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The Memorable Summer of 1933

The summer of 1933 provided unusually frequent periods of fine, warm weather, among the most notable being June 1st to 8th, July 1st to 7th, and 18th to 27th, and August 1st to 8th and 26th to 30th. Early in June conditions in the eastern districts of England were governed by a continental anticyclone which, by the 4th, had extended its influence over the whole country. The fair spells in July and August were due to the passage eastward or north-eastward of anticyclones situated initially off our south-west coasts. The system which was centred over northern Ireland on July 4th is worthy of mention since the reading at Malin Head at 1h. (1037·9 mb.) has not been equalled in the summer in the British Isles since July 11th, 1911. It is significant that all the cases of highest temperature (90° F. or above) in the midland and eastern districts of England occurred when the anticyclone had moved to central Europe or the southern Baltic. On the record hot day of August 9th, 1911, the synoptic chart also shows an anticyclone centred over the southern Baltic. Monthly mean pressure was well below the normal in June, 1933, but above normal in July and August except in the north of Scotland.

In Scotland, July was the warmest month of that name for over thirty years, August the warmest since 1911, while the exceptional warmth of June may be illustrated by the fact that

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the mean monthly temperature (0-24hr.) at Aberdeen was the highest for June since observations were begun in the north wall screen in 1869. At Eskdalemuir Observatory (Dumfriesshire) there were eight days during the three months with a maximum temperature above 77° F., the previous largest number in any year back to 1911 being three in 1921 and 1925. In England the remarkable warmth may be illustrated from the London observations. At Greenwich the mean temperature for the three months June to August, 64·6° F., has only three times been slightly exceeded since 1841, viz. 65·0° F. in 1859, 65·1° F. in 1868 and 64·8° F. in 1911, while the mean minimum temperature for the three months, 54·5° F., has only been exceeded twice, in 1846 and 1859. The following table gives the number of days at Kew Observatory with high maximum temperatures during the period June to August in warm summers since 1901 :—

TABLE I.—FREQUENCY OF WARM DAYS AT KEW.

	1901	1904	1906	1911	1914	1919	1921	1923	1925	1929	1932	1933
No. of days with max. temp. above 77° F.	17	15	14	35	13	12	23	20	13	13	12	32
No. of days with max. temp. above 86° F.	1	0	1	7	1	0	3	4	0	1	2	3

The table shows how exceptionally frequent were the warm days during the summer of 1933. The persistently warm nights were as notable as the unusual number of hot days.

Rainfall was deficient during each of the three months in England and Wales and Ireland. In Scotland there was an excess in July. It was the driest August in England and Wales since 1818, but Table II shows that for the summer as a whole the years 1887 and 1921 were drier, while as far as can be ascertained at present 1911 was about equally dry.

TABLE II.—RAINFALL FOR ENGLAND AND WALES.

(*Percentage of Average*, 1881-1915.)

Year.		June.	July.	August.	Mean of 3 months.
1887	...	30	59	65	51
1911	...	124	23	66	71
1921	...	18	44	116	59
1929	...	78	87	84	83
1933	...	92	82	38	71

The years 1921 and 1929 were much more remarkable with regard to deficiency of rainfall if the eight months January to August are considered in place of June to August.

In Scotland rainfall was more variable, July being notably wet in the south and August in the west and north-west, while locally in eastern districts August was the driest on record. Over Ireland as a whole rainfall for each month was below the

normal, the deficiency being greatest in August. At Phœnix Park, Dublin, August, 1933, was drier than any previous August since records were begun in 1877, apart from the equally dry one of 1913. At individual stations in England and Wales all three months were notably dry; for example, the mean of the percentages of the normal for the three months was only 36 at Wath-upon-Dearne (Yorkshire), and 39 at Scarborough and Chelmsford.

In spite of the general deficiency of rainfall, thunderstorms were frequent, notably so in June, thunder occurring somewhere in the British Isles during this month on no fewer than twenty days. At Copdock (Suffolk) the observer reported thunderstorms on seven consecutive days, which is unique in his 33 years' experience, and at Kew Observatory the number of days of thunder was one more than the previous June record for the period 1881-1932.

The summer was not only exceptionally warm and dry but markedly sunny. The percentage of the normal sunshine for

TABLE III.—SUNSHINE IN HOURS FOR THE PERIOD JUNE TO AUGUST.

Station	1899	1901	1905	1906	1911	1921	1933	Average 1881-1915
Stornoway ...	541	494	*560*	415	540	431	488	456
Aberdeen ...	560	590	528	514	*632*	514	588	493
Edinburgh ...	—	615	590	547	*641*	538	571	501
Markree Castle ...	496	384	495	459	*565*	472	466	433
Armagh ...	540	439	529	511	*597*	477	474	447
Valentia ...	627	402	491	503	*636*	588	446	502
Worthing ...	889	804	648	792	*900*	774	837	682
Southampton ...	*878*	736	601	756	842	709	753	636
Jersey	*928*	831	663	797	922	761	847	723
Falmouth ...	*883*	689	582	684	850	723	689	657
Bath	—	646	575	711	*824*	573	712	606
Kew	760	695	563	734	*789*	647	753	585
Oxford	*776*	672	554	719	744	650	708	576
Cambridge ...	724	773	609	715	*777*	657	707	591
Blackpool ...	639	682	692	680	*800*	617	646	612
Harrogate ...	—	*725*	681	578	654	568	627	537

the British Isles excluding the north of Scotland and the Channel Isles is 114. Many stations in England enjoyed more than 100 hours in excess of the normal during the period June to August, and in south-east England many recorded more than 150 hours in excess. Table III gives totals for the three months at a selection of stations for some of the sunniest years since 1899. The year 1905 is included because of the good totals in the west and north. It will be seen that the 1921 records were

exceeded in 1933 at most stations, but that the figures of 1911 were not equalled. At Valentia Observatory in south-west Ireland the total for the summer of 1933 was substantially below the normal. Days with no sunshine were notably rare. Statistics have been examined back to 1913 for a selection of stations throughout the British Isles. It was found that for the months June to August, out of 14 stations examined, so few sunless days had not been recorded at five stations, while at another five, although the number of days was equally small in one or two years, it was never smaller.

L. F. LEWIS.

The charts of deviations of pressure from normal over the northern hemisphere show that the weather of Europe has been more or less dominated by high-pressure systems throughout the first nine months of 1933. The location of the centre has, however varied greatly. In January there was a great westward extension of the Siberian anticyclone across northern Europe, pressure being 19 mb. above normal at Waigatz and 13 mb. at Moscow. The excess of pressure included the British Isles, where the weather was on the whole cold and bright, though an exceptionally intense Icelandic low made itself felt from time to time. In February the greatest excess of pressure lay between Iceland and Greenland (+15 mb.), and included most of the British Isles; our weather was again bright and on the whole mild, but with one noteworthy snowstorm. In March a centre of excess pressure lay over central Europe, but the British Isles came under the influence of a stormy area on the Atlantic.

In April the deficit of pressure over the Atlantic was maintained, but the high-pressure area moved westward to include France and the British Isles, most of these countries having an excess of more than 5 mb. Pressure was low in Russia but high in Canada, Greenland, Iceland and the Mediterranean; an anticyclonic belt extended from Greenland to North Africa across the British Isles and almost completely barred the passage of depressions until the 22nd. On this date the belt of high pressure gave way and a trough of low pressure extended from west to east. The break was, however, only temporary, and throughout May the British Isles was a no-man's land between areas with pressure above normal over Scandinavia and the Mediterranean and areas with pressure below normal over the Atlantic and Russia. On the whole the month was dry but towards the end especially the pressure distribution became rather uniform and unstable, a type suitable for thunderstorms which became notably frequent in the last part of May. In June there was a general fall of pressure over western Europe, the deficit exceeding 5 mb. in northern France, but pressure was again high over the North Atlantic, and in spite of an

abnormal number of thunderstorms (see *Meteorological Magazine* for June, p. 129) and some heavy individual falls, the general rainfall was again below normal.

In July the Atlantic anticyclone spread over Europe, where pressure was generally above normal, but the British Isles came under the influence of several secondaries from a depression over Iceland, and it was not until August that anticyclonic conditions became persistent, though not intense. In September they became far more marked, but the anticyclonic centre lay to the north-eastward of the British Isles. In southern England conditions were considerably affected by an area of low pressure over France and the Bay of Biscay.

Considering the period as a whole, we find that the mean pressure from April to September inclusive was slightly above normal over the British Isles, Scandinavia, the whole of western and central Europe and the Mediterranean. The excesses nowhere exceeded 2·5 mb. however; considering the general dryness much more definitely anticyclonic conditions would have been expected. The explanation seems to be that while most of Europe was under the influence of fairly persistent anticyclones, the high-pressure centres were for the most part just outside the borders of Europe. From the limited data available at present, it seems probable that the deficit of rainfall included Scandinavia and western Europe as well as the British Isles, while temperatures were above normal in Scandinavia and the British Isles but only normal in central and southern Europe.

The Sunshine Records of the North and South Compared

Is there a Four-Year Cycle in our Periods of good and bad Weather?

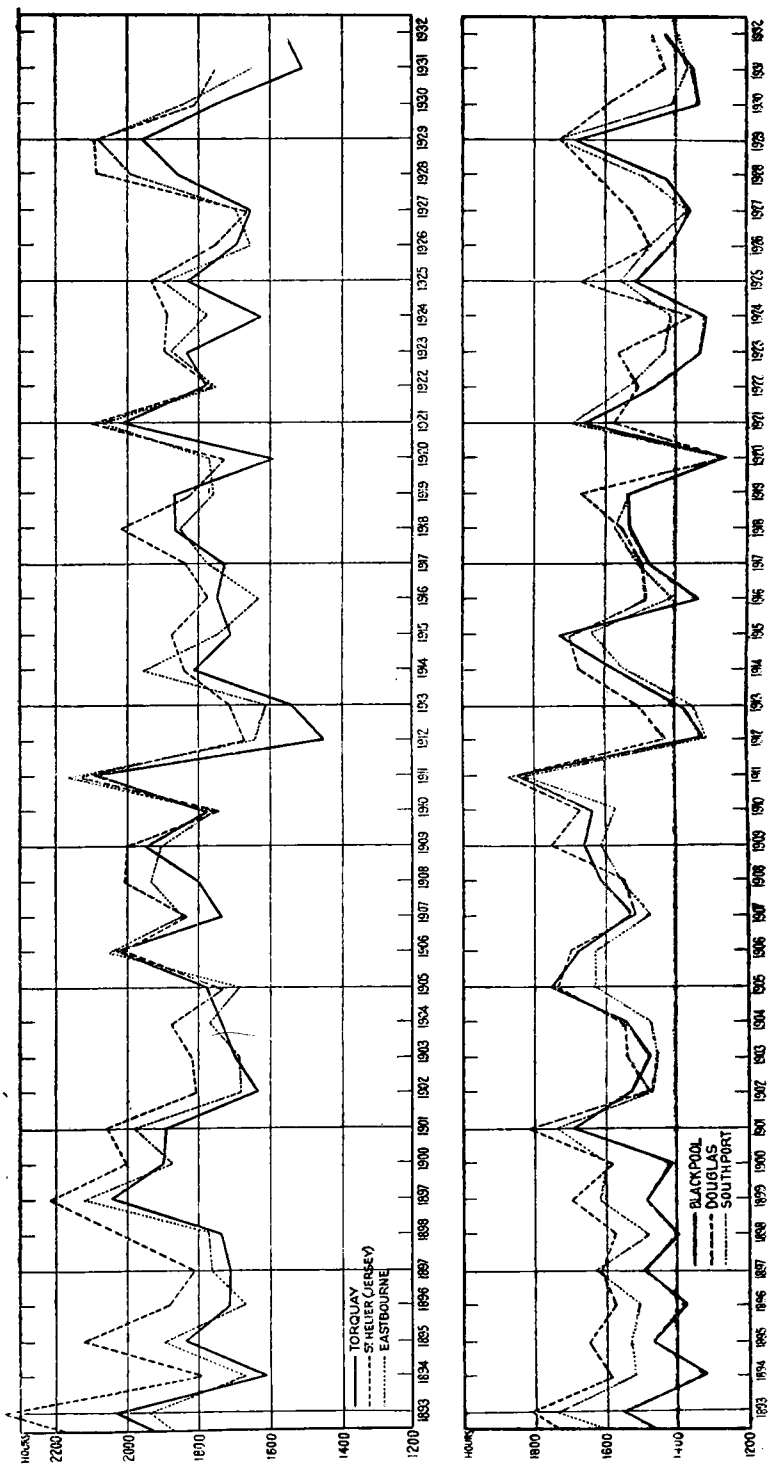
By JOHN B. C. KERSHAW, F.I.C.

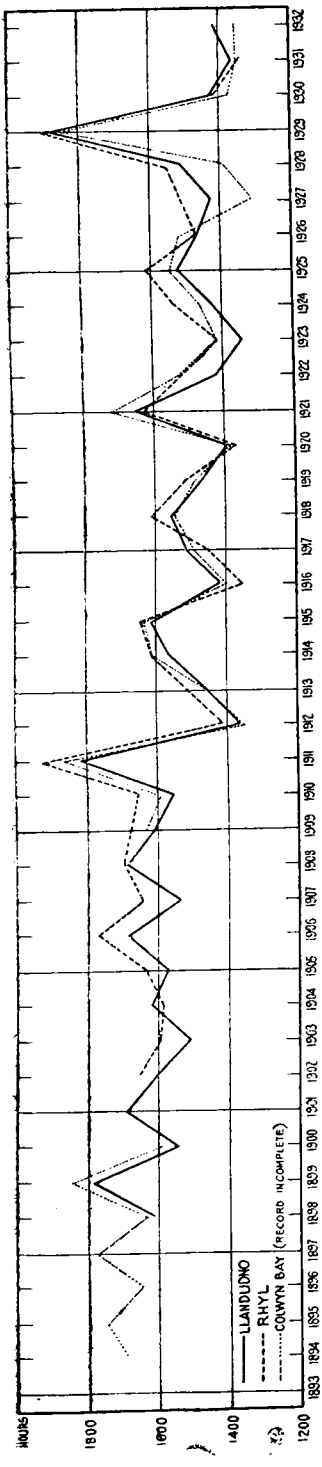
The writer had occasion recently in connexion with his work for the Smoke Abatement movement in the north, to study by graphic methods the official sunshine records of some of our leading seaside resorts. This examination of the official figures has brought to light one remarkable feature which no other observer has so far noted, namely, that there is a three-and-a-half, or four-year cycle, in the return of good summers, and this periodic variation can be traced back so far as the returns have been examined. It must be noted, however, that the Campbell-Stokes Sunshine Recorder had not come into general use until after 1896, and that the totals recorded before and after that date are not comparable.*

* Mr. Baxendell informs me that the earlier figures at Southport were obtained by a different type of recorder which gave totals 4 per cent higher than the Stokes instrument; and the Southport figures for 1892 to 1895 have been corrected accordingly before using in the diagram.

ANNUAL SUNSHINE RECORDS

reproduced by the courtesy of Mr. J. B. C. Kershaw





It is now quite established that there is a sunspot cycle which varies between eleven and thirteen years, and that this cycle does exert an influence upon our records of sunshine. During the last forty years, 1899, 1911, 1921 and probably 1933 have been the years of minimum sunspot activity, and these have all been marked by very high totals of sunshine in this country. The prospects of another very high total during the present year are certainly favourable, since the totals of the earlier maximum years have been passed for the first eight months, and if we have a fine autumn, which is probable, the very high sunshine totals of the years 1911 and 1929 will be exceeded by those of 1933.

In the series of diagrams printed opposite, the annual figures of hours of sunshine of nine of the leading seaside resorts, in the north and south, have been plotted for the forty-year period extending from 1893 to 1932. It will be seen that in each of these nine places, there has been a three- to four-year cycle in the returns of high sunshine figures, especially marked in the period since the end of the war, and the only exceptions have been at the dates when the eleven-year sunspot period clashed with the shorter periodicity. Another feature of the curve is, that the years of very high sunshine totals are in nearly all cases followed by a sudden drop of the curve in the succeeding year, and this is followed by a gradual ascent extending over two or three years, to the next peak year.

The causes of this three-and-a-half to four-year period are probably of solar origin, but as the observations have been made so recently they have not yet been discussed by expert meteorologists. In a later article, the writer proposes to discuss observations he is making upon the influence of the Smoke Abatement movement upon the

sunshine records, in order to determine how far the improvement noticeable in the atmosphere in London and other large towns and cities, is being shared by the surrounding districts of the country.

Thanks are due to Mr. J. Baxendell, the Corporation Meteorologist of Southport and to the Meteorological Office for supplying many of the official figures of sunshine duration upon which the diagrams are based.

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings will be:—

October 30th, 1933.—*The mechanism of the great burst of cold air at the end of November*, 1930. By E. Ekhart (Beitr. Geophs., Leipzig, **38**, 1933, pp. 282-308) (in German). *Opener*—Mr. H. W. L. Absalom, B.Sc.

November 13th, 1933.—*American air mass properties.* By H. C. Willett (Cambridge, Mass., Papers in meteorology, **2**, No. 2, 1933). *Opener*—Capt. F. Entwistle, B.Sc.

OFFICIAL PUBLICATION

The following publication has recently been issued:—

Annual Report *of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the year ending March* 31, 1933.

The chief item of interest in this report concerns the British participation in the Second International Polar Year. From August, 1932, to August, 1933, expeditions sent by 14 countries have been stationed in various polar regions; a British party which includes four members of the Office staff has occupied a station at Fort Rae in north-west Canada making observations of meteorology, terrestrial magnetism and aurora.

The demands for meteorological information both by Government departments and the general public continued to increase; and with the increase of civil and private flying there was naturally an increase in the number of demands for information for aviation. Special arrangements were made for the supply of information to the *Graf Zeppelin* during its visit to this country in July, 1932; and a special meteorological organization was brought into operation for supplying information to the pilots of the Fairey-Napier monoplane for the non-stop flight from England to Walvis Bay in February, 1933.

Correspondence

To the Editor, *The Meteorological Magazine.*

Cloud

In connexion with Mr. Wooldridge's letter in the September

issue, I venture to forward for comparison some data for a southern station, Grayshott. Observations have been taken at 9h. daily, and the period examined is from 1901-32.

As at Market Harborough, the lowest monthly mean was in July, 1911, the amount being 3·2. On five other occasions has the amount been less than 4, the last being 3·8 in June, 1925. Cloud amount 5 or lower has occurred during the period considered at least once in all the months March-October.

The most interesting result of the investigation is, however, in connexion with high monthly means. The highest is 8·7 in April, 1920. After this comes 8·6 in February, 1926. Cloud amount 8 or more has occurred at least once in every month except September and November. The absence of high cloud means in November is a curious result, as is also the high value of 8·5 in a summer month, June, 1909.

S. E. ASHMORE.

22, *Soho Road, Handsworth, Birmingham*, 21. *October 1st*, 1933.

Luminous Night Clouds

On reading the letter with the above title on p. 186 of the *Meteorological Magazine*, I wondered whether the cloud formation described therein would throw any light on a hitherto rather obscure passage in Eddius' life of St. Wilfred (634-709), Archbishop of York and Apostle of Sussex. The passage, as rendered by Colgrave is as follows:—" Chap. LXVIII. The sign of the bow.

" On the anniversary of our holy bishop . . . . when the feast which accompanied the solemnity was over the abbots went out with the whole community to compline in the evening twilight. Suddenly they saw a wonderful sign in the sky, namely, a white arc, surrounding the whole monastery like a rainbow by day but without its various colours. For this white arc starting from the gables of our church dedicated to S. Peter (now Ripon Cathedral) opposite where the limbs of our holy bishop rest and stretching southward made a wide sweep round the right-hand side of the monastery until it reached the north. Then continuing towards the south-east quarter of the morning sky and tending upwards it ended there. We worshipped and praised the Lord . . . . . "

Both aurora and lunar rainbows have been suggested as an explanation of this " sign," but Colgrave rules both suggestions out. It is tempting to see therein, a perhaps glorified description, of some cloud phenomenon as described by Mr. Horrex.

CICELY M. BOTLEY.

Guildables, 17, *Holmesdale Gardens, Hastings. September 20th*, 1933.

On the Temperature of Rain

In the July issue of the *Meteorological Magazine* Colonel E. Gold

briefly discusses from a theoretical standpoint the interesting question of the temperature of rain and arrives at the conclusion that "apart from evaporation, even the largest drops will warm up practically to the air temperature; the net result when evaporation is taken into account will, therefore, be a temperature not very far from the wet-bulb temperature . . . . " I wish to mention here that the existing records of the temperature of rain, so far as my information goes, generally support the above conclusion. The observations of Schlagintweit ("Neue Untersuchungen") on Vincenthütte showed that the temperature of rain was sometimes slightly higher, sometimes slightly lower than the temperature of air. The numerous measurements of Breitenlohner at Lobostiz and of Arendt at Potsdam* during thunderstorms showed that the temperature of rain was 3°C. to 0·8°C. lower than that of air. Passerini†, who made a number of measurements of the temperature of rain, also obtained more or less the same result.

In general, therefore, experimental data show that the temperature of rain is slightly lower than the temperature of air. It may be remarked, however, that a distinction should be made between frontal rain and the rain associated with thunderstorms, the temperature of the latter type of rain being more likely to be lower. If the rain is accompanied by hail or snow, the temperature can sometimes be very low. In most cases, therefore, the cooling of air directly by rain should not exceed about 3°, and would often be considerably less. One factor that would tend to reduce the cooling effect of rain is the heat developed due to friction between the falling raindrops and the surrounding air which would be quite appreciable at least in moist air with a weak temperature gradient. Another factor which would probably have an opposing effect is the absorptive action of the falling rain on the air through which it falls. The falling raindrops would adsorb air from the higher levels and liberate it in the lower levels; the adsorbed air will not, most probably, be dynamically heated up as it is brought down by the rain and will therefore tend to cool the air in the lower levels.

A. K. Das.

Alipore Observatory, Calcutta. September 1st, 1933.

Waterspout in Kirkwall Bay

Mr. J. Crichton sends us some notes by Mr. J. Muir, the Observer at Kirkwall, and a cutting from *The Orcadian*, describing a waterspout which occurred in Kirkwall Bay, Orkneys, on August 21st. During the morning heavy thundery clouds lay to the north of Kirkwall. Shortly after 11 a.m. a whirling

* *Wetter, Berlin* xii, 1895, p.62.

† *Torino. Boll. Mens. Soc. Meteor. Ital.* xiv, 1894.

funnel-shaped cloud grew downwards from this mass of storm cloud, tapering towards the water surface. The surface of the sea was violently agitated, and the spray was estimated to have risen to a height of more than twenty feet. The spray resembled smoke and the volume was so great that it was mistaken by several spectators for smoke from a burning motor-boat.

The waterspout moved towards the south-west at a speed estimated at about 20 miles per hour. It broke up just off the Quanterness shore, to the west of Kirkwall Bay, but about an hour later there was a cloud-burst at Dounby, 11 miles to the west-north-west of Kirkwall. For about half an hour the rain "stopped pouring and simply gushed."

The waterspout was preceded and followed by peculiar optical phenomena. Mr. Muir writes: "There was reported to me by the crew of a steamer that they saw a perfectly circular rainbow brightly coloured and perfectly complete about 8h. the same morning. I questioned them closely about it and I am convinced they actually saw it, but it lasted only a short time." This would seem to have been some sort of halo. Another phenomenon occurred after the waterspout had passed. One observer stated: "I observed a strange bright light in the sky, almost as brilliant as lightning, though of course, it was not a flashing light." Two others said that after the spout had passed into the Bay of Firth, towards Quanterness, they saw two rainbow-coloured bands stretching horizontally across the horizon.

A possible explanation of these horizontal bands is that they were the summits of the arcs of rainbows, the greater part of which would be below the horizon. At 11.15 a.m. B.S.T. on August 21st in the latitude of Kirkwall, the highest part of the arc of a primary bow would be only about 4° above the horizon, and would appear, as described, almost as a horizontal band.

Another waterspout was observed on the afternoon of September 23rd over Eday Sound, Orkneys. The observer at Kirkwall states, "it seems strange that we have had two this year and, so far as I have read or heard have heard no mention of them before. None of the local writers of the past made any mention of them."

Remarkable Thunderstorm at Shanklin

We had a rather remarkable thunderstorm at Shanklin, Isle of Wight, last Tuesday evening, September 26th.

It had been thundery all Tuesday, but towards sunset the sky became clear and I thought the electrical disturbance was passing off. About 9 p.m., however, it became heavy and clouded over, and soon after 9.30 p.m., distant thunder and lightning occurred in the north-east away over Culver Cliff. Very soon the storm worked its way towards Shanklin and broke

fair and square about 10 p.m. with vivid lightning and loud thunder accompanied by heavy rain. About 10.30 p.m., the rain ceased, and the lightning and thunder eased off, and for about 10 minutes there was a complete cessation, the air being very still and the sky heavily overcast. Then without any warning a terrific flash of ball lightning rent the sky just east-south-east of the town, followed immediately by the loudest and most terrifying crack of thunder I have ever heard, either in England or the tropics. Not a drop of rain fell and that ended the storm entirely, no further rain, thunder or even sheet lightning occurring.

J. E. COWPER.

The Plough and Harrow Hotel, Edgbaston, Birmingham. October 3rd, 1933.

Heavy Rainfall at Fleet, near Aldershot, September 26th, 1933

The intense thunderstorm rain which occurred during the evening of September 26th is of special interest, not only because of the large amounts recorded, but also because of its occurrence late in the year. Usually about two-thirds of the total number of intense falls which qualify for special mention in *British Rainfall* occur in the three months June, July and August. Mrs. L. M. Kent, of Fleet, drew attention to the storm in a letter to *The Times* of September 29th. The largest measurements were:—

Fleet (Home Wood)	5·14 in.
Crookham	4·25 in.
Winchfield (The Chase)	4·02 in.
Hartley Wintney (Council Offices) ...	3·90 in.

At Fleet the rain is reported to have fallen between 15h. and 19h.,* at Winchfield Major R. E. Fryer gives between 15h. 30m. and 19h. 30m., while the Sanitary Surveyor and Inspector at Hartley Wintney gives the following details:—"Light rain commenced to fall at 15h. 30m., heavy rains accompanied by very heavy thunder and vivid lightning continued incessantly from 16h. to 18h. 20m. There was a cessation for 10 to 15 minutes when heavy hail followed again by heavy rains continued until 19h. 35m. Light rain fell until 19h. 40m., after which there was nothing beyond a slight drizzle."

At South Farnborough, four miles east of Fleet, the total rainfall was only 0·30 in. So far as can be ascertained more than four inches fell over about 8 sq. miles, and more than three inches over about 21 sq. miles. The whole of this rain occurred within 4½ hours. Comparable intense rains are those of July 24th, 1904, near Huddersfield, October 20th to 21st, 1908, near Portland Bill, and August 18th, 1924, near Cannington. On each of these occasions the intense rain lasted about five hours and the

* All times are G.M.T.

areas with more than four inches were about 7, 11 and 10 sq. miles respectively.

Thunderstorm rains occurred over a wide area in the south of England on September 26th. More than two inches was recorded at Bramley to the north and at Hoddington House to the south of Basingstoke, while as much as 4·31 inches fell at Monkton Park near Chippenham. Heavy rain occurred from 15h. to about 17h. but subsequently there was another storm lasting about 10 minutes.

J. GLASSPOOLE.

Degree of Accuracy in Estimating Tenths

Apropos the note under the above title in the *Meteorological Magazine*, September, 1933, p. 191, I have two sets of observations which may be of interest.

(1) Mr. C. J. Boyden, of this Office, and I once made an experiment on ourselves, similar to that described in the above note. Centimetre scales were drawn, and in each centimetre a transverse mark was made. The intervals were estimated to two decimal places (*e.g.*, 0·47), and afterwards measured with a half-millimetre scale, the second decimal place being estimated. For 100 readings, taking the measured values as correct, my mean error (irrespective of sign) was 0·018, and I find that I too tended to under-estimate values below 0·5 and over-estimate those above 0·5. Mr. Boyden beat me, having a mean error of ·011 for 50 readings, and his errors were practically uniformly distributed. Our estimates were made with extreme care, and I believe we used a pen or pencil as a pointer to help in mentally subdividing the intervals. A set of readings made in the course of an ordinary day's work would probably be much less accurate. One does not, of course, usually estimate to two decimal places.

(2) Some time ago I was dealing with tabulated hourly readings, in which the curves are measured with a millimetre scale, the readings being estimated to tenths of a millimetre. I happened to notice that the figure 7 was very rare in the decimal place, and this led me to count the number of times that each figure from 0 to 9 occurred in the decimal place in two months' tabulations (about 1,500 readings). The result was as follows:—

Figure	0	1	2	3	4	5	6	7	8	9
Percentage frequency	32	16	7	6	4	3	4	1·4	7	20

Another two months, about two years later in date, gave the following result:—

Figure	0	1	2	3	4	5	6	7	8	9
Percentage frequency	27	14	13	5	3	2	5	1·8	11	18

In the first year 68 per cent., and in the second 59 per cent. of the readings ended in 0·9, 0·0 or 0·1. It is obvious that the frequency of each figure ought to be 10 per cent. How much

variation is to be expected with the given number of readings I am not prepared to say, but it seems that there might have been a gain in accuracy on the average by reading to the nearest half millimetre, making all readings end in 0·0 or 0·5.

This has a bearing on the question of units in meteorology, and suggests that it is better to choose a unit of suitable size and read to whole numbers than to have a larger unit and read to decimals. I ought to say that in the case quoted it was thought that the scale used and the method of measuring were not very suitable and might have been responsible for some inaccuracy, and that in tabulations of another kind (anemograms) the same tabulator tended, in common with another, merely to emphasize slightly the figures 0 and 5. No doubt most of us would be guilty of a certain degree of favouritism. But the fact remains that the first tabulations show a bias great enough to make the decimal figure practically meaningless.

D. N. HARRISON.

Meteorological Office, 6, Drumsheugh Gardens, Edinburgh, 3. October 3rd, 1933.

NOTES AND QUERIES

Report on Ascents Carried Out at Shoeburyness with Large Pilot Balloons

Towards the end of August three large pilot balloons were obtained for experimental purposes, and this note gives particulars of interest concerning each of these ascents. The three balloons were by Pirelli and were extremely well made, and all weighed 735 grams to the nearest gram. They all bore date August 10th, 1933. One of the objects kept in mind in making these ascents was the value of the number q which appears in the formula connecting the rate of ascent of pilot balloons with their weight and free lift. Simultaneously with each ascent of a large balloon, therefore, an ascent with a 90-inch pilot balloon was carried out with two other theodolites. In this way a check could be secured upon the vertical movements of the atmosphere. Fortunately on all three occasions vertical motion was very small and the rates of ascent for the large balloons can be considered as reasonably free from any but small errors due to vertical currents.

The first ascent was made on September 5th. The lift given was 907 grams. The ascent began at 14h. 30m. and the balloon burst after a flight of 67 minutes. Visibility was excellent and the balloon was seen to be torn into several distinct and separate fragments. The mean rate of ascent of the balloon was 1,165 feet per minute over the first 10 minutes, and 1,125 feet per minute over the first 20 minutes. At the 66th minute the height was about 76,200 feet, which is now the record for this station. As far as is known winds have never before been measured at this height with two theodolites.

The wind structure on this day was such that the balloon throughout its flight was never more than 3 miles horizontally from the point of release. Indeed after the 27th minute the angle of elevation at both theodolites was always over 80° and on one occasion reached 88·9°. This, of course, gave excellent triangulation as far as horizontal motion was concerned, but rendered the internal agreement of the heights less exact than usual. The wind structure showed an easterly current up to 13,000 feet, a transitional stage up to 17,000 feet and then a westerly drift up to 57,000 feet. The balloon crossed the base line between the observing stations at a height of 36,000 feet. Between 57,000 feet and 76,000 feet the balloon described a complete spiral, and when last seen was travelling towards the south-east. In many places the wind was very light. Above 5,000 feet it never reached 30 feet per second, and above 36,000 feet it did not anywhere exceed 20 feet per second. There were several patches of very light airs.

The second balloon was released on September 15th. It was given a free lift of 794 grams and the ascent began at 9h. 35m. The balloon survived for 60 minutes and was then seen to collapse; it remained however in one piece. Over the first 10 minutes the mean rate of ascent was 1,105 feet per minute and over the first 20 minutes 1,095 feet per minute. At the 60th minute the balloon was at a height of about 65,000 feet. On this day there was a light wind at the surface from the south-west. At 7,000 feet this had veered to north-west, and this general direction was maintained all the way up to 65,000 feet. At 12,000 feet the wind strengthened to over 50 feet per second and maintained these speeds to about 50,000 feet when the wind fell off somewhat in velocity. The later part of this ascent is rendered somewhat uncertain by the small parallax of the base line, which fell to 0·9° at the 60th minute. Working was done as usual with graphically smoothed parallaxes.

On the following day, September 16th, a flight was made with the remaining balloon, commencing at 9h. 45m. On this occasion a free lift of 681 grams was applied. This balloon was observed for 79 minutes and was then perceived to collapse and fall, like the second balloon, in one piece. Over the first ten minutes the rate of ascent was 1,026 feet per minute, and over the first 20 minutes 1,010 feet per minute. At about the 70th minute the rate of ascent began to fail and the balloon only rose about 4,000 feet in the remaining 10 minutes of the flight. At the 79th minute the height was about 74,300 feet.

The wind structure on this day was as follows. The light south-easterly drift at the surface soon passed through south to south-south-west, and at 10,000 feet a current of 20 to 30 feet per second from a point between south and south-south-west was established, which persisted very regularly up to about 32,000

feet. This current then freshened very considerably and the direction kept much nearer south. At 47,000 feet the speed began to fall off rapidly and the direction worked into the south-west and west-south-west. The fall off in velocity continued, and the wind was down to light airs by 66,000 feet. These calm conditions remained till about 70,000 feet when the wind began to freshen again to about 20 feet per second, but now from the north. Unfortunately the lifting power of the balloon, which had been well maintained until now, began to fail rapidly and soon after the balloon burst. In the last 4,000 feet, however, the northerly current seems to have become well established.

Examining the data here obtained in connexion with the usual formula

$$V = q \frac{L^{\frac{1}{4}}}{(L + W)^{\frac{3}{4}}}$$

we derive the following values of q

Balloon.	W	L	V	q
September 5th ...	735	907	1,165	456
,, 15th ...	735	794	1,105	452
,, 16th ...	735	681	1,025	441

It will be noticed that there is a decrease in the value of q with the free lift. There are insufficient data here to show whether the effect is real, but there seems to be no reason for regarding q as a constant even for a given balloon. The dimensions of the equation indicate a somewhat complex structure for q.

The following conclusions seem to emerge from the results of these balloon ascents:—

(1) The appropriate value of q for a 735-gram balloon is about 450 with the possibility that this quantity is also a function of the free lift.

(2) The balloons are capable of reaching a height of about 75,000 feet normally and probably as much as 80,000 feet might be secured on some occasions.

(3) There are varied and unexpected wind structures in the lower regions of the stratosphere.

The base lines used in normal pilot balloon work here are much too short for really satisfactory performance in long ascents of this type. The possibilities of a base line of about 22,000 feet are being examined with a view to its use if further ascents with these 735-gram balloons can be arranged.

C. BRITTON.

Bibliography of Actinometry

The issue of the "Bibliography of Actinometry" initiated by M. Volochine* is being actively carried forward. A series of

* See *Meteorological Magazine*, 67, 1932, p. 263.

abstracts recently received deals mainly with papers published in the U.S.A. previous to 1930, but also includes abstracts of eight papers by British authors. Abstracts of most of the British contributors will be issued in a later series.

Obituary

Vice-Admiral Hugo Dominik.—We much regret to record the death of Vice-Admiral Hugo Dominik, the President of the Deutsche Seewarte, which occurred at Hamburg on September 15th. Though his friends had known for some time that his health was failing the end came with tragic suddenness, for the same post which brought to the Meteorological Office the official announcement of his death also brought a letter on routine business bearing his autographed signature.

Admiral Dominik became President of the Seewarte in September, 1926. His earlier career had been spent in the German Navy. Though most of the commands he had held had been on the fighting side he was a man of wide scientific interests which he had found time and opportunity to foster. He had been in command of the Survey Ships " Planet " and " Möwe," and his work in them had brought him into frequent contact with the scientific institution which, in after years, he was to direct. The scientific traditions of the Seewarte were thus safe in his keeping.

Among meteorologists Dominik has won for himself a unique position during the few years of his directorship, for it is to him that we owe the suggestion to celebrate the jubilee of the First Polar Year by repeating the original enterprise in an extended form. Though some looked askance at the suggestion, when he first mooted it, as being impracticable in the difficult economic times through which the world was passing, yet the idea caught the imagination and eventually sufficient promises of co-operation were forthcoming to ensure success. During the thirteen months August, 1932, to August, 1933, many countries have sent special expeditions to make meteorological and geophysical observations in polar and sub-polar regions. It must have been a source of bitter disappointment to Dominik that the proposed official German co-operation had to be abandoned for financial reasons, and it is tragic to think that he himself has now passed away before even the first fruits of the enterprise have been gathered.

Though the proposed German expedition has proved impracticable, the Seewarte is nevertheless taking an active share in the work; a share which corresponds closely with that which our own Office took in the venture of 1882-3. For that year we prepared and published daily synoptic charts of the North

Atlantic Ocean and adjoining continents using in them all observations from ships and shore stations which we could come by. Things have changed in 50 years, and synoptic broadcasts now give us the material for constructing, day by day, maps of the North Atlantic which in 1882 took months or even years to compile. Nevertheless the need for authoritative maps embracing the greatest possible area remains one of which all meteorologists are conscious. The possibility of meeting the demand has been discussed at most recent international conferences, and a plan has at last been formulated for effective international co-operation, under which the Seewarte is acting as a central collecting house and undertakes the task of plotting the collected material. Specimen charts embracing the whole Northern Hemisphere were printed at the Seewarte and submitted by Admiral Dominik for the approval of the International Meteorological Committee at its meeting in Locarno in 1931. In due course we may expect to have the complete set for the 13 months comprising the Polar Year 1932-3, with at any rate some prospect that the enterprise may take permanent shape and be continued in subsequent years. Admiral Dominik's name is thus permanently linked up with two of the great co-operative meteorological efforts of our time.

By German meteorologists his loss will be felt in a peculiarly personal manner, for the jubilee meeting of the Deutsche Meteorologische Gesellschaft is being held at Hamburg as these notes go to press. For many who had looked forward to a personal meeting with the distinguished head of the Seewarte the occasion has been turned from one of rejoicing to one of mourning.

Mr. William George James.—Mr. James, whose death on August 24th at the age of 82 was briefly recorded in our last issue, was born in 1851 and entered the Meteorological Office in June, 1864, being appointed to the Ocean Meteorology Branch. He rose to the rank of Staff Assistant and retired on December 31st, 1919, the whole of his long period of service being occupied in marine meteorology. He was especially associated with the preparation of the Monthly Meteorological Charts for the North Atlantic Ocean and East Indian Seas and other atlases of ocean meteorology, and he developed great skill and accuracy in the responsible cartographic work required for these charts.

News in Brief

We learn that Prof. Dr. Martins Costa has resigned from the directorship of the Instituto de Meteorologia Hidrometria e Ecologia Agricola at Rio de Janeiro and was succeeded by Mr. F. E. Magarinos Torres on June 1st, 1933.

The Weather of September, 1933

Pressure was above normal over Spitsbergen, Iceland, northern, central and south-east Europe (including Italy and south-west Portugal and Spain), part of the North Atlantic, Bermuda and northern Labrador, the greatest excess being 10·3 mb. at Haparanda. Pressure was below normal over France, Switzerland and most of the Iberian Peninsula, most of the North Atlantic including the Azores, Canada (except northern Labrador) and the United States the greatest deficits being 6·2 mb. at 50° N. 100° W. and 2·7 mb. at Corunna. Temperature was above normal at Spitsbergen and northern and central Europe, but below normal in south-west Europe. The rainfall distribution was irregular in Sweden, being above normal only in southern Norrland, in Dalecarlia and Gothland.

Warm and unusually sunny weather prevailed over the British Isles during September with a general lack of rain in Scotland, Ireland and north and west England. Some new sunshine records were set up—at Ballinacurra, Co. Cork, 205·9hrs. of bright sunshine were registered during this September, the previous highest amount being 188hrs. in September, 1906. The drought ended in south England on the 12th, but in many places in the north and west it was not broken until the 17th, and at Felixkirk (Yorkshire) not until the 20th. During the first days of the month occasional slight rain or drizzle was experienced in the north and west, but on the 3rd the anticyclone over the south of the country spread northwards and warm dry sunny weather prevailed over the whole country. The warmest days were the 3rd and 4th when 80° F. and over was recorded at several places and 83° F. at Cambridge and Woodhall Spa (Lincolnshire). Sunshine records frequently exceeded 11hrs. each day, and 12·3hrs. was recorded at Lowestoft and 12·2hrs. at Littlehampton and Bath on the 5th and 12·2hrs. at Catterick on the 2nd. During the night of the 11th-12th a depression over the Bay of Biscay moved north-eastwards and rain fell heavily in southern England on the 12th, 2·09 in. at Ventnor, 1·81 in. at Southsea and 1·40 in. at Chewton Mendip, Somerset. Rain was also experienced generally in the south-east the following day and slight drizzle locally in the eastern districts, but in the west the dry anticyclonic conditions continued though with cool northerly winds. On the 14th-16th the anticyclone passed again across the country and sunny dry weather was renewed, warm during the day but cold at night, ground frosts being general on the 14th to 16th. Sunshine records exceeded 11hrs. locally and on the 14th reached 12·1hrs. at Calshot. On the 16th a secondary depression approached Ireland and slight rain fell in Ireland and south England that day. On the 17th rain fell and from then until the 26th a complex low-pressure area moved over the country and the weather was generally mild and unsettled but with long

periods of bright sunshine. Tiree had 11·2hrs. bright sunshine on the 24th. Thunderstorms, severe in places, occurred over a wide area during this period and in the south were often accompanied by heavy rain especially on the 24th and 26th.* A southerly gale occurred at Lerwick on the 18th and a north-easterly gale at Inchkeith on the 24th. On the 26th the anti-cyclones over the North Atlantic and Scandinavia joined up across Scotland and Ireland and then extended over the rest of the British Isles. Weather was fair to cloudy with slight rain or drizzle locally whilst mist was experienced generally with fog at times in the Midlands and east England. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	155	+40	Liverpool	166	+38
Aberdeen	148	+24	Ross-on-Wye	163	+27
Dublin	154	+15	Falmouth	197	+34
Birr Castle	169	+43	Gorleston	179	+17
Valentia	205	+72	Kew	190	+45

The special message from Brazil states that the rainfall was scarce over the whole country with averages 0·55in. 0·16in. and 0·28in. below normal in the northern, central and southern regions respectively. Three anticyclones passed across the country. The crops were generally in good condition. At Rio de Janeiro pressure was 0·9 mb. above normal and temperature 0·7° F. below normal.

Miscellaneous notes on weather abroad culled from various sources. Storms were experienced generally in France between about the 8th and 13th, when five people were drowned and many vineyards were destroyed. It is reported that widespread damage has been caused by rain to the grain crops in the Urals, western Siberia and south Russia. Eight people were drowned at Montpellier about the 27th, when a house collapsed as the result of floods following heavy rain. Severe storms were also experienced in Provence. On the 30th, the river Loire rose nearly 8 ft. owing to violent rainstorms, and stormy weather occurred generally in south France. (*The Times*, September 14th-October 2nd.)

Although the rains of August eased the drought in Cape Province and the Orange Free State, it was reported on the 19th that there was still great need of rain in the north of South Africa. (*The Times*, September 20th.)

Floods continued throughout central and western India during the first half of the month. On the 20th it was reported that the Arabian Sea monsoon was weakening, and on the 27th that the monsoon had withdrawn from India. A typhoon struck the coast in the Shanghai region on the 3rd, and another typhoon

* *See* p. 211 and p. 212.

struck Shanghai at midnight on the 18th, causing floods. (*The Times*, September 15th-29th.)

At the end of the month advices were received that good general rains had fallen over many areas of New South Wales, Queensland and Victoria. (*The Times*, September 29th and October 3rd.)

In Canada severe frosts in the Peace River District and moderate frosts in northern and central Alberta damaged late crops. The hurricane which struck the Bahamas on August 31st passed along the north-east coast of Cuba from Caibarien to Havana on the 1st, and then continued westward through the Gulf of Mexico, striking Texas near Freeport on the 4th, and passing through a large part of southern Texas on the 5th. About 150 people were killed in Cuba and 1,000 injured; coast towns and sugar districts suffered most. The hurricane reached its maximum intensity at Havana at 5 p.m. on the 1st, when the wind velocity was 98 m.p.h. In Texas 32 people were killed mainly owing to the huge waves which flooded communities on the coast and thousands were rendered homeless—the material damage here was estimated at $12,000,000, the greatest damage being to the citrus crops. Another hurricane blowing with a velocity of 100 m.p.h. swept the Bahamas on the 3rd and continued in a north-westerly direction, striking the east coast of Florida on the 4th. In Florida two lives were lost, and it is estimated that 70 per cent of Florida's citrus crop was ruined. Two tropical storms struck the east coast of Mexico on the 4th, doing damage to water-front buildings. A hurricane swept along the Atlantic seaboard of North Carolina and Virginia on the 16th, many of the coastal towns were flooded and 15 people were killed. In a hurricane which occurred shortly before the 20th in Mexico 135 people lost their lives and 3,000 were made homeless in consequence of the ensuing floods. A hurricane raged near Tampico, Mexico, for nearly 12 hours on the 24th, and then passed inland as far as Victoria and S. Luis Potosi; floods occurred generally owing to the overflowing of the Panuco and Tambesi Rivers and huge waves from the Gulf, so that more than 54 people were killed. Temperature was above normal over the whole of the United States, except the Pacific Coast, while the rainfall distribution was irregular. Good general rains fell over the whole Argentine agricultural zone. (*The Times*, September 2nd-28th, and *Washington, D.C., U.S. Dept. Agric. Weekly Weather and Crop Bulletin.*)

General Rainfall for September, 1933

England and Wales ...	94	per cent of the average 1881-1915.
Scotland	41	
Ireland	45	
British Isles	70	

Rainfall: September, 1933: England and Wales.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square	3·01	165	*Leis.* .	Thornton Reservoir ...	1·40	77
Kent .	Tenterden, Ashenden...	4·32	202	,, .	Belvoir Castle.....	2·04	109
,, .	Folkestone, Boro. San .	5·79	...	*Rut* .	Ridlington	2·09	109
,, .	St. Peter's, Hildersham	...	...	*Lincs* .	Boston, Skirbeck	1·99	113
,, .	Eden'bdg., Falconhurst	3·52	155	,, .	Cranwell Aerodrome ...	2·07	116
,, .	Sevenoaks, Speldhurst	3·29	...	,, .	Skegness, Marine Gdns	1·11	61
Sus .	Compton, Compton Ho.	2·88	103	,, .	Louth, Westgate	1·65	82
,, .	Patching Farm	4·17	174	,, .	Brigg, Wrawby St. ...	1·79	...
,, .	Eastbourne, Wil. Sq.	4·62	185	*Notts* .	Worksop, Hodsock ...	1·43	94
,, .	Heathfield, Barklye ...	4·24	173	*Derby* .	Derby, L. M. & S. Rly.	1·89	115
Hants .	Ventnor, Roy. Nat. Hos.	4·45	179	,, .	Buxton, Terr. Slopes	·81	25
,, .	Fordingbridge, Oaklnds	2·65	123	*Ches* .	Runcorn, Weston Pt...	·60	22
,, .	Ovington Rectory	3·80	166	*Lancs* .	Manchester, Whit Pk.	1·08	45
,, .	Sherborne St. John ...	4·13	201	,, .	Stonyhurst College ...	1·00	26
Herts .	Welwyn Garden City...	2·48	...	,, .	Southport, Hesketh Pk	·77	28
Bucks .	Slough, Upton	2·45	139	,, .	Lancaster, Greg Obsy.	1·05	31
,, .	H. Wycombe, Flackwell	2·37	...	*Yorks* .	Wath-upon-Dearne ...	1·79	113
Oxf .	Oxford, Mag. College...	1·97	117	,, .	Wakefield, Clarence Pk.	1·60	100
Nor .	Pitsford, Sedgebrook...	1·57	87	,, .	Oughtershaw Hall.....	2·78	...
,, .	Oundle.....	2·51	...	,, .	Wetherby, Ribston H.	2·11	117
Beds .	Woburn, Crawley Mill	1·84	103	,, .	Hull, Pearson Park ...	2·81	163
Cam .	Cambridge, Bot. Gdns.	1·74	108	,, .	Holme-on-Spalding ...	1·96	...
Essex .	Chelmsford, County Lab	1·89	110	,, .	West Witton, Ivy Ho.	2·04	95
,, .	Lexden Hill House ...	1·70	...	,, .	Felixkirk, Mt. St. John	1·50	82
Suff .	Haughley House.....	2·52	...	,, .	York, Museum Gdns.	2·09	128
,, .	Campsea Ashe.....	3·44	180	,, .	Pickering, Hungate ...	1·70	89
,, .	Lowestoft Sec. School	3·33	170	,, .	Scarborough	1·42	79
,, .	Bury St.Ed., Westley H.	2·88	145	,, .	Middlesbrough	1·32	80
Norf .	Wells, Holkham Hall	1·67	88	,, .	Baldersdale, Hury Res.	1·90	76
Wilts .	Devizes, Highclere.....	2·85	140	*Durh* .	Ushaw College	2·99	149
,, .	Calne, Castleway	4·14	201	*Nor* .	Newcastle, Town Moor	1·69	83
Dor .	Evershot, Melbury Ho.	2·75	103	,, .	Bellingham, Highgreen	1·46	61
,, .	Weymouth, Westham .	2·18	104	,, .	Lilburn Tower Gdns...	1·48	63
,, .	Shaftesbury, Abbey Ho.	2·42	99	*Cumb* .	Carlisle, Scaleby Hall	·68	25
Devon .	Plymouth, The Hoe ...	1·76	69	,, .	Borrowdale, Seathwaite	2·00	21
,, .	Holne, Church Pk. Cott.	3·62	101	,, .	Borrowdale, Moraine...	1·79	...
,, .	Teignmouth, Den Gdns.	2·83	142	,, .	Keswick, High Hill...	·98	23
,, .	Cullompton.....	1·44	64	*West* .	Appleby, Castle Bank	1·51	59
,, .	Sidmouth, Sidmount...	1·92	83	*Mon* .	Abergavenny, Larch...	2·40	103
,, .	Barnstaple, N. Dev. Ath	1·32	49	*Glam* .	Ystalyfera, Wern Ho.	2·40	55
,, .	Dartm'r, Cranmere Pool	2·20	...	,, .	Cardiff, Ely P. Stn. ...	1·90	61
,, .	Okehampton, Uplands	2·82	87	,, .	Treherbert, Tynywaun	2·89	...
Corn .	Redruth, Trewirgie ...	1·96	63	*Carm* .	Carmarthen Friary ...	1·99	58
,, .	Penzance, Morrab Gdn.	2·79	95	*Pemb* .	Haverfordwest, School	2·62	74
,, .	St. Austell, Trevarna...	2·67	84	*Card* .	Aberystwyth	1·17	...
Soms .	Chewton Mendip	2·90	94	*Rad* .	Birm W.W. Tyrmynydd	1·22	31
,, .	Long Ashton	2·35	98	*Mont* .	Lake Vyrnwy.....	1·33	38
,, .	Street, Millfield.....	1·64	73	*Flint* .	Sealand Aerodrome ...	·49	24
Glos .	Blockley	2·01	...	*Mer* .	Dolgelley, Bontddu ...	1·77	42
,, .	Cirencester, Gwynfa ...	3·04	138	*Carn* .	Llandudno	1·13	50
Here .	Ross, Birchlea.....	3·03	158	,, .	Snowdon, L. Llydaw 9	3·68	...
Salop .	Church Stretton.....	1·37	67	*Ang* .	Holyhead, Salt Island	·94	35
,, .	Shifnal, Hatton Grange	·65	34	,, .	Lligwy.....	1·16	...
Staffs .	Market Drayt'n, Old Sp.	·78	38	*Isle of Man*			
Worc .	Ombersley, Holt Lock	1·08	61		Douglas, Boro' Cem. ...	·98	30
War .	Alcester, Ragley Hall..	1·37	77	*Guernsey*			
, .	Birminghm. Edgbaston	·71	40		St. Peter P't. Grange Rd	3·63	140

Rainfall: September, 1933: Scotland and Ireland.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per cent. of Av.
Wig .	Pt. William, Monreith	.62	21	*Suth* .	Melvich	·60	21
,, .	New Luce School.....	·50	14	,, .	Loch More, Achfary...	1·55	27
Kirk .	Dalry, Glendarroch ...	·89	24	*Caith* .	Wick	1·17	47
,, .	Carsphairn, Shiel	1·83	34	*Ork* .	Deerness	1·19	41
Dumf .	Dumfries, Crichton, R.I	1·16	45	*Shet* .	Lerwick	2·17	72
,, .	Eskdalemuir Obs.	1·04	28	*Cork* .	Caheragh Rectory	1·21	...
Roxb .	Branxholm	1·11	50	,, .	Dunmanway Rectory .	1·54	38
Selk .	Ettrick Manse.....	1·47	41	,, .	Cork, University Coll.	1·59	59
Peeb .	West Linton	1·67	...	,, .	Ballinacurra	1·04	41
Berw .	Marchmont House.....	1·34	56	*Kerry* .	Valentia Obsy.....	2·47	60
E.Lot .	North Berwick Res....	1·21	58	,, .	Gearhameen	1·80	29
Midl .	Edinburgh, Roy. Obs.	1·87	91	,, .	Darrynane Abbey	2·05	58
Lan .	Auchtyfardle	...	...	*Wat* .	Waterford, Gortmore...	2·24	82
Ayr .	Kilmarnock, Kay Pk. .	·75	...	*Tip* .	Nenagh, Cas. Lough ..	1·67	59
,, .	Girvan, Pinmore.....	·74	19	,, .	Roscrea, Timoney Park	2·36	...
Renf .	Glasgow, Queen's Pk. .	·81	29	,, .	Cashel, Ballinamona ...	2·21	90
,, .	Greenock, Prospect H.	·71	15	*Lim* .	Foynes, Coolnanes.....	·83	30
Bute .	Rothesay, Ardencraig.	1·19	...	,, .	Castleconnel Rec.....	1·53	...
,, .	Dougarie Lodge.....	1·49	...	*Clare* .	Inagh, Mount Callan...	1·50	...
Arg .	Ardgour House	1·89	...	,, .	Broadford, Hurdlest'n.	1·57	...
,, .	Glen Etive	...	...	*Wexf* .	Gorey, Courtown Ho...	1·37	55
,, .	Oban	1·07	24	*Kilk* .	Kilkenny Castle.....	1·92	83
,, .	Poltalloch	2·12	46	*Wick* .	Rathnew, Clonmannon	1·93	...
,, .	Inveraray Castle	1·38	21	*Carl* .	Hacketstown Rectory..	1·80	64
,, .	Islay, Eallabus	1·08	26	*Leix* .	Blandsfort House	2·10	77
,, .	Mull, Benmore	3·03	...	,, .	Mountmellick.....	2·25	...
,, .	Tiree	1·37	37	*Offaly* .	Birr Castle	1·40	61
Kinr .	Loch Leven Sluice.....	2·20	86	*Dublin*	Dublin, FitzWm. Sq....	·97	51
Perth .	Loch Dhu	1·70	30	,, .	Balbriggan, Ardgillan.	1·22	60
,, .	Balquhidder, Stronvar	1·33	...	*Meath.*	Beauparc, St. Cloud ...	·80	...
,, .	Crieff, Strathearn Hyd.	1·72	60	,. .	Kells, Headfort.....	·61	23
,, .	Blair Castle Gardens...	1·89	80	*W.M* .	Moate, Coolatore	1·20	...
Angus.	Kettins School	2·11	95	,, .	Mullingar, Belvedere...	·82	30
,, .	Pearsie House.....	2·13	...	*Long* .	Castle Forbes Gdns....	·81	28
,, .	Montrose, Sunnyside...	1·13	57	*Gal* .	Galway, Grammar Sch.	1·31	...
Aber .	Braemar, Bank	2·29	91	,, .	Ballynahinch Castle...	2·52	53
,, .	Logie Coldstone Sch....	1·73	...	,, .	Ahascragh, Clonbrock.	1·48	48
,, .	Aberdeen, King's Coll.	·90	41	*Mayo* .	Blacksod Point	...	..
,, .	Fyvie Castle	1·37	52	,, .	Mallaranny.....	2·52	...
Moray	Gordon Castle.....	2·04	82	,, .	Westport House.....	1·66	46
,, .	Grantown-on-Spey.....	·99	40	,, .	Delphi Lodge.....	3·18	37
Nairn.	Nairn	·74	34	*Sligo* .	Markree Obsy.....	·85	25
Inv's	Ben Alder Lodge.....	...	...	*Ferm* .	Enniskillen, Portora...	·34	...
,, .	Kingussie, The Birches	1·34	...	*Arm* .	Armagh Obsy.....	·15	6
,, .	Inverness, Culduthel R.	1·02	...	*Down* .	Fofanny Reservoir.....	1·76	...
,, .	Loch Quoich, Loan.....	...	...	,, .	Seaforde	·73	27
,, .	Glenquoich	1·67	19	,, .	Donaghadee, C. Stn....	·76	32
,, .	Arisaig, Faire-na-Sguir	1·32	...	,, .	Banbridge, Milltown...	1·59	65
,. .	Fort William, Glasdrum	...	...	*Antr* .	Belfast, Cavehill Rd....	·91	...
,, .	Skye, Dunvegan.....	1·12	...	,, .	Aldergrove Aerodrome	·52	21
,, .	Barra, Skallary	1·43	...	,, .	Ballymena. Harryville	·61	20
R & C .	Alness, Ardross Castle	·53	18	*Lon* .	Garvagh, Moneydig ...	1·12	...
,, .	Ullapool	·50	13	,, .	Londonderry, Creggan	·86	26
,, .	Achnashellach	1·07	15	*Tyr* .	Omagh, Edenfel.....	·46	15
,, .	Stornoway	·90	23	*Don* .	Malin Head.....	·54	...
Suth .	Lairg	·14	5	,. .	Milford, The Manse ...	·73	22
,, .	Tongue	·92	29	,, .	Killybegs, Rockmount.	·47	...

Climatological Table for the British Empire, April, 1933

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F	°F.	%	0—10	in.	in.			
London, Kew Obsy. ..	1020·0	+ 5·6	70	32	57·6	41·0	49·3	+ 2·0	42·5	85	6·1	0·66	— 0·79	6	5·8	42
Gibraltar.....	1017·4	+ 1·0	82	48	72·1	53·5	62·8	+ 1·9	54·0	87	4·6	2·86	+ 0·17	5	..	..
Malta	1016·9	+ 3·5	74	48	65·2	54·6	59·9	— 1·0	55·4	77	5·3	0·06	— 0·80	3	9·3	71
St. Helena	1012·4	— 0·2	72	58	67·9	61·4	64·7	— 0·6	62·3	94	8·7	1·40	..	17	..	..
Freetown, Sierra Leone	1011·5	+ 0·7	93	71	90·3	75·9	83·1	+ 0·7	77·7	78	6·3	3·72	— 0·34	11	..	..
Lagos, Nigeria	1009·7	+ 0·3	95	72	89·1	76·8	82·9	+ 0·1	77·5	81	7·3	3·95	— 2·13	9	6·6	54
Kaduna, Nigeria	1009·5	— 2·2	100	65	93·8	72·3	83·1	+ 1·6	72·4	69	6·0	3·04	— 0·04	8	7·8	63
Zomba, Nyasaland ..	1014·6	+ 2·1	88	55	78·6	61·5	70·1	+ 0·8	64·3	72	6·4	0·46	— 3·20	6	..	..
Salisbury, Rhodesia ..	1015·0	— 0·3	89	44	77·6	53·1	65·3	— 0·4	57·8	63	2·7	2·57	+ 1·58	7	8·7	74
Cape Town.....	1017·0	+ 0·6	104	44	76·7	56·7	66·7	+ 3·5	56·2	75	3·6	0·64	— 1·23	3	..	..
Johannesburg	1016·9	+ 0·7	81	38	70·8	50·1	60·5	+ 0·5	51·3	59	2·3	3·38	+ 1·64	7	9·3	81
Mauritius	1013·2	— 0·8	84	66	82·0	71·8	76·9	+ 1·1	73·2	76	6·4	2·60	— 1·87	22	6·6	57
Calcutta, Alipore Obsy.	1007·2	+ 0·9	101	68	95·0	75·5	85·3	— 0·3	75·7	80	3·1	3·16	+ 0·98	6*	..	..
Bombay	1009·0	+ 0·2	94	73	90·5	77·8	84·1	+ 1·0	75·4	72	1·5	0·00	— 0·05	0*	..	..
Madras	1009·0	+ 0·6	98	71	91·3	77·5	84·4	— 0·9	79·2	79	6·0	0·03	— 0·60	0*	..	..
Colombo, Ceylon	1009·9	+ 1·2	91	73	88·0	76·0	82·0	— 0·7	78·1	76	6·7	3·25	— 6·48	13	8·5	69
Singapore	1009·2	+ 0·3	92	70	87·9	74·3	81·1	— 0·5	77·6	81	6·9	4·33	— 3·30	17	5·6	46
Hongkong	1012·9	+ 0·3	87	57	77·3	68·3	72·8	+ 2·0	68·0	77	7·8	1·91	— 3·74	8	4·8	38
Sandakan	1010·0	..	89	74	87·5	76·0	81·7	— 0·5	78·5	80	6·2	4·35	— 0·14	9	..	..
Sydney, N.S.W.	1019·4	+ 1·0	89	46	71·1	56·3	63·7	— 1·0	58·2	76	5·7	7·54	+ 2·02	14	5·7	53
Melbourne	1020·8	+ 1·3	86	37	69·0	49·9	59·5	0·0	53·2	70	6·0	0·55	— 1·62	7	6·0	54
Adelaide	1021·3	+ 1·4	85	45	72·6	52·6	62·6	— 1·3	54·5	56	5·1	1·98	+ 0·25	7	7·1	64
Perth, W. Australia ..	1018·4	0·0	90	48	78·6	58·1	68·3	+ 1·5	58·6	59	3·1	0·80	— 0·85	5	8·5	75
Coolgardie	1018·8	+ 0·2	93	43	78·3	50·5	64·4	— 0·6	53·7	43	1·9	0·30	— 0·66	2	..	..
Brisbane	1018·2	+ 0·6	90	56	78·3	61·8	70·1	— 0·2	63·6	67	4·4	8·95	+ 5·18	9	7·7	67
Hobart, Tasmania....	1017·4	+ 2·6	70	36	59·3	46·1	52·7	— 2·5	47·3	69	6·4	2·22	+ 0·37	12	5·4	50
Wellington, N.Z.	1011·4	— 6·7	70	41	62·2	50·9	56·5	— 0·6	52·5	70	5·7	4·07	+ 0·19	11	6·1	55
Suva, Fiji	1010·7	+ 0·1	92	71	83·9	73·9	78·9	+ 0·3	75·9	87	7·5	33·09	+ 20·88	27	3·2	27
Apia, Samoa	1010·2	+ 0·3	88	72	86·3	74·5	80·4	+ 1·5	77·8	82	6·6	17·04	+ 6·89	22	5·8	49
Kingston, Jamaica ..	1012·7	— 1·4	92	68	86·9	70·7	78·8	+ 0·4	69·3	75	1·9	0·05	— 1·19	2	10·7	86
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1014·0	— 2·1	71	27	52·6	37·4	45·0	+ 2·9	39·9	74	5·6	2·47	+ 0·18	16	5·4	40
Winnipeg	1015·7	— 1·0	72	14	45·3	28·6	36·9	— 0·8	29·5	79	6·4	0·20	— 1·20	2	7·1	52
St. John, N.B.	1016·3	+ 2·9	57	22	46·3	32·6	39·5	+ 0·5	35·6	75	7·0	5·07	+ 1·56	16	4·5	33
Victoria, B.C.	1018·9	+ 1·4	63	36	51·0	41·2	47·6	— 0·3	43·9	73	5·3	0·34	— 1·18	5	8·5	63

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