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## Physical and Dynamical Meteorology\*

The aim of this book, as Professor Brunt explains in the preface, is to provide a text-book of physical meteorology suitable for post-graduate students. Anyone who is familiar with preparation for the Mathematical Tripos of days gone by will readily understand what he means and appreciate his object as covering that part of meteorology which is not also a part of physical geography, which deals with individual values rather than with means and comparisons. The physical side of the dynamics of the atmosphere is explicitly recognised, much more so than was the practice in my own experience of the tripos years ago; temperature did not interfere with rigid dynamics as it does with every part of the dynamics of the atmosphere. But the analogy between Professor Brunt's achievement and the text-books written for us by our lecturers in those days is very striking. All that is wanted to make the analogy complete is a set of examination questions at the end of each chapter and the industrious reader will do well if he make one for himself.

There is no tripos for meteorological students; but in such matters with the excellent assistance that Professor Brunt provides they can now help themselves. Incidentally, let us say that it might have been a little easier if the references had carried the subjects as well as the names of the authors quoted. It is nice to know what they were thinking about when they wrote.

The book is made up of twenty chapters of unequal length. Chapter I expounds "The facts which call for explanation" in

\* D. BRUNT, M.A., B.Sc., Physical and dynamical meteorology. Size  $10\frac{1}{2} \times 7\frac{1}{2}$  in. pp. xx + 411. *Illus.*, Cambridge: at the University Press, 1934, 25s. net.

twenty-two pages from which, perhaps, in passing, someone may note the omission of snow, apart from its radiative properties, as a meteorological agency of some importance. Chapter II devotes twenty-six pages to "Statical and thermal relationships" of the atmospheric variables with which meteorologists are more or less familiar. Then follow fourteen chapters on the application of the accepted principles to the recognised facts of the atmosphere. This group of chapters may be regarded as the "formulation" of atmospheric processes by their expression as algebraical equations with proper numerical constants. There are not far short of six hundred numbered equations altogether. Sixty-three of them occur in the setting out of the recognised statical and thermal relationships in Chapter II. Twenty-seven are wanted for Chapter III, "The ascent of damp air"; four for Chapter IV "The thermodynamics of the atmosphere"; sixty for V "The processes of radiation"; twenty-five for VI "Radiation in the troposphere"; thirty-four for VII "Radiative equilibrium and the stratosphere"; seventy for VIII "The general equations of motion"; twenty-four for IX "Motion under balanced forces: the gradient wind"; twenty-four, also, for X, "Surfaces of discontinuity"; thirteen for XI "Wind in the troposphere and the effect of horizontal gradients of temperature"; ten for XII, "The general aspects of turbulence"; a hundred and forty-eight for XIII, a chapter of forty-seven pages, "Turbulence in the atmosphere: the eddies as diffusing agencies"; thirteen for XIV, a short chapter of six pages on "The classification of winds"; thirty-one for XV "The transformations of energy in the atmosphere"; twenty-three for XVI "The formation of depressions and anti-cyclones".

It will be readily understood, using one of Professor Brunt's favourite idioms, from the ordinary implication of the headings of the chapters as quoted here, that the equating of the atmosphere has been skilfully put together and all recent work on the numerical relations of meteorological quantities has been carefully co-ordinated for the reader's instruction. We notice the names of Ångström, Dines, L. H. G. and W. H., Dobson, Durst, Gold, Humphreys, Jeffreys, Johnson, Margules, Normand, Prandtl, O. Reynolds, Richardson, Roberts, Scrase, Simpson, O. G. Sutton, G. I. Taylor, and F. J. W. Whipple in this connexion. Some processes, especially in regard to diffusion, are examined which are not always noted in the ordinary text-books of meteorology. The temperature of the wet bulb seems to have become a sort of finger print of rambling air.

The demonstration of these equations is not too modern or transcendental for post-graduates but is often necessarily approximate, because the variables are sometimes afflicted with variations that defy algebra. If my recollection holds good the approximation depends sometimes on disregarding small quantities of the *first* order; the approximations of days gone by used to neglect small quantities of the *second* order; but then we did not

achieve so many integrations and, anyway, these are small matters. Sometimes, as one reads equation after equation, as applied to the atmosphere, one cannot help remembering the ingenuous if not ingenious school-boy's howler in which he defines algebra as "what you do when you don't know what you are talking about." It even loses some of its impertinence when one reads of Wüst's estimate of evaporation of water from the whole surface of the earth as 2 mm. per day agreeing with the measures of evaporation from a Swedish lake and remembers the puckish nature of evaporation in more or less windy weather, from a water-surface, wet soil, herbage and leafage.

Incidentally we learn to attach new meaning to old words, for example, a cloud 50 m. thick must be regarded as a black body, and even snow itself merits that appellation.

After Chapter XVI we break off from algebra and get to weather maps and become graphical. Chapter XVII discusses the idea of air masses and their classification; in XVIII we find the Polar Front and its relation to the development of cyclones, fifty-five pages on the work of the Norwegian School and others, with subsidence, and occlusions (backbent and others) and some typical examples. In XIX we have fourteen pages on anticyclones and in Chapter XX nearly thirty pages describing the general circulation of the atmosphere which, also, is more or less "equated", though the equations lack numbers. In these chapters we notice the names of Bergeron, Bjerknes, J. and V., of W. H. Dines, Emden, Exner, C. S. Durst again and M. A. Giblett, referred to more than once, and that of C. K. M. Douglas appears frequently as a collaborator with Professor Brunt in a number of memoirs on the physics or dynamics of the cyclone and anticyclone. Their contributions are of special importance on account of the practical experience of the two authors in what perhaps we may call micro as well as macro dynamical meteorology.

An epilogue leads up to Problems of Modern Meteorology with those set out in the *Quarterly Journal of the Royal Meteorological Society* suggested as examples.

Looking back over this exposition of the physical and dynamical aspects of modern meteorology, excellent for purposes of ready reference, we may be allowed to remark that in theoretical meteorology we hear a good deal about wind-velocity but not much about wind-momentum. For example, a wind at a ridge station in Greenland, going over the top and down the fjord at 120 m.p.h., is mentioned in order to say that it is of no dynamical consequence to the atmosphere; it is only a thin layer and gets dissipated without anything else happening—well! let us call its thickness 10 yards—the height of an anemometer generally reaches that—and a cube of ten yards weighs a ton, so for every 30 ft. of its width the flowing stream puts momentum into the atmosphere at the rate of more than 30 million foot-tons/sec. per hour; and the same thing may be happening at a number of places in the 1,200 miles of coast-line of

one side of Greenland. A transport engineer would not think it negligible. And when on the weather map of February 23rd, 1935, one sees four isobars making almost a bee-line from Newfoundland to Spain and we allow the breadth of the four as 500 miles, the length of the stretch 2,500 miles and the velocity 20 miles an hour, the momentum of the ten-yard layer is 113 billion foot-tons per second. It would take several transport engineers to deal with that.

As the current across the Atlantic is many tens of yards thick the whole structure must have enormous momentum, the change of which requires force and while that remains unconsidered I am prepared to regard as an open question about the origin and development of cyclones the decision as to whether it is the momentum and its changes with the assistance of the earth's rotation that make the distribution of pressure or the distribution of pressure that causes the velocity. That would mean an additional Chapter which some day may attract the Professor's attention.

NAPIER SHAW.

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## **Rainfall as Measured by Gauges Set in Turf, Gravel and Concrete. Some Comparisons at Kew Observatory**

By F. J. W. WHIPPLE, Sc.D.

Some months ago there was a good deal of discussion in the *Meteorological Magazine* about the splashing of rain. Colonel Gold brought out the interesting fact that drops do not splash from a dry surface, it is only when the drops fall on a continuous film of water that they appear to rebound. By way of parenthesis it may be remarked that when drops fall into comparatively deep water and seem to bounce the rising drops are constituted by water which has been driven out of the way by the original falling drop and has rushed back afterwards with excessive speed. That this is probably what happens may be demonstrated by substituting lead spheres for the falling drops. The experiment, originally due to Worthington, has been exhibited of late in slow-motion pictures. Contributions to the discussion in the magazine were made also by Mr. Bilham, who measured the height reached by splashing drops by means of a distempered sloping board. One outcome of this discussion was a request from the Meteorological Office for observations to be made at Kew Observatory with a number of rain-gauges to ascertain whether the splashing of rain from the surrounding area would affect the catch of a gauge appreciably. A gauge with its rim very close to the ground would certainly receive a great deal of in-splashing. What was to be expected with gauges set according to the official instructions with their rims 12 in. above the ground level?

Four rain-gauges, each 5 in. in diameter, were utilised for this investigation. One (A) had the orthodox exposure, the splayed base

being buried in turf, one (B) was set in gravel and another (C) in concrete. The rims of these three were at the standard height of 12 in. The fourth gauge (D) stood on concrete so that the height of the rim above ground was 21 in. The positions of the gauges are shown in the photograph, reproduced as the frontispiece to this number of the magazine, which was taken with the camera facing north-east. The width of the path is 4 ft. and the length of the concrete path is 8 ft. The hedges are about 46 ft. from the path. A wooden building, the "Old Magnetic Hut" is about 67 ft. to the south of the concrete patch. The turf round the site of the rain-gauges is always kept short. The soil is fairly light so that the turf does not get sticky. No puddles have been seen in the neighbourhood of the experimental gauges. All the gauges were provided with bottles and the collected water was measured in one and the same tapered glass measure. On two occasions of large falls an 8-inch measure was used instead of the 5-inch. The order of measurement was varied so that sometimes one gauge and sometimes another had the initial advantage of the dry measure.

The results of the observations made during the period from September 1st, 1933, to August 31st, 1934, are summarised in Tables I and II.

TABLE I—MONTHLY TOTALS

Gauge		A.	B-A.	C-A.	D-A.
Month					
1933.		mm.	mm.	mm.	mm.
September ...	...	68.4	+ 0.8	+ 0.8	+ 0.7
October ...	...	36.2	+ 0.1	+ 0.3	+ 0.4
November ...	...	24.7	+ 0.1	+ 0.2	- 0.2
December ...	...	7.8	- 0.1	0.0	0.0
1934.					
January ...	...	30.7	+ 0.2	+ 0.5	- 0.3
February ...	...	3.3	0.0	0.0	- 0.1
March ...	...	56.7	+ 0.5	+ 0.8	- 0.1
April ...	...	36.1	- 0.1	+ 0.3	- 0.6
May ...	...	11.1	0.0	+ 0.1	- 0.1
June ...	...	24.7	- 0.1	+ 0.1	- 0.3
July ...	...	82.7	+ 0.1	+ 0.8	- 0.7
August ...	...	44.7	- 0.2	+ 0.1	0.0
Year ...	...	427.1	+ 1.3	+ 4.0	- 1.3

It will be seen that there is no appreciable systematic difference between the amounts caught by the gauges standing in gravel and the gauge in the orthodox position in turf, the rim being in each case at the standard height of 12 in. The gauge with its basin in concrete catches about 1 per cent more rain. On the other hand if the gauge stands on concrete with the rim at the height of 21 in. the catch is

just normal. It looks as if the effect of eddies over the gauge is to compensate in this case for any splashing which may surmount the higher rim.

The in-splashing, which presumably was responsible for the excess of rainfall measured in the gauge standing in concrete, was not

TABLE II—OCCASIONS OF HEAVY RAIN

Gauge		A.	B-A.	C-A.	D-A.	Gauge
Day of Reading						Weather
1933.		mm.	mm.	mm.	mm.	
September 20	...	10.7	+ 0.2	+ 0.3	+ 0.3	R
24	...	8.8	+ 0.1	+ 0.1	0.0	iR
26	...	7.9	0.0	0.0	- 0.1	PR
1934.						
March 14	...	6.7	0.0	+ 0.1	0.0	R
July 14	...	13.6	+ 0.2	+ 0.3	+ 0.1	TLR
19	...	34.0	0.0	+ 0.3	0.0	TLRH
23	...	20.7	0.0	+ 0.1	- 0.7	TLR
25	...	9.0	0.0	+ 0.1	0.0	TLR
August 13	...	8.6	0.0	0.0	- 0.1	R

especially characteristic of days with heavy rain. The day on which the rate of rainfall registered by the minute-by-minute gauge reached 5 mm. per min. was July 18th.\* It will be seen that on this occasion, when the rainfall was measured next morning the gauge set in concrete showed 1 per cent in excess of the others, so that in spite of the violence of the downpour the in-splashing was not at all abnormal.

While the results of the comparisons apply strictly only to gauges on a 4-foot path in a wide lawn in a relatively sheltered situation, they may be taken as sufficient warrant for replacing the grass immediately surrounding a rain-gauge (placed on a standard turfed site) by a narrow belt of gravel or the like, without seriously affecting the catch of the gauge.

## Forecasting Weather from height of Barometer and Temperature of Wet Bulb

A suggestion has been received that useful empirical weather forecasts can be made by means of an instrument combining a barometer and a wet-bulb thermometer. In order to obtain an idea of the accuracy of this method of forecasting, an investigation has been carried out to ascertain the percentage of successful forecasts of rain that could have been made at one of the Meteorological Office Observing

\* See *Meteorological Magazine*, 69, 1934, p. 157.

Stations by this method over a chosen period. Rain was the phenomenon selected for investigation owing to its great importance in a forecast for "the man in the street".

The period selected was January and February during each of the years 1923-1932 inclusive and the station, St. Mary's, Scilly. The

TABLE I

Barometer.	Wet Bulb.	Percentage number of cases of :—			Number of obs.
		No rain.	Rain up to 4 mm.	Rain over 4 mm.	
Below 986 mb. ...	Above 48° F. ...	0	33	67	3
	44°-48° F. ...	0	75	25	8
	39°-43° F. ...	0	43	57	7
	Below 39° F. ...	—	—	—	0
986-995 mb. ...	Above 48° F. ...	0	40	60	5
	44°-48° F. ...	3	50	47	30
	39°-43° F. ...	0	46	54	13
	Below 39° F. ...	—	—	—	0
996-1005 mb. ...	Above 48° F. ...	0	38	62	13
	44°-48° F. ...	0	52	48	23
	39°-43° F. ...	0	65	35	34
	Below 39° F. ...	0	67	33	3
1006-1015 mb. ...	Above 48° F. ...	3	69	28	29
	44°-48° F. ...	11	59	30	53
	39°-43° F. ...	5	59	36	41
	Below 39° F. ...	11	78	11	9
1016-1025 mb. ...	Above 48° F. ...	10	73	17	29
	44°-48° F. ...	17	66	17	72
	39°-43° F. ...	29	55	16	42
	Below 39° F. ...	37	63	0	19
1026-1035 mb. ...	Above 48° F. ...	20	73	7	15
	44°-48° F. ...	30	68	2	43
	39°-43° F. ...	38	59	3	34
	Below 39° F. ...	71	29	0	31
Above 1035 mb. ...	Above 48° F. ...	—	—	—	0
	44°-48° F. ...	62	38	0	16
	39°-43° F. ...	64	36	0	14
	Below 39° F. ...	100	0	0	5
Total number of observations ... ..					591

readings of the wet-bulb thermometer and barometer at 7h. daily were taken as ordinate and abscissa and the amount of the rainfall for the ensuing 24 hours plotted. The means of barometer and

wet-bulb thermometer for the period in question were 1015.6 mb. and 43.8° F.

From this diagram it was clear that "low barometer and high wet bulb" was followed by most rain and that "high barometer and low wet bulb" was followed by least rain. Other interesting facts that came to light were :—

1. Rainfall during the next 24 hours was never more than 7 mm. with wet bulb below 40° F. or with the barometer above 1029 mb. at 7h.

2. A complete absence of rain for the next 24 hours was only experienced on eight occasions when the barometer at 7 h. was less than 1015 mb.

3. Of the 58 occasions when the rainfall for the next 24 hours was above 7 mm., 42 occurred with the wet bulb at 7h. above average.

Table I shows in detail the results obtained.

This method of forecasting does not, of course, distinguish between different kinds of rain such as :—

1. Rain from warm front and occlusions.

2. Convectonal showers including cold front rain and thunderstorms.

3. Orographic rain including drizzle.

These represent different kinds of weather which the average person wishes to distinguish between. For instance, it may make all the difference to his plans if he expects rain in the form of one or two showers instead of six hours continuous slight rain although the total rainfall may be the same in each case.

Another investigation, therefore, seems necessary in which the rain is divided into different types before one can compare this method of forecasting with more old-fashioned ones regularly employed which rely on the height of the barometer, the barometric tendency, the appearance of the sky, wind direction, temperature and visibility as indications of coming weather changes. To anyone carrying out such an investigation it is recommended that the rainfall for 12 hours rather than for 24 hours should be considered, as the latter period is too long a one for which to expect to forecast successfully from local observations alone.

T. R. BEATTY.

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### Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, February 20th, at 49, Cromwell Road, South Kensington. Lt.-Col. E. Gold, D.S.O., F.R.S., President, in the Chair.

The following papers were read and discussed :—

*E. G. Bilham, B.Sc., D. I. C.—On the interpretation of some measurements by A. C. Best of horizontal temperature differences over small distances.*

By a theoretical treatment of the case of simple harmonic oscillations of temperature propagated along the line joining two stations,



it is concluded that the amplitude of the oscillations must be of the order of four or five degrees Fahrenheit in order to produce the short-period fluctuations observed by Best during periods of normal lapse. It appears also that the observed decrease of amplitude with increase of wind speed may not be real.

In view of the importance of the subject in relation to climatology as well as to the general physics of the atmosphere, it is very desirable that further investigations should be undertaken, employing thermometric devices of a much higher order of sensitivity than those used hitherto in work of this character. It appears to the present writer that undesirable complications are introduced when observations are made by means of a difference-thermograph, and it is suggested that the aim should be to obtain, in the first place, an accurate record of the variation of temperature with time at a fixed point, the time-scale being sufficiently open to reveal the short-period fluctuations. It seems probable that such a record would strongly resemble a quick-run record from a pressure-tube anemograph.

*C. E. P. Brooks, D. Sc., and C. S. Durst, B. A.—The circulation of air by day and night during the south-west monsoon near Berbera, Somaliland.*

In a previous publication emphasis was laid on the large diurnal variations of wind during the south-west monsoon at Berbera and also over the Gulf of Aden far from land. The diurnal variation of pressure over the Gulf of Aden, the Red Sea and surrounding regions, is examined in the present paper and it is found that each day a region of higher pressure is formed regularly at that season over the head of the Gulf, and a similar region over the Red Sea. From the consideration of the thermal conditions in the atmosphere over narrow seas and neighbouring mountainous land areas an explanation is attempted of the formation of this high pressure area and the consequent daytime outflow of air which gives the large diurnal wind variations.

*M. G. Bennett, M.Sc., F.Inst.P.—Further conclusions concerning visibility by day and night.*

Experiments have been carried out at Kew and Farnborough to test the theories of visibility put forward by Koschmieder and the author, and to determine the relation between visibility by day and night. The following conclusions are drawn :—

1. Koschmieder's formula relating the visibility of ordinary objects by day with the transmission factor, and hence with the visibility of lights at night, is not quite correct quantitatively.

2. It is undecided whether the discrepancy is due to Koschmieder incorrectly assuming the threshold  $\epsilon$  in his equation to be constant, or to his neglect of the scattering of the light from the object (referred to as the "ground glass plate" effect) which is included in the author's theory.

The experiments have enabled a table to be drawn up showing

approximately the distances that lights of various candle-powers can be seen on the average at night, in meteorological conditions corresponding to different daytime visibilities.

### OFFICIAL PUBLICATION

The following publication has recently been issued :—

*Cloud Forms* (M.O. 233, 3rd edition).

One of the most popular features of "The Meteorological Observers' Handbook" is the section on the observation of clouds—a classification of cloud forms with formal definitions and brief descriptions of the various types of cloud, illustrated by a series of twenty reproductions of photographs. This section is of interest to many amateur meteorologists, photographers and others who do not require the remaining parts of the Handbook. It is accordingly issued separately at the price of 9d., and can be obtained from His Majesty's Stationery Office or through any bookseller.

### Correspondence

To the Editor, *Meteorological Magazine*

### Dry March and Wet April

Observers and others have at times mentioned to me that "a dry March brings a wet April." It occurred to me to investigate the truth of the statement and its converse for a given place. Through the kindness of the observer I have been permitted to analyse the records obtained at Grayshott during the 38 years, 1897–1934.

In Table I "wet" and "dry" have been used to imply above

TABLE I

	Following April (Number of Years).				
	Rainfall.		Rain-days.		
	Above Average.	Below Average.	Above Average.	Below Average.	Average.
March rainfall below average (22 years).	13	9	10	10	2
March rainfall above average (16 years).	7	9	7	8	1
March rain-days below average (18 years).	8	10	9	7	2
March rain-days above average (20 years).	9	11	8	11	1

or below normal respectively, with regard both to rain and rain-days. From the table there seems to have been a tendency for rainfall

above average in March to precede rainfall below average in April, and vice versa. Also the excess of rain-days in March have tended to be followed by deficiency of rainfall and of rain-days in April.

In Table II fresh grouping has been made, this time "dry" meaning less than 75 per cent. and "wet" more than 125 per cent. of the average, both with respect to rainfall and rain-days. Results from this table are mostly negative, but a March with few days of rain seems to be followed more often than not by a wet April.

TABLE II

	Following April (Number of Years).			
	Rainfall.		Rain-days.	
	Above 125%.	Below 75%.	Above 125%.	Below 75%.
March rainfall < 75% (17 years).	7	7	7	5
March rainfall > 125% (16 years).	5	5	3	3
March rain-days < 75% (10 years).	6	3	5	3
March rain-days > 125% (12 years).	3	4	2	1

Table III is similar, but this time I have taken "dry" to mean less than 50 per cent. and "wet" to mean more than 150 per cent. of the average. The results regarding rain-days are negligible, but one can see that a really wet March has been followed by a similarly

TABLE III

	Following April (Number of Years).			
	Rainfall.		Rain-days.	
	Above 150%.	Below 50%.	Above 150%.	Below 50%.
March rainfall < 50% (9 years).	3	1	0	0
March rainfall > 150% (9 years).	0	3	0	1
March rain-days < 50% (3 years).	2	1	0	1
March rain-days > 150% (4 years).	0	1	1	0

dry April, and the converse is also true. This means to say that in a really wet spring, or in a drought in spring, the conditions are not likely to persist over the two months of March and April.

From the above, then, there has been a definite tendency for a dry March to precede a wet April, and conversely. To complete the work, correlation coefficients between the rainfall and rain-days of the two months have been calculated, and are given in Table IV.

TABLE IV.—CORRELATION COEFFICIENTS ( $r$ )

- (a) Rainfall in March and Rainfall in April  $r = -0.181$
- (b) Rainfall in March and Rain-days in April  $r = -0.155$
- (c) Rain-days in March and Rainfall in April  $r = -0.335$
- (d) Rain-days in March and Rain-days in April  $r = -0.037$

All the coefficients are negative, showing the slight inverse relationship of the rain in the two months. Perhaps (c) could safely be summed up by saying "a rainy March tends to bring a dry April."

S. E. ASHMORE.

19, Vicarage Road, Handsworth, Birmingham 19, September 9th, 1934.

[These interesting results appear to be related to the movements of centres of excess and deficit of pressure which are most regular in spring.\* The main track is from the Azores north-eastward across the British Isles. If an excess of pressure lies over the Azores in March, the odds are several to one that pressure will be above normal over the British Isles in April. An excess of pressure over the Azores generally means a westerly current over the British Isles, probably of unstable polar maritime air with showery weather and numerous rain days, but not necessarily a high total of rain. The reverse distribution, deficit of pressure over the Azores in March moving to the British Isles in April, also tends to occur, but less regularly. At other seasons of the year the tracks of centres of pressure anomaly are much less definite and it is interesting that no similar relationship is attributed to any other pair of months. C. E. P. BROOKS.]

### Rain in advance of True "Warm Front" Rain

The article by Colonel Gold under this heading in the *Meteorological Magazine* for November, 1934, was very interesting, particularly as similar characteristics of the rainfall on October 6th, 1934, were observed at Watford, Herts., on that day. During the morning I was struck by the rapid weakening of the sky, the change from cirrus and cirro-stratus to gradually thickening alto-stratus and nimbo-stratus being extremely rapid. As was pointed out, it is difficult to assign an explanation of the advance rain and it appears as if the data available will not readily yield one that is completely satisfactory.

An even more remarkable occurrence of this kind happened on

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\* Variations of pressure from month to month in the region of the British Isles.—*London, Q.J.R. Meteor. Soc.*, 52, 1926, pp. 263-76.

May 8th, 1934. A well-marked warm front was situated off west Ireland at 7h. G.M.T. aligned practically north to south, but its southern extremity was on this occasion still about 300 miles west of Brest, whereas on October 6th the warm front was nearing the French coast at this time. Rain was already falling at 7h. G.M.T. practically 400 miles in advance of the front, while before 13h. continuous slight rain had set in over East Anglia and a slight shower had occurred at Croydon. Simultaneously, slight rain had begun to fall in Belgium and west Germany, and I was told by a pilot who left Croydon at 12h. that it rained the whole way from the English coast to Cologne. Now at 13h. the warm front was situated roughly from Malin Head to Cork, and the "warm front" rain had just started at Pembroke but not at Scilly; subsequently it spread rapidly across southern England, and by 18h. it was raining almost everywhere except near the south coast.

In normal circumstances rain may be expected not more than 150-200 miles in front of a warm front, at any rate in southern England, but these cases of preliminary rain make "routine forecasting" a matter of extreme difficulty, especially as the rain was wide-spread and so far in advance of the warm front. It is quite evident that when rain is falling over an area from East Anglia to west Germany when a warm front is still no further east than central Ireland, we must look for a cause quite removed from that particular front. It is doubtful if the preliminary rain was caused by another front, inasmuch as no positive indication is given by synoptic chart, neither do the pilot balloon ascents available suggest a discontinuity in the lowest 10,000 ft. The upper air ascents at Duxford reveal that in the morning, air forced to rise locally through its environment from 2,000 ft. up to 8,000 ft. would be just thermally stable; above 8,000 ft. was an inversion about 3,000 ft. thick. At midday similar conditions obtained except that the base of the inversion was lowered by about 1,000 ft. The observer during this ascent noted cumulus 3/10 from 2,000-5,000 ft., and strato-cumulus 10/10 with rain falling, from 6,500-18,000 ft. It is difficult to visualise strato-cumulus of this great thickness; probably higher up there was nimbo-stratus and alto-stratus. In any case, this layer of cloud formed during the morning, as at 6h. only alto-stratus about 2,000 ft. thick existed. As has already been pointed out, the tephigram does not give a true criterion of stability, except when considering local showers or thunderstorms and even then marked wind shearing must be absent. Rainfall, apart from showers or thunderstorms, must invariably be due to convergence of air in the lower layers which causes an uplift of a large mass of saturated or nearly saturated air and from dynamical considerations precipitation must soon follow.\*† Surface winds in East Anglia were light

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\* W. N. SHAW, *Forecasting Weather*, p. 233.

† C. K. M. DOUGLAS, *London Q.J.R. Meteor. Soc.* 60, 1934, p. 145-7.

westerly at 7h. G.M.T. May 8th, but by 13h. had become light E. to S.E. at Felixstowe and Shoeburyness. At Felixstowe two pilot balloon ascents during the morning gave the following results:—

<i>Ft.</i>	6h. G.M.T.		10h. G.M.T.	
	°	<i>m.p.h.</i>	°	<i>m.p.h.</i>
<i>Surface.</i>	275	4	Calm	
1,000	320	10	125	3
2,000	290	7	190	3
3,000	300	13	230	6
4,000	255	17		
6,000	255	17		
8,000	270	17		
10,000	250	9		

At Croydon, South Farnborough and Upper Heyford these large changes of wind in the lowest 3,000 ft. did not occur, although ascents at midday showed some backing on the earlier ones, due to the approach of the warm front, and at these places no rain fell until well after 13h., apart from a slight shower at Croydon. Thus, as far as the preliminary rain in East Anglia is concerned it seems likely that it was due to a breakdown of dynamical stability caused by horizontal convergence of a large mass of air in the lower layers. It is unfortunate that with the methods available at present such occurrences cannot be scientifically forecast, for doubtless it will be agreed that the convergence which took place could hardly have been foreseen. There remains, however, the reason why rain commenced almost simultaneously in Belgium and west Germany. Since rain was falling from cloud which extended from 6,000–18,000 ft. it is quite possible that the rain was carried to this area by the westerly winds which were blowing at 25 to 40 m.p.h. at these heights, but further investigation on this point is necessary.

This is the first of two outstanding cases of rain far in advance of a warm front that have occurred this year, but doubtless there have been others less remarkable and therefore the whole question needs careful investigation. It is curious that on each occasion certain similarities emerge. The warm fronts approached the British Isles very rapidly while the barometer was rising fast, yet each passed with very little fall in pressure, e.g., at Croydon between 7h. May 8th and 7h. May 9th pressure fell from 1029·8 mb. to 1028·1 mb., only 1·7 mb., and then rose again; while on October 6th the fall was even smaller, for at 7h. the barometer was still rising and reached 1023·8 mb. at 13h.; at 18h. it read 1022·6 mb. while at 1h. October 7th it had risen to 1023·2 mb. Again, in each case a supply of typical maritime polar air was replaced within 48 hours by sub-tropical air, at any rate in the higher levels. May not this rapid fluctuation in air supply have been a contributory factor in connexion with the preliminary rainfall?

C. W. G. DAKING.

*Barton Airport, Manchester, November 30th, 1934.*

### Weather Diary 1808-1875

With reference to the note on p. 18 of the *Meteorological Magazine* for February, 1935, regarding Henry Cox's phenological diary for 1808-75, it may be of use to remind readers interested that the complete series of tabulated observations was reprinted in my paper on the Marsham Phenological Records.\* Cox's record was of considerable value as it bridged the only serious gap in the Marsham Record between 1736 and the present day, though it deals with conditions in south-east England and the other with Norfolk.

I. D. MARGARY.

*Yew Lodge, East Grinstead, February 27th, 1935.*

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### Cirriform Cloud at a very Low Level

An observation of cirriform cloud at 5,700 feet made by the entire staff at this station on the afternoon of Monday, October 22nd, 1934, may be of interest to readers of this magazine.

The cirrus cloud had been increasing rapidly during the late afternoon, and at about 15h. 45m. G.M.T. some apparent cirrus uncinus (long straight stems with upturned ends like claws) was noticed to west-south-west near the zenith, in the centre of a large patch of blue sky. Although it was generally agreed that the cloud gave the distinct impression that it was not at the usual cirrus level, there was no hesitation in deciding that cirrus uncinus was a correct description. By 16h. 20m. the cirrus cloud types had still further increased and the sky was covered for the most part with a thick veil of fibrous structure cloud, comprising practically all the forms and varieties of cirrus cloud, and presenting an appearance which can only be described as wildly chaotic. The cirrus uncinus was very marked, had spread to other parts of the sky and some of the tufted tops had developed, so it seemed, into miniature anvils while it was remarked upon that some of the predominating masses of cirrus densus were assuming alto-cumulus formation. At 16h. 30m. it was seen that the cirrus uncinus had been thrown into shadow and had changed from white to a brownish colour, and considerable patches were more compact and amorphous than when first observed. It was now apparent that the original surmise that the cirrus uncinus was at a lower level than the cirrus densus was correct, but none of the observers was prepared for the sudden announcement from the observer making the pilot balloon ascent that the balloon had disappeared in the brownish cloud at 5,700 feet. There is little doubt that the balloon had entered the cloud which had been under observation for about an hour, although none of the staff would have dared to suggest an hour before that the convincing cirrus uncinus was even as low as 10,000 feet. We are still wondering how many other things are not what they appear to be !

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\* See *London, Q.J.R. Meteor. Soc.* 52, 1926, p. 42.

In the "International Atlas of Clouds", Plate 4 gives an excellent illustration of the cloud form referred to in the note, except that the hooks were rather more pronounced as in Plate 5.

F. H. DIGHT.

*Meteorological Station, R.A.E., S. Farnborough, Hants, October 26th, 1934.*

### Unusual Visibility of a Pilot Balloon

At 9h. 30m. (local time) on September 10th, an ordinary white pilot balloon was released from the Meteorological Station at Bermuda with a calculated rate of ascent of 600 feet per minute. The balloon was followed in the theodolite up to a height of 37,800 feet when it disappeared behind cumulus cloud. Six minutes later the cloud had cleared off but the balloon had moved out of the field of view of the theodolite; it was picked out, however, by the naked eye when looking along the open sight, being then at the calculated height of 41,400 feet. The balloon was again placed under observation in the theodolite and eventually lost at 48,600 feet; it is interesting to note, however, that at 45,000 feet it was still clearly visible to the naked eye.

The upper winds were light on this day and at 41,000 feet the horizontal distance of the balloon from the observer was only about 4,700 yards, even so the visibility would seem to have been exceptionally good for the balloon to be so clearly distinguishable.

The pressure distribution for the morning of the 10th, shows a large high pressure area extending from the Azores to the middle United States ( $90^{\circ}$  W.), the centre of this anticyclone being in the vicinity of Bermuda. The great area of the high pressure was due to an anticyclone having moved eastward from the neighbourhood of the Rocky Mountains and having merged with the Azores anticyclone.

Local conditions at 9h. 30m. on the 10th were:—

Barometer, 1023·1 mb., steady. Visibility, 9 (to seaward).

Weather, bc.

Cloud, cirrus 1/10, cumulus 2/10.

H. B. MOORHEAD.

*Meteorological Station, St. Georges, Bermuda, October 2nd, 1934.*

### The Sunniest Month

In the notice of the new publication *Averages of Bright Sunshine for the British Isles for Periods ending 1930 (M.O. 377)*, which appears on page 10 of the February issue of this magazine, it is stated that "at all stations May or June is the sunniest month." Examination of the tables shows that at Lowestoft, Deal, Lympne, Croydon and Biggin Hill, the distinction mentioned belongs to July, though in four of the five cases by a margin of less than 0·1 hour per day. At Deal, July leads May, the next sunniest month, by 0·14 hrs. per day, or by about five hours in the aggregate.

These exceptions in the east and south-east of England to the



general rule are of interest in view of the notable falling-off in the duration of bright sunshine which takes place from June to July over a large part of Britain. It may be ascertained from the tables that at a majority of the stations in Scotland, and at a good many of those in the northern, central and western counties of England (as far south as Bude), the daily average is at least an hour greater in the former month than in the latter, while at Rothesay, Renfrew and Leuchars, June's advantage over July is rather more than an hour and a half per day.

E. L. HAWKE.

*Caenwood, Rickmansworth, Herts, February, 22nd, 1935.*

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## NOTES AND QUERIES

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### Scarcity of Sunshine in the British Isles during the last quarter of the year 1934

The phenomenal weather of December, 1934, in the British Isles has already been described in many places, but more attention has been paid to the abnormal warmth and excessive rainfall than to the scanty sunshine. The deficiency of sunshine was, however, general and very marked; the percentage of the average for districts 1-10 in the *Monthly Weather Report* of the Meteorological Office was only 60, while for Scotland west, England east, and England north-east, the values were 35, 45 and 48 respectively. These figures are remarkable in themselves, but if the two preceding months, October and November (in both of which sunshine over the country as a whole was deficient) are also taken into account, the deficiency of sunshine for the last quarter of the year 1934 is still more remarkable. Taking the mean for the country as a whole as being the mean of the 12 districts into which it is divided in the *Monthly Weather Report*, the percentage of the average sunshine, (mainly 1901-30) over the British Isles for the three months, October to December, is 72. In a paper entitled "General sunshine values, England and Wales, Scotland, Ireland and British Isles for the period 1909-1933" by D. S. Hancock, published in the *Quarterly Journal of the Royal Meteorological Society*, **61**, 1935, pp. 45-52, percentage values of the average sunshine (1909-33) over the British Isles for the period October to December are set out for the years 1909-33 inclusive. No value as low as 72 is found in this series, the only comparable figure being 76 in 1912. The next lowest was 87 in 1916.

If we consider England and Wales separately, the results are even more striking. The percentage of the average for the three months under consideration is 67. Referring to Mr. Hancock's figures, the lowest percentage for the same period in previous years back to 1909 was 81, in 1912. In Scotland, however, the last quarter of the year gave less sunshine in 1912 than in 1934 and nearly as

little in 1916. In Ireland, 1921 (with 76 per cent. of the average) was duller than 1934 (78 per cent.).

The values published by Mr. Hancock in the *Quarterly Journal* were obtained by a method different from that used in deriving the district values printed in the *Monthly Weather Report*, but as Mr. Bilham pointed out in the discussion on Mr. Hancock's paper, the two methods give results in close agreement. It may be noted also that Mr. Hancock's percentages refer to the period 1909-33 while those given in the *Monthly Weather Report* are means of station percentages based on records of varying length up to 30 years ended 1930. It is unlikely, however, that this difference in the bases of comparison has affected the percentages by more than two or three per cent.

L. F. LEWIS.

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### Bibliography of Actinometry

We have received three further series of abstracts forming part of the "Bibliography of Actinometry" which is being completed by M. Volochine and issued by the National Meteorological Office of France.\* Two of these new series deal with papers published during 1932 in a variety of countries (no fewer than 18 are referred to in the list of contractions), while the other series gives abstracts of earlier papers published in the United States back to the beginning of the century and beyond. The work of dealing with arrears is proceeding rapidly, and when that is completed the process of keeping pace with current work will be relatively simple.

Under the general heading of actinometry a great variety of subjects find place. A glance at those hitherto issued shows papers dealing with instruments, absorption by the atmosphere, including the effect of water vapour, ozone, fog and volcanic dust, radiation from the sky by day and night, the temperature of Mars, actinometric measurements and the solar constant, ionization in the upper atmosphere, aurora, radio transmission and terrestrial magnetism.

The rapid accumulation of these papers and the wide range of subjects, raises the problem of the best method of filing them. In the Meteorological Office Library two sets are available, one of which is minutely sub-divided according to the particular aspect of the subject, while the other is being given a purely alphabetical arrangement. The sub-classified abstracts form a valuable adjunct to a more general though less complete collection of abstracts dealing with meteorology in general, which was described in the *Meteorological Magazine* for March, 1932, p. 42.

Since the above was written two more series of abstracts have been received one dealing with the papers published in Poland

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

mainly between 1920 and 1932 and the other continuing the first two series referred to above, those from a variety of countries for 1932.

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## REVIEW

*Aerologische Beobachtungen und Terminbeobachtungen in Reykjavik während des Internationalen Polarjahres. 1932-1933. K. Ned. Meteor. Inst. 106A. Ergebnisse aerologischer Beobachtungen 21A. 's-Gravenhage 1933.*

The series of observations obtained by the Dutch expedition to Iceland was probably the most valuable of the entire Polar Year, at any rate on the meteorological side. No less than 330 aeroplane observations were made, of which 309 reached 5 Km., and 87 reached 6 Km. In addition, 13 radio-sounding balloons were sent up, between July 21st and 31st, and again on August 9th and 10th, 1933, from which the signals were received at least up to 14 Km. in all cases, and to 21 Km. on one occasion. The observations agree well with those from the aeroplanes at the heights where comparison is possible. The height of the base of the stratosphere averaged 10.1 Km., and ranged from 8.7 to 11.2 Km. No striking developments took place during these periods, but no doubt the observations will be of great value in conjunction with the other international observations. To the reviewer the aeroplane observations are more interesting, as they include such varying conditions.

Dr. Cannegieter, who organised the expedition, gives an account of its origin and history, and of the methods and instruments used, illustrated by photographs. Various interesting points are mentioned, including two cases of exceptional visibility. On August 21st, 1933, the Greenland mountains and ice-cap were visible from 6,700 metres, at a distance of 350 miles. On September 25th, 1932, the whole of Iceland was visible from 6,735 metres, the furthest point being about 280 miles away.

The data are published both in tabular and diagrammatic form. One set of tables gives pressure, temperature and humidity at fixed heights, and another set refers to fixed pressures. The pressures at aerodrome level (8 m.) are reduced to sea level. All times given are those for 15° W., and 1 hour must be added to give G.M.T. These points might with advantage have been mentioned in the tables, and not only in the text. The details of 298 pilot balloon ascents are also published, including 142 to above 4 Km. and 24 to above 10 Km. The ground observations at the station appear in a coded tabular form.

The reviewer wrote a preliminary note\* on 141 of the observations which were received by wireless and printed in the *British Daily Weather Report*. The total number of observations is 330, but a rough examination shows that the main conclusions of the earlier note

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\* See *Meteorological Magazine* 68, 1933, p. 253.

are little affected, though the dates of the extremes are altered. The temperature at 4 Km. on March 18th and 19th ( $-27^{\circ}\text{F.}$ ) was a small fraction of a degree lower than on April 12th, and the absolute maximum ( $30^{\circ}\text{F.}$ ) occurred on July 17th, with a sea level pressure of 1,007 mb. The observation on January 3rd, 1933, was made at 14h., G.M.T., when sea level pressure was only 938 mb., a very notable figure. Three days later sea level pressure had risen to 995 mb., but upper air temperature had fallen slightly, and at 4 Km. the rise of pressure was only 30 mb., compared with 57 mb. at sea level, illustrating the diminution with height of very large pressure changes.

The mean temperature at 4 Km. over Reykjavik in November, 1932, was  $25^{\circ}\text{F.}$  lower than at Duxford, compared with a mean difference of only  $4^{\circ}\text{F.}$  in May, 1933, and of  $3^{\circ}\text{F.}$  in June. The Reykjavik means from 3 to 5 Km. in November were the lowest for any month except January, when there were only 8 observations. There were 17 observations in November, but there were none during the mild period from the 10th to 16th, owing to the machines being under repair, and this no doubt lowered the mean temperatures for the month at all levels. Too much weight should not be attached to a single year, but it is clear that a deep layer of cold air existed over the polar basin by November, and this feature presumably develops regularly, though perhaps varying in intensity. It explains why snowfalls are fairly common in the British Isles in the early winter with north or north-west currents, though they are very rare at that season in easterly conditions, when the cold air is shallow unless there has recently been a pronounced arctic current on the continent. The early formation of a deep layer of cold air in high latitudes explains the development of disturbed conditions in the autumn, and the October maximum of rainfall in the British Isles is due to this, together with the high temperature of the Atlantic and the correspondingly high water content of the over-lying air. It is doubtful whether surface cooling on land contributes to this maximum, as this is largely superficial and any increase of warm front rain must be more than off-set by the falling off of convectional rain.

The volume contains material that is unlikely to be exhausted for many years, and its full value will be brought out in relation to the complete Polar Year observations. Owing to lack of space, the observations of turbulence made on the aeroplanes, and some of the cloud observations, have been held over till later. Dr. Cannegieter informs me that papers are being prepared in which the results are studied more extensively than was possible in the preface of the present publication. These will be awaited with interest.

C. K. M. DOUGLAS.

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### BOOKS RECEIVED

*Apia Observatory, Western Samoa. Annual Report for 1932, Wellington, 1933.*

## OBITUARY

*Dr. Axel Wallén.*—We have to record with deep regret the sudden death at Stockholm on February 24th of Dr. Axel Wallén, the Director of the Swedish Meteorological Service. His loss, at the comparatively early age of 58, will be a severe blow to international meteorology, in which he had taken an ever increasing part since 1919, when he attended a meeting in London called together by Sir Napier Shaw with the object of picking up the threads of international co-operation which had been so rudely broken by the war. The invitations to the meeting, which were purely personal, were sent to individuals who had taken a leading part in the international organisation before the war and the one that found its way to Sweden was actually addressed to the veteran Hildebrandsson, who had long ago severed his connexion with official work. Hildebrandsson, already over 80, could not face a journey to London, but he was able to arrange that Wallén, then newly appointed Director of the unified Meteorological and Hydrographical Service of Sweden, should come. Later in the year those who had met in London attended an official Conference of Directors of Meteorological Services and Observatories held in Paris at the invitation of the French Government and Wallén was then elected a member of the International Meteorological Committee.

On that body his wide scientific knowledge and pronounced organising ability soon made itself felt. He was asked to serve on most Commissions and in 1923 became President of that for Agricultural Meteorology. He was actually in the midst of preparations for a meeting of this Commission which is to be held in Warsaw in September next when death overtook him. But it was not only in the old meteorological organisation that derives its authority from the International Conference of Directors of Meteorological Services that Wallén played a prominent part. He was also active at the meetings of the International Union of Geodesy and Geophysics. At the meeting held in Stockholm in 1930 he was elected President of the Meteorological Section in succession to Sir Napier Shaw, and three years later guided the deliberations of the section at Lisbon with conspicuous success. Alas, that wise guidance will no longer be available when the Union meets in Edinburgh in 1936 and the embroidered collar of the dress suit of the Swedish Academy of Sciences which Wallén generally wore at social functions will not be seen there, at any rate on his person.

Wallén was a man of wide and varied scientific interests. In addition to holding the coveted honour of membership of the Swedish Academy of Sciences, he was a member of the Academies of Agriculture and of Engineering Science. For many years he was Secretary of the Anthropological and Geographical Society and editor of its well-known *Geografiska Annaler*. He was its President in 1932. We see from this what a large part he took in the scientific life of Sweden.

His personal work lay mainly on the climatological and geographical sides. He had become head of the Hydrographic Bureau while still a young man in his early thirties. This institution was responsible for the collection of rainfall data and their application to the problems of inland hydrography. Thus, through this early association, he has to his credit a long list of papers on river and lake levels in Sweden in relation to rainfall and evaporation, on long-range forecasting and kindred subjects, but his interests were by no means confined to this aspect of meteorology. We have only to glance through the Memoirs and Year Books of the Swedish Meteorological Institute to realise what a many-sided scientist its director was. The work of the geophysical observatory at Abisko, which ranges over terrestrial magnetism, auroral research and the investigation of the stratosphere by itself testifies to an intense activity.

We should like to express to Mrs. Wallén and to the meteorologists of Sweden our sincere sympathy in their great loss.

R. G. K. LEMPFERT.

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News has been received that Dr. G. Stüve, of Frankfort-on-Maine, died on February 20th, 1935.

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### NEWS IN BRIEF

The Fourteenth Annual Dinner of the staff of the Meteorological Office, Shoeburyness, was held at the Queen's Hotel, Westcliff, on February 9th. Mr. F. Entwistle, the Superintendent for Army Services, was present and a number of past members of the staff attended including all those recently transferred to another Government Department.

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### The Weather of February, 1935

Pressure was below normal over Canada, eastern United States, most of the North Atlantic, Spitsbergen, Europe except for the Iberian Peninsula and western Asia, the greatest deficit being 19.3 mb. at Rost (Norway), while pressure was above normal over the western and central United States, Bermuda, Azores, the Iberian Peninsula and the north-west coasts of Africa, the greatest excess being 6.5 mb. at Horta. Temperature was above normal over Spitsbergen (as much as 18° F.), and northern and central Europe, but below normal in Portugal, while precipitation was deficient at Spitsbergen and north Norway and in excess in Sweden (as much as four times the normal in Lapland) and central Europe.

The weather of February over the British Isles was generally unsettled and stormy with rainfall in excess of the normal in most areas and sunshine below normal except in parts of south-west Scotland and central Ireland. Temperature was above normal during most of the month, markedly so at the beginning, but there were some cold spells. From the 1st to 5th depressions, with

associated secondaries, approaching and crossing the country, maintained unsettled and mainly mild conditions with strong winds and gales in the north and west on the 1st and 2nd—Eskdalemuir recorded a gust of 75 m.p.h. on the 1st. The maximum temperature of 57° F. at Aberdeen on the 1st was the highest recorded there in early February since 1871 and elsewhere maxima exceeded 55° F. at many places on the 2nd, but after that it became generally colder. Light to moderate rain occurred at most places during this time, while snow or sleet fell in Scotland on the 2nd and 5th. Some good sunshine values were recorded in northern England on the 2nd and in the south on the 5th, 7.5 hrs. at Berwick-on-Tweed on the 2nd, and 7.6 hrs. at Weymouth on the 5th. On the 6th strong winds and gales were experienced in the south-west as the winds veered to N. and NE. and the Azores anticyclone spread north-east to the north of Scotland. From then until the 10th this anticyclone covered the country, but was moving slowly south after the 8th. Temperature was low in England and Ireland, a maximum of 33° F. being recorded at Rhayader on the 8th and at Rothamsted on the 9th and snow showers were experienced generally from the 6th to 8th, even as far south as Jersey on the 8th. Mist or fog occurred locally but good sunshine records were obtained on some days in west Scotland, west Ireland and south and west England. Temperature rose in Scotland about the 8th and as the winds backed to W. or SW. temperature became above normal over the rest of the country. From the 10th to 28th a series of deep and complex depressions crossing the country caused unsettled and often stormy weather. Gales were frequent, especially in the west and north and were widespread on the 16th and 27th. Liverpool reported a gust of 79 m.p.h. on the 16th. Temperature at first was above normal with maxima frequently above 50° F., but after the 22nd there were some cold periods when maxima did not exceed 35° F. in Scotland and the north Midlands, 34° F. at Rothesay on the 24th and 35° F. at Harrogate on the 25th. Sharp night frosts occurred generally after the 22nd, 4° F. being recorded on the ground at Dalwhinnie and 10° F. at Rhayader on the 26th. Occasional precipitation was experienced in all areas and was heavy at times, especially in the Lake District on the 15th and 16th; at Watendlath (Cumberland) 3.70 in. fell on the 15th and 3.24 in. on the 16th; elsewhere the heavier falls were mainly from the 24th to 27th. Sleet and hail occurred at times and snow fell generally in Scotland and England except the south-west and also on the hills in Ireland between the 22nd and 27th. Thunderstorms were reported from south-west Scotland on the 16th, south Wales on the 19th, and many parts of England on the 21st and 23rd–25th. Sunshine records were variable, but the 14th and 26th were sunny days over the whole country, Calshot had 9.6 hrs. on the 26th. Good records were also registered in south England on the 21st and in

Scotland and Ireland on the 25th. The distribution of bright sunshine for the month was as follows :—

			Diff. from						Diff. from		
			Total	normal		Total	normal		Total	normal	
			(hrs.)	(hrs.)		(hrs.)	(hrs.)		(hrs.)	(hrs.)	
Stornoway	...	52	—	2	Liverpool	...	45	—	21		
Aberdeen	...	63	—	4	Ross-on-Wye	...	57	—	8		
Dublin	...	76	+	1	Falmouth	...	65	—	14		
Birr Castle	...	78	+	14	Gorleston	...	55	—	20		
Valentia...	...	65		0	Kew	...	53	—	8		

*Miscellaneous notes on weather abroad culled from various sources.* Heavy snow and storms were experienced in Switzerland and Austria at the beginning of the month; temperature rose generally on the 2nd and 3rd causing an unusual number of avalanches—several people were killed. From about the 7th to 14th however, the cold was intense and ski-ing conditions were again safe but after the 14th gales and heavy rain, or snow in the higher regions, occurred frequently and there were numerous avalanches, many people being killed. In Italy the cold gave way to exceptionally mild weather on the 3rd and 4th, but on the 8th heavy snow again fell in northern Italy and in places was 20 in. deep. A bitterly cold NW. gale raged on the 7th on the north and west coasts of France. Snow occurred in Lisbon on the 9th, the last fall there being in 1926. A fierce gale swept across western Germany on the 16th-17th and another crossed France on the 23rd when 8 houses collapsed in Savoy. Gales were also experienced at Gibraltar, the western coasts of France, in the Bay of Biscay and in the English Channel from the 24th-26th, doing much damage to shipping. Heavy rains caused floods in several parts of western France on the 25th. The ice was breaking up in the Danube between Braila and Sulina by the 27th (*The Times*, February 2nd–March 3rd).

Heavy falls of snow were reported from northern Algeria on the 11th (*The Times*, February 13th).

Heavy rain continuing almost without intermission from the 1st-5th caused floods in Syria and Palestine, several people were drowned. Heavy snowfalls occurred over Afghanistan and the tribal territory in the North-West Frontier at the beginning of the month. During the middle of the month the weather in Calcutta was favourable to seed crops and the heavy rains in Karachi were followed by fine weather (*The Times*, February 6th-21st).

Good and general rains were experienced in most districts of Australia early in the month except in parts of Victoria. A hurricane passed over Cook Islands about the 12th doing serious damage to plantations and houses. Floods following more than 3 days of rain at the end of the month caused the deaths of 5 people on Oahu Island, Hawaii (*The Times*, February 12th–March 1st).

In the eastern United States temperature was below normal at first becoming generally above normal about the middle of the



month while in the western and middle States temperature was considerably above normal. Precipitation was mainly below normal. Twelve persons were killed and 70 injured by a hurricane which passed across east Texas and Louisiana on the 9th. Tornadoes and blizzards were experienced over most of the middle States on the 24th and 25th (*The Times*, February 11th-26th and *Washington, D.C., U.S. Dept. Agric, Weekly Weather and Crop Bulletin*).

Gales and snowstorms were frequent off the coasts of Iceland and severe gales were experienced on the Atlantic between the 24th and 27th (*The Times*, February 11th-28th).

### Daily Readings at Kew Observatory, February, 1935

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp.		Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see p. 1).
			Min.	Max.				
	mb.		°F	°F	%	in.	hrs.	
1	1015.2	WSW.4	40	48	72	0.06	0.0	r-r <sub>0</sub> 13h.-15h.
2	1008.6	W.5	48	58	63	—	1.0	
3	1014.4	WSW.4	41	52	80	trace	0.1	r <sub>0</sub> 16h. 30m. & 24h.
4	1014.0	NW.2	51	51	70	0.05	1.9	r-r <sub>0</sub> 8h.-10h.
5	1012.6	WNW.4	40	49	60	0.09	6.2	r <sub>0</sub> -r 22h.-24h.
6	1010.9	NE.6	37	43	74	0.07	0.0	rr <sub>0</sub> 0h.-8h.
7	1028.0	NE.3	35	40	52	trace	3.0	ps <sub>0</sub> 14h.
8	1026.2	NNE.4	32	37	63	trace	0.2	s <sub>0</sub> 5h., 10h. & 11h.
9	1025.1	NE.3	30	37	59	—	3.8	x early.
10	1024.9	SW.2	33	45	76	—	0.4	f 18h.
11	1023.1	WSW.2	40	50	71	—	0.2	
12	1013.8	SW.4	43	49	79	trace	1.0	r <sub>0</sub> 15h.
13	1002.0	SW.3	43	49	92	0.15	0.0	r-r <sub>0</sub> 10h.-15h.
14	1009.0	W.4	45	51	44	—	6.2	
15	1010.1	SSW.4	39	53	88	0.17	0.0	r 10h.-14h.
16	1005.5	SW.6	53	55	75	0.09	0.3	r <sub>0</sub> 16h. & 17h.; pR 19h.
17	1023.1	W.4	42	51	60	—	3.5	
18	1021.8	SW.5	41	51	66	—	0.2	
19	1011.6	WSW.4	47	50	79	trace	0.1	d <sub>0</sub> 14h. 30m.
20	997.4	SSW.6	48	53	75	0.17	0.0	r <sub>0</sub> -r 14h.-22h.
21	992.9	SW.5	47	50	56	0.04	6.3	r <sub>0</sub> 2h., 21h. & 23h.
22	977.4	NNW.5	43	49	80	0.20	1.5	r <sub>0</sub> r 2h.-8h. & 13h.
23	983.2	NW.3	33	45	59	—	2.8	x early.
24	990.3	SSE.3	33	46	76	0.29	3.0	r <sub>0</sub> -r 17h.-24h.
25	976.3	WSW.3	40	45	85	0.42	0.3	pr during day.
26	1006.5	N.2	33	44	49	—	8.9	xz night.
27	988.9	S.4	33	47	91	0.47	0.4	rsr 8h.-14h.
28	986.5	SW.3	40	48	81	0.02	1.4	r 11h. 25m.-50m.
*	1007.1	—	40	48	71	2.30	1.9	* Means or totals.

### General Rainfall for February, 1935.

England and Wales	...	158	} per cent. of the average 1881-1915.
Scotland ...	...	126	
Ireland ...	...	125	
British Isles	...	144	

## Rainfall : February, 1935 : England and Wales

Co.	STATION.	In.	Per cent of Av.	Co.	STATION.	In.	Per cent of Av.
<i>Lond.</i>	Camden Square.....	2.20	121	<i>Leics.</i>	Thornton Reservoir ...	2.62	157
<i>Sur.</i>	Reigate, Wray Pk. Rd..	3.82	174	"	Belvoir Castle.....	2.15	129
<i>Kent.</i>	Tenterden, Ashenden...	5.51	280	<i>Rut.</i>	Ridlington .....	1.98	121
"	Folkestone, Boro. San.	3.68	...	<i>Lincs.</i>	Boston, Skirbeck.....	1.62	111
"	Eden'bdg., Falconhurst	4.85	219	"	Cranwell Aerodrome...	1.89	126
"	Sevenoaks, Speldhurst.	3.05	...	"	Skegness, Marine Gdns.	2.33	154
<i>Sus.</i>	Compton, Compton Ho.	4.46	169	"	Louth, Westgate.....	2.84	148
"	Patching Farm.....	3.97	180	"	Brigg, Wrawby St.....	2.32	...
"	Eastbourne, Wil. Sq....	4.11	185	<i>Notts.</i>	Worksop, Hodsock.....	2.52	164
"	Heathfield, Barklye....	4.73	201	<i>Derby.</i>	Derby, L. M. & S. Rly.	2.22	137
<i>Hants.</i>	Ventnor, Roy.Nat.Hos.	3.47	165	"	Buxton, Terr. Slopes...	7.53	200
"	Fordingbridge, Oaklands	4.35	175	<i>Ches.</i>	Runcorn, Weston Pt....	2.38	128
"	Ovington Rectory.....	5.30	204	<i>Lancs.</i>	Manchester, Whit. Pk.	3.03	158
"	Sherborne St. John.....	3.59	164	"	Stonyhurst College.....	7.56	226
<i>Herts.</i>	Royston, Therfield Rec.	2.04	132	"	Southport, Bedford Pk.	3.14	149
<i>Bucks.</i>	Slough, Upton.....	2.25	132	"	Lancaster, Greg Obsy.	5.36	185
"	H. Wycombe, Flackwell	2.44	126	<i>Yorks.</i>	Wath-upon-Deerne.....	2.45	149
<i>Oxf.</i>	Oxford, Mag. College...	1.78	113	"	Wakefield, Clarence Pk.	2.01	118
<i>Nor.</i>	Pitsford, Sedgebrook...	...	...	"	Oughtershaw Hall.....	13.64	...
"	Uundle .....	1.47	...	"	Wetherby, Ribston H..	...	...
<i>Beds.</i>	Woburn, Exptl. Farm...	2.75	186	"	Hull, Pearson Park.....	2.97	179
<i>Cam.</i>	Cambridge, Bot. Gdns.	1.56	122	"	Holme-on-Spalding.....	2.30	137
<i>Essex.</i>	Chelmsford, County Lab	2.13	144	"	West Witton, Ivy Ho.	5.02	175
"	Lexden Hill House.....	2.64	...	"	Felixkirk, Mt. St. John.	3.01	178
<i>Suff.</i>	Haughley House.....	2.14	...	"	York, Museum Gdns....	2.65	175
"	Campsea Ashe.....	2.69	195	"	Pickering, Hungate....	3.50	201
"	Lowestoft Sec. School...	1.69	121	"	Scarborough.....	3.26	194
"	Bury St. Ed., Westley H.	2.64	176	"	Middlesbrough.....	3.01	232
<i>Norf.</i>	Wells, Holkham Hall...	2.30	155	"	Baldersdale, Hury Res.	6.65	221
<i>Wilts.</i>	Calne, Castleway.....	2.28	112	<i>Durh.</i>	Ushaw College.....	3.19	200
"	Porton, W.D. Exp'l. Stn	3.18	161	<i>Nor.</i>	Newcastle, Town Moor.	2.47	155
<i>Dor.</i>	Evershot, Melbury Ho.	4.42	141	"	Bellingham, Highgreen	3.45	136
"	Weymouth, Westham.	...	...	"	Lilburn Tower Gdns....	1.96	98
"	Shaftesbury, Abbey Ho.	3.15	138	<i>Cumb.</i>	Carlisle, Scaleby Hall..	4.56	204
<i>Devon.</i>	Plymouth, The Hoe....	3.75	126	"	Borrowdale, Seathwaite	...	...
"	Holne, Church Pk. Cott.	8.30	151	"	Borrowdale, Moraine...	20.78	231
"	Teignmouth, Den Gdns.	4.04	155	"	Keswick, High Hill....	8.92	180
"	Cullompton .....	4.70	168	<i>West.</i>	Appleby, Castle Bank...	4.54	153
"	Sidmouth, U.D.C.....	3.49	...	<i>Mon.</i>	Abergavenny, Larchf'd	3.93	123
"	Barnstaple, N. Dev. Ath	3.63	134	<i>Glam.</i>	Ystalyfera, Wern Ho....	8.33	162
"	Dartm'r, Cranmere Pool	12.00	...	"	Cardiff, Ely P. Stn.....	3.55	118
"	Okehampton, Uplands.	7.37	169	"	Treherbert, Tynywaun.	13.48	...
<i>Corn.</i>	Redruth, Trewirie.....	4.09	108	<i>Carm.</i>	Carmarthen, Priory St..	6.21	168
"	Penzance, Morrab Gdn.	4.52	135	<i>Pemb.</i>	Haverfordwest, Portf'd	4.90	...
"	St. Austell, Trevarna...	5.27	137	<i>Card.</i>	Aberystwyth .....	4.46	...
<i>Soms.</i>	Chewton Mendip.....	3.49	103	<i>Rad.</i>	Birm W.W. Tyrmynydd	8.64	164
"	Long Ashton.....	3.24	138	<i>Mont.</i>	Lake Vyrnwy .....	11.07	244
"	Street, Millfield.....	2.49	124	<i>Flint.</i>	Sealand Aerodrome....	2.32	149
<i>Glos.</i>	Blockley .....	2.93	...	<i>Mer.</i>	Dolgelley, Bontddu....	7.70	173
"	Cirencester, Gwynfa....	2.86	127	<i>Carn.</i>	Llandudno .....	2.94	151
<i>Here.</i>	Ross, Birchlea.....	2.11	105	"	Snowdon, L. Llydaw 9..	27.17	...
<i>Salop.</i>	Church Stretton.....	4.53	206	<i>Ang.</i>	Holyhead, Salt Island...	3.35	137
"	Shifnal, Hatton Grange	2.55	157	"	Lligwy .....	4.98	...
<i>Staffs.</i>	Market Drayt'n, Old Sp.	2.66	154	<i>Isle of Man</i>			
<i>Worc.</i>	Ombersley, Holt Lock.	2.09	127		Douglas, Boro' Cem....	4.30	131
<i>War.</i>	Alcester, Ragley Hall...	1.71	104	<i>Guernsey</i>			
"	Birmingham, Edgbaston	2.57	152		St. Peter P't. Grange Rd.	5.61	228

## Rainfall: February, 1935: Scotland and Ireland

Co.	STATION.	In.	Per cent of Av.	Co.	STATION.	In.	Per cent of Av.
<i>Wig</i>	Pt. William, Monreith.	3.83	124	<i>Suth</i>	Melvich.....	3.80	127
	New Luce School.....	...	...		Loch More, Achfary....	10.02	152
<i>Kirk</i>	Dalry, Glendarroch.....	6.30	124	<i>Caith</i>	Wick.....	2.57	113
	Carsphairn, Shiel.....	11.57	176	<i>Ork</i>	Deerness .....	2.98	99
<i>Dumf.</i>	Dumfries, Crichton, R.I.	4.13	130	<i>Shet</i>	Lerwick .....	4.10	130
	Eskdalemuir Obs.....	7.78	157	<i>Cork</i>	Caheragh Rectory.....	4.89	...
<i>Roxb</i>	Branxholm.....	3.29	125		Dunmanway Rectory...	5.49	94
<i>Selk</i>	Ettrick Manse.....	...	...		Cork, University Coll...	2.95	79
<i>Peeb</i>	West Linton.....	4.50	...		Ballinacurra.....	2.94	79
<i>Berw</i>	Marchmont House.....	1.83	88		Mallow, Longueville....	3.45	103
<i>E.Lot</i>	North Berwick Res....	1.20	77	<i>Kerry</i>	Valentia Obsy.....	5.07	97
<i>Midl</i>	Edinburgh, Roy. Obs..	1.71	103		Gearhameen.....	14.40	162
<i>Lan</i>	Auchtyfardle .....	5.03	...		Darrynane Abbey.....	4.59	99
<i>Ayr</i>	Kilmarnock, Kay Pk....	4.93	...	<i>Wat</i>	Waterford, Gortmore...	3.04	94
	Girvan, Pinnore.....	5.59	131	<i>Tip</i>	Nenagh, Cas. Lough....	3.83	123
<i>Renf</i>	Glasgow, Queen's Pk....	4.29	146		Roscrea, Timoney Park	3.60	...
	Greenock, Prospect H..	8.58	153		Cashel, Ballinamona....	3.20	100
<i>Bute</i>	Rothsay, Ardenraig....	6.28	...	<i>Lim</i>	Foynes, Coolnanes.....	3.96	124
	Dougarie Lodge.....	5.23	...		Castleconnel Rec.....	3.80	...
<i>Arg</i>	Ardgour House.....	16.14	...	<i>Clare</i>	Inagh, Mount Callan...	6.66	...
	Glen Etive.....	...	...		Broadford, Hurdlest'n.	2.72	...
	Oban.....	5.49	...	<i>Wexf</i>	Gorey, Courtown Ho...	3.07	109
	Poltalloch.....	7.26	173	<i>Wick</i>	Rathnew, Clonmannon...	3.04	...
	Inveraray Castle.....	12.60	186	<i>Carl</i>	Hacketstown Rectory...	3.62	121
	Islay, Eallabus.....	4.39	105	<i>Leix</i>	Blandsfort House.....	3.97	148
	Mull, Benmore.....	12.20	110		Mountmellick .....	4.79	...
	Tiree .....	4.07	118	<i>Offaly</i>	Birr Castle.....	3.02	132
<i>Kinr</i>	Loch Leven Sluice.....	...	...	<i>Dublin</i>	Dublin, FitzWm. Sq....	3.14	166
<i>Perth</i>	Loch Dhu.....	10.95	147		Balbriggan, Ardgillan...	3.30	168
	Balquhiddel, Stronvar.	6.94	...	<i>Meath</i>	Beauparc, St. Cloud....	3.84	...
	Crieff, Strathearn Hyd.	3.43	97		Kells, Headfort.....	4.41	163
	Blair Castle Gardens...	4.13	148	<i>W.M</i>	Moate, Coolatore.....	3.26	...
<i>Angus</i>	Kettins School.....	1.74	74		Mullingar, Belvedere...	4.54	163
	Pearsie House.....	2.58	...	<i>Long</i>	Castle Forbes Gdns.....	3.33	117
	Montrose, Sunnyside...	1.98	108	<i>Gal</i>	Galway, Grammar Sch.	4.46	...
<i>Aber</i>	Braemar, Bank.....	3.25	114		Ballynahinch Castle....	4.84	94
	Logie Coldstone Sch....	2.04	98		Ahascragh, Clonbrock.	4.20	136
	Aberdeen, King's Coll..	1.73	84	<i>Mayo</i>	Blacksod Point.....	5.00	123
	Fyvie Castle.....	3.06	149		Mallaranny .....	5.81	...
<i>Moray</i>	Gordon Castle.....	2.17	113		Westport House.....	4.82	122
	Grantown-on-Spey .....	...	...		Delphi Lodge.....	9.67	115
<i>Nairn</i>	Nairn .....	2.20	122	<i>Sligo</i>	Markree Obsy.....	3.89	113
<i>Inv's</i>	Ben Alder Lodge.....	6.77	...	<i>Cavan</i>	Crossdoney, Kevit Cas..	3.74	...
	Kingussie, The Birches.	4.97	...	<i>Ferm</i>	Enniskillen, Portora....	3.63	...
	Inverness, Culduthel R.	3.61	...	<i>Arm</i>	Armagh Obsy.....	3.27	147
	Loch Quoich, Loan.....	17.85	...	<i>Down</i>	Fofanny Reservoir.....	7.34	...
	Glenquoich .....	...	...		Seaforde .....	3.70	121
	Arisaig, Faire-na-Sguir.	5.01	...		Donaghadee, C. Stn....	2.93	127
	Fort William, Glasdrum	12.54	...		Banbridge, Milltown....	2.88	138
	Skye, Dunvegan.....	5.43	...	<i>Antr</i>	Belfast, Cavehill Rd....	4.61	...
	Barra, Skallary.....	5.10	...		Aldergrove Aerodrome.	3.42	142
<i>R&amp;C</i>	Alness, Ardross Castle.	4.12	125		Ballymena, Harryville.	4.50	139
	Ullapool .....	5.62	131	<i>Lon</i>	Garvagh, Moneydig....	4.44	...
	Achnashellach .....	14.76	203		Londonderry, Creggan.	4.83	151
	Stornoway .....	4.58	103	<i>Tyr</i>	Omagh, Edenfel.....	5.10	171
<i>uth</i>	Lairg.....	5.71	184	<i>Don</i>	Malin Head.....	3.17	...
	Tongue .....	3.23	93		Killybegs, Rockmount.	4.40	...

## Climatological Table for the British Empire, September, 1934

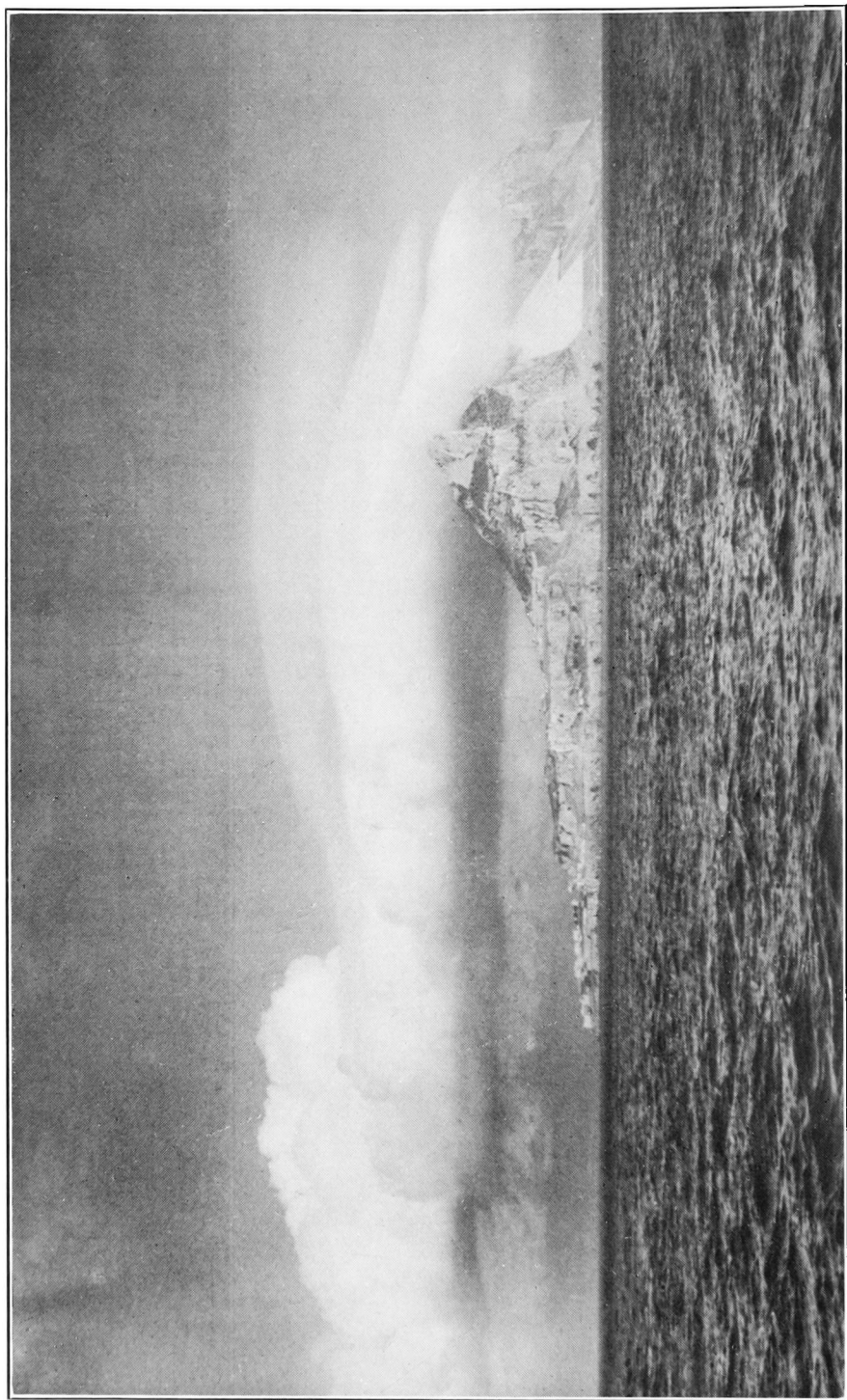
STATIONS.	PRESSURE.			TEMPERATURE.						RELATIVE HUMIDITY.		PRECIPITATION.			BRIGHT SUNSHINE.			
	Mean of Day M.S.L.	Diff. from Normal.	mb.	Absolute.		Mean Values.				Mean.	Wet Bulb.	%	Mean Cloud Am't	Am't.	Diff. from Normal.	Days.	Hours per day.	Per-cent- age of possi- ble.
				Max.	Min.	Max.	Min.	Max.	Min.									
London, Kew Obsv...	1015.9	-1.5	...	81	44	68.9	51.4	60.1	3.0	53.8	91	5.3	1.26	0.61	10	6.2	49	
Gibraltar.....	1017.9	-0.7	...	87	60	80.7	66.2	73.5	1.1	64.6	82	5.0	0.01	1.30	1	...	...	
Malta.....	1018.1	-1.8	...	88	65	79.8	69.3	74.5	1.5	69.7	78	3.9	1.55	0.28	2	9.9	80	
St. Helena.....	1015.1	-0.1	...	64	53	61.7	55.4	58.5	1.1	56.1	94	9.4	2.31	...	...	...	...	
Freetown, Sierra Leone	1013.9	-1.7	...	89	69	84.8	72.9	78.9	0.2	75.8	92	8.4	31.85	3.27	27	...	...	
Lagos, Nigeria.....	1012.7	-0.5	...	87	70	85.0	74.7	79.9	1.2	75.2	87	7.7	4.32	1.27	12	4.7	39	
Kaduna, Nigeria.....	1009.2	...	...	89	64	85.6	66.6	76.1	0.8	71.2	88	7.8	12.30	0.80	21	6.1	50	
Zomba, Nyasaland....	1015.7	-2.0	...	88	48	78.5	67.8	68.1	1.4	60.6	63	4.8	0.25	0.09	5	...	73	
Salisbury, Rhodesia...	1016.4	-0.1	...	89	37	77.2	50.7	63.9	2.5	53.2	45	1.9	0.28	0.00	4	8.8	...	
Cape Town.....	1019.1	0.0	...	87	41	68.3	51.4	59.9	2.0	53.0	82	5.4	2.13	0.11	10	...	...	
Johannesburg.....	1018.5	-1.8	...	81	35	72.0	46.6	59.3	0.1	46.1	41	1.4	0.49	0.47	2	10.0	84	
Mauritius.....	1020.9	-0.7	...	78	58	74.8	62.4	68.6	1.5	64.8	70	6.5	3.37	2.07	21	6.8	57	
Calcutta, Alipore Obsv.	1002.9	-1.6	...	93	75	89.2	79.3	84.3	1.1	80.0	91	7.4	12.42	2.41	17*	...	...	
Bombay.....	1007.5	-0.5	...	89	73	86.1	76.2	81.1	0.2	78.4	85	7.0	5.88	2.85	13*	...	...	
Madras.....	1006.0	-0.5	...	98	73	93.3	78.0	85.7	0.5	76.5	72	6.4	2.00	2.85	4*	...	...	
Colombo, Ceylon.....	1010.5	-0.6	...	87	73	85.6	76.8	81.2	0.4	77.1	76	6.7	2.23	2.53	10	7.3	60	
Singapore.....	1009.8	0.0	...	90	72	86.6	76.3	81.5	0.7	77.9	80	8.3	4.57	2.22	9	5.9	49	
Hongkong.....	1007.2	-1.1	...	93	72	87.0	77.7	82.3	1.3	77.9	77	5.6	10.72	1.03	15	7.4	60	
Sandakan.....	1009.1	...	...	94	72	89.8	74.8	82.3	0.6	76.7	81	7.8	8.84	0.49	15	...	...	
Sydney, N.S.W.....	1016.2	0.1	...	86	46	69.4	52.5	60.9	1.7	55.6	66	4.6	7.34	0.48	15	8.0	67	
Melbourne.....	1015.4	-0.4	...	78	32	64.1	43.5	53.8	0.3	49.7	64	5.6	1.61	0.83	9	5.9	50	
Adelaide.....	1015.9	-1.6	...	86	40	68.8	49.8	59.3	2.2	51.8	53	5.4	3.87	1.82	14	7.1	60	
Perth, W. Australia....	1016.2	-1.8	...	78	43	66.4	51.2	58.8	0.6	54.0	69	5.8	3.32	0.10	20	7.0	59	
Coolgardie.....	1015.0	-2.1	...	84	35	71.4	47.6	59.5	0.8	52.6	57	3.2	1.14	0.47	4	...	...	
Brisbane.....	1017.9	-0.3	...	90	45	74.6	55.0	64.8	0.4	59.1	64	3.4	1.33	0.67	6	9.2	77	
Hobart, Tasmania.....	1009.9	-1.1	...	76	34	59.9	43.8	51.9	0.9	45.2	58	5.3	3.12	1.05	13	6.7	57	
Wellington, N.Z.....	1015.0	-0.4	...	64	37	56.6	45.7	51.1	0.5	49.0	77	7.3	2.21	1.76	11	5.4	46	
Suva, Fiji.....	1014.4	-1.2	...	88	63	79.6	68.9	74.3	0.2	69.5	78	8.0	9.68	1.99	18	4.4	37	
Apia, Samoa.....	1011.6	-0.6	...	87	69	85.1	73.6	79.3	1.1	75.5	77	5.0	10.41	5.30	18	7.5	63	
Kingston, Jamaica.....	1012.6	-0.4	...	91	71	88.2	72.9	80.5	1.0	72.6	85	4.1	2.81	1.22	10	5.4	44	
Grenada, W.I.....	...	...	...	87	70	84	71	77.5	2.8	72	74	5	13.90	5.91	23	...	...	
Toronto.....	1016.9	-0.9	...	78	44	69.6	56.2	62.9	2.6	59.2	91	6.9	4.24	1.57	15	4.5	36	
Winnipeg.....	1014.0	-0.2	...	83	26	58.9	42.0	50.5	3.2	42.4	87	6.7	3.91	1.69	14	4.0	31	
St. John, N.B.....	1021.0	-3.6	...	74	45	66.5	53.6	60.1	4.2	56.7	90	7.2	3.98	0.24	14	4.4	35	
Victoria, B.C.....	1016.8	-0.4	...	87	42	63.3	50.4	56.9	0.8	52.3	81	6.3	1.26	0.55	11	6.3	50	

For India stations a rain day is one in which rain falls at any time.

\* For Indian stations a rain day is a day on which 0.1 in. or more rain has fallen.  
 For other stations temperature, max., min., and diff. from normal, cloud, and rainfall and diff. from normal should read Apr.  
 For London, Kew, 1934, Apr. 1935, max., min., and diff. from normal, cloud, and rainfall and diff. from normal should read Apr.  
 For London, Kew, 1934, Apr. 1935, max., min., and diff. from normal, cloud, and rainfall and diff. from normal should read Apr.







LEVANTER CLOUD AT GIBRALTAR, OCTOBER 25TH, 1934, 7h. 30m. (see p. 68).