while thunderstorms were reported on the 13th, 14th and 16th from south and east England. Ground frosts were experienced frequently. On the 21st the anticyclone over France moved northwards and from then to the 31st anticyclonic conditions prevailed with mainly fair weather though much

cloud developed at times in the north and west with slight rain or drizzle. The 24th, 26th, 27th, 30th and 31st were all very sunny days, 15.0 hrs. bright sunshine were recorded at Weymouth on the 24th, at Valentia on the 26th, and at Falmouth and Cardiff on the 27th, 15.1 hrs. at Lowestoft on the 30th, and 15.0 hrs. at Dalwhinnie on the 31st. The distribution of bright sunshine for the month was as follows:—

	Total	Diff. from		Total	Diff. from
	(hrs.)	normal		(hrs.)	normal
Stornoway	151	—30	Liverpool	153	—46
Aberdeen	188	+15	Ross-on-Wye	211	+18
Dublin	182	— 5	Falmouth	243	+28
Birr Castle	159	—15	Gorleston	207	—22
Valentia	154	—35	Kew	201	— 2

*Miscellaneous notes on weather abroad culled from various sources.*

A cloudburst accompanied by hail destroyed the vines and crops at Orjaïs near Covilhan, Portugal, on the 11th, and a storm of hail, rain, wind and thunder of unusual violence occurred at Rome on the 12th. A violent hailstorm wrought great havoc among the vineyards of Tokay and the surrounding district of the Hegyalja on the 17th, but the plentiful rain all over Hungary during the previous two days saved the grain harvest. Night frosts caused much damage to the vineyards in the side-valleys of the Moselle about the 20th. Crops have been lost in some of the southern regions of Russia owing to drought. (*The Times*, May 14th-29th.)

Severe gales were experienced at Karachi on the 9th. A cloudburst at noon on the 14th destroyed a portion of the old part of Tiberias on the Sea of Galilee. Two inches of rain fell in 45 minutes and 25 people were killed. Another cloudburst on a similar scale occurred at noon on the following day. The monsoon rain had not reached Burma by the 21st, which constitutes a record for nearly 50 years. Little rain fell in the Madras Presidency, and a heat-wave was experienced towards the end of the month. (*The Times*, May 12th-June 1st.)

Rainfall in South Australia this year was 4 in. short of the average towards the end of May. (*The Times*, May 29th.)

About the 9th and 10th duststorms occurred over Saskatchewan, where the previous week-end snow ploughs had had to be used to clear the roads and railways. These duststorms developed in intensity over western Canada and western United States and then spread eastwards. A heat-wave was experienced in Canada in the later part of the month accompanied by forest fires, but rain fell in north-west Quebec and north Ontario about the 28th and the heat-wave had broken by the 31st. Copious rain also fell on the 30th in north Alberta, but in the central regions drought still prevailed. In the United

(Continued on p. 132)

**Rainfall: May, 1934: England and Wales.**

Co.	STATION	In.	Per- cent. of Av.	Co.	STATION	In.	Per- cent. of Av.
<i>Lond.</i>	Camden Square .....	·46	26	<i>Leics.</i>	Thornton Reservoir ...	·96	48
<i>Sur.</i>	Reigate, Wray Pk. Rd.	·58	31	„	Belvoir Castle.....	·72	34
<i>Kent.</i>	Tenterden, Ashenden...	·61	39	<i>Kut.</i>	Ridlington .....	·71	35
„	Folkestone, Boro. San.	1·09	...	<i>Lincs.</i>	Boston, Skirbeck .....	·80	45
„	Eden'bdg., Falconhurst	·76	41	„	Cranwell Aerodrome ...	·50	28
„	Sevenoaks, Speldhurst	·67	...	„	Skegness, Marine Gdns	·93	55
<i>Sus.</i>	Compton, Compton Ho.	·66	30	„	Louth, Westgate .....	1·19	59
„	Patching Farm .....	·44	24	„	Brigg, Wrawby St. ...	·94	...
„	Eastbourne, Wil. Sq.	·49	30	<i>Notts.</i>	Worksop, Hodsock ...	1·02	51
„	Heathfield, Barklye ...	·68	38	<i>Derby.</i>	Derby, L. M. & S. Rly.	·77	40
<i>Hants.</i>	Ventnor, Roy. Nat. Hos.	·78	46	„	Buxton, Terr. Slopes	3·22	104
„	Fordingbridge, Oaklands	·93	45	<i>Ches.</i>	Runcorn, Weston Pt...	1·82	79
„	Ovington Rectory .....	1·24	57	<i>Lancs.</i>	Manchester, Whit. Pk.	1·91	90
„	Sherborne St. John ...	·82	42	„	Stonyhurst College ...	4·28	150
<i>Herts.</i>	Welwyn Garden City...	·68	37	„	Southport, Hesketh Pk	3·26	156
<i>Bucks.</i>	Slough, Upton .....	·39	23	„	Lancaster, Greg Obsy.	4·58	185
„	H. Wycombe, Flackwell	·42	23	<i>Yorks.</i>	Wath-upon-Deerne ...	·92	45
<i>Oxf.</i>	Oxford, Mag. College...	·69	39	„	Wakefield, Clarence Pk.	·90	46
<i>Nor.</i>	Pitsford, Sedgebrook...	·77	40	„	Oughtershaw Hall.....	6·24	...
„	Oundle.....	·49	...	„	Wetherby, Ribston H.	1·36	66
<i>Beds.</i>	Woburn, Exptl. Farm...	·48	25	„	Hull, Pearson Park ...	·81	42
<i>Cam.</i>	Cambridge, Bot. Gdns.	...	...	„	Holme-on-Spalding ...	1·37	68
<i>Essex.</i>	Chelmsford, County Lab	·51	35	„	West Witton, Ivy Ho.	2·00	89
„	Lexden Hill House ...	·99	...	„	Felixkirk, Mt. St. John	·84	45
<i>Suff.</i>	Haughley House.....	1·04	...	„	York, Museum Gdns.	1·00	50
„	Campsea Ashe.....	1·88	125	„	Pickering, Hungate ...	1·18	60
„	Lowestoft Sec. School	1·22	76	„	Scarborough .....	1·10	58
„	Bury St. Ed. Westley H.	·75	41	„	Middlesbrough .....	·66	34
<i>Norfol.</i>	Wells, Holkham Hall	1·76	109	„	Baldersdale, Hury Res.	...	...
<i>Wilts.</i>	Calne, Castleway .....	·89	47	<i>Durh.</i>	Ushaw College .....	1·96	91
„	Porton, W.D. Exp'l. Stn	·78	45	<i>Nor.</i>	Newcastle, Town Moor	1·08	53
<i>Dor.</i>	Evershot, Melbury Ho.	1·20	59	„	Bellingham, Highgreen	1·73	72
„	Weymouth, Westham .	·68	42	„	Lilburn Tower Gdns...	1·62	70
„	Shaftesbury, Abbey Ho.	·76	36	<i>Cumb.</i>	Carlisle, Scaleby Hall	2·80	117
<i>Devon.</i>	Plymouth, The Hoe ...	2·27	110	„	Borrowdale, Seathwaite	11·75	170
„	Holne, Church Pk. Cott.	2·64	83	„	Borrowdale, Moraine...	9·21	166
„	Teignmouth, Den Gdns.	·96	52	„	Keswick, High Hill...	5·18	162
„	Cullompton.....	1·66	77	<i>West.</i>	Appleby, Castle Bank	...	...
„	Sidmouth, U.D.C. ...	·81	...	<i>Mon.</i>	Abergavenny, Larchfd	1·62	61
„	Barnstaple, N. Dev. Ath	1·54	74	<i>Glam.</i>	Ystalyfera, Wern Ho.	4·09	117
„	Dartm'r, Cranmere Pool	4·20	...	„	Cardiff, Ely P. Stn. ...	1·57	63
„	Okehampton, Uplands	3·26	121	„	Treherbert, Tynywaun	5·16	...
<i>Corn.</i>	Redruth, Trewirgie ...	2·43	105	<i>Carm.</i>	Carmarthen, Priory St.	...	...
„	Penzance, Morrab Gdn.	1·65	75	<i>Pemb.</i>	Haverfordwest, School	2·38	95
„	St. Austell, Trevarna...	1·74	72	<i>Card.</i>	Aberystwyth .....	4·22	...
<i>Soms.</i>	Chewton Mendip .....	1·52	55	<i>Rad.</i>	Birm W.W. Tyrmynydd	3·09	90
„	Long Ashton .....	1·46	69	<i>Mont.</i>	Lake Vyrnwy.....	4·05	129
„	Street, Millfield.....	·99	52	<i>Flint.</i>	Sealand Aerodrome ...	1·43	76
<i>Glos.</i>	Blockley .....	·74	...	<i>Mer.</i>	Dolgelley, Bontddu ...	5·93	179
„	Cirencester, Gwynfa ...	·98	48	<i>Carn.</i>	Llandudno .....	3·17	178
<i>Here.</i>	Ross, Birchlea.....	1·43	67	„	Snowdon, L. Llydaw 9	12·35	...
<i>Salop.</i>	Church Stretton.....	2·14	83	<i>Ang.</i>	Holyhead, Salt Island	3·87	197
„	Shifnal, Hattton Grange	·99	48	„	Lligwy.....	4·39	...
<i>Staffs.</i>	Market Drayt'n, Old Sp.	1·04	47	<i>Isle of Man</i>			
<i>Worc.</i>	Ombersley, Holt Lock	1·00	49	„	Douglas, Boro' Cem. ...	3·36	133
<i>War.</i>	Alcester, Ragley Hall..	·92	45	<i>Guernsey</i>			
„	Birmingham, Edgbaston	·92	43	„	St. Peter P't. Grange Rd	1·42	83

## Rainfall: May, 1934: Scotland and Ireland.

Co.	STATION	In.	Per- cent. of Av.	Co.	STATION	In.	Per- cent. of Av.
<i>Wig</i>	Pt. William, Monreith	3.94	167	<i>Suth</i>	Melvich .....	2.75	134
"	New Luce School.....	4.66	164	"	Loch More, Achfary...	7.13	162
<i>Kirk</i>	Dalry, Glendarroch ...	3.94	125	<i>Caith</i>	Wick .....	1.76	85
"	Carsphairn, Shiel .....	6.23	148	<i>Ork</i>	Deerness .....	2.16	108
<i>Dumf.</i>	Dumfries, Crichton, R.I.	2.67	103	<i>Shet</i>	Lerwick .....	2.67	128
"	Eskdalemuir Obs. ....	4.79	145	<i>Cork</i>	Caheragh Rectory .....	3.58	...
<i>Roxb</i>	Branhholm .....	3.03	135	"	Dunmanway Rectory .	4.06	119
<i>Selk</i>	Ettrick Manse.....	4.19	114	"	Cork, University Coll.	1.98	88
<i>Peeb</i>	West Linton .....	2.84	...	"	Ballinacurra .....	2.17	91
<i>Berw</i>	Merichmont House.....	1.83	74	"	Mallow, Longueville ...	2.34	105
<i>E. Lot</i>	North Berwick Res....	1.43	72	<i>Kerry</i>	Valentia Obsy.....	2.26	71
<i>Midl</i>	Edinburgh, Roy. Obs.	1.24	61	"	Gearhameen .....	4.40	84
<i>Lan</i>	Auchtyfardle .....	2.66	...	"	Darrynane Abbey .....	2.15	72
<i>Ayr</i>	Kilmarnock, Kay Pk. .	3.43	...	<i>Wat</i>	Waterford, Gortmore...	2.83	123
"	Girvan, Pinmore.....	4.95	166	<i>Tip</i>	Nenagh, Cas. Lough ..	2.40	97
<i>Renf</i>	Glasgow, Queen's Pk. .	...	...	"	Roscrea, Timoney Park	1.15	...
"	Greenock, Prospect H.	3.82	111	"	Cashel, Ballinamona...	1.87	78
<i>Bute</i>	Rothesay, Ardencraig.	3.88	...	<i>Lim</i>	Foynes, Coolnanes.....	2.00	86
"	Dougarie Lodge.....	3.85	...	"	Castleconnel Rec.....	2.23	...
<i>Arg</i>	Ardgour House .....	7.09	...	<i>Clare</i>	Inagh, Mount Callan...	4.01	...
"	Glen Etive .....	8.24	165	"	Broadford, Hurdlest'n.	2.26	...
"	Oban .....	3.62	...	<i>Wexf.</i>	Gorey, Courtown Ho...	2.44	110
"	Poltalloch .....	4.79	166	<i>Wick</i>	Rathnew, Clonmannon	2.33	...
"	Inveraray Castle .....	6.48	165	<i>Carl</i>	Hacketstown Rectory..	2.53	97
"	Islay, Eallabus .....	3.47	131	<i>Leix</i>	Blandsfort House .....	1.78	73
"	Mull, Benmore .....	14.50	194	"	Mountmellick.....	1.62	...
"	Tiree .....	2.85	114	<i>Offaly</i>	Birr Castle .....	2.00	90
<i>Kinr</i>	Loch Leven Sluice.....	2.17	89	<i>Dublin</i>	Dublin, FitzWm. Sq...	1.78	87
<i>Perth</i>	Loch Dhu .....	...	...	"	Balbriggan, Ardgillan.	1.51	73
"	Balquhider, Stronvar	3.58	...	<i>Meath</i>	Beauparc, St. Cloud...	1.68	...
"	Crieff, Strathearn Hyd.	2.07	83	"	Kells, Headfort.....	2.17	80
"	Blair Castle Gardens...	2.78	137	<i>W. M.</i>	Moate, Coolatore .....	1.85	...
<i>Angus</i>	Kettins School .....	1.87	69	"	Mullingar, Belvedere...	2.11	86
"	Pearsie House .....	2.62	...	<i>Long</i>	Castle Forbes Gdns...	2.69	104
"	Montrose, Sunnyside...	1.88	92	<i>Gal</i>	Galway, Grammar Sch.	3.50	...
<i>Aber</i>	Braemar, Bank .....	2.99	126	"	Ballynahinch Castle...	3.94	109
"	Logie Coldstone Sch....	2.91	117	"	Ahascragh, Clonbrock.	2.81	101
"	Aberdeen, King's Coll.	3.45	148	<i>Mayo</i>	Blacksod Point .....	3.74	133
"	Fyvie Castle .....	2.63	102	"	Mallaranny.....	4.62	...
<i>Moray</i>	Gordon Castle.....	2.57	121	"	Westport House.....	2.48	87
"	Grantown-on-Spey.....	...	...	"	Delphi Lodge.....	7.31	121
<i>Nairn</i>	Nairn .....	1.98	110	<i>Sligo</i>	Markree Obsy.....	3.07	112
<i>Inv's</i>	Ben Alder Lodge.....	3.69	...	<i>Cavan</i>	Crossdoney, Kevit Cas.	3.02	...
"	Kingussie, The Birches	2.69	...	<i>Ferm</i>	Enniskillen, Portora...	2.80	...
"	Inverness, Culduthel R.	2.02	...	<i>Arm</i>	Armagh Obsy.....	2.80	118
"	Loch Quoich, Loan.....	...	...	<i>Down</i>	Fofanny Reservoir.....	4.57	...
"	Glenquoich .....	...	...	"	Seaforde .....	3.25	124
"	Arisaig, Faire-na-Sguir	...	...	"	Donaghadee, C. Stn....	3.00	132
"	Fort William, Glasdrum	5.80	...	"	Banbridge, Milltown...	2.22	99
"	Skye, Dunvegan.....	3.81	...	<i>Antr</i>	Belfast, Cavehill Rd...	3.76	...
"	Barra, Skallary .....	3.05	...	"	Aldergrove Aerodrome	2.83	125
<i>R &amp; C</i>	Alness, Ardross Castle	2.81	108	"	Ballymena, Harryville	4.11	144
"	Ullapool .....	2.41	94	<i>Lon</i>	Garvagh, Moneydig ...	2.96	...
"	Achnashellach .....	7.07	158	"	Londonderry, Creggan	3.22	123
"	Stornoway .....	2.61	102	<i>Tyr</i>	Omagh, Edenfel.....	3.75	145
<i>Suth</i>	Lairg .....	2.42	95	<i>Don</i>	Malin Head.....	2.56	...
"	Tongue .....	2.56	107	"	Killybegs, Rockmount.	...	...

## Climatological Table for the British Empire, December, 1933

STATIONS	PRESSURE			TEMPERATURE								Mean Cloud Am't	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	mb.	Absolute		Mean Values					Rela- tive Humi- dity %		Am't in.	Diff. from Normal	Days	Hours per day	Per- cent- age of possible
				Max.	Min.	Max.	Min.	1/2 max. and min.	Diff. from Normal	Wet Bulb							
London, Kew Obsy. . .	1021.8	+ 8.1	44	25	38.5	32.0	35.3	- 5.0	32.6	82	8.1	0.32	1.97	5	0.6	8	
Gibraltar.....	1016.5	+ 3.8	66	35	58.3	45.1	51.7	- 4.3	45.7	81	5.3	8.56	3.14	16	..	..	
Malta.....	1012.5	- 3.7	69	43	62.1	53.0	57.5	- 0.4	52.4	73	6.3	5.42	1.71	15	5.8	60	
St. Helena.....	1011.5	- 1.4	68	55	64.4	56.7	60.5	- 1.2	57.5	94	9.5	0.77	..	14	..	..	
Freetown, Sierra Leone	1012.7	+ 1.3	89	64	85.6	67.6	76.6	- 4.8	72.4	73	2.0	1.23	0.19	6	..	..	
Lagos, Nigeria.....	1009.5	- 0.5	90	70	87.1	75.0	81.1	- 0.7	74.4	83	4.8	0.97	0.16	2	7.2	62	
Kaduna, Nigeria.....	..	..	99	53	92.4	57.8	75.1	+ 1.8	59.2	53	1.6	0.00	0.00	0	9.3	81	
Zomba, Nyasaland ..	1008.8	+ 0.5	83	52	77.9	63.9	70.9	- 2.2	66.1	78	8.0	11.04	0.17	23	..	..	
Salisbury, Rhodesia ..	1011.2	- 0.5	82	51	76.7	58.0	67.3	- 2.3	61.7	68	6.5	5.21	0.88	13	5.9	45	
Cape Town.....	1013.4	- 0.9	96	57	82.3	62.4	72.3	+ 4.4	62.7	61	3.8	0.04	0.77	2	..	..	
Johannesburg .....	1011.7	+ 0.7	87	43	74.6	53.9	64.3	- 1.2	56.9	68	5.8	5.94	0.51	14	6.9	50	
Mauritius .....	1013.4	- 0.6	90	64	85.3	70.2	77.7	- 0.6	72.3	65	6.6	2.00	2.73	17	8.5	64	
Calcutta, Alipore Obsy.	1014.0	- 1.7	82	54	77.9	57.8	67.9	+ 1.4	58.9	87	1.3	0.00	0.24	0*	..	..	
Bombay .....	1012.0	- 1.5	92	65	86.2	69.5	77.9	+ 0.5	67.5	73	2.1	0.93	0.88	3*	..	..	
Madras .....	1011.7	- 1.8	85	63	82.6	68.9	75.7	- 1.0	71.6	87	5.8	15.00	9.65	6*	..	..	
Colombo, Ceylon ..	1010.2	- 0.1	88	66	84.8	71.7	78.3	- 1.2	73.8	74	4.9	1.16	3.96	5	7.7	66	
Singapore .....	1009.0	- 0.7	89	69	84.7	71.5	78.1	- 1.8	74.8	82	7.2	4.49	6.07	18	4.4	37	
Hongkong .....	1017.3	- 2.4	77	55	70.4	61.4	65.9	+ 2.9	60.0	71	4.2	1.37	0.34	5	6.7	62	
Sandakan .....	1008.2	..	91	71	88.7	74.2	81.5	+ 1.3	76.8	84	7.9	9.25	9.39	22	..	..	
Sydney, N.S.W. ....	1013.9	+ 2.0	90	55	75.4	62.4	68.9	- 1.2	64.2	69	6.2	3.33	0.47	18	8.0	56	
Melbourne .....	1014.3	+ 1.6	90	47	74.7	56.3	65.5	+ 0.7	59.4	64	6.8	4.74	2.47	13	6.6	45	
Adelaide .....	1014.9	+ 1.7	102	49	81.6	57.9	69.7	- 1.4	58.4	40	4.3	0.38	0.17	7	9.9	69	
Perth, W. Australia ..	1013.6	+ 0.4	108	52	83.9	62.9	73.4	+ 2.6	63.1	52	3.9	0.04	0.52	1	10.2	72	
Coalgardie .....	1012.0	+ 0.8	110	51	90.6	60.8	75.7	- 0.0	62.4	41	2.5	0.40	0.29	2	..	..	
Brisbane .....	1012.4	+ 0.4	88	62	81.6	66.7	74.1	- 2.3	68.2	81	6.7	5.20	0.31	19	7.4	54	
Hobart, Tasmania.....	1013.2	+ 3.5	90	43	68.5	51.9	60.2	- 0.0	53.9	58	6.5	1.93	0.06	17	7.5	49	
Wellington, N.Z. ....	1014.6	+ 2.4	74	43	66.3	53.6	59.9	- 0.3	56.1	70	7.3	0.89	2.33	9	8.1	54	
Suva, Fiji .....	1010.0	+ 1.4	92	72	85.9	74.6	80.3	+ 1.3	76.2	80	6.5	18.95	6.43	25	6.8	52	
Apia, Samoa .....	1009.4	+ 1.1	86	71	83.0	73.8	78.4	- 0.9	75.7	82	8.0	15.63	1.74	23	4.7	36	
Kingston, Jamaica ..	1014.8	+ 0.8	88	63	83.2	68.0	76.6	- 1.1	67.8	89	6.0	0.90	0.69	6	6.9	62	
Grenada, W.I. ....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Toronto .....	1019.6	+ 2.0	50	-22	31.5	16.9	24.2	- 2.9	20.0	52	7.2	1.09	1.38	11	2.4	27	
Winnipeg .....	1021.9	+ 3.2	40	-42	5.6	-14.8	-4.6	-10.4	..	..	5.3	0.00	0.94	0	2.9	35	
St. John, N.B. ....	1015.7	+ 1.7	43	-21	24.2	6.6	15.4	- 9.0	12.0	72	6.9	1.86	2.31	6	3.1	35	
Victoria, B.C. ....	1009.0	- 7.7	56	30	45.2	38.4	41.8	+ 0.7	40.0	84	8.5	10.34	4.60	25	1.2	14	

\* For Indian stations a rain day is a day on which 0.1 in. or more rain has fallen.

\* For Indian stations a rain day is a day on which 0.1 in. or more rain has fallen.



(Continued from p. 127)

States temperature was considerably above normal in the western part, while in the eastern part it was above normal at first becoming about or below normal later. Rainfall was generally below normal, and drought conditions were experienced in the north-west and middle western States. Twenty people lost their lives in floods caused by four days' torrential rain at Andacollo, Coquimbo, Chile, about the 22nd. Much damage was done to property by a cyclone at Concepcion, Chile, on the 27th. (*The Times*, May 11th-June 1st, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, May, 1934

* Date	Pressure, M.S.L. 13h	Wind, Dir., Force 13h	Temp.		Rel. Hum. 13h.	Rain	Sun	REMARKS (see p. 1)
			Min.	Max.				
	mb.		°F	°F	%	in.	hrs.	
1	1012·9	NNW.2	43	67	73	—	6·1	
2	1012·7	W.2	47	63	60	0·01	1·5	f early pr <sub>o</sub> 14h. 16h.
3	1013·6	NNE.3	50	64	50	—	3·5	
4	1007·6	W.2	43	63	46	—	0·7	
5	1008·6	SW.3	46	59	66	0·04	4·7	r <sub>o</sub> r6h.-9h. pr <sub>o</sub> 12h. 30m.
6	1013·8	S.6	42	62	55	0.15	0.1	r <sub>o</sub> 9h. r <sub>o</sub> r 21h.-24h..
7	1023·2	W.3	42	61	58	0·10	7·2	r <sub>o</sub> r 0h.-2h.
8	1029·6	SW.2	47	59	56	0·03	0·0	r <sub>o</sub> 15h. r <sub>o</sub> r 17h. 24h.
9	1029·4	NNW.2	50	59	71	0·03	0·5	r <sub>o</sub> 0h.-4h. f 15h.-17h.
10	1030·6	ENE.3	49	64	54	—	10·5	m early
11	1028·9	E.3	47	74	54	—	13·3	
12	1022·2	NE.2	49	79	50	—	9·3	tl 20h.
13	1018·3	N.W.3	52	63	42	—	11.9	
14	1015·3	NW.4	47	56	36	0·01	9·2	pr <sub>o</sub> 18h.-9h.
15	1013·4	SW.3	39	59	37	—	8·0	
16	996·5	WNW.3	48	56	60	0·07	6·0	r <sub>o</sub> r 3h.-8h. pr <sub>o</sub> 12h.
17	1008·9	SW.4	37	55	44	trace	10·9	pr <sub>o</sub> 12h. pr <sub>o</sub> h. 15h. 30m.
18	1013·4	S.4	43	62	40	—	10·7	Solar halo 9h.
19	1014·6	SW.5	44	65	41	trace	5·3	pr <sub>o</sub> 15h. 30m.
20	1021·4	SW.4	45	60	49	—	1·2	
21	1022·5	SW.3	52	68	68	—	2·1	
22	1026·7	W.3	58	70	67	—	5·2	
23	1026·8	SW.2	54	69	64	—	0·4	
24	1025·3	NNW.2	48	65	40	—	14·0	
25	1018·6	W.1	43	66	45	trace	5·3	pr <sub>o</sub> 14h. 30m., 16h.
26	1027·6	N.3	44	58	35	—	13·1	
27	1026·2	N.W2	44	65	44	—	12·8	
28	1024·4	WNW.3	46	62	62	—	7·2	
29	1022·7	S.2	49	69	53	—	3·5	
30	1020·3	E.4	51	65	45	—	13·0	
31	1016·5	E.3	50	70	58	—	3·8	

\* The dates of Sundays are in heavy type.

General Rainfall for May, 1934

England and Wales	...	71	} per cent of the average 1881-1915.
Scotland	...	120	
Ireland	...	103	
British Isles	...	89	