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Exceptionally Dry Air, July 10th, 1934

THE synoptic reports of observations at 13h. G.M.T. on July 10th contained some exceptionally low readings of relative humidity. Several stations in southern England recorded values below 25 per cent., the lowest readings being 16 at Kew Observatory, 20 at Ross-on-Wye and 23 at Biggin Hill. As relative humidities of 20 per cent. or lower are decidedly rare in the British Isles, details of the occurrence were collected. At most of the stations dry- and wet-bulb readings are available at 13h., 16h. and 18h. and hair-hygrograms are also available for the purpose of examining the variations of relative humidity during the exceptionally dry period. This examination showed that in all cases the lowest relative humidity occurred during the period 13h. to 18h. and that the extreme value did not differ by more than one or two per cent. from the lowest reading at one or other of the fixed hours when the dry- and wet-bulb thermometers were read. Table I, which shows the lowest such values recorded at various stations, may be taken therefore as giving a close approximation to the extreme values on this occasion.

At Kew Observatory readings were taken at frequent intervals between 13h. and 15h. by means of an Assmann psychrometer. These are shown in Table II. Data relating to other occasions of notably dry air at Kew Observatory are given in Table III. The humidity data in Tables I and III were derived from the wet- and dry-bulb readings by means of the Meteorological Office "Hygrometric Tables"; those in Table II were derived by means of the Tables of

the Prussian Meteorological Institute, the wet- and dry-bulb readings (originally in degrees Absolute) being subsequently converted to

TABLE I.—LOWEST HUMIDITIES FROM DRY- AND WET-BULB READINGS,
JULY 10TH 1934

Station.	Time.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Vap. Press.	Dew Point.
		°F.	°F.	%	mb.	°F.
Richmond (Kew Obsy.)	13h.	78·3	55·9	16	5·2	28·0
S. Farnborough ...	16h.	82·0	57·8	15	5·5	29·5
Croydon ...	16h.	77·8	56·8	20	6·4	33·1
Biggin Hill ...	13h.	76·2	56·9	23	7·2	36·0
Boscombe Down ...	18h.	81·6	61·6	27	9·8	44·1
Manchester ...	16h.	85·6	63·6	25	10·3	45·5
Birmingham (Edgbaston).	13h.	82·4	63·1	29	11·1	47·4
Ross-on-Wye ...	13h.	83·3	60·4	20	7·7	37·8
Liverpool (Bidston)...	13h.	83·0	62·9	28	10·7	46·2

degrees Fahrenheit. It will be observed that the minimum relative humidity, at Kew on July 10th 1934, was slightly lower than the minimum value on April 1st 1931. This latter occasion was the subject of a note by W. H. Pick in the *Meteorological Magazine* for

TABLE II.—READINGS AT KEW OBSERVATORY, JULY 10TH 1934.
WITH ASSMANN PSYCHROMETER

Time G.M.T.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Vap. Press.	Dew Point.
	°F.	°F.	%	mb.	°F.
h. m.					
13 5 ...	{ 81·9 82·4	{ 56·3 56·5	{ 16 16	{ 6·0 5·9	{ 31·5 31·1
13 30 ...	{ 81·2 82·1	{ 57·2 57·6	{ 20 19	{ 7·3 7·1	{ 36·4 35·7
13 45 ...	{ 82·8 82·6	{ 57·6 57·4	{ 18 18	{ 6·9 6·8	{ 35·0 34·7
14 0 ...	82·8	57·6	18	6·9	35·0
14 30 ...	82·8	59·4	22	8·4	40·0
15 0 ...	82·4	58·9	22	8·3	39·7

May 1931, and he mentioned that a reading of approximately 15 per cent. occurred at Cardington at 12h. 30m. on that day. It seems probably that a value of 15 per cent. represents the lowest relative humidity likely to be recorded in the British Isles.

A point of special interest is that, on July 10th 1934 with an air

temperature round about 80° F., the dew point was below freezing point at Kew and South Farnborough. Air cooling at the dry adiabatic lapse rate would have had to rise nearly 10,000 feet before arriving at the dew-point temperature. An observation made at South Farnborough at 15h. 55m. showed a temperature of 46° F. at 9,400 feet and 42° F. at 10,500 feet. It is not surprising therefore that no convectional clouds occurred on the day in question.

Another point to which attention may be drawn is the rise of vapour pressure at Kew Observatory from 5·9 mb. at 13h 5m. to 8·4 mb. at 14h. 30m. in what appears to have been the same air-mass.

TABLE III.—PREVIOUS OCCASIONS OF LOW HUMIDITY AT KEW OBSERVATORY

Date.	Time.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Vap. Press.	Dew Point.	
1921, July 11th	...	14h.	°F. 86·2	°F. 61·9	% 19	mb. 8·0	°F. 38·6
1931, April 1st	...	11h.	46·0	35·2	20	2·2	7·5
		12h.	45·9	34·7	17	1·8	4·0
		13h.	46·4	35·6	21	2·3	8·6
1911, Aug. 13th	...	13h.	88·1	65·6	25	11·5	48·3
		14h.	88·9	66·7	27	12·5	50·5
		15h.	87·5	64·3	23	10·3	45·3
		16h.	88·0	65·8	26	11·8	49·0

At 9h. the vapour pressure in the north-wall screen at Kew had been 14·1 mb. Had the absolute humidity remained at this figure the relative humidity would have fallen no lower than 37 per cent. when the temperature rose to the maximum value of 82·8° F. as measured by the Assmann psychrometer. By some agency, therefore, more than half the moisture content of the atmosphere was removed between 9h. and 13h.

Note on the Synoptic Situation, by R. S. Read. During July 9th to 10th an anticyclone was almost stationary over the North Sea and the circulation of winds around this system was bringing air from the western parts of Germany across Belgium and northern France to south-east England. The dew points of the air lying over Belgium during the afternoon and evening of July 9th were higher than those over all parts of south-east England on that day and also on July 10th. It is thus improbable that this air could have travelled unchanged over south-east England. Another possibility exists in that by convectional movements the damper surface layers may have been mixed with drier air at higher levels or that descent of air may have taken place in the anticyclone over England.

The upper air temperature observations at Hamburg, Utrecht and Duxford cannot be used directly in this case without some quali-

fication. There were however indications of a drier stratum of air at Duxford at a height of about 1,100 feet at midday on July 9th and again during the early morning ascent on July 10th and mixing of these layers would reduce the absolute humidity near the ground. It is possible that similar changes were taking place at Richmond and in other parts of England and that these effects would show more during the afternoon when convection was more active.

The Diurnal Variations of Barometric Tendencies

By C. S. DURST, B.A., and R. M. STANHOPE, B.A.

C. K. M. Douglas* has surmised that there is a tendency for depressions to deepen by night, and has supported the supposition by statistics of the frequency with which depressions to the west or south-west of the British Isles deepened by day and by night. This suggested that it would be worth while investigating statistically whether there was a diurnal variation in the frequency with which different barometric tendencies have been reported. The period December, 1929, to February, 1934, was used and two seasons were examined, namely, Summer—June, July and August; Winter—December, January and February. Frequencies were then obtained with which tendencies occurred (grouped to half millibars per three hours) at the hours 0100, 0700, 1300 and 1800 at Inchkeith, Valentia and Croydon. These tendencies were of course affected by the normal diurnal variation of pressure. For this, the normal hourly pressures at Kew, Eskdalemuir, and Valentia given in the Year Book for 1927, were assumed to hold and an allowance was made, but even so this allowance was small. There resulted the figures given in Table I.

It must be remembered that a barometer at a fixed point is affected by a neighbouring depression (*a*) by the depression deepening or filling up, (*b*) by the depression travelling towards or away from the fixed point. Douglas has excluded the latter by his method of investigation, but in using tendencies, as is done here, both these effects are included; there is, however, as far as we know, no evidence that depressions move with varying speeds by day and by night.

Now turning to the consideration of Table I. Large falls are comparatively rare in summer and even moderate falls only occur on about 1 per cent. of occasions. In regard to falls exceeding 1.75 mb. per 3 hours in summer, there are definitely fewer falls at night at Valentia than by day, although at Croydon the frequency of falls is greater by night than by day. In winter at all three stations great falls at 0100 are less frequent than at 0700 and 1800, and at Valentia at any rate less frequent than at 1300. A smaller frequency is shown at Valentia at 0100 than at any of the three other hours,

* See *Meteorological Magazine* 66, 1931, pp. 39-41.

even when we include falls of more than 1.75 mb. per 3 hours ; but with falls of this amount at Croydon and at Inchkeith, there seem to be more frequent falls by night than at midday.

If depressions were in the habit of deepening by night it would involve a transfer of air from the low pressure areas to the high, and in consequence it was thought that perhaps the effect suggested

TABLE I—PERCENTAGE FREQUENCIES WITH WHICH TENDENCIES EXCEEDED CERTAIN VALUES (AFTER ALLOWANCE HAS BEEN MADE FOR THE NORMAL DIURNAL VARIATION OF PRESSURE)

	Winter.				Summer.			
	<i>Negative tendencies greater than 3.75 mb. per 3 hours.</i>							
	0100	0700	1300	1800	0100	0700	1300	1800
Inchkeith ...	1.6	2.9	1.1	3.3	0.4	0.2	0.0	0.2
Valentia ...	1.8	3.3	3.1	3.1	0.4	0.0	0.7	0.2
Croydon ...	1.8	2.0	2.0	2.4	0.2	0.0	0.0	0.0
	<i>Negative tendencies greater than 2.75 mb. per 3 hours.</i>							
Inchkeith ...	5.8	5.5	2.9	5.5	0.9	1.1	0.4	0.2
Valentia ...	3.4	5.1	7.8	5.1	0.9	0.9	1.5	1.1
Croydon ...	4.1	3.8	3.6	3.8	1.7	1.1	0.4	0.2
	<i>Negative tendencies greater than 1.75 mb. per 3 hours.</i>							
Inchkeith ...	11.4	12.6	7.8	11.8	3.1	4.4	2.7	6.6
Valentia ...	8.3	12.0	14.9	10.2	2.8	4.8	5.0	5.7
Croydon ...	10.0	10.2	8.0	9.1	4.8	4.3	2.4	2.8
	<i>Positive tendencies greater than 1.75 mb. per 3 hours.</i>							
Inchkeith ...	11.8	11.1	14.5	10.2	5.3	3.8	3.6	2.0
Valentia ...	14.9	9.5	11.3	11.3	5.2	3.5	5.2	4.8
Croydon ...	10.2	9.8	10.6	10.2	3.3	5.0	4.6	2.6
	<i>Tendencies, positive or negative, greater than 1.75 mb. per 3 hours.</i>							
Inchkeith ...	23.2	23.7	22.3	22.0	8.4	8.2	6.3	8.6
Valentia ...	23.2	21.5	26.2	21.5	8.0	8.3	10.2	10.5
Croydon ...	20.2	20.0	18.6	19.3	8.1	9.3	7.0	5.4

by Douglas would be most clearly shown if the frequency was taken out with which rather large tendencies, positive or negative, were experienced. That is given in the last panel of the table. In no case is there a marked diurnal variation in frequency.

The conclusion of this examination is that there is no very marked diurnal variation in barometric tendency ; at Inchkeith and Croydon falls of 1.75 mb. per 3 hours are least frequent at 1300, while at Valentia they are least frequent at 0100.

Line Squalls and Heavy Rain in Iraq and Palestine on May 14th–15th, 1934

Towards the middle of May, 1934, weather was very disturbed in Palestine and Iraq, culminating in a disastrous "cloudburst" at

Tiberias and a violent squall and sandstorm in Iraq and Palestine, both on May 14th. The following account combines various communications.

The *Daily Weather Reports* from May 7th to 12th show an anticyclone over Europe and a persistent low pressure area over the north of Egypt and Arabia. An account by Mr. C. V. Ockenden at Heliopolis continues:—

There is evidence of a small cyclonic disturbance having moved north-eastwards on May 13th from near Baharia in the western Desert of Egypt to the northern part of the Sinai peninsula, and it may be necessary to invoke the movement of the "low" and consequent convergence to account in part for the comparatively heavy falls of rain. Upper air humidities were probably somewhat high on account of the fact that Mediterranean air had already invaded the area two days previously. It was, in fact, the arrival of this initial supply of less stable air on the 11th which marked the break up of an abnormal type of weather which had persisted for five days in Egypt.

A layer of thick altostratus formed early in the morning of the 7th at Heliopolis and remained with but few breaks (chiefly at night) until the 11th. On the 8th and 11th the sunshine amounts were only 0·7hrs. and 0·3hrs., respectively, whereas the average duration for this time of year is well over 10hrs. It is a matter of interest that a film-making company were compelled to suspend operations during this period on account of bad or insufficient light. The wind was consistently NE.'ly fresh at times. The cloud sheet at times covered a very wide area, extending nearly to Rutbah in the east, Sollum and Siwa Oasis in the west, and Aswan in the south. Drizzle or light rain fell at places on the Red Sea coast and at Luxor on the 10th and 11th, and Luxor and Aswan reported a thunderstorm in the past weather on the morning of the 12th. This is very unusual at these places at any time of the year. Throughout the whole period, May 7th to 10th inclusive, the microbarograph and barograph at Heliopolis showed very disturbed traces, short-period oscillations having an amplitude of 1 to 2 millibars at times. The surface of discontinuity between the lower north-east current and an upper westerly was generally found by pilot balloon observation to be at a height of a little over 5,000 ft.*

The disastrous "cloudburst" which occurred at Tiberias on May 14th was due to a severe thunderstorm accompanied by torrential rain. Thunderstorms occurred over a wide area in Syria and northern Palestine on that day and distant thunder and lightning were reported early in the morning from Amman in Trans-Jordan and from Aboukir in Egypt. As far as can be seen from the limited data available, it appears probable that the Tiberias storm did not occur with the arrival of a cold front but some distance behind, and

* See *Meteorological Magazine*, 69, 1934, p. 95.

intense heating of surface air during the course of the morning in the comparatively sheltered Jordan Valley is thought to have provided the trigger action creating abnormally vigorous convection in an already highly unstable general air current. It is noteworthy that no rain occurred at Amman between 8h. and 20h. hours local time on the 14th, and only "trace" was reported from Ramleh. These places are about 70 miles south-south-east and south-south-west respectively from Tiberias.

The cold front to which reference has been made was probably of the nature of a bent-back occlusion associated with a not very deep depression in the northern Levant. On the afternoon of May 13th in Egypt there were other fronts of cold front type which preceded the bent-back occlusion. One of these reached Heliopolis at about 15h. 15m. G.M.T. (17h. 15m. local time) when temperature fell 15°F . in two distinct stages within 30 minutes; the second stage was accompanied by heavy showers, rising sand and a gust of 39 m.p.h. Ismailia records show well-marked sudden falls of temperature at 15h. 15m. and 17h. 15m. G.M.T., the first fall of 10°F . was accompanied by rising sand and a gust of 47 m.p.h., but there was no rain. The second fall amounted to 6°F . and 1 mm. of rain was recorded. The main bent-back occlusion arrived at night: a thunderstorm occurred at Heliopolis and 3 mm. of rain fell between 20h. 30m. and 21h. 50m., but there was no pronounced fall of temperature at the ground. At Ismailia a fall of temperature of 4.5°F . occurred at 22h. and 10 mm. of rain fell in 30 minutes.

The positions of the various stations referred to are shown in fig. 1.

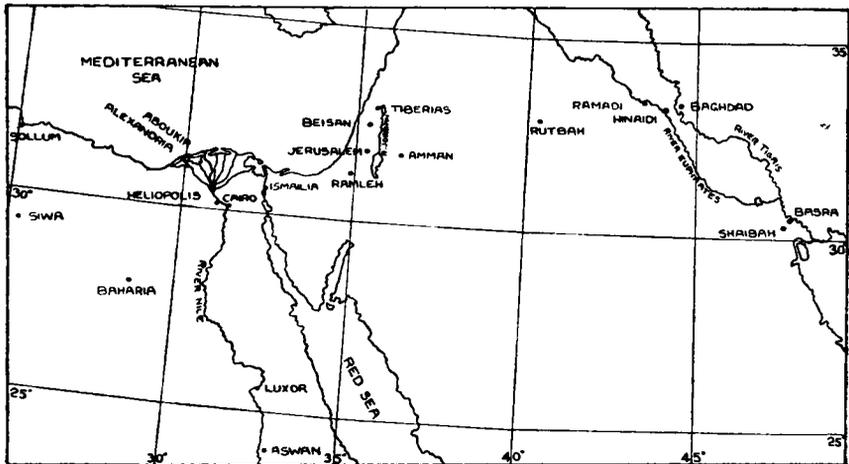


FIG. 1

Mr. H. E. Carter, of Ramleh, states that "no statistics of the rainfall in the centre of the storm area exist, but according to a newspaper report, 53 mm. (2.1 in., more than one-third of the total rainfall in 1933) fell in 45 minutes at Beisan, the nearest rainfall station to Tiberias."

The following detailed description of the "cloudburst" is contributed by Mr. J. R. Morgan, of Ramleh, Palestine.

The disasters which occurred at Tiberias on May 14th and 15th, 1934, are interesting inasmuch as they reveal the possibility of the damage which can be caused by a heavy, sudden rain, if certain initial conditions of situation and environment are combined together. It is probable that the cloudbursts which occurred on those two days were not phenomenal meteorological disturbances, although in the absence of accurate meteorological observations this must be in the nature of a surmise. No rain-gauges were situated in the vicinity of the cloudbursts, and the actual times of duration of the bursts were approximately 90 minutes and 50 minutes on the Monday and Tuesday respectively. Palestine enjoys a Mediterranean climate, and it is a feature of the district in the neighbourhood of Tiberias that at the beginning and end of the rainy season, *i.e.*, at the end of October and the end of April respectively, it experiences heavy torrential showers.

The old city of Tiberias is situated at the foot of a hill rising some 1,600 ft. above the level of the lake, which is itself 600 ft. below sea level. The hill has a surface layer of cotton soil which, in wet weather, is converted into loose mud and carried down the mountain side. During the cloudbursts of May 14th and 15th the maximum rainfall occurred directly over this cotton soil region, and when the surface layer was washed away, it loosened many granite boulders which had been held secure in the hard dry surface for many years. These boulders descended the hill side at a tremendous speed and carried with them in their descent additional boulders, which in turn were carried through to the native Suk (market) below. The rivers of mud and stones which were carried down the mountain side were directed in their journey by the contour of the country in the vicinity and swept through the Municipal Gardens, uprooting trees and tearing down enclosure walls in their progress to the sea. The greatest loss of life and damage to property occurred in the native quarter itself, where complete houses were carried away by boulders washed down the hill side. In addition, many of the native population were washed into the sea by the avalanche.

In Iraq the phenomena took the form of a destructive line squall at 13h. 15m. G.M.T. on May 14th. An account by Mr. R. H. Mathews states that this was responsible for considerable structural damage in the Port of Basrah and for the loss of an aeroplane which had landed at the air port. The force of the squall was so great that it lifted the machine, which weighed seven tons, completely off the ground and deposited it in a canal 50 yards away.

The pilot stated that at 11h. 30m. G.M.T. (14h. 30m. Iraq zone time) he noticed a thunderstorm threatening from the west and he decided to go to the landing ground in case it should be necessary to taxi the aeroplane round because of a change of wind. By 13h.

G.M.T. (16h. Iraq zone time) the sky had a very threatening appearance with what appeared to be a wall of dust in the direction of Shaibah (14 miles west-south-west of Basrah). At 13h. 15m. G.M.T. (16h. 15m. Iraq time) the pilot ordered the crew to stand by and

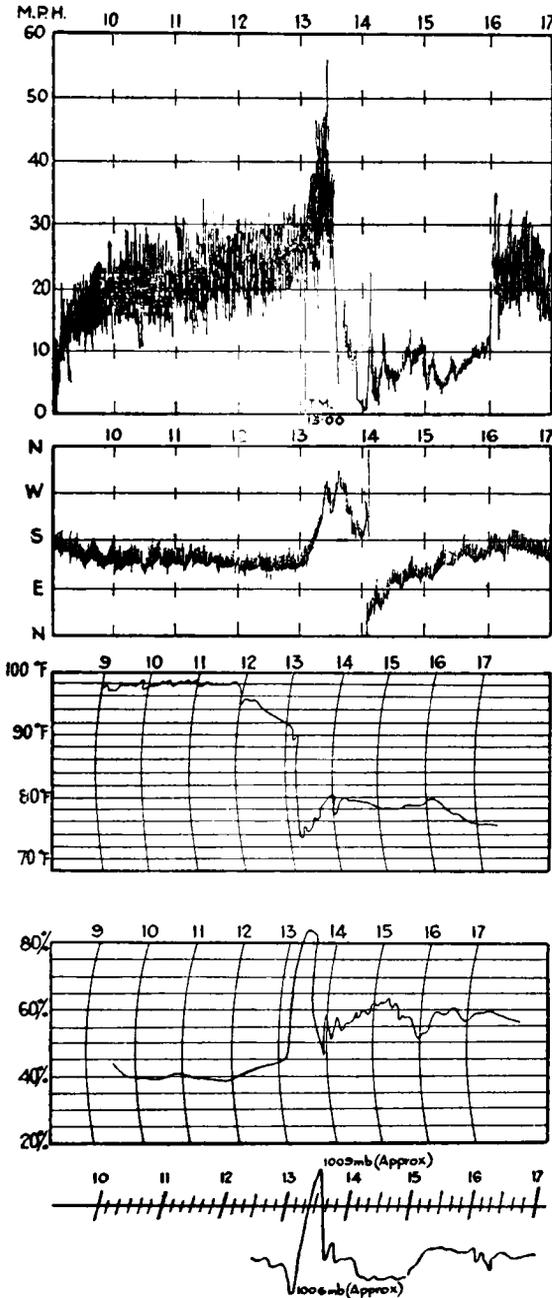


FIG. 2.

a few minutes later he had the engines started. Almost immediately the wind increased and began to veer; the pilot taxied the aeroplane to the right about 45°, but the crew had great difficulty in keeping the chocks behind the wheels to prevent the aircraft riding back on the tail skid. Then an intense squall of wind swept across the landing ground accompanied by a dust storm so thick that the pilot could only see a few feet. The aeroplane was blown back over the chocks, the pilot tried to hold her in place by opening the throttle but he was immediately airborne; as he considered the risk of flying too great he throttled back and tried to hold the aircraft with less throttle. This was impossible, and he was blown back steadily at 5 or 6 m.p.h. The pilot was about to jump when there was a crash and he found that the tail and port wing were lodged against a brick hut. He got clear and as he did so the aeroplane was lifted over

the hut and disappeared in the dust. The storm continued at its height for about 10 minutes and then it gradually cleared. The aeroplane was found at the bottom of a canal which is under construction. There were no marks on the ground between the hut and the canal, a distance of 50 yards.

The meteorological records from Shaibah, 14 miles west-south-west of Basrah, are reproduced as fig. 2, and demonstrate the extreme severity of the squall. At Shaibah at 13h. G.M.T. thunder was heard to the west, with a bank of dust approaching from the south, and by 13h. 10m. the visibility had fallen to 50 yards in thick dust, which lasted for 10 minutes. At 13h. 20m. the main squall arrived, and was accompanied by a heavy shower (1 mm. in 0.3 hrs.). The wind rose to 57 m.p.h. in a squall and the temperature fell 18°F. almost instantaneously, while the humidity rose 38 per cent. and the pressure about 3 mb. After 10 minutes the wind had fallen to 5 m.p.h. The changes in wind direction were remarkable. The general meteorological situation at 13h. G.M.T. showed a large low-pressure area over southern Iraq, and it appears that the squall at Basrah was of the local thundery type.

The experiences of Mr. Mathews while flying from Ramleh in Palestine (about 22 miles west-north-west of Jerusalem) to Hinaidi, near Baghdad, on the same day show that the squally weather was general from the Mediterranean Sea to the Persian Gulf. His start from Ramleh was delayed 90 minutes as a line squall which had passed eastwards was enveloping the high ground (3,000 ft.) round the Jordan Valley. At 5h. 30m. G.M.T. (7h. 30m. Palestine zone time) the machine set off, but an hour later had to turn back and land at Amman, about 60 miles east of Ramleh, as the line squall had been overtaken. At 8h. 45m. G.M.T. (10h. 45m. Palestine time) the aeroplane left Amman; an hour later the tail end of the line-squall was seen ahead, its general movement having been north-eastwards. This end of the squall took the form of a wall of dust like a haboob; it took about ten minutes to fly through it, the bumps being terrifying. After flying in bright sunshine for about twenty minutes, a large waterspout or whirlwind was seen to the northwards; this would be ahead of the squall. A landing was made at Rutbah, about 250 miles west of Baghdad, at 10h. 55m. G.M.T. (13h. 55m. Iraq time) and the machine took off again at 12h. 10m. (15h. 10m. Iraq time); by this time the haboob was seen approaching Rutbah from the west, looking more intense than ever. For the first 100 miles after leaving Rutbah the weather was showery all round, and then the aeroplane ran into thunderstorms of tropical intensity which lasted for the remaining 150 miles to Hinaidi. The desert below was swamped with water, an unusual appearance at any time of the year. The air was painfully bumpy, the machine losing and gaining height more than a thousand feet at a time. It was altogether an educative if terrifying experience for a meteorologist. Hinaidi was

reached at 14h. 50m. G.M.T., a few minutes only before a storm of rain burst over the cantonment.

The sparse network of stations in these parts does not allow of fronts being followed, but it is evident from the above accounts that there were many squall-lines passing across Iraq during the day.

Correspondence

To the Editor, *Meteorological Magazine*

Summer Frosts

Some unusually low minimum temperatures were registered here during the spell of chilly weather at the end of August:—

1934.		Screen.	Grass.
		°F.	°F.
August 26th	...	31·9	24·9
,, 30th	...	33·0	27·3
,, 31st	...	30·1	24·7

There was copious hoar-frost each morning, and at 6h. (G.M.T.) on August 31st a thin coating of ice was found on shallow water in the neighbourhood.

Since continuous records of this markedly "continental" valley-climate were begun, in 1929, the latest "spring" frost in the screen has been on June 10th, 1932 (31·8°F.): the earliest "autumn" frost is that of August 26th, 1934, reported above. A minimum within half a degree of the freezing-point was noted on the same date of August in 1931. The length of the period during which the air temperature has not once fallen to 32·0°F. is thus 76 days, or a trifle more than one-fifth of the year. Since readings below 35°F. have occurred twice in July, it seems reasonable to suppose that over a long series of years no calendar month would be wholly exempt from frost.

By the thermometer exposed one inch above short grass, minima at or below 32·0°F. have been distributed through June, July and August during the last six years as follows:—

Dates.	<i>Number of frosts.</i>		
	<i>June.</i>	<i>July.</i>	<i>August.</i>
1st-10th	12	5	2
11th-20th	9	6	3
21st-30th (31st)	17	2	11
Total	38	13	16

Ground frosts may thus occur at any time throughout the summer. Since 1929 they have never been sharp enough to damage vegetation noticeably in July, but in both June and August they have wrought considerable destruction on several occasions.

The Greenwich volumes gives the dates of the latest and earliest frosts on the Glaisher stand since 1841 as May 24th, 1867, and

September 27th, 1885, respectively, so that the interval of complete immunity there has been 125 days, or more than one-third of the year. According to data published in "The Book of Normals (Section IV)," Falmouth and St. Mary's, Scilly, experienced no frost in the screen later than April or earlier than November from 1871 to 1921: at Buxton the temperature fell to 31°F. in July, 1921, but among the 30 stations included in the tables Ben Nevis is the only one to record a screen-minimum below 32°F. in every month. It appears that the period of summer freedom from frosts varies in different parts of the British Isles from zero to six months or more.

E. L. HAWKE.

Cænwood, Rickmansworth, Herts. September 1st, 1924.

A Whirlwind at Horndon-on-the-Hill

Mr. F. Claude Banks of Horndon-on-the-Hill has sent the following notes of a whirlwind which struck that district on Sunday, August 17th, 1934. It was preceded by a thunderstorm beginning at 4 p.m. with fairly heavy rain lasting for half-an-hour and then a sunny interval. The whirlwind struck the district at 5.30 p.m. B.S.T., and lasted two minutes, progressing in an irregular path very narrow and about a mile and a half in length. It appeared to originate at Golden Bridge on the Orsett-Bulphan-Brentwood road and not to have crossed the Horndon-Laindon road on the east. Much damage was done to trees and poultry sheds. Winds were very violent further west and also east (to the foot of Laindon Hills).

After the whirlwind there was a calm spell with a heavy shower, then a fair interval which was followed by a rather severe thunderstorm which slowly moved away to the east-south-east clearing about 7 p.m. The wind was then WNW. A mist developed at 8 p.m., soon clearing when the wind backed to SW. and showers began about 9 p.m.

Funnel-shaped Cloud

You may be interested to hear that the formation of a funnel shaped cloud characteristic of a tornado was observed here at about 19h. 25m. B.S.T. on Saturday, August 11th, and was visible for 5-10 minutes. The sequence of events which led up to the formation of this cloud was as follows:—

From about 18h. B.S.T. rain fell from low cloud travelling almost due east and developed into almost continuous moderate rain. Shortly after 19h. an intense and very low cloud, whose back edge with blue sky beyond could be plainly seen, approached and the rain became torrential. Distant thunder was subsequently heard but no lightning was observed in the neighbourhood. This heavy rain lasted for at least 15 minutes when it eased gradually and the sun

came out. A rainbow developed gradually and later a second, both were weak. A small extent of the ragged underside of cloud was then seen to be driven up more and more vigorously until a vertical rotary movement seemed to be in progress. This then developed sideways and downwards till finally there was a funnel shaped mass of whitish vapour whirling horizontally in a clockwise direction and carried along in the same direction as the cloud to which it was attached, almost due east. Pieces of paper were observed to be lifted high in the air in the neighbourhood of its path.

The distance travelled from the spot where it formed to where it seemed to diminish would not be much more than two miles. The ground over which the cloud travelled is open and covered with low saplings having heavy foliage which would greatly aid evaporation.

E. C. PACKHAM.

Woodlands, Bromley Green, Kingsnorth, nr. Ashford, Kent. August 12th, 1934.

Distances travelled by Toy Balloons

I send the following note, in case it is of interest in regard to air-currents.

On July 28th, between 3 and 6 p.m., at a village fête here, some 120 toy balloons, gas-filled, were sent up, each with an addressed card attached for return in case it was found; a prize was offered for the balloon which travelled farthest, 10 days being allowed for reports to come in. Only 9 were reported; the winner was picked up east of Stuttgart, the second longest distance was Luxembourg, and 5 were reported from the Pas de Calais, one from Godalming, and one from Alton (Hants). A very strong wind from some point near south-west was blowing when the balloons were released.

ARTHUR F. HORT.

Hurstbourne Tarrant, Andover, Hants. August 19th, 1934.

(The synoptic charts for July 28th show that a depression was centred over southern Scandinavia and that the winds at 1 Km. and 2 Km. above mean sea level were between W. and WNW. Ed. M.M.)

The Colour of Moonlight

The interesting correspondence, which resulted from Dr. G. C. Simpson's letter in the *Meteorological Magazine* of November, 1932, raising the question why moonlight appears blue, does not seem to have led to a satisfactory conclusion regarding the cause of the blue colour of moonlight; the general impression left in one's mind after carefully considering the various views expressed is that the predominant colour in moonlight is blue, but the cause of this phenomenon is perhaps partly physical and partly physiological. However that may be, this correspondence has not brought out any observations of the "green light" of the moon. The object of this note

is to put on record a rather striking and probably unusual phenomenon which I observed at Alipore, Calcutta on May 27th, 1934 (nearly full-moon). The observation was corroborated by other persons, so that it could not be attributed to any defect of my colour vision.

At about 6.45 p.m. (Calcutta time) I was struck by a rather peculiar appearance of the sky and my first impulse was to look to the west. There was nothing unusual on that side, the sun had set and the western horizon had a faint pink glow which could be clearly seen through banks of stratified clouds. On looking towards the opposite direction I noticed that the moon was up and stood at an estimated altitude of about 30° . Its colour was an unmistakable green with perhaps a tinge of blue. The sky was about 7/10 covered and the moon was shining through a veil of cirrostratus, which also gave more or less the same colour impression as the moon itself. The colour gradually changed and by 7.15 p.m. it became "bluey-grey", which is very often observed in this region of the earth. A bright white halo had also appeared round the moon by that time and the clouds had changed to altostratus. By about 7.25 p.m. the sky became practically free from cloud except that region where the moon was, but soon after that the sky again became about 6/10 covered with cumulus; as a matter of fact, the whole of that evening the sky was remarkably variable.

The bluish-grey colour of the moon so often noticed particularly in the tropics is undoubtedly the result of the reflection of sunlight by the earth and then by the moon, as explained first by Leonardo da Vinci (see Valentiner, "Handwörterbuch der Astronomie," 1899) and as argued by S. Škreb, the first reflection takes place most likely at the cloud layers in the earth's atmosphere. But this double reflection alone would not explain the sequence of optical phenomena mentioned above. I have not been able to find any clear mention of the green light of the moon in meteorological literature accessible to me. The only indication, as far as I have seen, that the green light of the moon has been observed is in Arago's *Astronomie Populaire*, T.III, pp. 481-4, 1856. There it is mentioned that Arago himself and others have sometimes observed a greenish tinge in the *lumière cendrée* of the moon. But the case recorded above is somewhat different, because here the predominant colour is green. It is difficult to arrive at any definite conclusion regarding the cause of this phenomenon from the meagre and only visual observations available, but it seems probable that scattering by cloud particles of appropriate size and selective absorption by water vapour, which has absorption bands in the orange and the yellow (the so-called "rain-bands" in the solar spectrum), were principally responsible for this phenomenon.

A. K. DAS.

The Observatory, Alipore, Calcutta. June 1st, 1934.

Sounds accompanying Lightning

While glancing through "The Romance of Electricity," by J. Munro (R.T.S., 1893), I came across the following reference, which may be of interest. A footnote on page 173 runs as follows :—

"Condensers also emit sounds on being charged and discharged other than the crackle of the spark. In reporting this fact as early as 1863, Sir William Thomson refers to sounds heard at the instant of a flash of lightning a considerable distance from the line of discharge and before the clap of thunder. (Papers on Electrostatics and Magnetism.)"

CICELY M. BOTLEY.

Guildables, 17, Holmesdale Gardens, Hastings, July 24th, 1934.

NOTES AND QUERIES

The Effect of Lightning on a Haystack

When lightning strikes sandy soil, the intense heat generated by the passage melts the sand and forms a cylindrical mass of fused silica penetrated by a small hole, which is known as a "fulgurite". Colonel C. Buckle, of 9, Walbrook, has described a somewhat similar process which occurs when lightning strikes a haystack. He writes that "the enamel on the stems of the grasses is, I believe, largely silica from the soil. Ordinarily, of course, if a stack burns the quantities of silica in any one place are too minute to coagulate and they remain in the soft ash. When a stack has been struck by lightning however, you may find masses of fused matter which are hard and ring like a tile and which sometimes take the form of walls of a rough tube, the walls being about an inch thick and the tube up to about a yard in diameter.

The only explanation I can think of is that the heat of the discharge instantaneously consumes the hay or straw in its path and the gaseous products of combustion create an outward pressure against the remaining part of the stack which brings all the silica against the side of the tubular hole. Unfortunately the tube usually collapses with the ultimate destruction of the stack and you only find pieces. I have a fragment here however, which gives a good idea of the shape and size of the whole.

It is several years since I formed this opinion but I have only recently been able to confirm it by getting a specimen from a stack which was undoubtedly struck by lightning as a man was killed whilst sheltering by it. The School of Mines fulgurite has a small hole down it and it seemed to me vastly interesting that the same sort of thing can happen in a haystack but that, owing to the very small quantities of silica present, the hole is vastly bigger and the fused walls very much thinner. If we could get such a "thunder-bolt" whole it would look very much like the bark of the trunk of a tree minus the rest of the tree.

Colonel Buckle kindly lent a specimen of part of one of these silica tubes to Dr. G. C. Simpson. The specimen has the appearance on one side of the effect of great heat, and the curvature of the fragment showed that the diameter of the whole tube was about one metre, which is approximately the diameter of the lightning channel in the air.

“Mother-of-Pearl” Clouds at Aberdeen

Throughout the night of February 4th the sky at Aberdeen had gradually cleared, and on the morning of the 5th the day had dawned with a strongly green-tinted sky, in which a band of deep-red cirro-stratus lay low down along the eastern horizon. Temperature had fallen to 31° F. during the night but at 7h. it stood at 34° F. A light south-westerly wind was blowing and the temperature rose steadily, eventually reaching 52° F. in the early afternoon. During the morning the sky had been about two-tenths covered with very slight cirrus and cirro-stratus in lines and patches, but after 13h. alto-cumulus made its appearance and gradually increased in quantity from three-tenths at 15h. to five-tenths by 18h. The alto-cumulus was present in detached patches and bands, very slightly lenticular in arrangement, and was intermixed with some stray wisps of cloud at levels somewhat different from that of the main cloud, and partly above, and partly below the latter. Still farther above this cloud (which in places resembled cirro-cumulus), at 15h. some very small patches of shining cloud were noticed, and were kept under observation because of their brilliant irisation. By 16h. their number had apparently increased, and, though observation was much impeded by the presence of the alto-cumulus, it was nevertheless possible to maintain a fair watch on their development. These shining clouds were confined to an area of the westward sky between azimuths 200° and 330° and a theodolite measurement gave the elevation of the highest one visible as 36° at the moment when the sun's disc was touching the south-western horizon, *i.e.*, about 16h. 30m.

But, since some of these clouds, visible at the same time, were situated well to the north of west (azimuth 300°) and at almost the same elevation, their angular distance from the sun must have been between 70° and 80°. It was therefore obvious that the colouring was not the usual irisation seen sometimes on the intermediate cloud-layers within limits much nearer to the sun's position, but that the clouds were in fact the nacreous high-level clouds called “Perlmütter wolken” by Prof. Carl. Størmer of Oslo, who has studied them extensively in Norway. The individual clouds exhibited all the characteristics mentioned in Størmer's paper “Höhe und

Farbenverteilungen der Perlmütter-Wolken"—*Geofys. Publ.*, Vol. IX, No. 4, so far as appearance, variation and colours were concerned, but of course I was unable to make any height-determination.

At 15h. the clouds nearest to the sun's position showed intense colours; prominent amongst which was a very cold clear "electric-blue" tint, whose intensity far exceeded that of any of the other tints, and which seemed to be present chiefly on the upper edges of the clouds. The larger masses of the clouds were situated about azimuth 270° to 290° , and at an elevation of 20° - 30° , and had a pale milky hue, called blue-grey by Størmer, until about 16h. 30m., after which they became tinted with pale rose-pink, violet and green, in the customary "contour" pattern, having in the meantime either (1) actually moved southwards to about azimuth 260° , or (2) developed in that direction while dispersing at their northern extremities, much after the manner of the internal changes seen in the ordinary lenticular clouds. The nacreous clouds themselves were decidedly lenticular in form, but continuous observation of the individual clouds was seriously interrupted by the presence of the lower alto-cumulus cloud sheets which tended to increase in quantity.

After sunset the lower cloud (alto-cumulus) assumed very brilliant orange to crimson colouring from about 16h. 45m. until at least 17h. 30m.; at about 17h. the rose-red colour spread right across the sky to the eastern horizon, the whole sky thus appearing tinted in varying shades of red at the same time. As the sunset colours faded and the alto-cumulus became dark and grey, the mother-of-pearl clouds shone out more brilliantly and sharply, and showed more red and yellowish-green than formerly, with brownish and violet here and there. I hoped to obtain a photograph of them when the sky became dark enough but unfortunately the alto-cumulus cloud now began rapidly to overspread the western sky in the region where the chief group of these nacreous clouds lay, and I was disappointed. The last view I had of these beautiful clouds was at 18h. 30m. when one single small perfectly lenticular cloud was shining with a flame-like colour in the dark twilight sky, close to the edge of the alto-cumulus layer which soon advanced and hid the cloud from view.

It is worthy of note too that on the evening of the next day, Tuesday, February 6th, a very fine display of sunset colouring was again seen on the under-surface of a widely extended alto-cumulus to alto-stratus cloud sheet, which had covered eight- to nine-tenths of the sky all day, leaving a narrow band of clear sky along the western horizon. Low in the north-west where the edge of this cloud-sheet thinned out and became striated, three small lenticular mother-of-pearl clouds were seen for a short time shining blue-white above the lower layer.

During both February 5th and 6th the surface wind was chiefly SW.ly, very variable in force, and somewhat squally and gusty.

The alto-cumulus and cirro-cumulus clouds moved steadily from west. Temperature was high for the time of year, 47° F. to 52° F., during the daytime, and the usual local slight föhn effect was noticeable. The mother-of-pearl clouds, as mentioned above, seemed to be moving from either north or north-north-east, but this is not certain because of the great difficulty of proper observation.

G. A. CLARKE.

BOOKS RECEIVED

- Falmouth Observatory. Meteorological Notes and Tables, 1932*, also additional meteorological tables of temperature, rainfall and sunshine, 1880–1932. By W. T. Hooper, Falmouth, 1933.
- Deutsches Meteorologisches Jahrbuch, 1930*. Freistaat Sachsen. Edited by Prof. Dr. E. Alt. Jahrgang 48, Dresden, 1933.

OBITUARY

We regret to announce the death, from pneumonia on September 8th, of Mr. C. H. Kellett, B.Sc., Senior Professional Assistant in the Meteorological Office.

We regret to learn of the death on August 11th, 1934, of Mr. A. Latchmore who maintained a climatological station at Hitchin and contributed observations which were published in the *Monthly Weather Report* from 1918 to 1926. His rainfall readings were published in *British Rainfall* for subsequent years.

NEWS IN BRIEF

Rear-Admiral Dr. F. Spiess has been appointed President of the Deutsche Seewarte in succession to Vice-Admiral H. Dominik, who died on September 15th, 1933.*

The Weather of August, 1934

Pressure was above normal over Spitsbergen, northern Russia, northern Scandinavia, southern Iberian Peninsula, north-west African coast and across the North Atlantic to the eastern United States, central and west Canada and Alaska, the greatest excesses being 6.2 mb. at Kodiak and 4.2 mb. at Ekaterinburg. Pressure was below normal elsewhere in Europe, Iceland, south Greenland, eastern Canada and most of the central and western United States, the greatest deficits being 6.9 mb. at 60° N., 60° W. Temperature was above normal in northern Europe but below normal in south-west Europe while rainfall was in excess in Switzerland and deficient in northern Norway. In Sweden the rainfall for the country as a whole was 10 per cent. above normal.

* See *Meteorological Magazine* 68, 1933, p. 217.

The weather of August over the British Isles was generally unsettled with rain in excess in most parts of Scotland and Ireland, while the distribution of bright sunshine was irregular. Thunderstorms occurred fairly frequently. From the 1st to 7th, complex systems of low pressure passed across the British Isles giving unsettled conditions with heavy rain on occasions but long bright periods; 2·07 in. of rain occurred at Fofanny (Co. Down) and at Castlecaulfield (Co. Tyrone) on the 1st, 1·97 in. at St. Austell (Cornwall) on the 5th and 2·04 in. at Cockle Park (Northumberland) on the 6th, while 14·3 hrs. bright sunshine were registered at Morecambe, 14·2 hrs. at Eastbourne and 14·1 hrs. at Aberdeen on the 4th. Thunderstorms occurred in the north and west on the 2nd and 3rd and strong winds between S. and W. reaching gale force in places were experienced in the south-west on the night of the 1st-2nd, and later reached north-east England, having moderated slightly. Fair to fine weather occurred generally in the north and west on the 7th and on the 8th in England as a wedge of high pressure passed across the country; day temperatures rose above 75° F. in parts of the south, east and Midlands, 82° F. being registered at Norwich and 81° F. at Cambridge on the 8th. From the 9th to 13th a deep depression centred between Iceland and Scotland was moving slowly eastwards and conditions again became unsettled. Thunderstorms occurred in the south and east on the 12th and 13th. On the 14th a wedge of high pressure extended over the whole country and from then to the 19th fair or fine warm weather was enjoyed in the south though depressions moving to the north of the British Isles caused alternations of sunny weather and unsettled rainy periods in the north and west. On the 19th a depression moved south-east and the next day SW.-W. gales were experienced generally at exposed places in England and north Ireland, Spurn Head recording Beaufort Force 9 at 13h. Unsettled conditions continued until the 23rd, but there were long sunny periods. Thunderstorms occurred in parts of north England and north Ireland on the 22nd and 23rd. For the next 3 or 4 days the high pressure area from the Azores extended over the British Isles and a period of fine, warm, sunny weather was experienced except that on the 25th severe thunderstorms occurred on parts of the Kent coast; 2·09 in. were recorded at Deal on the night of the 24th-25th. The 25th and 26th were the sunniest days of this period with 13·5 hrs. of bright sunshine at Weymouth on the 26th and 13·0 hrs. at Morecambe on the 25th. From the 27th to 31st a deep depression over the North Atlantic gradually approached and then extended over the British Isles causing a renewal of unsettled conditions with heavy rain at times, but long sunny intervals. Gales occurred in north Scotland on the 28th and 29th, and thunderstorms were experienced in England and south Ireland from the 29th-31st. With the advent of southerly winds on the 27th temperature rose somewhat but fell in the south on the

28th and 29th and remained low for the time of year with local ground frosts at night. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from		Total (hrs.)	Diff. from	
		normal (hrs.)			normal (hrs.)	
Stornoway ...	99	—32		Liverpool ...	167	+ 8
Aberdeen ...	173	+34		Ross-on-Wye ...	181	+14
Dublin ...	144	—12		Falmouth ...	207	+ 9
Birr Castle ...	149	+11		Gorleston ...	212	+17
Valentia... ..	139	—11		Kew	192	+ 9

Miscellaneous notes on weather abroad culled from various sources.

Six people were drowned by floods caused by cloudbursts in the Zhupa district of Yugoslavia about the 7th. Vineyards and fields in the district of Nierstein on the Rhine suffered heavy damage from a severe thunderstorm on the evening of the 9th. Gales occurred on the 14th on the Dutch coast and in the Cattetat. In consequence of torrential rain on the 17th several of the lower lying districts in Bucharest were flooded—damage by floods is also reported from other parts of Roumania. Severe storms accompanied by hail occurred on the 23rd on the Chiem See, Upper Bavaria and over the Neuchatel and Bernese Jura in Switzerland; 5 people were drowned.

Ten people were drowned and many houses in Sidi-Aissa, Algeria, destroyed by floods following heavy rains about the 21st. The Nile flood water was unusually high this year but the precautions taken had prevented any serious damage before August 31st.

The monsoon was generally active in India except over the Peninsula at the beginning of the month, but later heavy rains fell also in Madras. In Bombay the rainfall during the month was considerably above the average. Severe floods occurred in Bihar, Orissa and Bengal from the 24th to 31st when the water was receding in all parts. The damage to towns was generally small but many villages were washed away, crops destroyed and communications broken. Drought accompanied by high temperatures prevailed in the four provinces of China adjacent to the lower Yangtze during most of the month and was reported to have spread to Hupeh and Hunan about the 13th—the crops, especially the rice crop suffered much damage. Severe frost damaged some of the tea plantations in the high districts of east Java about the 20th.

Satisfactory rains in South Australia before the 16th averted crop failures, but storms did damage along the coast and Port Pirie was flooded by sea-water on the 14th.

Drought and high temperatures were experienced generally in Canada during the month although parts of the country and even of the prairie provinces received abundant rain at times. During the first half of the month temperature was above normal in western and central United States (more than 10°F. in parts of the Missouri

Valley) and about or below normal in the eastern States but later temperature fell below normal in the central States as well. The rainfall was mainly deficient. Eight people were killed and much damage done to property by a storm over Michigan on the 2nd. A heat wave passed across the Missouri Valley from the 6th-11th, 110°F. being reached at several places on the 8th, 9th and 10th. The drought continued in the middle States until about the 10th when rain fell in many parts of the middle West—heavy rains were also reported from more of the drought stricken areas on the 16th.

Daily Readings at Kew Observatory, August, 1934

* Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp.		Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (sec p. 1).
			Min.	Max.				
	mb.		°F.	°F.	%	in.	hrs.	
1	1011.1	SW.3	57	72	50	0.04	5.7	r ₀ 17h. 15m.-23h. 15m.
2	998.8	SW.4	61	67	60	0.02	1.2	ir ₀ 1 h.-4 h.
3	1006.2	SSW.4	54	70	55	trace	9.1	pr ₀ 18h., T 18h. 30 m.
4	1010.0	W.3	49	72	41	—	9.9	w early.
5	1013.0	S.3	52	71	55	trace	5.1	r ₀ 21h.-21h. 15m.
6	1009.3	SSE.3	62	71	72	trace	0.7	pr ₀ 10h. 30m.
7	1009.8	NE.4	59	72	77	0.15	0.1	r 7h.-9h. 40m.
8	1015.4	N.3	58	75	80	—	3.5	
9	1011.5	WNW.4	61	69	47	0.08	5.1	r 6h. 5m.-7h. [25m.
10	1009.6	SW.5	57	69	83	0.02	0.8	r ₀ -r 19h. 50m.-20h.
11	1010.9	SW.3	53	65	63	0.02	3.9	pr 11h.25m.-11h.35m.
12	1010.7	SW.4	54	65	86	0.34	2.0	!T 17h. 23m.
13	1012.1	NW.3	53	66	54	0.03	3.4	pr 14h. 5m.-14h. 20m.
14	1018.3	NNW.2	54	66	66	—	5.4	w early.
15	1019.2	SW.3	52	72	56	—	11.6	w early.
16	1019.7	W.2	55	74	68	—	5.7	
17	1022.4	WSW.1	60	73	59	—	1.3	
18	1021.0	NW.2	58	79	47	—	8.3	w early.
19	1016.2	W.3	59	72	45	—	8.2	
20	1008.2	WSW.5	52	70	51	trace	9.3	d ₀ 8h. 35m.-9h. 45m.
21	1012.3	SW.4	54	70	52	—	10.5	
22	1008.8	SSW.4	58	71	57	0.16	5.4	ir 19h.50m.-23h.15m.
23	1010.5	SW.3	53	70	53	trace	11.8	pr ₀ 13h. 40m.
24	1018.3	WNW.2	48	68	51	—	9.3	w early.
25	1020.9	NE.3	51	69	42	—	11.2	w early.
26	1024.5	E.3	47	70	41	—	12.3	f w early.
27	1016.9	SE.2	54	77	51	—	6.5	f early.
28	1006.7	SSW.3	54	71	74	0.59	2.9	rr ₀ 14h.-20h.
29	1001.6	WSW.3	52	64	52	0.29	8.4	T 10h., PR 16h.
30	1007.6	WSW.2	45	62	48	0.01	4.7	pr 14h., T 16h.
31	1009.5	SW.2	43	65	53	—	8.6	F till 8h.
	1012.6		54.2	69.9	58	1.75	6.2	

General Rainfall for August, 1934

England and Wales	...	95	} per cent of the average 1881-1915.
Scotland	...	122	
Ireland	...	113	
British Isles	...	106	

Rainfall: August, 1934: England and Wales

Co.	STATION.	In.	Per cent of Av.	Co.	STATION.	In.	Per cent of Av.
<i>Lond.</i>	Camden Square.....	1.94	88	<i>Leics.</i>	Thornton Reservoir ...	2.35	84
<i>Sur.</i>	Reigate, Wray Pk. Rd...	2.04	83	"	Belvoir Castle.....	1.95	74
<i>Kent.</i>	Tenterden, Ashenden...	1.69	74	<i>Rut.</i>	Ridlington	1.62	64
"	Folkestone, Boro. San.	1.79	...	<i>Lincs.</i>	Boston, Skirbeck.....	2.09	87
"	Eden'bdg., Falconhurst	1.59	61	"	Cranwell Aerodrome...	2.13	78
"	Sevenoaks, Speldhurst.	1.95	...	"	Skegness, Marine Gdns.	2.55	105
<i>Sus.</i>	Compton, Compton Ho.	3.68	119	"	Louth, Westgate.....	2.28	81
"	Patching Farm.....	2.76	110	"	Brigg, Wrawby St.....	2.02	...
"	Eastbourne, Wil. Sq...	3.26	131	<i>Notts.</i>	Worksop, Hodsock.....	1.26	51
"	Heathfield, Barklye....	2.69	100	<i>Derby.</i>	Derby, L. M. & S. Rly.	2.56	98
<i>Hants.</i>	Ventnor, Roy.Nat.Hos.	1.75	88	"	Buxton, Terr. Slopes...	3.19	73
"	Fordingbridge, Oaklands	3.74	142	<i>Ches.</i>	Runcorn, Weston Pt....	2.42	67
"	Ovington Rectory.....	3.41	126	<i>Lancs.</i>	Manchester, Whit. Pk.	3.02	87
"	Sherborne St. John.....	2.75	114	"	Stonyhurst College.....	5.46	108
<i>Herts.</i>	Welwyn Garden City ...	1.90	80	"	Southport, Bedford Pk.	3.30	95
<i>Bucks.</i>	Slough, Upton.....	2.71	125	"	Lancaster, Greg Obsy.	4.64	103
"	H. Wycombe, Flackwell	2.51	104	<i>Yorks.</i>	Wakefield, Clarence Pk.	.68	28
<i>Oxf.</i>	Oxford, Mag. College...	1.67	74	"	Oughtershaw Hall.....	.91	35
<i>Nor.</i>	Pitsford, Sedgebrook...	1.79	74	"	Wetherby, Ribston H.	5.25	...
"	Oundle	1.41	...	"	Hull, Pearson Park.....	1.32	48
<i>Beds.</i>	Woburn, Exptl. Farm...	1.91	83	"	Holme-on-Spalding.....	2.51	86
<i>Cam.</i>	Cambridge, Bot. Gdns.	1.92	82	"	West Witton, Ivy Ho.	2.59	97
<i>Essex.</i>	Chelmsford, County Lab	1.46	67	"	Felixkirk, Mt. St. John.	2.21	75
"	Lexden Hill House.....	1.31	...	"	York, Museum Gdns....	2.66	93
<i>Suff.</i>	Haughley House.....	1.69	...	"	Pickering, Hungate....	1.42	56
"	Campsea Ashe.....	2.13	108	"	Scarborough.....	3.19	124
"	Lowestoft Sec. School...	1.70	77	"	Middlesbrough.....	2.43	87
"	Bury St. Ed., WestleyH.	1.73	67	"	Baldersdale, Hury Res.	2.26	82
<i>Norf.</i>	Wells, Holkham Hall...	1.59	66	"	Ushaw College.....	...	...
<i>Wilts.</i>	Calne, Castleway.....	2.32	82	<i>Durh.</i>	Newcastle, Town Moor.	2.93	101
"	Porton, W.D. Exp'l. Stn	2.51	111	<i>Nor.</i>	Bellingham, Highgreen	2.85	98
<i>Dor.</i>	Evershot, Melbury Ho.	5.10	162	"	Lilburn Tower Gdns....	4.22	119
"	Weymouth, Westham.	2.50	117	"	Carlisle, Scaleby Hall...	3.57	127
"	Shaftesbury, Abbey Ho.	2.75	95	<i>Cumb.</i>	Borrowdale, Seathwaite	4.12	100
<i>Devon.</i>	Plymouth, The Hoe....	4.71	152	"	Borrowdale, Moraine...	15.00	138
"	Holne, Church Pk. Cott.	5.92	132	"	Keswick, High Hill.....	12.25	141
"	Teignmouth, Den Gdns.	3.28	144	"	Appleby, Castle Bank...	6.14	117
"	Cullompton	3.00	98	<i>West.</i>	Abergavenny, Larchf'd	3.53	107
"	Sidmouth, U.D.C.....	3.64	...	<i>Mon.</i>	Ystalyfera, Wern Ho....	3.40	114
"	Barnstaple, N. Dev. Ath	3.82	116	<i>Glam.</i>	Cardiff, Ely P. Stn.....	4.99	81
"	Dartm'r, Cranmere Pool	7.10	...	"	Treherbert, Tynywaun.	3.86	89
"	Okehampton, Uplands.	4.90	116	"	Cardmarthen, Priory St.	8.48	...
<i>Corn.</i>	Redruth, Trewirgie.....	5.00	146	<i>Carm.</i>	Haverfordwest, School.	4.05	87
"	Penzance, Morrab Gdn.	3.11	98	<i>Pemb.</i>	Aberystwyth .....	...	...
"	St. Austell, Trevarna...	5.27	146	<i>Card.</i>	Birm W.W. Tyrmynydd	4.48	...
<i>Soms.</i>	Chewton Mendip.....	4.22	94	<i>Rad.</i>	Lake Vyrnwy	7.08	131
"	Long Ashton.....	3.08	88	<i>Mont.</i>	Sealand Aerodrome.....	5.39	104
"	Street, Millfield.....	3.70	135	<i>Flint.</i>	Dolgelley, Bontddu.....	1.94	68
<i>Glos.</i>	Blockley	2.01	...	<i>Mer.</i>	Llandudno	8.79	156
"	Cirencester, Gwynfa....	2.21	74	<i>Carn.</i>	Snowdon, L. Llydaw 9.	2.97	105
<i>Here.</i>	Ross, Birchlea.....	1.95	76	"	Holyhead, Salt Island...	19.24	...
<i>Salop.</i>	Church Stretton.....	3.09	95	<i>Ang.</i>	Lligwy	2.80	88
"	Shifnal, Hatton Grange	2.37	84	"	Douglas, Boro' Cem....	3.50	...
<i>Staffs.</i>	Market Drayt'n, Old Sp.	2.39	72	<i>Isle of Man</i>	St. Peter P't. Grange Rd.	3.43	88
<i>Worc.</i>	Ombersley, Holt Lock.	2.06	77	<i>Guernsey</i>			
<i>War.</i>	Alcester, Ragley Hall...	2.15	78				
"	Birmingham, Edgbaston	2.31	85				

Errata: Treherbert, Tynywaun, July, for 2.68 read 2.55.

Rainfall : August, 1934 : Scotland and Ireland

Co.	STATION.	In.	Per cent of Av.	Co.	STATION.	In.	Per cent of Av.
<i>Wig</i>	Pt. William, Monreith.	4·61	120	<i>Suth</i>	Melvich.....	5·93	199
"	New Luce School.....	4·26	95	"	Loch More, Achfary....	9·09	155
<i>Kirk</i>	Dalry, Glendarroch.....	4·92	103	<i>Caith</i>	Wick.....	4·09	149
"	Carsphairn, Shiel.....	7·34	109	<i>Ork</i>	Deerness	3·79	132
<i>Dumf.</i>	Dumfries, Crichton, R.I.	6·64	174	<i>Shet</i>	Lerwick	2·79	93
"	Eskdalemuir Obs.....	7·00	136	<i>Cork</i>	Caheragh Rectory.....	2·80	...
<i>Roxb</i>	Branhholm.....	4·28	133	"	Dunmanway Rectory...	3·59	76
<i>Selk</i>	Ettrick Manse.....	6·46	124	"	Cork, University Coll...	3·31	98
<i>Peeb</i>	West Linton.....	3·67	...	"	Ballinacurra.....	4·36	117
<i>Berw</i>	Marchmont House.....	3·25	98	"	Mallow, Longueville....	2·82	91
<i>E.Lot</i>	North Berwick Res....	2·97	94	<i>Kerry</i>	Valentia Obsy.....	5·43	113
<i>Midl</i>	Edinburgh, Roy. Obs..	3·27	102	"	Gearhameen.....	7·20	95
<i>Lan</i>	Auchtyfardle	3·96	...	"	Darrynane Abbey.....	3·99	92
<i>Ayr</i>	Kilmarnock, Kay Pk....	3·77	...	<i>Wat</i>	Waterford, Gortmore...	4·53	119
"	Girvan, Pinmore.....	4·96	111	<i>Tip</i>	Nenagh, Cas. Lough....	5·08	129
<i>Renf</i>	Glasgow, Queen's Pk....	4·54	128	"	Roscrea, Timoney Park	4·76	...
"	Greenock, Prospect H..	5·27	97	"	Cashel, Ballinamona....	3·37	95
<i>Bute</i>	Rothsay, Ardenraig....	5·68	...	<i>Lim</i>	Foynes, Coolnanes.....	4·20	109
"	Dougarie Lodge.....	5·01	...	"	Castleconnel Rec.....	3·45	...
<i>Arg</i>	Ardgour House.....	9·16	...	<i>Clare</i>	Inagh, Mount Callan....	7·07	...
"	Glen Etive.....	11·95	159	"	Broadford, Hurdlest'n.	4·01	...
"	Oban.....	5·16	...	<i>Wexf</i>	Gorey, Courtown Ho....	2·85	86
"	Poltalloch.....	4·95	101	<i>Wick</i>	Rathnew, Clonmannon.	3·62	...
"	Inveraray Castle.....	6·72	102	<i>Carl</i>	Hacketstown Rectory...	5·01	124
"	Islay, Eallabus.....	3·95	91	<i>Leix</i>	Blandsfort House.....	4·64	117
"	Mull, Benmore.....	13·30	114	"	Mountmellick	5·16	...
"	Tiree.....	4·43	106	<i>Offaly</i>	Birr Castle.....	4·58	120
<i>Kinr</i>	Loch Leven Sluice.....	4·44	116	<i>Dublin</i>	Dublin, FitzWm. Sq....	3·01	99
<i>Perth</i>	Loch Dhu.....	...	...	"	Balbriggan, Ardgillan...	3·08	90
"	Balquhidder, Stronvar.	5·95	...	<i>Meath</i>	Beauparc, St. Cloud....	4·32	...
"	Crieff, Strathearn Hyd.	4·20	100	"	Kells, Headfort.....	3·73	90
"	Blair Castle Gardens...	4·55	126	<i>W.M.</i>	Moate, Coolatore.....	3·60	...
<i>Angus</i>	Kettins School.....	5·32	145	"	Mullingar, Belvedere...	4·01	96
"	Pearsie House.....	4·06	...	<i>Long</i>	Castle Forbes Gdns.....	5·88	144
"	Montrose, Sunnyside...	3·02	108	<i>Gal</i>	Galway, Grammar Sch.	...	...
<i>Aber</i>	Braemar, Bank.....	4·52	132	"	Ballynahinch Castle....	5·95	108
"	Logie Coldstone Sch....	3·49	110	"	Ahascragh, Clonbrock.	5·92	141
"	Aberdeen, King's Coll..	4·38	160	<i>Mayo</i>	Blacksod Point.....	3·66	80
"	Fyvie Castle.....	4·97	156	"	Mallaranny	5·77	...
<i>Moray</i>	Gordon Castle.....	3·58	113	"	Westport House.....	5·20	128
"	Grantown-on-Spey .....	...	...	"	Delphi Lodge.....	10·82	126
<i>Nairn</i>	Nairn	1·75	73	<i>Sligo</i>	Markree Obsy.....	6·37	147
<i>Inv's</i>	Ben Alder Lodge.....	3·82	...	<i>Cavan</i>	Crossdoney, Kevit Cas..	5·01	...
"	Kingussie, The Birches.	2·17	...	<i>Ferm</i>	Enniskillen, Portora....	...	...
"	Inverness, Culduthel R.	2·11	...	<i>Arm</i>	Armagh Obsy.....	5·48	152
"	Loch Quoich, Loan.....	...	...	<i>Down</i>	Fofanny Reservoir.....	9·72	...
"	Glenquoich .....	...	...	"	Seaforde	4·99	133
"	Arisaig, Faire-na-Sguir.	...	...	"	Donaghadee, C. Stn.	4·72	142
"	Fort William, Glasdrum	7·26	...	"	Banbridge, Milltown....	4·55	130
"	Skye, Dunvegan.....	6·44	...	<i>Antr</i>	Belfast, Cavehill Rd....	5·50	...
"	Barra, Skallary.....	4·39	...	"	Aldergrove Aerodrome.	4·46	124
<i>R&C</i>	Alness, Ardross Castle.	3·24	110	"	Ballymena, Harryville.	5·42	127
"	Ullapool	4·11	116	<i>Lon</i>	Garvagh, Moneydig....	5·26	...
"	Achnashellach.....	8·35	125	"	Londonderry, Creggan.	5·52	119
"	Stornoway	4·71	118	<i>Tyr</i>	Omagh, Edenfel.....	4·76	112
<i>Suth</i>	Lairg.....	4·08	129	<i>Don</i>	Malin Head.....	4·89	...
"	Tongue.....	4·95	155	"	Killybegs, Rockmount.	...	...

Climatological Table for the British Empire, March, 1934

STATIONS.	PRESSURE.			TEMPERATURE.							Relative Humidity. %	Mean Cloud Am't	PRECIPITATION.			BRIGHT SUNSHINE.		
	Mean of Day M.S.L.	Diff. from Normal.	mb.	Absolute.		Mean Values.			Mean.	Wet Bulb.			°F.	Am't.	Diff. from Normal.	Days.	Hours per day.	Per-centage of Possi-ble.
				Max.	Min.	Max.	Min.	1/2 and 1/2											Max. and Min.	Diff. from Normal.	°F.	°F.	in.
London, Kew Obsy.....	1006.0	-	7.4	57	28	48.9	35.8	42.3	0.1	36.3	89	7.3	2.12	0.43	14	3.56	30	
Gibraltar.....	1015.5	-	1.6	70	39	62.6	47.3	54.9	2.7	47.1	75	4.7	5.07	0.33	15	...	...
Malta.....	1010.9	-	3.3	68	44	60.9	51.8	56.3	0.8	51.9	79	5.8	1.81	0.33	10	7.15	60	
St. Helena.....	1011.1	-	0.3	74	60	68.6	62.3	65.3	0.8	63.3	97	9.3	5.08	...	25	...	...
Freetown, Sierra Leone.....	1011.6	+	0.9	90	64	86.8	67.9	77.3	5.1	73.5	80	5.8	0.06	1.10	2	...	53	
Lagos, Nigeria.....	1008.6	-	0.3	91	72	89.1	77.1	83.1	0.3	77.1	83	7.4	4.75	1.00	6	6.3	67	
Kaduna, Nigeria.....	1005.6	...	...	101	53	95.9	64.9	80.4	0.7	63.2	47	2.7	0.74	0.20	2	8.0	...
Zomba, Nyasaland.....	1009.1	-	0.6	86	61	80.1	64.4	72.3	1.0	68.6	79	7.5	9.90	0.82	24	...	63	
Salisbury, Rhodesia.....	1011.1	-	0.8	84	51	79.5	58.7	69.1	0.9	62.5	72	6.3	1.65	3.05	8	7.7	...	
Cape Town.....	1014.6	+	0.1	88	51	77.8	58.8	68.3	0.2	59.5	78	3.9	0.60	0.28	6	...	61	
Johannesburg.....	1012.4	+	0.0	81	50	74.8	54.9	64.9	1.5	57.4	80	5.5	1.99	2.45	12	7.5	...	
Mauritius.....	1012.5	+	0.5	88	68	84.4	71.8	78.1	0.1	73.6	74	4.8	1.87	7.50	24	9.7	79	
Calcutta, Alipore Obsy.....	1009.2	-	0.7	104	62	94.4	70.5	82.5	2.3	69.7	74	2.1	0.16	1.22	24	...	...
Bombay.....	1009.8	-	1.1	95	66	85.6	71.8	78.7	0.8	70.4	74	1.0	0.04	0.02	0*	...	...
Madras.....	1009.6	-	1.3	95	65	88.5	71.5	80.0	1.1	74.9	82	4.3	0.00	0.34	0*	...	...
Colombo, Ceylon.....	1009.9	-	0.2	87	64	85.2	72.5	78.9	2.9	75.8	78	5.8	7.57	3.29	18	7.5	62	
Singapore.....	1008.6	-	1.1	90	69	85.5	71.8	78.7	2.5	75.3	83	8.3	10.65	3.25	22	5.1	42	
Hongkong.....	1015.2	-	0.8	82	50	68.9	59.4	64.1	0.8	59.1	74	7.4	1.75	1.19	12	3.9	32	
Sandakan.....	1009.6	...	...	91	71	86.3	74.2	80.3	0.7	76.4	87	8.0	12.18	3.71	22	...	...
Sydney, N.S.W.....	1019.0	+	2.7	95	57	77.7	63.8	70.7	1.4	66.0	74	6.2	1.93	3.05	14	7.2	59	
Melbourne.....	1018.5	+	1.6	103	45	82.1	59.3	70.7	6.2	61.6	64	6.4	0.14	2.04	7	6.7	54	
Adelaide.....	1017.3	+	0.2	111	54	88.3	65.6	76.9	7.1	61.7	36	4.7	0.66	0.37	8	7.5	62	
Perth, W. Australia.....	1012.8	-	2.5	101	56	82.5	65.2	73.9	2.7	62.9	58	4.6	5.71	4.90	7	7.2	59	
Coolgardie.....	1012.8	-	2.0	110	50	85.1	62.0	73.5	1.6	65.5	65	5.5	1.81	0.87	5	...	...
Brisbane.....	1017.4	+	3.0	86	60	81.2	65.4	73.3	1.0	67.4	67	5.8	0.82	4.95	10	8.6	69	
Hobart, Tasmania.....	1018.8	+	4.6	88	44	70.3	53.0	61.7	2.4	54.5	63	7.1	0.64	1.06	11	5.7	46	
Wellington, N.Z.....	1020.1	+	2.9	77	42	64.1	52.4	58.3	2.3	54.8	75	7.2	2.44	0.89	12	5.8	47	
Suva, Fiji.....	1008.2	-	0.2	91	70	86.5	74.7	80.6	0.5	76.3	83	8.8	20.03	8.16	26	5.0	41	
Apia, Samoa.....	1008.3	-	0.9	87	72	83.7	74.3	79.0	0.3	76.1	84	8.8	20.03	6.05	23	...	58	
Kingston, Jamaica.....	1014.7	-	0.2	88	65	84.7	67.0	75.9	1.2	65.8	83	4.0	1.44	0.42	5	...	...
Grenada, W.I.....	1010.5	-	2.5	90	71	87.0	73.0	80.0	2.2	72.0	70	4.0	6.76	4.10	20	...	35	
Toronto.....	1020.9	+	3.6	53	1	34.7	21.3	28.0	1.6	22.7	68	6.3	1.59	0.82	11	4.2	49	
Winnipeg.....	1021.1	+	1.9	44	-	19	14.4	14.4	0.6	...	...	4.1	0.27	0.89	1	5.8	49
St. John, N.B.....	1019.7	+	5.6	46	2	35.1	20.4	27.7	0.7	23.4	...	5.9	3.07	1.47	9	5.8	49	
Victoria, B.C.....	1019.1	+	3.2	63	37	54.6	42.8	48.7	5.2	45.1	78	6.0	4.12	1.69	13	...	...

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