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ERRATA

Page 194, line 20. For "Walten" *read* "Wallén".
Page 216, line 1. For "Charles E. Brooks" *read* "Charles F. Brooks".
See also pages 22, 170, 218, 242, 270.

ILLUSTRATIONS

CUMULUS CLOUD AT MOUNT BATTEN, 10H. 15M. G.M.T., AUGUST 4TH, 1934 (*see* p. 19)

M.O. 381.

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LONDON: PRINTED AND PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE

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Periodic Pressure Oscillations at Malta

Pressure fluctuations are distinct features of the pressure records at Malta, particularly during early summer.* Changes so large and sudden which would be associated with line squalls in the British Isles, frequently occur at Malta with no violent surface phenomena. Definite periodic oscillations of pressure, however, are rare. Four cases only have occurred since records have been made during the last 11½ years at Malta.

An example occurred in the early hours of June 6th, 1934. Periodic oscillations commenced at 1h. and ceased at 4h. The autographic records covering the period are shown in Fig. 1. The ten pressure peaks in this three-hour period coincide with ten maximum wind veers. The wind speed trace is defective but shows periodic oscillations, the minima coinciding with the maxima of pressure. Temperature and humidity vary slightly, but not in any periodic manner. The interesting fact is brought out, however, that these two quantities are inverse functions, revealing the constancy of absolute humidity and therefore show the homogeneity of the air mass at the surface. The periodic oscillations are due, therefore, to some upper air phenomenon.

Two synoptic charts nearest the time of the pressure oscillations are reproduced in Fig. 2. It will be seen from these that Malta, which was in a sector of warm air, lay to the south-east and almost on the

* *London, Meteor. Off., Prof. Notes,* No. 62.

boundary of a quasi-stationary front which produced large amounts of medium cloud but no rain except for a few drops (unmeasurable) on the 5th. The maximum temperature on the 6th was 14° below that of the 4th when the warm air first arrived at Malta from the Libyan desert. Levelling of temperature on each side of the cold front, owing to the breakdown of the pressure gradient and consequent stagnation, brought about its degeneration at the surface.

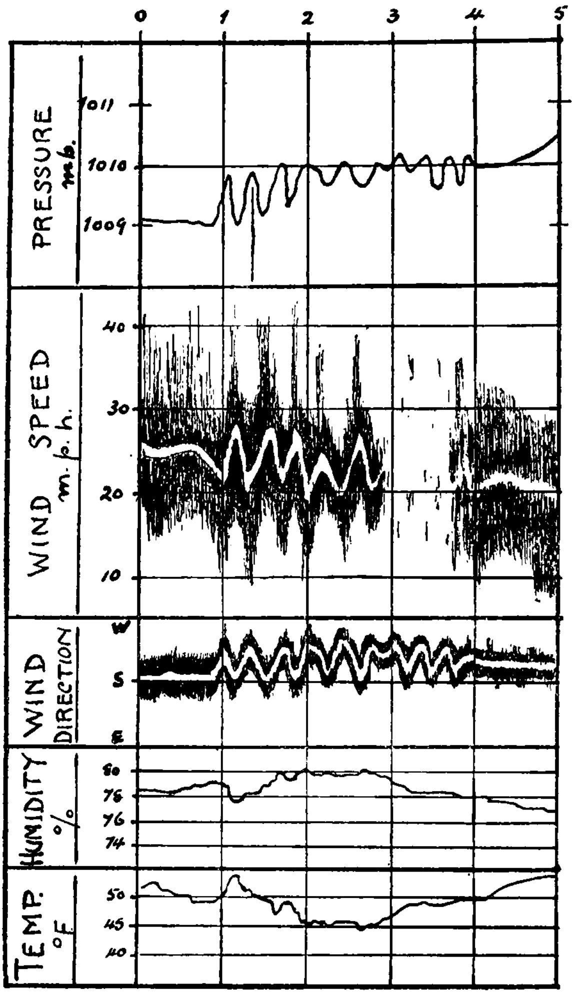


Fig. 1

Upper air temperatures of the 5th and 7th are represented by Fig. 3. These are applicable to the 6th since they are made in the same air mass. (Actually the cold front did not move eastwards on the surface after the 5th.) These graphs reveal convective equilibrium above the inversion level denoting air of true desert origin, having a potential temperature of over 100° F. The effect of cooling of the lower layer by contact with the sea is pronounced. Upper winds on both sides of the discontinuity were southwesterly and with the weakening of the surface pressure gradient the motion of the disturbances was along the front and not at right angles to it.

The pressure oscillations were undoubtedly caused by the intermittent encroachment of overrunning cold air. Any spasmodic bulging of cold air at right angles to its path would of course give spasmodic variations of pressure at the surface and would not explain the periodic oscillations. An explanation of the periodic oscillations is that the front itself in horizontal section was undulating and that a wave motion was taking place along the front. There is no indication

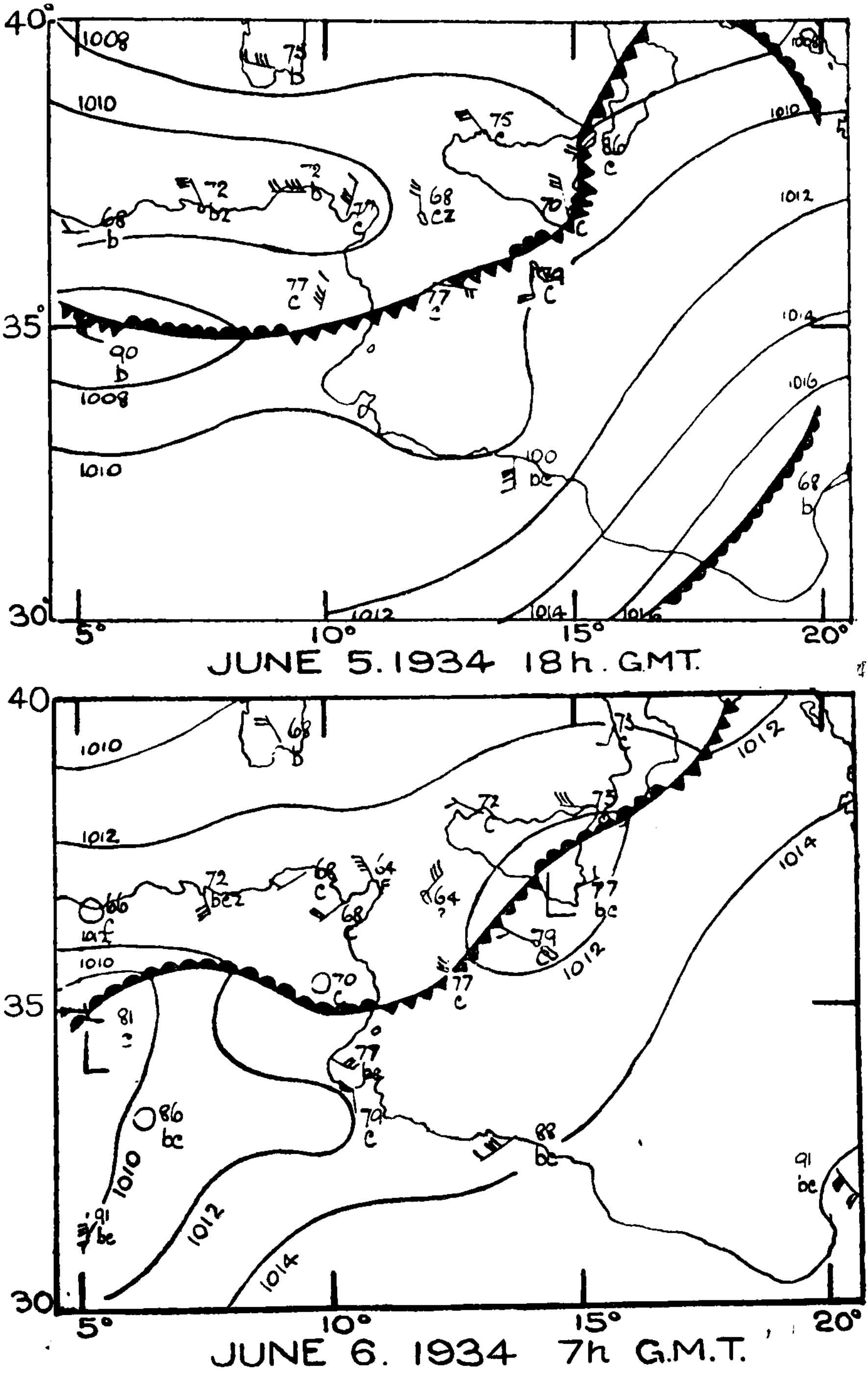
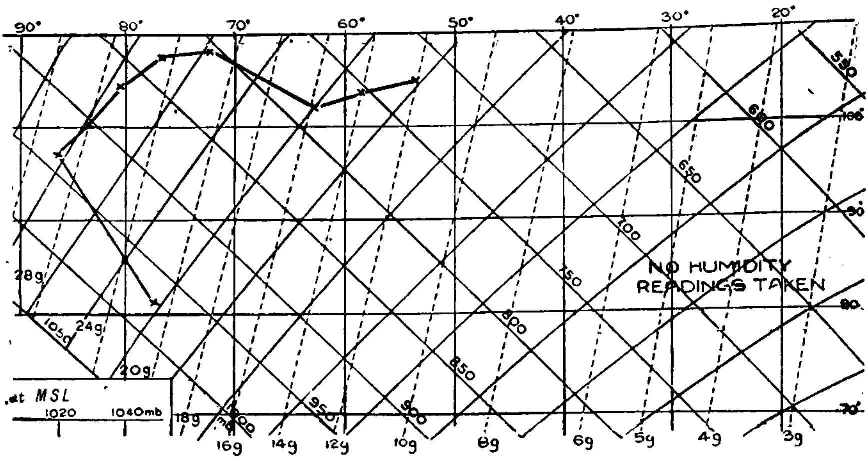
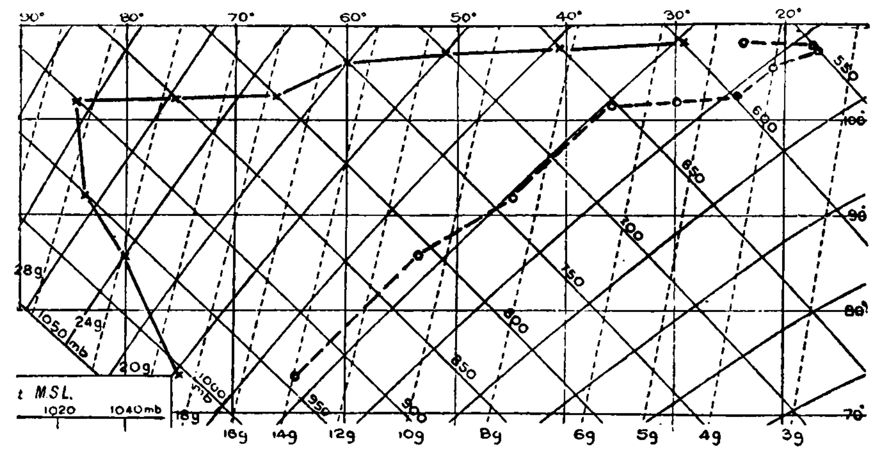

40°
35°
30°
5°
10°
15°
20°
1008
1010
1012
1014
1016
JUNE 5.1934 18h. G.M.T.
40
35
30
5°
10°
15°
20°
1010
1012
1014
JUNE 6. 1934 7h G.M.T.

FIG. 2



HALFAR, MALTA, 8h. 45m. G.M.T., JUNE 5th, 1934.



HALFAR, MALTA, 6h. 35m. G.M.T., JUNE 7th, 1934.

FIG. 3. (See Note on p. 5.)

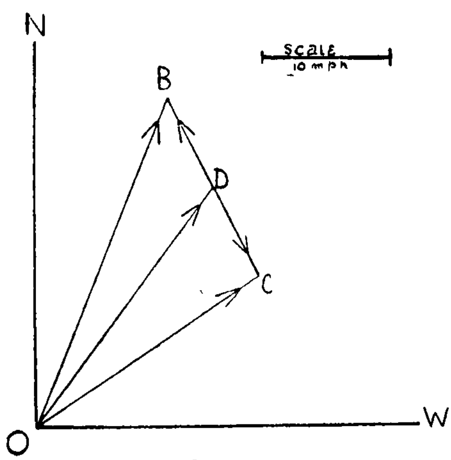


FIG. 4

of any bulging of cold air in the upper air temperature curves to account for periodic oscillations in pressure, but since the times of the ascents do not coincide with the time of the oscillations, no bulging would be expected. An analysis of the surface wind is made in Fig. 4. It can be seen that a wind vector varying periodically between NNW., 8 m.p.h. (DC) and SSE., 8 m.p.h. (DB) is added to the mean surface wind (OD).

As the oscillation originates from some upper air source a similar periodic vector change is taking place at some height above Malta. This is consistent with the hypothesis of the lateral oscillation of an upper front running approximately south-west and north-east. This front, which arrived at some height above Malta, remained for three hours, after which it withdrew and finally disappeared by complete degeneration.

A. WALTERS.

[NOTE.—In Fig. 3 the scale at the top represents air temperature, the lines sloping downwards from left to right pressure in millibars, and the vertical scale on the right, potential temperature.]

Problems of Meteorology

When as Editor of the *Quarterly Journal of the Royal Meteorological Society* Prof. D. Brunt in 1930 began the publication of a series of articles under the general title of " Some Problems of Modern Meteorology " he did one of the most useful things that could well be imagined. Sixteen articles appeared between 1930 and 1934 and the Society has now rounded off Prof. Brunt's distinguished services as Editor during that period by publishing the series in collected form at the modest price of three shillings and sixpence. To anyone who wants to know what meteorology has done and what it aims at doing, this clearly-written and authoritative symposium is indispensable.

The problems discussed in the series of sixteen articles cover a very wide range. Prof. Brunt himself contributes papers on the origin of cyclonic depressions, radiation and absorption in the atmosphere and the transformations of energy in the atmosphere. The last is perhaps rather more cursory than the importance of the subject would lead the reader to expect. Another article which strikes the present reviewer as erring on the side of brevity is that on seasonal weather forecasting by Dr. C. W. B. Normand. Mention is made of the use of world-wide charts of monthly, seasonal or annual anomalies as a possible basis for long-range forecasting, but Dr. Brooks' important paper on this subject in the *Quarterly Journal* for 1926 appears to have been completely overlooked.

Dr. Brooks contributes articles on the origin of anticyclones—a problem hardly less important than that of the origin of cyclones—and on post-glacial climates and the forests of Europe. In the latter paper the author has suffered from undue parsimony in regard to the scale of reproduction of the accompanying charts. As originally printed in the journal the charts were barely legible; as now reprinted they are illegible. It is only fair to state, however, that the " Replika " process employed for the production of this volume has, on the whole, yielded very good results.

In a volume devoted to the setting forth of problems one rather expects to find the question mark filling a prominent rôle. One writer, Mr. M. G. Bennett, is to be commended for concluding his article on the condensation of water in the atmosphere by writing down a series of questions to which answers are required. The problems of Antarctic meteorology which await solution are also very clearly set out by Dr. Kidson. In some other articles the problems are not so clearly formulated, attention being devoted to what has been ascertained rather than to what remains to be ascertained. The research worker must, however, be fully informed of the existing state of knowledge before he can plan his attack on the unknown, just as an explorer needs an accurate map of the territory already surveyed by his predecessors before planning new expeditions. The " stocktaking " now put before us will undoubtedly save many hours of work for those who are able to devote their talents to the advance of meteorology. The paths to be explored are very alluring, even if they are beset with many pitfalls and quicksands. " Path " is perhaps an optimistic metaphor, since the progress of research is in some instances rather more likely to resemble the threading of a labyrinth or the blasting of a tunnel through a mountain.

One of the main objects of meteorology is the issue of weather forecasts, and it is not surprising that this aspect of the science should receive a large share of attention in the present publication. The view has recently been expressed that some new line of attack must be evolved before a major advance can be expected. To quote from Prof. Brunt's Introduction, " the time is surely ripe for some new idea to be brought forward, and many young meteorologists are eagerly looking for a new method which may help to elucidate some of the puzzling features of the physics of the atmosphere. But it is not clear where the new idea is to come from." Stimulated by these words the present reviewer feels impelled to put forward a suggestion, though with much diffidence. The observer who participates in the international exchange of weather information is required to make certain instrumental observations and to forward the data to headquarters. In his report he gives the temperature to the nearest degree Fahrenheit or Centigrade, the relative humidity rounded off to the nearest five per cent., the pressure measured to *one part in ten thousand*, and certain other things such as wind force, cloud amount, cloud height, etc., either estimated or measured very roughly. The point it is desired to emphasise is that one element, and one only, namely pressure, is measured and expressed with great precision. Now it is a fact that the first big step forward in forecasting was made when it was found that accurate readings of pressure, when reduced to sea level and plotted on a map, grouped themselves unmistakably into certain definite conformations which were related to the weather, and whose movements and developments could be followed from day to day. It is exceedingly doubtful if the isobaric systems would have been recognised and their importance realised had our predecessors been satisfied to measure pressure with an accuracy of say five or ten per cent. It so happens that an accuracy of less than one part in a thousand is readily obtainable in the case of pressure. To attempt a similar degree of accuracy in the case of, say, wind velocity would be unprofitable because the wind velocity varies over a wide range from moment to moment. It seems possible, however, that a study of synoptic precision measurements of some such element as atmospheric moisture content might lead to important results. It is rather curious that although the importance of moisture in the atmosphere is increasingly emphasised by every fresh research the synoptic meteorologist appears to remain satisfied with very rough and ready determinations of its value. Would it not be worth while to inaugurate a campaign for the intensive study of this element in the hope that something would be added to our knowledge of the atmospheric processes which go to make up the weather ?

E. G. BILHAM.

A further discussion of the temperature at 4 Km. at Reykjavik and Duxford during the Polar Year

Nearly simultaneous observations were made at Reykjavik and Duxford on 210 days from September, 1932, to August, 1933. In the table below are given differences at 4 Km. for each season, also the number and percentage of occasions when the temperature at 4 Km. was higher at Reykjavik than at Duxford.

	No. of cases.	*Mean diff., °F.*	*No. of reversals*	*Per cent.*
Autumn (Sept.–Nov.) ...	57	18·2	3	5
Winter (Dec.–Feb.) ...	36	16·2	5	14
Spring (Mar.–May) ...	57	10·4	10	18
Summer (June–Aug.) ...	60	8·0	12	20
Year	210	{12·9, 13·2}	30	14

The figure 12·9 is the mean of all cases, while 13·2 is the mean when each season is given equal weight. The percentage of reversals is 14, compared with 17 in my earlier article,* which was based only on the observations in the *Daily Weather Report*. These observations were received by wireless and only commenced at the end of October, and this explains the difference, since the percentage was lowest in the autumn.

The variability of the temperature at 4 Km. may be measured either by changes in 24 hours, or by standard deviations from the quarterly means. The results of both methods are given in the table below, the number of observations being given in brackets in each case. Only one observation per day was used, but all observations

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

on separate days were used, even when they were not simultaneous at the two stations. The number available for 24-hour changes is reduced by two when a single day is missed. The standard deviations are affected by long-period as well as short-period changes, and they are increased by seasonal changes, especially in spring and autumn. At Duxford in the summer of 1933 there was a period of low upper air temperature in June, and unusually high temperatures in July and August, and this raises the standard deviation for the summer.

	24-hour changes, °F.		*Standard deviations, °F.*	
	Reykjavik	*Duxford*	*Reykjavik*	*Duxford*
Autumn ...	6·0 (55)	5·5 (54)	10·0 (67)	9·4 (70)
Winter ...	6·1 (30)	7·1 (51)	9·2 (47)	9·5 (66)
Spring ...	4·5 (51)	5·2 (57)	10·2 (70)	7·3 (73)
Summer ...	4·0 (51)	3·6 (58)	6·3 (72)	7·5 (73)

Some additional figures for winter :—

Reykjavik, sea level pressure,	mean 24-hour change	9·9 mb.,	standard deviation	24·2 mb.
Duxford, ,, ,, ,,	,, ,, ,,	6·5 mb.,	,, ,,	10·9 mb.
Reykjavik, temperature at 1 Km.,	,, ,, ,,	5·6° F.,	,, ,,	4·3° F.
Duxford, ,, ,, ,, ,,	,, ,, ,,	5·1° F.,	,, ,,	4·1° F.

The additional figures for winter are included because both the 24-hour changes and the standard deviation of temperature at 4 Km. are lower at Reykjavik than at Duxford at that season. This seems at first sight surprising, considering that the standard deviation of sea level pressure (taking only the cases when there were upper air observations) is much greater at Reykjavik. At 1 Km. the variability of temperature is greater at Reykjavik, but at 4 Km. this is reversed, which probably indicates that the latitudinal temperature gradient at 4 Km. is lower in Iceland than in England. This is no doubt due to the fact that the air to south of Iceland is predominantly maritime polar, in the genuine sense of that sometimes overworked term. The analyses of air masses on the published Bergen charts show no case from September, 1932 to April, 1933, inclusive, when there was tropical air at Reykjavik at 7h. There is little doubt that two small warm sectors consisting of tropical air crossed Iceland, but no upper air observation was made in them. According to J. Bjerknes,* the mean position of the Atlantic polar front in winter is from Cuba over Bermuda to the English Channel. This conception of the polar front differs from that given in the majority of text-books, and obviously represents the southern boundary of the initially very cold air which on the average flows south-eastward into the Atlantic between the Iceland "low" and the North American "high." The temperature difference between this maritime polar air and air of tropical or sub-tropical origin is very much larger at 4 Km. than near sea level, and this is probably the explanation of the result

* *London, Q.J.R. Meteor. Soc.*, 58, 1932, p. 319.

brought out in the above table. A study of extreme cases supports this view. The temperature at 4 Km. in tropical air over Duxford was 24° F. on December 17th and February 4th, and 23° F. on February 9th, while the winter maximum at Reykjavik was 9° F. on December 7th and February 8th, not in tropical air, and 15° F. less than the Duxford maximum. The absolute minimum for the winter quarter was — 19° F. at Duxford on February 23rd, and — 26° F. at Reykjavik on January 18th, both cases being in arctic air, which penetrates to England fairly frequently, retaining most of its original coldness at the 4 Km. level. In a paper read recently at the Royal Meteorological Society, I showed that an air mass sometimes flows from Iceland to England with almost no temperature change at 4 Km., but on these occasions the temperature at 4 Km., though low, was not extremely low. In an extreme case the upward convection of heat in the cumulo-nimbus clouds developed over or near the sea would tend to be larger.

In summer, tropical air is less rare in Iceland than at other seasons. It should be remembered that the classification of air masses is sometimes quite arbitrary, being a matter of personal opinion, not always of a decided type. If the stability of the lowest kilometre is taken as a criterion, it is obvious that land and sea distribution exercises a very large influence, often producing stability over the sea in summer and instability in winter.

The " Iceland low " lies on the average position of the boundary between maritime polar and genuine polar or arctic air, often known as the " arctic front." No doubt this front is one of the main causes of the Iceland low itself, but some weight must be given to the fact that Iceland lies 2,000 miles north-east of the region to south of Newfoundland, where many depressions develop.* A depression starting with a large warm sector contains enough potential energy to deepen it during a passage of about 2,000 miles without any additional source of energy, provided that there is not too much frictional resistance. The open sea gives this condition, independently of its temperature. On the Atlantic to southward of Iceland there are frequently deep occluded depressions with a fairly uniform temperature round them. Depressions of essentially similar origin and nature often move to Iceland, and must contribute greatly to the low mean pressure. At the same time there is no doubt that the large temperature contrasts near Iceland play an important part in the development of new depressions and the regeneration of old ones. Depressions on the arctic front often resemble those on the polar front, but if the air in the warm sector is markedly unstable there are special features, as is sometimes shown in our own area. I summarised the question in a reply to the discussion of

* The statistics given by Miss L. D. Sawyer (*London, Meteor. Off. Prof. Notes*, No. 50) for the development of depressions show a principal maximum off Nova Scotia and a secondary maximum near Iceland.

one of my papers.* Depressions in polar air are often slow and erratic in their movements, and their development tends to be rapid, though usually only for a comparatively brief period.

C. K. M. DOUGLAS.

OFFICIAL PUBLICATIONS

The following publications have recently been issued :—

GEOPHYSICAL MEMOIRS.

No. 63. *Wind records from the Bell Rock Lighthouse.* By A. H. R. Goldie, M.A., F.R.S.E. (M.O. (356*f*).

From time to time in the *Geophysical Memoirs* issued by the Meteorological Office there appear memoirs dealing with research on wind and wind structure. Notable examples in recent years have been *Geophysical Memoirs* No. 54, " The Structure of Wind over Level Country "—which was an exhaustive report on experiments carried out at the Royal Airship Works, Cardington, and *Geophysical Memoirs* No. 59, " A Survey of the Air Currents in the Bay of Gibraltar ". A further Memoir now issued, No. 63, " Wind Records from the Bell Rock Lighthouse ", is concerned with the behaviour of winds over the open sea. In 1929 an anemograph was erected on the Lighthouse ; the instrument is thus 12 miles distant from the nearest coast and it is also about 130 feet above water level. This Memoir gives some account of the wind structure as recorded at different times and seasons in this unique situation, and of the diurnal variations in wind speed and direction.

Averages of Bright Sunshine for the British Isles for Periods ending 1930 (*M.O.* 377)

This publication contains two main tables, the first of which gives average monthly totals, daily means and percentages of possible duration of sunshine for all stations having 10 years or more of observations in the period 1901–30. The second table gives for eighteen selected stations the average and percentage number of days in each month with sunshine within stated limits of duration.

The total number of stations for which averages are printed is 172 of which 31 are in Scotland and 9 in Ireland. For most stations the records cover a period of 20 years or more. The effect on the averages of variations in the number of years used is illustrated by tables in the Introduction.

The data show that the average annual duration of recorded sunshine varies from over 1800 hours in the Channel Isles and on the south coast of England to under 1100 hours in the Shetlands and in certain industrial areas where heavy smoke pollution occurs. At all stations May or June is the sunniest month, and December or January the dullest.

* *London, Q.J.R. Meteor Soc.*, 55, 1929, p. 151.

Discussions at the Meteorological Office

The subjects for discussion for the two meetings are :—

February 25th, 1935. (1) *Stratospheric steering during the cold period in February*, 1929. By R. Mügge; (2) *The change of stratospheric steering October 1st–8th*, 1932. By G. Stüve; and (3) *Stratospheric steering in the cold February of* 1932. *An example of an independent stratosphere system.* By H. Christians. (Frankfurt a. M., Synopt. Bearb. Nos. 1, 2 and 3. 1932–3.) (in German.) *Opener*—Mr. G. A. Bull, B.Sc.

March 11th, 1935. *Subsidence within the atmosphere.* By Jerome Namias (Cambridge, Mass., Harvard Meteor. Studies No. 2, 1934). *Opener*—Mr. E. G. Bilham, B.Sc.

Royal Meteorological Society

The Annual General Meeting of the Society was held on Wednesday, January 16th, in the Society's house, 49, Cromwell Road, S. Kensington, Lt.-Col. E. Gold, D.S.O., F.R.S., President, in the Chair.

The Report of the Council for the year 1934 was read and adopted and the Council for the ensuing year duly elected. Lt.-Col. Gold continues as President for a second year of office.

Lt.-Col. Gold delivered an address on "Fronts and Occlusions", of which the following is an abstract :—

The dividing surfaces between large masses of atmospheric air are called "frontal surfaces". These masses of air are usually moving and consequently the frontal surfaces are also moving.

The line in which a frontal surface dividing different masses cuts the ground is called a "front".

A "warm front" is a front where the warm mass is replacing the cold mass at ground level. The front is therefore moving forward in the direction from warm air to cold air.

A "cold front" is a front where the cold mass is replacing the warm mass at ground level. The front is therefore moving in the direction from cold air to warm air.

There are also "stationary fronts" where warm air and cold air are both moving parallel to the front, so that the front itself does not move.

If a cold front and a warm front coalesce the result is an "occlusion" (or "shutting up" of the cyclone). The frontal surfaces in that case do not meet at ground level, but they do meet above the ground: and the warm air is above them, the cold air below them.

The weather phenomena associated with fronts have been known from the earliest times, but it was not until the nineteenth century that these phenomona began to be associated with the discontinuities known as fronts. Meteorologists then began to see the connection between weather phenomena and cold fronts: but it was not until about fifteen years ago that the relation between weather phenomena and warm fronts was discovered, and that the role of fronts in the constitution of a cyclone began to be understood. In the last fifteen years a large number of investigations have been carried out to extend this work. They have dealt with the genesis of fronts and the dissolution of fronts: with the changes taking place in the air masses on the two sides of the frontal surface: and with the upward and downward motion of air at the frontal surfaces. Fronts and occlusions are now keystones in the science of weather forecasting and the increased accuracy of forecasts for short periods is largely due to a knowledge of these entities.

A number of examples of the genesis and dissolution of fronts (frontogenesis and frontolysis) are given, and the effect of vertical motion upwards or downwards in modifying the lapse rate or vertical fall of temperature is discussed. It is shown that if the descending motion is zero at the surface—as it usually would be—and becomes greater as the height above the ground increases, then the vertical fall of temperature in the atmosphere is replaced in a relatively short time by an isothermal state. Effects of this kind are usually found in the lower levels of the atmosphere—below about 1,500 feet.

Although the relation between fronts and weather and cyclones represents a great advance in meteorological knowledge, the question as to how the fronts originate has not yet been satisfactorily answered. The suggestion has been made that they are due to the difference of temperature between equator and pole. This is not an adequate explanation, because the transfer of energy from equator to pole could be effected without the large velocities required for, and associated with, fronts. It is suggested that fronts arise, primarily, owing to the discontinuities caused by the differences between radiation from continent and ocean, or from solid ice and open water, and that on a uniform globe the meteorologist's life would be free from both frontogenesis and frontolysis.

Correspondence

To the Editor, *Meteorological Magazine*

Green Ray at Sea

Miss C. M. Botley, of 17, Holmesdale Gardens, Hastings, has drawn attention to a letter by Mr. Stewart, of Swansea, which appeared in the *Radio Times* of November 2nd. In it he says that "while serving in the Persian Gulf and Indian Ocean on British Tanker Company's ships between 1926 and 1928 I saw it (the green ray) scores of times, probably because after seeing it once it became a temporary superstition to look for it on every possible occasion. . . . The point of interest is that one evening the Mate and I saw it twice. That evening there was a mirage effect on the sun, and two suns, indistinguishable from one another set at a distance of roughly two suns apart. We saw the green ray from the first and then several minutes later again from the second when that set in its turn, both equally vivid." Miss Botley comments as follows " the interesting point is the duplication of the solar image apparently without distortion. It reminds one of Applegate's observation recorded in the *Meteorological Magazine*, 64, 1929, pp. 67–8."

A Flash of Lightning at Newport Pagnell, Bucks

I was driving a Morris Minor saloon car into Newport Pagnell, Bucks, at about 5.10 p.m. to-day, January 11th, from Northampton. The weather had been increasingly unpleasant as I left Northampton and after, strong wind and drizzling rain from the south-west—my " off " side.

As I was actually entering Newport and about 40 yards ahead of me I saw a violent explosion in the air about eight feet above the ground which reminded me forcibly of a small-calibre shell-burst. I felt nothing, but saw and heard the explosion which was accompanied by a bluish flame and was immediately immersed in torrential rain.

Inquiry later elicited the presence of heavy snow and hail falling at the time about 1 mile south. The subsequent thunder caused a good deal of local alarm, but I did not pause to inquire of any damage.

M. St. L. Simon.

4, *Stanmore Hall, Stanmore, Middlesex, January* 11*th*, 1935.

Sun Pillar seen from Linlithgow

This morning, around 9h., I observed that somewhat rare phenomenon—a sun pillar. At least 9/10 of the sky was unclouded at the time—a small amount of strato-cumulus being to the left of the sun pillar. The ground was snow-covered and frozen and the haze on the horizon gave the phenomenon a reddish-orange tint.

William G. Gray.

27, *Philip Avenue, Linlithgow. January* 8*th*, 1935.

The Christmas Storm

I have heard it said that the last week of the old year is sure to give a storm. While visiting Grayshott, on the Surrey border, recently I experienced what, according to the saying, would be the 1934 Christmas storm, and it occurred to me to investigate the matter in the records of the station there. " A storm " was assumed to be an occasion on which the wind force rose to " high," approximately Beaufort force 7, accompanied by appreciable precipitation. As the Beaufort scale of wind was not employed at Grayshott prior to 1912, the years studied were from 1912–34 (23 years). Of these, only four, 1917, 1926, 1931, 1933 failed to give an occasion of "storm" during the last week of the year (December 25th to January 1st).

Gales and high winds at this time of year often spring up in the night hours, and the precipitation associated with them may occur on both sides of the succeeding morning observation hour. In some cases below the rainfall amounts for two days have been added when this has been the case.

TABLE I

(a) *Wind high, moderate rain*	(b) *Gale and heavy rain*	(c) *Gale and very heavy rain*
1912	1914	1915
1913	1922	1919
1916	1925	1924
1918	1927	
1920	1929	
1921	1934	
1923		
1928		
1930		
1932		
(10 years)	(6 years)	(3 years)

In Table I the years of storm have been grouped into (*a*) occasions of wind high and moderate rainfall (in no case has an occasion been counted as a storm if the associated rainfall has not exceeded 0·20 in.); (*b*) occasions of gale with heavy rain (rainfall associated with the gale, and measured between 9h. and 9h. between the limits 0·68 in. and 0·90 in.); (*c*) gale and very heavy rain (rainfall between 9h. and 9h. 0·90 in. or more).

The table is very simple owing to the fact that during the storms the strongest winds seem to have accompanied the heaviest rain.

Going back in the records further than 1912 the Christmas storm seems still evident, although the wind records are indefinite. For instance, in 1897 the observer wrote "one of the biggest storms of the year." The storm has usually been in a mild period, but on some occasions the precipitation has taken the solid form, particularly in 1906, 1908 and the memorable blizzard of 1927.

Perhaps the information given above merely reveals occurrences taking place according to the laws of probability; it has not been possible for me to calculate the probability of a "storm" occurring during the final week of the year, but the fact that only four years in twenty-three failed to provide a storm seems to indicate that, in the part of south-east England considered, the Christmas storm is a fairly regular occurrence.

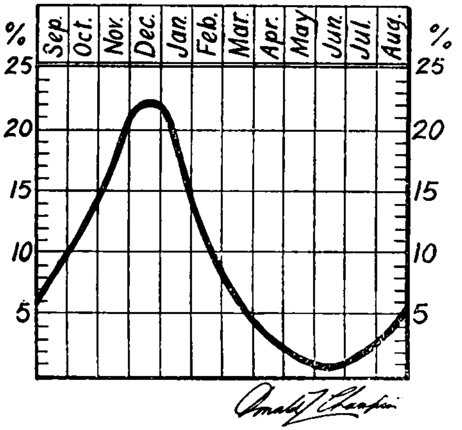
S. E. Ashmore.

19, Vicarage Road, Handsworth, Birmingham, 19, January 14th, 1935.

High Frequency of Calms in Winter

Based on observations of wind taken at Waltham Cross, Herts, during the ten years ending December 31st, 1934, there is a remarkably rhythmic distribution of calms throughout the year. In the attached diagram it will be seen that the percentage frequency of calms rises smoothly from a minimum of 0·8 per cent. in June to a maximum of 22·0 per cent. in December, the subsequent fall being as smooth as the rise.

At first sight it seems peculiar that the maximum frequency should occur during the winter quarter, but I have noticed that during this period the barometric gradient in England, south-east of the Chiltern Hills, is frequently influenced by continental anticyclonic systems, when the rest of the British Isles are suffering from high winds or gales associated with Icelandic depressions and this may account for the observed high frequency of calms.



MEAN FREQUENCY
winter 14·4 %, summer 3·4 %, annual 8·9 %

It would be interesting to know if the high frequency of calms in winter is experienced at other stations in south-east England, or if it is peculiar to the lower Lea Valley in which Waltham Cross is almost centrally situated.

DONALD L. CHAMPION.

7, Robinson Avenue, Goff's Oak, Waltham Cross, Herts., January 19th, 1935.

December, 1933, and December, 1934, at Guernsey

A remarkable occurrence in the weather of December, 1933 and December, 1934, at Guernsey is I think, worthy of notice.

December, 1933, was the coldest month of the name in forty years of observation at this station ; every day was colder than the normal and the month as a whole (mean 39·8° F.), 5·8° F. below the forty years' average, viz., 45·6° F. This long cold spell began on November 24th and ended on January 2nd, 1934. In rainfall the month's precipitation, 2·30 in., was 1·84 in. below the average, and the station recorded the first " absolute " December drought of the four decades, no rain being measured for 17 days, viz., from the 8th to the 24th.

On the other hand, and by a really extraordinary happening, as it seems to me, December, 1934, was the mildest December on record (41 years). Every one of its 31 days was warmer than the normal and its mean temperature, 50·3° F., 4·7° in excess of the average. The month as a whole was 10·5° warmer than December, 1933. The mild spell began on December 1st and ended on January 5th. Another record has to be credited to December, 1934. It was the wettest December of 1894–1934 (41 years). Its total precipitation, 8·74 in., was 4·60 in. in excess of the average fall, which is 4·14 in.

One further remark with reference to December, 1933. Despite the fact of the month being very decidedly the coldest December in forty years of observation here, no really severe weather was experienced, and practically no frost. In proof of this, no temperature below 31·2° F. was recorded in the screen at Les Blanches, and the mean of the coldest day, the 12th, was as high as 34·3° F.—a low mean, certainly, for Guernsey in December but, taking the month's unprecedented depressed mean into consideration, nothing outstanding.

BASIL T. ROWSWELL.

Les Blanches, St. Martin's, Guernsey, January 30*th*, 1935.

The December Rains in southern England

The heavy rainfall of December, 1934, in the hilly counties south of the Thames was highly typical both as regards intensity and distribution of very wet winter months, and marked a feature of our climate which deserves comment. Apparently every county bordering on the Channel from Cornwall to Kent had between 5 and 10 inches of rain in December as a minimum, large tracts of country in the Downs of Sussex, Hampshire, Wiltshire and Dorset had between 10 and 20 inches, and small areas on the flanks of Dartmoor the colossal quantity of between 20 and 30 inches. To the lee of these southern ranges, on the contrary, London and Oxford had round about 5 inches, and Cambridge with numerous other East Anglian and Midland places only about 3 inches.

We may recall that this very wet area which barely had a single slight frost in December, 1934, lay for two or three weeks under snow in December, 1933—especially the south-western districts. Indeed the two Decembers had little in common but dark dank days.

L. C. W. BONACINA.

35, *Parliament Hill, London, N.W.*3. *January* 22*nd*, 1935.

Drizzle Falling from a Clear Sky

A remarkable case of drizzle falling without cloud occurred at Benson, Oxfordshire, on Sunday morning, January 20th, 1935. At 9.20 a.m. drizzle was observed, and as the sun was shining brightly the state of the sky was carefully studied. No cloud was visible although the blue of the sky was somewhat pale and watery, an effect which may well have been produced by the drizzle itself. The drizzle continued for ten minutes and during this period some cloud formed though it was not overhead and did not appear to be the source of the drizzle. Some idea of the intensity of the precipitation can be formed by the fact that after its cessation a paving stone in the ground appeared moist and the sloping glass roof of a verandah was thickly covered with water particles. These, however, did not coalesce and run down the glass. The sun shining on the drizzle formed a rainbow though not of any particular brilliance. The cloud which began to form was probably of fracto-stratus type, though it was extremely difficult to form any idea as to its height above the ground. It continued to develop rapidly and three-quarters of an hour later the whole sky was heavily overcast and further drizzle occurred. As the first drizzle was unconnected with cloud it seems by no means improbable that this later drizzle may also have formed in clear air in the region between the cloud and the ground and the question naturally arises whether precipitation (rain or drizzle) may not be formed in clear air without passing through the initial form of cloud particles more frequently than is commonly supposed. It may be added that the conditions prevailing at Benson on the morning of January 20th were markedly anticyclonic. At ground level there was a calm though the clouds showed a light north-easterly wind above, the air temperature was 40° F. at the time and pressure approximately 1,040 millibars.

J. S. DINES.

January 21st, 1935.

Praktische Orkankunde

I thank you heartily for reviewing my book "Praktische Orkankunde," in the *Meteorological Magazine.* The reviewer errs in only one point.

> Crossley says (p. 245, November, 1934) :—" . . . . The author accepts Meldrum's statement that a large number of cyclones . . . . are stationary, but this view has not found much favour with recent writers . . . . In this connexion he quotes a statement by R. A. Watson, who gives the average life of a cyclone as 4½ days, but this appears to be a misunderstanding, for Watson's figure refers only to the existence of cyclones within certain limits, viz. . . . ."

The misunderstanding here is Crossley's, for he has apparently overlooked my sentence referring to Meldrum's stationary cyclones. Page 59 (translated) :—" The latter would be those whose progress is hindered by movements of anticyclones, as happens for example in West Indian hurricanes." In this sentence, I depart from Meldrum's statement and agree with recent writers. My reference to Watson concerns the small area of ocean which can be surveyed from Mauritius and which was mentioned a little earlier.

L. SCHUBART.

Rahlstadt, Friedrichstrasse 28, *December 2nd,* 1935.

Blue-green Moon in Calcutta

This, as reported in your September issue, strongly suggests association with those seen after the Krakatoa eruption in 1883. Writing from York on December 3rd, 1883 to *Nature* (December 6th, p. 131), I quoted from a letter of November 26th by my father, still a keen observer, although over 70:—" A wide arc above the sunset was lit up with the most glorious pink shade. But the most remarkable of all was a longish cloud, to north of sunset and above and beyond the circle of pink, that was a bright sage-green. I never before saw such a colour in any cloud." The previous day I had recorded that from 2.45 to 3 p.m. " the clear sky from 10° to 25° or 30° from the sun (i.e., Bishop's Ring) was of a delicate rose pink. It gave a greenish-gray cast to cirro-cumuli through which it was seen."

Here we seem to have two distinct phenomena: after sunset a sage-green cloud beyond the rose-tinted sky, very lofty and not due to contrast and at a lower level an obvious contrast effect. The former, one associates with the " green moon " first recorded by me on December 3rd and 4th, 1883, from York and Street, as " blue-green " and at Eastbourne as blue, after a reference to green suns seen in September at Madras and further suggesting as cause Krakatoa impalpable dust at a great height.

In the possible absence of an eruption this year the green moon at Madras may perhaps be due to the recent abnormal dust storms. Symons' *Meteorological Magazine* of December, 1883, refers to a blue sun seen in Bermuda after the Barbadoes eruption of 1831.

J. EDMUND CLARK.

Street, Somerset. September 24th, 1934.

Weather Diary, 1808-1875

Mr. Richard Cooke, of The Croft, Detling, Maidstone, has kindly sent us extracts from and a summary of a weather diary kept by Henry Cox, the manuscript of which is at Wye College. The period covered by the diary is 1808 to 1875 and it is described as a " Journal of Natural Appearances and Occurrences in Farming, with occasional remarks on the weather, etc., made at Farningham, near Dartford, Kent, until Michaelmas, 1817; and since at Trevereux, near Limpsfield, Surrey." The extracts and summary have been deposited in the Library of the Meteorological Office.

Cloud formed by an Aeroplane

The cloud formation described below was produced by an aeroplane, and remained visible between 10h. 35m. and 11h. 10m. on November 8th, 1934. The cloud commenced to form from east to west at about 10h. 35m. in a thin, slightly curved horizontal band parallel to the horizon, then rose vertically forming an angle of nearly 90°. This vertical band was narrow when formed but after a time it widened and became more diffuse. By 10h. 50m. it has fallen over to the left towards the horizontal band, which maintained its position unchanged all the time the phenomenon remained visible. By 11h. the cloud had fallen over sufficiently to come within a suitable position near the sun for a prismatic but ill-defined parhelion to form. From this fact it was obvious that the cloud consisted of ice crystals and was not exhaust-smoke from the aeroplane. After 11h. the cloud became more diffuse as already mentioned, and was then commencing to break up. The point at which the horizontal band joined the vertical one was apparently connected to a dense patch of cirro-cumulus which expanded and became broken into detached cloudlets, a faint line being traceable through it to the right from the point at which the two bands joined each other. The vertical band was densest at its edges, but the thinner horizontal one was uniform throughout; both were pure white, cirriform in appearance and at a considerable height.

The position of the cloud was west-south-west from the observation point, and at an altitude of about 45° from the horizon.

Soon after 11h. a mass of strato-cumulus advanced rapidly and at 11h. 25m. slight showers developed. Meteorological conditions on the ground at the time were quiet with a light (force 3) south-west wind following a west-north-west wind of force 1 early; frost occurred early in the morning but temperature after 7h. rose rather quickly. As the day advanced the wind increased considerably and after 16h. heavy rain set in; between this time and 18h. over half an inch fell, while from 18h. to 7h. on the 9th 1.54 in. occurred, the total for the 8th being 2·12 in. The 9th was very unsettled with a gale. The high clouds just described were travelling very slowly from west-north-west, while the strato-cumulus moved quickly from west-south-west.

The aeroplane which caused this cloud development was manœuvring at a great height. At 10h. 50m. two others passed almost overhead travelling towards the north-west, also at a considerable height and were difficult to locate although the atmosphere below the high cloud was clear; these two machines did not produce any trace of cloud development.

A. E. MOON.

39, *Clive Avenue, Clive Vale, Hastings, November 15th,* 1934.

NOTES AND QUERIES

Cumulus Cloud at Mount Batten

A very good example of cumulus cloud formation with a brilliantly white colouring is shown in the picture forming the frontispiece of this volume of the magazine taken at Mount Batten by the local Photographic Section of the R.A.F. at about 10h. 15m. G.M.T. on August 4th, 1934.

The weather map for 7h. of the 4th showed a depression off the west coast of Scotland with a shallow trough extending from it to Cornwall moving north-eastwards. During the early morning the wind was light north-easterly. The clouds began to form with the arrival of a supply of maritime polar air when the temperature here rose 11 degrees in a few hours and the humidity dropped from 90 per cent. at 7h. to 69 per cent. at 13h. Slight showers were observed to fall from scud cloud before and after the formation of the line of cloud but at no time was rain seen to fall from the line of cloud itself.

The clouds of the picture were part of a complex system which formed in a dead straight line about four miles long and running from west-south-west to east-north-east. The whole system moved east-north-east along this line and maintained faithfully its general structure until lost to sight the only change noted being the gradual fading of the cumulo-nimbus part with a typical anvil cirrus at the extreme westerly end of the line. The whole base of the clouds remained very definitely marked showing calm conditions and it was interesting to see the cauliflower heads with Pileus veils above on the left of the picture though at the time the picture was taken the view was rather obscured by some of the many patches of scud cloud.

M. J. THOMAS.

Aurora of December 29th, 1934

A display of the aurora seen in Scotland, Ireland and the south and west of England on the evening of December 29th, 1934, was described in the Daily Press and also by observers at some of the official stations of the Meteorological Office. Two independent descriptions from the neighbourhood of Oxford referred to an arch of light, the upper part of which faded for a time. Rays running up to the zenith were described by Lt. Col. A. Lloyd, Dryslwyn, Carmarthenshire, and rays like distant searchlight beams shooting out above the arched bank by Commander K. B. M. Churchill, Muston Manor, Dorchester. A more precise description by Mr. R. A. Hamilton, of 7, Worcester Crescent, Bristol, of the phenomenon as seen from Bristol, gave the positions of the regions of contact of the arc with the horizon as 29° and 69° west of north, the maximum elevation of the base as 4° and the width of the band as 3°. The star η Ursae Majoris (the "handle" of the "Plough") was seen to be shining through the band, which appeared pale green. Most of these observations were made between about 6.50 p.m. and 7.15 p.m.

At Aldergrove (Co. Antrim), the description was of a broad arc reaching an altitude of about 15° seen between 10 p.m. and

10.40 p.m., during which time it diminished in intensity. Accounts of luminous patches, resembling the high type of luminous night cloud studied in recent years by Prof. Carl Störmer, that were received from Worthy Down (near Winchester) and Aldergrove (Co. Antrim) presumably refer to the aurora, unless it can be supposed that two phenomena of such a different nature happened to appear simultaneously—an unlikely coincidence seeing that the luminous night clouds are rare, and the aurora very rare as far south as Winchester.

The Highest Recorded Wind Velocity

On Mount Washington in New Hampshire very high wind speeds are sometimes experienced. In order to obtain records of these high winds the Meteorological Observatory of Harvard University, which is situated on the summit 6,284 ft. above sea level, has been equipped with a new type of anemometer; this anemometer is rugged in construction to withstand the mechanical strain of the high winds and its cups (or fins) are electrically heated in order to prevent the accumulation of rime on the rotor. Last April a good record of a very high wind was obtained; a reproduction of the record and an account of the storm are given in the *Monthly Weather Review*.*

The high wind occurred in association with an intense depression which was centred over the Great Lakes on the morning of April 10th and, moving south-eastward, was centred over Connecticut on the 12th. On Mount Washington pressure fell slowly from the afternoon of the 11th until 6 a.m. on the 12th, when it fell rapidly until the minimum of 22·82 in. (772·8 mb.) was reached at 12.45 p.m. By the morning of the 11th the wind, which was SE., had reached a velocity of 80 m.p.h., it increased steadily and during the following night the hourly movement was never less than 107 miles. On the morning of the 12th the wind speed increased rapidly and by noon it had reached 155 m.p.h. with gusts of over 200 m.p.h. The maximum speed occurred between 12 noon and 1 p.m.; during this hour the wind covered 173 miles. The highest gusts were timed by two observers with stop watches for the time taken for $\frac{1}{10}$ mile; S. Pagliuca gives the highest of these as 231 m.p.h. but C. F. Marvin† who discusses the calibration of the instrument gives the highest as probably 225 m.p.h. For a 5-minute period Marvin gives the greatest average velocity as about 200 m.p.h. The maximum 24-hour movement was from 4 p.m. on April 11th to 4 p.m. on April 12th with a total of 3,095 miles or an average of 129 m.p.h.

Pagliuca states that no serious difficulty was experienced by the

* The great wind of April 11–12, 1934, on Mt. Washington, N.H. and its measurement. Part I by S. Pagliuca. *Washington Mon. Weath. Rev.* 62, 1934, pp. 186–9.

† Ibid. Part III, by C. F. Marvin. pp. 191–5.

observers in attending to their necessary outdoor duties. He points out that at the height of Mount Washington the force of the wind is reduced by about $\frac{1}{5}$ of its value at sea level, and that on the rough rocky surface the velocity would be less than in the free air where the anemometer was exposed; but he also thinks that experienced men can adapt themselves to the impact of the wind. Only slight damage occurred, chiefly to the exposed instruments. The telephone line to the base station was undamaged. The building shook considerably but the covering of rough frost on the roof and on the exposed side increased the rigidity of the structure.

BOOKS RECEIVED

Records of the Far East Geophysical Institute, No. 11 (ix). U.S.S.R. Hydrometeorological Committee of the R.S.F.S.R., Vladivostok, 1932.

Weather types associated with Nor'westers in Bengal. By V. V. Sohoni. J. and Proc., Asiatic Soc. Bengal (New Series), Vol. xxviii, 1932, No. 1.

NEWS IN BRIEF

On his election as a member of the Chamber of Deputies, Commandant A. de F. Morna has retired temporarily from the Directorship of the Portugal Marine Meteorological Service for the period of this Parliament. Lieut. José de Castro e Sousa will take his place during this time.

Erratum

JANUARY, 1935, p. 295 *for* "3·26 in., 2·36 in. and 2·33 in. at Fofanny (Co. Down) on the 4th, 14th and 25th, respectively" *read* "2·33 in., 2·36 in. and 3·26 in. at Fofanny (Co. Down), on the 4th, 14th and 25th respectively."

The Weather of January, 1935

Pressure was above normal over western Asia except for the extreme north-west, over Europe except for the north-east, the south-east, southern Italy and Spitsbergen, over the North Atlantic as far south as latitude 35° and over North America except for some of the western States, the greatest excesses being 15·5 mb. at lat. 50° N., long. 30° W. and 5·6 mb. at lat. 60° N., long. 110° W., while the greatest deficits were 4·2 mb. at Brindisi and 4·1 mb. at Waigatz. In Sweden temperature and precipitation were above normal in Norrland but about or below normal elsewhere.

The outstanding features of the weather of the British Isles during January were the lack of rainfall, except in the eastern districts and the wintry conditions prevailing from the 26th–28th. In many places the rainfall was less than half the normal and Valentia reported the driest January since records began in 1866. Warm westerly winds prevailed during the first days of the month and temperature was unusually high reaching 55° F. at many places, even in Scotland. Rain occurred generally on the 1st and mist or fog was experienced from the 1st to 3rd. After the 3rd temperature fell slowly as a depression moved south-eastwards from Iceland giving north-westerly winds over the country. Rain was generally slight during this period and some good sunshine amounts were recorded on the 4th and 6th, notably 7·2 hrs. at Plymouth and 6·6 hrs. at Blackpool on the 6th. Between the 7th and 9th sharp frosts were experienced, 15° F. on the ground at Auchincruive (Ayr) on the 8th and 16° F. at Rothamsted on the 9th, and snow or sleet fell in many parts of Scotland and eastern England. Mist or fog were recorded locally. With the approach of a depression from Iceland on the 9th, the weather became milder temporarily and rainfall was general on the 10th and 11th with heavy rain in the Isle of Wight. On the 11th S. gales veering W. were experienced in Scotland, Ireland and west England, Stornoway reported force 10 at 7h. and Pembroke force 10 at 13h. on the 11th. Thunderstorms occurred locally on the same day. and snow fell in North Ireland and Scotland. The 12th was a sunny day in most parts with moderating north-westerly winds and local snow or sleet showers, 7·3 hrs. bright sunshine occurred at Calshot and Bournemouth. From then onwards an anticyclone gradually approached our south-west coasts, spread over southern England and moved northwards being centred over Scotland from the 18th to 20th, after which it withdrew south-west. After the 13th when snow was still being experienced in the north the winds backed and conditions became mild and rainy at first gradually changing later to colder and drier weather. Good sunshine records were obtained on parts of the south coast on the 15th and 18th, 7·6 hrs. at Weymouth on the 18th, but fog was experienced generally on several days. The approach of a depression from Iceland on the 22nd brought a gradual rise of temperature and many maxima above 50° F. were registered on the 23rd and 24th, 53° F. at Nairn on the 24th, and rain occurred generally on the 24th. From the 24th to 26th a deep depression moving from Iceland to Scandinavia caused strong W. winds and gales veering to N. on the 25th and 26th, force 9 was recorded at many exposed places in the north-east on the 25th, while gusts of 87 m.p.h. occurred at South Shields on the 25th and 26th and of 86 m.p.h. at Liverpool on the 25th. Temperature dropped considerably and snow fell in the north on the 25th and also in the south on the 26th (Hampstead had 4½ in.). Further snow fell in the eastern districts on the 27th and 28th, but temperature was rising in the west. Thunderstorms occurred locally in north England on the 25th–27th. On the 29th and 30th mainly cloudy conditions prevailed with local fog in the Midlands and eastern districts and drizzle in the west. On the 31st moderate rain fell in the extreme north but elsewhere the weather was bright and sunny with a moderate temperature, Leuchars had 7·7 hrs. bright sunshine. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	23	− 4	Liverpool ...	48	− 4
Aberdeen ...	37	− 7	Ross-on-Wye ...	53	+ 1
Dublin	49	− 5	Falmouth ...	50	− 9
Birr Castle ...	33	−15	Gorleston ...	49	− 6
Valentia... ...	37	− 5	Kew	45	+ 1

Miscellaneous notes on weather abroad culled from various sources. Conditions for winter sports were good generally in Switzerland and Austria throughout the month. About the 8th the arctic regions of Russia experienced high temperatures for the time of year and after that date severe cold was felt from southern Russia to France and Italy; snow occurred on the Riviera on the 9th, but soon melted. Very heavy snow occurred in Yugo-slavia and Montenegro from about the 6th, parts of Serbia and Montenegro being quite cut off from the outer world. Snow and frost occurred in Naples on the 21st, and in Rome on the 22nd, while heavy falls of snow also occurred at Cagliari (Sardinia). Stormy weather accompanied by snow was experienced over north and west France on the 26th to 28th. On the 31st owing to heavy rain and snow the rivers Tunja and Maritza overflowed their banks in Thrace and washed away the railway near Adrianople. (*The Times*, January 5th–February 2nd).

A break occurred in the drought at Colombo about the 10th. Extreme cold was experienced in north-west and central India from about the 14th to 20th, temperatures below freezing-point being registered in the plains even at Delhi and Naushabro (Sind), while frost damaged the crops in various districts. The passes into Afghanistan were under snow. (*The Times*, January 11th–21st.)

Snow fell on the Tangier hills and there were also heavy falls of snow in the Grand Atlas near the end of the month. (*The Times*, February 1st.)

One of the worst storms ever experienced occurred near Darwin (Western Australia) about the 16th. Moderate to heavy rain fell in New South Wales about the middle of the month and in Queensland especially the Peninsula towards the end. (*The Times*, January 18th and *Rainfall in Australia, 3-day reports.*)

After a week of bitter cold there was an 18-inch snowfall in Vancouver on the 20th followed by incessant rain with strong winds until the 26th, 13 inches fell in 6 days. Floods were experienced generally in the coastal regions of British Columbia—all communications with Vancouver were cut off—while the interior and mountain districts suffered heavy snowstorms. Temperature was above normal during the first fortnight but later a cold spell began in the north-west States and from the 22nd onwards all Canada and the Middle and eastern United States suffered from intense cold and blizzards accompanied by severe gales in the eastern States on the 23rd–24th. Floods were reported from several parts of the country especially in the north-west and the valley of the Mississippi. Many people were drowned or died from the cold. In the western States the temperature was high at the end of the month. Snow was experienced even as far south as Florida. Precipitation was below normal generally except for the third week. (*The Times*, January 24th–28th and *Washington D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Severe storms were experienced to the west of Iceland about the 25th and 26th. (*The Times*, January 26th.)

Daily Readings at Kew Observatory, January, 1935

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see p. 1).
	mb.		°F	°F	%	in.	hrs.	
1	1020·2	WSW.2	47	53	91	0·08	0·0	r_0r 5h.–8h. & 8h.–10h.
2	1028·8	NW.2	51	54	87	0·06	0·0	frr_0 early.
3	1032·2	WNW.3	51	51	87	—	0·0	
4	1022·7	NW.4	45	48	66	—	6·0	
5	1019·1	NW.3	39	44	60	—	1·0	
6	1013·4	N.3	34	42	76	0·01	0·7	pr_0 9h., r_0 23h.–24h.
7	1017·6	N.3	34	38	85	0·01	1·4	r_0 3h., 15h. & 16h.
8	1024·4	NE.2	35	38	85	—	0·0	f 14h.–17h.
9	1029·8	CALM	27	35	92	—	0·0	Fx till 17h., f 18h.
10	1032·3	SSW.3	34	44	81	—	0·6	w late.
11	1020·4	SW.4	37	46	80	0·21	0·4	r_0 5h., 9h.; R 18h.
12	1011·0	NW.5	36	39	69	—	4·1	x late.
13	1014·2	W.1	32	41	82	0·08	1·4	r_0r 18h.–24h.
14	1018·1	NW.4	39	53	70	0·01	1·3	r_0 1h.–3h.
15	1032·6	W.2	43	51	82	—	4·5	w early; m. 21h.
16	1036·8	NW.2	43	48	78	—	0·0	F 19h.–24h.
17	1036·4	NNE.3	37	46	79	—	0·5	w early.
18	1037·9	ENE.4	42	45	69	trace	0·1	r_0 0h.–3h.
19	1037·9	NE.3	42	43	78	—	0·0	z 15h.
20	1039·2	NNE.2	39	43	80	—	0·9	z 13h.
21	1038·4	N.3	42	43	90	0·01	0·0	r_0 23h.–24h.
22	1036·2	NNE.3	39	48	71	trace	0·0	pr_0 6h.; f 21h.
23	1033·7	W.2	37	46	77	—	1·9	mw early.
24	1024·7	WSW.2	38	47	88	0·04	0·0	r_0 10h.–13h. & 15h.
25	992·3	W.4	44	50	81	0·24	0·5	s 21h.–22h.
26	999·9	NNW.5	34	42	54	0·08	0·2	rs 16h.–19h.; s 24h.
27	1018·4	NNW.4	32	38	68	0·03	5·0	s 0h.–2h.; rs 20h.
28	1026·5	N.3	29	38	64	—	6·7	x 7h.; f. 21h.
29	1026·1	NE.1	28	39	61	—	2·2	f till 13h.
30	1021·9	SW.2	33	42	90	—	0·6	f till 12h.
31	1021·7	NW.3	40	46	61	0·03	4·8	rr_0 0h.–4h.
*	1024·7		38	45	77	0·89	1·4	*Means or totals.

General Rainfall for January, 1935.

England and Wales ...	65	per cent. of the average 1881–1915.
Scotland	81	
Ireland	45	
British Isles	65	

Rainfall : January, 1935 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square.........	1·09	59	*Leics* .	Thornton Reservoir ...	1·12	57
Sur .	Reigate, Wray Pk. Rd..	1·38	57	,, .	Belvoir Castle...........	1·60	90
Kent .	Tenterden, Ashenden...	...	...	*Rut* .	Ridlington	1·22	66
,, .	Folkestone, Boro. San.	2·33	...	*Lincs* .	Boston, Skirbeck.........	2·41	149
,, .	Eden'bdg., Falconhurst	1·16	47	,, .	Cranwell Aerodrome...	2·21	128
,, .	Sevenoaks, Speldhurst.	·88	...	,, .	Skegness, Marine Gdns.	2·13	123
Sus .	Compton, Compton Ho.	·97	30	,, .	Louth, Westgate.........	2·21	102
,, .	Patching Farm..........	·88	34	,, .	Brigg, Wrawby St.......	2·02	...
,, .	Eastbourne, Wil. Sq....	·88	33	*Notts* .	Worksop, Hodsock......	1·68	95
,, .	Heathfield, Barklye....	·93	34	*Derby*.	Derby, L. M. & S. Rly.	·76	38
Hants.	Ventnor, Roy.Nat.Hos.	1·56	61	,, .	Buxton, Terr. Slopes...	3·84	86
,, .	Fordingbridge, Oaklnds	·76	28	*Ches* .	Runcorn, Weston Pt....	1·44	61
,, .	Ovington Rectory.......	·86	32	*Lancs*.	Manchester, Whit. Pk.	2·07	82
,, .	Sherborne St. John......	·51	22	,, .	Stonyhurst College......	3·21	75
Herts .	Welwyn Garden City ...	...	...	,, .	Southport, Bedford Pk.	1·80	71
Bucks.	Slough, Upton............	·81	44	,, .	Lancaster, Greg Obsy.	1·76	50
,, .	H. Wycombe, Flackwell	·82	38	*Yorks*.	Wath-upon-Dearne......	1·12	59
Oxf .	Oxford, Mag. College...	·59	34	,, .	Wakefield,Clarence Pk.	1·11	58
Nor .	Pitsford, Sedgebrook...	...	...	,, .	Oughtershaw Hall.......	2·67	...
,, .	Oundle	·57	...	,, .	Wetherby, Ribston H..	2·14	104
Beds .	Woburn, Exptl. Farm...	·77	45	,, .	Hull, Pearson Park......	1·85	103
Cam .	Cambridge, Bot. Gdns.	2·23	149	,, .	Holme-on-Spalding......	2·18	115
Essex .	Chelmsford, County Lab	1·69	110	,, .	West Witton, Ivy Ho.	1·55	49
,, .	Lexden Hill House......	2·36	...	,, .	Felixkirk, Mt. St. John.	2·80	140
Suff .	Haughley House.........	2·28	...	,, .	York, Museum Gdns....	1·93	109
,, .	Campsea Ashe............	2·49	137	,, .	Pickering, Hungate......	3·28	157
,, .	Lowestoft Sec. School...	2·49	149	,, .	Scarborough..............	2·38	119
,, .	Bury St. Ed., WestleyH.	2·61	146	,, .	Middlesbrough............	2·12	132
Norf. .	Wells, Holkham Hall...	1·99	137	,, .	Baldersdale, Hury Res.	...	...
Wilts .	Calne, Castleway.........	·68	30	*Durh* .	Ushaw College............	2·58	126
,, .	Porton, W.D. Exp'l. Stn	·52	23	*Nor* .	Newcastle, Town Moor.	2·71	133
Dor .	Evershot, Melbury Ho.	·80	23	,, .	Bellingham, Highgreen	1·97	69
,, .	Weymouth, Westham.	·61	25	,, .	Lilburn Tower Gdns....	1·67	81
,, .	Shaftesbury,Abbey Ho.	·92	35	*Cumb*.	Carlisle, Scaleby Hall...	1·52	61
Devon.	Plymouth, The Hoe....	·71	21	,, .	Borrowdale, Seathwaite	13·00	103
,, .	Holne, Church Pk. Cott.	1·47	24	,, .	Borrowdale, Moraine...	4·26	42
,, .	Teignmouth, Den Gdns.	·50	17	,, .	Keswick, High Hill......	3·17	63
,, .	Cullompton	·84	26	*West* .	Appleby, Castle Bank...	2·22	69
,, .	Sidmouth, U.D.C........	·47	...	*Mon* .	Abergavenny, Larchf'd	·91	27
,, .	Barnstaple, N. Dev.Ath	1·14	35	*Glam* .	Ystalyfera, Wern Ho....	2·18	34
,, .	Dartm'r,Cranmere Pool	3·10	...	,, .	Cardiff, Ely P. Stn.......	·89	24
,, .	Okehampton, Uplands.	1·43	28	,, .	Treherbert, Tynywaun.	2·53	...
Corn .	Redruth, Trewirgie......	1·60	38	*Carm* .	Carmarthen, Priory St..	1·65	38
,, .	Penzance, Morrab Gdn.	1·89	50	*Pemb* .	Haverfordwest,Portfld.	1·49	...
,, .	St. Austell, Trevarna...	1·71	40	*Card* .	Aberystwyth	1·79	...
Soms .	Chewton Mendip.........	1·05	27	*Rad* .	BirmW.W.Tyrmynydd	3·15	50
,, .	Long Ashton............	1·07	37	*Mont* .	Lake Vyrnwy	2·50	44
,, .	Street, Millfield..........	·66	27	*Flint* .	Sealand Aerodrome......	1·44	73
Glos .	Blockley	·79	...	*Mer* .	Dolgelley, Bontddu......	4·12	72
,, .	Cirencester, Gwynfa....	·78	31	*Carn* .	Llandudno	1·42	59
Here .	Ross, Birchlea............	·77	32	,, .	Snowdon, L. Llydaw 9..	9·14	...
Salop .	Church Stretton.........	1·20	47	*Ang* .	Holyhead, Salt Island...	1·02	35
,, .	Shifnal, Hatton Grange	·99	51	,, .	Lligwy	2·44	...
Staffs .	Market Drayt'n, Old Sp.	1·06	48	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	·84	44		Douglas, Boro' Cem....	2·16	64
War .	Alcester, Ragley Hall...	·98	51	*Guernsey*			
,, .	Birminghm, Edgbaston	1·06	53		St. PeterP't.Grange Rd.	1·00	34

Rainfall: January, 1935: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig	Pt. William, Monreith.	1·75	54	*Suth*	Melvich	5·07	154
,,	New Luce School	3·65	90	,,	Loch More, Achfary	12·53	172
Kirk	Dalry, Glendarroch	2·49	45	*Caith*	Wick	3·57	145
,,	Carsphairn, Shiel	4·55	62	*Ork*	Deerness	4·86	141
Dumf.	Dumfries, Crichton, R.I.	1·41	47	*Shet*	Lerwick	3·48	82
,,	Eskdalemuir Obs.	3·22	60	*Cork*	Caheragh Rectory	·90	...
Roxb	Branxholm	1·53	56	,,	Dunmanway Rectory	1·14	18
Selk	Ettrick Manse	2·44	52	,,	Cork, University Coll.	·84	21
Peeb	West Linton	2·64	...	,,	Ballinacurra	·76	19
Berw	Marchmont House	1·81	80	,,	Mallow, Longueville	1·01	26
E.Lot	North Berwick Res.	·85	49	*Kerry*	Valentia Obsy	1·07	19
Midl	Edinburgh, Roy. Obs.	1·26	72	,,	Gearhameen	3·60	35
Lan	Auchtyfardle	1·83	...	,,	Darrynane Abbey	1·45	29
Ayr	Kilmarnock, Kay Pk.	2·71	...	*Wat*	Waterford, Gortmore	·63	17
,,	Girvan, Pinmore	3·49	74	*Tip*	Nenagh, Cas. Lough	1·71	43
Renf	Glasgow, Queen's Pk.	1·69	51	,,	Roscrea, Timoney Park	1·58	...
,,	Greenock, Prospect H.	3·25	48	,,	Cashel, Ballinamona	1·35	36
Bute	Rothesay, Ardencraig	3·50	...	*Lim*	Foynes, Coolnanes	1·57	41
,,	Dougarie Lodge	2·50	...	,,	Castleconnel Rec.	1·46	...
Arg	Ardgour House	10·52	...	*Clare*	Inagh, Mount Callan	3·02	...
,,	Glen Etive			,,	Broadford, Hurdlest'n.	1·35	...
,,	Oban	3·16	...	*Wexf*	Gorey, Courtown Ho.	·80	26
,,	Poltalloch	5·15	103	*Wick*	Rathnew, Clonmannon.	1·24	...
,,	Inveraray Castle	6·52	79	*Carl*	Hacketstown Rectory	1·39	39
,,	Islay, Eallabus	3·50	75	*Leix*	Blandsfort House	1·47	45
,,	Mull, Benmore	12·40	91	,,	Mountmellick	1·57	...
,,	Tiree	2·88	68	*Offaly*	Birr Castle	1·24	44
Kinr	Loch Leven Sluice	·72	23	*Dublin*	Dublin, FitzWm. Sq.	1·18	51
Perth	Loch Dhu			,,	Balbriggan, Ardgillan	1·02	45
,,	Balquhidder, Stronvar.		...	*Meath*	Beauparc, St. Cloud	1·65	...
,,	Crieff, Strathearn Hyd.	1·13	28	,,	Kells, Headfort	1·57	50
,,	Blair Castle Gardens	1·54	46	*W.M*	Moate, Coolatore	1·45	...
Angus	Kettins School	·93	35	,,	Mullingar, Belvedere	1·47	46
,,	Pearsie House	·81	...	*Long*	Castle Forbes Gdns.	1·57	47
,,	Montrose, Sunnyside	1·17	59	*Gal*	Galway, Grammar Sch.	...	...
Aber	Braemar, Bank	2·39	75	,,	Ballynahinch Castle	3·62	58
,,	Logie Coldstone Sch.	1·96	89	,,	Ahascragh, Clonbrock.	1·69	44
,,	Aberdeen, King's Coll.	1·72	79	*Mayo*	Blacksod Point	2·32	46
,,	Fyvie Castle	2·36	100	,,	Mallaranny	3·53	...
Moray	Gordon Castle	2·12	105	,,	Westport House	2·28	49
,,	Grantown-on-Spey			,,	Delphi Lodge	5·95	60
Nairn	Nairn	1·23	62	*Sligo*	Markree Obsy	3·54	91
Inv's	Ben Alder Lodge	3·83	...	*Cavan*	Crossdoney, Kevit Cas.	1·34	...
,,	Kingussie, The Birches.	2·57	...	*Ferm*	Enniskillen, Portora	1·62	...
,,	Inverness, Culduthel R.	1·89	...	*Arm*	Armagh Obsy	1·44	57
,,	Loch Quoich, Loan	12·65	...	*Down*	Fofanny Reservoir	1·39	...
,,	Glenquoich	13·86	101	,,	Seaforde	1·33	42
,,	Arisaig, Faire-na-Sguir.	4·77	...	,,	Donaghadee, C. Stn.	1·13	45
,,	Fort William, Glasdrum	6·81	...	,,	Banbridge, Milltown	1·35	60
,,	Skye, Dunvegan	5·78	...	*Antr*	Belfast, Cavehill Rd.	1·65	...
,,	Barra, Skallary	4·37	...	,,	Aldergrove Aerodrome.	1·20	44
R&C	Alness, Ardross Castle.	2·11	56	,,	Ballymena, Harryville.	2·13	57
,,	Ullapool	4·33	94	*Lon*	Garvagh, Moneydig	2·24	...
,,	Achnashellach	10·44	108	,,	Londonderry, Creggan.	3·32	92
,,	Stornoway	5·03	97	*Tyr*	Omagh, Edenfel	2·40	68
Suth	Lairg	5·11	156	*Don*	Malin Head	2·34	...
,,	Tongue	3·63	92	,,	Killybegs, Rockmount.	2·93	...

Climatological Table for the British Empire, August, 1934

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal.	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy	1012·9	− 2·4	79	43	70·0	53·8	61·9	+ 0·3	55·1	85	7·0	1·77	− 0·47	12	6·2	43
Gibraltar	1015·3	− 1·2	91	63	83·5	66·6	75·1	− 0·9	64·3	79	2·3	0·00	− 0·12	0	...	...
Malta	1014·4	− 0·4	89	69	84·5	72·7	78·6	− 0·5	73·7	82	2·2	0·00	− 0·14	0	11·5	85
St. Helena	1016·4	+ 0·5	65	54	60·6	55·3	57·9	+ 0·5	56·0	95	9·5	3·89	...	19	...	...
Freetown, Sierra Leone	1014·3	+ 1·6	87	64	82·2	72·3	77·3	− 0·6	74·8	91	9·5	47·63	+ 11·06	25	...	...
Lagos, Nigeria	1013·7	+ 0·7	87	70	82·9	75·0	78·9	+ 1·0	74·8	88	9·2	7·91	+ 5·27	15	4·2	34
Kaduna, Nigeria	1009·8	...	87	65	81·9	67·4	74·7	+ 0·8	70·8	91	9·6	13·94	+ 1·62	25	2·7	22
Zomba, Nyasaland	1016·8	0·0	81	48	76·7	58·1	67·4	+ 2·5	61·3	67	4·7	0·00	− 0·37	0	...	...
Salisbury, Rhodesia	1018·7	− 0·4	79	40	74·0	48·5	61·3	+ 1·1	52·7	51	1·8	0·01	− 0·05	1	8·5	74
Cape Town	1021·0	+ 0·7	74	39	62·4	48·0	55·2	− 0·4	49·3	89	5·8	3·35	− 0·02	13	...	...
Johannesburg	1019·8	+ 0·6	74	38	67·2	47·0	57·1	+ 2·7	45·6	48	2·0	0·82	+ 0·31	6	8·9	80
Mauritius	1022·5	+ 2·0	75	54	73·2	61·7	67·5	− 1·0	63·3	70	5·5	2·79	+ 0·44	22	7·8	68
Calcutta, Alipore Obsy.	1000·5	− 0·5	93	77	89·0	78·7	83·9	+ 0·7	79·8	91	7·8	14·10	+ 0·72	22*	...	...
Bombay	1005·3	− 0·6	86	74	84·0	76·2	80·1	− 0·7	76·7	89	9·1	14·07	− 0·38	25*	...	...
Madras	1005·7	+ 0·2	97	72	92·8	77·6	85·2	− 0·8	76·0	76	8·1	7·17	+ 2·63	8*	...	...
Colombo, Ceylon	1010·8	+ 1·5	86	73	84·9	77·0	80·9	− 0·3	77·2	80	7·0	1·46	− 1·78	15	6·8	55
Singapore	1010·0	+ 0·5	90	70	86·5	76·4	81·5	+ 0·4	77·3	81	7·8	5·95	− 2·00	14	5·8	48
Hongkong	1007·2	+ 2·4	91	73	84·9	76·9	80·9	− 1·2	78·3	87	7·2	24·36	+ 9·96	18	5·9	46
Sandakan	1009·8	...	92	73	88·5	75·8	82·1	+ 0·3	76·9	82	6·9	6·91	− 0·98	16	...	...
Sydney, N.S.W.	1016·6	− 1·6	73	41	63·2	48·3	55·7	+ 0·7	50·5	75	5·4	6·12	+ 3·15	16	5·8	54
Melbourne	1017·7	− 0·3	76	34	58·7	43·5	51·1	+ 0·1	46·9	77	6·4	1·97	+ 0·10	17	4·4	41
Adelaide	1018·6	− 0·7	73	40	62·0	46·5	54·3	+ 0·4	49·1	69	7·3	4·15	+ 1·62	19	4·7	44
Perth, W. Australia	1019·0	+ 0·1	76	40	65·5	48·5	57·0	+ 1·0	50·5	69	4·3	5·65	0·00	15	7·0	64
Coolgardie	1019·6	+ 0·3	74	37	65·2	44·9	55·1	+ 1·5	48·8	64	4·5	0·61	− 0·38	6	...	...
Brisbane	1018·6	− 0·6	77	41	70·1	51·0	60·5	+ 0·1	54·8	65	3·4	1·26	− 0·75	4	8·0	72
Hobart, Tasmania	1014·4	+ 1·0	67	36	56·4	42·5	49·5	+ 1·5	44·5	70	5·9	1·30	− 0·53	14	4·9	47
Wellington, N.Z.	1019·1	+ 4·0	59	32	53·1	42·9	48·0	− 0·6	45·7	83	6·8	5·15	+ 0·66	20	4·1	39
Suva, Fiji	1015·6	+ 1·4	86	64	79·6	70·0	74·8	+ 1·2	70·5	79	7·3	5·23	− 3·06	18	4·7	41
Apia, Samoa	1012·3	0·0	87	66	84·6	73·0	78·8	+ 1·0	73·7	73	4·6	1·10	− 2·53	9	...	...
Kingston, Jamaica	1014·4	+ 0·9	93	70	88·8	73·1	80·9	− 0·6	72·7	80	3·4	4·98	+ 1·43	6	6·0	47
Grenada, W.I.	...	...	88	70	85	71	78	− 1·7	72·0	78	4	12·37	+ 3·04	23	...	...
Toronto	1016·3	+ 0·9	89	45	75·5	55·5	65·5	− 1·7	58·3	71	4·4	1·01	− 1·68	9	9·0	64
Winnipeg	1014·7	+ 1·5	92	34	73·7	51·0	62·3	− 1·5	51·4	83	5·5	3·28	+ 1·12	9	7·6	52
St. John, N.B.	1015·3	0·0	75	49	67·8	53·0	60·4	− 0·2	56·7	81	5·8	3·31	− 0·55	11	7·8	55
Victoria, B.C.	1017·6	+ 0·7	81	50	67·9	53·1	60·5	+ 0·8	56·0	78	3·8	0·65	+ 0·01	5	10·3	72

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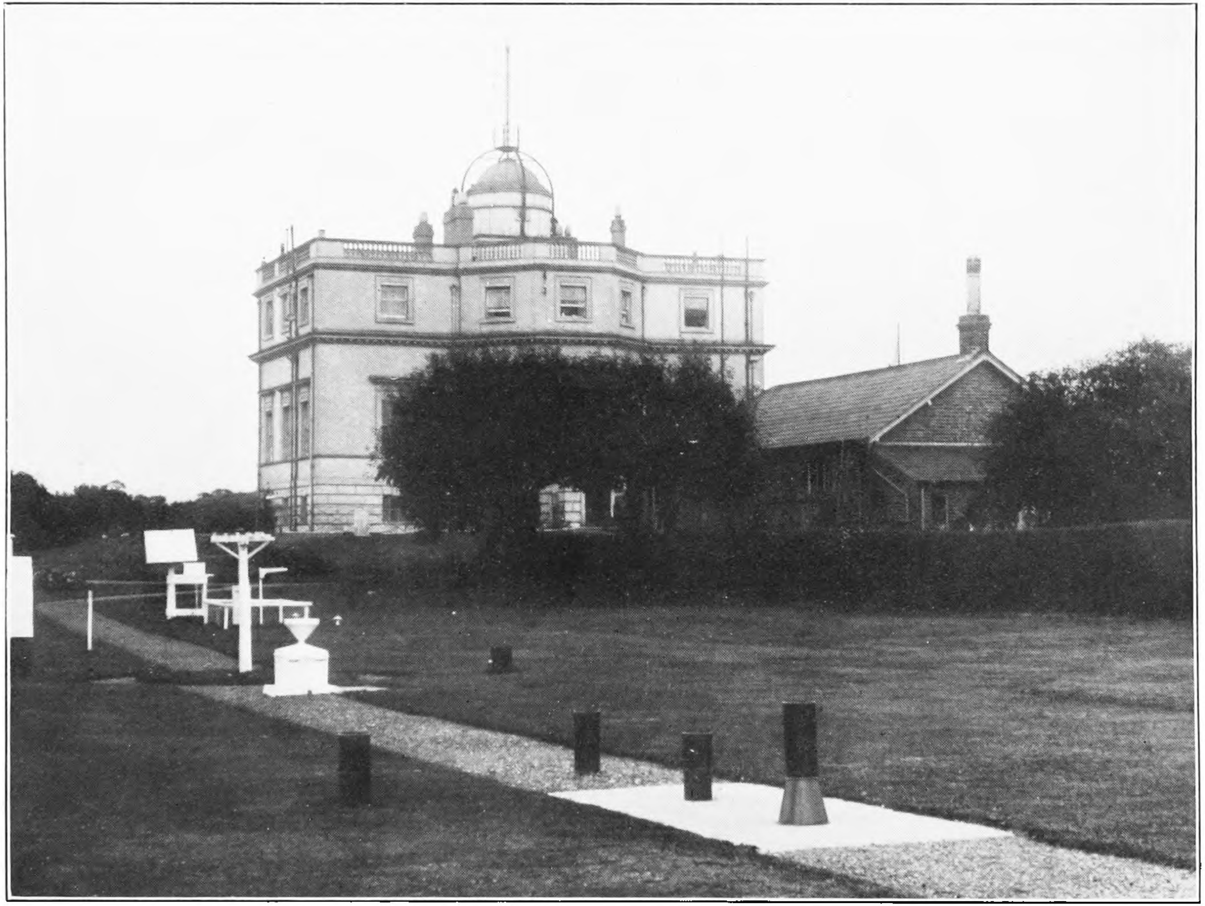

EXPOSURE OF 5 IN. RAIN-GAUGES DURING COMPARISON. BECKLEY GAUGE AND 8 IN. STANDARD GAUGE IN BACKGROUND (*see* p. 32).

M.O. 381.

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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, 25*s*. 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 anticyclones ".

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 momemtum 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.

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

Month \ Gauge	A.	B–A.	C–A.	D–A.
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

Day of Reading \ Gauge	A.	B–A.	C–A.	D–A.	Gauge / 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 :— No rain.	Rain up to 4 mm.	Rain over 4 mm.	Number of obs.
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. Convectional 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.

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 ε 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 9*d.*, 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	$r = -0{\cdot}181$
(*b*) Rainfall in March and Rain-days in April	$r = -0{\cdot}155$
(*c*) Rain-days in March and Rainfall in April	$r = -0{\cdot}335$
(*d*) Rain-days in March and Rain-days in April	$r = -0{\cdot}037$

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* 9*th*, 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

* 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 :—

	6h. G.M.T.		10h. G.M.T.	
Ft.	°	*m.p.h.*	°	*m.p.h.*
Surface.	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.

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 !

* 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° 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.

NOTES AND QUERIES

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.

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

* 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.

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

* 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° F.) was a small fraction of a degree lower than on April 12th, and the absolute maximum (30° 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° F. lower than at Duxford, compared with a mean difference of only 4° F. in May, 1933, and of 3° 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.

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.

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

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.

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 mp.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 occured 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 :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (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_0 13h.–15h.
2	1008·6	W.5	48	58	63	—	1·0	
3	1014·4	WSW.4	41	52	80	trace	0·1	r_0 16h. 30m. & 24h.
4	1014·0	NW.2	51	51	70	0·05	1·9	r–r_0 8h.–10h.
5	1012·6	WNW.4	40	49	60	0·09	6·2	r_0–r 22h.–24h.
6	1010·9	NE.6	37	43	74	0·07	0·0	rr_0 0h.–8h.
7	1028·0	NE.3	35	40	52	trace	3·0	ps_0 14h.
8	1026·2	NNE.4	32	37	63	trace	0·2	s_0 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_0 15h.
13	1002·0	SW.3	43	49	92	0·15	0·0	r–r_0 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_0 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_0 14h. 30m.
20	997·4	SSW.6	48	53	75	0·17	0·0	r_0–r 14h.–22h.
21	992·9	SW.5	47	50	56	0·04	6·3	r_0 2h., 21h. & 23h.
22	977·4	NNW.5	43	49	80	0·20	1·5	r_0r 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_0–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.
Lond .	Camden Square	2·20	121	*Leics* .	Thornton Reservoir	2·62	157
Sur .	Reigate, Wray Pk. Rd.	3·82	174	,, .	Belvoir Castle	2·15	129
Kent .	Tenterden, Ashenden	5·51	280	*Rut* .	Ridlington	1·98	121
,, .	Folkestone, Boro. San.	3·68	...	*Lincs* .	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
Sus .	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	*Notts* .	Worksop, Hodsock	2·52	164
,, .	Heathfield, Barklye	4·73	201	*Derby*.	Derby, L. M. & S. Rly.	2·22	137
Hants.	Ventnor, Roy.Nat.Hos.	3·47	165	,, .	Buxton, Terr. Slopes	7·53	200
,, .	Fordingbridge, Oaklnds	4·35	175	*Ches* .	Runcorn, Weston Pt	2·38	128
,, .	Ovington Rectory	5·30	204	*Lancs*.	Manchester, Whit. Pk.	3·03	158
,, .	Sherborne St. John	3·59	164	,, .	Stonyhurst College	7·56	226
Herts .	Royston, Therfield Rec.	2.04	132	,, .	Southport, Bedford Pk.	3·14	149
Bucks.	Slough, Upton	2·25	132	,, .	Lancaster, Greg Obsy.	5·36	185
,, .	H. Wycombe, Flackwell	2·44	126	*Yorks*.	Wath-upon-Dearne	2·45	149
Oxf .	Oxford, Mag. College	1·78	113	,, .	Wakefield, Clarence Pk.	2·01	118
Nor .	Pitsford, Sedgebrook	...	...	,, .	Oughtershaw Hall	13·64	...
,, .	Oundle	1·47	...	,, .	Wetherby, Ribston H.	...	...
Beds .	Woburn, Exptl. Farm	2·75	186	,, .	Hull, Pearson Park	2·97	179
Cam .	Cambridge, Bot. Gdns.	1.56	122	,, .	Holme-on-Spalding	2·30	137
Essex .	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
Suff .	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., WestleyH.	2·64	176	,, .	Middlesbrough	3·01	232
Norf. .	Wells, Holkham Hall	2·30	155	,, .	Baldersdale, Hury Res.	6.65	221
Wilts .	Calne, Castleway	2·28	112	*Durh* .	Ushaw College	3·19	200
,, .	Porton, W.D. Exp'l. Stn	3·18	161	*Nor* .	Newcastle, Town Moor.	2·47	155
Dor .	Evershot, Melbury Ho.	4·42	141	,, .	Bellingham, Highgreen	3·45	136
,, .	Weymouth, Westham.	...	...	,, .	Lilburn Tower Gdns	1·96	98
,, .	Shaftesbury, Abbey Ho.	3·18	138	*Cumb*.	Carlisle, Scaleby Hall	4·56	204
Devon.	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	*West* .	Appleby, Castle Bank	4·54	153
,, .	Sidmouth, U.D.C.	3·49	...	*Mon* .	Abergavenny, Larchf'd	3·93	123
,, .	Barnstaple, N. Dev.Ath	3·63	134	*Glam* .	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	...
Corn .	Redruth, Trewirgie	4.09	108	*Carm* .	Carmarthen, Priory St.	6.21	168
,, .	Penzance, Morrab Gdn.	4·52	135	*Pemb* .	Haverfordwest, Portfld.	4·90	...
,, .	St. Austell, Trevarna	5·27	137	*Card* .	Aberystwyth	4·46	...
Soms .	Chewton Mendip	3·49	103	*Rad* .	BirmW.W.Tyrmynydd	8·64	164
,, .	Long Ashton	3·24	138	*Mont* .	Lake Vyrnwy	11·07	244
,, .	Street, Millfield	2·49	124	*Flint* .	Sealand Aerodrome	2·32	149
Glos .	Blockley	2·93	...	*Mer* .	Dolgelley, Bontddu	7·70	173
,, .	Cirencester, Gwynfa	2·86	127	*Carn* .	Llandudno	2·94	151
Here .	Ross, Birchlea	2·11	105	,, .	Snowdon, L. Llydaw 9.	27·17	...
Salop.	Church Stretton	4·53	206	*Ang* .	Holyhead, Salt Island	3·35	137
,, .	Shifnal, Hatton Grange	2·55	157	,, .	Lligwy	4·98	...
Staffs.	Market Drayt'n, Old Sp.	2·66	154	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	2·09	127		Douglas, Boro' Cem.	4·30	131
War .	Alcester, Ragley Hall	1·71	104	*Guernsey*			
,, .	Birminghm, Edgbaston	2·57	152		St. PeterP't.Grange Rd.	5·61	228

Rainfall : February, 1935 : Scotland and Ireland

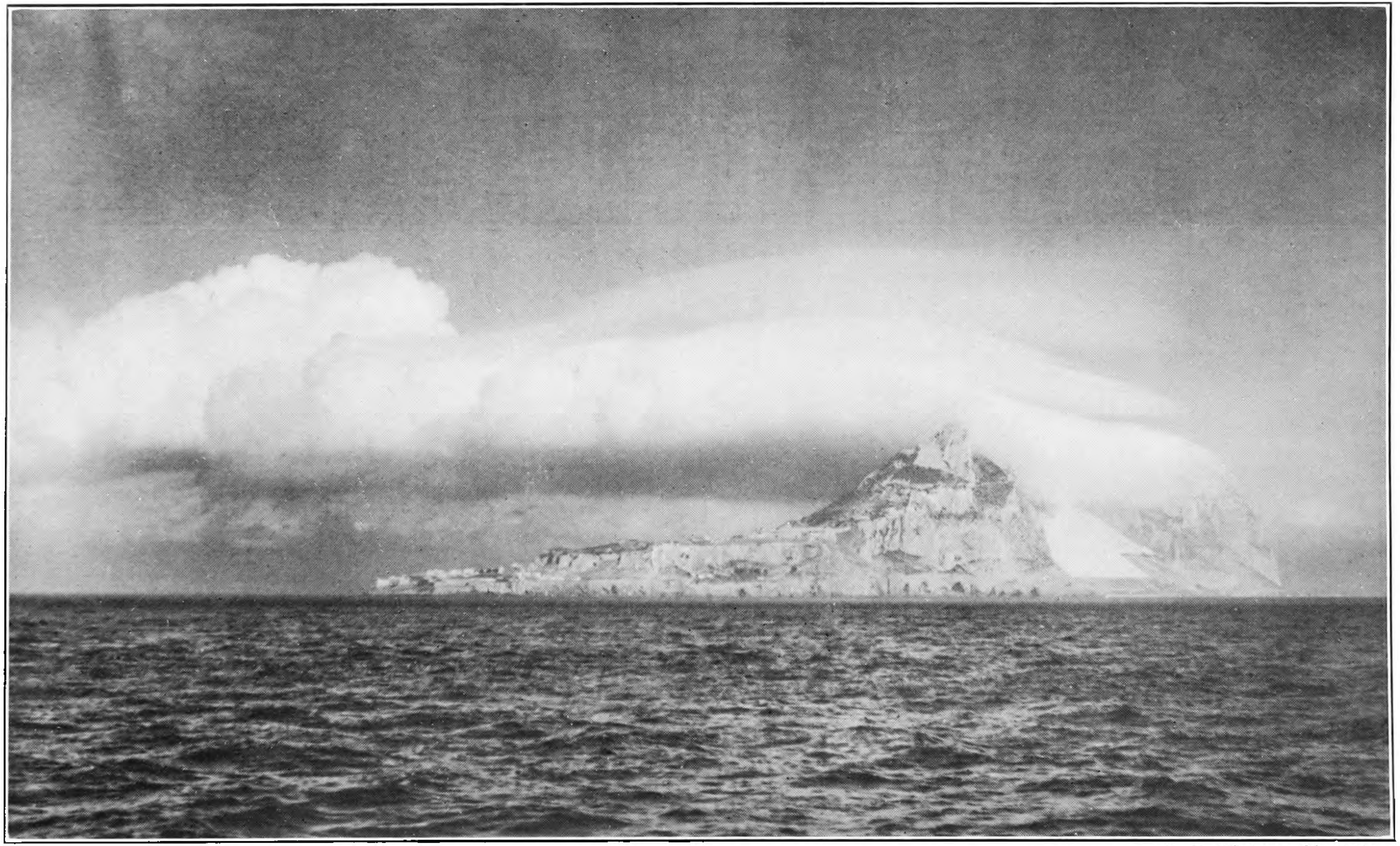
Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig	Pt. William, Monreith.	3·83	124	*Suth*	Melvich	3·80	127
,,	New Luce School	...	...	,,	Loch More, Achfary	10·02	152
Kirk	Dalry, Glendarroch	6·30	124	*Caith*	Wick	2·57	113
,,	Carsphairn, Shiel	11·57	176	*Ork*	Deerness	2·98	99
Dumf	Dumfries, Crichton, R.I.	4·13	130	*Shet*	Lerwick	4·10	130
,,	Eskdalemuir Obs	7·78	157	*Cork*	Caheragh Rectory	4·89	...
Roxb	Branxholm	3·29	125	,,	Dunmanway Rectory	5·49	94
Selk	Ettrick Manse	...	...	,,	Cork, University Coll	2·95	79
Peeb	West Linton	4·50	...	,,	Ballinacurra	2·94	79
Berw	Marchmont House	1·83	88	,,	Mallow, Longueville	3.45	103
E.Lot	North Berwick Res	1·20	77	*Kerry*	Valentia Obsy	5·07	97
Midl	Edinburgh, Roy. Obs	1·71	103	,,	Gearhameen	14·40	162
Lan	Auchtyfardle	5.03	...	,,	Darrynane Abbey	4·59	99
Ayr	Kilmarnock, Kay Pk	4·93	...	*Wat*	Waterford, Gortmore	3·04	94
,,	Girvan, Pinmore	5·59	131	*Tip*	Nenagh, Cas. Lough	3·83	123
Renf	Glasgow, Queen's Pk	4·29	146	,,	Roscrea, Timoney Park	3·60	...
,,	Greenock, Prospect H.	8·58	153	,,	Cashel, Ballinamona	3·20	100
Bute	Rothesay, Ardencraig	6·28	...	*Lim*	Foynes, Coolnanes	3·96	124
,,	Dougarie Lodge	5·23	...	,,	Castleconnel Rec	3·80	...
Arg	Ardgour House	16·14	...	*Clare*	Inagh, Mount Callan	6·66	...
,,	Glen Etive	...	...	,,	Broadford, Hurdlest'n.	2·72	...
,,	Oban	5·49	...	*Wexf*	Gorey, Courtown Ho	3·07	109
,,	Poltalloch	7·26	173	*Wick*	Rathnew, Clonmannon.	3·04	...
,,	Inveraray Castle	12·60	186	*Carl*	Hacketstown Rectory	3·62	121
,,	Islay, Eallabus	4·39	105	*Leix*	Blandsfort House	3·97	148
,,	Mull, Benmore	12·20	110	,,	Mountmellick	4·79	...
,,	Tiree	4.07	118	*Offaly*	Birr Castle	3·02	132
Kinr	Loch Leven Sluice	...	...	*Dublin*	Dublin, FitzWm. Sq	3.14	166
Perth	Loch Dhu	10.95	147	,,	Balbriggan, Ardgillan	3·30	168
,,	Balquhidder, Stronvar.	6·94	...	*Meath*	Beauparc, St. Cloud	3·84	...
,,	Crieff, Strathearn Hyd.	3·43	97	,,	Kells, Headfort	4·41	163
,,	Blair Castle Gardens	4·13	148	*W.M*	Moate, Coolatore	3·26	...
Angus	Kettins School	1·74	74	,,	Mullingar, Belvedere	4·54	163
,,	Pearsie House	2·58	...	*Long*	Castle Forbes Gdns	3·33	117
,,	Montrose, Sunnyside	1·98	108	*Gal*	Galway, Grammar Sch.	4.46	...
Aber	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	*Mayo*	Blacksod Point	5·00	123
,,	Fyvie Castle	3·06	149	,,	Mallaranny	5·81	...
Moray	Gordon Castle	2·17	113	,,	Westport House	4·82	122
,,	Grantown-on-Spey	...	...	,,	Delphi Lodge	9·67	115
Nairn	Nairn	2·20	122	*Sligo*	Markree Obsy	3·89	113
Inv's	Ben Alder Lodge	6·77	...	*Cavan*	Crossdoney, Kevit Cas.	3·74	...
,,	Kingussie, The Birches.	4·97	...	*Ferm*	Enniskillen, Portora	3·63	...
,,	Inverness, Culduthel R.	3·61	...	*Arm*	Armagh Obsy	3·27	147
,,	Loch Quoich, Loan	17.85	...	*Down*	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	...	*Antr*	Belfast, Cavehill Rd	4·61	...
,,	Barra, Skallary	5·10	...	,,	Aldergrove Aerodrome.	3·42	142
R&C	Alness, Ardross Castle.	4·12	125	,,	Ballymena, Harryville.	4·50	139
,,	Ullapool	5·62	131	*Lon*	Garvagh, Moneydig	4·44	...
,,	Achnashellach	14·76	203	,,	Londonderry, Creggan.	4·83	151
,,	Stornoway	4·58	103	*Tyr*	Omagh, Edenfel	5·10	171
uth	Lairg	5·71	184	*Don*	Malin Head	3·17	...
,,	Tongue	3·23	93	,,	Killybegs, Rockmount.	4·40	...

Climatological Table for the British Empire, September, 1934

STATIONS.	PRESSURE. Mean of Day M.S.L. mb.	PRESSURE. Diff. from Normal. mb.	TEMPERATURE. Absolute. Max. °F.	TEMPERATURE. Absolute. Min. °F.	TEMPERATURE. Mean Values. Max. °F.	TEMPERATURE. Mean Values. Min. °F.	TEMPERATURE. Mean Values. ½ Max. and Min. °F.	TEMPERATURE. Mean Values. Diff. from Normal. °F.	TEMPERATURE. Mean. Wet Bulb. °F.	Relative Humidity. %	Mean Cloud Am'nt 0–10	PRECIPITATION. Am'nt. in.	PRECIPITATION. Diff. from Normal. in.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
London, Kew Obsy.	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	...	10	...	...
Freetown, Sierra Leone	1013·9	+ 1·7	89	69	84·8	72·9	78·9	− 0·2	75·8	92	8·4	31·85	+ 3·37	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	57·8	68·1	− 1·4	60·6	63	4·8	0·25	− 0·09	5	...	...
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	73
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 Obsy.	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	76·4	85	7·0	5·88	− 4·80	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	0·0	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	+ 0·4	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	+ 4·48	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	5·5	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 Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

ERRATA.—Mauritius, 1934, Apr. and May. Temperature, max., ½ max. and min., and diff. from normal, Cloud, and Rainfall and diff. from normal *should read* Apr. [illegible]·5, 78·7, +0·9, 5·0, 10·41, +5·94. May, 78·4, 79·0, +0·4, 6·5, 7·72, +4·69.



R. N. Photographic Section

LEVANTER **CLOUD AT** GIBRALTAR, **OCTOBER** 25TH, 1934, 7H. 30M. (see p. 68).

M.O. 381.

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On- and Off-Shore Winds in East Africa

It was thought that the following notes on some new diagrams of air movement might be interesting as a somewhat unusual method of construction, and perhaps more especially as showing how well-marked on- and off-shore breezes can be, on the shores of both sea and lake.

In constructing a rainfall map of Uganda, Tanganyika and Kenya, it was decided to make use of a certain amount of interpolation, aided by all possible external evidence, in drawing the isohyets. Thus, although the rainfall totals for many stations, when considered in relation to the relief features of the area, gave in themselves definite evidence of a rain-shadow effect, this evidence was supplemented by reference to wind direction diagrams, which were obtainable from a limited number of stations.

Among the stations collecting data of this nature are three First Order Meteorological Stations set up at Kololo Hill (Kampala, Uganda, altitude 1,310 m.), Kabete (near Nairobi, Kenya, altitude 1,830 m.), and Chukwani (Zanzibar, altitude 20 m.) during 1931 and 1932. From the monthly records of these stations it is now possible to obtain hourly wind readings throughout the year. These readings indicate (*a*) direction, at 5° intervals, and (*b*) velocity, in metres per second, to the nearest tenth of a metre per second. From these figures wind roses were constructed, which appeared to possess considerable interest in themselves, particularly those from Chukwani and Kololo Hill, which showed in a striking manner the incidence of the on- and off-shore breezes in relation to the dominant winds.

It was difficult at first to decide in what manner the diagrams should be constructed, in order to give the most satisfactory indication of total air flow from different directions. Finally the following method was adopted. A circular diagram was drawn, consisting of concentric circles at regular intervals apart, and with radii drawn at 5° intervals. At the same time it was decided to sum the total velocities recorded from each direction. On each radius a mark was then placed at a distance from the centre proportional to the sum of the velocities. Thus were plotted the points A B C D, as on the accompanying figure (Fig. 1). It was intended next to join up these points to form a continuous line. But, before doing this, one modification had to be introduced, since it was found that, presumably owing to human error in reading the graphic record of the Dines pressure-tube anemometer, there was invariably a higher quantum at angles consisting of whole 10°s. To overcome the gross irregularities which this obvious error would have given to the curve, a moving average of adjacent pairs was used, and this gave the line joining the points X Y Z. There are some other irregularities in the curves on each diagram, especially those for Kololo Hill, but it was not thought advisable to attempt to eliminate them.

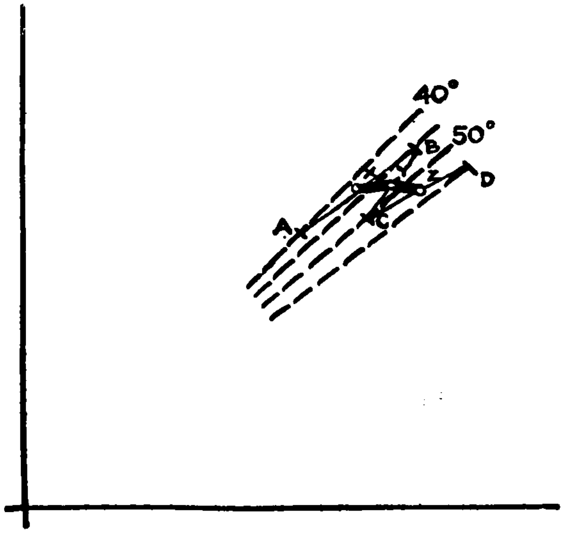


FIG. 1.

The interest of the diagrams appears to be twofold. Not only do they show the very striking effect of on- and off-shore breezes in east Africa, but also, it is suggested, the method of combining velocities and directions in this way might demonstrate the incidence of such breezes in diagrammatic form more readily than if directions alone were plotted. This was shown in the case of the Kololo Hill Station by drawing a conventional wind-rose, in which the total effect of the air movement in each direction, although still in this case fairly clear, was rather inclined to be lost, since velocities varied from one direction to another. Thus the method might possibly be applied with advantage in other areas, where the effect of the breezes is not so markedly distinct as in East Africa.

Fig. 2 shows the diagram for Kololo Hill for October, 1931. It is not known how far these readings are typical, since no readings for the same month in subsequent years are as yet available. The dotted

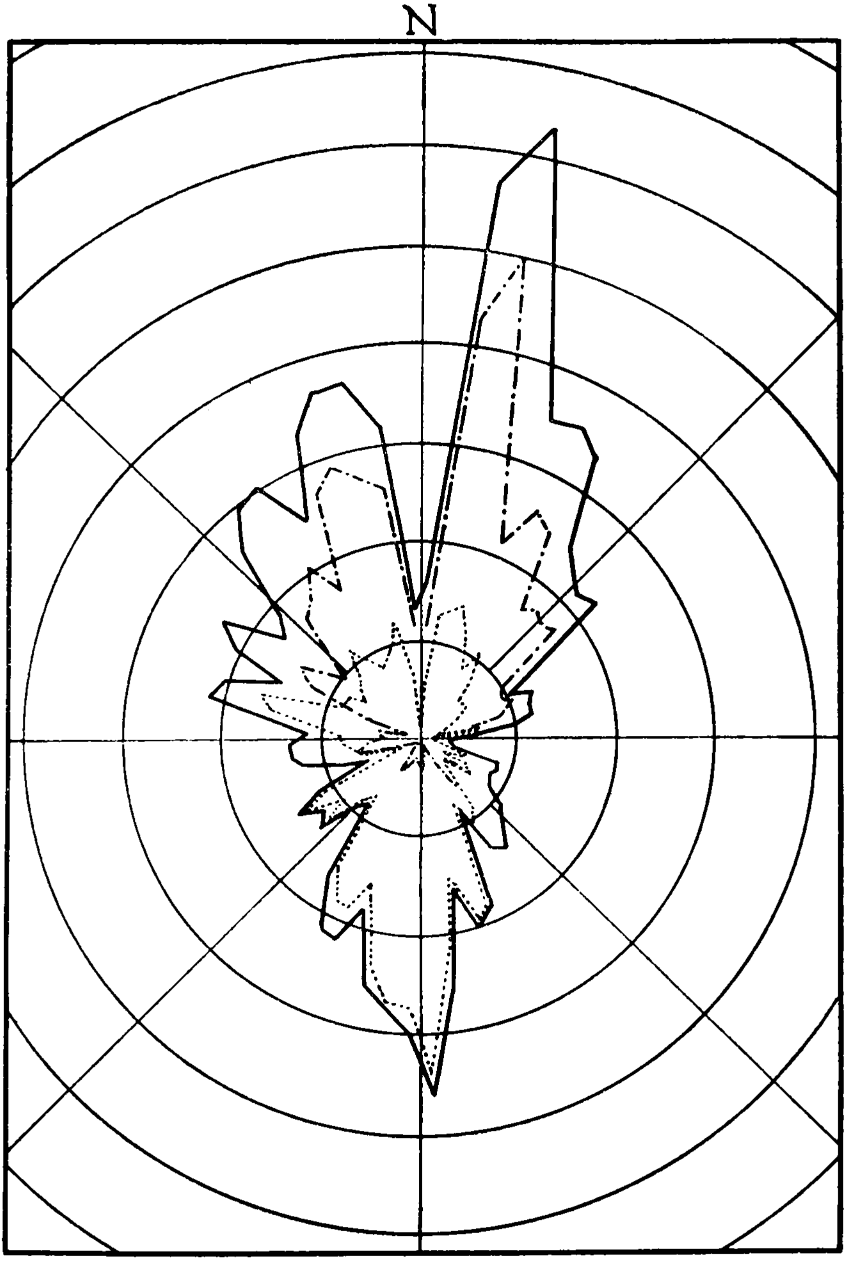


FIG. 2. KOLOLO HILL, UGANDA, OCTOBER, 1931.

line represents all readings from noon till 11 p.m. inclusive, and the dot-and-dash line all readings from midnight till 11 a.m. inclusive. The full line represents the readings for the 24 hours.

It should be noted that the shore of Lake Victoria Nyanza runs almost east–west in general direction near this point. In July the winds could well be due purely to diurnal changes in land and lake temperatures. In the case of October there seems to be a northerly wind superimposed on the on- and off-shore breezes, whilst in January the winds are predominantly south. But it should be observed in the latter case that the south winds blow much more strongly when reinforced apparently by the on-shore movement after midday.

The hour chosen to divide the day into two equal parts was that which by experiment gave the most striking contrast in directions. Thus for Zanzibar, it was more convenient to divide the day into the two parts, 3 a.m.–2 p.m. and 3 p.m.–2 a.m. Actually two unequal divisions would have shown an even clearer contrast, but the equal divisions were adhered to, for easier comparison with the other station.

The predominant wind in January in Chukwani is the north-east monsoon, and in July the south-east monsoon, both being, as would be expected, responsible for more air movement than anything at Kololo Hill. But the winds in a western quadrant at Chukwani appear in each case to be off-shore winds from the coast of Tanganyika, occurring entirely after midnight, and being deflected from their direct east–west course by the force of the monsoonal air movement.

The implications of these movements are interesting when studied in conjunction with the *Meteorological Office Geophysical Memoirs* No. 55, "A Study of the Atmospheric Circulation over Tropical Africa," by C. E. P. Brooks, D.Sc., and S. T. A. Mirrlees, M.A. The study, in connexion with which the diagrams were drawn, will be found in *Geography* for September, 1933, "An Outline of the Geography of Kenya," by Professor Rodwell Jones. The rainfall maps for the whole of British East Africa are in the hands of the Imperial Bureau of Soil Science.

F. H. W. GREEN.

Frequency Distribution of Sunshine at Newquay (Cornwall)

Dr. C. C. Vigurs, meteorological observer at Newquay, has prepared the analysis of the Newquay sunshine records shown in the table below. In this table the figures in Roman type show for each month the percentage frequency of occurrence of daily durations of sunshine between the limits given in the first column. We see, for example, that 6·7 per cent. of days in June yield a sunshine duration of 14·0 to 14·9 hours. The italic figures were obtained by successive summation of the Roman figures, beginning from the top of the column in each case, and they represent the percentage frequencies

Percentage Frequency and Accumulated Percentage Frequency of Days with Specified Duration of Sunshine at Newquay, Cornwall, 1893–1932

Duration.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Hours												
> 14·9	—	—	—	—	—	0·7	0·2	—	—	—	—	—
	—	—	—	—	—	*0·7*	*0·2*	—	—	—	—	—
14–14·9	—	—	—	0·1	2·9	6·7	4·0	0·1	—	—	—	—
	—	—	—	*0·1*	*2·9*	*7·4*	*4·2*	*0·1*	—	—	—	—
13–13·9	—	—	—	0·3	8·2	8·3	5·5	2·3	—	—	—	—
	—	—	—	*0·4*	*11·1*	*15·7*	*9·7*	*2·4*	—	—	—	—
12–12·9	—	—	—	5·6	8·1	7·2	6·5	6·3	0·7	—	—	—
	—	—	—	*6·0*	*19·2*	*22·9*	*16·2*	*8·7*	*0·7*	—	—	—
11–11·9	—	—	0·8	6·6	6·5	6·3	6·1	6·7	4·3	—	—	—
	—	—	*0·8*	*12·6*	*25·7*	*29·2*	*22·3*	*15·4*	*5·0*	—	—	—
10–10·9	—	—	3·7	8·9	5·6	6·5	7·3	9·0	8·3	0·4	—	—
	—	—	*4·5*	*21·5*	*31·3*	*35·7*	*29·7*	*24·4*	*13·3*	*0·4*	—	—
9– 9·9	—	0·7	7·7	7·6	6·6	6·4	6·2	8·1	10·2	3·9	—	—
	—	*0·7*	*12·2*	*29·1*	*37·9*	*42·1*	*35·9*	*32·5*	*23·5*	*4·3*	—	—
8– 8·9	0·1	4·9	7·9	7·7	6·5	5·7	5·9	7·7	6·8	6·8	1·6	—
	0·1	*5·6*	*20·1*	*36·8*	*44·4*	*47·8*	*41·8*	*40·2*	*30·3*	*11·1*	*1·6*	—
7– 7·9	2·2	8·0	8·1	7·3	6·8	5·4	6·3	6·9	7·7	8·0	6·0	0·2
	2·3	*13·6*	*28·2*	*44·1*	*51·2*	*53·2*	*48·1*	*47·1*	*38·0*	*19·1*	*7·6*	*0·2*
6– 6·9	5·0	7·0	6·9	5·9	5·2	6·1	4·4	7·1	6·6	8·8	6·7	3·4
	7·3	*20·6*	*35·1*	*50·0*	*56·4*	*59·3*	*52·5*	*54·2*	*44·6*	*27·9*	*14·3*	*3·6*
5– 5·9	5·3	5·8	8·6	6·2	5·8	4·8	7·8	5·6	7·4	8·6	9·0	4·8
	12·6	*26·4*	*43·7*	*56·2*	*62·2*	*64·1*	*60·3*	*59·8*	*52·0*	*36·5*	*23·3*	*8·4*
4– 4·9	7·4	8·0	8·1	6·1	5·5	4·9	4·7	6·2	7·2	8·8	6·6	6·9
	20·0	*34·4*	*51·8*	*62·3*	*67·7*	*69·0*	*65·0*	*66·0*	*59·2*	*45·3*	*29·9*	*15·3*
3– 3·9	7·8	6·7	7·6	7·0	5·4	5·1	6·1	5·2	6·5	7·4	7·8	8·7
	27·8	*41·1*	*59·4*	*69·3*	*73·1*	*74·1*	*71·1*	*71·2*	*65·7*	*52·7*	*37·7*	*24·0*
2– 2·9	8·6	7·9	8·3	6·6	5·5	4·7	5·7	5·8	5·7	8·6	9·2	10·5
	36·4	*49·0*	*67·7*	*75·9*	*78·6*	*78·8*	*76·8*	*77·0*	*71·4*	*61·3*	*46·9*	*34·5*
1– 1·9	10·7	9·7	7·2	5·7	5·0	6·1	5·8	6·6	7·5	8·6	10·0	10·8
	47·1	*58·7*	*74·9*	*81·6*	*83·6*	*84·9*	*82·6*	*83·6*	*78·9*	*69·9*	*56·9*	*45·3*
0·1– 0·9	16·6	13·7	9·6	9·6	7·3	8·3	9·9	8·7	9·5	11·5	15·4	17·8
	63·7	*72·4*	*84·5*	*91·2*	*90·9*	*93·2*	*92·5*	*92·3*	*88·4*	*81·4*	*72·3*	*63·1*
< 0·1	36·3	27·6	15·5	8·8	9·1	6·8	7·5	7·7	11·6	18·6	27·7	36·9
	100	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

of days yielding a sunshine duration not less than the lower limit in the first column. For example, we see that in June, 29·2 per cent. of the days have a sunshine duration not less than 11·0 hours ; or in other words, 29·2 per cent. of June days yield 11·0 hours or more of sunshine.

The "class-interval" is one hour, except for the last two lines which show respectively the percentage frequencies of days with 0·1 to 0·9 hour, and no sunshine. The frequencies tabulated in Roman figures for these two groups should be added together to obtain the percentage frequencies for the complete interval 0·0 to 0·9 hour. When this is done it will be seen that in all months of the year the maximum frequency is represented by the interval 0·0 to 0·9 hour. In the winter months December and January more than half the days fall in this class. In June, however, only 15 per cent. of the days receive less than 1 hour of sunshine and only 6·8 per cent. have none at all.

The data here summarised show many points of interest. It will be noticed, for example, that in May and June the most frequent duration, next to 0·0–0·9 hour, is 13–13·9 hours. In winter months the percentage frequencies (Roman figures) increase steadily as you go down the table from top to bottom ; that is to say, the frequency decreases as the duration increases. For other months, however, there is comparatively little variation in frequency over a wide range of duration values. For example, in June, durations 1–1·9 hours, 6–6·9 hours, 11–11·9 hours and 14–14·9 hours are all about equally frequent. A similar feature has been noticed in the records from other stations which will form the subject of a forthcoming *Professional Note.* The mean daily duration of sunshine at Newquay varies from 1·6 hours in December to 7·2 hours in June. Dr. Vigurs' table shows that there is no tendency in any month for the mean duration to be associated with a maximum in the frequency curve.

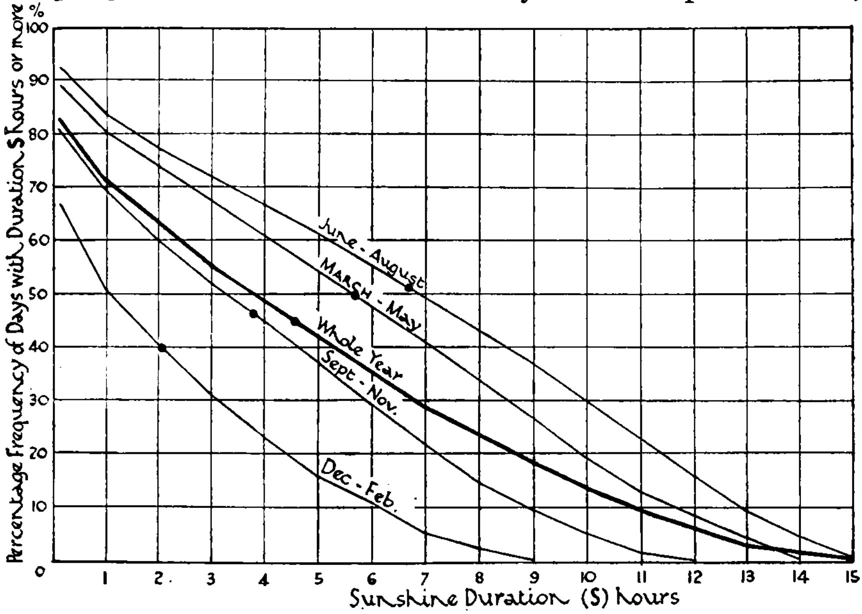
A minor point of interest is that days with more than 6 hours of sunshine are rather more frequent in August than in July. The same remark applies to days with more than 1 hour, 2 hours, 3 hours and 4 hours, but not to days with more than 7, 8............hours.

It is of interest to see how the total sunshine of a given month is distributed among days of different types. This has been done for the month of June with the results given below :—

Days	with	< 2·0	hours	contribute	2	per	cent.	of	the	total.
,,	,,	2–4	,,	,,	4	,,	,,	,,	,,	
,,	,,	4–6	,,	,,	7	,,	,,	,,	,,	
,,	,,	6–8	,,	,,	11	,,	,,	,,	,,	
,,	,,	8–10	,,	,,	15	,,	,,	,,	,,	
,,	,,	10–12	,,	,,	19	,,	,,	,,	,,	
,,	,,	12–14	,,	,,	27	,,	,,	,,	,,	
,,	over	14	,,	,,	15	,,	,,	,,	,,	

It will be seen that days with between 12 and 14 hours of sunshine contribute more than a quarter of the total duration. This is, of course, a direct consequence of the high frequency of such days at Newquay.

The diagram shows the values of the accumulated percentage frequencies for the whole year and for the four seasons. Values of the mean daily duration are indicated by dots. It will be noticed that in spring and summer the dot lies nearly on the 50 per cent. line,



CURVES SHOWING THE PERCENTAGE FREQUENCY OF DAYS ON WHICH THE DURATION OF SUNSHINE EXCEEDS SPECIFIED VALUES (NEWQUAY 1893–1932).

indicating that durations above and below the mean are equally frequent. In winter, on the other hand, the dot lies on the 40 per cent. line, which means that in winter only 40 per cent. of the days give a sunshine duration exceeding the mean for the season.

E. G. BILHAM.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday evening, March 20th, at 49, Cromwell Road; Lt.-Col. E. Gold, D.S.O., F.R.S., President, in the Chair. As is customary in March, the meeting took the form of a lecture (The Symons Memorial Lecture), which was delivered on this occasion by Dr. F. J. W. Whipple, F.Inst.P., the subject being :—

The Propagation of Sound to Great Distances

It is well known that the sounds produced by explosions are sometimes heard at very great distances even when no sounds are to be heard at points comparatively close to the origin. This phenomenon has attracted the interest of meteorologists for a paradoxical reason —whilst the wind carries sound with it to moderate distances (and this is readily explained), the transmission to greater distances, 100 miles or more, seems to be independent of the weather. For closer investigation, microphones are used which record not only sounds which can be heard but also infrasonic waves which are too deep for perception by the human ear. By such means it is proved that when sounds are heard at great distances the energy has traversed the atmosphere at levels far above the highest mountains. The maximum height of the path along which the energy travels is generally comparable with 25 miles. There is good evidence that at such a height the air is warmer than on the ground.

It was found during the war that the firing on the Western Front could be heard in this country only in summer and at like distances in Germany only in winter. This alternation, which is very consistent, is due to the change of the prevailing wind in the upper atmosphere. At a height of 12 miles the wind is generally from the east in summer, from the west in winter. How this reversal was connected with the great range of the changes of temperature in the course of the year in the upper atmosphere in Arctic regions was explained in the lecture.

No satisfactory explanation has yet been given of the high temperature which prevails in the upper atmosphere, apparently from pole to pole and at all seasons. There is much scope for further research.

Correspondence

To the Editor, *Meteorological Magazine*

Optical Phenomena of February 28th, 1935

On February 28th I observed one of the brilliant complex optical phenomena which are rare enough to warrant description. I was at Aston, Birmingham, and first saw it at 8h. 23m.

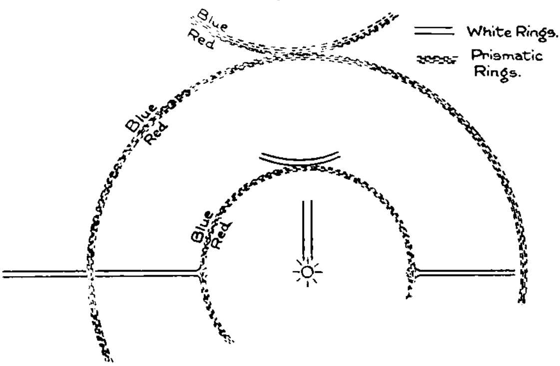
Brilliant parhelia of the 22° halo were shining, and through each ran a spectral band. Short fragments of parhelic circle began at the parhelia and stretched outwards for about 3°. They were colourless. A short, faint sun pillar showed above the sun. Short colourless pieces of the 22° halo were dimly visible near the parhelia. Finally, the circumzenithal arc was brilliant enough to attract the attention of ordinary pedestrians, who spoke of "a rainbow upside down." The length of the arc was about 90°.

The weather at the time was fine. A gentle SW. wind was blowing light stratus across, otherwise no cloud was visible; I should have said, had there been no halos, that high cloud was quite absent. Near the parhelia, however, the illumination was enough to show faintly the high cloud with a little structure.

The display varied considerably. One component after another would vanish, and reappear. The only thing which persisted the whole time was the circumzenithal arc.

The sun pillar had disappeared by 8h. 25 m., and three minutes later the 46° halo appeared, faint and white. By 8h. 30m. it was complete and prismatic, but still faint. It had gone in another 3 minutes. An upper arc of contact of the 22° halo became visible at 8h. 35m. At 8h. 40m. the whole of the 22° halo, the upper arc of contact, the two parhelia and the parhelic circle were bright. The last was visible only on the left-hand side, starting at the left parhelion and extending about 50° away from it. The left parhelion was particularly brilliant, almost as bright as the sun itself, shining as it was through the factory smoke usual in Aston at this time of day. The circumzenithal arc was just becoming fainter, and the structure of the high cloud distinguishable.

The figure includes all the components observed, whether they occurred simultaneously or not.



At 9h. 10m. I noticed the curious effect that neither the circumzenithal arc nor the arc of the 22° halo were touching their respective halos at the highest points (the 46° halo had reappeared). The point of contact in each case seemed to be slightly to the left of the point vertically above the sun. I feel that this was quite definitely the case, and not due to illusions caused by sloping buildings and like causes. On two other occasions recently observations of slanting upper arcs have been recorded.* I do not know the cause of the phenomenon, but I have no doubt about its reality.

The optical display commenced to fade by 10h. 15m., although the circumzenithal arc still remained coloured for some time after this. The system of ice crystals broke down gradually in normal fashion, leaving the most stable form at the end, which was still producing the 22° halo, but nothing else, at 11h. 10m.

From what has been said above, it appears that what we commonly call " circumzenithal arc " may have its centre somewhere other than at the zenith.

S. E. Ashmore.

14, Villa Road, Handsworth, Birmingham, 19, March 7th, 1935.

I enclose a diagram of solar halos, which were observed here this morning (February 28th).

I noticed them for the first time at 8h. 25m. The left-hand parhelion was not yet visible, but the halos were quite distinct. The outer halo was, perhaps, a little more brightly coloured than the inner one. The arcs of contact were well defined. At 8h. 45m. the right-hand parhelion became very bright and slightly elongated to the right. The colour was yellowish white, with only a trace of prismatic shades. At about 9h. 20m. both parhelia were visible.

* A. E. Moon, *Meteorological Magazine*, 65, 1931, pp. 287–9 ; S. E. Ashmore, *Meteorological Magazine*, 69, 1934, p. 216.

The outer halo had almost disappeared, but its upper arc of contact was extremely brilliant. The colours were as clear as those in a rainbow and the reds were on the side of the sun.

This was the most spectacular point of the display. A labourer exclaimed that he had never seen a halo " going that way before " The clouds at 8h. 25m. were, I think, cirrus and alto-stratus.

DONALD WATERER.

Whitfield Court, Knap Hill, Surrey, February 28th, 1935.

[Mr. Waterer's sketch (not reproduced) shows the halo of 22° with parhelia and arc of upper contact, the halo of 46° and its arc of upper contact, i.e. " the circumzenithal arc ". A small portion of the mock-sun ring is also shown extending from the right-hand parhelion away from the sun.

A number of other accounts of the halo phenomena seen on February 28th have been received. The circumzenithal arc was seen by Mr. M. A. Bolton at Oakamoor (North Staffordshire) from 13h. 45m. to 14h. 45m., and by Mr. J. Dover at Totland Bay (Isle of Wight) at 8h. 50m. A display including all the arcs seen by Mr. Waterer was observed at Felixstowe Aerodrome between 14h. 55m. and 15h. 55m. The observer writes: " The colours were exceptionally brilliant in this arc, (i.e. the circumzenithal arc), the blue was very pronounced and the violet quite noticeable ". Mr. M. W. Binns of Lutterworth (Leicestershire) observed a similar display from 9h. 45m., but the 46° halo itself is not shown in his sketch of the appearances. In addition, he observed a portion of the mock-sun ring extending from the left-hand parhelion.

Mr. A. O. Young, of Hazel Hurst, Kerne Bridge, Ross-on-Wye, sends an interesting account with two sketches. One of these, illustrating the appearance at 11h. 30m., shows an upper arc of contact, concave to the sun, similar to that illustrated in the upper photograph on Plate IV of the " Meteorological Observer's Handbook," 1934 edition (Aberdeen, May 27th, 1912).—E. G. BILHAM.]

Peculiar Phenomena on March 3rd, 1935

While almost every conceivable phenomenon in connexion with the passage of fronts has been noted upon by readers of the *Meteorological Magazine* in past issues, it appears that the extraordinary influence on visibility by these mystical divisions between air masses has not yet been sufficiently remarkable to warrant the attention of the readers. The events of Sunday, March 3rd, 1935, seem, however, to be of sufficient importance to permit the establishment of a precedent in this direction.

The day was marked in England by the passage of a front which showed peculiar characteristics. From dawn until noon the sky was partly covered by a very nondescript stratocumulus. Fog or mist was omnipresent, but never reduced visibility below 1,200 yds. At

12h. 30m. G.M.T. a thickening in the mist was observed. This continued until 15h. 15m., when a minimum of 250 yds. visibility was noted. The wind throughout had been south-easterly, force 1. The sky was by now obscured, but glimpses of an intense red sun through broken cloud moving from 300° could be noted.

By 16h. 15m. the day resembled a "London black-out". Lights were necessary to read, even by a window, and cars were lit up. At 16h. 35m. heavy rain began with extreme suddenness, and continued for 7 minutes, giving a total fall of 0·10 in. At the onset of this rain the wind, which had dropped to a virtual calm, became a gentle breeze from NW., force 2. No squalliness was associated with this change. Temperature dropped 6° F., while the barometer continued uninterrupted a gentle rise.

The outstanding effect of the change of air conditions was, however, the banishment of the fog. At 16h. 45m. visibility had improved to 2,000 yds. and this subsequently improved steadily. Lights, etc., were rendered superfluous until the normal lighting up time of 17h. 50m.

These phenomena were, I believe, widespread.

F. K. HARE.

Wyleigh, Windsor Road, Slough, Bucks, March 25th, 1935.

[The phenomena referred to by Mr. Hare were also reported from south and west London, but did not extend north as far as Harrow or south as far as Malden, Surrey.—Ed. *M.M.*]

Thunderstorm Survey

The thunderstorm survey will be continued during the coming summer, when we shall again very greatly appreciate the privilege of the help of your readers in the observational work.

The main details required are the place, date and time of the occurrence, in any part of the British Isles, of thunder, lightning or hail, with the direction in which the lightning is seen, especially at night. The additional information desired is essentially the same as hitherto and is given fully in the *Meteorological Magazine*, for April, 1934.

The sections investigating lightning damage have, however, been extended recently and some fuller account of these may be of use.

Mr. Sidney T. E. Dark, B.Sc., 21, Fernwood Avenue, Streatham, S.W.16, is responsible for the section of trees struck by lightning. It is now possible to adopt a preliminary classification of types of damage and illustrated examples have been prepared. Mr. Dark will be glad to receive details of damaged trees, which should include a note of the kind of tree, its approximate height, the nature of the soil and subsoil, the nature and distance of the nearest water, and a note of the locality of the tree.

Reports of wireless aerials struck by lightning are collected by

Mr. R. A. Price, of 56, Ludgate Hill, E.C.4. He will appreciate such particulars as the supposed path of the discharge, how and to what the aerial was fixed, whether any switch or safety device was provided in the aerial circuit, and a note of the type of earthing employed.

General records of thunderstorms should be sent to the undersigned, from whom full details of the survey and postcards for observations may be obtained.

S. MORRIS BOWER.

Langley Terrace, Oakes, Huddersfield, March 27th, 1935.

NOTES AND QUERIES

Levanter Cloud at Gibraltar

A very good example of the Levanter cloud at Gibraltar is shown in the photograph forming the frontispiece to this number of the magazine, which was taken by the Royal Naval Photographic Section from a position 2½ miles south-east from Europa Point, on October 25th, 1934, at 7h. 30m. G.M.T. The weather map at 7h. G.M.T. that morning showed a large anticyclone centred over Russia and south-east Europe but also extending over the western Mediterranean and Spain, while a rather deep depression was centred off Ireland with a trough extending to between the Azores and Portugal. Over a considerable area around Gibraltar the gradient of pressure was slight. At 7h. the conditions indicated in the coded weather report from Gibraltar were wind SE., force 2; temperature, 64° F.; visibility, 6 to 12 miles; $\frac{4}{10}$ to $\frac{6}{10}$ of stratocumulus or stratus cloud with its base at 1,000–2,000 ft. This cloud report accords with the observation which an observer immediately beneath the Levanter cloud might be expected to make. By 13h. the wind had veered to E. and increased to force 3.

In the photograph three distinct layers of cloud are shown, not directly superposed but progressing northwards, and the cumulus hump, which forms a feature of these clouds, is seen well formed before breaking away to move down wind. An account of the formation of the Levanter cloud is to be found in *Geophysical Memoirs No.* 59: "A survey of the air currents in the Bay of Gibraltar, 1929–30", by J. H. Field, C.S.I., M.A., and R. Warden, Ph.D. (M.O. 356b).

Wind Pressure on Buildings

In the October issue of this magazine, Mr. C. S. Durst draws attention to a recent paper which gives information on the distribution of pressure observed on the gabled roof of a shed lying across a wind. The suction effect on the lee slope of the roof is greater, while that just behind the windward eaves is less, than would be expected from experiments with a model in a wind-tunnel. It is well known that the model experiment is not simply the natural experiment on a small scale. Suppose in the model the scale of length is reduced in the ratio 1 : 30. The wind speed, pressure (static) and viscosity, all of which have a power of the length as one of their dimensions, are, however, left unaltered in the model experiment. Nevertheless it had been assumed in the past that ratios of the pressures at two points, not being dependent on the scale of length, would be the same in the two experiments. Recent investigations have shown that this is not so.

The assumption tacitly assumes that the air stream in the natural wind is of the same type as that in the tunnel. When the wind meets a building in its path, the deformation it undergoes in order to circumvent the obstacle may consist of either a relatively smooth stream-line motion, or an irregular turbulent motion. The possibility that the motion in the natural wind is unstable, while that in the wind tunnel is more nearly stream-lined is suggested by a consideration of the Reynolds number in the two cases. This is given by Vl/ν, where V is the wind speed, l the linear dimension, and ν the kinematic viscosity. As V and ν are the same in both cases, the Reynolds number in the wind tunnel is $\frac{1}{30}$ of that in the natural wind. The critical values may not be the same, but the large difference in the two numbers supports the suggestion that the two motions are far from being dynamically similar. If this is the case, it would provide a qualitative explanation of the different distributions of pressure, while the difference between the structure of the free wind in nature and in the tunnel would be of only secondary importance.

In regard to the destructive effect of tornadoes, it can hardly be doubted that the quasi-explosive action contributes to the damage (W. G. Kendrew in "Climate," p. 274, mentions that in a tornado "bottles are uncorked"), but this effect would be greatest on a wall or roof subject to the additional effect due to the wind alone; hence the reason why sometimes a wall on the lee side of a building falls outwards while the other walls remain standing, although it appears that in some cases the explosive effect is sufficient to blow all the walls outwards. The curious fact stands out that a person wishing to shelter from a tornado had better stand on the exposed side of a building than against the "sheltered" side.

A. F. CROSSLEY.

Irish Bog Flow

A cutting from the *Irish Times* of October 29th, kindly sent by Lieut.-Col. W. A. Bentley, of Hurdlestown, Broadford, Co. Clare, describes the bursting of a large bog, 20 acres in extent, at Maghera, Co. Clare. The bog has always been "trembling," and as a result of heavy rain in October—Col. Bentley recorded 1·05 in. on the 24th—it began to move down the mountain side early on the 25th, with a deep rumbling noise. It spread out in the valley below, inundating fields and crops over an area of about six square miles, and making several roads impassible for traffic. The bog travelled about four miles, along a front of about 150 yards, before it came to rest, and its passage was irresistible. Similar flows have occurred from time to time in other bogs and Col. Bentley recalls one which took place about 30 years ago near Lindonvarna in Co. Clare.

They occur in high bogs on mountain tops in an oceanic climate, where according to E. Granlund* conditions are especially favourable for the growth of bogs, which can grow to an almost indefinite height and develop an unnaturally steep margin, so that sooner or later, the lateral pressure becomes greater than the surface tension. Thus a bog outbreak is a quite natural development, though its actual occurrence may be the result of special conditions, such as a period of heavy rainfall. Outbreaks have been known to occur in many places in the west, centre and north of Ireland, but not in the east.

REVIEWS

World Weather and Solar Activity. By H. Helm Clayton, Washington, D.C., Smiths Misc. Coll. Vol. 89, No. 15, 1934. pp. 1–52.

For a number of years Mr. Clayton has been painstakingly working out the relations between variations of solar radiation and changes of terrestrial weather. The general result has been that the association between solar and terrestrial conditions is most definite in certain "centres of action," but that the latter are not fixed in space. In this paper he works out the beginnings of a mechanism of the relationship. The most active regions are in tropical regions where the water vapour content of the atmosphere is high. Here pressure tends to be low when solar radiation is high, and it is suggested that the fall of pressure is due to the absorption of radiation by the water vapour causing a rise of temperature and a decrease of density. The resultant fall of pressure is compensated by a rise in higher latitudes: if the solar radiation is especially high, the fall of pressure extends into regions further from the equator, and the rise is pushed into very high latitudes.

The correlation coefficients listed on p. 24 are obscure. It appears that the annual values of solar radiation were divided into six groups ranging from very high to very low. The mean departures of pressure for seasons falling into each group were then found for each of a number of stations, and the mean departures for very high and very low radiation were correlated, also those for moderately high and low radiation and slightly high and low radiation, for the northern and southern hemispheres separately. Five of the six coefficients are negative, the mean value being — ·32. A little consideration shows, however, that since at any station the sum of all the deviations

* Die Geologie der schwedischen Hochmoore. *Stockholm, Sverig. geol. Unders. Afh.*, 26, 1932, No. 1.

must be zero, if the mean deviation at any station for any one radiation group is positive, the odds are that the mean deviation at that station for any other radiation group will be negative. Hence negative coefficients of about the amount found would be expected irrespective of whether any real relationship existed. If only two radiation groups had been made instead of six, the correlation would necessarily have been — 1.

There is a curious slip on p. 23, where it is stated that an increase of radiation by 1 per cent. would be balanced by " an increase of ·01 per cent. in cloudiness." The figure should of course be 1 per cent. But these slips are merely incidental, and do not detract from the interest of the paper as a whole.

C. E. P. Brooks.

Subsidence Within the Atmosphere. By Jerome Namias. Harvard Meteorological Studies No. 2. Cambridge, Mass., Harvard Univ. Press, 1934.

The author gives a simple and lucid general account of subsidence and associated problems, followed by a detailed aerological analysis of three periods (in October, March and December), during which subsidence took place in America. Observations of upper air temperature and humidity were available from 14 stations in the United States, covering a very much larger area than the European network. This paper brings out the importance of a good network and a large area for this type of investigation. The analysed synoptic charts and a large mass of upper air data are clearly and conveniently set out.

The problem investigated is the subsidence and lateral divergence of a cold air mass, associated with the " isallobaric high " in front of a moving anticyclone. The subsidence inversion, or " surface of subsidence " is developed within the subsiding air mass, and is found to assume the form of a dome. On one occasion (p. 43) the discontinuity appeared first at a height of 3·6 Km., and next day was probably nowhere higher than 2·1 Km., while the area covered by the cold air had greatly increased. Subsequently the inversion descended in places to quite low levels, joining with the surface radiation inversion. On another occasion (p. 19) a subsidence of about 1 Km. per day was obtained.

Margules* showed that when a slab of air subsides the expression $(\alpha + \gamma)/pq$ remains constant, where p is the pressure, q the cross-section of the slab, and $\alpha + \gamma$ is the difference between the actual lapse-rate and the adiabatic rate. It is impossible to observe the changes of q without a close network of really accurate upper wind observations, but the other variables can be measured, and the changes of q deduced from them. By this method, Namias proves the existence of divergence at the 3-Km. level. It is clear from the formula that subsidence normally reduces the lapse-rate and intensifies an ordinary

* *Met. Zs. Braunschweig.*, 1906, p. 241.

discontinuity with the smaller lapse-rate above it. The main difficulty is to account for the initial discontinuity high up in the polar air, from which the main inversion subsequently develops as the air descends. Over the oceans there is convectional cloud up to a considerable height in the early stages of subsidence, and it is not difficult to envisage the formation of a well-defined upper limit to the convection and cloud. But in America in winter the lower strata are normally stable, and turbulence from the ground cannot penetrate beyond a shallow layer. The author suggests radiation from a layer of haze as a possible cause, but it is difficult to account for the haze.

Another unsolved problem is that of down-sliding on the surface of subsidence. The author argues in favour of this, on the ground that the potential temperature at the top of the inversion sometimes rose as the inversion descended. His actual figures show that in these cases absolute humidity also rose, suggesting that the air mass was not originally homogeneous. In order to obtain real proof of down-sliding, one would need to follow up the motion of relatively small air masses by means of upper wind observations. No doubt the available data are inadequate for this, but the paper would have been improved if more upper wind observations had been published. In ordinary anticyclones it is very difficult to explain genuine-down-sliding, as distinct from a general sinking of the entire air mass, with a vertical motion increasing *continuously* up to 3 or 4 Km. A sloping inversion cuts a horizontal surface (say at 1 or 2 Km.) at a sharp front, and the main wind discontinuity is parallel to the front, and has no effect on the vertical motion. If the wind is geostrophic, the difference of density results in a slight down-sliding at a cold front, but this effect is very small. If the down-sliding is large enough to be of any practical importance, there must be an appreciable diverging non-geostrophic wind component at the front. This need only be small in relation to the geostrophic wind, but dynamically it is important, and no adequate explanation of such divergence at an anticyclonic inversion has ever been offered. A study of the isallobars indicates a general divergence, both below and above the discontinuity, and near the ground friction adds to the divergence of the lower strata—an effect opposed to down-sliding up above, since the latter involves an abrupt increase of downward motion above the inversion, usually a kilometre or more above the ground.

Namias has made a real contribution to our knowledge of the subject, but there is still much to be explained.

C. K. M. DOUGLAS.

The upper winds of Hong Kong from observations made with pilot balloons, 1921–1932. By G. S. P. Heywood, B.A., B.Sc. Size 12 in. × $8\frac{1}{4}$ in., pp. 13 + 9 plates. Hong Kong, 1933.

This pamphlet summarises in two tables and nine diagrams the results of 1,382 pilot balloon ascents made during the period June, 1921 to December, 1932 at Hong Kong. These results are set out in a very convenient form, and the discussion of the upper air structure at Hong Kong, which precedes the tables and diagrams, is clear and concise.

This upper air structure is interesting as in the winter, when the north-east monsoon is blowing, the prevailing winds near the surface are from ENE, whilst at a height varying between 5,000 and 10,000 feet there is a reversal of wind direction, and above this level strong westerly winds prevail. In the summer, on the other hand, the upper winds are easterly, whilst the surface winds, although much more variable than in the winter, are mainly southerly. There is little doubt that this marked difference between the upper air structure of winter and that of summer is largely due to the north and south movements of the equatorial belt of easterly upper winds, which in the winter lies to the southward of the latitude of Hong Kong (22° 18′ N), but which moves north throughout the spring, and south during the autumn. From June to September Hong Kong is within this belt, whilst during the remaining months of the year it is in the region of westerly upper winds which lies to the northward of the equatorial belt.

A table is given showing the individual results of every pilot balloon ascent made when the centre of a typhoon was within 1,000 miles of Hong Kong. The observations are mostly confined to the north-west and south-west quadrants of typhoons, and naturally very few flights could be carried out when a typhoon was within two or three hundred miles of Hong Kong. It is a pity that this table was not arranged so that the reader could tell at a glance the relative position of the typhoon at the time of any particular set of observations, or alternatively the data in this table might with advantage have been put into diagrammatic form.

It is to be hoped that some reliable method of forecasting the movements of typhoons will emerge as a result of the gradual accumulation of upper air observations in the vicinity of these storms, and in this connexion it is interesting to note that the forecasters at the Hong Kong Observatory have always held that an upper westerly wind precludes the possibility of a typhoon approaching the colony from the eastward (the usual direction from which these storms approach), and this precept appears to be correct.

A. E. M. DODINGTON.

India Meteorological Department, Memoirs, Vol. XXVI, Part I—Registration of earth current with neutral electrodes. By S. K. Banerji, D.Sc.

A method of recording earth current with short lines is described which is free from complications due to large polarisation current, the chief drawback to short line registration. Typical records are reproduced of earth current at Colaba and Alibag, distant respectively

5 and 25 miles from the centre of Bombay. The natural earth current at Colaba is swamped by artificial disturbances due to leakage from the electric tramway system in Bombay ; a record of the fluctuation in voltage at the Bombay power station is included for comparison. The declination magnetogram also shows disturbance during the period when the fluctuation in voltage is considerable. From records at Alibag, where the artificial disturbance is much smaller, the diurnal variation of earth current is deduced and curves showing the mean diurnal variation for the year and for the winter season separately are compared with similar curves of atmospheric potential gradient and of magnetic force. Finally, the earth current record and the magnetograms at Alibag on a day of magnetic disturbance are reproduced and compared in detail. The paper is clear and concise and touches briefly on the chief points which arise in the study of earth currents.

H. L. WRIGHT.

BOOKS RECEIVED

On the nature of the frequency distribution of precipitation in India during the monsoon months, June to September. By D. Sankaranarayanan. India Meteor. Dept., Sci. Notes, Vol. V, No. 55.

OBITUARY

We regret to learn of the death on March 2nd of Dr. Karl Langer, who maintained a climatological station at Bucklebury Place, Woolhampton, Berks, from 1905 to 1929.

We regret to learn of the death on March 19th, 1935, in his 35th year, of Mr. S. N. Plummer, Grade II Clerk in the Meteorological Office. Mr. Plummer served in the R.N.A.S. and R.A.F. from 1917–9 ; he entered the Office in January, 1920, and has worked mostly at Distributive Stations.

The Weather of March, 1935

Pressure was above normal over Europe and the Mediterranean, north and east Iceland, Spitsbergen, Alaska, northern Canada, eastern United States and Bermuda, the greatest excess being 11·1 mb. at Röst (Norway) and 4·0 mb. off Nantucket U.S.A. Pressure was below normal over southern Canada, most of the United States and the North Atlantic and also western Siberia, the greatest deficits being 5·8 mb. near Manitoba and 5·4 mb. at 50° N., 30° W. Temperature was above normal in Spitsbergen and generally in Scandinavia, but below normal in central and south-west Europe while rainfall was in excess in northern Norway and Svealand, but deficient elsewhere in Sweden and in central Europe.

The outstanding feature of the weather of the month over the British Isles was the deficiency of rainfall especially in the south-east, where at a few places absolute droughts occurred between about the 4th and 22nd. A cold spell was experienced on the 8th to 11th and on the 14th, while temperature was considerably above normal from the 16th to 28th. From the 1st to 3rd low pressure extended from Greenland to central Europe giving generally unsettled conditions, while gales were experienced in north Scotland and on the 2nd in south-west England as well. Snow was reported on the hills in Scotland and Wales and local mist or fog in England. After the 3rd the high-pressure area over the Azores extending north-east, joined with the high-pressure area over Scandinavia and gradually anticyclonic conditions spread from the south over the whole country. Gales with local hail and snow occurred at times in the extreme north and a thunderstorm was reported from Oban on the 5th. Elsewhere there was slight rain but many bright intervals ; Harrogate had 9·8 hours bright sunshine on the 4th. On the 7th mist or fog occurred generally. From the 7th to 14th an anticyclone was centred over Scandinavia and very cold easterly winds prevailed in the south with snow at most places in the Channel Islands and England as far north as York and Southport. Further north the winds were mainly SE. to S. and the weather fair and milder ; 10·6 hours bright sunshine were recorded at Oban on the 14th. Maximum temperatures in the south did not rise above 32° F. at Jersey and Tunbridge Wells on the 9th, and at many places in the south did not exceed 35° F. both then and on the 10th. The 12th and 13th were milder with much sun—10·4 hours at Lowestoft and Oxford on the 12th, but on the 14th there was a renewal of cloudy, cold conditions in the south. A depression passed eastwards across the country from the 15th to 17th and from then to the 26th pressure was low to the west and north and high to the south. Weather was unsettled in the north and west and mainly fair in the south with slight rain at times from the 16th to 21st, but heavier rain generally from then to the 26th—1·33 in. fell at Snowdon and 1·16 in. at Lake Vyrnwg (Montgomery) on the 23rd. Strong westerly winds reaching gale force at times were experienced in the south-west and west on the 23rd and again in the north and west on the 25th and 26th. Local mist or fog occurred frequently in England. Temperature was considerably above the normal during this time and rose above 65° F. at several places on the 20th and 21st—68° F. was recorded at S. Farnborough on the 20th and at Cromer on the 21st. These two days were also the sunniest—Manston (Kent) had 11·2 hours on the 21st. On the 26th the anticyclone to the south spread over the whole country and remained until the 30th and 31st, when the north and west came under the influence of another depression. The 27th and 28th were warm sunny days generally though thick fog occurred in the English Channel, but on the 29th the northerly wind current brought cooler weather with rain or drizzle in the east and cloudier conditions in the west. The 30th was a dull day and by the 31st strong winds rising to gale force were reported in the north in the evening. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	150	+45	Liverpool ...	102	− 2
Aberdeen ...	101	− 6	Ross-on-Wye ...	133	+25
Dublin	114	− 3	Falmouth ...	107	−28
Birr Castle ...	121	+11	Gorleston ...	140	+17
Valentia... ...	100	−15	Kew	109	+ 6

Miscellaneous notes on weather abroad culled from various sources

The Douro river was in flood on the 1st. Severe cold was again experienced in Switzerland after the 6th and snow fell in abundance on the 7th even in the low country, making ski-ing conditions good. Owing to a strong easterly gale and heavy seas, steamship communication between Spain and Africa was suspended about the 8th. A sudden cold spell occurred in Italy from about the 8th to 10th and snow fell in Naples and the surrounding country, and also in Abruzzi and many districts of Apulia as far south as Taranto on the night of the 8th–9th. Snowstorms and bad weather occurred in southern France, expecially the south-east on the 12th ; parts of the railway lines between Lyons and Nîmes were blocked by snowdrifts. Strong winds were experienced in the Austrian mountains from about the 10th–12th. By the 11th navigation was entirely free at Constanza. Red snow is reported to have fallen and laid nearly 1 in. deep at Kars (Transcaucasia) on the 22nd. On the 30th and 31st gales occurred in the Adriatic and five trawlers were sunk ; much destruction was also done in the Lake Garda region, while snow fell along the Tuscan Apennines (*The Times*, March 2nd–April 1st).

A heat wave was experienced in Bombay between the 8th and 11th, temperature reaching 100° F., while the humidity was much below the average. A severe sandstorm swept across Baghdad on the night of the 30th–31st and a 60 m.p.h. wind caused severe damage to the Kotah pontoon bridge (*The Times*, March 11th–April 1st).

Fewer bush fires than usual had been experienced in South Australia up to the 11th, although the dry spell was reaching record length. Heavy rain fell during the month in Victoria, New South Wales, the Northern Territory and parts of Western Australia, and light to moderate rain elsewhere in Western Australia and in New Zealand, while drought conditions prevailed generally in Queensland. A severe storm occurred off the north-west coasts of Western Australia on the 26th ; at Broome some houses collapsed (*The Times*, March 11th–29th).

A severe thunderstorm was experienced over St. John's, Newfoundland, on the 4th. The flooded tributaries of the Mississippi were still rising on the 14th and floods were reported from Missouri, southern Illinois and north-east Arkansas. Dust storms in the Middle Western States caused 19 deaths during the last fortnight of the month, besides much material damage, especially in western Kansas, eastern Colorado and parts of Wyoming. Temperature in the United States was very variable and unusually high readings were obtained during two warm spells in the fortnight ending the 26th. Precipitation was generally below normal except in some of the Gulf States, where the rainfall was heavy for the week ending the 12th (*The Times*, March 6th–28th, and *Washington D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin*).

Daily Readings at Kew Observatory, March, 1935

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see p. 1).
	mb.		°F	°F	%	in.	hrs.	
1	992·9	SW.2	37	47	70	0·01	3·1	r–r_0 1h.–2h.
2	1010·8	NNW.3	38	48	74	trace	0·1	m 7h. & 18h., r_0 21h.
3	1016·5	ENE.2	41	47	85	0·13	0·0	f 13h., r_0–R 16h.–23h.
4	1027·4	WNW.2	36	49	57	—	8·3	m 18h.–21h.
5	1028·8	WSW.3	32	51	44	trace	3·5	r_0 15h. & 16h. 10m.
6	1031·2	N.3	40	47	71	0·03	0·1	r_0 7h.–9h. 40m.
7	1036·4	NE.2	41	48	50	—	4·7	m 18h.–21h.
8	1038·1	ENE.4	35	38	58	trace	0·1	ps_0 21h. & 22h.
9	1032·0	ENE.7	30	35	53	trace	0·2	s_0 9h. & 17h.
10	1023·5	ENE.5	32	37	65	trace	0·2	s_0 23h. 50m.
11	1028·7	ENE.5	36	40	58	trace	3·0	s_0 early.
12	1033·2	NE.3	33	51	26	—	9·1	x early, z 9h.
13	1026·2	NE.4	34	49	57	—	5·6	z 9h. & 18h.–21h.
14	1017·5	N.2	35	41	81	—	0·0	m 0h.–17h, f 18h.
15	1012·5	S.2	38	51	57	—	5·3	f 18h, z 21h.
16	1000·0	SSE.2	38	56	64	0·01	0·1	f 0h.–10h., r_0 19h.
17	1006·8	N.1	45	54	72	trace	0·1	f 10h., r_0 14h. & 15h.
18	1019·4	W.2	40	55	74	—	5·9	f 0h.–8h.
19	1018·3	S.3	35	59	58	—	9·0	fx early.
20	1015·0	SSW.2	40	63	54	—	7·4	fw early.
21	1016·3	SW.3	38	63	56	trace	10·4	fx early, pr_0 22h.
22	1011·9	SW.4	47	55	79	0·02	1·3	$r_0$11h.,13h.,18h.&20h.
23	1013·4	SW.4	44	53	86	0·17	0·4	rr_0 11h.–18h.
24	1023·7	WNW.3	47	60	52	trace	8·4	d_0 23h.
25	1027·2	WSW.3	49	55	65	trace	0·8	d_0 0h.–0h. 15m.
26	1027·5	SW.3	40	58	79	—	2·4	w early.
27	1028·7	NNW.2	41	56	53	—	8·7	w early.
28	1029·0	W.3	39	59	58	—	6·4	fw early.
29	1028·8	N.4	44	52	59	—	1·5	w early.
30	1027·3	SW.3	40	47	67	—	0·0	
31	1017·1	W.3	43	57	62	—	3·4	
*	1021·5	—	39	51	63	0·37	3·5	* Means or totals.

General Rainfall for March, 1935.

England and Wales ...	38	per cent. of the average 1881–1915.
Scotland	71	
Ireland	53	
British Isles	49	

Rainfall: March, 1935: England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square.........	·37	20	*Leics* .	Thornton Reservoir ...	·78	42
Sur .	Reigate, Wray Pk. Rd..	·63	27	,, .	Belvoir Castle...........	·78	43
Kent .	Tenterden, Ashenden...	·28	13	*Rut* .	Ridlington	·70	40
,, .	Folkestone, Boro. San.	·28	...	*Lincs* .	Boston, Skirbeck.........	·37	24
,, .	Eden'bdg., Falconhurst	·44	18	,, .	Cranwell Aerodrome...	·45	32
,, .	Sevenoaks, Speldhurst.	·46	...	,, .	Skegness, Marine Gdns.	·37	22
Sus .	Compton, Compton Ho.	1·01	36	,, .	Louth, Westgate.........	·51	24
,, .	Patching Farm.........	·60	28	,, .	Brigg, Wrawby St.......	·42	...
,, .	Eastbourne, Wil. Sq....	·67	30	*Notts* .	Worksop, Hodsock......	·66	39
,, .	Heathfield, Barklye....	·94	38	*Derby*.	Derby, L. M. & S. Rly.	·69	40
Hants.	Ventnor, Roy.Nat.Hos.	1·48	72	,, .	Buxton, Terr. Slopes...	2·02	49
,, .	Fordingbridge, Oaklnds	·94	40	*Ches* .	Runcorn, Weston Pt....	1·00	50
,, .	Ovington Rectory.......	·91	35	*Lancs*.	Manchester, Whit. Pk.	1·22	54
,, .	Sherborne St. John......	·58	26	,, .	Stonyhurst College......	1·50	41
Herts .	Royston, Therfield Rec.	.58	32	,, .	Southport, Bedford Pk.	·97	44
Bucks.	Slough, Upton...........	·54	31	,, .	Lancaster, Greg Obsy.	1·46	46
,, .	H. Wycombe, Flackwell	·66	33	*Yorks*.	Wath-upon-Dearne......	1·30	75
Oxf .	Oxford, Mag. College...	·46	30	,, .	Wakefield,Clarence Pk.	·85	47
Nor .	Wellingboro, Swanspool	·46	26	,, .	Oughtershaw Hall.......	2·04	...
,, .	Oundle	·46	...	,, .	Wetherby, Ribston H..	·81	42
Beds .	Woburn, Exptl. Farm...	·41	24	,, .	Hull, Pearson Park......	·66	36
Cam .	Cambridge, Bot. Gdns.	.30	20	,, .	Holme-on-Spalding......	·85	47
Essex .	Chelmsford, County Lab	·76	44	,, .	West Witton, Ivy Ho.	·90	29
,, .	Lexden Hill House......	·55	...	,, .	Felixkirk, Mt. St. John.	·85	43
Suff .	Haughley House.........	·80	...	,, .	York, Museum Gdns....	·77	46
,, .	Campsea Ashe...........	·67	40	,, .	Pickering, Hungate......	·84	42
,, .	Lowestoft Sec. School...	·69	43	,, .	Scarborough..............	·62	34
,, .	Bury St. Ed., WestleyH.	·79	42	,, .	Middlesbrough...........	·53	34
Norf. .	Wells, Holkham Hall...	·36	22	,, .	Baldersdale, Hury Res.	1·68	54
Wilts .	Calne, Castleway.........	·72	34	*Durh* .	Ushaw College...........	·79	36
,, .	Porton, W.D. Exp'l. Stn	·81	41	*Nor* .	Newcastle, Town Moor.	·50	24
Dor .	Evershot, Melbury Ho.	1·19	40	,, .	Bellingham, Highgreen	1·11	38
,, .	Weymouth, Westham.	1·10	53	,, .	Lilburn Tower Gdns....	1·46	55
,, .	Shaftesbury,Abbey Ho.	1·33	57	*Cumb*.	Carlisle, Scaleby Hall...	1·32	54
Devon.	Plymouth, The Hoe....	1·11	38	,, .	Borrowdale, Seathwaite	...	...
,, .	Holne, Church Pk. Cott.	2·06	38	,, .	Borrowdale, Moraine...	2·61	31
,, .	Teignmouth, Den Gdns.	1·37	53	,, .	Keswick, High Hill......	1·15	26
,, .	Cullompton	1·30	47	*West* .	Appleby, Castle Bank...	1·32	49
,, .	Sidmouth, U.D.C........	1·27	...	*Mon* .	Abergavenny, Larchf'd	·78	26
,, .	Barnstaple, N. Dev.Ath	1·27	48	*Glam* .	Ystalyfera, Wern Ho....	1·55	29
,, .	Dartm'r,Cranmere Pool	2·30	...	,, .	Cardiff, Ely P. Stn.......	1·09	34
,, .	Okehampton, Uplands.	2·11	51	,, .	Treherbert, Tynywaun.	2·21	...
Corn .	Redruth, Trewirgie......	·96	27	*Carm* .	Carmarthen, Priory St..	1·00	26
,, .	Penzance, Morrab Gdn.	1·18	37	*Pemb* .	Haverfordwest,Portfld.	...	...
,, .	St. Austell, Trevarna...	1·57	46	*Card* .	Aberystwyth	1·59	...
Soms .	Chewton Mendip.........	1·33	37	*Rad* .	BirmW.W.Tyrmynydd	2·28	42
,, .	Long Ashton............	·68	27	*Mont* .	Lake Vyrnwy	2·13	50
,, .	Street, Millfield.........	·98	48	*Flint* .	Sealand Aerodrome......	·80	45
Glos .	Blockley	·39	...	*Mer* .	Dolgelley, Bontddu......	2·20	45
,, .	Cirencester, Gwynfa....	·50	22	*Carn* .	Llandudno	·69	34
Here .	Ross, Birchlea...........	·50	25	,, .	Snowdon, L. Llydaw 9..	5·48	...
Salop.	Church Stretton........	1·14	48	*Ang* .	Holyhead, Salt Island...	·91	35
,, .	Shifnal, Hatton Grange	·87	47	,, .	Lligwy	...	...
Staffs .	Market Drayt'n, Old Sp.	·57	27	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	·50	29		Douglas, Boro' Cem....	1·56	53
War .	Alcester, Ragley Hall...	·60	35	*Guernsey*			
,, .	Birminghm, Edgbaston	·64	34		St. PeterP't.Grange Rd.	1·54	62

Rainfall: March, 1935: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	1·25	44	*Suth* .	Melvich	3·16	111
,, .	New Luce School	1·83	52	,, .	Loch More, Achfary	7·94	123
Kirk .	Dalry, Glendarroch	1·67	37	*Caith* .	Wick	1·93	85
,, .	Carsphairn, Shiel	2·44	40	*Ork* .	Deerness	2·77	99
Dumf.	Dumfries, Crichton, R.I.	1·04	37	*Shet* .	Lerwick	3·65	116
,, .	Eskdalemuir Obs.	2·58	53	*Cork* .	Caheragh Rectory	2·11	...
Roxb .	Branxholm	1·21	42	,, .	Dunmanway Rectory	2·15	44
Selk .	Ettrick Manse	2·08	41	,, .	Cork, University Coll.	1·54	51
Peeb .	West Linton	1·56	...	,, .	Ballinacurra	1·65	58
Berw .	Marchmont House	1·51	57	,, .	Mallow, Longueville	1·61	56
E.Lot.	North Berwick Res.	1·42	76	*Kerry*.	Valentia Obsy.	2·17	48
Midl .	Edinburgh, Roy. Obs.	·91	46	,, .	Gearhameen	3·40	42
Lan .	Auchtyfardle	1·62	...	,, .	Darrynane Abbey	1·80	44
Ayr .	Kilmarnock, Kay Pk.	2·56	...	*Wat* .	Waterford, Gortmore	1·55	57
,, .	Girvan, Pinmore	1·85	49	*Tip* .	Nenagh, Cas. Lough	2·11	68
Renf .	Glasgow, Queen's Pk.	1·75	67	,, .	Roscrea, Timoney Park	2·17	...
,, .	Greenock, Prospect H.	2·12	43	,, .	Cashel, Ballinamona	1·86	68
Bute .	Rothesay, Ardencraig	2·29	...	*Lim* .	Foynes, Coolnanes	2·50	85
,, .	Dougarie Lodge	1·70	...	,, .	Castleconnel Rec.	2·83	...
Arg .	Ardgour House	6·89	...	*Clare* .	Inagh, Mount Callan	3·94	...
,, .	Glen Etive	6·07	77	,, .	Broadford, Hurdlest'n.	2·12	...
,, .	Oban	3·19	...	*Wexf* .	Gorey, Courtown Ho.	1·16	50
,, .	Poltalloch	3·50	92	*Wick* .	Rathnew, Clonmannon.	·96	...
,, .	Inveraray Castle	4·87	77	*Carl* .	Hacketstown Rectory	1·39	50
,, .	Islay, Eallabus	1·94	51	*Leix* .	Blandsfort House	1·72	66
,, .	Mull, Benmore	10·40	98	,, .	Mountmellick	...	...
,, .	Tiree	2·22	66	*Offaly*.	Birr Castle	1·36	57
Kinr .	Loch Leven Sluice	1·02	34	*Dublin*	Dublin, FitzWm. Sq.	·51	26
Perth .	Loch Dhu	3·20	49	,, .	Balbriggan, Ardgillan	·77	38
,, .	Balquhidder, Stronvar.	2·72	...	*Meath*.	Beauparc, St. Cloud	·99	...
,, .	Crieff, Strathearn Hyd.	1·62	51	,, .	Kells, Headfort	1·18	43
,, .	Blair Castle Gardens	2·14	82	*W.M* .	Moate, Coolatore	1·68	...
Angus.	Kettins School	1·37	56	,, .	Mullingar, Belvedere	2·07	77
,, .	Pearsie House	2·14	...	*Long* .	Castle Forbes Gdns	2·06	70
,, .	Montrose, Sunnyside	1·94	93	*Gal* .	Galway, Grammar Sch.	2·86	...
Aber .	Braemar, Bank	1·54	52	,, .	Ballynahinch Castle	2·46	48
,, .	Logie Coldstone Sch.	1·29	50	,, .	Ahascragh, Clonbrock.	2·36	71
,, .	Aberdeen, King's Coll.	2·06	85	*Mayo*.	Blacksod Point	2·13	52
,, .	Fyvie Castle	1·40	51	,, .	Mallaranny	2·99	...
Moray	Gordon Castle	2·00	86	,, .	Westport House	2·05	53
,, .	Grantown-on-Spey	1·53	58	,, .	Delphi Lodge	3·38	41
Nairn.	Nairn	1·37	73	*Sligo* .	Markree Obsy.	2·16	64
Inv's .	Ben Alder Lodge	3·26	...	*Cavan*.	Crossdoney, Kevit Cas.	1·52	...
,, .	Kingussie, The Birches.	2·00	...	*Ferm* .	Enniskillen, Portora	1·64	...
,, .	Inverness, Culduthel R.	1·35	...	*Arm* .	Armagh Obsy.	1·25	53
,, .	Loch Quoich, Loan	6·93	...	*Down*.	Fofanny Reservoir	1·44	...
,, .	Glenquoich	5·74	59	,, .	Seaforde	1·09	37
,, .	Arisaig, Faire-na-Sguir.	3·74	...	,, .	Donaghadee, C. Stn.	1·29	59
,, .	Fort William, Glasdrum	5·29	...	,, .	Banbridge, Milltown	·98	45
,, .	Skye, Dunvegan	4·40	...	*Antr* .	Belfast, Cavehill Rd.	1·96	...
,, .	Barra, Skallary	2·36	...	,, .	Aldergrove Aerodrome.	1·47	59
R&C .	Alness, Ardross Castle.	2·36	72	,, .	Ballymena, Harryville.	1·40	44
,, .	Ullapool	4·06	97	*Lon* .	Garvagh, Moneydig	1·20	...
,, .	Achnashellach	5·59	78	,, .	Londonderry, Creggan.	1·50	47
,, .	Stornoway	3·77	92	*Tyr* .	Omagh, Edenfel	1·54	49
Suth .	Lairg	2·47	80	*Don* .	Malin Head	1·34	...
,, .	Tongue	3·29	98	,, .	Killybegs, Rockmount.	1·98	...

Climatological Table for the British Empire, October, 1934

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and ½ Min.	TEMPERATURE. Mean Values. Diff. from Normal.	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy.	1015·4	+ 1·4	66	29	58·1	46·9	52·5	+ 2·6	48·3	89	7·5	0·87	− 1·83	12	2·6	24
Gibraltar	1018·9	+ 1·7	82	53	74·2	61·5	67·9	+ 1·5	60·5	83	5·3	1·27	− 2·00	5	...	...
Malta	1016·9	+ 0·9	82	58	73·2	63·9	68·5	− 2·4	63·9	80	5·2	2·94	+ 0·07	12	7·3	65
St. Helena	1015·1	+ 0·7	66	53	61·4	55·0	58·2	− 0·1	55·8	94	9·7	1·95	...	21	...	...
Freetown, Sierra Leone	1014·0	+ 2·4	90	70	85·0	72·4	78·7	− 1·4	75·5	88	6·5	12·67	+ 0·05	27	...	...
Lagos, Nigeria	1012·1	+ 1·1	87	70	84·9	74·5	79·7	0·0	75·5	87	8·1	13·45	+ 5·68	20	5·2	44
Kaduna, Nigeria	1008·8	...	91	64	88·0	66·8	77·4	+ 1·1	71·9	86	7·2	2·96	+ 0·21	12	8·1	68
Zomba, Nyasaland	1010·9	0·0	91	54	84·5	62·9	73·7	− 0·4	63·3	55	3·3	2·48	+ 0·96	3	...	...
Salisbury, Rhodesia	1011·3	− 0·7	92	49	82·6	57·6	70·1	− 0·6	57·3	39	1·4	1·67	+ 0·54	5	8·6	69
Cape Town	1017·3	− 0·1	88	43	71·3	55·0	63·1	+ 1·9	56·4	73	4·7	2·10	+ 0·45	12	...	...
Johannesburg	1012·6	0·0	85	37	75·8	52·5	64·1	+ 1·3	52·1	45	3·2	1·70	− 0·86	10	9·1	72
Mauritius	1018·8	+ 0·6	81	56	77·4	63·0	70·2	− 2·5	66·0	63	5·3	1·13	− 0·25	15	8·5	68
Calcutta, Alipore Obsy.	1009·5	+ 0·1	93	69	88·0	75·4	81·7	+ 2·4	75·9	87	4·3	5·36	+ 0·46	8*	...	...
Bombay	1009·9	+ 0·1	96	74	91·3	76·5	83·9	+ 1·5	74·9	76	2·8	0·21	− 1·46	1*	...	...
Madras	1008·6	− 0·3	96	72	88·3	75·4	81·9	− 0·4	77·5	86	6·9	16·82	+ 5·67	13*	...	...
Colombo, Ceylon	1010·3	+ 0·3	88	71	84·5	73·9	79·2	− 1·3	76·4	79	7·1	21·10	+ 7·74	25	6·0	50
Singapore	1009·8	+ 0·1	89	73	85·1	75·3	80·2	− 0·9	77·0	79	9·1	10·30	+ 2·23	20	4·8	40
Hongkong	1014·8	+ 1·1	85	63	79·2	70·6	74·9	− 2·0	68·6	71	7·4	2·21	− 2·73	11	5·1	44
Sandakan	1009·5	...	92	74	89·0	75·5	82·3	+ 0·9	77·7	82	7·5	8·42	− 1·91	24	...	...
Sydney, N.S.W.	1016·0	+ 1·2	83	45	69·3	54·4	61·9	− 1·7	57·6	64	6·1	1·93	− 0·92	12	8·5	66
Melbourne	1015·3	+ 0·5	81	37	66·6	46·4	56·5	− 1·2	52·2	61	6·6	6·16	+ 3·53	20	4·8	37
Adelaide	1015·9	− 0·1	92	41	71·4	51·8	61·6	− 0·4	54·6	53	6·9	2·00	+ 0·27	16	6·7	52
Perth, W. Australia	1017·8	+ 1·0	83	45	69·1	50·6	59·9	− 0·9	54·2	59	3·7	0·98	− 1·24	8	9·0	70
Coolgardie	1014·6	− 0·5	96	39	76·3	47·7	62·0	− 1·7	55·0	53	2·4	0·25	− 0·41	2	...	...
Brisbane	1018·6	+ 2·4	85	50	76·3	58·9	67·6	− 2·2	61·1	57	5·6	1·34	− 1·19	8	7·8	61
Hobart, Tasmania	1010·1	− 0·2	82	36	62·4	46·1	54·3	+ 0·2	48·4	59	6·4	2·69	+ 0·43	22	6·2	47
Wellington, N.Z.	1018·3	+ 5·2	67	39	59·6	47·1	53·3	− 1·1	50·8	77	7·1	6·85	+ 2·77	14	6·3	48
Suva, Fiji	1014·5	+ 1·3	88	66	82·0	70·3	76·1	+ 0·3	72·0	77	6·3	11·48	+ 3·19	15	6·1	49
Apia, Samoa	1011·6	+ 0·1	87	71	85·3	73·2	79·3	+ 0·9	75·7	75	5·4	4·90	− 1·48	14	7·9	64
Kingston, Jamaica	1011·9	+ 0·4	92	69	87·3	72·5	79·9	− 0·6	71·9	87	5·1	3·72	− 3·74	11	5·3	45
Grenada, W.I.	...	...	88	70	85	71	78	− 2·1	73	82	6	12·86	+ 5·10	21	...	...
Toronto	1017·3	− 0·2	73	28	55·9	41·2	48·5	− 0·1	41·8	79	5·8	1·31	− 1·26	6	5·4	49
Winnipeg	1015·6	+ 0·7	82	19	54·1	36·7	45·4	+ 4·7	38·2	86	6·6	0·42	− 0·95	7	4·1	38
St. John, N.B.	1013·2	− 2·6	67	30	51·7	39·4	45·5	+ 0·2	41·0	78	6·1	4·12	− 0·42	13	4·6	42
Victoria, B.C.	1014·7	− 2·4	72	42	57·8	47·0	52·4	+ 2·1	49·6	86	6·2	2·34	− 0·23	16	4·8	44

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

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Measuring the Flow of Rivers

Ere rivers league against the land
In piratry of flood,
Ye know what waters slip and stand
Where seldom water stood,
Yet who will note,
Till fields afloat,
And washen carcass and the returning well,
Trumpet what these poor heralds strove to tell! (*Kipling.*)

These lines, which Dr. H. R. Mill prefaced to the 1907 volume of 'British Rainfall", might have served as an inspiration to the British Association's Inland Water Survey Committee, whose efforts have now resulted in the setting up of an Inland Water Survey, under the auspices of the Ministry of Health. The driving force which caused the British Association to move in the matter came from Capt. W. N. McClean, who subsequently became Secretary of the British Association's Committee, of which Vice-Admiral Sir H. P. Douglas is Chairman and Lt.-Col. E. Gold, Vice-Chairman. For some years Capt. McClean has devoted himself with great enthusiasm and success to the measurement of river-flow. His work on the rivers draining into Loch Ness is well known to hydrologists. More recently he has worked on the River Dee (Aberdeenshire) and we now have his records for that river in the form of a portfolio containing data and charts of levels, flow and rainfall, published at the price of 10*s.* 6*d.**

* River Dee (Aberdeenshire). The records of water level, rainfall and run-off for the year 1934 by Capt. W. N. McClean (late R.E.), M.A.

It is not inappropriate that we should take notice of this work in the *Meteorological Magazine.* The amount of water flowing across a particular section of a river is an expression of the integrated result of a number of factors, partly geographical, partly geological and partly meteorological. Everyone knows that the water in the river represents the running-off of the rainfall which has occurred at some previous period over the area drained by the river, an area commonly referred to as the catchment area. It is also well known that the run-off in a period of say 12 months is very much below the figure obtained by integrating the rainfall over the catchment area. The loss is mainly due to evaporation, but is also partly due to seepage or percolation of water down to low-lying strata which do not drain into the river. For example, part of the loss in the Thames catchment area goes to replenish the deep-seated supplies which can be tapped below London by driving wells through the clay into the chalk.

The various factors cannot be readily disentangled. It is impossible, for example, to give a reliable estimate of the loss due purely to evaporation. We have measurements of evaporation from tanks, such as that at Camden Square, but if we compare such a record of evaporation for a series of years with a record of losses we find that the two do not run parallel. Evaporation from a tank is greatest in dry years, but the losses in a catchment area are greatest in wet years. The explanation of this fact is not far to seek, but we need not turn aside to consider it now. The important point is that if one really wants to know how much water runs off a given catchment area there is only one satisfactory method of obtaining the information, and that is to measure the flow of the streams draining the area.

Various methods of recording stream-flow are in use and descriptions of them are to be found in text-books. Only one method is regarded, however, as entirely satisfactory. In this method, which is that employed by Capt. McClean, two sets of data are involved. The first is a continuous record of the water level at one or more suitable gauge points. The second is a series of flow-meter readings for the purpose of determining the rate of flow corresponding to any given value of the water level. The recording of river levels is a comparatively simple operation; the real difficulty lies in the accurate determination of the flow and it is to this part of the problem that Capt. McClean has made important contributions. The method of procedure is fully described in a paper entitled "Practical River-Flow Measurement and its place in Inland Water Survey, as exemplified on the Ness (Scotland) Basin", read before the Institution of Water Engineers, December 1st, 1933. Briefly, the gauging of a stream for a particular value of the level involves the determination of the velocity of flow at a sufficient number of points on the selected cross section of the stream to permit of the total flow across the section being calculated by integration. The readings must be taken at various points across the stream from bank to bank, and at various depths. When the calculation has been made we have the value of the flow corresponding to one particular value of the water level; that is to say, we have one point on the "stage-discharge curve". The whole operation must be repeated for different levels from very low water up to high flood levels. The complete stage-discharge curve can then be drawn. Fortunately, it is found that in ordinary circumstances the river bed does not change its characteristics appreciably over long periods. Consequently the stage-discharge curve may be assumed to hold good for some years at least after its determination. Readings of level can thus be converted to flow by simple reference to the stage-discharge curve. The flow, which is usually expressed in "cusecs" (cubic feet per second), may, of course, readily be converted into millions of gallons per day, or depth in inches over the whole catchment area. The latter form of expression is the most useful for comparison with the rainfall.

From the meteorological point of view the relation of the run-off to the rainfall is naturally the most interesting part of Capt. McClean's work. For the determination of this relationship it is necessary to evaluate the general rainfall over the whole catchment area. The evaluations have been made from the formula

$$R_G = \sum (n/100 \times p/100 \times R)$$

where R is the rainfall measured by a particular gauge, regarded as representing n per cent. of the area, and p is the annual average general rainfall expressed as a percentage of the annual average for the particular gauge. Ten rain-gauges are available in the area, which has an average annual general rainfall of 42 in. The formula can obviously only give an approximation to the true general rainfall when a short period such as a day or a week is in question, but it is probably accurate enough for practical purposes.

The results for the year 1934 show that the rainfall exceeded the net run-off by 9·0 in. In the Thames basin the annual average loss is about 18 in. Although the rainfall of the Dee basin exceeds that of the Thames basin by no more than 50 per cent., it appears that a square mile of the Dee basin yields nearly four times as much surface run-off as a square mile of the Thames basin under normal conditions. This result serves to impress on our minds the vital importance of accurate determinations of run-off if we are ever to possess reliable data in regard to the surface-water supplies of this country.

E. G. BILHAM.

The Influence of the North Sea on Cold Easterly Winds

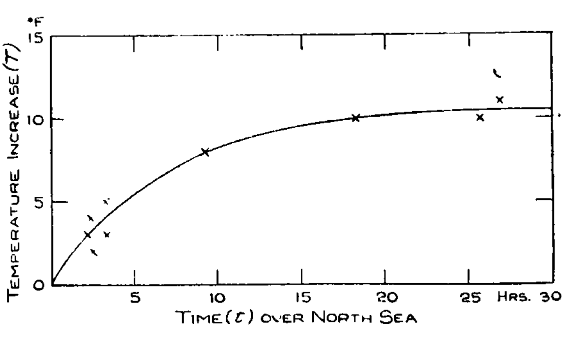
The effect of the North Sea as a tempering influence on the cold east winds from the continent in winter and the warm east winds in summer is well known. An example of the former case which occurred on March 9th, 1935, is sufficiently well marked to be put on record.

The cold easterly current set in on March 8th and was firmly established by 7h. G.M.T. on March 9th, when the temperatures at coastal stations on the east coast, given in column (2), were recorded.

Station.	Temperature at 7h. on March 9th.	Increase of temperature in crossing North Sea.	Length of air-track across North Sea.	Geo-strophic wind.	Time over North Sea.
	° F.	° F.	miles.	m.p.h.	hours.
Aberdeen ...	40	10	410	16	25·6
Leuchars ...	38	11	430	16	26·8
Tynemouth ...	37	10	400	22	18·2
Spurn Head ...	35	8	240	26	9·2
Yarmouth ...	33	3	120	36	3·3
Felixstowe ...	33	4	120	50	2·4
Shoeburyness...	32	5	130	40	3·25
Manston ...	30	3	90	40	2·25
Lympne ...	29	2	100	40	2·5

The length of the air track across the North Sea from coast to coast was measured and also the geostrophic wind at the different stations. The temperatures at stations on the coasts of Holland, Germany and Denmark which bordered on the North Sea were next examined. They varied irregularly between 27° and 30° F., but by taking the approximate temperature corresponding to the point where the easterly current left the shores of the continent, the increase in temperature of the current in passing over the North Sea to the stations given in column (1) was deduced. The values are set out in column (3).

The increase in temperature of the easterly current between the latitudes of Manston or Lympne in south-east England and the Scottish stations, is well marked, and on a first examination would appear to be proportional to the length of track over the North Sea. A glance at the geostrophic winds, however, indicates that a similar, but inverse, relation holds for the wind strength. In other words, the increase in temperature of the air current in crossing the North Sea is a function of both the length of track and of the speed of the current; i.e., a function of the time taken (column 6) to cross the North Sea. A



curve showing the relation between the increase of temperature (T) and the time (t) over the North Sea is given in the diagram. The curve indicates that at $t = 0$, i.e., assuming the east coasts of England and Scotland were joined to the neighbouring coastline of the continent, there would have been no increase of temperature. For values of t greater than about 25 hours the curve appears as if it might become asymptotic to the line $T = 11$; i.e., the maximum increase of temperature in crossing the sea is of the order of 11° F. This means that, taking an average figure of 29° F. for the temperature of the air current entering the North Sea from the east, the temperature will not rise appreciably above 40° F. in its further passage westwards. Now it would be expected that an air current would eventually take up the temperature of the sea over which it was travelling, provided the track was of sufficient duration. The figure of 40° F. is in good agreement with the average temperature of the surface water of the North Sea in March. The curve also indicates that it took approximately 24 hours of sea track for the air temperature to rise to this figure. Owing to lack of surface wind observations on the North Sea, however, the geostrophic wind, i.e., the wind at 1–2,000 ft. as deduced from the surface pressure gradient, was used in constructing column (6) of the table. Assuming the surface wind to be one-half of the geostrophic wind, a duration of approximately 48 hours sea track is required for the temperature of the air current to rise to its maximum, viz., the sea temperature.

A similar distribution of temperature to that noted in the table, though not always so pronounced each day, occurred along the east coasts of England and Scotland throughout the cold spell from March 8th to 11th, 1935. W. H. Bigg.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, April 17th, 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 :—

W. F. Tyler.—Bracing and relaxing climates.

Mr. Tyler considered the question of whether the cause of bracing and relaxing conditions can be ascertained. The conclusion arrived at was that while relative humidity was the only ordinary meteorological factor that might control those conditions and though doubtless it was frequently an important factor, yet on the average its effect was entirely swamped by one or more climatic stimuli of which we had no knowledge. In effect, the conclusion come to was that the problem of what bracing and relaxing conditions depend on was at present insoluble.

In connexion with the subject a curious climatic phenomenon at Shanghai—for which no reason could be found—was described. On days occurring perhaps once in six weeks, Chinese pedestrians in the fast motor traffic of the Nanking Road are so lethargic that they saunter across it looking neither to the right nor left, quite oblivious to the risk of doing so. At similar intervals—not necessarily alternate ones—the opposite occurs. Men dash across dodging cars; boys often double back like rabbits; women put their heads down and blindly flutter over; and rickshawmen race along at extra speed swerving to the right and left in an ecstasy of vigour. These two conditions do not merge into the normal; they are sharply marked. The only known approach to this behaviour in the West is the occasional collective wild orgy of skilful recklessness shown by the Paris taxi-drivers.

Lt.-Col. E. Gold, D.S.O., F.R.S.—The effect of wind, temperature, humidity and sunshine on the loss of heat from a body at a temperature, 98° F.

(*a*) Diagrams are given showing isopleths of cooling power of the air in millicalories per cm.^{2} per second for winds up to 30 m.p.h., and for temperatures from 0° to 90° F. for (i) a "dry" body at 98° F.; (ii) a "wet" body at 98° F.—(1) for dry air, (2) for saturated air; (iii) a "wet" body at 98° F. for wet-bulb temperatures from 0° to 90° F. They are based on the formulæ given by Sir Leonard Hill.

(*b*) The cooling power of the air at Croydon has been computed for each day of the year 1934 both for a dry body and for a wet body and a frequency table is given showing the number of days in each month with different degrees of cooling power. In an exposed situation there is little difference on the average between the cooling power by day and by night.

(*c*) The effect of reducing the wind to values similar to those ordinarily experienced in unexposed places has been examined for typical months. It is found that this smoothes the differences and reduces the mean values of cooling power by about one-third.

(*d*) The effect on cooling power in the daytime of solar and sky radiation is computed: in a warm summer month the gain of heat in the middle of the day exceeds the loss of heat by a body at 98° F. in a situation when the wind is only 1/4 of that recorded at Croydon at 100 ft. above the ground. The effect of loss of heat by outward radiation to sky and earth at night is shown to be generally insignificant compared with the losses due to convection and radiation to the surroundings at the temperature of the air.

(*e*) The relation between cooling power and the terms hot, warm, cold, is examined and a scale suggested which agrees with a scale independently proposed by Conrad. From this scale a scheme of terms appropriate to different conditions of temperature, wind, and cloud is obtained.

A. E. M. Geddes, D.Sc.—Temperature trend at Aberdeen from 1870–1932.

Temperature records at Aberdeen during the period 1870–1932 have been examined to test whether they show evidence of a change of climate in the north-east area of Scotland during the period mentioned. The first method adopted in the investigation is that of moving 20-year summations of temperature. This method was first applied to the whole year. The results seem to indicate a tendency, however, less marked at the end of the period.

To test the effect in the seasons, the year was divided into four, the winter season commencing with December. From the charts exhibited one might conclude that from near the end of last century the climate has become milder in winter and spring, has remained unchanged in summer, while in the autumn it has become colder. One finds from the examination of the months, that spells of warm seasons and warm months have occurred, but that these spells have not occurred simultaneously in all seasons nor in all months of the same season. Milder winters have been experienced during the last half of the 63-year period. There appears to be no evidence however, that the change is progressive, nor any guarantee that it will continue. The cause of the milder winters cannot be attributed to the increase in the number of houses, nor to the increase of fuel consumption in the neighbourhood. It may be found in a more persistent south-westerly air current during the winter months.

Correspondence

To the Editor, *Meteorological Magazine*

Rain in advance of true "Warm-front" Rain

A note by Col. Gold on this subject appeared in the November, 1934, number of this magazine. A similar occurrence was observed at Aldergrove on Friday, December 14th.

A very deep depression, centred about 600 miles west of Ireland at 7h., was moving eastwards. A few spots of rain fell at Aldergrove between 11h. 40m. and 11h. 45m., G.M.T. but were not recorded by the rain-gauge. There was then a short interval without any precipitation until about 12h. 10m. when, after a few minutes of heavy rain, there was continuous rain until about 12h. 50m., after which slight rain continued until about 13h. 30m. A further interval with no rain then followed and the appearance of the sky definitely improved. At about 14h. 25m. rain commenced again and continued up to 18h.

The sequence of events noted above is very similar to the case described by Col. Gold. In the present case, however, the wind veered from ESE. at 12h. 10m. to SSE. by 12h. 20m. and then backed again to ESE. by 13h. The speed also increased sharply from about 12 m.p.h. to 18 m.p.h. at the commencement of the veer, subsequently decreasing gradually to about 10 m.p.h. by 12h. 45m., after which there was an increase to an average of about 20 m.p.h. during the afternoon. These changes suggest that the rain may in this case have been due to some form of discontinuity.

A special pilot balloon ascent was made at 10h. 40m. The results are given below.

Height *ft.*	*Upward.* *ft. min.*	*Direction* *from N.*	*Speed* *m.p.h.*	
(525)	—	137	18	
1050	+50	153	29	
1560	+10	160	30	
2060	0	167	31	
2580	+20	171	36	
{3140	+60	171	41	Swinging Tail ?
3470}	−170	172	31	
3940	−30	171	42	
4440	0	166	46	
4980	+40	167	50	
5450	−30	164	41	

Balloon lost in cloud.

Though there are no outstanding features the changes in direction are of the same nature as those occurring at the surface later.

D. DEWAR.

R.A.F., Aldergrove, Co. Antrim, December 17th, 1934.

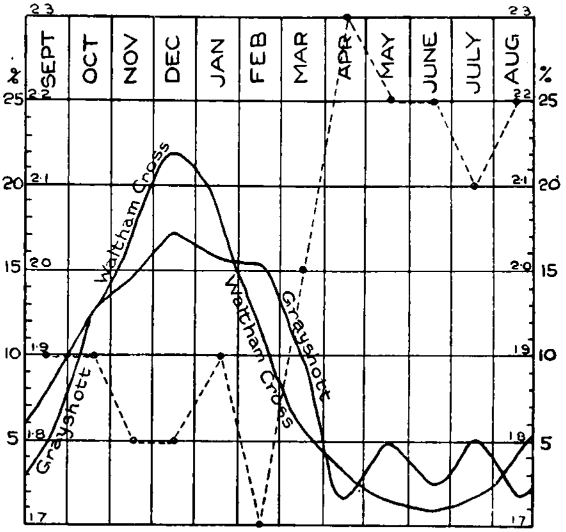
(At 13h. on December 14th, there was a slight but distinct warm front, roughly on a line from Aldergrove to Calshot. The main front was 150 miles to the rear and was occluded as far south as Scilly. The slight rain ahead of the first warm front had reached Croydon and Sealand by 13h., while the rain from the main front had not yet reached Pembroke or Portland Bill. The first front only gave very slight rain at most places.—C. K. M. DOUGLAS.)

Frequency of Calms in Winter

In the *Meteorological Magazine* for February, 1935, Mr. Donald L. Champion invited information as to the above subject.

The observer at Grayshott, on the Surrey border, has kindly placed the records at my disposal and I have found the monthly percentage frequency of calms at the observation hour (9h.) for the ten years 1925–34. The investigation was limited to this period to make the results comparable with Mr. Champion's. No mention was made of smoothing in his note, so I have plotted results directly as obtained. Both Waltham Cross and Grayshott curves are shown in the diagram. No smoothness was evident from the latter—in fact, I doubt whether I am justified in presenting the data as a continuous curve. Both, however, have their maxima in December; and the Waltham Cross minimum in June has its analogy at Grayshott, but here the curve is very irregular and a lower minimum occurs in April.

It has been the custom of the observer at Grayshott to make every month an arithmetical mean of the Beaufort numbers recorded each day. Though valueless quantitatively, the mean gives a rough idea of whether a month was quiet or windy generally. These mean Beaufort numbers have been plotted as a dotted line on the same graph. There is a rough inverse relationship with the percentage frequency of calms. From this we can assume with some safety that, for instance, the December minimum shows that it is generally a quiet month, rather than one in which conditions rapidly alternated from stormy to dead calm and back to stormy.



	Mean Frequency.		
	Winter.	Summer.	Year.
	%	%	%
Grayshott ...	14·1	1·7	8·8
Waltham Cross	14·4	3·4	8·9

Small figures inside the ordinates indicate means of Beaufort numbers of wind speed.

Grayshott is 661 ft. above M.S.L. I should think its climate is quite different from Waltham Cross, and this fact may cause the difference between the two curves of frequency of calms. I consider also that ten years is far too short a period of time to employ. The smoothness of Mr. Champion's curve may be largely fortuitous. Furthermore, at Grayshott, eight years out of the ten gave zero days of calm in April. I cannot believe that this is a regular occurrence.

S. E. Ashmore.

14, *Villa Road, Handsworth, Birmingham*, 19, *March 12th*, 1935.

Brilliant Refraction Phenomenon in Unusual Circumstances

A particularly brilliant refraction phenomenon was observed at this station at 15h. 30m. on January 29th, 1935. Bright orange colouring was first noticed on the side nearest the sun of an isolated fragment of comparatively low cloud moving with the general northerly drift and at the same altitude as the sun. In a short time the whole of the cloud fragment became a brilliant glowing patch of light, like a "luminous ball of cotton wool". The diameter of the roughly circular cloud fragment was approximately three times that of the sun, and the brightness became so intense that it caused temporary blindness similar to that experienced after looking directly at the sun itself. The brilliant phase was quite transient and soon began to fade gradually as the cloud moved toward the sun; at one or more phases of the phenomenon a greenish blue tint was also seen but unfortunately we are not in entire agreement as to the exact stages when this tint was observed. It was, however, less pronounced than the orange colouring. Within a short while the luminosity had faded and the cloud structure was again visible for a time before the cloud finally dispersed. It should be mentioned that the azimuth bearing of the luminous cloud was 23° north of the sun. At the time of the display the cloud fragment was in an almost blue sky although the front edge of a sheet of stratocumulus was approaching from the north at a height of 6,000 ft.

A further point of interest was a report from Flight Lieut. G. H. Stainforth, A.F.C., that he had produced "aeroplane" cloud at 5,500 ft. (temperature at this height about −8° C.) during the afternoon, and that he had seen the "mock sun" effect on this fragment of cloud soon after he had produced it. The appearance of the halo phenomenon establishes the fact that the artificially produced cloud was composed of ice crystals.

Whether the unusual brilliance was due purely to the halo effect or whether some of the luminosity was due also to an added "mock sun" effect is not obvious; the fact that the whole of the cloud fragment was equally brilliant and the band of orange colouring also prominent are rather against the "mock sun" effect and one is tempted to suggest that the restricted vertical thickness of the artificial cloud was a contributory factor.

F. H. Dight.

R.A.E., South Farnborough, Hants, February 12th, 1935.

Nocturnal Cooling and the Prediction of Night Mininum Temperatures

In view of Col. Gold's note in the *Meteorological Magazine* for May, 1934, suggesting further investigation into the subject of noctural cooling, begun at Larkhill* similar data have been extracted for the station at Abbotsinch, Renfrewshire.

Table I is based on observations for 8 months from September 1st, 1933, to April 30th, 1934, and varies in the same way as those for Larkhill, Ismailia and Catterick.† The short period for which data have been extracted is due to the fact that the station at Abbotsinch has only been open since February, 1933, and an anemometer record was only available from June, 1933; there is however, sufficient material to show that the formula found by plotting (T—M) against (T—D), as suggested by Col. Gold, is similar to those already published. The formula found to apply to Abbotsinch is :—

$$(T-M) = 0\cdot4\ (T-D) + 0\cdot35\ T - 4\cdot5$$

It is not surprising to see a variation in the constants when the geographical position of the various stations is considered; whereas Larkhill is situated on comparatively high ground, the land round Abbotsinch is very flat for about 2 to 3 miles in all directions with

* See *Meteorological Magazine* 69, 1934, p. 61.

† *Ibid.*, 69, 1934, p. 230.

hills rising rather abruptly to 800 to 1,200 ft. about 4 miles distant both to north and south.

TABLE I.—MEAN DIFFERENCE BETWEEN 16H. TEMPERATURE AND MINIMUM SCREEN TEMPERATURE, ON CLEAR OR PARTLY CLEAR NIGHTS WHEN THE MEAN WIND SPEED WAS LESS THAN 10 M.P.H. AT ABBOTSINCH, SEPTEMBER 1ST, 1933 TO APRIL 30TH, 1934.

Temperature at 16h.	35–44° F.	45–54° F.	55–64° F.	65–74° F.
Relative Humidity 16h.	Temperature Difference (T—M) ° F.			
90–100 per cent	10	—	—	—
80–89 per cent	11	12	18	—
70–79 per cent	13	16	20	—
60–69 per cent	15	17	21	22
50–59 per cent	16	21	23	—
40–49 per cent	—	—	—	—
30–39 per cent	—	—	25	—

R. T. ANDREWS.

R.A.F., Abbotsinch, Paisley, November 29th, 1934.

Sun Pillar seen from Salisbury Plain

A very distinct and noteworthy sun pillar was observed on Salisbury Plain at sunset between 18h. 30m. and 19h. on Saturday, March 30th, 1935. The sun was just below the horizon and the clouds in the immediate vicinity of the setting sun appeared to be a small amount of cirrostratus down on the horizon and some altocumulus at a rather higher altitude. The vertical pillar reached to a height which subtended an angle of about 8° to 10°. It was red in colour but brighter and lighter than the colour of the actual sunset.

A similar but much less marked pillar was also observed on the following evening, Sunday, March 31st, 1935.

C. W. LAMB.

R. A. F., Boscombe Down, Amesbury, Wilts. April 2nd, 1935.

[A sun pillar was also observed by Mr. H. W. L. Absalom from Wallington, Surrey, on the evening of March 31st, 1935—Ed. *M.M.*]

Temperature at Falmouth

For some years there had been an impression on my mind that the maximum temperature at Falmouth during the summer months was higher than is given in the *Book of Normals.* It is stated there, on p. 84, that at Falmouth the readings refer to a louvred screen on a north wall.

A set of *Reports of the Royal Cornwall Polytechnic Society* was given to me and from them were extracted the monthly mean maxima and minima for the 20 years 1893 to 1912 as taken by thermometers in the north wall screen and in a Stevenson screen. Averages from the two screens were computed with the following results.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
				Maximum Temperatures								
North wall Screen ..	47·0	47·1	49·2	53·1	57·9	62·7	66·4	65·6	62·2	56·5	51·4	49·3
Stevenson Screen ..	47·5	47·7	50·0	53·9	58·8	63·4	67·3	66·6	63·6	57·6	52·1	49·8
Deviation of North wall from Stevenson Screen ..	−0·5	−0·6	−0·8	−0·8	−0·9	−0·7	−0·9	−1·0	−1·4	−1·1	−0·7	−0·5
				Minimum Temperatures								
North wall Screen ..	40·3	39·8	40·4	43·3	47·1	52·1	55·5	55·3	52·8	48·3	44·0	42·7
Stevenson Screen ..	39·6	39·1	39·9	42·8	46·7	51·9	55·3	55·1	52·7	48·3	43·5	41·9
Deviation of North wall from Stevenson Screen ..	+0·7	+0·7	+0·5	+0·5	+0·4	+0·2	+0·2	+0·2	+0·1	0	+0·5	+0·8

The greatest deviation in the maximum is seen to be in September with 1·4° and in the minimum in December with 0·8°.

The north wall screen was dismantled in 1913.

C. C. VIGURS.

Marcus Hill, Newquay, Cornwall.

Abnormal Behaviour of a Pressure Tube Anemometer

The pressure tube anemometer, fully described in the *Meteorological Office Observer's Handbook,* records the wind velocity as measured by the movement of a float due to the difference in pressure between a " pressure pipe " open to the direct force of the wind and a " suction pipe " in which the pressure is reduced by the wind blowing past a number of small holes. The pressure and suction sides each contribute to the total effect and when either side is cut out and the bottom of the appropriate pipe opened directly to the surrounding air by means of the tap provided the recorded velocity is reduced. The following behaviour, recently observed, was therefore rather mystifying.

During a period of light winds, about 4 m.p.h., the suction pipe was opened to the room and instead of the recorded velocity decreasing there was a marked increase of some 3 m.p.h. When, on the other hand, the pressure side was cut out and the suction side alone in action the reading fell rapidly to zero. Broadly speaking the pressure pipe alone gave a reading of 7 m.p.h., both pipes together 4 m.p.h., and the suction pipe alone registered a flat calm. The immediate and obvious inference, that for some reason the suction pipe was behaving as a pressure pipe, was however not substantiated by any apparent defect and it was some time before the true explanation presented itself. It has been mentioned that either side is cut out by opening the float to the air in the room while the tube leading to the anemometer head is closed. If, therefore, the air in the room is at a lower pressure than that outside, the suction effect will appear weak and the pressure effect strong; if the pressure in the room is even less than that in the suction pipe this side will appear to have a negative effect, opening it to the room will cause an increase in the reading. That this was the correct interpretation was easily demonstrated by the opening of the door or window of the room when, the pressure within and without being equalized, the instrument was found to work normally.

The only cause which can be suggested to account for the smaller pressure within the room is the forced outflow of air caused by an open fire; there has so far been no opportunity of making a test in the room without fires and it will be interesting to see whether the cause has been rightly inferred. The necessary pressure is only a small fraction of a millibar, for the total pressure difference in a wind of 5 m.p.h. is only about ·04 mb.; at higher velocities the effect of the same pressure differences rapidly becomes negligible. It is, of course, important to note that the effect is only to give an apparent failure of the suction side as, when both pressure and suction sides are in action, the working of the instrument is independent of the pressure within the room.

R. C. SUTCLIFFE.

R.A.F., Felixstowe, February 13th, 1935.

Cloud Formation at Sealand

During the late afternoon of Monday, March 11th, 1935, a very interesting example of cloud formation was witnessed at Sealand, near Chester.

An isolated band of cirrus appeared to the east at 17h. 30m. and proceeded to extend towards the west. This westerly development continued until 17h. 40m. when the band extended from an elevation of 22° to 84°. During the time the first band of cirrus was extending to the west two further bands appeared, one on each side of the original and at an angular distance of 20° from it.

A most interesting phase now occurred as, although the front parts of these three bands remained almost stationary, the eastern ends dissolved with the result that the western ends seemed to absorb the remainder of the bands until at 17h. 50m. three isolated patches in an almost clear sky were all that remained. The cirrus was particularly dense and white in appearance, and while the northerly edge of all three bands was quite smooth, the southerly edge was rough and tufted. The cirrus movement was 9 rad./h. from 90°.

G. R. READ.

Roker, Station Road, Gt. Saughall, nr. Chester, March 12th, 1935.

Fog at Anacapri

Fog is very unusual here. In fact the long distance lighthouse on the south-west corner of this island of Capri is not, as far as I know, provided with any fog signalling apparatus.

But on Thursday last, April 11th, towards sunset, a thick tide of fog lying close on the water was seen to be advancing from the south-west. During the whole of the night the fog covered the sea and lay there until it was dispersed by the sun about midday on the 12th. Throughout the whole time it was close down on the water.

I suppose that the fog cannot have been more than 100 ft. deep. Above was warm air and a perfectly clear sky which followed on a clear and warm day (exceptionally warm for this year, which has been distinguished here by the length of the winter and unusual cold). It struck me that, as the fog lay so very close on the water it might be due to some cold water which had been thrown up from depths by some submarine earthquake.

The usual thing which happens to us here at the early part of the spring is cold winds coming down from a northerly and north-easterly direction off the snows on the mountains of the mainland.

M. RAWNSLEY.

Dil-Aram, Anacapri, Italy, April 15th, 1935.

Unusually Bright Tangential Arc.

Attention was drawn by Mr. Goodyear this morning to an unusually large and bright tangential arc (46°). The colours were equal in brilliance to the brightest rainbow. Elevation of arc was approximately 65°, and the extremities subtended an angle of over 80° at the ground.

The arc persisted from 9h. 0m., when first seen, to about 9h. 10m., when it faded rapidly. No other halo phenomenon was seen. The appearance of the sky at the time was chaotic with clouds mostly high and medium at various heights. Thin altostratus could be seen passing in front of the arc, as evidenced by watery streaks against the bright colours.

J. C. CUMMING.

Meteorological Station, R.A.F., Upper Heyford, Oxford, March 5th, 1935.

NOTES AND QUERIES

Rainfall at Cranmere Pool, Dartmoor

Everyone who has had occasion to study rainfall statistics closely is aware of the fact that our data are apt to be least complete for the areas of greatest interest, namely, the moors and uplands where rainfall is heavy and where many streams and rivers have their birth-place. Such areas are very sparsely inhabited and it is a matter of considerable difficulty to obtain even monthly readings of a rain-gauge. One such area about which we possessed, until recently, little information is the northern part of Dartmoor. In 1930, information was received from Mr. H. P. Cornish, of Keswick, that two residents of Okehampton—Mr. E. P. Burd and Mr. R. Harry—would be prepared to read monthly rain-gauges set up in this area. Shortly afterwards two gauges of the new " Octapent " pattern were installed at Newbridge (1,500 ft.) and Cranmere Pool (1,845 ft.) about 3 miles and 6 miles respectively, south of Okehampton.

Initially, the Newbridge gauge was read by Mr. Burd, but he was obliged to relinquish the task in September, 1933, and since that date both gauges have been read by Mr. Harry. We were aware from the outset that a monthly visit to Cranmere Pool, in particular, was an undertaking that called for real enthusiasm. In the belief that the observer's experience would be of interest to readers of this magazine, I invited Mr. Harry to contribute the note printed below and I am glad to take this opportunity of acknowledging our indebtedness to him, and to Mr. Burd also, for their services in extending our knowledge of the rainfall of this interesting region.

It may be added that the readings show that the rainfall at Cranmere Pool is a little less than at Princetown Prison, some 8 miles further south. The highest monthly total so far recorded is 22·9 in. at Cranmere Pool in December, 1934.

E. G. Bilham.

" Is this all that there is to see? " is perhaps the most usual remark made by those who visit Cranmere Pool for the first time. Pool, there is none ; though probably there was one there once before the peat washings from the surrounding bogs half filled it and the erosion of the winter storms cut a channel through the banks on the north side. And yet this weird and lonely hollow, 1,850 ft. above sea level, concealed in the great central morass of Dartmoor is a rendezvous for thousands every year from all parts of Devon. Tucked in a hole on the west side is a zinc box containing a visitors' book. The last book was filled in sixteen months and contained over 4,000 names. Postcards and letters are also left to be taken away and posted the next day, the writer once posted 140 letters and cards at one time. Besides being an objective point, it is almost equidistant from Princetown, Lydford, Okehampton and Chagford ; its charm lies, I believe, in its remoteness from civilization—four miles from a house and seven from a town, or village, and also the difficulty for a stranger even when equipped with a map and compass in finding it. There is an entire absence of adjacent landmarks to guide one and the ground around is a bewildering maze of hummocks, ridges, gullies and fissures, covering the great beds of peat in places as much as 8 ft. deep. A few years ago a gauge was placed at the Pool and has been visited once every month. A second journey had to be made once as the water in the gauge had frozen solid. Whilst the seven-mile journey—five of which from Okehampton can be done by car—is in summer a pleasant journey, winter time is a different story. Contrary to general belief, fog is very rare and has never caused any trouble, but snow blocking the road with drifts and filling all the gullies and pits is a much worse enemy. Two years ago the car had to be dug out of a drift in which it stuck, and this year being unable for the drifts to take it more than half-way the rest of the journey was made on foot. The snow was thawing rapidly and the ground underneath waterlogged; more than one gully was slipped into waist deep, not nice when filled with ice cold water, but eventually the Pool was reached, the gauge read and the homeward journey made in safety. When the gauge was first placed at the Pool it was often interfered with by thoughtless persons, but the provision of a lock and its removal to a short distance away did much to reduce this. The Pool is popularly supposed to be haunted by the ghost of a former Mayor of Okehampton—Benjamin Gayer ("Bengie" for short)—who was banished to this lonely place by the local clergy with "candle bell and book" for returning to this mortal world to trouble his widow who had consoled herself with a second husband.

S. R. Harry.

REVIEWS

India Meteorological Department, Scientific Notes, Vol. V, No. 56. *A Preliminary Study of a Tornado at Peshawar.* By Flt.-Lieut. R. G. Veryard, B.Sc., R.A.F.

This interesting paper describes a tornado which passed close to the meteorological station at Peshawar on April 5th, 1933. A very full description is given of the meteorological conditions during April 4th and 5th, and the account is accompanied by very fine photographs of the tornado taken at five-minute intervals. This tornado ploughed up a furrow 90 feet wide and 1 foot deep for 1¼ miles but did little damage beyond tearing up some crops.

The aerological situation is described in great detail based on upper air temperature observations made by the R.A.F. at Risalpur 30 miles east of Peshawar and on pilot balloon observations at Peshawar, Quetta, Lahore and Karachi. The tornado occurred close to the tip of the warm sector of a depression passing eastwards across North-West India and three different air masses were in the vicinity of Peshawar at the time it occurred. These air masses were (1) warm moist air in the warm sector moving from south-west, (2) cold dry air moving from north-west, and (3) cool dry air moving from between south-east and north-east. The warm moist air was in an unstable state with a lapse rate of temperature exceeding the saturated adiabatic and approaching the dry adiabatic lapse. The cold air surface is assumed to have taken the form described by Giblett of an overhanging wedge extending in front of the surface cold front. As described by Wegener there is a tendency for the formation of a vortex about a horizontal axis along the overhanging wedge while the violent convection produced in the unstable warm air by the underrunning cold air leads to the formation of vortices about vertical axes. Both these effects are considered to have played a part in the production of the tornado. The cool dry air in front of the depression appears to have been moving towards Peshawar from the north-east or north and the author considers this to have played an essential part. His reason for this does not seem quite clear. Tornadoes do not occur exclusively at the tip of warm sectors with three different air masses in close proximity but also occur along straightforward cold fronts and even under cumulonimbus unassociated with any front.

The paper is accompanied by numerous diagrams in addition to the tornado photographs. These diagrams give maps of the tornado track, isobaric charts, charts of upper winds, pilot balloon trajectories and height curves, reproductions of the autographic records at Peshawar of pressure, temperature, wind and rainfall, and height-temperature and tephigrams of the Risalpur upper air temperature observations.

G. A. Bull.

General Astronomy by H. Spencer Jones, M.A., Sc.D., F.R.S., Astronomer Royal, 2nd edition, Size 8½ in. × 5½ in., pp. viii + 437. *Illus.*, London, E. Arnold & Co., 1934, 12*s.* 6*d.* net.

Dr. Spencer Jones published the first edition of his well-known text-book in 1922. Since that date the science has made notable strides, especially in the realm of astrophysics. The second edition has been thoroughly revised and contains much additional matter.

The work is essentially a text-book and provides a well-balanced summary of modern astronomy and astrophysics. It is not intended as a popular account of the more spectacular aspects of the science but Dr. Spencer Jones has the gift of lucid exposition and the book is suitable for the general reader as well as for those desirous of beginning a serious study of the subject. With the exception of occasional formulæ the book is non-mathematical in character. It is well-produced and is illustrated with many clear diagrams and reproductions of astronomical photographs.

E. W. Barlow.

Radio round the World. By A. W. Haslett. Size 7½ in. by 5 in., pp. vii + 196. *Illus.* Cambridge University Press, 1934, 5*s.*

This is a really excellent little book for the general reader. Mr. Haslett has a wide knowledge of his subject, both in its theoretical basis and in the problems of practical application, and he has also the ability to set out his knowledge in a lucid and non-technical way. After a brief prelude on waves in general, he proceeds with an historical account of the work of Maxwell, Hertz and Marconi. The latter introduces the problem of long-distance transmission and an account is given of the "mirrors" in the upper atmosphere—the Kennelly-Heaviside and Appleton layers.

Although " popular " in the sense that no mathematical symbols appear and technical jargon is successfully avoided, this section is very thorough and should be read by meteorologists with interest. The present reviewer certainly both profited by it and enjoyed it.

Chapter IV, entitled "Up in the Sky", and Chapter V, "The sun calls the tune", carry the story further, describing the diurnal and seasonal changes in the height of the reflecting layers and the influence of the eleven year sunspot cycle and other solar changes on the propagation of wireless waves. The book is sufficiently up-to-date to include an account of the work carried out by the British party at Tromsö during the Polar Year of 1932–3, but the discussion of the nature of corpuscular radiation from the sun might have been fuller and clearer.

The remaining chapters deal with applied radio, including probable future uses of ultra-short and micro waves (shorter than 1 metre). To illustrate the relation between X-rays, light rays, etc. and wireless waves the old analogy of octaves on the electro-magnetic piano is adopted but the diagram is not very helpful and could have been made clearer. The description of the properties and uses of ultra-short and micro waves is good. There are interesting chapters on Television, Radio and Medicine, Radio and Safety at Sea, and Radio in War, and the book concludes with a short account of " Radio and the Weather Forecaster ". The description of the international exchange of weather information is far too sketchy even for a popular book (it occupies only 1½ pages), but the account of the location of thunderstorms and cold fronts by direction finding on atmospherics is fuller.

References to authorities are few—the name of Watson Watt for example is not once quoted in spite of frequent mention of the cathode-ray oscillograph—but that is not a serious fault in a book of this kind. The author does what he sets out to do, and it is likely that his readers, next time they tune-in to a broadcast programme, will spare a thought for the romance and invention behind the knobs.

BOOKS RECEIVED

Jaarboek, Koninklijk Nederlandsch Meteorologisch Instituut, 1932. A. Meteorologie, B. Aard-Magnetisme (Nos. 97 and 98), Utrecht, 1933.

Ergebnisse Aerologischer Beobachtungen, 1932. K. Ned. Meteor. Inst. (No. 106A), Utrecht, 1933.

The Weather of April, 1935

Pressure was above normal over Alaska, most of Canada, Greenland, Iceland, Spitsbergen, the extreme north of Europe, and over southern Europe and the Mediterranean, the greatest excesses being 8·8 mb.

at Spitsbergen, and 4·9 mb. in central Canada, while pressure was below normal over the United States, south-east Canada, the North Atlantic, western, central and eastern Europe, and western Asia, the greatest deficits being 8·0 mb. at Bornholm, and 4·7 mb. at 50° N., 30° W., and near Reno (Nevada, U.S.A.). Temperature was above normal at Spitsbergen, most of Scandinavia and at Kew; but was below normal in Portugal and in central Europe. Rainfall was generally in excess especially in Norrland and western Svealand where in some parts it was more than three times the normal.

The dominant feature of the weather of April over the British Isles was the excess of rainfall except in the Hebrides and parts of Ireland. Sunshine was generally deficient in Scotland and south-east England, but variable elsewhere. From the 1st to the 5th with high pressure on the Atlantic and low pressure on the continent, the British Isles came under the influence of north-west to north winds, which reached gale force at times in the extreme north; bright periods with snow, sleet, hail or rain occurred generally over the whole country. The 1st was a warm day, but the weather got colder after that and a maximum of 37° F. was reported from Aberdeen and 39° F. from Cambridge on the 4th. From the 6th to the 23rd complex low pressure systems with alternate ridges of comparatively high pressures passed across the country coming gradually further south and unsettled weather with rain generally ensued. Gales occurred at times at exposed places, especially on the 10th and thunderstorms were experienced locally, especially between the 20th and 23rd. Between the passage of depressions, however, bright intervals with good sunshine amounts were enjoyed, particularly so on the 6th, 11th and 12th, in Scotland on the 19th, east England on the 23rd, and at isolated places on other days, 13·0 hrs. were measured at Tiree on the 19th, 12·8 hrs. at Clacton on the 23rd, and 12·5 hrs. at Oban on the 12th. During this period rainfall was frequently moderate to heavy, 2·03 in. were registered at Trecastle (Brecon) on the 8th, 1·95 in. at Treherbert (Glamorgan) on the 9th, 1·94 in. at Denshaw (Yorkshire) on the 23rd, and 1·56 in. at Fofanny (Co. Down) on the 19th. Temperature was mainly about or above the normal, maxima of 60° F. being reported occasionally, while 63° F. occurred at Greenwich on the 20th and 65° F. at Cranwell and Camden Square (London) on the 23rd, but frosts were experienced on many nights, especially on the nights of the 6th–7th, 11th–12th, and 12th–13th; 17° F. was recorded at Rhayader on the 12th and Durham on the 13th. Mist or fog occurred in the south-east and east on the 13th–15th and inland on the 20th. On the 23rd the low pressure system gave way to an anticyclone over the Atlantic which moved north and east and remained covering the British Isles for the rest of the month. Quiet variable conditions prevailed generally with cool northerly winds and much cloud and some drizzle, especially in the east—in the west conditions were finer and sunnier, though some sunny days were also experienced in the east. Tiree had 14·5 hrs.

bright sunshine on the 25th and Mallarany 13·6 hrs. on the 27th. Thunderstorms occurred locally on the 23rd and 24th and slight mist or fog was frequent. Temperature was variable during this time but reached 60° F. at some places on most days; 66° F. was recorded at Waterford on the 27th and 65° F. at Markree Castle on the 26th and Valentia on the 27th. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	137	−20	Liverpool ...	172	+13
Aberdeen ...	107	−44	Ross-on-Wye ...	142	− 5
Dublin	145	−17	Falmouth ...	149	−39
Birr Castle ...	157	+ 3	Gorleston ...	136	−34
Valentia... ...	164	+ 5	Kew	113	−36

Miscellaneous notes on weather abroad culled from various sources.

Severe frosts occurred in the Bordeaux area on the 3rd and 4th and severe frosts also damaged the vines over a large area round Santarem, Portugal, about the 7th. Heavy rains caused a landslide near Ober-Audorf, Upper Bavaria, on the night of the 22nd–23rd, and a big landslide caused by the thaw and heavy rain also occurred in the valley of Abondance, Haute Savoie, on the 24th, the main road to Abondance being blocked by mud in spite of protective works. Snow fell in many parts of France on the 24th. Navigation reopened at Vasa (Finland) on the 10th, at Riga on the 25th, and Levisa (Finland) on the 26th. (*The Times*, April 8th–27th.)

A dense duststorm occurred in the Baghdad area on March 30th. A typhoon swept across the Philippine Islands on the 7th, killing 70 people on Luzon Island and 33 on Samar Island, and doing extensive damage. (*The Times*, April 1st–12th.)

At the beginning of the month rain fell in the northern pastoral districts of South Australia, in parts of which it is reported that no rain has fallen for 12 years. (*The Times*, April 3rd.)

The Newfoundland train service was paralysed for about a week at the beginning of the month by snowstorms; in some places the snow was 14 ft. deep on the line. Tornadoes were experienced in Louisiana, Mississippi and Alabama on the night of the 6th and on the 7th, causing the death of 26 people and injuring about 200 others. Snow fell on the 7th in Missouri and parts of Iowa, Illinois and Kansas and was followed by low temperatures. Gales occurred on the North Atlantic seaboard and over the North Atlantic on the 7th, 8th and 9th. Duststorms were continuing in Oklahoma, Kansas and parts of Colarado, Texas and Nebraska during the middle of the month, while rain had broken the drought in the Dakotas and parts of Nebraska, Colorado and Wyoming. Snow fell over a wide area stretching from New York to Cleveland (Ohio) and Charleston (Virginia) on the 16th, while 11° of frost were recorded at the Niagara Falls. Heavy rain and snow broke the drought over a large part of the north and middle-west about the 26th, but duststorms were again experienced at the end of the month. During the first three weeks of the month temperatures were mainly below normal except in the Gulf States early in the month and in the Mountain Region and Pacific coast about the middle of the month, while rainfall was generally irregular in distribution and slight, though some heavier falls occurred in the east early in the month. (*The Times*, April 8th–May 3rd, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, April, 1935

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see p. 1).
	mb.		°F	°F	%	in.	hrs.	
1	1012·8	NW.4	47	52	46	0·03	3·8	r_0–r 21h.–24h.
2	1015·1	NNW.5	38	48	46	0·04	5·7	pr 15h. ; pr_0 18h.
3	1017·2	N.4	35	44	69	0·02	6·8	ph_0 rs_0 s_0 12h.- 16h.
4	1005·6	NNW.3	35	45	71	0·11	0·0	prs_0 7h. ; r 14h.–17h.
5	1006·2	WNW.3	32	46	62	0·03	6·8	prs 12h. & 15h.
6	1009·5	W.4	33	51	42	0·01	9·5	r 23h.–24h.
7	1003·5	WNW.3	42	55	54	0·54	2·6	r 0h.–6h. & 15h.–24h.
8	1005·8	NW.3	42	52	90	0·45	4·6	Rrs 12h.–13h.
9	1002·7	SW.5	45	57	81	0·10	0·0	rr_0 0h.–2h. & 8h.–11h.
10	999·3	SW.6	52	57	65	0·20	1·7	rr_0 0h.–9h. & 21h.–
11	1007·5	WSW.5	49	57	46	0·09	7·8	pr 10h. [23h.
12	1004·3	NE.3	38	53	56	—	2·0	x early.
13	1015·1	SSE.3	34	52	53	0·14	5·3	f 7h. ; r 19h.–22h.
14	1006·2	W.2	41	53	65	0·04	3·7	r 14h.–15h.
15	1012·0	SW.2	37	57	65	0·06	3·1	F 7h. ; r 21h.–24h.
16	996·7	WSW.4	46	52	65	0·26	5·1	r 0h.–5h. ; pr 13h.
17	994·3	W.3	40	54	51	0·06	8·4	rr_0 1h.–3h. & 9h.
18	1004·6	W.3	44	56	51	0·07	4·6	rr_0 15h.–19h. & 24h.
19	1008·0	SW.4	49	58	73	0·09	2·7	rr_0 0h.–3h.
20	1002·6	S.2	48	58	80	0·04	1·3	pr 14h.
21	1000·6	S.4	47	58	61	—	5·2	
22	1006·5	SSW.4	45	57	63	0·01	3·8	pr 11h.
23	1014·5	N.2	39	61	57	—	4·8	f 0h.–10h.
24	1021·0	NE.4	44	54	77	—	3·6	w early.
25	1018·3	N.3	40	49	69	0·29	0·0	r–r_0 13h.–19h.
26	1019·4	NNE.4	46	53	72	—	5·0	
27	1024·0	NNE.4	44	49	78	—	0·0	
28	1027·9	NE.3	44	51	70	—	0·1	
29	1026·3	WSW.2	44	61	70	—	4·0	w early.
30	1021·0	SSW.1	43	61	70	—	0·8	f w early.
*	1010·3		42	54	64	2·69	3·8	* Means or totals.

General Rainfall for April, 1935.

England and Wales ...	186	per cent. of the average 1881–1915.
Scotland	144	
Ireland	116	
British Isles	162	

Rainfall : April, 1935 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square	3·09	200	*Leics* .	Thornton Reservoir	3·57	210
Sur .	Reigate, Wray Pk. Rd.	3·62	217	,, .	Belvoir Castle	2·38	156
Kent .	Tenterden, Ashenden	3·69	228	*Rut* .	Ridlington	3·55	226
,, .	Folkestone, Boro. San.	3·32	...	*Lincs* .	Boston, Skirbeck	2·09	155
,, .	Eden'bdg., Falconhurst	3·60	193	,, .	Cranwell Aerodrome	2·67	202
,, .	Sevenoaks, Speldhurst.	3·17	...	,, .	Skegness, Marine Gdns.	2·28	170
Sus .	Compton, Compton Ho.	4·41	221	,, .	Louth, Westgate	2·77	166
,, .	Patching Farm	4·03	230	,, .	Brigg, Wrawby St.	2·16	...
, .	Eastbourne, Wil. Sq.	3·80	209	*Notts* .	Worksop, Hodsock	1·61	110
,, .	Heathfield, Barklye	4·05	219	*Derby*.	Derby, L. M. & S. Rly.	3·24	199
Hants.	Ventnor, Roy.Nat.Hos.	3·59	214	,, .	Buxton, Terr. Slopes	4·16	141
,, .	Fordingbridge, Oaklnds	3·62	198	*Ches* .	Runcorn, Weston Pt.	2·34	135
,, .	Ovington Rectory	5·09	269	*Lancs*.	Manchester, Whit. Pk.	2·74	143
,, .	Sherborne St. John	3·67	207	,, .	Stonyhurst College	3·49	129
Herts .	Royston, Therfield Rec.	2·96	188	,, .	Southport, Bedford Pk.	2·23	121
Bucks.	Slough, Upton	2·94	205	,, .	Lancaster, Greg Obsy.	2·81	125
,, .	H. Wycombe, Flackwell	3·77	231	*Yorks*.	Wath-upon-Dearne	1·93	122
Oxf .	Oxford, Mag. College	3·30	214	,, .	Wakefield, Clarence Pk.	2·46	146
Nor .	Wellingboro, Swanspool	3·18	213	,, .	Oughtershaw Hall	4·43	...
,, .	Oundle	2·66	...	,, .	Wetherby, Ribston H.	...	...
Beds .	Woburn, Exptl. Farm	2·98	199	,, .	Hull, Pearson Park	2·06	132
Cam .	Cambridge, Bot. Gdns.	2.85	209	,, .	Holme-on-Spalding	2·19	132
Essex .	Chelmsford, County Lab	2·66	208	,, .	West Witton, Ivy Ho.	3·18	148
,, .	Lexden Hill House	2·36	...	,, .	Felixkirk, Mt. St. John.	2·77	166
Suff .	Haughley House	2·66	...	,, .	York, Museum Gdns.	1·93	121
,, .	Campsea Ashe	2·16	153	,, .	Pickering, Hungate	2·32	139
,, .	Lowestoft Sec. School	2·10	142	,, .	Scarborough	2·29	147
,, .	Bury St. Ed., WestleyH.	2·48	162	,, .	Middlesbrough	2·48	181
Norf. .	Wells, Holkham Hall	2·71	211	,, .	Baldersdale, Hury Res.	...	...
Wilts .	Calne, Castleway	4·20	226	*Durh* .	Ushaw College	3·20	169
,, .	Porton, W.D. Exp'l. Stn	3·81	228	*Nor* .	Newcastle, Town Moor.	3·28	200
Dor .	Evershot, Melbury Ho.	5·06	214	,, .	Bellingham, Highgreen	3·26	151
,, .	Weymouth, Westham.	3·10	187	,, .	Lilburn Tower Gdns.	3·54	179
,, .	Shaftesbury, Abbey Ho.	3·09	145	*Cumb*.	Carlisle, Scaleby Hall	3·44	176
Devon.	Plymouth, The Hoe	4·94	217	,, .	Borrowdale, Seathwaite	8·25	120
,, .	Holne, Church Pk. Cott.	9·15	253	,, .	Borrowdale, Moraine	6·66	119
,, .	Teignmouth, Den Gdns.	3·66	183	,, .	Keswick, High Hill	4·10	134
,, .	Cullompton	4·73	208	*West* .	Appleby, Castle Bank	3·09	158
,, .	Sidmouth, U.D.C.	3·87	...	*Mon* .	Abergavenny, Larchf'd	5·63	223
,, .	Barnstaple, N. Dev.Ath	4·35	205	*Glam* .	Ystalyfera, Wern Ho.	7·40	195
,, .	Dartm'r, Cranmere Pool	10·50	...	,, .	Cardiff, Ely P. Stn	5·05	200
,, .	Okehampton, Uplands.	7·91	248	,, .	Treherbert, Tynywaun.	9·43	...
Corn .	Redruth, Trewirgie	5·21	181	*Carm* .	Carmarthen, Priory St.	...	...
,, .	Penzance, Morrab Gdn.	4·45	183	*Pemb* .	Haverfordwest, Portfld.	...	...
,, .	St. Austell, Trevarna	6·39	226	*Card* .	Aberystwyth	3·71	...
Soms .	Chewton Mendip	6·16	207	*Rad* .	BirmW.W.Tyrmynydd	8·22	222
,, .	Long Ashton	4·85	222	*Mont* .	Lake Vyrnwy	6·16	220
,, .	Street, Millfield	4·09	204	*Flint* .	Sealand Aerodrome	2·08	141
Glos .	Blockley	4·46	...	*Mer* .	Dolgelley, Bontddu	6·54	179
,, .	Cirencester, Gwynfa	4·58	245	*Carn* .	Llandudno	1·88	111
Here .	Ross, Birchlea	4·27	225	,, .	Snowdon, L. Llydaw 9	10·35	...
Salop .	Church Stretton	3·82	177	*Ang* .	Holyhead, Salt Island	2·26	109
,, .	Shifnal, Hatton Grange	3·17	189	,, .	Lligwy	2·44	...
Staffs .	Market Drayt'n, Old Sp.	3·16	183	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	3·53	232		Douglas, Boro' Cem.	3·75	152
War .	Alcester, Ragley Hall	4·20	248	*Guernsey*			
,, .	Birminghm, Edgbaston	3·50	201		St. PeterP't.Grange Rd.	3·37	168

Rainfall: April, 1935: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	3·06	139	*Suth* .	Melvich....................	1·88	81
„ .	New Luce School.........	4·15	156	„ .	Loch More, Achfary....	3·46	71
Kirk .	Dalry, Glendarroch......	4·45	145	*Caith* .	Wick.........................	2·86	144
„ .	Carsphairn, Shiel.........	6·94	167	*Ork* .	Deerness	2·99	144
Dumf.	Dumfries, Crichton, R.I.	3·62	163	*Shet* .	Lerwick	2·00	88
„ .	Eskdalemuir Obs........	5·79	170	*Cork* .	Caheragh Rectory.......	4·43	...
Roxb .	Branxholm.................	4·12	218	„ .	Dunmanway Rectory...	5·18	125
Selk .	Ettrick Manse............	3·87	110	„ .	Cork, University Coll...	3·31	126
Peeb .	West Linton...............	3·44	...	„ .	Ballinacurra..............	3·49	135
Berw .	Marchmont House......	3·22	159	„ .	Mallow, Longueville....	2·90	119
E.Lot .	North Berwick Res.....	3·28	234	*Kerry*.	Valentia Obsy...........	3·72	101
Midl .	Edinburgh, Roy. Obs..	2·97	202	„ .	Gearhameen..............	7·90	137
Lan .	Auchtyfardle	3·17	...	„ .	Darrynane Abbey.......	3·52	102
Ayr .	Kilmarnock, Kay Pk....	2·93	...	*Wat* .	Waterford, Gortmore...	3·51	140
„ .	Girvan, Pinmore.........	2·92	98	*Tip* .	Nenagh, Cas. Lough....	2·80	112
Renf .	Glasgow, Queen's Pk....	3·03	154	„ .	Roscrea, Timoney Park	3·45	...
„ .	Greenock, Prospect H..	3·84	105	„ .	Cashel, Ballinamona....	2·77	111
Bute .	Rothesay, Ardencraig...	3·43	...	*Lim* .	Foynes, Coolnanes......	3·76	154
„ .	Dougarie Lodge..........	3·19	...	„ .	Castleconnel Rec.........	2·82	...
Arg .	Ardgour House..........	4·11	...	*Clare* .	Inagh, Mount Callan....	...	...
„ .	Glen Etive................	...	...	„ .	Broadford, Hurdlest'n.	2·97	...
„ .	Oban.......................	2·59	...	*Wexf* .	Gorey, Courtown Ho...	3·10	141
„ .	Poltalloch.................	3·21	110	*Wick* .	Rathnew, Clonmannon.	3·04	...
„ .	Inveraray Castle.........	3·77	82	*Carl* .	Hacketstown Rectory...	3·19	120
„ .	Islay, Eallabus...........	3·70	129	*Leix* .	Blandsfort House.......	2·84	109
„ .	Mull, Benmore...........	8·60	112	„ .	Mountmellick	3·05	...
„ .	Tiree	...	...	*Offaly*.	Birr Castle...............	1·77	82
Kinr .	Loch Leven Sluice.......	3·53	184	*Dublin*	Dublin, FitzWm. Sq....	1·52	80
Perth .	Loch Dhu..................	5·80	122	„ .	Balbriggan, Ardgillan...	2·82	142
„ .	Balquhidder, Stronvar.	...	...	*Meath*.	Beauparc, St. Cloud....	2·19	...
„ .	Crieff, Strathearn Hyd.	3·38	154	„ .	Kells, Headfort..........	2·77	111
„ .	Blair Castle Gardens....	2·88	136	*W.M* .	Moate, Coolatore.........	2·90	...
Angus.	Kettins School...........	3·16	174	„ .	Mullingar, Belvedere...	2·93	123
„ .	Pearsie House............	4·12	...	*Long* .	Castle Forbes Gdns......	2·96	124
„ .	Montrose, Sunnyside...	3·94	216	*Gal* .	Galway, Grammar Sch.	2·26	...
Aber .	Braemar, Bank...........	4·44	187	„ .	Ballynahinch Castle....	4·64	131
„ .	Logie Coldstone Sch....	4·15	206	„ .	Ahascragh, Clonbrock.	2·89	114
„ .	Aberdeen, King's Coll..	4·15	222	*Mayo*.	Blacksod Point..........	3·89	134
„ .	Fyvie Castle..............	3·88	181	„ .	Mallaranny	4·20	...
Moray	Gordon Castle............	3·03	173	„ .	Westport House.........	2·88	107
„ .	Grantown-on-Spey	...	...	„ .	Delphi Lodge............	5·18	90
Nairn.	Nairn	2·33	155	*Sligo* .	Markree Obsy...........	4·21	159
Inv's .	Ben Alder Lodge.........	...	...	*Cavan*.	Crossdoney, Kevit Cas..	3·03	...
„ .	Kingussie, The Birches.	2·37	...	*Ferm* .	Enniskillen, Portora....	2·77	...
„ .	Inverness, Culduthel R.	...	...	*Arm* .	Armagh Obsy............	2·11	100
„ .	Loch Quoich, Loan......	3·45	...	*Down*.	Fofanny Reservoir......	6·20	...
„ .	Glenquoich................	...	...	„ .	Seaforde	3·28	125
„ .	Arisaig, Faire-na-Sguir.	1·98	...	„ .	Donaghadee, C. Stn....	1·70	85
„ .	Fort William, Glasdrum	2·98	...	„ .	Banbridge, Milltown....	1·66	81
„ .	Skye, Dunvegan.........	3·14	...	*Antr* .	Belfast, Cavehill Rd.....	3·02	...
„ .	Barra, Skallary..........	3·33	...	„ .	Aldergrove Aerodrome.	2·40	114
R&C .	Alness, Ardross Castle.	4·17	172	„ .	Ballymena, Harryville.	3·48	132
„ .	Ullapool	2·35	76	*Lon* .	Garvagh, Moneydig....	2·69	...
„ .	Achnashellach	3·83	68	„ .	Londonderry, Creggan.	3·41	133
„ .	Stornoway	2·31	76	*Tyr* .	Omagh, Edenfel.........	2·66	101
Suth .	Lairg......................	2·19	95	*Don* .	Malin Head..............	3·03	...
„ .	Tongue	2·55	97	„ .	Killybegs, Rockmount.	2·97	...

Climatological Table for the British Empire, November, 1934

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. 1/2 Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal.	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy.	1017·3	+ 2·7	56	30	48·2	40·1	44·1	+ 0·1	41·6	92	9·4	1·76	− 0·46	14	1·3	14
Gibraltar	1016·0	− 2·0	78	47	63·2	52·8	58·0	− 2·0	52·5	83	6·7	9·30	+ 2·87	21	...	...
Malta	1016·8	+ 0·9	75	54	69·6	60·9	65·3	+ 1·4	61·7	85	7·6	4·76	+ 1·19	13	4·4	43
St. Helena	1013·0	− 0·3	67	54	64·2	56·2	60·2	+ 0·6	56·8	89	9·3	1·11	...	14	...	...
Freetown, Sierra Leone	1013·5	+ 2·6	89	71	86·4	74·3	80·3	− 0·9	76·8	87	4·5	4·35	− 0·77	15	...	...
Lagos, Nigeria	1010·4	+ 0·3	91	72	88·0	76·6	82·3	+ 0·6	76·9	87	5·7	1·17	− 1·50	8	7·5	64
Kaduna, Nigeria	1009·3	...	95	52	92·4	56·5	74·5	− 1·7	64·2	71	2·0	0·00	− 0·21	0	10·5	91
Zomba, Nyasaland	1009·6	+ 0·7	93	60	82·9	65·2	74·1	− 1·5	67·7	71	7·1	2·86	− 2·22	15	...	...
Salisbury, Rhodesia	1010·6	− 0·8	89	56	79·5	60·0	69·7	− 1·0	61·3	63	6·8	4·80	+ 1·20	13	5·6	43
Cape Town	1014·1	− 1·7	97	47	77·8	58·6	68·2	+ 3·8	60·8	72	4·9	0·46	− 0·63	6	...	...
Johannesburg	1012·6	+ 0·4	82	46	72·6	53·4	63·0	− 0·7	56·4	71	6·2	6·51	+ 1·55	17	7·2	54
Mauritius	1015·3	− 0·8	85	61	81·9	67·6	74·7	− 0·8	70·5	68	6·1	6·69	+ 5·11	13	7·4	57
Calcutta, Alipore Obsy.	1012·6	− 0·7	87	53	82·0	64·3	73·1	− 0·4	65·0	85	3·4	0·86	+ 0·21	2*	...	...
Bombay	1012·2	+ 0·2	92	68	87·2	71·4	79·3	− 1·3	70·1	79	2·8	3·23	+ 2·78	3*	...	...
Madras	1011·8	+ 0·5	88	62	84·8	71·0	77·9	− 1·0	73·0	81	6·0	1·86	− 11·75	4*	...	...
Colombo, Ceylon	1011·2	+ 1·2	86	68	83·7	72·7	78·2	− 1·8	74·4	77	5·8	20·61	+ 8·85	19	6·9	58
Singapore	1009·6	+ 0·2	89	72	85·6	74·2	79·9	− 0·7	76·2	80	8·8	12·47	+ 2·56	24	4·3	36
Hongkong	1017·1	− 0·5	83	58	75·0	65·8	70·4	+ 0·8	65·4	73	7·1	0·41	− 1·33	5	4·8	43
Sandakan	1009·3	...	89	73	87·1	75·2	81·1	+ 0·2	77·7	85	8·2	17·44	+ 2·72	25	...	...
Sydney, N.S.W.	1013·7	− 0·1	91	48	72·0	59·8	65·9	− 1·1	62·3	68	7·2	4·23	+ 1·38	16	7·0	50
Melbourne	1013·3	− 1·1	90	45	70·2	52·7	61·5	+ 0·2	57·2	66	7·8	5·24	+ 3·01	18	4·4	31
Adelaide	1014·2	− 1·0	97	48	76·4	55·6	66·0	− 1·0	57·0	48	6·3	4·10	+ 2·95	12	8·3	60
Perth, W. Australia	1015·1	− 0·3	90	48	74·1	55·1	64·6	− 1·5	55·8	51	5·0	0·72	− 0·08	8	9·7	71
Coolgardie	1012·7	− 0·4	99	43	79·2	52·1	65·7	− 5·0	57·9	56	2·7	1·10	+ 0·51	3	...	...
Brisbane	1014·4	− 0·2	88	58	78·8	63·8	71·3	− 2·2	65·8	65	7·6	5·68	+ 1·95	12	6·9	51
Hobart, Tasmania	1011·8	+ 2·2	88	39	66·1	50·2	58·1	+ 0·9	52·7	61	7·6	1·85	− 0·62	16	5·7	39
Wellington, N.Z.	1018·8	+ 6·7	81	40	66·3	52·1	59·2	+ 2·4	56·5	71	5·5	2·16	− 1·36	8	9·2	64
Suva, Fiji	1011·9	+ 0·8	90	67	84·2	72·8	78·5	+ 1·4	75·1	82	6·7	5·33	− 4·46	17	6·2	48
Apia, Samoa	1009·3	− 0·2	89	72	85·7	74·7	80·2	+ 1·5	76·9	78	6·2	14·05	+ 4·22	21	6·3	50
Kingston, Jamaica	1011·5	− 0·9	90	66	86·1	70·4	78·3	− 1·0	69·3	86	4·3	4·06	+ 1·03	9	4·9	43
Grenada, W.I.	...	...	85	70	84	73	78·5	− 1·0	73	78	5	11·62	+ 3·16	19	...	...
Toronto	1018·0	+ 0·7	63	25	47·6	36·6	42·1	+ 5·1	38·5	82	7·9	3·10	+ 0·47	14	2·2	23
Winnipeg	1016·8	− 0·6	55	7	35·9	23·7	29·8	+ 8·5	25·5	83	7·6	0·26	− 0·81	3	2·8	31
St. John, N.B.	1019·0	+ 4·4	59	19	45·2	32·8	39·0	+ 2·3	36·9	86	8·0	6·46	+ 2·05	16	2·6	27
Victoria, B.C.	1011·0	− 4·9	56	41	51·0	44·7	47·9	+ 3·4	45·9	91	8·4	4·58	− 0·83	23	1·7	18

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

(26039) Wt. 18/32 1000 5/35 Hw. G.377/6

VALLEY BETWEEN RICKMANSWORTH AND CHORLEYWOOD, HERTS., MAY 27TH, 1935, showing oak trees stripped of their leaves and ashes with blackened and shrivelled foliage—the result of the severe frost of May 16th–17th, 1935 (*see* p. 108).

M.O. 381.

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The Severe Weather of May 12th–19th, 1935

The onset of northerly winds of polar origin on May 12th caused a rapid fall of temperature over the British Isles and there ensued, until the 19th, a spell of exceptionally cold and inclement weather for the time of year. The most severe frost occurred as a rule on the 17th, but in some northern and western districts the lowest temperatures were registered on the 15th. Widespread hail, sleet and snow were experienced between the 13th and 18th. Among the lowest minima in the screen from data at present available are 21° F. at Dalwhinnie on the 13th, 22° F. at Eskdalemuir and 25° F. at Newton Rigg, Penrith on the 15th, 17° F. at Rickmansworth, 21° F. at Dalwhinnie, 24° F. at Purley, 25° F. at Dorstone (Hereford), Marlborough, Upper Heyford and Tunbridge Wells, and 26° F. at South Farnborough on the 17th and 24° F. at Auchincruive on the 18th. Temperature on the grass fell to 14° F. at Dalwhinnie on the 13th, 10° F. at Rickmansworth, 13° F. at South Farnborough and 14° F. at Rhayader on the 17th and to 15° F. at Newton Rigg, Penrith on the 15th and at Auchincruive on the 18th. The exceptional character of the frost at certain stations with long records may be illustrated by comparison with the lowest temperatures registered in previous Mays. At Aberdeen, the minimum in the Stevenson screen on the 17th, 29° F., has only once previously been equalled in May since before 1871, namely, in 1891. At Kew Observatory, 30° F. was equalled in 1877 but no lower temperature has been recorded in May since at least 1871. Similarly at Greenwich, in the long record back to 1841, an equally low temperature (28° F.) was recorded only in May 1855 and 1877. At Yarmouth the minimum 31° F. on the 17th is the lowest recorded in May since before 1872, at Birmingham, 30° F, on the 17th is the lowest since before 1887 and at Falmouth, 35° F. on the 18th, is the lowest in May since before 1871.

The damage done by this frost to early vegetables, flowers, shrubs, fruit and trees was widespread and extensive. A letter from Mr. Robert Gray, of Dorstone, Herefordshire, states that " plums, pears, apples, cherries, strawberries, blackcurrants, hops, ..." have suffered severely. In *The Times* of the 18th, reference is made to similar damage suffered in Kent, South Wales, Bedfordshire and South Lincolnshire, and in the issue of the 28th, a correspondent tells of extensive damage to fruit farms in Hampshire.

The snowfall during this period was heavy in some parts and widespread, being reported in most parts of Ireland and west Cornwall as well as in other parts of Great Britain. In Yorkshire snow fell for more than four hours at some places on the 17th ; it was reported to be lying to a depth of 5 inches at Harrogate, and according to *The Times*, in some small villages in the dales two to three feet fell. At Cockle Park, in Durham, snow lay to a depth of 4½ inches on the morning of the 17th. It was also reported in *The Times* that a large part of Westmorland, including the Lake District and Shap Fells experienced a heavy fall of snow on the 17th, the main road north to Scotland over Shap Fells having a covering of 4 to 5 inches. The same article records a heavy snowstorm in the north of Scotland on the 16th. Snow is rare in west Cornwall in May ; at the Scilly Isles it was recorded only once between 1876 and 1921 ; in May 1935, however, snow fell at Falmouth on the 16th and at Scilly Isles (accompanied by heavy squalls) on the 17th. We read in the Press that the grain ship *Herzogin Cecilia*, which arrived at Falmouth on the 20th, had been caught in a hurricane and snowstorm off the Lizard on the 17th. At Tiverton, Devon, snow fell heavily between 3 and 5 p.m. on the 17th, and lay to a depth of about 4½ inches without drifting.

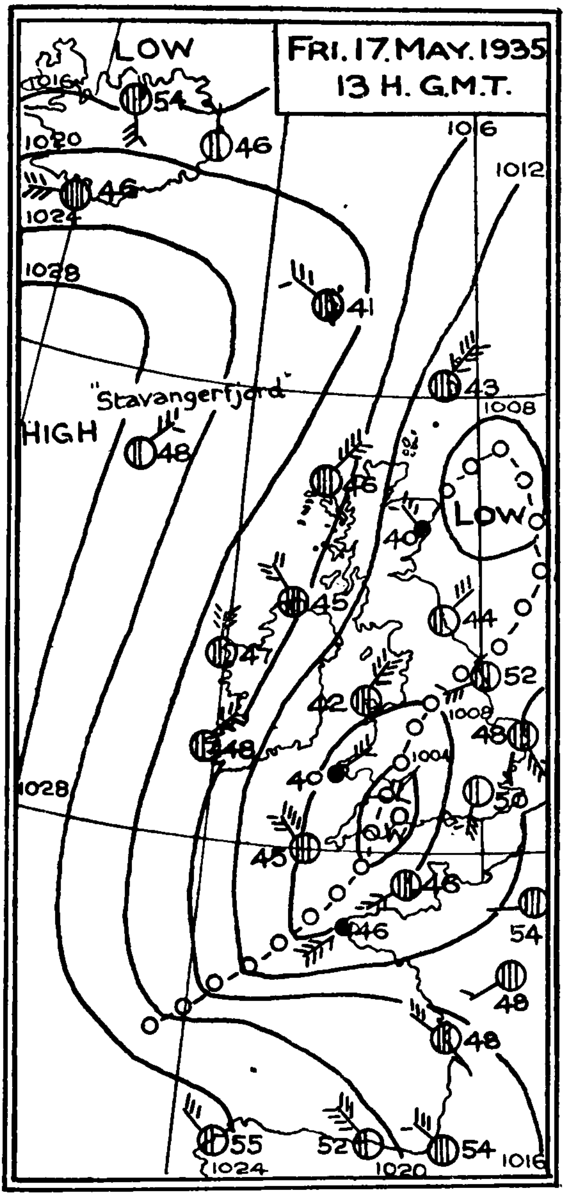
Cold spells of more or less severity are not infrequent in May. Among those which are somewhat comparable with that of the present month, may be mentioned those of the first parts of May, 1876 and 1877, May 15th–18th, 1891, the first seven or eight days of May, 1892, May 13th–15th, 1915, and May, 1923, when considerable damage was done to crops by frost on the 24th, particularly in midland and eastern counties.

In reading accounts of the cold spell of May 15th–18th, 1891 (see *Symon's Meteorological Magazine* for June, 1891, and " Notes on Weather at York," May 11th to 21st, 1891 by J. E. Clark from the *Report of the Yorkshire Philosophical Society* for 1891) one is struck by many similarities with the present cold spell. In 1891, extensive damage was done to vegetation and fruit of all kinds notably in

Yorkshire by the frost on the 17th and 18th and considerable snow fell on the 16th and 17th, particularly in the midland and eastern counties of England.

L. F. Lewis.

The anticyclone which covered the British Isles from May 6th to 8th and which was responsible for the brilliant weather of the 6th, moved slowly away towards the north-west; and by the morning of the 11th the country lay in the broad northerly air stream on its eastern side. This current, supplied from a region to the north-east or east of Spitsbergen, covered the country until the 19th, and was responsible for the unusual weather of that period.



The eastern boundary of the current was at first formed by a large depression over Russia, but, beginning on the 13th, a series of small depressions formed near the Norwegian coast and moved southwards across the North Sea. Their presence increased the northerly gradient in the main current, which was, doubtless, one reason why the weather became colder towards the end of the period. Moreover it was the "fronts" associated with these depressions which caused the frequent rain and snow in the British Isles.

The most important of them, in its consequences to this country, formed over southern Norway on the 16th, and grew steadily deeper, though remaining almost stationary; but an occlusion associated with it began to move southward across Scotland during the afternoon. The approach of this occlusion greatly weakened the barometric gradient over England. On the night of the 16th–17th, therefore, for the first time since the cold spell began, winds were light in England; and, as there was no protection from clouds except in a narrow belt close to the front, the severe frost already described occurred.

During the night of the 16th–17th a secondary depression formed on the occlusion near the Isle of Man, and moved southward across Wales and south-west England, bringing heavy rain and snow to all parts of the country except the extreme south-east. Unfortunately, before night this secondary had moved away over France. The clouds disappeared after dusk, and, as England was then in an area of light winds between the primary and secondary depressions, another severe frost resulted on the night of the 17th–18th.

On the 18th a depression moved south-east from Iceland to the Hebrides and at last cut off the supply of cold air. That night cloud and rain spread over Scotland, Ireland and western England, and brought the cold spell to an end; but in eastern England, still covered by the remains of the polar current, there was again a frost, though less severe than on the two previous nights.

Short cold spells with northerly winds are not uncommon in spring, but they are almost always of short duration. In no other case since 1880—the earliest year examined—has there been such a spell longer than three days, whereas in the present instance the duration was about eight days. Nor was any other case found in which the cold current originated so far north.

B. C. V. ODDIE.

From May 13th to 19th sharp frost occurred in this valley each morning. On May 16th–17th the temperature in the thermograph screen was under the freezing-point continuously for a period of $13\frac{3}{4}$ hours, from $17\frac{3}{4}$h. to $7\frac{1}{2}$h. (G.M.T.). It remained below 25°F. from 23h. to $6\frac{1}{2}$h., and below 20°F. from 3h. to 6h., falling to 18°F. at about $5\frac{1}{4}$h., 1h. 5m. after sunrise. There was moderate to slight valley fog until $6\frac{1}{2}$h. In the standard screen, 15 ft. to north of the other, the minimum was 16·5°F., and at 1 in. above short grass it was 10·3°F. These two latter readings closely approached the extreme minima for the past winter, which were respectively 15·5°F. and 8·5°F. early on January 9th.

The havoc wrought by this frost in the low-lying districts of south-west Hertfordshire and south-east Buckinghamshire can only be described as appalling. It would take less space to list the surviving members of the local flora than those which have succumbed. For once in a way it is probably safe to trust the testimony of the "oldest inhabitants," who declare that no such destruction amongst fruit and vegetable crops, flowers and foliage has been seen within memory. The most striking (though not the most serious) effect of the intense cold is the markedly autumnal aspect which a majority of the woods and coppices have gradually assumed since May 17th. Many of the trees in the vicinity of the climatological station, including a pedunculate oak 83 ft. high, have been stripped practically bare of foliage from top to bottom ; the predominant beeches of the neighbourhood are commonly showing their November hue of russet brown, and the young leaves of the great ash trees hang dead in black and shrivelled clusters.

In the course of several tours of inspection it has been ascertained that a similar state of affairs exists along much of the eight-mile stretch of the Chess Valley between Rickmansworth and Chesham. On the adjacent high ground the damage is comparatively slight. Above an altitude of 400 ft., in fact, the trees do not appear to have suffered at all. One nurseryman at Chipperfield, four miles to the north of this place, and nearly 300 ft. higher up, reports that he has had no losses of any kind through the frost. But in the valleys on either side of the Hertfordshire–Buckinghamshire boundary it will be long before the night of May 16th–17th, 1935, is forgotten.

E. L. HAWKE.

"Caenwood," Rickmansworth, Herts, May 29th, 1935.

The snowstorm on May 17th, 1935, at West Kirby, Cheshire, was quite without precedent ; in the life of the oldest inhabitant, aged 106, there is no recollection of such an outstanding snowstorm in May. After rain and sleet which fell from 8h. to 8h. 50m. G.M.T., the wind veered from NW. to N. and snow began to fall, at first lightly and then increasing in thickness until a full snowstorm was being experienced. This continued without a break until 14h. 30m. G.M.T., at which time the snow lay 2 to 2½ inches in depth on the low ground and 4 to 5 inches on the high ground. And this at a seaside station, on the west coast, in mid-May ! The temperature was also remarkable, falling from 39° at 8h. G.M.T. to 35° at 9h., 33° at 10h. and 31° from noon to 14h., after which it rose again to 32° at 14h. 30m., 36° at 16h. and 37° at 19h. The measurement of melted snow and rain was 0·61 in.

E. F. ROBSON.

St. Andrew's Vicarage, West Kirby, Cheshire, June 3rd, 1935.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, May 15th, 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 :—

S. Chapman, F.R.S.—The lunar atmospheric tide over Canada, 1897 *to* 1932.

The lunar atmospheric tide is determined for five Canadian stations, three in the east (St. John, Montreal and Toronto) and two in the west (Vancouver and Victoria, about 60 miles apart); the material used averaged 23 years per station; the days used were not selected according to their range. The three eastern stations give similar values, the mean being 28 sin $(2t + 77°)$ microbars (probable error 2·5); this is normal for their latitude (mean 45°). The two western stations have a much smaller tide, the mean being 4 sin $(2t + 101°)$, probable error 2·4, this is abnormally low for their latitude (mean 49°); the phase angle is, of course, not well determined.

The three eastern stations show a seasonal variation similar to that found at most other stations, the amplitude and phase angle both being less in December than in June.

The harmonic coefficients of the first four components of the solar diurnal variation are also given; here also, in the second component, Vancouver and Victoria agree in giving a smaller amplitude (and also a smaller phase angle) than the eastern stations.

F. J. Scrase, M.A., B.Sc.—The sampling errors of the Aitken nucleus counter.

It is deduced theoretically and confirmed by observation that the frequency distribution of nucleus counts made with the Aitken counter conforms to Poisson's exponential limit to the binomial expansion. The standard deviation of a series of counts is given by the square root of the mean number of nuclei in a count, and the standard error of the mean is inversely proportional to the square root of the total number of nuclei counted. When the total number is 100 the standard error is about 9 per cent. of the mean.

It is shown how the results of the investigation can be applied to distinguish between genuine fluctuations and random errors in observations of nucleus content. The results also show that the stirring vane fitted to the Aitken counter is an unnecessary complication; a random distribution of nuclei is produced in the apparatus without the aid of the device.

C. S. Durst, B.A., and W. H. Bigg, B.Sc.—The diurnal variation of the maximum gusts occurring in each hour at Worthy Down (Winchester).

From a statistical consideration of the maximum gusts measured at Worthy Down the opinion is formed that frictional gusts are directly proportional to the speed of the wind and that those due to convection have a speed of about 9 m.p.h.

Correspondence

To the Editor, *Meteorological Magazine*

Lunar Cross and Halo at Scilly

A lunar halo observed at Scilly on March 22nd, 1935, was associated with some interesting optical phenomena. The upper two-thirds of the halo (apparently the halo of 22°) first appeared at 23h., and at 23h. 15m. two mock moons appeared, nearly as bright as the moon, on the halo on either side of the moon at the same height; these remained throughout the display. At 23h. 40m. a lunar cross appeared for ten minutes, after which the remainder of the halo formed. Another observer stated that for a brief period the horizontal arms of the cross extended to connect the two mock moons. The halo faded at midnight but the cross was again observed from 0h. 10m. to 0h. 40m. on the 23rd.

Dr. F. J. W. Whipple remarks that "the cross was presumably at the intersection of a moon pillar and the mock-moon circle. This is confirmed by the observation of the latter circle by the independent observer. It is remarkable that the cross was seen from 0h. 10m. to 0h. 40m. without the mock-moons. That the pillar should persist was to be expected but the occurrence of the horizontal arm of the cross without the mock-moons implies that the crystals responsible for them, the hexagonal crystals with vertical axes, were localised in a small part of the atmosphere."

Moon Pillar seen from Sussex

On May 15th, between the hours of 22h. 45m. and 23h. 0m. G.M.T., I observed a rare lunar phenomenon for these latitudes. The sky to the south was covered with a thinnish cirrus haze, through which Jupiter and Mars were visible. Parallel rays stretched out from the moon to form a cross; the horizontal beams being the longest and most persistent; those to my left extending three diameters from the moon; those to my right, about 1½ diameters; while the beams above and below the moon were about one diameter in length. The phenomenon lasted roughly six minutes. There was a surface calm, and the high clouds, which were gradually becoming denser, were drifting slowly towards the east-south-east.

I have not observed anything in the nature of a moon pillar since the winter of 1918–9, while serving in north Russia, just south of the Arctic Circle. In this case there were no lateral beams, but a pillar of the moon's diameter reached from its lower rim to within 5° of the horizon; through about 45° in all.

D. S. HANCOCK.

Greenways School, Bognor Regis, Sussex, May 16th, 1935.

Halo Phenomena at Barton, Manchester

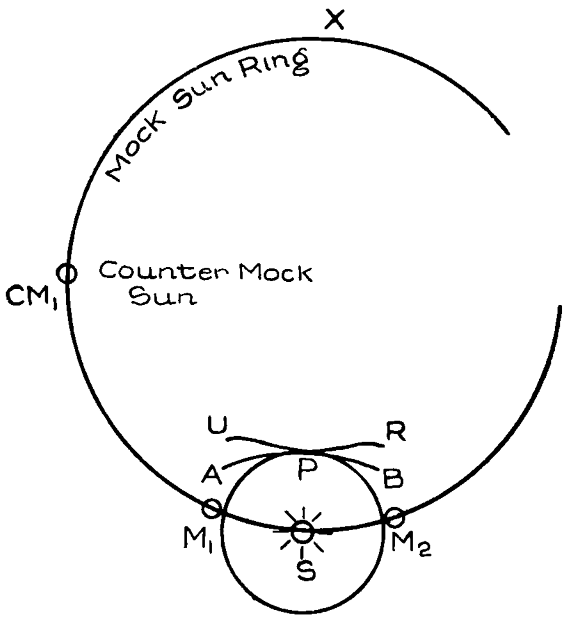
On March 28th, 1935, at 14h. 30m. G.M.T. there was visible here the most complete halo phenomena I have ever witnessed. Mr. Bell, of this station, saw it also and confirms my observations.

At 14h. 30m. G.M.T. there was a complete halo, 22°, with a mock sun on either side of it, a mock sun ring extending to seven-eighths of the horizontal circle, a counter mock sun to the left of the sun, and two arcs of contact. All these were seen simultaneously and together; they persisted for about half-an-hour, after which the mock sun ring began to fade, then the counter mock sun ; but the halo with its arcs of contact and mock suns lasted intermittently till about 18h. 15m.

The following measurements were made with a theodolite :—

Elevation of the sun	29°.
Bearing of sun's centre from true North	226°.
Bearing of mock suns from true North	196° and 256°.
Bearing of counter mock sun from true North	106°.

These bearings were taken at 14h. 45m. and confirmed bearings taken at 14h. 35m. as regards relative positions of the phenomena.



The mock suns were particularly brilliant, all the colours from red to blue being quite clear ; the counter mock sun was white, as was the mock sun ring. The latter, however, was seen clearly to pass through the halo to the sun. The arc of upper contact had its extremities bent downwards, while the other arc of contact was part of the circumscribed elliptical halo.

When the phenomena were first observed the sky was almost covered with cirrostratus which was denser in the vicinity of the halo and thinned somewhat to the east and north-east, and there was a patch of blue sky where the other counter mock sun would have been situated. The cirrostratus continued to vary in density and accounted for the intermittent view of the halo and mock suns.

This cirrostratus was the advance guard of a cold front. The situation at 7h. on March 28th was as follows :—A cold front extending from Utsire to Wick was moving slowly southwards and during the next twelve hours its orientation changed from roughly east—west to east-south-east—west-north-west.

In the accompanying diagram, which is similar to that in the "Meteorological Observer's Handbook," p. 65. *S* is the sun's position, M_1 and M_2 are the mock suns, CM_1 the counter mock sun, X, CM_1, M_1, S, M_2 is the mock sun ring, UPR the arc of upper contact, APB the other arc of contact, while the 22° halo is shown.

T. H. APPLEGATE.

Barton Airport, Manchester, April 4th, 1935.

Solar Halo witnessed at Sealand

On Wednesday, April 3rd, 1935, a brilliant solar halo was witnessed at Sealand. It was first observed at 14h. 20m. and persisted until about 18h. 30m. when the sky became covered with altostratus. The halo was well developed.

At 16h. 23m. two mock suns together with the arc of contact and the mock sun ring were visible. The inner edge of the halo was reddish brown in colour while the remainder was a brilliant white. Red, yellow and green were plainly visible on the mock suns with red the nearest to the sun.

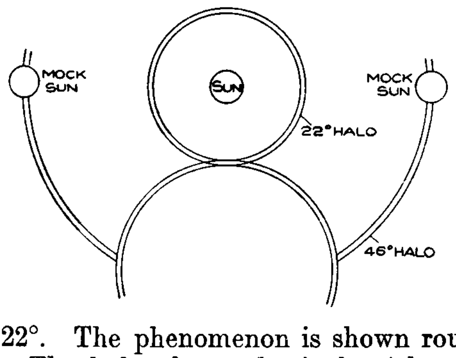
Angular measurements of the phenomenon showed that the width of the halo was 2°, and the distance from centre of sun to the centre of a mock sun was 25°. The mock sun ring increased in width as it approached the sun and disappeared in the glare about 5° from the sun.

GEO. R. READ.

Roker, Station Road, Gt. Saughall, Chester, May 2nd, 1935.

Unusual Solar Halos seen at Sealand

Interesting and unusual examples of solar halos were observed at Sealand on May 3rd and 4th, 1935. The halo observed on the 3rd was first visible at 9h. G.M.T. and persisted with slight variations in form until 17h. G.M.T. At 12h. 30m. a complete halo of 22° was visible together with the lower arc of contact from which ran the halo of 46° on which mock suns were well developed. The remarkable feature of this halo was that mock suns were plainly discernible on the 46° halo although none was apparent on that of 22°. The phenomenon is shown roughly in the attached sketch.



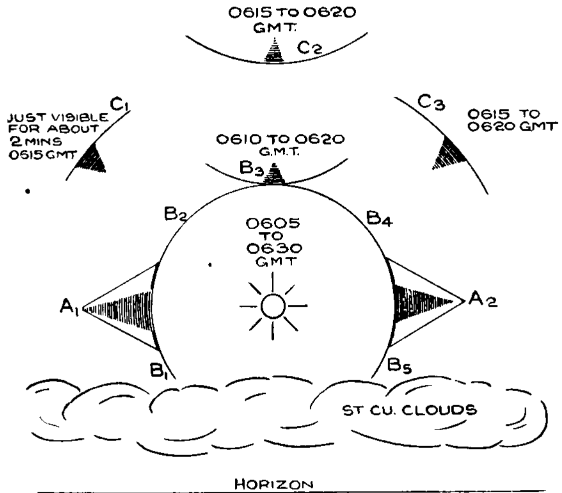
The halo observed on the 4th was of unusual dimensions. At 10h., when the halo was first observed, the sky was covered with moderately thick cirrostratus and angular measurements showed that the distance from the centre of the sun to the inner edge of the halo was 32°. The lower arc of contact was clearly visible for a distance of about 50° while a faint upper arc of contact appeared for a few minutes about 10h. 5m. The colours observed in the halo were red, yellow, green and blue with red nearest the sun.

WILLIAM D. FLOWER.
GEO. R. READ.

R.A.F., Sealand, Chester, May 10th, 1935.

Unusual halo phenomena seen at Wick

ON April 24th, 1935, Mr. T. J. McGuiness of Wick (Caithness) observed the optical phenomena shown in the attached diagram. A_1 and A_2 were the first parts to appear then the small halo marked B_1 B_2 B_4 B_5 and finally the arcs of the halo C_1 C_3 (probably the 22° halo) with the upper arc of contact C_2. Mr. McGuiness reports that the whole was brightly coloured "like a rainbow with the shaded part white" and that the radius of the inner halo and the difference between the radii of the two halos were both equal to approximately 4¼ inches measured with a pencil at arm's length. The brilliant colours at so many points are exceptional and confirm that this was not an ordinary display. The halos faded from left to right and in the reverse order to their appearance. A_1 faded about 5 minutes before A_2 which finally faded out at 7h. 25m.



Halos differing in size from the 22° and 46° halos are occasionally observed and some of them have been accurately measured. A list is given by L. Besson in the *Comptes Rendus,* 170, 1920, p. 334. Among the better known ones are Van Buijsen's with radius of 7° 30′ to 10° and Rankin's with radius of 17° to 18°. Mr. McGuiness's measurements were approximate.

Optical phenomena seen at Hastings

This morning, May 6th, at 6h. 25m. G.M.T., the circumzenithal arc was visible, well-developed and beautifully coloured. There was no other trace of halo phenomena save a short segment of the 22° halo above the sun and two patches each side on a level with the sun.

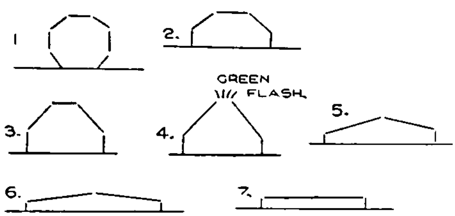
CICELY M. BOTLEY.

Guildables, 17, *Holmesdale Gardens, Hastings, May 6th,* 1935.

The Green Flash seen from Anacapri

On the 22nd, we had what I suppose amounted to a sort of tornado here. The Scirocco is always our dangerous wind, but in the 8 years I have lived here I have seen nothing of this kind. The landscape was obscured with dust and the sea was torn up into the air in white squalls. A great deal of damage was done to trees, vines and other crops ; but as usual, worse in some localities than others.

On the following day the 23rd the sun was observed to sink in the fashion sketched herewith beginning as an octagon which gradually narrowed to a point and flashed green, then flattening out until it became oblong. The stages numbered 5, 6, 7, seemed to take a long time.



M. RAWNSLEY.

Dil-Aram, Anacapri, Italy, May 25th, 1935.

The Green Flash seen from Crinan

Last night I had ascended a small knoll to see the sun set over Scarba a bare and rocky island, which rises to 1,500 feet, 8 miles to the north-west of Crinan. Apart from a few fleecy clouds overhead the sky was clear, and as the last limb of the sun disappeared it changed momentarily from red to green. The phenomenon was so definite that it left no doubt in my mind as to its reality. Although I have often looked for the green flash I only remember seeing it once before, in the Scilly Islands, with the sun setting over the sea which is, I believe, the horizon most favourable to its appearance. The atmosphere last night was not exceptionally clear. The mountains of Mull, 30 miles distant, stood out sharply, but an east wind had brought a slight haze which showed as a brownish colouration for a few degrees above the horizon and through which the sun set.

J. S. DINES.

Crinan Hotel, Crinan, Argyllshire, May 28th, 1935.

Peculiar gloom of March 3rd, 1935, and electric phenomena of April 18th, 1935

On page 67 of your April issue I see it stated that the peculiar gloom of Sunday, March 3rd, was not observed as far north as Harrow. I write from memory and without notes as to date and time, but I remember being greatly struck on a Sunday evening early in March by a peculiar darkness. Long before lighting-up time, and I think actually before sunset, the darkness was like midnight, while by about 6.0 p.m. conditions were about normal again. If I am right in identifying this with the " black-out " described by your correspondent, it is interesting to note that the effects were observed here about an hour later than at Slough. There was little rain recorded here on March 3rd, ·07 in. for the 24 hours.

On Thursday, April 18th, I had an opportunity of witnessing an effect often recorded in the Alps, but comparatively rare, I think, on British hills. I was one of a party of four which was descending the ridge of Liatbach, above Glen Torridon, in Ross-shire. We had had an extremely beautiful day of sunshine and clear visibility with occasional hail. At about 3,000 ft. we ran into a short sharp hailstorm approaching from the north-east. All four of us were carrying ice-axes, and suddenly all began hissing like grasshoppers. No thunder was heard or lightning seen, but the hissing of the axes continued for several minutes, proceeding from both metal ends of the axes and increasing in intensity when they were pointed into the hail. We were none of us conscious of any other electric symptoms. There was a fair depth of accumulated snow on the mountains.

HUGH GARDNER.

Oakhurst, Mount Park, Harrow-on-the-Hill, May 26th, 1935.

Drizzle falling from a Clear Sky

I read with interest the article by J. S. Dines on this occurrence in the February *Meteorological Magazine*. I have one or two records of the same kind of thing occurring at Grayshott. On December 29th, 1929, following on a very stormy day, with gale, hail, sleet, heavy rain and lightning, the evening was fine, and the stars brilliant. At 21h. 40m. with the stars as bright as ever and not a trace of cloud visible, palpable drizzle fell for a few minutes. Again on January 3rd, 1933, after a similar kind of day, the evening provided a beautiful display of middle-level cloud, which disappeared before 18h. At 19h. 19m. light drizzle as in the previous case, occurred, and it was some time before cloud reappeared.

The best case was one of which I have unfortunately lost the date, but I am fairly certain that it was during the first ten days of January, 1931. The evening was practically cloudless since sunset, and the temperature near freezing point. At 19h. 35m. copious drizzle fell, enough to wet the face and clothing. A gentleman on coming out of church put up his umbrella, and persisted in keeping it up even when it was pointed out to him that the stars were shining as on the most brilliant of winter evenings.

I think these three observations tend to support Dines's assumption that it is not a very uncommon occurrence for rain to form in clear air without passing through the intermediate stage of cloud particles.

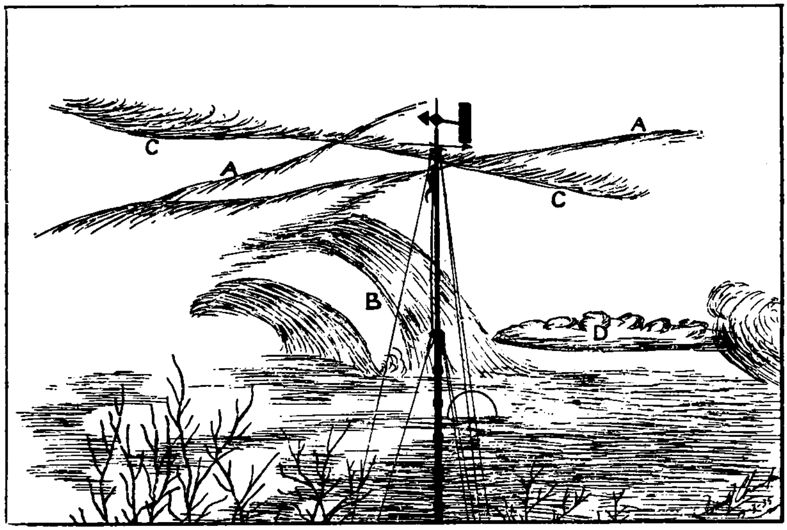
S. E. ASHMORE.

14, *Villa Road, Handsworth, Birmingham* 19, *March 9th,* 1935.

Cirrus Clouds at Different Heights

It has been occasionally noted in this magazine that cirriform cloud moving in different directions has been observed simultaneously at different levels and the following note may be of interest.

At 17h. 50m. on March 18th at Goff's Oak, Herts, I was enjoying the view of the setting sun behind the wind vane mast when my attention was drawn to the cirrus clouds in the western sky. There were three distinct layers of cirrus which I have attempted to depict in the attached sketch. The nearer clouds were moving fairly fast and on this account the original sketch was somewhat hastily made and the result does not do justice to the beauty of the scene.



The cirrus bands, marked A, were moving from a northerly point and were the lowest of the cirriform types. The "cascade" of cirrus, B, which appeared as a waterfall quenching the setting sun, was also moving from the north but at a lower speed than the bands A and the movement appeared to bring this cloud between the bands A and C. The latter, C, was advancing from west-south-west towards the station and was the highest in the sky. The cloud D was apparently alto-stratus and was lenticular at first but later became slightly castellated on its upper edge. This cloud followed the cirrus bands A towards the south. The surface wind was SW., force 1. The sun itself finally set behind an advancing sheet of alto-stratus which, later on, covered the whole sky but passed away eastwards, leaving the sky cloudless at 23h. 0m., to be followed by mist, which at 7h. 0m. the next morning had become a moderate fog.

As a guide to the altitude of the clouds in the sketch, I may mention that the angle subtended at eye level (at the point of observation) by the centre of the wind vane was about 10° 5′.

DONALD L. CHAMPION.

7, *Robinson Avenue, Goff's Oak, Waltham Cross, Herts, March* 21*st*, 1935.

Blue Snow and Inky Rain in the Shetlands

Rain which fell on the forenoon of March 16th was quite dark-coloured. My attention was called to the colour of the water in the pools and when I got home I at once examined the water in the rain-gauge and found it too was tinted; looked as if it had been slightly diluted with black ink. The sky looked thundery, but I did not hear any thunder, though a thunderstorm was reported from Lerwick, about 40 miles distant.

T. EDMONDSTON SAXBY.

Halligarth, Baltasound, Shetland, April 2nd, 1935.

[According to the *Shetland Times* of March 23rd, following a spell of very fine bright weather, the sky was overcast after daylight on Saturday, March 16th, and there were showers of wet snow. Thunder was heard shortly after 9h. and by 10h. the morning was becoming darker, with an ominous looking sky and a peculiar greenish light. Heavy thunder and several bright flashes of lightning followed between 10h. and 11h. and about 10h. 30m. exceptional darkness was experienced. In some districts heavy rain fell and in Lerwick the thunderstorm was followed by a heavy shower of wet snow and later rain. By noon weather conditions were normal and the afternoon and evening were fine. A peculiar feature in several districts during the thunderstorm was that the snow which fell was of a dirty bluish colour and rain water which was collected in tanks and barrels was something of the colour of ink. Dr. Harrison, of Lerwick Observatory, states that black rain was reported from Bressay, " but we saw nothing of this or of blue snow here." The pressure gradient on March 15th and 16th was such that air from industrial districts might have reached Shetland.—ED., *M.M.*]

Frequency of Calms in Winter

Having read Mr. S. E. Ashmore's interesting note on the above in the May issue of the *Meteorological Magazine*, may I be permitted to add the following remarks to my previous note ?

The frequency curve for Waltham Cross is the result of plotting the actual percentages and is not in any way smoothed out. The observations used were taken twice a day; the morning reading being at 9h. G.M.T. throughout the year and the afternoon at 15h. G.M.T. in winter, and at 14h. G.M.T. during " Summer Time ". It is true that the curve might, and probably would be modified by the passage of time, but if only a coincidence, it is remarkable that the values for ten years should give so smooth a curve. In the month of June, five years gave zero calms and five only one calm each. In the month of December only one year failed to give ten calms.

Considering the great difference in exposure between Grayshott and Waltham Cross, which latter place lies in a valley, there is fair agreement between the two curves.

I should imagine the curve for Waltham Cross is a fair representation of the normal, because the local topography is such that with a flat barometric gradient and clear night skies in winter, the air on the surrounding hills being cooled by radiation probably drifts katabatically down the many small valleys converging on this station and forms a quasi-stationary pool of cold air. This cold air in slowly drifting down the Lea Valley may partly be the cause of the valley fogs, which, as noted by Mr. J. Fairgrieve, frequently invade London from the north-east in winter.

Unfortunately the station at Waltham Cross is now closed, as far as regular observations are concerned; and it will not be possible to ascertain if the distribution of calms as shown by the curve is normal or merely transitory.

DONALD L. CHAMPION.
7, Robinson Avenue, Goff's Oak, Waltham Cross, Herts, May 22nd, 1935.

NOTES AND QUERIES

Honour for Dr. G. C. Simpson

The Honours List, issued on the occasion of His Majesty's Birthday on June 3rd, includes the announcement that Dr. G. C. Simpson, C.B., Director of the Meteorological Office, is promoted to K.C.B.

The Ideal Weather Home*

This little book is an expansion of a short series of broadcast talks on weather under the same title early last year. Its subject matter is more or less that of any popular book on the weather, but it is not like other popular books. The author draws a parallel between the atmosphere and an all-electric house, and then produces the parallel lines to infinity. Even the frontispiece showing the "floors" of the weather house is drawn like a sky-scraper.

The house is No. 3 Sun Street, lighting, heating and power are delivered by "wireless" from the sun, the clouds are the "stair carpets" and a thunderstorm is an express lift, while unkind swarms of meteors throw stones at the sky-scraper, and the higher floors are furnished with the rich draperies of aurora. The author even carries the analogy into history, two chapters on the "picture gallery"—the "old masters" and the "moderns."

The idea was an excellent one for a series of broadcast talks, and it makes a very readable book. The general reader will absorb a good deal of meteorology without any tears; to the meteorologist the chief interest lies in the method of presentation, but many even among professional meteorologists will profit by the author's expert

* Through the weather house or the wind, the rain and six hundred miles above. By R. A. Watson Watt. London, Peter Davies, 1935, pp. xi + 192, illus. Price 7*s*. 6*d*.

knowledge of the "ionosphere". In less skilled hands there would have been the danger that the facts might be distorted to fit the allegory; Watson Watt avoids this trap, but at times one does feel that he overworks his model. The chapter on "The Servant's Quarters," which describes the realities behind the preparation of a daily weather chart, is one of the most interesting in the book, in spite of the fact that after the first paragraph the author has to descend from his hobby-horse and walk. The chapters, "Saws, saints and sages," and "Controlling the weather," though short, contain much good sense, and the final "Further outlook—?" points out that if a book on meteorology finishes "in the air" it is because the subject has not yet produced the Newton who is so urgently needed.

BOOKS RECEIVED

Deutsches Meteorologisches Jahrbuch für Bayern, 1933.

The Bavarian Meteorological Yearbook for 1933 contains as usual a number of valuable appendices, among which may be mentioned "Verhalten der relativen Feuchtigkeit auf der Zugspitze," by A. Schmauss. "Bericht über die Arbeiten des Kalmitobservatoriums in den Jahren 1932 and 1933," by K. Sonntag. "Feldstärke-und Schwundmessungen im Rundfunkwellenbereich auf dem Zugspitzgipfel," by A. Agricola. "Uber einen lokalen Kälteeinbruch in München und seine Ursachen," by R. Geiger, and "Die München Registrierballonfahrten im Jahre, 1933," by P. Zistler and H. Zierl.

Nautisk-Meteorologisk Aarbog, 1933. The Danish Meteorological Institute, Copenhagen, 1934.

In addition to the tables, charts and description of the state of the ice in the Arctic Seas published each year, the Nautisk-Meteorologisk Aarbog for 1933 contains an appendix by J. Egedal, entitled "On the determination of the normal height of the sea-level round the Danish coasts."

OBITUARY

Vilhelm Carlheim-Gyllensköld.—The death of Dr. V Carlheim-Gyllensköld at Stockholm on December 13th, 1934, robs Sweden of a great magnetician and geophysicist. Born at Stockholm on October 17th, 1859, he studied at the University of Uppsala. In 1882–3 he joined the Swedish Polar Year expedition to Spitsbergen, where he made a series of auroral observations of great value, including spectrum measurements of remarkable accuracy. After the completion of his work on the Polar Year data, he became an assistant astronomer at Pulkova, but after a few years he returned to terrestrial magnetism and began a series of magnetic surveys in southern Sweden, the results of which, reduced to the epoch 1892, he discussed in a number of papers, culminating in 1895 in his "Mémoire sur le magnétisme terrestre dans la Suède meridionale" (Stockholm, K. Svenska Vetensk. Akad., Handl. 27, No. 8). In the following year he published his best known paper," Sur la forme analytique de l'attraction magnétique de la terre exprimée en fonction du temps" (Stockholm, Astron. iaktt. och unders. på Stockholms Observatorium, 5, No. 5, 1896).

In 1898 Carlheim-Gyllensköld went again to Spitsbergen with the expedition to measure an arc of the meridian, and made magnetic observations there. Returning to Sweden he carried out pioneer work on the geophysical prospecting of iron-ore deposits and also urged the establishment of a detailed magnetic survey of Sweden, which after many years was carried out by the Geological Survey in 1928–34. Meanwhile, in 1907, he became lecturer in physics at the University of Stockholm and received the title of Professor in 1911. In 1927 he became Vice-president of the section of Terrestrial Magnetism and Atmospheric Electricity of the International Union for Geodesy and Geophysics, and he presided at the meetings in Stockholm in 1930. He organised the magnetic work at the Swedish station in Spitsbergen during the Second International Polar Year of 1932–3, and his active scientific career which began with the first Polar Year, was rounded off by the second.

We regret to learn of the death, at Santiago, on March 26th, 1935, of Capitan de Corbeta en retiro Don Waldo Nuño, aged 52 years. When the Meteorological services of Chile were reorganised in 1929, Capitan de Corbeta Nuño was the founder and first director of the Oficina Meteorologica de Chile, which became the sole official meteorological service, and he retained this position until 1931.

The Weather of May, 1935

Pressure was above normal over most of Europe, the north-east North Atlantic, west and central Canada, north and south-east United States and west Mexico, the greatest excesses being 9·6 mb. at Thorshavn and Lerwick and 5·4 mb. south of the Great Slave Lake, while pressure was below normal over Spitsbergen, the extreme north of Norway, the Iberian peninsula, south France, most of the North Atlantic, Alaska, east Canada, north-east and south-west United States, the greatest deficits being 8·0 mb. near St. Johns, Newfoundland, 4·0 mb. at Point Barrow and 3·9 mb. at Waigatz.

A conspicuous feature of the weather of May over the British Isles was the marked contrasts experienced ; high temperatures on the 6th were followed about a week later by a reversion to wintry conditions to be succeeded in turn by mild weather towards the end of the month. A marked feature was the prevalence of high pressure. In Scotland generally there was a pronounced excess of sunshine, but in south England there was a considerable deficiency ; at

Eskdalemuir the month's sunshine total of 108 hours above the normal, was the highest since records began there in 1910. Rainfall was deficient in most parts and absolute droughts occurred in several areas within the period April 21st to May 12th. The low pressure area to the south of Iceland on the 1st moved south-east to France during the first five days of the month giving generally unsettled cool weather at first, getting milder later. Some rain occurred locally in the south on the 3rd, but elsewhere there was little or none. By the 6th the Azores anticyclone had spread north-east and become established over Scotland giving brilliantly fine warm weather over the whole country that day—77° F. was recorded at Tottenham, Westminster, Brighton, Portsmouth and Collumpton, while Lympne had 13·5 hrs. bright sunshine, Liverpool 12·7 hrs. and Stornoway 11·2 hrs. On the 7th the wind current became north-easterly in the east and south and temperature there dropped considerably. For the next few days from the 8th to 11th easterly winds prevailed over the country, light in the north but moderate to fresh in the south and temperature was about or below normal on the 8th and 9th rising somewhat later. Sunshine records were generally good on the 10th and 11th, Aldergrove having as much as 14·6 hrs. bright sunshine on the 11th. A thunderstorm was reported from Auchincruive on the 11th. On the 11th the winds backed to N. and on the 12th wintry conditions set in and were maintained from then to the 20th. During this period the winds were mainly between N. and E., fresh to strong locally, reaching a gale in places on the 15th and 17th, snow, heavy locally, was experienced over a wide area even as far south as Cornwall while severe ground frosts occurred generally*. Temperature did not rise above 41° F. at Inverness on the 16th and 42° F. at Nairn and Manchester on the 16th and Harrogate on the 17th. Thunderstorms occurred locally in England on the 18th and 20th. From the 21st to the end of the month pressure was high to the north with mainly easterly winds in the south, moderate to strong at first becoming lighter later while in the north the winds were more variable and lighter. In the north the weather was fine and sunny with temperature about normal, 16·2 hrs. bright sunshine were recorded at Stornoway on the 27th and 16·0 hrs, at Dalwhinnie on the 28th and at Stornoway on the 26th and 30th, while in the south the weather was unsettled, rain occurring on many days but with some long bright periods. As the easterly winds diminished in force the temperature rose and on the 29th, 72° F. was recorded at Tottenham, Brighton and Portsmouth. Thunderstorms occurred locally in south England from the 27th to 30th and in Ireland on the 29th and 30th; 1·46 in. of rain were measured during a thunderstorm at Bognor and 1·16 in. at Blockley, Gloucester on the 30th. The distribution of bright sunshine for the month was as follows :—

* See p. 105.

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	274	+93	Liverpool ...	241	+42
Aberdeen ...	172	− 1	Ross-on-Wye ...	193	0
Dublin	225	+38	Falmouth ...	194	−21
Birr Castle ...	226	+52	Gorleston ...	264	+35
Valentia... ...	256	+67	Kew	190	−13

Miscellaneous notes on weather abroad culled from various sources.

A severe snowstorm occurred in Poland on the 1st and 2nd, making the roads impassable in many places and doing much damage to the orchards and gardens. Severe frosts also caused serious damage in the orchards and vineyards in Hungary at the beginning of the month and near Hochheim about the middle of the month. Heavy rain and low temperatures prevailed in north Italy from about the 13th–17th ; a gale occurred in Venice on the 16th and snow fell on the mountains round Lake Maggiore while floods were reported from Venetia and Piedmont. Snow occurred in most of central Europe and France about the middle of the month, the snowfalls in Switzerland being reported as the heaviest in May for 80 years. Much damage was done to property early on the 28th at Amiens by a cloudburst which in a few minutes flooded many streets. It was reported from Uleaborg (Finland) on the 31st that the whole district was ice free (*The Times*, May 3rd–June 1st).

A slight fall of snow occurred in Johannesburg and other Reef towns on the 27th (*The Times*, May 28th).

Severe heat occurred in Calcutta during the week ending the 11th, 110° F. being reported on the 11th, the highest reading since May, 1924. It is reported that during a hailstorm at Sann and Amri in Sind early in May some of the hailstones weighed nearly ½ lb. and injured men and crops, even killing small cattle. A hailstorm accompanied by thunder and torrential rain swept across central Japan on the 21st damaging the mulberry crop and breaking the telephone wires (*The Times*, May 13th–22nd).

Cool weather with rain or snow showers delayed farming operations in many districts of Canada about the middle of the month and later the weather continued cool and cloudy. Dust storms were again experienced in the south central United States early in the month. Sixteen people were killed in a storm over the south-east States on the 3rd. Twenty people in Texas and Oklahama were killed on the 19th by flooded rivers and tornadoes which did material damage estimated at a million dollars. Alabama and Mississippi were struck by another tornado which killed 5 people on the 20th ; floods were also reported along the Red river in Louisiana. Floods in east Wyoming and north-east Colorado resulting from cloudbursts on the 30th caused the deaths of 10 people ; and hurricanes and floods occurred in Nebraska on the 31st when it was estimated that 250

(*continued on p.* 128).

Rainfall : May, 1935 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square..........	1·07	61	*Leics* .	Thornton Reservoir ...	·68	34
Sur .	Reigate, Wray Pk. Rd..	1·97	108	„ .	Belvoir Castle...........	·59	28
Kent .	Tenterden, Ashenden...	1·65	105	*Rut* .	Ridlington	1·00	50
„ .	Folkestone, Boro. San.	1·80	...	*Lincs* .	Boston, Skirbeck.........	·32	18
„ .	Eden'bdg., Falconhurst	1·80	97	„ .	Cranwell Aerodrome...	·41	23
„ .	Sevenoaks, Speldhurst.	1·68	...	„ .	Skegness, Marine Gdns.	·30	18
Sus .	Compton, Compton Ho.	1·19	54	„ .	Louth, Westgate.........	·33	16
„ .	Patching Farm..........	1·63	88	„ .	Brigg, Wrawby St.......	·31	...
, .	Eastbourne, Wil. Sq....	1·24	75	*Notts* .	Worksop, Hodsock......	·42	21
„ .	Heathfield, Barklye....	1·96	109	*Derby*.	Derby, L. M. & S. Rly.	·39	20
Hants.	Ventnor, Roy.Nat.Hos.	1·40	82	„ .	Buxton, Terr. Slopes...	·67	22
„ .	Fordingbridge, Oaklnds	1·95	94	*Ches* .	Runcorn, Weston Pt....	1·45	63
„ .	Ovington Rectory.......	1·18	54	*Lancs*.	Manchester, Whit. Pk.	·84	40
„ .	Sherborne St. John......	·79	41	„ .	Stonyhurst College......	1·16	41
Herts .	Royston,Therfield Rec.	1·32	68	„ .	Southport, Bedford Pk.	1·46	70
Bucks.	Slough, Upton............	1·20	71	„ .	Lancaster, Greg Obsy.	1·50	60
„ .	H. Wycombe, Flackwell	·79	43	*Yorks*.	Wath-upon-Dearne......	·41	20
Oxf .	Oxford, Mag. College...	1·70	95	„ .	Wakefield,Clarence Pk.	·61	31
Nor .	Wellingboro, Swanspool	·95	49	„ .	Oughtershaw Hall.......	1·33	...
„ .	Oundle	·67	...	„ .	Wetherby, Ribston H..	·35	17
Beds .	Woburn, Exptl. Farm...	2·37	122	„ .	Hull, Pearson Park......	·49	25
Cam .	Cambridge, Bot. Gdns.	·73	41	„ .	Holme-on-Spalding......	·45	22
Essex.	Chelmsford, County Lab	1·18	82	„ .	West Witton, Ivy Ho.	·94	42
„ .	Lexden Hill House......	1·37	...	„ .	Felixkirk, Mt. St. John.	1·27	68
Suff .	Haughley House.........	2·31	...	„ .	York, Museum Gdns....	1·07	54
„ .	Campsea Ashe...........	1·98	132	„ .	Pickering, Hungate......	1·15	59
„ .	Lowestoft Sec. School...	1·32	82	„ .	Scarborough..............	1·10	58
„ .	Bury St. Ed., WestleyH.	1·28	70	„ .	Middlesbrough............	·69	36
Norf. .	Wells, Holkham Hall...	·38	24	„ .	Baldersdale, Hury Res.	·56	22
Wilts .	Calne, Castleway.........	1·10	59	*Durh* .	Ushaw College............	·96	44
„ .	Porton, W.D. Exp'l. Stn	·84	49	*Nor* .	Newcastle, Town Moor.	1·05	52
Dor .	Evershot, Melbury Ho.	1·84	90	„ .	Bellingham, Highgreen	·94	39
„ .	Weymouth, Westham.	2·02	125	„ .	Lilburn Tower Gdns....	1·08	47
„ .	Shaftesbury,Abbey Ho.	1·31	62	*Cumb*.	Carlisle, Scaleby Hall...	·85	36
Devon.	Plymouth, The Hoe....	1·45	70	„ .	Borrowdale, Seathwaite	1·25	18
„ .	Holne, Church Pk. Cott.	3·38	107	„ .	Borrowdale, Moraine...	1·21	22
„ .	Teignmouth, Den Gdns.	2·92	160	„ .	Keswick, High Hill......	·85	27
„ .	Cullompton	2·06	95	*West* .	Appleby, Castle Bank...	·77	35
„ .	Sidmouth, U.D.C........	1·82	...	*Mon* .	Abergavenny, Larchf'd	·68	25
„ .	Barnstaple, N. Dev.Ath	2·43	117	*Glam* .	Ystalyfera, Wern Ho....	2·40	69
„ .	Dartm'r,Cranmere Pool	3·50	...	„ .	Cardiff, Ely P. Stn.......	1·17	47
„ .	Okehampton, Uplands.	3·11	115	„ .	Treherbert, Tynywaun.	2·63	...
Corn .	Redruth, Trewirgie......	2·17	94	*Carm* .	Carmarthen, Priory St..	...	...
„ .	Penzance, Morrab Gdn.	1·65	75	*Pemb* .	Haverfordwest,Portfld.	...	...
„ .	St. Austell, Trevarna...	2·19	90	*Card* .	Aberystwyth	2·32	...
Soms .	Chewton Mendip.........	1·28	46	*Rad* .	BirmW.W.Tyrmynydd	2·19	64
„ .	Long Ashton............	1·11	53	*Mont* .	Lake Vyrnwy	1·11	35
„ .	Street, Millfield..........	1·04	54	*Flint* .	Sealand Aerodrome......	1·80	96
Glos .	Blockley	2·60	...	*Mer* .	Dolgelley, Bontddu......	2·50	76
„ .	Cirencester, Gwynfa....	1·32	64	*Carn* .	Llandudno	1·24	70
Here .	Ross, Birchlea............	1·05	49	„ .	Snowdon, L. Llydaw 9..	3·84	...
Salop .	Church Stretton.........	·68	26	*Ang* .	Holyhead, Salt Island...	1·42	72
„ .	Shifnal, Hatton Grange	·94	46	„ .	Lligwy	1·78	...
Staffs .	Market Drayt'n, Old Sp.	·82	37	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	1·00	49		Douglas, Boro' Cem....	1·06	42
War .	Alcester, Ragley Hall...	1·44	70	*Guernsey*			
„ .	Birminghm, Edgbaston	1·77	83		St. PeterP't.Grange Rd.	1·81	106

Rainfall: May, 1935: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig	Pt. William, Monreith	·53	23	*Suth*	Melvich	1·20	59
,,	New Luce School	1·11	39	,,	Loch More, Achfary	4·19	95
Kirk	Dalry, Glendarroch	·92	29	*Caith*	Wick	·56	27
,,	Carsphairn, Shiel	1·38	33	*Ork*	Deerness	·53	27
Dumf.	Dumfries, Crichton, R.I.	·74	29	*Shet*	Lerwick	·94	45
,,	Eskdalemuir Obs.	1·16	35	*Cork*	Caheragh Rectory	1·03	...
Roxb	Branxholm	...	...	,,	Dunmanway Rectory	·98	29
Selk	Ettrick Manse	·96	26	,,	Cork, University Coll.	·71	31
Peeb	West Linton	·99	...	,,	Ballinacurra	·52	22
Berw	Marchmont House	1·03	42	,,	Mallow, Longueville	·84	38
E.Lot	North Berwick Res.	1·00	50	*Kerry*	Valentia Obsy	1·35	43
Midl	Edinburgh, Roy. Obs.	·93	45	,,	Gearhameen	1·90	36
Lan	Auchtyfardle	·84	...	,,	Darrynane Abbey	1·40	47
Ayr	Kilmarnock, Kay Pk.	·64	...	*Wat*	Waterford, Gortmore	·70	30
,,	Girvan, Pinmore	1·08	36	*Tip*	Nenagh, Cas. Lough	1·39	56
Renf	Glasgow, Queen's Pk.	·61	25	,,	Roscrea, Timoney Park	1·05	...
,,	Greenock, Prospect H.	·57	17	,,	Cashel, Ballinamona	1·09	45
Bute	Rothesay, Ardencraig	1·11	...	*Lim*	Foynes, Coolnanes	1·12	48
,,	Dougarie Lodge	1·10	...	,,	Castleconnel Rec.	1·09	...
Arg	Ardgour House	1·41	...	*Clare*	Inagh, Mount Callan	1·73	...
,,	Glen Etive	...	...	,,	Broadford, Hurdlest'n.	1·29	...
,,	Oban	·46	...	*Wexf*	Gorey, Courtown Ho.	·88	40
,,	Poltalloch	·83	29	*Wick*	Rathnew, Clonmannon	·74	...
,,	Inveraray Castle	1·19	30	*Carl*	Hacketstown Rectory	·97	37
,,	Islay, Eallabus	1·13	43	*Leix*	Blandsfort House	1·06	44
,,	Mull, Benmore	3·60	48	,,	Mountmellick	1·38	...
,,	Tiree	·98	39	*Offaly*	Birr Castle	1·04	47
Kinr	Loch Leven Sluice	...	...	*Dublin*	Dublin, FitzWm. Sq.	1·39	68
Perth	Loch Dhu	·55	12	,,	Balbriggan, Ardgillan	1·45	70
,,	Balquhidder, Stronvar	·37	...	*Meath*	Beauparc, St. Cloud	1·58	...
,,	Crieff, Strathearn Hyd.	·26	10	,,	Kells, Headfort	1·19	44
,,	Blair Castle Gardens	·60	30	*W.M*	Moate, Coolatore	1·13	...
Angus	Kettins School	·57	21	,,	Mullingar, Belvedere	1·78	73
,,	Pearsie House	1·09	...	*Long*	Castle Forbes Gdns.	·83	32
,,	Montrose, Sunnyside	1·12	55	*Gal*	Galway, Grammar Sch.	1·08	...
Aber	Braemar, Bank	1·22	51	,,	Ballynahinch Castle	1·81	50
,,	Logie Coldstone Sch.	1·91	77	,,	Ahascragh, Clonbrock	...	...
,,	Aberdeen, King's Coll.	1·60	69	*Mayo*	Blacksod Point	1·16	41
,,	Fyvie Castle	2·54	98	,,	Mallaranny	...	...
Moray	Gordon Castle	1·51	71	,,	Westport House	2·16	76
,,	Grantown-on-Spey	2·25	97	,,	Delphi Lodge	3·08	51
Nairn	Nairn	1·51	84	*Sligo*	Markree Obsy	1·70	62
Inv's	Ben Alder Lodge	·84	...	*Cavan*	Crossdoney, Kevit Cas.	1·06	...
,,	Kingussie, The Birches	1·42	...	*Ferm*	Enniskillen, Portora	1·10	...
,,	Inverness, Culduthel R.	1·14	...	*Arm*	Armagh Obsy	·84	35
,,	Loch Quoich, Loan	1·49	...	*Down*	Fofanny Reservoir	1·75	...
,,	Glenquoich	...		,,	Seaforde	·87	33
,,	Arisaig, Faire-na-Sguir	·90	...	,,	Donaghadee, C. Stn.	·59	26
,,	Fort William, Glasdrum	1·04	...	,,	Banbridge, Milltown	·92	41
,,	Skye, Dunvegan	1·84	...	*Antr*	Belfast, Cavehill Rd.	1·21	...
,,	Barra, Skallary	1·00	...	,,	Aldergrove Aerodrome	·96	42
R&C	Alness, Ardross Castle	2·43	93	,,	Ballymena, Harryville	1·65	58
,,	Ullapool	2·04	80	*Lon*	Garvagh, Moneydig	1·05	...
,,	Achnashellach	2·23	50	,,	Londonderry, Creggan	1·98	76
,,	Stornoway	1·66	65	*Tyr*	Omagh, Edenfel	1·18	46
Suth	Lairg	2·20	87	*Don*	Malin Head	1·22	...
,,	Tongue	1·61	68	,,	Killybegs, Rockmount	1·46	...

Climatological Table for the British Empire, December, 1934

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy....	1003·0	−10·7	57	34	50·9	44·2	47·5	+ 7·2	45·6	91	8·0	4·42	+ 2·13	26	0·8	11
Gibraltar..........	1021·6	+ 1·3	69	45	64·5	51·8	58·1	+ 2·1	52·8	86	4·9	3·44	− 1·98	14	...	...
Malta..........	1015·2	− 1·0	68	50	62·3	54·2	58·3	+ 0·4	54·5	81	6·7	4·48	+ 0·77	17	5·5	57
St. Helena	1012·7	0·0	70	57	65·8	58·2	62·0	+ 0·3	59·5	93	9·6	2·24	...	21	...	...
Freetown, Sierra Leone	1013·9	+ 3·0	89	71	85·6	74·2	79·9	− 1·5	75·4	82	3·4	0·27	− 1·15	2	...	...
Lagos, Nigeria	1010·9	+ 0·9	89	70	86·3	74·7	80·5	− 1·3	75·4	92	2·9	4·72	+ 3·91	3	6·1	52
Kaduna, Nigeria	1010·7	...	93	50	89·2	53·6	71·4	− 1·9	55·6	45	1·3	0·00	0·00	0	9·4	82
Zomba, Nyasaland	1009·7	+ 1·4	88	60	78·8	64·6	71·7	− 1·4	67·5	78	7·9	13·29	+ 2·42	21	...	...
Salisbury, Rhodesia...	1010·2	− 1·1	87	51	76·9	59·4	68·1	− 1·5	62·4	71	6·8	8·19	+ 2·10	20	4·9	37
Cape Town	1015·1	+ 0·8	97	55	80·5	60·2	70·3	+ 2·4	61·0	63	3·2	0·21	− 0·60	3	...	...
Johannesburg	1011·5	+ 0·7	83	47	74·9	54·6	64·7	− 0·8	58·0	69	5·2	6·17	+ 0·74	13	6·9	50
Mauritius	1013·1	− 0·9	90	66	85·5	72·9	79·2	+ 0·9	73·8	69	5·6	1·07	− 3·66	14	8·6	65
Calcutta, Alipore Obsy.	1016·2	+ 0·5	82	52	77·9	58·8	68·3	+ 1·8	59·9	90	1·2	0·31	+ 0·07	2*	...	...
Bombay	1013·5	0·0	92	67	87·7	70·1	78·9	+ 1·5	67·3	71	2·2	0·00	− 0·05	0*	...	...
Madras	1014·0	+ 0·5	85	64	82·4	68·3	75·3	− 1·4	70·3	82	5·8	2·19	− 3·16	6*	...	...
Colombo, Ceylon	1011·2	+ 0·9	88	68	86·0	72·2	79·1	− 0·4	73·4	74	4·6	2·05	− 3·07	6	7·8	67
Singapore	1010·4	+ 0·7	89	71	86·0	73·8	79·9	0·0	75·4	78	7·6	3·28	− 7·28	14	6·1	51
Hongkong	1019·2	− 0·5	79	43	69·2	59·6	64·4	+ 1·4	59·1	75	5·6	0·53	− 0·50	4	5·6	52
Sandakan	1009·5	...	89	72	86·6	74·4	80·5	+ 0·3	76·1	83	7·2	16·02	− 2·62	22	...	...
Sydney, N.S.W..........	1010·8	− 1·1	90	55	72·8	60·5	66·7	− 3·4	61·9	67	7·2	6·20	+ 3·34	21	6·3	44
Melbourne	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Adelaide	1013·2	0·0	104	49	81·3	57·6	69·5	− 1·6	58·2	40	6·0	1·18	+ 0·18	8	8·3	58
Perth, W. Australia ...	1013·5	+ 0·3	103	50	79·8	60·2	70·0	− 0·8	59·7	49	4·3	0·35	− 0·21	6	10·0	70
Coolgardie	1011·2	0·0	105	52	90·1	61·2	75·7	0·0	63·7	51	3·1	0·00	− 0·69	0	...	...
Brisbane	1009·8	− 2·2	97	58	82·1	65·2	73·7	− 2·7	67·7	65	5·6	9·82	+ 4·93	16	8·6	62
Hobart, Tasmania......	1012·5	+ 2·8	94	44	66·1	52·2	59·1	− 1·1	53·8	64	7·4	5·23	+ 3·24	16	5·2	34
Wellington, N.Z.	1018·5	+ 6·3	84	50	74·1	58·3	66·2	+ 6·0	61·8	66	5·5	0·05	− 3·17	1	10·1	67
Suva, Fiji	1008·5	− 0·1	91	70	86·0	73·8	79·9	+ 0·9	74·8	77	5·7	6·20	− 6·32	17	8·8	67
Apia, Samoa	1007·2	− 1·1	88	71	84·6	74·4	79·5	+ 0·2	76·3	81	7·5	20·05	+ 6·16	23	5·5	43
Kingston, Jamaica	1014·2	+ 0·2	91	65	86·1	69·6	77·9	+ 0·2	67·7	85	4·6	1·40	− 0·19	2	4·3	39
Grenada, W.I.	...	...	85	70	83	70	76·5	− 1·7	72	78	5	13·09	+ 5·89	19	...	...
Toronto..........	1018·2	+ 0·6	45	0	31·8	19·3	25·5	− 1·6	22·5	79	7·7	0·90	− 1·57	6	1·7	19
Winnipeg	1020·9	+ 2·2	35	−37	13·3	−3·2	5·1	− 0·7	...	...	5·8	0·00	− 0·94	0	2·6	32
St. John, N.B.	1012·6	− 1·4	56	0	26·2	11·5	18·9	− 5·5	14·1	69	5·1	3·15	− 1·02	6	4·2	48
Victoria, B.C..........	1017·5	+ 0·8	52	31	45·8	38·7	42·3	+ 1·2	40·1	89	7·1	6·42	+ 0·68	23	2·3	27

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

Climatological Table for the British Empire, Year 1934

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal.	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy.	1015·3	− 0·1	84	22	58·4	44·7	51·5	+ 1·8	46·0	85	7·2	19·71	− 4·09	149	4·3	32
Gibraltar	1017·9	0·0	91	36	71·2	56·6	63·9	− 0·3	55·8	81	4·5	26·11	− 9·16	81	...	...
Malta	1015·8	+ 0·4	97	41	70·9	60·7	65·8	− 0·3	60·5	76	4·9	22·80	+ 2·94	90	8·3	67
St. Helena	1013·4	− 0·1	74	53	65·1	58·5	61·8	+ 0·3	59·4	94	9·0	40·81	...	223	...	...
Freetown, Sierra Leone	1013·1	+ 1·7	92	62	85·8	71·1	78·5	− 2·2	75·6	86	6·3	172·96	+ 15·73	161	...	...
Lagos, Nigeria	1011·2	+ 0·4	92	67	86·3	75·4	80·9	+ 0·2	75·7	87	6·6	77·80	+ 5·82	129	5·6	47
Kaduna, Nigeria	1008·6	...	105	50	89·1	64·2	76·6	+ 0·2	66·1	69	5·3	53·38	− 0·45	117	7·5	63
Zomba, Nyasaland	1012·1	− 0·2	93	47	79·1	61·1	70·1	+ 0·7	64·7	73	6·0	48·97	− 5·57	137	...	...
Salisbury, Rhodesia	1014·1	− 0·7	92	37	76·9	54·4	65·7	+ 0·4	57·8	61	4·0	33·67	+ 2·12	98	7·6	63
Cape Town	1016·9	− 0·1	103	37	73·6	55·3	64·5	+ 2·2	56·3	78	4·4	19·19	− 5·85	90	...	...
Johannesburg	1015·9	+ 0·5	85	26	70·5	50·2	60·3	+ 0·6	51·5	62	3·8	34·36	+ 1·14	104	8·2	68
Mauritius	1016·5	+ 0·4	90	54	79·8	67·3	73·6	− 0·4	69·4	71	5·7	47·55	− 2·11	249	7·9	65
Calcutta, Alipore Obsy.	1007·1	− 0·5	105	45	81·1	71·7	79·9	+ 1·1	72·4	86	4·9	54·39	− 9·93	87*	...	...
Bombay	1008·8	− 0·4	96	53	87·1	73·9	80·5	− 0·1	72·8	78	4·3	73·25	+ 1·06	86*	...	...
Madras	1008·4	− 0·4	110	59	90·0	74·8	82·4	− 0·7	75·1	77	6·1	36·66	− 12·90	51*	...	...
Colombo, Ceylon	1010·2	+ 0·5	90	63	85·1	74·6	79·9	− 1·1	76·0	78	6·3	114·77	+ 34·64	187	6·8	56
Singapore	1009·4	− 0·1	90	67	85·8	74·3	80·0	− 0·9	76·5	81	8·2	106·55	+ 11·43	194	5·6	46
Hongkong	1013·1	+ 0·6	93	43	76·5	67·7	72·1	− 0·2	67·4	76	7·2	97·68	+ 11·95	153	5·1	42
Sandakan	1009·5	...	94	70	87·6	74·7	81·2	− 0·1	76·8	85	7·4	166·12	+ 41·33	242	...	...
Sydney, N.S.W.	1016·6	+ 0·7	103	40	70·2	56·2	63·2	+ 0·1	58·4	73	...	64·91	+ 17·43	183	6·7	56
Melbourne	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Adelaide	1017·5	+ 0·5	111	38	74·6	54·3	64·5	+ 1·5	54·9	51	5·8	20·24	− 0·94	125	6·9	57
Perth, W. Australia	1016·1	− 0·3	110	37	74·0	56·1	65·1	+ 0·9	56·8	61	4·7	40·61	+ 6·24	119	7·7	64
Coolgardie	1015·2	− 0·7	111	35	77·4	53·5	65·5	+ 1·0	56·9	60	4·0	11·31	+ 1·04	50	...	...
Brisbane	1016·7	+ 0·8	97	40	76·3	59·2	67·7	− 1·2	61·8	67	5·3	54·26	+ 8·97	117	7·6	63
Hobart, Tasmania	1015·4	+ 2·9	99	31	62·3	47·4	54·9	+ 0·5	49·1	66	6·7	23·17	− 0·62	167	5·3	44
Wellington, N.Z.	1017·4	+ 2·7	84	32	60·8	48·8	54·8	− 0·6	51·8	76	6·7	43·34	− 4·70	151	5·9	49
Suva, Fiji	1012·1	+ 0·8	95	63	83·0	72·2	77·6	+ 0·6	73·3	81	7·0	134·33	+ 17·19	246	5·2	43
Apia, Samoa	1010·2	− 0·1	89	66	84·9	74·0	79·5	+ 1·0	75·9	79	6·2	120·22	+ 10·51	213	...	...
Kingston, Jamaica	1013·8	+ 0·1	93	65	86·5	70·7	78·6	− 0·7	69·9	83	4·2	26·62	− 6·97	82	5·9	49
Grenada, W.I.	...	...	90	70	85	72	78·5	− 0·3	73	75	5	121·88	+ 47·29	241	...	...
Toronto	1017·1	+ 0·5	94	−21	53·8	37·4	45·6	+ 0·4	40·0	72	6·0	20·49	− 10·80	103	5·7	47
Winnipeg	1016·4	+ 0·2	99	−39	46·6	26·6	36·6	+ 2·0	...	...	5·7	15·42	− 4·76	70	...	...
St. John, N.B.	1015·5	+ 0·9	80	−20	48·5	33·0	40·7	− 0·5	36·7	78	6·3	42·44	− 5·64	135	5·4	43
Victoria, B.C.	1016·8	+ 0·1	87	31	57·7	46·2	51·9	+ 2·5	48·5	83	6·0	30·92	+ 0·61	156	6·4	52

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

(*continued from p.* 123).

people were killed. In the United States temperature was mainly below normal except during the first part of the month in the Gulf States where it was above normal and along the Pacific coast where it was about normal, while the rainfall was generally about or above normal at first becoming mainly below normal. One hundred icebergs were reported to be moving south to within 30 miles of the westbound steamer lane on the North Atlantic early in the month (*The Times*, May 3rd–June 4th and *Washington, D.C., U.S. Dept. Agric. Weekly Weather and Crop Bulletin*).

Daily Readings at Kew Observatory, May 1935

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see p. 1).
	mb.		°F	°F	%	in.	hrs.	
1	1024·6	SSW.2	44	49	82	0·11	0·0	r–r_0 3h. 50m.–13h.
2	1022·5	SSW.3	37	62	48	—	8·5	X early.
3	1014·4	ESE.4	47	65	24	—	11·2	
4	1012·6	E.4	50	64	44	—	4·1	
5	1019·5	ENE.1	46	70	50	—	5·9	f m early.
6	1025·7	NE.3	50	74	30	—	12·5	w early.
7	1029·1	N.E.3	49	64	43	—	3·9	w early.
8	1030·9	NE.3	48	57	60	trace	3·1	d_0 8h. 45m.
9	1024·8	NE.4	47	58	43	—	8·2	
10	1020·6	ENE.5	45	63	37	—	13·8	
11	1020·0	NNE.5	45	65	39	—	12·3	
12	1021·7	NE.4	45	53	44	—	5·0	
13	1023·3	NNW.3	39	52	43	—	5·3	
14	1018·5	N.4	39	50	61	0·13	5·0	rr_0 5h.–8h., pr $h_0 s_0$ 11h.
15	1017·8	NNE.4	39	54	47	0·15	6·8	r–ir_0 0h. 30m.–6h.
16	1018·9	NNE.4	41	47	51	trace	2·8	r_0 7h. & 12h. $pr_0 h_0$ 18h.
17	1009·4	SSW.4	30	52	43	trace	8·7	x early, pr_0 23 h. 55m.
18	1012·0	N.3	36	51	45	0·01	9·8	pr_0 13h., r–r_0 19h.–20h
19	1013·6	S.3	34	50	85	0·19	0·3	r–r_0 11h. 30m.–18h.
20	1015·6	S.3	46	57	81	0·60	1·1	rr_0 0h.–3h., pr_2 10h.
21	1022·3	NNE.4	42	56	52	—	11·0	
22	1021·9	NNE.5	42	54	49	—	6·2	
23	1013·2	NE.6	43	64	45	—	7·8	
24	1015·1	NE.6	50	67	45	trace	4·3	pr_0 12h. & 23h. 40m.
25	1017·1	ENE.5	50	67	56	0·13	3·9	r–r_0 2h.–10h.
26	1019·1	NE.4	46	65	54	—	9·7	
27	1018·4	NE.3	46	60	72	0·02	0·1	pr_0 14h., pr 15h. 30m.
28	1014·9	E.2	51	66	74	0·05	0·6	pr_0 8h., 11h. & 12h.
29	1013·1	NNE.3	49	68	68	—	11·9	
30	1011·3	NE.2	50	68	55	trace	6·1	pr_0 17h. 45m.–18h.
31	1015·8	NE.2	49	55	79	0·01	0·0	d_0 3h., 5h., 7h. & 10h.
*	1018·6		45	60	53	1·40	6·1	* Means or totals.

General Rainfall for May, 1935.

England and Wales ...	60	per cent. of the average 1881–1915.
Scotland	48	
Ireland	46	
British Isles	55	

(26566) Wt. 18/32 1000 6/35 Hw. G.377/6

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The Halo Phenomena of May and June, 1935

The *Meteorological Magazine* for June included a number of letters describing remarkable displays of halo phenomena on several days in March and April, and again on May 3rd and 4th. Halos continued to be frequently observed throughout May and the early part of June. Halo phenomena were reported from some part of the British Isles on no fewer than 21 days in May, including every day from the 2nd to 8th and 11th to 21st inclusive. The most widespread phenomena occurred on the 3rd to 5th and 15th, being reported at 21 stations (out of 47 for which weather diaries are available) on the 3rd, 24 on the 4th and 5th, and 23 on the 15th.

On May 4th the upper arc of contact of the 22° halo was observed at Limpsfield (Surrey), Worthing, Torquay and Paignton, and mock suns at the latter station and at Calshot.

A remarkable display occurred in the north of England and southern Scotland on May 8th. Parts of this display were observed at nine stations out of 47. The most complete record was obtained by Mr. Tom Wilson from Honister Pass; his sketch, representing the phenomena as seen at about 2.30 p.m. B.S.T. is reproduced in Fig. 1, in which coloured arcs or circles are represented by three lines and white arcs or circles by two lines. S is the sun and Z the zenith. The altitude of the sun was approximately 50°. Mr. Wilson made several sketches at the time and afterwards revisited the scene with measuring instruments. He determined the radius of the large halo C as about 46°. B is evidently the halo of 22°. Inside B was another halo A, showing the colours of the spectrum with the red towards the sun. Unfortunately the radius of this halo cannot be determined exactly, but Mr. Wilson describes it as nearer to B than to the sun. It was probably Rankin's halo of about 17° and has been inserted in Fig. 1 on that assumption. Where it crossed the mock-sun ring D two mock suns HH appeared very distinctly. The mock-sun ring was complete, E appears to be part of a circumzenithal ring tangent to the innermost halo, but F was "rather elusive," and it is not clear whether it represents a circumzenithal ring or parts of the oblique arcs through the anthelion or both. As described below (Fig. 2), the oblique arcs were clearly seen not far off at Ambleside and from a study of three rough sketches made by Mr. Wilson at 1.45, 2.10 and 2.45 p.m., it seems probable that F in Fig. 1 represents parts of these arcs. The identity of the coloured bands G is not clear; it is possible that they represent parts of the oblique arcs descending from the intersection of the mock-sun ring and halo of 46°, which have only been recorded twice before.*

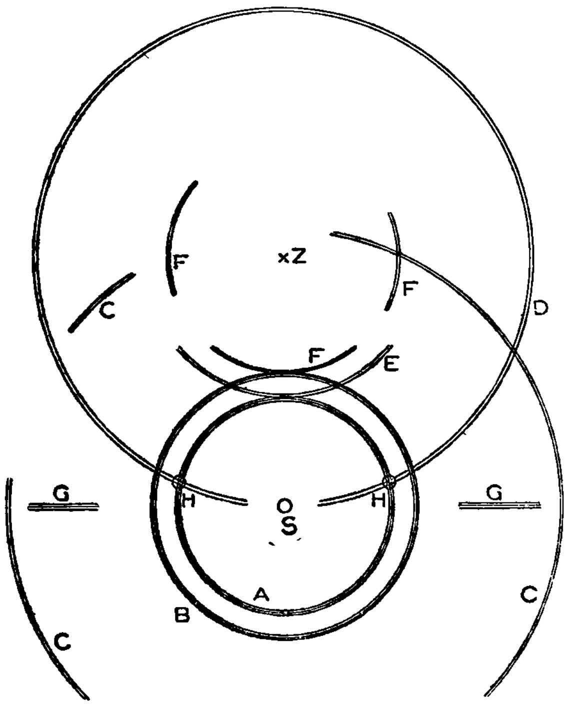

FIG. 1

Mr. Wilson adds: "I have been informed that a much larger circle outside C was observed though I could find none from my point of observation. It reached from the sun and circled the whole of the sky, but was not fully observed"; this, however, may have been merely the mock-sun ring seen at a later hour when the sun was lower. The phenomena lasted from 1 p.m. to 3.30 p.m. B.S.T.

Mr. R. K. Pilsbury reported some parts of the same display from Eskdalemuir Observatory: "On May 8th, 1935, a bright halo of 22° was first observed at 9.30 a.m. B.S.T., and this persisted more or less until late afternoon. At 4 p.m. no halo was visible, but at

* See *Meteorological Magazine*, 66, 1931, pp. 289–90.

4.15 p.m. the halo reappeared with a great brilliance, being accompanied by a horizontal circle or mock-sun ring, together with two mock suns, that on the right of the sun from the observer being brighter than the other. The mock-sun ring was incomplete, the portion joining the mock suns through the sun not being visible, while the portion outside the mock suns was broken. . . . The halo itself was complete and its colouring was very strong, being distinctly very red on its inner edge, the usual colour variations following until the outer edge faded away in whiteness. Another noteworthy feature of the display was the presence of iridescent cloud within the halo; this cloud appeared to vary its position and gave at time the impression of a band or portion of a ring. The mock suns appeared just outside the white edge of the halo." Can it be that the inner halo observed by Mr. Wilson began to form also at Eskdalemuir?

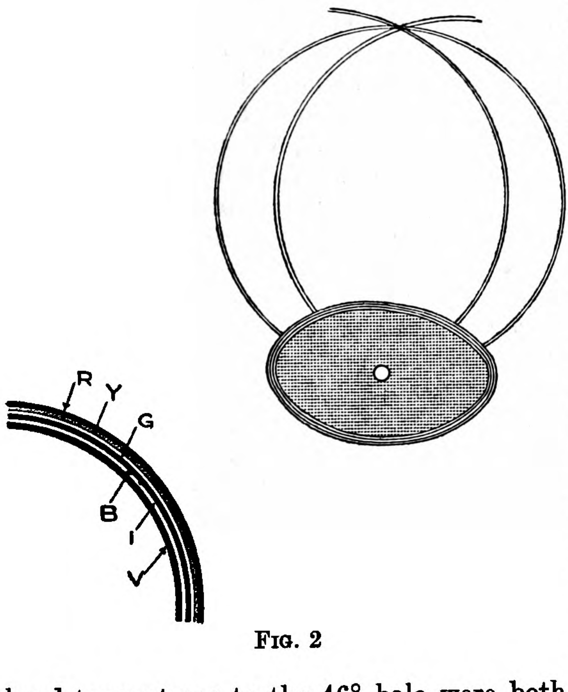

Fig. 2

On the same day, Miss L. Scowcroft, at Ambleside, Westmorland, observed the display shown in Fig. 2 from 2.10 to 3 p.m. B.S.T. Here neither the 22° nor the 46° halo was seen, but the circumscribing elliptical halo to the 22° halo and the left-hand tangent arc to the 46° halo were both visible and brilliantly coloured. The sketch also shows very clearly the mock-sun ring and the oblique arcs through the anthelion. The colour inside the elliptical halo is described as a dark greyish blue contrasting with the deep clear blue of the rest of the sky. Mr. F. Howson at Ambleside also sent a rough sketch showing apparently the halos of 22° and 46° and the mock-sun ring; the hour is not stated, but it is curious that this observation differs so markedly from Miss Scowcroft's.

On May 8th also, Mr. W. S. Davenport observed near Saltdean, Sussex, from 3.25 to 7 p.m. B.S.T., a halo the radius of which he estimated (by theodolite) as 25°, but which was probably the halo of 22°; on either side was a mock sun showing prismatic colours, and elongated away from the sun into white streaks. The colours are described as " ending not unlike osprey feathers ". A halo with mock suns and sun pillar was reported at Lympne at 4.15 p.m. B.S.T.

A widespread display, including besides the halo of 22°, the arc of contact and mock suns, occurred on the 13th, being recorded at 12 stations, chiefly in the north and west but as far south as Oxford.

Another remarkable display occurred on the afternoon and evening of June 2nd. At Westcliff-on-Sea, Essex, Mr. E. J. Horrex observed the halo of 22° with parhelia and the 46° halo with part of the circumzenithal arc, from 6.18 to 6.32 p.m. B.S.T., when the mock sun to the right was obscured by passing fractocumulus, reappearing at 6.45 p.m. The mock sun to the left was not seen from 6.22 to 7.24 p.m., though the sky was clear. The 46° halo at the point of contact with the circumzenithal arc was brilliantly coloured, the inner edge was red and the outer blue, whilst the remainder of the halo was white. At 6.40 p.m. the 46° halo and circumzenithal arc suddenly faded and were not seen again. No well-marked arc of contact was visible with the 22° halo, but there was a distinct thickening of the halo at the top, which was as brilliantly coloured as was the point of contact of the 46° halo with its circumzenithal arc. During the display the sky within the 22° halo and outside the 46° halo was a deep blue, while the sky between the halos was a very pale blue; the contrast was reminiscent of Oxford and Cambridge colours. The mock suns were prolonged into tapering shafts of brilliant white light extending horizontally half-way to the inner edge of the 46° halo.

At Steyning, Sussex, for two hours on the afternoon of the same day, Mr. G. D. Pegler observed the 22° halo, part of the mock-sun ring and two mock suns. " The latter, which were situate on the outer rim of the halo, appeared in the form of two bright patches of light tapering away from the sun, finally diminishing to bright narrow beams. The axes of these beams were not horizontal but were both raised above the horizontal diameter of the halo by about 10°. A very faint line of light was observed between the mock suns and the sun itself . . . . later in the afternoon I observed that the light from the outside edges of one of the mock suns was stratified, giving the appearance of being produced by a layer in which rifts were developing."

Miss Cicely M. Botley observed similar phenomena at Hastings at 5.45 p.m. B.S.T. The 22° halo was fairly bright, while the two mock suns were very brilliant, and the mock-sun ring could be traced in the black mirror up to the sun on both sides and to a considerable distance outside the halo. The parts nearest to the mock suns were bright and of a silvery appearance. The presence of the summit of the 46° halo was at one time suspected.

The display was also seen at West Wickham and, according to correspondence in *The Times*, at Sevenoaks, Woking, Canterbury and Dover. At Dover Mr. H. L. Baker recorded also about sunset a white sun-pillar extending from the sun to the summit of the 22° halo.

The many rare features of the halo complex of May 8th point to the presence of ice crystals of a variety of forms. The commoner phenomena are caused through the refraction or reflection of light by small hexagonal prisms of ice with flat ends, the length of the prisms being great in proportion to their diameter (ice crystals). The halo of 22° with its mock suns and tangent arcs results from refraction through two alternate faces of a prism which make an angle of 60° ; when the directions of the axes are irregular the 22° halo is formed, but refraction through prisms falling with axis vertical gives the mock suns. The prisms may fall like this on account of included bubbles. If the crystals float or fall with their axes horizontal, they give the tangent arcs or, if the sun is at a sufficient elevation, the circumscribed elliptical halo. The-mock sun ring is explained very simply as the reflection of the sun's rays from the vertical faces of the prisms, or of their vertical ends if they are floating with their axes horizontal.

The 46° halo is caused by the refraction of light through one side and the base of hexagonal prisms, the refracting angle being 90°. Associated with the 46° halo are the infra-lateral arcs. These are explained as due to the refraction of light through crystals floating with their axes horizontal, that is to say the same crystals as produce the arcs of contact of the 22° halo. The explanation of the oblique arcs through the anthelion is very uncertain so the type of crystal indicated by these arcs cannot be stated.

All the phenomena hitherto described arise from reflection, or from refraction through crystal faces inclined at angles of 60° or 90°, which are the only refracting angles possible in a hexagonal prism with flat ends. The small halo seen by Mr. Wilson inside the 22° halo is in a different category. A halo of 16° to 17° requires a refracting angle of 48° to 50°. It is likely that the crystals producing such a halo are prisms with pyramidal ends. Apparently there are no good observations of well formed crystals of this type, but the general theory of crystallography has been called upon to prove that the crystals ought to exist. The rarity of the halos with small radii indicates that these specialised crystals are seldom in great profusion. The circumstances of May 8th were most exceptional when the small halo observed by Mr. Wilson was so brilliantly coloured. I believe that mock suns on such a halo are hitherto unknown. It would seem that not only was there a remarkable profusion of ice crystals in the air above Cumberland on May 8th, but that these crystals had taken on a still more remarkable variety of form.

Lake Deposits in the Crimea and the Rainfall of Europe since 2000 B.C.

A recent publication by W. B. Schostakowitch* contains a table of measurements of annual layers of the mud deposit in Lake Saki. The Map Curator of the Royal Geographical Society informs me that Saki is a salt lake on the west coast of the Crimea in 45° 7′ N., 33° 33′ E., separated from the sea by a strip of sandy beach; from *The Times* atlas, the neighbouring country seems to be flat. The total thickness of the deposit is several metres, most of the individual layers measuring only a few millimetres. The measurements, in tenths of a millimetre, were made partly on photographs and partly on the original sections; the earliest layer is dated 2294 B.C., but in some parts of the sections it was difficult to distinguish the lines separating the annual layers and there may have been some errors in calculating the age of parts of the sections.

This series would form a valuable climatic record, comparable in importance with the tree-rings of western America, if we can decide what causes the variations in thickness of the layers. The most obvious agency is rainfall, and in particular heavy rainstorms which would cause rapid run-off. The measurements show a number of isolated years with very thick layers five or ten times as thick as neighbouring layers, which is consistent with this suggestion. A possible connexion with rainfall was further examined by comparing overlapping five year means with the variations in level of the Caspian Sea. E. Brückner† has calculated annual means of the level from 1851 to 1878, and has also given a few additional data from which the curve can be extended back to about 1822 and on to 1882. The results are shown in Fig. 1, in which the five year Saki means are each entered to the middle year of the five. Although the curves show many differences of detail, there can be no doubt that their general course, from maximum to minimum and back to a second maximum, is similar. Since rainfall is presumably an important factor in determining the fluctuations of the Caspian, it seems probable that the deposits of Lake Saki are also to some extent a measure of rainfall.

The measurements of the Saki deposit were next summed to give a series of ten-year means and these in turn were combined to form overlapping series of fifty years. These overlapping fifty-year means are shown in curve I of Fig. 2. The oscillation shown in Fig. 1 is represented here only by the last small hook of the curve. This curve presents several points of interest. Beginning at a

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* Bodenablagerungen der Seen und periodische Schwankungen der Naturerscheinungen. Reprinted from *Leningrad Mem. Hydr. Inst.* (in Russian, with a German summary).

† Klimaschwankungen seit 1700, Vienna, 1890.

very high level, it drops rapidly from 2140 B.C. to 2060 B.C., then more slowly and very irregularly to 1400 B.C. From that point it oscillates about a mean of some 2·8 mm. until about 900 B.C. when there appears to be a rise to a new mean of about 3·1 or 3·2 mm. From 900 B.C. the general trend of the curve is slightly downwards to a minimum of slightly below 3·0 mm. between 300 A.D. and 700 A.D. followed by a steady rise to 4·0 mm. at 1890 A.D., interrupted, however, by two marked maxima at 800 and 1130 A.D.

If the layer attributed to 2294 B.C. is really the beginning of the deposit, we should expect the first layers to be abnormally thick, like the first rings of a tree, but even so the drop after 2160 B.C. seems to be abnormally steep. Recently a good deal of evidence has been found in the dry regions of Mekran and north-west India that the rainfall was appreciably greater than now for some time

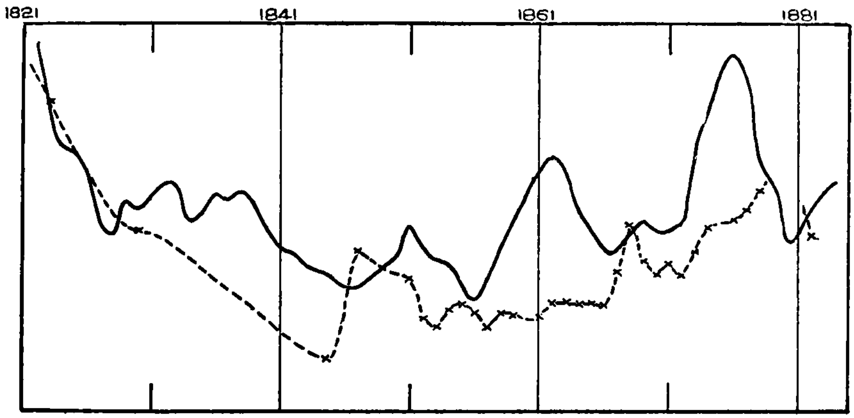

FIG. 1.—THICKNESS OF DEPOSITS OF LAKE SAKI (FULL LINE) AND LEVEL OF CASPIAN SEA (BROKEN LINE)

after 3000 B.C., while according to H. J. E. Peake,* settlements in south-west Asia were abandoned about 2200 B.C., probably owing to intense drought, and were not re-occupied until Persian times.

On the other hand in any deposit of this nature the weight of the upper layers tends to compress the lower layers, giving a gradual increase in thickness of the layers towards the top of the section, which would account for the gradual rise in the average level of the curve. There is sufficient evidence to show that about the beginning of the Christian era conditions in the Near East were not greatly different from those prevailing at present, which confirms such a steady rise of the base line. Small variations of sea-level and changes in the vegetative covering of the shores of the lake may also have had some effect on the thickness of the deposit.

The clearly marked maxima at 800 and 1130 A.D. offer an opportunity of checking the dating. From the data collected and critically examined by Brückner, it appears that the Caspian was

* The Bronze Age and the Celtic World, London, 1922.

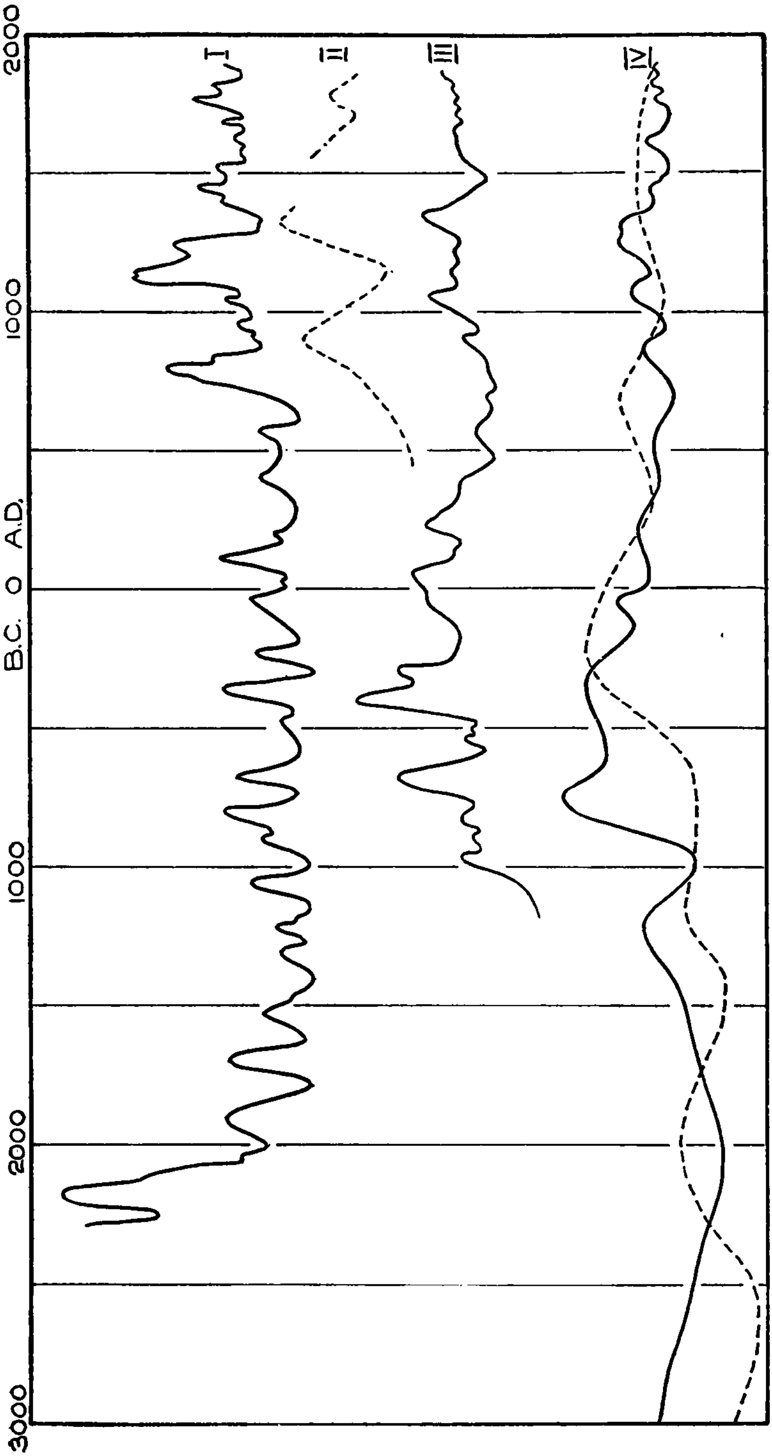

FIG. 2.—I. DEPOSITS OF LAKE SAKI. II. LEVEL OF CASPIAN SEA. III. TREE GROWTH IN WESTERN U.S.A.
IV. ESTIMATED RAINFALL IN CENTRAL EUROPE AND SWEDEN.

very high from 915 to 921 A.D., very low in the 12th century, still higher about 1306–7, after which it fell steadily to about 1715–20, followed by a further rise about 1730. These data are indicated by the broken line in curve II of Fig. 2. It is evident that while the last maximum fits curve I sufficiently closely, the first two maxima are completely discordant. They would, however, fit if this part of curve I were displaced about 100 years to the right, and it is possible that we have here one of the errors of dating the Saki deposits, the possibility of which was referred to earlier. An obvious possibility is that many of the layers are double, because of seasonal irregularities. It must be remembered, however, that the hydrographic conditions of the Caspian basin have changed from time to time, thus about 1306 A.D. the Oxus River entered the Caspian instead of the Sea of Aral as at present, and the Caspian curve may not be a fair representation of the rainfall.

Curve III shows the variations of tree growth in western North America,* standardised by data as to variations of level of inland lakes. The first maximum, about 700 B.C., agrees with a fairly well-marked double maximum on the Lake Saki curve. The second maximum in 400 B.C. also agrees and in general the courses of curves I and III are similar until about 600 A.D., but the two maxima at 800 and 1100 A.D. on curve I are displaced to 1050 and 1350 on curve III, agreeing more closely with the Caspian curve II than with the Saki curve.

The full curve in IV is also transcribed from "Climate through the Ages"; it represents variations in Europe derived from a variety of sources, chiefly variations of lake levels, and may be taken as representing central Europe. The main maximum at about 800 B.C. is probably placed too early. The broken curve in IV is that derived by E. Granlund† from a detailed study of peat bogs in Sweden. The great increase in rainfall in the Early Iron Age is displaced to about 500 B.C., a subsidiary maximum is shown about 2000 B.C. in good agreement with the Saki curve.

In spite of the doubts as to the timing, the data from Lake Saki have several useful lessons. Apart from the very earliest figures, the fluctuations are of the same order of magnitude throughout, except for the two maxima in the Middle Ages. All the other curves show an increasing amplitude with increasing age. In the tree curve III this is due in part to the decrease in the number of trees available as we go back in time. With the other records it may well be due to an exaggeration of the importance of ancient events for which the evidence is naturally somewhat less clear than for more recent changes. An increase in the average thickness of the Saki deposits during the Early Iron Age is fairly clear; moreover,

* Brooks, C.E.P., Climate through the Ages, London, 1926.

† De Svenska hogmossarnas geologi. *Stockholm, Sverig. geol. Unders. Afh.*, C, 26, 1932, No. 1.

both the maxima and the minima lie at a higher level, but the maxima of the "dry" period are well above the minima of the "wet" period. This is in accord with the trend of recent investigations into the history of vegetation in Europe, and it seems that we must be on our guard against too ready generalisations on the "climate" of long stretches of time.

C. E. P. BROOKS.

OFFICIAL PUBLICATION

The following publication has recently been issued:—

GEOPHYSICAL MEMOIRS.

No. 66. *The three components of microseismic disturbance at Kew Observatory.* A discussion of the records for 1932. By A. W. Lee, M.Sc., A.R.C.S., D.I.C.

The microseisms recorded during 1932, by the N–S, E–W and Z components of the Galitzin seismograph at Kew Observatory have been tabulated for four hours daily. The mean amplitudes and periods of the three components for the whole year are approximately equal (0·9μ and 5·6 sec.). The amplitudes of the two horizontal components are nearly equal for all periods, but the ratio of horizontal to vertical amplitudes diminishes from about 1·2 for microseisms of period 4½ sec. to 0·85 for periods of 9 sec.; this variation is consistent with the hypothesis that the microseisms may be regarded as Rayleigh waves through granite covered by a superficial layer. The yearly mean amplitudes of the simple Rayleigh waves with energy equal to that of the microseisms are 0·5μ in the horizontal and 0·8μ in the vertical components.

The vertical is more reliable than either of the horizontal components for tabulations of the microseisms, since there are no uncertainties due to changes in the direction of travel of the waves, and effects of the local geological structure are smaller.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, May 19th, 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:—

W. E. Knowles Middleton.—Unusually great visual range over Ontario.

The author gives details of exceptional visibility on the morning of January 30th, 1935, during an aeroplane ascent from Toronto, when the hills of Manitoulin Island in Lake Huron, 280 Km. away, were visible at a height of 2,623 metres. The light path is calculated by means of the meteorological data recorded on the flight. These data disclosed a temperature inversion, and it is shown that the existence of the inversion over the entire region was necessary for the geometrical possibility of the observation, and that the air at the time must have been exceptionally clean and dry for the contrast between the distant hills and the sky behind them to be perceived.

Major H. C. Gunton, F.R.Ent.Soc.—Phenological Records of British Lepidoptera.

The author explains a graphical method of analysing records of the first appearance dates of fifty common species of indigenous British lepidoptera in relation to meteorological conditions and draws conclusions with reference to the causes and extent of early and late appearance. It is considered that the next stage of these investigations must include the adjustment of the lists of species to suit the local requirements of the different districts, the comparison of results obtained from different districts, and the differences in the response of individual insects according to their life-histories and to the extent of their protection in the pupa state. To do this effectively there must be an increase in the number of observers.

Capt. W. N. McClean, A.M.Inst.C.E., gave an account of rainfall and run-off records from the River Dee catchment area, Aberdeenshire, January to May, 1935.

Mr. K. Chandra described instruments used in India for the purpose of making upper air observations.

The Summer Meeting of the Royal Meteorological Society was held at Kew Observatory, Richmond, on the afternoon of June 27th, by kind invitation of the Director of the Meteorological Office and Dr. F. J. W. Whipple, Superintendent of the Observatory. More than a hundred fellows and guests were shown the activities of the Observatory, including the normal work of a station of the first order as well as a seismographic observatory, and a number of experimental investigations of great interest. The latter included several recently designed instruments for the detailed study of rainfall—the Jardi Rate of Rainfall Recorder, Rainfall Chronograph, and four rain-gauges exposed on short grass, gravel, and cement respectively, to determine whether the splashing of rain affects the catch of a gauge appreciably.* The various investigations of atmospheric electricity also excited great interest, especially the ingenious experimental apparatus for determining the sign of the charge in different parts of a cloud directly by means of an electrograph carried up through a thunderstorm cloud by a balloon.

Balloons in general formed the most attractive part of the programme. Throughout the afternoon a series of small pilot balloons were liberated and followed by theodolites to determine the upper winds and height of the clouds; postcards were attached, to be returned to the Society by the finders. At 5.30 p.m. a sounding balloon was liberated, carrying a Dines meteorograph. The meeting

* See *Meteorological Magazine*, 70, 1935, pp. 32–4.

as a whole was an unqualified social success, aided by ideal weather, the heat being tempered by a pleasant breeze.

The programme of the meeting included a historical note of the Kew Observatory, which is of sufficient interest to be reprinted here:

"The Kew Observatory, which was originally known as the King's Observatory at Richmond, was built in time for observations of the transit of Venus in 1769. It is believed that the architect was Sir William Chambers. During the reigns of George III, George IV and William IV, there were in succession two 'King's Observers,' Dr. S. C. T. Demainbray and his son the Rev. S. G. F. T. Demainbray. In 1842, after the accession of Queen Victoria and the dedication of Kew Gardens to the public use, the British Association became tenants of the Observatory. Subsequently, from 1871, the Observatory was under the control of the Royal Society. In 1900 the nucleus of the National Physical Laboratory was established at the Observatory, but the work of the Laboratory was soon transferred to Teddington, and in 1911 the Observatory passed to the administration of the Meteorological Office."

The Council of the Royal Meteorological Society has awarded the Howard Prize for 1935 to Robert Arthur Neville Cox of H.M.S. *Worcester*. The subject of the competition was an essay on "Forecasting of weather at sea from observations in his own ship alone."

Correspondence

To the Editor, *Meteorological Magazine*

Partial Cloud Dispersal by an Aeroplane

On the evening of May 29th, 1935, I noticed a remarkable dispersal of a portion of a cloud by an aeroplane flying through it. Next day I was able to discover the pilot and obtained a few details from him.

The aircraft was flying on a level keel over Otmoor to the north of Oxford at a height of 10,500 feet. At this height an oval patch of altocumulus cloud, calculated to be 1,200 feet long and 600 feet wide, was just beginning to form. The aircraft flew in a straight line through the cloud sheet leaving a clear-cut track in its wake, throughout the breadth of the cloud, which was cut completely in two. The track, which was slightly wider than the span of the wings of the aeroplane, 40 feet, persisted for about seven minutes before closing up again owing to the reformation of the cloud.

The incident was observed independently by quite a large number of people. The pilot stated that the cloud was just forming and was about 10–12 feet thick. It was quite thin and he could see through it from above. The temperature he noticed was—5° C. (23° F.), while the ground temperature at the time was 64° F. and the relative humidity 60 per cent.

The point arises as to how the cloud was dispersed in such a clear-cut path. Was it due to the turbulence of the slip-stream in the rear of the aeroplane, or the temperature of the slip-stream being sufficiently above the dew point to warm up and disperse the cloud, or a combination of both effects ?

R. E. WATSON.

Meteorological Station, R.A.F., Abingdon, Berks, May 31st, 1935.

While taking my observations at 13h., G.M.T., on June 26th, a curious phenomenon was witnessed. An Imperial Airways liner which was flying from south-east to north-west entered a patch of relatively low alto-cloud (altostratocumulus) which was moving up from south-west by south. The machine and its shadow on the cloud could be distinctly seen and soon after its passage a perfectly straight lane appeared, which, as the cloud advanced, became clear and widened, giving the appearance that the cloud was cut in two When at the same altitude as the sun the cloud quickly dissolved. Other cloud forms at the time consisted of large high level cumuli with bases at about the same altitude as the altostratocumulus.

A. E. MOON.

39, *Clive Avenue, Clive Vale, Hastings, June 27th*, 1935.

[This cloud " divided into two halves by a lane of clear sky " was also observed by Miss C. M. Botley of 17, Holmesdale Gardens, Hastings. Ed. *M.M.*]

Thunderstorms of June 15th, 1935

Saturday, June 15th, 1935, produced the remarkable phenomenon of five distinct thunderstorms in the nine hours from 10h. 30m. to 19h. 30m. G.M.T. All the storms, which were of a light or moderate intensity, passed over or near Goff's Oak, Herts, from between south and west. The thunder of the first storm was first heard at 10h. 40m. and was last heard at 10h. 53m. in the east, and produced slight rain between 10h. 40m. and 10h. 44m. The second storm followed between 12h. 16m. and 12h. 30m. and produced but one clap of thunder with a trace of light rain. The third storm commenced at 13h. 58m. and was the most intense of all, giving moderate rain for 17 minutes with a heavy fall of rain and hail between 14h. 14m. and 14h. 25m. The wind backed from WSW., force 2 at 14h. 0m. to SE., force 2 at 14h. 3m. and in a gust of force 3 veered again to WSW. at 14h. 8m. The wind then slowly backed again in feeble gusts to ENE., force 1 at 14h. 30m. falling to calm at 14h. 37m.

The sun shone again at 15h. 5m. but the fourth storm was already approaching from WSW. and for 15 minutes there was the curious combination of thunder and lightning in the east from the third storm, bright sunshine, and thunder in the west from the fourth storm. These two storms produced considerable changes in wind direction, etc., which are shown in Fig. 1, the claps of thunder being

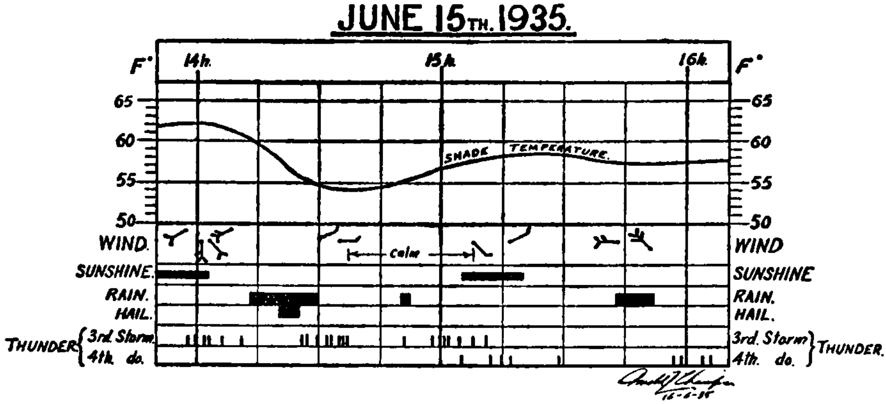

FIG. 1

indicated by vertical strokes at the time of occurrence. The fourth storm followed the third so closely that for a time both cloud masses were reflected in the nephometer mirror, the appearance of the sky reflected therein at 15h. 10m. being as shown in Fig. 2. At 15h. 8m. the period of calm was replaced by a wind from SE., force 1 which backed ENE. at 15h. 17m. At 15h. 43m. the wind suddenly veered to W., force 3 and rain commenced, the wind veering to NW., force 4 and rain ceasing at 15h. 49m. Thunder continued intermittently until 16h. 35m., with wind slowly backing WSW.

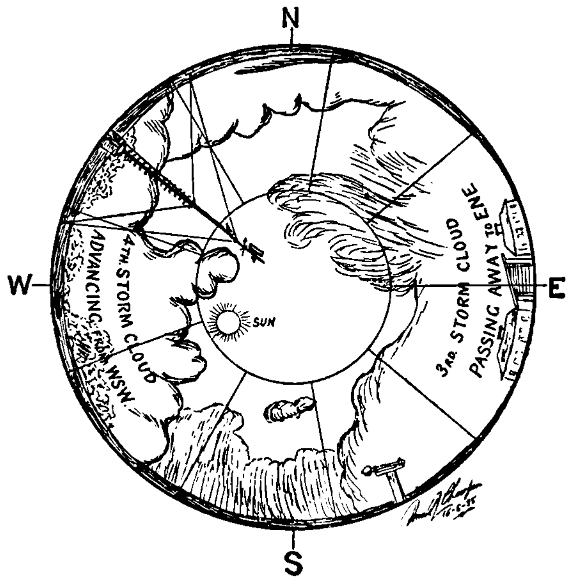

FIG. 2

The fifth, and final storm commenced at 18h. 30m. and passed away to the east at 19h. 17m.

Total rainfall from these storms, measured at 6h. 0m. on the morning of the 16th, was 0·22 in.

DONALD L. CHAMPION.

7, Robinson Avenue, Goff's Oak, Waltham Cross, Herts, June 17th, 1935.

Mr. J. E. Clark reports that three distinct thunderstorms were experienced at Street, Somerset, the same day, Saturday, June 15th.

The first one lasted from 9h. 20m. to 10h. 14m. and passed from north-west to east; only 0·06 in. of rain was measured during this storm. By 10h. 30m. it was fine overhead but there were signs of a new storm approaching from the west. This second storm lasted 20 minutes from 12h. 15m. to 12h. 35m. and was heavy to the south-east and south. The storm cloud had a ragged fringe to the east at about 8° and Mr. Clark remarks that "incipient waterspouts were forming and retracting but one fully 1° or more long, straight funnel widening at base where cloudlet formed and in two minutes extended 3° or 4° as funnel slowly vanished." 0·15 in. were measured during this storm. The third storm began at 12h. 55m. and was accompanied by heavy rain and hail at intervals which made the ground white. The total rain measured at 16h. amounted to 1·14 in.

At Castle Cary, 11 miles to east-south-east of Street, a cloudburst was experienced shortly after 12h. during a severe thunderstorm accompanied by hail which lasted some 10 to 20 minutes. Torrents of rain fell "over not many acres" in the south of the town and rushed like a waterfall over a high wall bounding several acres of allotments and carried a lot of soil and plants with it into the roadway and down South Street to the centre of the town where the water became some feet deep. A good many houses were flooded.

Mr. Clark adds that little or no rain fell more than some four or five miles off to the north-east and north-west.

NOTES AND QUERIES

Thunderstorm Rains of June 25th, 1935

The thunderstorm rains of Tuesday afternoon, June 25th, call for special comment, not only because of the large amounts recorded, but also because of the widely different localities affected. The storms were also remarkable for the frequency of the thunder and lightning over a prolonged period. Reports of heavy and intense rains have been received from Co. Tipperary, in central Wales, near Bath, the south-east Midlands, and the London District. The rain recorded in the neighbourhood of Bath was especially remarkable, recalling that experienced at Bruton on June 28th, 1917, and at Cannington on August 18th, 1924, the centre of the Bath storm being only 20 miles from Bruton and 35 miles from Cannington.

Co. Tipperary.—Mr. E. W. M. Murphy reports one of the worst thunderstorms he has ever experienced at Ballinamona ($1\frac{1}{2}$ miles west of Cashel). He measured 1·42 in. of rain and hail in about $1\frac{1}{2}$ hours after 15h. 30m.

Central Wales.—Two stations to the east of Aberystwyth, maintained by the University at the Plant Breeding Station and at Lletty-evan-hen, recorded 2·76 in. and 3·25 in. respectively, within five hours from 15h. to 20h. At Abergorlech to the north of Llandilo in Carmarthenshire 2·95 in. fell between 15h. 30m. and 17h. 30m.

and is referred to as the heaviest rainfall there within living memory.

Near Bath.—Over an area of about 10 sq. miles to the north-east of Bath more than 2 in. fell during 3½ hours. At the climatological station at Bath (Henrietta Park) 1·90 in. occurred between 13h. and 16h. 30m. It is reported that more than 2·7 in. occurred at Lambridge House and more than 4·0 in. at Bathford (both to the east of Bath) but the gauges then overflowed. The Bath Waterworks gauges gave the following readings: Batheaston Reservoir, 4·83 in.; Monkswood Reservoir, 3·69 in.; Lansdown, 3·68 in.; and Charlcombe, 3·11 in. At Ashwicke Park, 5 miles to the north-east of Bath, 3·05 in. was recorded at the Hall and 4·50 in. at the Home Farm. The height of the storm is reported as from 13h. 30m. to 16h. 15m. At Swainswick, two miles to the north of Bath, the gauge, which is usually read once a month only, contained 6 in. more after the storm than before. At Oriel Lodge, Lower Swainswick 3·79 in. was recorded for the 3 hours from 13h. 15m. to 16h. 15m.

The damage done by the flood water was extensive and due to the sudden swelling of the usually small streams draining these narrow valleys. The village of Swainswick occupies one side of the valley, which lies between the Lansdown and Charmy Down spurs of the Cotswolds and drains an area some three miles long to the River Avon. All down the valley, fences adjoining the stream were washed away, low-lying gardens and cottages damaged, numerous landslides occurred and in some cases bridges were entirely swept away. Mr. J. S. Shackell of the Manor House, Swainswick reports the most severe downpour in the valley at any rate during the last 65 years. The River Avon at Bath is reported to have risen as much as 4 ft. in less than two hours and 6 ft. in 4¼ hours. The flooding which occurred in the east of Bath, was so severe that the Mayor asked for contributions for the relief of the sufferers. The tram service was held up at Lambridge to the east of Bath, the bus services were delayed between Bath, Chippenham and Melksham, while trains were delayed both at Melksham Station and Box tunnel owing to the depth of water on the lines.

Other areas of intense rain occurred further to the east of Bath. At Beanacre, 10 miles to the east of Bath, 3·00 in. fell between 13h. 30m. and 15h. 30m., no less than 2·5 in. occurring between 14h. 30m. and 15h. 30m. Lt.-Col. Sir Reginald Blake also writes "As regards local damage, this was far greater than within living memory. The River Avon, which flows about half-a-mile from here did not overflow its banks, but the small streams and ditches did. The fact that a great deal of hay was lying in the fields is believed to have contributed largely to the flooding, as it was washed against hedges and gateways and filled culverts. One farmer had ten tons of hay washed from a field. The notable feature of the storm was that certain places, never previously known to be flooded were under water". At Chippenham, 12 miles to the east-north-east of Bath, 4 in. of rain is reported to have fallen within three hours. From further east, at Devizes, we have the following report: "In 1 hr. 20 mins. between 14h. 50m. and 16h. 10m. I measured 1·87 in. Two storms appeared to meet almost immediately over this place and thunder and lightning were almost simultaneous, although nothing in the immediate neighbourhood was struck."

The south-east Midlands.—At Blisworth as much as 2·50 in. was recorded within 3½ hours from 14h. to 17h. 30m. in a thunderstorm said to have been the heaviest for 50 years, only one larger amount (and then in a much longer period) having been recorded for any day there. Lightning struck a number of houses in Northampton and also a thatched cottage at Blisworth. At Market Harborough 1·21 in. was measured in 1 hr. 20 mins. from 15h. 55m. to 17h. 15m.

London Area.—Over the County of London few stations recorded as much as half an inch, but in certain localities the intensity exceeded two inches an hour for periods up to 15 minutes. Some of the more striking measurements are set out below :—

	Amount in.	Duration min.	Rate inches per hour.
Brockwell Park	0·22	5	2·64
Deptford Pumping Station ...	0·40	9	2·66
Camberwell (Myatts Fields) ...	0·45	10	2·70
Forest Hill	0·74	15	2·96
North Woolwich	0·38	15	1·52
Putney Heath	0·44	20	1·32

Much larger amounts were recorded to the south-west of London and amongst these reference may be made to the following :—

	inches.
Ewell (Stoneleigh Park)	3·25
Sutton (Sewage Works)	2·10
Banstead (Burgh Heath)...	2·18
Reigate (Alvington)	1·43
Frimley Green (Ridgemount)	1·78

The rain at Ewell is said to have fallen in two hours between 12h. 30m. and 14h. 30m. (when "jagged shaped pieces of ice some of them an inch long" were found); at Sutton in 40 minutes from 13h. 20m. to 14h.; at Reigate 1·36 inches fell in two hours from 11h. 30m. to 13h. 30m., the bulk between 12h. and 13h.; at Frimley Green 1·76 in. fell in 2¼ hours.

J. GLASSPOOLE.

OBITUARY

We regret to learn of the death, at Rome, on May 21st, 1935, of Prof. G. Magrini, Editor of the Bibliographia Oceanographica.

BOOKS RECEIVED

Functions and Organisation of the India Meteorological Department, 1934 *and* 1935. Government of India, Dept. of Industries and Labour, Simla, 1934 and 1935.

Deutsches Meteorologisches Jahrbuch, 1933. Freie Hansestadt Bremen. Edited by Dr. A. Mey, Jahrgang 44, Bremen, 1934.

NEWS IN BRIEF

Miss I. L. Coryton, The Manor House, Greatham, Liss, Hants, has for disposal a series of *British Rainfall* for the years 1866 to 1891. Anyone wishing to purchase these should communicate directly with Miss Coryton.

Mr. R. J. Watson, of Foxhole, Calfstock Lane, Farningham, near Dartford, Kent, informs us that he has a Stevenson thermometer screen built to Meteorological Office specifications and a galvanised (brass-rimmed) 5-in. rain-gauge and glass measure by Short and Mason which he desires to sell. Anyone interested should communicate direct with Mr. Watson.

The Weather of June, 1935

Pressure was below normal over Alaska, most of the United States, southern Canada, Bermuda, the area extending from south Greenland to north Russia and Finland, Denmark, western France and Madeira, and over the extreme eastern Mediterranean the greatest deficits being 8·6 mb. at Valentia, 4·3 mb. at Point Barrow and 3·0 mb. near Salt Lake City and at Helwan. Pressure was above normal over the rest of Europe and most of the western North Atlantic, the greatest excesses being 4·6 mb. near St. Johns, Newfoundland, and 4·2 mb. at Lemberg. Temperature was above normal in central Europe and Sweden generally but below normal at Spitsbergen, Lapland and the Iberian Peninsula. Rainfall was deficient in central Europe, eastern Svealand (Sweden), north Norway and Spitsbergen, but about 50 per cent. above normal elsewhere in Sweden.

The weather of June over the British Isles was generally dull, cool and rainy until the 20th but warm and sunny for the last ten days. There were many days of thundery conditions and two very warm spells from the 22nd–25th and 29th–30th. Rainfall was mainly above normal, at Valentia the previous highest rainfall total on record, viz. 7·76 in. in June 1912, was exceeded by 0·39 in. Sunshine was generally below normal except in east and south-east England. From the 1st to 8th, the British Isles was under the influence of a complex low pressure system extending from the Azores to north Russia with mainly dull unsettled cool weather. In this period thunderstorms occurred locally from the 2nd–7th mainly in Scotland and northern England and rain was frequently heavy, 1·90 in. fell at Aberdeen and 1·75 in. at Pickering (Yorkshire) on the 5th, and 1·20 in. at Southampton on the 6th, while hail was experienced locally. Strong winds between S. and W. occurred in south and east England on the 6th and 7th, reaching gale force in places, mainly on the east coast. On the 8th the anticyclone over central and southern Europe extended northwards over this country and caused a temporary change to sunny conditions; 14·9 hrs. bright sunshine occurred at Ilfracombe on the 8th and 14·5 hrs. at Auchincruive (Ayr) on the 9th. On the 9th however the depression centred south of Iceland was moving south and extending over Ireland and from then to the 20th the country was under the influence of depressions moving from the Atlantic in an easterly or north-easterly direction. Generally cloudy unsettled cool weather prevailed with thunderstorms locally each day from the 9th to 18th, rain occurred on most days but was usually only slight to moderate, though 1·30 in. fell at Lympne on the morning of the 10th during a thunderstorm. There was much thick fog in the English and Irish Channels on the 19th to 22nd. On the 21st pressure rose generally over central and north Europe and anticyclonic conditions spread westwards over the British Isles giving very warm sunny weather in most of England and Wales and south-west Scotland from then to the 25th. Temperature rose above 80° F. in many parts, 88° F. was recorded at Brighton on the 25th and 86° F. at Jersey, Huddersfield and Manchester on the 22nd, at Chester and Manchester on the 23rd, at Tottenham on the 24th and at Cambridge on the 25th. Minimum temperatures were also high on the nights of the 23rd to 24th and 24th to 25th, 66° F. at Kew on the latter night being the highest value experienced there in June since records began. In Ireland and Scotland however rain occurred locally on the 22nd and 24th and temperature remained only slightly above normal in Scotland (except the south-west), Ireland and the north-east coast of England. Thunderstorms were experienced in north Wales on the 23rd, when 2·70 in. of rain fell at Waenfawr (Carnarvon) and also in Scotland and north-west England on the 24th. On the 25th the depression over the Bay of Biscay moved northwards and severe thunderstorms accompanied by heavy rain occurred over a wide area in south England and the Midlands* bringing the very warm spell to a close. The weather, however, continued warm and sunny except in Scotland and Ireland on the 26th and 27th when slight rain fell there. On the 29th and 30th there was a return to high temperatures and 80° F. was again exceeded locally. From the 20th onwards much sun was registered on most days all over the country, among the largest amounts being 15·6 hrs. at Valentia on the 23rd and Torquay on the 28th, 15·5 hrs. at Nottingham and Norwich on the 24th and 15·4 hrs. at Norwich on the 23rd, at Mablethorpe on the 24th and Nairn on the 29th. The distribution of bright sunshine for the month was as follows:—

* See p. 143.

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	175	+7	Liverpool ...	178	−26
Aberdeen ...	136	−45	Ross-on-Wye ...	181	−29
Dublin	172	−14	Falmouth ...	179	−43
Birr Castle ...	148	−13	Gorleston ...	235	+27
Valentia... ...	166	−10	Kew	207	+8

Miscellaneous notes on weather abroad culled from various sources. Four people were killed by lightning during a thunderstorm in which hail destroyed crops over a wide area around Ruschuk (Bulgaria) on the 7th. A violent hailstorm broke over Paris on the evening of the 14th, some of the hailstones being the size of shrapnel bullets. Two men were killed in a storm which broke over Milan and the surrounding country on the 15th, when much damage was done at Stresa and Pallanza. During the last week a heat wave was experienced over central and southern Europe, 99° F. was recorded at Munich and Breslau on the 27th. Many people, mostly field labourers, died of the heat in northern Italy. Forest fires occurred in the forests of Fonlade (south France) on the 29th and 30th. The rapid melting of the snows and glaciers in the heat caused serious flooding in the Rhone Valley, where the dykes burst in two places (*The Times*, June 8th–July 2nd, and the British *Daily Weather Report*).

Heavy floods occurred round Durban on the 13th almost isolating the city and the harbour was closed (*The Times*, June 14th).

At the beginning of the month the monsoon was affecting Burma and Assam only, but on the 14th it broke on Bombay with a severe thunderstorm, some parts of the city having over 3 in. of rain. Torrential rain amounting to 10 in. fell in Bombay on the 18th and 19th. During the rest of the month the monsoon continued active and heavy rain fell in Bombay, Deccan and Malabar, and general rain in central India, the Central Provinces and Berars. Very heavy rain occurred in south-west Japan on the 28th and 29th; at Kyoto nearly 15 in. of rain is said to have fallen between 11 p.m. on the 28th and 2 p.m. on the 29th, the rivers became torrents and 515 bridges were washed away, 90 people were drowned, and 190,000 houses flooded (*The Times*, June 7th–July 2nd).

Much damage to telegraph wires was done by heavy snow in New Zealand early in the month; later, moderate to heavy rain was general. Excessive rain occurred in Victoria about the middle of the month and light and scattered showers generally in Western and South Australia, but dry conditions continued in New South Wales. Useful rains of from 1 to 2 in. fell in the pastoral districts of South Australia at the end of the month (*The Times*, June 11th–July 2nd).

In central Canada the month was generally wet but rain was needed in parts of Alberta and Saskatchewan late in the month; elsewhere in these two provinces slight damage from hailstones occurred. The floods in Nebraska were subsiding by the 3rd, but the floods in Kansas and Missouri were still spreading on the 5th. Renewed floods due to heavy rain occurred in Kansas and Arkansas about the 23rd; four people were drowned and several bridges washed away. Fog was experienced locally off the east coast of North America. In the United States two warm spells passed across the eastern United States during the month but temperature in the Mountain Region and on the Pacific Coasts was mainly above normal throughout. Rainfall was variable in distribution (*The Times*, June 5th–27th, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin*).

Daily Readings at Kew Observatory, June, 1935

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
	mb.		°F	°F	%	in.	hrs.	
1	1013·8	S.2	51	65	71	0·04	1·9	
2	1006·9	SSW.4	53	65	69	0·10	5·0	r_0–r 0h.–3h.
3	1007·0	WSW.4	50	62	68	0·10	7·4	t 12h. 15m., prh 15h.
4	1005·2	SSW.4	51	61	65	0·02	1·1	r–r_0 5h.–6h.
5	999·3	SSW.3	50	64	69	0·39	2·5	r 6h.–9h., t 14h. & [20h.
6	1001·1	SW.4	51	62	63	0·13	2·1	ir_0–r 15h.–24h.
7	1003·4	SW.6	55	63	60	0·16	4·7	r_0–r 0h.–10h.
8	1015·7	W.4	53	63	54	—	10·7	
9	1019·2	S.3	42	68	50	—	9·7	
10	1007·4	SW.3	55	69	73	0·56	2·0	TLR 2h.–6h.
11	1005·7	SW.5	54	63	59	0·06	5·2	pr 9h., r_0 16h.–18h.
12	1011·1	SW.4	51	65	76	Trace	7·3	pr_0 9h. & 13h.
13	1012·8	SW.4	53	66	52	0·08	9·1	ir–r_0 1h.–7h.
14	1009·9	SW.4	53	66	55	0·11	3·5	pr early, r 17h.–20h.
15	1006·1	SW.1	49	63	77	0·19	3·9	prht 10h.–14h.
16	1007·4	W.3	50	63	69	0·31	10·0	r_0 early, TLRH 13h.
17	1013·5	SW.3	51	66	58	0·15	5·0	ir_0–r 19h.–24h.
18	1010·0	SW.4	53	67	76	0·05	3·1	r_0 early, pr 12h.
19	1021·0	SW.2	54	68	69	0·02	1·0	r_0 early, r_0 22h.–24h.
20	1016·5	SSW.3	58	62	87	0·10	0·0	r_0 3h.–6h., 12h. & 16h
21	1019·1	SW.3	59	77	74	—	6·4	
22	1018·7	SE.3	57	84	52	—	13·6	
23	1019·7	E.3	63	81	36	—	13·9	
24	1013·9	E.4	64	84	43	—	14·4	
25	1009·7	S.4	66	82	84	0·79	6·1	TLRh 13h.–15h.
26	1015·6	SW.4	62	74	61	—	13·5	
27	1020·9	SW.4	61	70	75	—	2·0	
28	1030·1	WNW.2	53	78	61	—	14·4	
29	1026·4	E.2	57	80	45	—	13·7	
30	1019·6	E.3	60	78	42	—	13·3	
*	1012·9		55	69	63	3·37	6·9	* Means or totals.

General Rainfall for June, 1935.

England and Wales ...	149	per cent. of the average 1881–1915.
Scotland	146	
Ireland	196	
British Isles	158	

Rainfall : June, 1935 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square..........	2·81	139	*Leics* .	Thornton Reservoir ...	3·31	153
Sur .	Reigate, Wray Pk. Rd..	4·90	235	,, .	Belvoir Castle............	2·57	135
Kent .	Tenterden, Ashenden...	2·08	109	*Rut* .	Ridlington	2·96	154
,, .	Folkestone, Boro. San.	2·39	...	*Lincs* .	Boston, Skirbeck.........	2·12	116
,, .	Eden'bdg., Falconhurst	2·92	133	,, .	Cranwell Aerodrome...	1·76	105
,, .	Sevenoaks, Speldhurst.	2·36	...	,, .	Skegness, Marine Gdns.	1·87	104
Sus .	Compton, Compton Ho.	3·96	159	,, .	Louth, Westgate.........	2·02	93
,, .	Patching Farm..........	2·69	133	,, .	Brigg, Wrawby St.......	2·64	...
,, .	Eastbourne, Wil. Sq....	1·88	102	*Notts* .	Worksop, Hodsock......	3·42	173
,, .	Heathfield, Barklye....	2·44	116	*Derby*.	Derby, L. M. & S. Rly.	2·83	126
Hants.	Ventnor, Roy.Nat.Hos.	2·34	128	,, .	Buxton, Terr. Slopes...	5·17	161
,, .	Fordingbridge, Oaklnds	5·34	289	*Ches* .	Runcorn, Weston Pt....	4·41	171
,, .	Ovington Rectory.......	4·50	194	*Lancs*.	Manchester, Whit. Pk.	3·21	121
,, .	Sherborne St. John......	4·84	227	,, .	Stonyhurst College......	3·73	121
Herts .	Royston, Therfield Rec.	2·61	116	,, .	Southport, Bedford Pk.	3·55	163
Bucks.	Slough, Upton............	3·90	189	,, .	Lancaster, Greg Obsy.	4·13	161
,, .	H. Wycombe, Flackwell	4·16	207	*Yorks*.	Wath-upon-Dearne......	2·08	94
Oxf .	Oxford, Mag. College...	4·11	193	,, .	Wakefield, Clarence Pk.	2·09	97
Nor .	Wellingboro, Swanspool	3·02	144	,, .	Oughtershaw Hall.......	4·58	...
,, .	Oundle	3·20	...	,, .	Wetherby, Ribston H..	...	...
Beds .	Woburn, Exptl. Farm...	1·95	100	,, .	Hull, Pearson Park......	2·14	104
Cam .	Cambridge, Bot. Gdns.	2·10	100	,, .	Holme-on-Spalding......	2·57	117
Essex .	Chelmsford, County Lab	3·49	184	,, .	West Witton, Ivy Ho.	3·20	157
,, .	Lexden Hill House......	3·32	...	,, .	Felixkirk, Mt. St. John.	3·37	154
Suff .	Haughley House.........	2·82	...	,, .	York, Museum Gdns....	2·38	115
,, .	Campsea Ashe............	2·64	140	,, .	Pickering, Hungate......	4·05	191
,, .	Lowestoft Sec. School...	2·01	111	,, .	Scarborough...............	2·04	111
,, .	Bury St. Ed., WestleyH.	3·09	147	,, .	Middlesbrough...........	2·69	142
Norf. .	Wells, Holkham Hall...	2·65	135	,, .	Baldersdale, Hury Res.	...	...
Wilts .	Calne, Castle Walk......	4·36	...	*Durh* .	Ushaw College...........	3·00	72
,, .	Porton, W.D. Exp'l. Stn	4·12	213	*Nor* .	Newcastle, Town Moor.	2·52	116
Dor .	Evershot, Melbury Ho.	5·04	221	,, .	Bellingham, Highgreen	4·01	174
,, .	Weymouth, Westham.	3·39	190	,, .	Lilburn Tower Gdns....	3·61	174
,, .	Shaftesbury, Abbey Ho.	2·54	109	*Cumb*.	Carlisle, Scaleby Hall...	4·17	165
Devon.	Plymouth, The Hoe....	4·10	190	,, .	Borrowdale, Seathwaite	9·00	148
,, .	Holne, Church Pk. Cott.	7·12	248	,, .	Borrowdale, Moraine...	6·57	135
,, .	Teignmouth, Den Gdns.	3·95	201	,, .	Keswick, High Hill......	4·54	156
,, .	Cullompton	3·66	173	*West* .	Appleby, Castle Bank...	3·22	141
,, .	Sidmouth, U.D.C........	3·60	...	*Mon* .	Abergavenny, Larchf'd	4·61	189
,, .	Barnstaple, N. Dev.Ath	2·63	117	*Glam* .	Ystalyfera, Wern Ho....	7·74	205
,, .	Dartm'r, Cranmere Pool	7·00	...	,, .	Cardiff, Ely P. Stn.......	3·68	148
,, .	Okehampton, Uplands.	5·28	191	,, .	Treherbert, Tynywaun.	9·82	...
Corn .	Redruth, Trewirgie......	3·33	134	*Carm* .	Carmarthen, The Friary	5·26	183
,, .	Penzance, Morrab Gdn.	3·09	139	*Pemb* .	Haverfordwest, Portfld.	...	...
,, .	St. Austell, Trevarna...	3·79	146	*Card* .	Aberystwyth	7·37	...
Soms .	Chewton Mendip.........	4·17	141	*Rad* .	BirmW.W.Tyrmynydd	5·91	180
,, .	Long Ashton............	4·20	166	*Mont* .	Lake Vyrnwy	5·58	177
,, .	Street, Millfield..........	3·95	185	*Flint* .	Sealand Aerodrome......	2·76	130
Glos .	Blockley	3·33	...	*Mer* .	Dolgelley, Bontddu......	8·32	239
,, .	Cirencester, Gwynfa....	3·93	164	*Carn* .	Llandudno	2·57	135
Here .	Ross, Birchlea............	3·35	154	,, .	Snowdon, L. Llydaw 9..	17·11	...
Salop.	Church Stretton.........	3·34	138	*Ang* .	Holyhead, Salt Island...	3·30	153
,, .	Shifnal, Hatton Grange	2·45	110	,, .	Lligwy	4·93	...
Staffs.	Market Drayt'n, Old Sp.	2·71	111	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	2·20	97		Douglas, Boro' Cem....	3·96	160
War .	Alcester, Ragley Hall...	3·77	165	*Guernsey*			
,, .	Birminghm, Edgbaston	2·35	101		St. PeterP't.Grange Rd.	3·64	197

Rainfall: June, 1935: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	3·18	135	*Suth* .	Melvich	2·32	120
,, .	New Luce School	3·74	129	,, .	Loch More, Achfary	2·95	80
Kirk .	Dalry, Glendarroch	...	...	*Caith* .	Wick	·92	51
,, .	Carsphairn, Shiel	7·14	179	*Ork* .	Deerness	1·53	83
Dumf.	Dumfries, Crichton, R.I.	4·45	186	*Shet* .	Lerwick	1·78	100
,, .	Eskdalemuir Obs.	5·29	168	*Cork* .	Caheragh Rectory	6·61	...
Roxb .	Branxholm	...	...	,, .	Dunmanway Rectory	7·33	209
Selk .	Ettrick Manse	4·56	126	,, .	Cork, University Coll.	5·31	210
Peeb .	West Linton	3·12	...	,, .	Ballinacurra	5·34	204
Berw .	Marchmont House	4·11	178	,, .	Mallow, Longueville	...	...
E.Lot.	North Berwick Res.	2·95	178	*Kerry*.	Valentia Obsy.	8·16	255
Midl .	Edinburgh, Roy. Obs.	2·15	107	,, .	Gearhameen	9·90	198
Lan .	Auchtyfardle	3·89	...	,, .	Darrynane Abbey	7·50	238
Ayr .	Kilmarnock, Kay Pk.	3·95	...	*Wat* .	Waterford, Gortmore	4·81	184
,, .	Girvan, Pinmore	3·49	121	*Tip* .	Nenagh, Cas. Lough	5·15	210
Renf .	Glasgow, Queen's Pk.	5·56	240	,, .	Roscrea, Timoney Park	7·73	...
,, .	Greenock, Prospect H.	3·42	104	,, .	Cashel, Ballinamona	7·24	134
Bute .	Rothesay, Ardencraig	3·96	...	*Lim* .	Foynes, Coolnanes	4·51	175
,, .	Dougarie Lodge	3·63	...	,, .	Castleconnel Rec.	5·50	...
Arg .	Ardgour House	6·86	...	*Clare* .	Inagh, Mount Callan	6·01	...
,, .	Glen Etive	7·05	150	,, .	Broadford, Hurdlest'n.	5·49	...
,, .	Oban	3·32	...	*Wexf* .	Gorey, Courtown Ho.	5·34	220
,, .	Poltalloch	4·33	145	*Wick* .	Rathnew, Clonmannon.	3·94	...
,, .	Inveraray Castle	6·85	173	*Carl* .	Hacketstown Rectory	4·62	165
,, .	Islay, Eallabus	...	...	*Leix* .	Blandsfort House	5·60	216
,, .	Mull, Benmore	4·20	53	,, .	Mountmellick	5·68	...
,, .	Tiree	2·12	83	*Offaly*.	Birr Castle	4·78	207
Kinr .	Loch Leven Sluice	2·89	132	*Dublin*	Dublin, FitzWm. Sq.	2·27	116
Perth .	Loch Dhu	...	...	,, .	Balbriggan, Ardgillan	3·58	178
,, .	Balquhidder, Stronvar.	5·26	...	*Meath*.	Beauparc, St. Cloud	4·24	...
,, .	Crieff, Strathearn Hyd.	6·85	259	,, .	Kells, Headfort	3·98	150
,, .	Blair Castle Gardens	5·98	302	*W.M* .	Moate, Coolatore	4·85	...
Angus.	Kettins School	3·43	165	,, .	Mullingar, Belvedere	6·34	244
,, .	Pearsie House	3·44	...	*Long* .	Castle Forbes Gdns.	4·39	170
,, .	Montrose, Sunnyside	3·89	234	*Gal* .	Galway, Grammar Sch.	5·35	...
Aber .	Braemar, Bank	2·91	148	,, .	Ballynahinch Castle	10·54	298
,, .	Logie Coldstone Sch.	3·05	156	,, .	Ahascragh, Clonbrock.	5·48	196
,, .	Aberdeen, King's Coll.	4·23	247	*Mayo*.	Blacksod Point	5·64	202
,, .	Fyvie Castle	2·21	105	,, .	Mallaranny	6·99	...
Moray	Gordon Castle	1·54	75	,, .	Westport House	5·80	215
,, .	Grantown-on-Spey	2·70	120	,, .	Delphi Lodge	10·78	187
Nairn.	Nairn	2·78	158	*Sligo* .	Markree Obsy.	4·89	166
Inv's .	Ben Alder Lodge	3·43	...	*Cavan*.	Crossdoney, Kevit Cas.	3·83	...
,, .	Kingussie, The Birches.	4·69	...	*Ferm* .	Enniskillen, Portora	4·64	...
,, .	Inverness, Culduthel R.	3·37	...	*Arm* .	Armagh Obsy.	4·09	162
,, .	Loch Quoich, Loan	2·67	...	*Down*.	Fofanny Reservoir	7·93	...
,, .	Glenquoich	5·93	121	,, .	Seaforde	4·73	172
,, .	Arisaig, Faire-na-Sguir.	3·03	...	,, .	Donaghadee, C. Stn.	3·50	150
,, .	Fort William, Glasdrum	...	...	,, .	Banbridge, Milltown	3·13	122
,, .	Skye, Dunvegan	4·67	...	*Antr* .	Belfast, Cavehill Rd.	5·59	...
,, .	Barra, Skallary	2·78	...	,, .	Aldergrove Aerodrome.	3·75	156
R&C .	Alness, Ardross Castle.	4·80	212	,, .	Ballymena, Harryville.	4·20	144
,, .	Ullapool	2·66	113	*Lon* .	Garvagh, Moneydig	5·19	...
,, .	Achnashellach	2·72	69	,, .	Londonderry, Creggan.	5·12	182
,, .	Stornoway	2·66	115	*Tyr* .	Omagh, Edenfel	4·45	158
Suth .	Lairg	2·94	141	*Don* .	Malin Head	3·19	...
,, .	Tongue	2·95	144	,, .	Killybegs, Rockmount.	4·97	...

Climatological Table for the British Empire, January, 1935

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy	1024·9	+ 7·3	54	27	44·8	37·4	41·1	+ 2·2	38·7	87	7·4	0·89	− 0·87	13	1·5	17
Gibraltar	1020·2	− 1·3	66	35	59·8	46·9	53·3	− 1·6	46·6	76	5·0	2·36	− 2·28	8	...	...
Malta	1013·6	− 3·4	60	42	54·7	46·3	50·5	− 4·8	46·0	72	7·8	5·20	+ 1·99	26	4·6	47
St. Helena	1011·2	− 0·4	74	58	69·4	61·0	65·2	+ 1·2	62·4	93	9·5	1·76	...	13	...	...
Freetown, Sierra Leone	1013·3	+ 2·5	90	67	86·2	72·9	79·5	− 1·8	73·6	79	2·3	0·80	+ 0·39	4	...	...
Lagos, Nigeria	1010·1	+ 0·5	93	67	87·5	74·2	80·9	0·0	73·8	87	3·1	0·00	− 1·04	0	6·5	56
Kaduna, Nigeria	1009·2	...	104	48	91·1	56·9	74·0	+ 0·6	55·1	43	1·1	0·00	0·00	0	9·1	79
Zomba, Nyasaland	1008·8	+ 1·4	86	58	78·2	64·2	71·2	− 1·6	67·9	82	8·5	18·49	+ 7·39	23	...	...
Salisbury, Rhodesia	1009·7	− 1·0	84	53	77·7	59·2	68·5	− 1·2	62·8	73	6·8	11·86	+ 4·54	15	5·8	44
Cape Town	1013·5	+ 0·1	98	50	81·3	62·1	71·7	+ 1·8	62·6	63	2·7	0·35	− 0·33	5	...	...
Johannesburg	1009·0	+ 0·1	88	51	80·7	56·5	68·6	+ 1·9	58·5	61	4·0	2·72	− 3·45	10	9·0	66
Mauritius	1011·3	− 0·6	92	68	86·2	72·7	79·4	+ 0·1	75·0	70	5·7	11·28	+ 3·52	21	8·2	62
Calcutta, Alipore Obsy.	1016·4	+ 1·2	85	48	76·6	55·7	66·1	− 0·5	56·2	86	1·8	0·54	+ 0·12	1*	...	...
Bombay	1014·0	+ 0·4	91	53	82·0	65·0	73·5	− 2·0	62·2	67	2·4	0·00	− 0·10	0*	...	...
Madras	1014·2	+ 0·1	85	63	83·1	69·1	76·1	− 0·1	70·6	83	5·6	0·57	− 0·57	2*	...	...
Colombo, Ceylon	1011·6	+ 0·8	90	67	86·8	72·1	79·5	0·0	74·0	73	5·2	0·69	− 2·56	5	8·0	68
Singapore	1010·9	+ 0·5	89	70	86·0	73·4	79·7	0·0	75·2	80	8·0	3·72	− 6·17	9	6·2	52
Hongkong	1019·6	− 0·1	76	47	64·3	56·8	60·5	+ 0·3	56·1	78	8·2	1·09	− 0·23	8	3·4	31
Sandakan	1011·3	...	89	70	85·8	74·3	80·1	+ 0·3	76·2	83	7·5	15·24	− 4·16	19	...	...
Sydney, N.S.W.	1009·3	− 3·1	102	56	77·8	64·3	71·1	− 0·5	66·2	68	7·1	3·06	− 0·61	10	6·4	45
Melbourne	1010·9	− 2·0	104	51	75·8	56·4	66·1	− 1·3	58·1	60	6·4	3·91	+ 2·02	11	8·1	56
Adelaide	1012·8	− 0·2	108	52	82·5	58·0	70·3	− 3·6	58·8	39	4·8	0·78	+ 0·06	5	9·3	66
Perth, W. Australia	1011·9	− 0·6	106	55	85·7	63·7	74·7	+ 0·9	62·3	51	4·4	0·18	− 0·16	4	10·4	75
Coolgardie	1010·7	− 0·8	111	51	91·4	61·3	76·3	− 1·1	65·6	59	2·7	0·66	+ 0·20	3	...	...
Brisbane	1009·3	− 2·0	95	61	86·6	68·5	77·5	+ 0·3	71·1	65	5·5	5·75	− 0·70	10	9·5	70
Hobart, Tasmania	1006·6	− 3·7	79	47	69·0	53·8	61·4	− 0·6	54·3	59	7·0	1·05	− 0·78	15	6·9	46
Wellington, N.Z.	1010·5	− 2·8	81	50	73·5	59·6	66·5	+ 4·0	61·2	69	6·5	1·87	− 1·46	9	8·6	58
Suva, Fiji	1006·8	− 0·7	88	71	84·4	74·5	79·5	− 0·4	75·3	86	7·8	22·37	+ 10·94	25	5·7	44
Apia, Samoa	1007·1	− 0·8	87	72	83·1	74·3	78·7	− 0·3	75·8	85	9·2	40·88	+ 23·83	27	2·7	21
Kingston, Jamaica	1014·4	− 0·7	89	61	84·1	66·6	75·3	− 1·5	64·5	81	3·3	0·95	− 0·01	3	4·5	40
Grenada, W.I.	...	...	85	71	83	72	77·5	+ 0·4	73	74	4	3·11	− 1·27	16	...	...
Toronto	1021·6	+ 3·7	46	−11	28·2	13·3	20·7	− 1·5	17·9	70	6·8	2·96	+ 0·17	18	2·3	25
Winnipeg	1024·0	+ 3·1	28	−43	1·6	−16·9	−7·7	− 3·8	...	...	5·9	1·61	+ 0·70	15	2·3	27
St. John, N.B.	1017·4	+ 1·9	45	−18	23·6	6·5	15·1	− 4·1	10·9	79	5·8	6·76	+ 1·96	8	3·8	41
Victoria, B.C.	1012·3	− 3·7	56	10	42·5	35·0	38·7	− 0·3	36·5	91	7·9	12·29	+ 7·75	20	1·7	19

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

(26931) Wt. 18/32 1050 7/35 Hw. G.377/6

facing p. 153

R.A.F.

FLOODS IN JORDAN VALLEY NEAR ALLENBY BRIDGE,
FEBRUARY 6TH, 1935.

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The Change of Climate in the British Isles

A recent inquiry led to the extraction of some figures dealing with the climate of the British Isles in the two periods 1851–1900 and 1901–30, and the results appear to be of sufficient interest to be put on record. Briefly, the second period has been appreciably more "oceanic" than the first, with higher winter temperatures, a smaller annual range of temperature and on the whole a greater rainfall, especially in the winter months.

The average temperatures and rainfalls of the two periods month by month at Greenwich, Oxford and Edinburgh are shown in table I. The winter months (December, January and February) in 1901–30 were all warmer than the corresponding months in 1851–1900, the average differences being 1·2° F. at Greenwich and 0·8° F. at Oxford and Edinburgh. On the other hand the summer months (June, July and August) were all cooler in the second period, the average differences being 0·7° F. at Greenwich and 0·4° F. at Oxford and Edinburgh. Another interesting point is that in the first period January was decidedly the coldest month, while in the second, February was slightly colder than January at all three stations. This retardation of the winter minimum is also characteristic of an oceanic climate. The difference between the averages of the warmest and coldest months has decreased by 2·0° F. at Greenwich, 1·3° F. at Oxford and 1·4° F. at Edinburgh. These changes, though small are quite appreciable. Similar changes occurred at Aberdeen during the period 1870–1932, which has been studied in detail by A. E. M. Geddes,* whose results point to a rise in the mean temperature for the six months December to May, to no change in the period June to August, and, for the remaining three months, to a maximum having been passed between 1908 and 1916, and to a decline having set in, though that decline has been temporarily arrested.

TABLE I.—TEMPERATURE AND RAINFALL, 1851–1900 AND 1901–30

	Temperature.						Rainfall.					
	Greenwich.		Oxford.		Edinburgh.		Greenwich.		Oxford.		Edinburgh.	
	1851–1900.	1901–30.	1851–1900.	1901–30.	1851–1900.	1901–30.	1851–1900.	1901–30.	1851–1900.	1901–30.	1851–1900.	1901–30.
	°F.	°F.	°F.	°F.	°F.	°F.	in.	in.	in.	in.	in.	in.
January ..	38·7	40·3	38·5	39·7	38·0	39·2	1·95	1·87	2·15	2·16	2·09	2·08
February ..	39·6	40·2	39·5	39·6	38·7	39·1	1·45	1·64	1·58	1·71	1·68	1·73
March	41·7	42·7	41·3	42·2	42·5	41·0	1·50	1·77	1·51	1·88	1·68	1·84
April	47·4	46·7	46·8	46·0	44·9	44·4	1·56	1·31	1·56	1·93	1·49	1·53
May	53·1	54·0	52·0	53·3	49·7	49·5	1·88	1·80	1·84	1·98	1·90	2·13
June	59·5	58·3	58·4	57·7	55·6	54·8	2·02	2·07	2·33	2·03	2·31	1·77
July	62·7	62·2	61·5	61·3	58·5	58·2	2·42	2·45	2·49	2·52	2·76	2·63
August ..	61·8	61·3	60·6	60·2	57·8	57·6	2·27	2·41	2·39	2·33	3·00	3·40
September ..	57·3	57·1	56·2	56·0	53·9	53·9	2·17	1·81	2·32	1·86	2·47	2·19
October ..	50·5	50·8	49·1	49·8	47·3	48·3	2·75	2·30	2·78	2·74	2·44	2·79
November ..	43·3	43·5	42·7	42·7	41·7	42·3	2·20	2·35	2·21	2·28	2·29	2·10
December ..	39·8	41·2	39·4	40·5	38·8	39·7	1·87	2·49	1·95	2·78	2·31	2·31
Year.. ..	49·6	49·9	48·8	49·1	47·3	47·3	24·04	24·77	25·11	26·20	26·42	26·50

Owing to the lack of long-period stations the changes from 1851 to 1930 cannot be followed in detail over the British Isles. A fair number of stations have homogeneous records since 1871 however, and from these it is possible to calculate the approximate changes for the various climatological districts. These are set out in Table II. It will be seen that the increase of temperature in winter was greatest in eastern, central and southern England and northern Ireland, while the decrease in summer was greatest in northern and eastern Scotland and eastern England.

The average annual rainfalls at Greenwich, Oxford and Edinburgh, given in Table I, all show a slight increase in 1901–30 over 1851–1900, but the increase exceeds an inch only at Oxford. The differences change irregularly from one month to another, but the

* *London, Q.J.R. Meteor. Soc.*, 61, 1935, pp. 347–56.

averages for the different seasons for 1901–30 are greater than for 1851–1900 in winter and spring and smaller in autumn at all three stations, while summer shows an increase at Greenwich and a decrease at Oxford and Edinburgh. It is a curious feature of Table I that the changes of both temperature and rainfall at Oxford resemble those at Edinburgh far more than those at Greenwich, although the latter station is so much nearer to Oxford.

TABLE II.—MEAN TEMPERATURE DIFFERENCES, 1901–30 MINUS 1871–1900

	Winter.	*Spring.*	*Summer.*	*Autumn.*	*Year.*
Scotland, N. ...	+0·5	−0·1	−0·7	−0·1	−0·1
Scotland, E. ...	+0·6	−0·1	−0·7	0·0	0·0
Scotland, W. ...	+0·6	+0·1	−0·3	+0·2	+0·2
England, N.E.	+0·8	+0·3	−0·7	+0·1	+0·1
England, E. ...	+1·2	+0·5	−0·8	+0·2	+0·3
Midlands ...	+1·2	+0·9	−0·1	+0·5	+0·6
England, S.E. ...	+1·1	+0·7	−0·4	+0·3	+0·4
England, N.W.	+0·8	+0·3	−0·5	+0·3	+0·2
England, S.W.	+0·9	+0·5	−0·2	+0·4	+0·4
Ireland, N. ...	+1·2	+0·4	−0·3	+0·6	+0·5
Ireland, S. ...	+0·5	−0·2	−0·5	+0·1	0·0
Mean... ...	+0·9	+0·3	−0·5	+0·2	+0·2

Similar features are shown by the average rainfall for England and Wales as a whole.* The seasonal averages are shown in Table III.

TABLE III.—RAINFALL FOR ENGLAND AND WALES

	Winter.	*Spring.*	*Summer.*	*Autumn.*	*Year.*
A. 1851–1900 (in.)	9·52	6·75	8·91	10·65	35·83
B. 1901–30 (in.) ...	10·34	7·50	8·89	10·03	36·76
B/A per cent. ...	109	111	100	94	103

The greatest increase has occurred in December, for which month the average rainfall of 1901–30 was 126 per cent. of that of 1851–1900. The greatest decrease was in September, the ratio being only 82 per cent.

It is natural to look for the immediate cause of this change of climate in a change in the distribution of pressure and winds. Table IV shows the average pressure at Greenwich and the pressure differences between Greenwich and Valentia (east-west) and between Greenwich and Aberdeen (south-north) for the periods 1871–1900 and 1901–30.

It will be noticed that in winter and to a less extent in spring, not only was the average pressure lower in the second period than in the first, but the gradients were also appreciably greater, indicating the more frequent passage of barometric depressions and stronger and steadier SW. winds. In summer on the other hand, pressure was

* *British Rainfall,* 1931, pp. 303–4.

higher in the second period than in the first but the gradients are practically the same. For the year as a whole the figures show little change.

Pressure data for Valentia and Aberdeen are not available back to 1851. Wind data for London and Edinburgh exist for the whole period, however, and for Dublin for most of it. These were converted into resultant direction (in degrees from north) and "constancy",* the latter term representing the vector sum of the winds, giving unit value to each observation irrespective of force, expressed as a percentage of the total number of observations. The results are shown in Table V. In winter the prevailing direction is between SW. and W. at all stations in both periods; there has been little

TABLE IV.—PRESSURE DISTRIBUTION, 1871–1900 AND 1901–30

	Greenwich.		Greenwich–Valentia.		Greenwich–Aberdeen.	
	1871–1900.	1901–30.	1871–1900.	1901–30.	1871–1900.	1901–30.
	mb.	mb.	mb.	mb.	mb.	mb.
Winter ...	1015·8	1014·8	+2·5	+2·8	+5·6	+6·2
Spring ...	1014·5	1014·1	+0·3	+0·5	+1·8	+2·2
Summer ...	1015·2	1015·7	0·0	−0·3	+2·5	+2·6
Autumn ...	1014·4	1015·0	+0·9	+1·4	+3·9	+3·7
Year ...	1015·0	1014·9	+0·9	+1·1	+3·4	+3·6

TABLE V.—WIND DIRECTION AND CONSTANCY

	Winter.		Summer.		Year.	
	Direction.	Constancy	Direction.	Constancy	Direction.	Constancy
London—	°	%	°	%	°	%
1851–1900	226	26	242	28	235	19
1901–30	229	31	250	26	239	21
Edinburgh—						
1851–1900	248	40	265	24	257	26
1901–30	229	46	266	26	241	30
Dublin—						
1851–1900	242	40	270	24	262	25
1901–30	237	51	278	32	256	17

* *London, Q.J.R. Meteor. Soc.*, 59, 1933, p. 384.

change of direction, but the " constancy " of the wind has increased by from 5 to 11 per cent. This increase in the frequency of winds from WSW. readily accounts for the greater warmth and heavier rainfall of the winter months. In summer on the other hand, there has been little change in the " constancy", but the prevailing direction was slightly more northerly in the second period. Thus the change of climate between the periods 1851–1900 and 1901–30 is in general accordance with the change in the pressure and winds.

C. E. P. BROOKS.

OFFICIAL PUBLICATION

PROFESSIONAL NOTES

No. 68. *Some notes on readings at Kew Observatory of the Gorczynski pyrheliometer, the sunshine recorder and the black-bulb thermometer.* By H. L. Wright, M.A. (M.O. 336h.).

The Gorczynski pyrheliometer is an instrument designed to give continuous registration of the intensity of solar radiation, and the results of a review of the records obtained between July and November, 1927, from a Gorczynski pyrheliometer installed at Kew Observatory are given in this paper. The relation between the daily aggregate of radiation recorded by the Gorczynski instrument and the daily duration of sunshine registered by the Campbell Stokes recorder both under the most favourable conditions, that is, when atmospheric absorption is at a minimum, and under average conditions is worked out, as well as the relation between the rate of radiation recorded by the pyrheliometer and the width of the burn recorded simultaneously on the sunshine card.

The paper ends with a short comparison between the daily readings of the black-bulb thermometer and the maximum rate of radiation registered each day by the pyrheliometer.

Correspondence

To the Editor, *Meteorological Magazine*

Green Clouds seen from Edinburgh

On July 10th, 1935, at about 8.15 p.m. B.S.T., or quite two hours before sunset, looking north-westward from the garden of No. 16, West Savile Road, Edinburgh, 9, I witnessed an unusually striking and beautiful sight.

Over the roof-tops of adjoining houses were visible snow-white cirrostratus clouds, tinted here and there with vivid green, and an occasional marginal tinge of orange; atmosphere clear, sky background a brilliant blue. The clouds being at an altitude of about fifteen degrees, were well clear of the housetops, but sun and horizon were shut out from view. Thus though I mentally connected the phenomenon with the green flash, I could not say if there were any flash in evidence lower down, either then or later.

About 9.15 p.m. the same clouds, slightly lower down, were lit up with the crimson glow of a beautiful sunset.

Since noting the foregoing I have wondered if what appeared to be patches of green cloud are capable of explanation as resulting from filtration of the intense blue of the sky background through bands of yellow sunlight across unnoticed gaps in the clouds. If so, the marginal orange tints would also be explained, the background in this case being white; but as this did not occur to me at the time, I am unable now to recall the picture with sufficient accuracy to be certain about it.

T. C. SKINNER.

Reigate, July 30th, 1935.

Segment of Greyish Light

From about 13h. to 19h. G.M.T. a segment (about 12° to 15° above the horizon at vertex) of pale greyish light was seen on the north to eastern horizon. Like the rainbow this was directly opposite the sun. Following the apparent motion of the sun, the segment remained clearly visible until a point due east was reached at 19h. The phenomenon had then become much fainter and as the sun's altitude above the horizon decreased it gradually disappeared. The segment was wide in extent.

S. M. JAMESON.

Butterwick, Barton-le-Street, Malton, August 2nd, 1935.

Strange Sunset Effect

At 20h. 45m., G.M.T., on June, 24th a phenomenon similar to that described by Mr. W. L. Baxter, in the *Meteorological Magazine*, 69, 1934, p. 119, was witnessed here. Four delicate pink bands were seen radiating from the north-west not far from where the sun had set about 25 minutes previously. The bands were traceable right across the sky to the south-east where a cumulonimbus had developed during the evening. The two outer bands were very broad; the two inner ones parallel with each other, narrow, and inclined to the left. The spaces between the bands were clear and of the ordinary colour of the evening sky after sunset. The general appearance of the sky at the time was cloudless with the exception of the remains of the cumulonimbus which had almost broken up. This cloud was very pink, especially the hard summits of the cumuli on the south-eastern horizon. The phenomenon vanished by 21h. The surface wind was NE. moderate, and the temperature 70° F.

A. E. MOON.

39, *Clive Avenue, Clive Vale, Hastings, June 27th,* 1935.

The Green Flash

When travelling in the Shetland–Orkney mail steamer on June 19th, 1935, I had a very good view of the " green flash " at sunset, approximately at 21h. 35m. G.M.T. In the south-west quadrant of the sky were visible cirrus and cirrostratus clouds, forerunners of the occlusion which passed over the Orkneys during the following afternoon, but towards north-west the sky was cloudless and the sun set behind a clear sea horizon.

The interesting point is that the colour of the " flash " was a vivid blue, not emerald green, as usually described. The actual colour of the " flash " under comparable conditions of temperature lapse probably depends on the amount of atmospheric pollution, in this case practically nil. The temperature of the air was probably only slightly, say 1° or 2° F., higher than that of the sea,* but direct observations of the temperature are not available.

A point which I cannot find quoted in the literature available here is the momentary appearance, between the first red colour of the sun's limb and the blue flash, of a silvery white or almost neutral tint, possibly a colour illusion due to contrast. I may mention, however, that I tried to avoid retinal fatigue for red by refraining from continuous view of the red until the last few moments of the sunset.

S. T. A. Mirrlees.

Meteorological Station, No. 1 F.T.S., Leuchars, Fife, July 6th, 1935.

World Weather and Solar Activity

In the recent review of my paper on " World Weather and Solar Activity," by C. E. P. Brooks, he points out that if positive correlations are found at any station between excess solar radiation and weather, then negative correlations should be found for defect in solar radiation even though the values are divided into six classes. This implies that if positive correlation is found for any one class then negative correlations should be found in the opposite condition of solar radiation for every other class. This criticism seems well taken but it so happens that I tested this relation between two classes of different values and did not get any appreciable correlation. The negative correlation came out distinctly when I made the comparison between classes having the same mean departure from normal.

With this explanation, which should probably have been included in the text, the fact that there was in most cases a fairly large correlation between stations in the same class still seems to me to indicate a real and not an accidental relation.

H. H. Clayton.

1410, *Washington Street, Canton, Mass., U.S.A., June 3rd,* 1935.

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* *cf.* note by R.W. Wood, quoted by Sir Napier Shaw, in " Manual of Meteorology ", Vol. III. p. 68.

Rain in Advance of True "Warm-front" Rain

With reference to Col. Gold's note on "Rain in advance of true warm-front rain", published in the *Meteorological Magazine* for November, 1934, my experience at Worthy Down during the years 1927–31, was that light rain before true warm-front rain was not uncommon and was frequently not confined to the few drops which, as Col. Gold remarks, are usual in these conditions. I do not remember, however, any occasion on which there was an interval of so long as two hours between the pre-frontal and true-frontal rain. I have notes of pre-frontal rain being conspicuous on September 29th, 1927, January 12th, 1928, June 8th, 1928, and December 2nd, 1929, but the interval was of the order of half-an-hour to one hour with the pre-frontal rain lasting about half-an-hour or rather less. On June 8th, 1928, the true warm-front rain commenced at 20h. 45m. G.M.T. and on December 2nd, 1929, it commenced at 9h. G.M.T. I am not in a position to check up my facts by reference to the *British Daily Weather Report.* There are not, so far as I am aware, any references to the occurrence of rain before continuous warm-front rain in the Middle East Area. There is, however, evidence that at Amman on December 5th, 1934, pre-frontal rain occurred from 9h. 20m. to 10h. G.M.T., the true warm-front rain not commencing until 11h. 20m. G.M.T.

C. V. OCKENDEN.

R.A.F., Heliopolis, Egypt. January 31st, 1935.

[The four cases mentioned by Mr. Ockenden have been examined by reference to the synoptic charts to obtain evidence regarding the magnitude of the pre-frontal rain and the time interval before the true-frontal, continuous rain area approached.

September 29th, 1927.—A shallow depression had formed on an occlusion which at 7h. G.M.T. lay along the line Eskdalemuir–Holyhead–St. George's Channel, and at the same time the forward edge of the frontal rain extended approximately from Portland to Leafield and Harrogate.

At South Farnborough slight rain occurred between 6h. and 7h. and by 7h. a trace was measured. At Worthy Down slight rain began between 5h. and 6h. and 1 mm. had been measured by 7h. G.M.T. The Beaufort letters recorded were r_0, and pr. Both of these must have been cases of pre-frontal rain with a time interval of one to two hours before the true-frontal rain.

January 12th, 1928.—A depression having a well-marked warm sector was travelling north-east with its centre passing a little west of Stornoway. At 13h. G.M.T. the forward edge of the true-frontal rain lay along the line Plymouth to the Wash.

Pre-frontal rain was reported from most stations in south-east and east England, the respective times of commencement being shown below :—

Worthy Down ...	... ...	r_0 began at 11h.
South Farnborough	... ...	d_0 „ „ 12h. 30m.
Kew	... ...	r_0 „ „ 12h. 30m.
Croydon	... ...	$r_0 r_0$ „ „ 9h.
Shoeburyness ...	... ...	r_0 „ „ 13h. 30m.
Clacton	... ...	r_0 „ „ 13h. 30m.

In this case the time interval ahead of the true warm front would be one to three hours.

June 8th, 1928.—A depression approached Valentia from the south-west and a wide band of warm-front rain was associated with it. At 1h. the forward edge of the true warm-front rain lay along the line Guernsey–Plymouth–near south coast of Ireland.

It is very difficult from the synoptic chart to decide regarding any pre-frontal rain on account of the small number of observations available at 1h. The rain area was not continuous and the time interval between the frontal and pre-frontal rain is doubtful.

December 2nd, 1929.—An intense depression was centred near south-west Iceland and there was a wide band of warm-front rain. At 7h. the forward edge of the true-frontal rain lay along the line Guernsey–Worthy Down–Sealand. Pre-frontal rain occurred at South Farnborough between 5h. and 6h. and 0·1 mm. was recorded by 7h. The time interval between pre-frontal and frontal rain was between one and two hours.—R. S. READ.]

NOTES AND QUERIES

Floods and Heavy Rain in Transjordan

The photograph reproduced as the frontispiece to this number of the magazine, which was taken by a Royal Air Force official on February 6th, 1935, shows the floods in the Jordan Valley near Allenby Bridge resulting from the heavy rain of the previous few days.

Towards the end of January a low pressure area was moving eastwards from Italy to Transcaucasia and at 7h. on the 31st, was centred to the south of the Black Sea. At Amman on that day the wind was WSW., force 6–7 until 14h. after which it decreased to force 4–5. Much cloud developed rapidly from 15h. and heavy continuous rain set in at 15h. 50m. continuing until 20h. 40m. During the next two days pressure remained low to the north and east and the winds SW. to W., force 4–6, with moderate rain. On the 3rd a secondary to the deep depression over northern Europe passed across Transjordan and more than 55mm. (2·1 in.) of rain were recorded. This was followed the next morning by a thunder-storm between 8h. 50m. and 9h. 15m. accompanied by hail and slight snow. Later on in the day pressure rose and anticyclonic conditions were established again by the 5th.

Temperature was low during the passage of this low pressure area, a maximum of 44° F. being recorded on the 4th. The rainfall amounts measured each day were :—

Jan. 31st, 32·0 mm. (1·26 in.). Feb. 3rd, 55·7 mm. (2·19 in.).
Feb. 1st, 22·4 mm. (0·88 in.). Feb. 4th, 26·5 mm. (1·04 in.).
Feb. 2nd, 16·3 mm. (0·64 in.).

making a total at Amman for the five days of 153 mm. (6·02 in.) which is 9 mm. more than the combined total average rainfall for the months of January and February.

The rainfall for Transjordan generally was heavy for these five days and Ramleh, Palestine had 84·6 mm. (3·33 in.) during this period. Heavy rain, however, was not experienced in Iraq or Egypt except locally on the 3rd when Shaibah had 32·8 mm. (1·29 in.) and Aboukir 16·3 mm. (0·64 in.).

Forecasting Weather from height of Barometer and Temperature of Wet Bulb

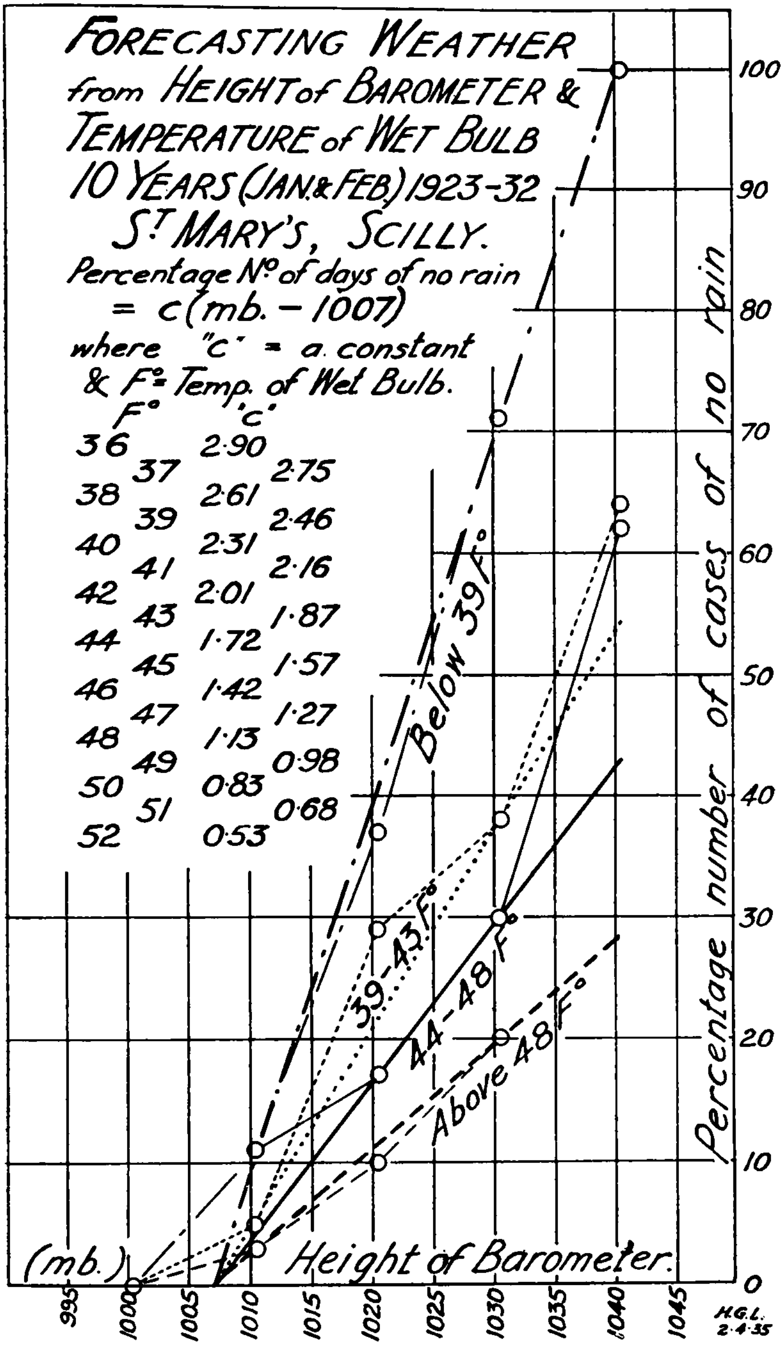
The mean results of the readings of the wet bulb thermometer and barometer at 7h. given in Lieut. Comdr. T. R. Beatty's table in the March issue of the *Meteorological Magazine* have been plotted by me on the accompanying diagram, where " the percentage numbers of cases of no rain " are ordinates amd the barometer readings in millibars are abscissæ. The approximate slopes are shown in thicker lines which converge on 1007 mb. making it possible to obtain the common formula :—" the percentage number of cases of no rain " $= C$ (mb.—1007) in which the values of C are 0·83 for F° above 48 ; 1·28 for 44–48 F° ; 1·63 for 39–43 F° and 2·97 for F° below 39. The additional constants shown in the table in the diagram have been interpolated from another diagram not reproduced here.

Although the formula devised by me from Lieut. Comdr. Beatty's data can only be claimed to be a rough approximation it may serve a useful purpose in providing a figure value which taken at intervals of an hour or more may indicate the rate of change of the weather at any one place. This type of formula may be applicable to other stations although the critical barometric pressure (1007 mb.) and the constants are likely to vary especially inland.

If a similar relationship is established elsewhere it does not appear to be worth while to make a special instrument for the purpose as the estimation is simple enough to meet the need of " the man in the street " who can read a wet bulb thermometer and a barometer.

H. G. LLOYD.

[I think Mr. Lloyd's result is an interesting one. It applies when the barometer is above 1007 mb. Clearly his " constant " C is a function of the wet-bulb temperature, T'. Approximately it is $15/(T'–32)$ so that the percentage number of cases of no rain may be represented by P when $P = 15\,\dfrac{B-1007}{T'-32}$ or in words " the excess of the pressure (barometer) above 1007 mb. divided by the



excess of the wet-bulb temperature above 32°F. and multiplied by 15 gives the percentage probability of no rain (at Scilly) in the next 24 hours in January and February ". It would be interesting to see if similar results applied to other months at Scilly and to other places.—E. GOLD.]

Severe Storm at Mafeteng, Basutoland

Mr. D. E. Millichamp of Mafeteng, Basutoland, has sent the following notes of a severe storm which passed over Mafeteng on January 3rd, 1935, when 1·50 in. of rain fell in 30 minutes. Such heavy rain has not been experienced there since February 18th, 1931, when 1·60 in. fell in 90 minutes.

During the last six days of December, 1934, the wind was from NW., but on the 31st there was a change to SSW. force 2 increasing somewhat during the day and with a further change to S. force 4 by 8h. 30m. on January 1st, when the relative humidity was as low as 25 per cent. Day temperature began to increase from December 30th, 82° F. being recorded on the 31st, 85° F. on the 1st and 86° F. on the 2nd, the highest screen temperature so far this summer. On the 2nd and early on the 3rd the wind was N. force 4 and the relative humidity increased to between 40 and 50 per cent., while the sky was clear at the hour of observation, 8h. 30m., on the 2nd but was $\frac{3}{10}$ covered with altocumulus on the 3rd at the same time. At 12h. 30m. on the 3rd the cloud changed to cumulus and increased to $\frac{6}{10}$ coming from the north-west. The wind also increased to force 5 from NW. by 14h., by which time the sky was overcast and the temperature had risen to 82° F.; a minute or so later a few large spots of rain fell and a rapid cooling was noticeable. At 14h. 30m. the wind had increased to force 6 from NW. and the cloud changed to mammatocumulus while, owing to dust which was now blowing along in clouds, visibility had lessened to 6¼ miles. The dust storm continued until 15h. 30m. when rain commenced to fall very heavily. " By this time the temperature had fallen to 72° F. and the wind increased to force 7. At 15h. 37m. hail commenced to fall, thick and very white and of the size of large fresh peas somewhat oval in shape. Hail fell for 3 minutes only and quickly melted. Thunder was heard, but flashes of lightning were not seen well owing to visibility having lessened to 220 yds. By 15h. 45m. the temperature had fallen to 51° F. Wind now began to lessen in force, but rain continued heavily until at 16h. one was able to approach the rain-gauge, the force of the storm having lessened. At this hour rain was measured and found to be 1·50 inches so that in the space of 30 minutes, 151½ tons of water had fallen per acre. Rain continued to fall until 20h. 40m., when the remainder was measured and the total fall found to be 1·61 in. Visibility had increased to 12½ miles at 16h.", by which time too the temperature had risen to 57° F.—59° F.was recorded at 19h. after which it decreased to a night minimum of 53° F.

The barograph showed two distinct minima on the 3rd, falling from 24·84 in. at midnight to 24·82 in. at 7h. and to 24·63 in. at 15h. Remaining at that for about 30 minutes it rapidly rose to 24·73 in. while the heavy rain was falling. By 18h. 30m. it had again fallen to 24·69 in. but by 20h. 15m. had risen to 24·83 in."

Mr. Millichamp further observes that in places where pools of water are generally left that take days to dry up, in two days after the storm just mentioned one could pass along the roads without splashing through mud.

High Soundings with Registering Balloons and the Effects of Solar Radiation on the Temperatures Recorded

In a report to the Commission Internationale pour l'Aerostation Scientifique, held at Monaco in 1909, the late Mr. W. H. Dines contended that owing to the difficulty of avoiding the effects of solar radiation on the thermograph during the hours of daylight, the best time at which to make soundings of the upper air was just before sunset. Other councils prevailed, and to this day upper air soundings according to the international programme are for the most part made during the hours of daylight.

Authentic information as to the temperature of the atmosphere at heights between 20 and 30 Km. is of increasing general interest, and with improved balloons, soundings are now occasionally made to even greater heights. The old problem has come forward again and is brought forcibly before our notice by Herr Peregrin Zistler in a paper entitled "Hohe Registrierballonaufstiege in München und der Einfluss der Sonnenstrahlung". (*Deutsches Meteorologisches Jahrbuch für Bayern*, 1934.

Herr Zistler has analysed the records of a large number of high soundings made at Munich during recent years with the definite object of determining quantitatively the magnitude of the thermometric error caused by instrumental lag and solar radiation. His method of attack is first to postulate an equation connecting the lag of the thermograph with the relative wind speed and the other variables; the form of the equation follows that of Jaumotte. He then develops some formulæ applicable to special cases. The meteorograph employed was the Bosch-Hergesell, which, as it includes a clock, enables the vertical velocity to be measured on both the ascent and descent of the apparatus. Since these two velocities are generally widely different, the two readings of the temperature at the same height on the ascent and descent give a fairly effective means of estimating what the recorded temperature would have been if the velocity had been so high that radiation could have been neglected. There may be differences of opinion about the absolute accuracy of some of the formulæ and their application, but they are undoubtedly of practical use in forming an estimate of the magnitude of the thermometric error, and the results carry conviction. Some graphs of temperature-height are given for cases in which the error was large, they bear a strong resemblance to many soundings made in England.

As the result of a systematic analysis of 64 high soundings made from Munich it is shown that at heights of 20 Km. and over the uncorrected readings of temperature during the daytime are too high, while those made at night may be relied on as accurate. The mean error at 20 Km. of the ascending portions of all the soundings from Munich taken together was found to be 2·7° C. The error increases with height and is greater in summer than in winter.

In England upper air temperatures are published in the form of means of the ascending and descending record in each sounding, and it has also been customary for many years to make a partial allowance for rises of temperature which there was good reason to suppose were due to solar radiation.* Even so, it has recently been found by an independent process that in the daytime the estimated temperatures have been too high by an amount of the same order of magnitude at that found at Munich.

One section of Herr Zistler's paper is devoted to a comparison between a series of soundings made at Uccle in the summer of 1933 by M. Jaumotte,† and some almost simultaneous soundings made from Munich. The soundings from Uccle reached great heights, and were remarkable for the pronounced negative lapse rate found in the stratosphere, and the very high temperatures at the highest levels. The comparative data are set out very fairly, the Munich soundings being analysed by the methods previously referred to. It is found that the negative lapse rate existed at Munich, but that the intensity was very much less. The abnormally high temperatures at high levels had no counterpart at Munich, and the evidence adduced points to the conclusion that some of the temperatures recorded at Uccle were affected by radiation to a serious extent.

This short paper is a very valuable contribution to the practical side of upper air work and deserves to be widely read. After reading it an irresistible feeling arises: Why do we continue to make soundings into the stratosphere during the daytime and spend long hours afterwards in trying to extract the truth from our distorted records, when by waiting till sunset indisputable data can always be obtained ?

L. H. G. DINES.

REVIEWS

India Meteorological Department, Memoirs, Vol. XXVI, Part IV —Discussion of Results of Sounding Balloon Ascents at Poona and Hyderabad during the period, October, 1928, *to December,* 1931. By K. R. Ramanathan, D.Sc., and K. P. Ramakrishnan, B.A.

The memoir is in the main a description and brief discussion of the features shown by the mean results of 78 balloon ascents at Poona, and 65 at Hyderabad (Deccan). The upper wind during the monsoon being easterly, most balloons sent up from Poona at this season

* *London, Meteor. Off., Obs. Yearb.* 1932, *p.* 439.

† *Bruxelles, Bull. Acad. R. Belg.,* Series 5, **19**, 1933, p. 1311–31. Reviewed in the *Meteorological Magazine*, 69, 1934, p. 31.

would fall into the sea. Hyderabad is free from this disadvantage, and was therefore used during the monsoon and the post-monsoon transition period. The number of ascents available varies from 5 in April and June to 23 in September. The winter months with an average of 13 ascents a month, and the monsoon, with 15 a month, are best represented.

While it cannot be expected that this small number of ascents will give normal values, and in fact there are what the authors treat as abnormalities in February which, with 15 ascents, is represented almost as well as any month, nevertheless Indian meteorologists are to be congratulated on maintaining up to date the summarising of their data. It keeps the subject alive, facilitates reference, provides a guide for future work, and makes the results available in convenient form to their colleagues in other countries.

In addition to the means, observations on a number of individual days are given, with brief notes, to illustrate the horizontal differences of temperature, and the variation of humidity with height in various types of weather.

The chief features considered are temperature, pressure, humidity and density, the tropopause, gradients between India and Batavia in relation to the wind, and the indications of tephigrams.

The maximum of temperature up to 2 dynamic kilometres (gkm.) found by the authors for April and May, was to be expected and it is natural, in view of the results obtained at Agra, to attribute the shift of the maximum from spring to the monsoon months between 5 and 15 gkm. to condensation over the Bay of Bengal and beyond. In view, however, of the later work in India on the upper circulation during the monsoon, and of the authors' subsequent conclusions, from the tephigrams, regarding the relative stability of the higher levels over Agra and the Deccan, it is at least worthy of consideration whether this slight elevation of temperature may be partly a latitude effect.

The explanation of various types of temperature change at the tropopause, suggested by J. Bjerknes, and based on meridional advection, is now applied to the explanation of the similar types found in India. The explanation seems a very probable one, and its possible contribution towards the large lapse rates encountered between 10 and 14 gkm. might usefully have been discussed. These lapse rates are attributed, on the basis of previous papers, to radiation effects, but advection effects are not specifically ruled out.

Observations made in India and Batavia, bearing on the upper currents in the intervening region, are of much interest and importance in connexion with the general circulation. If the direction of these currents is approximately uniform over the whole of the region, then the conclusions, given with regard to the upper easterly current of the monsoon and the lower north-easterly and upper westerly currents of winter and the hot season, are probably valid. If, however, the axis of the monsoon low pressure area over India, which is inclined upwards towards the south, is situated to the north of Batavia at all levels, and if the axis of the winter high is similarly inclined, the conclusions may need to be amplified. The distance between India and Batavia is very great and additional relevant observations at other places are much to be desired.

The temptation experienced by many workers on this subject to attach significance to the indications of the hair hygrometer at temperatures below those at which, according to experimental results up to the present, the instrument is not to be trusted, has arisen again in the examination of these observations and the authors have not been able entirely to resist it. Could the facilities at the Agra Observatory and the experimental ability of Mr. Chatterjee, in combination, provide a settlement of this uncertainty once for all, a great service would have been done to meteorology. The results of the present examination in relation to humidity agree in general with previous results, and there are no exceptional features.

Tephigrams for the mean conditions shown by these ascents are found not to add much to the points raised by the preceding tables and diagrams. The utility of the tephigram is probably more marked for estimating the stability in individual cases than as applied to mean results. An item of some interest might have been added by inserting, in the diagrams, curves showing the wet bulb potential temperatures. We look forward to the future application of this conservative feature of air masses, in the country of its origin.

W. A. Harwood.

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(1) *The Circulation of the Atmosphere in the Australia–New Zealand Region.* By E. Kidson. Fifth Pacific Science Congress, III, 3. (2) *Frontal Methods of Weather Analysis applied to the Australia–New Zealand Area.* By E. Kidson and J. Holmboe. Part I, Discussion; Part II, Weather Charts. Dept. of Scientific and Industrial Research, Wellington, N.Z., 1935.

The first paper contains a brief account of the general atmospheric conditions in the area mentioned. The first feature to attract attention is the regular procession of anticyclones moving eastward, the mean latitude of the centres being about 35° S. It is estimated that there are eight in the circuit of the globe, and that the circuit occupies six weeks on the average. The anticyclones are most frequently separated by troughs of low pressure, with the cyclonic centres to southward of New Zealand. The eastward movement of the pressure fluctuations or " waves " is faster than that of the surface air but much slower than that at high levels above (say) 5 kilometres at Wellington.

The second paper is an important new contribution, and combines the special knowledge of the region possessed by Dr. Kidson with the first-hand work of a representative of Bergen. Mr. J. Holmboe is one of the Bergen forecasters, and was attached to the Lincoln

Ellsworth Antarctic Expedition. He spent several months carrying out analysis at Wellington. This paper discusses four periods in detail, and 30 weather charts are reproduced in Part II. Some autographic records are shown in Part I, and also two rainfall maps illustrating very heavy rainfall in New Zealand, partly orographic.

The data available are on the scanty side, but they are supplemented by observations on Pacific Islands, and a few on ships, and some important features are brought out beyond reasonable doubt. Three of the periods illustrate families of depressions (called "waves" in the paper) affecting South Australia and New Zealand, and are stated to be typical. Thus the anticyclones are often separated by a few days of disturbed weather. These disturbed periods had many features in common with similar periods in our own area. The charts are of interest to all meterologists, as they help to distinguish general from local features. One general feature in both temperate zones is the fact that depressions have on the average a component of motion towards the pole. In the periods discussed in the paper, the direction towards which the depressions moved varied between east and south-south-east. Another general tendency is for well developed depressions to become quickly occluded near the centre. The depressions shown here continued to move after occlusion, though usually at a reduced speed. This usually happens in our own area also, but stationary depressions are fairly common. Stationary depressions and anticyclones are unusually frequent in western Europe and the eastern Atlantic, owing to the abnormally low latitudinal temperature gradient.

The fourth period examined illustrates the development of a tropical hurricane in the South Pacific, about latitude 20° S., whose centre was encountered by S.S. "Maunganui." This developed out of one of a family of shallow depressions on a front, which formed at the northern boundary of a relatively cool SE. wind flowing round an anticyclone to eastward of New Zealand. This application of frontal analysis to a tropical cyclone is interesting and important, but it must be remembered that though there are points of similarity between cyclones in tropical and temperate latitudes, there are also marked differences. A hurricane centre may maintain itself for days in the tropics, and the only satisfactory explanation of the source of energy is the marked vertical instability for saturated air, which is known to prevail in the tropics.

C. K. M. DOUGLAS.

BOOKS RECEIVED

Bulletin de l'Observatoire de Talence (*Gironde*), 3rd Series, Nos. 5–15; Talence, 1933, 1934 and 1935.

Monthly Rainfall of India for 1931 *and* 1932. Published by the various Provincial Governments and issued by the Meteorological Dept., Calcutta, 1933.

OBITUARY

John H. Bennett.—We regret to record the death on June 18th of Mr. John H. Bennett of Ballinacurra, Co. Cork. Mr. Bennett set up a climatological station at Ballinacurra in 1904 and was thus instrumental in adding considerably to our knowledge of the climate of southern Ireland. The esteem in which Mr. Bennett was held by those who knew him is indicated by the following passage from a letter received from Miss D. Trevor McNeill :

" He was always a man of immense energy and drive, and his death is a very great loss not only to all of us in Ballinacurra but also to a very much wider section of the community for which he worked consistently and unobtrusively for a long period."

We are glad to learn that arrangements have been made for continuing the valuable observations from Mr. Bennett's station.

NEWS IN BRIEF

Sir George Simpson, K.C.B., F.R.S., has been elected a Corresponding Member of the Mathematical and Physical Class of the Gesellschaft der Wissenschaften of Göttingen.

Miss D. Salter has copies of the *Meteorological Magazine* for February, 1928, to April, 1933, and of *British Rainfall*, 1927 to 1931, inclusive. Anyone wishing to purchase these should communicate direct with Miss Salter at the Bank House, Mickleton, Campden, Gloucestershire.

Erratum

JULY, 1935, p. 142, last line, *for* " the same day Saturday, June 15th " *read* " on Sunday, June 16th ".

The Weather of July, 1935

Pressure was below normal over Alaska, Canada, the United States (except the south-west), Greenland, Iceland, Spitsbergen, north Europe, western Siberia and Madeira, the greatest deficits being 7·5 mb. at Reykjavik, 4·8 mb. at Moscow and 3·2 mb. near Salt Lake City. Pressure was above normal from the east coast of the United States across western Europe to the Black Sea and the Mediterranean, the greatest excess being 5·6 mb. at Scilly. In Sweden, temperature was generally above normal except in western Norrland, and rainfall mainly deficient except in Norrland and southern Gothäland. In north and central Europe generally temperature was above normal and rainfall deficient.

The outstanding features of the weather of July over the British Isles were the widespread excess of sunshine, the continual high temperatures and in most districts the marked deficiency of rainfall. At Gorleston the total sunshine was the highest that has been recorded there for any month, and at several other stations new records were set up for sunshine and rainfall. On the 1st a shallow depression crossed north France and the English Channel and thunderstorms accompanied by heavy rain were experienced in the Channel Islands on the morning of the 1st and in south-east England on the night of the 1st–2nd; 3·25 in. fell at Exbury (Hants), 2·23 in. at Winchester and 2·09 in. at Southampton. From then to the 5th depressions moving north-east to the north of the British Isles with associated secondaries maintained westerly winds, fresh to strong at times generally, with, in the north and west, unsettled weather but long bright periods, and elsewhere mainly dry, sunny, warm conditions; 14·6 hrs. bright sunshine occurred at Gorleston and 14·5 hrs. at Inverness and Nairn on the 1st. Mist or fog were experienced locally and on the 3rd thunderstorms in north Scotland. From the 6th to the 16th anticyclonic conditions prevailed over the whole country except occasionally in the north-west. Temperature was high during this time, reaching 90° F. at Huddersfield and 89° F. at Brighton and London on the 13th, while the record did not fall below 66° F. at Dover, Brighton and Portsmouth during the night of the 12th–13th and at Westminster during the previous night. Much sunshine was experienced most days over the whole country, among the largest amounts being 16·6 hrs. at Lerwick and 15·8 hrs. at Inverness on the 11th. The weather was mainly dry but local thunderstorms occurred in south England and the Midlands on the 11th and north England on the 14th and occasional slight rain in Scotland and Ireland. Coastal fog was experienced from the 10th–13th. From the 17th–22nd depressions passed in an easterly direction across the British Isles giving unsettled weather generally with much sunshine but some rain, heavy locally in the north and west; 3·35 in. were measured at Lerwick on the 20th and 1·73 in. at Borrowdale (Cumberland) on the 19th. Thunderstorms occurred over England generally on the 18th and in eastern England on the 20th, while the winds were often moderate to strong and temperature slightly below normal. From the 23rd–31st pressure was high over England and south Ireland, while Scotland came under the influence of depressions moving from the North Atlantic to Scandinavia until the 28th, when the high-pressure area extended north to the Faroes. Winds were mainly light or moderate, though strong locally in the north on the 25th, 27th and 28th, and there was occasional rain at first in Scotland and Ireland, but from the 29th onwards the dry sunny conditions of the south spread also to these countries. Among the largest amounts of sunshine recorded were 15·6 hrs. at Pembroke and 15·2 hrs. at Abbotsinch, both on the 29th and 30th. Temperature exceeded the average on many days in most districts, 83° F. was reached in London on the 24th, and 65° F. was the minimum temperature at Harrogate and Hull on the 27th. Slight ground frost, however, occurred at one or two places on the 30th and 31st. Mist or fog was frequent off the south-west coasts. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	148	0	Chester ...	200	+40
Aberdeen ...	223	+72	Ross-on-Wye ...	257	+69
Dublin	215	+33	Falmouth ...	232	+11
Birr Castle ...	178	+30	Gorleston ...	309	+103
Valentia... ...	186	+28	Kew	272	+77

Miscellaneous notes on weather abroad culled from various sources

The heat experienced in northern and central Italy at the beginning of the month was abating by the 3rd (*The Times*, July 2nd).

The monsoon at first was strong in Malabar with general rains to the north and east while towards the middle of the month it was strong over Gujerat, Rajputana and Sindh with general rains to the east and south-east. By the 18th the rainfall had also extended to the Punjab. Towards the end of the month the monsoon was still active over the United Provinces, the Punjab and central India, but had weakened elsewhere. Torrential rain caused both the Yangtze and Hwang-ho rivers to rise about the 8th and 9th and serious floods resulted. Many cities were inundated; 2,000 people were reported drowned at Yenshih (Honan) and heavy loss of life occurred also in many other cities. By the 11th the floods were subsiding in western Honan but continued to increase along the lower reaches of both rivers until about the 15th; many of the dykes along the Hwang-ho gave way about this time. By the 16th the level of both rivers had started to fall but the central stream of the Hwang-ho was pouring into the Weishan Lake and the Grand Canal which overflowed its banks in Shantung the following week. By the 29th the general situation was improving with the exception of the flooded Weishan Lake area (*The Times*, July 10th–30th).

The drought in Western Queensland was broken by heavy rain over the greater part of the area affected about the 2nd and rain occurred locally in Western Australia during the first ten days but not sufficient to relieve the serious position. A severe duststorm in South Australia began on the morning of the 18th and continued during the following night. It ended with rain in the settled areas and parts of the far north where the weather had been persistently dry (*The Times*, July 3rd–20th).

Conditions were generally favourable for the crops in Canada early in the month. Tornadoes were experienced at Watford City and Ross (N. Dakota) on the 4th and a cloud-burst washed away part of the railway line near Bainville (Montana). Heavy and long-continued rain over New York State and New England on the 7th and 8th caused the deaths of 40 people and washed away bridges, while several dams burst adding greatly to the floods. Severe thunderstorms were experienced in the Ottawa Valley and at Montreal on the 16th when three people were killed, and also in New York on the 20th when four people were killed. In the United States temperature was generally above normal during most of the month except along the Pacific Coast and in the extreme south-east, while rainfall was irregular in distribution but mainly below normal. A heat-wave was experienced in New York State during the greater part of the month and at times the humidity was also high. A tornado accompanied by hail was experienced at Montevideo on the 8th; the storm passed after six minutes but two people were killed. Drought prevailed in the Argentine during the close of the month (*The Times*, July 4th–August 2nd, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin*).

Daily Readings at Kew Observatory, July, 1935

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
	mb.		°F	°F	%	in.	hrs.	
1	1012·0	NE.3	59	78	56	0·02	2·6	pr 13h. & 19h.
2	1018·0	W.3	60	72	55	1·09	8·7	tl RR 2h.–4h.
3	1025·7	SW.2	60	73	67	—	5·3	d_0 7h.
4	1024·6	WSW.3	60	75	69	—	5·4	
5	1021·7	WSW.3	61	73	63	—	7·3	d_0 20h. & 21h.
6	1022·6	NNW.2	56	70	51	—	13·6	
7	1024·3	E.3	52	73	52	—	13·3	w early.
8	1022·9	E.2	52	71	48	—	14·9	w early.
9	1018·0	S.2	57	80	50	—	10·6	w early.
10	1018·6	W.1	56	82	48	—	11·2	
11	1021·4	E.1	62	78	61	0·02	5·1	prt 15h.
12	1021·1	NE.2	61	81	58	0·13	4·1	pr 3h.–5h.
13	1021·0	E.3	62	85	40	—	12·9	w early.
14	1020·5	NE.2	60	85	42	—	12·9	w early.
15	1022·3	NNE.1	59	82	44	—	10·3	
16	1019·5	WNW.2	63	79	35	—	13·0	
17	1014·1	W.5	58	72	49	—	4·8	pr_0 10h. 40m.
18	1009·8	W.2	55	67	73	0·21	4·5	pr 13h. & 14h. pR 16h
19	1008·3	SW.4	53	69	58	0·04	1·9	pr_0 15h.–17h.
20	1002·4	SW.4	58	69	67	0·12	5·3	pr during day.
21	1021·4	WNW.3	51	68	45	—	9·2	
22	1025·7	Calm	59	73	64	—	1·8	
23	1025·4	SSE.1	58	79	57	—	8·6	w early.
24	1023·5	NNE.3	57	80	48	—	7·3	pr_0 17h. 20m.
25	1023·1	NE.3	58	77	48	—	13·5	
26	1021·5	N.1	58	75	45	—	11·4	
27	1018·7	WSW.4	57	77	60	—	6·3	
28	1016·5	W.3	63	77	49	—	8·1	r_0 5h.
29	1020·3	N.3	61	69	45	—	11·8	
30	1022·7	N.2	51	71	37	—	12·4	
31	1023·3	NE.2	49	72	42	—	13·6	
*	1019·7	—	58	75	52	1·63	8·8	*Means or totals.

General Rainfall for July, 1935.

England and Wales ...	30	per cent. of the average 1881–1915.
Scotland	75	
Ireland	36	
British Isles	41	

Rainfall : July, 1935 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square.........	·90	38	*Leics* .	Thornton Reservoir ...	·32	13
Sur .	Reigate, Wray Pk. Rd..	·83	37	,, .	Belvoir Castle...........	·20	8
Kent .	Tenterden, Ashenden...	·34	16	*Rut* .	Ridlington	·66	26
,, .	Folkestone, Boro. San.	·27	...	*Lincs* .	Boston, Skirbeck.........	·40	18
,, .	Eden'bdg., Falconhurst	1·60	70	,, .	Cranwell Aerodrome...	·67	29
,, .	Sevenoaks, Speldhurst.	·74	...	,, .	Skegness, Marine Gdns.	·69	32
Sus .	Compton, Compton Ho.	1·50	53	,, .	Louth, Westgate.........	·24	9
,, .	Patching Farm..........	·46	19	,, .	Brigg, Wrawby St.......	·32	...
,, .	Eastbourne, Wil. Sq....	·19	9	*Notts* .	Worksop, Hodsock......	·50	22
,, .	Heathfield, Barklye....	·41	16	*Derby*.	Derby, L. M. & S. Rly.	·34	14
Hants.	Ventnor, Roy.Nat.Hos.	·22	11	,, .	Buxton, Terr. Slopes...	1·96	50
,, .	Fordingbridge, Oaklnds	·56	28	*Ches* .	Runcorn, Weston Pt....	·69	25
,, .	Ovington Rectory.......	1·34	52	*Lancs*.	Manchester, Whit. Pk.	1·38	42
,, .	Sherborne St. John......	·54	24	,, .	Stonyhurst College......	2·99	77
Herts .	Royston, Therfield Rec.	·95	38	,, .	Southport, Bedford Pk.	·81	28
Bucks.	Slough, Upton............	1·33	69	,, .	Lancaster, Greg Obsy.	2·32	66
,, .	H. Wycombe, Flackwell	·60	30	*Yorks*.	Wath-upon-Dearne......	·71	28
Oxf .	Oxford, Mag. College...	·55	24	,, .	Wakefield, Clarence Pk.	·82	32
Nor .	Wellingboro, Swanspool	·80	35	,, .	Oughtershaw Hall.......	4·15	...
,, .	Oundle	·42	...	,, .	Wetherby, Ribston H..	...	...
Beds .	Woburn, Exptl. Farm...	·52	23	,, .	Hull, Pearson Park......	·22	9
Cam .	Cambridge, Bot. Gdns.	·54	25	,, .	Holme-on-Spalding......	·40	15
Essex .	Chelmsford, County Lab	1·10	52	,, .	West Witton, Ivy Ho.	·70	27
,, .	Lexden Hill House......	·21	...	,, .	Felixkirk, Mt. St. John.	1·14	42
Suff .	Haughley House.........	·56	...	,, .	York, Museum Gdns....	·35	14
,, .	Campsea Ashe............	·78	34	,, .	Pickering, Hungate......	·31	12
,, .	Lowestoft Sec. School...	·87	38	,, .	Scarborough..............	·51	21
,, .	Bury St. Ed., WestleyH.	·84	34	,, .	Middlesbrough...........	·48	19
Norf. .	Wells, Holkham Hall...	·82	35	,, .	Baldersdale, Hury Res.	...	...
Wilts .	Calne, Castle Walk......	1·15	...	*Durh* .	Ushaw College...........	·38	14
,, .	Porton, W.D. Exp'l. Stn	·69	35	*Nor* .	Newcastle, Town Moor.	·43	16
Dor .	Evershot, Melbury Ho.	·53	21	,, .	Bellingham, Highgreen	1·15	35
,, .	Weymouth, Westham.	·35	19	,, .	Lilburn Tower Gdns....	·94	38
,, .	Shaftesbury, Abbey Ho.	·68	26	*Cumb*.	Carlisle, Scaleby Hall...	1·70	52
Devon.	Plymouth, The Hoe....	·38	14	,, .	Borrowdale, Seathwaite	7·25	92
,, .	Holne, Church Pk. Cott.	·51	14	,, .	Borrowdale, Moraine...	4·22	67
,, .	Teignmouth, Den Gdns.	·10	4	,, .	Keswick, High Hill......	1·80	47
,, .	Cullompton	·61	23	*West* .	Appleby, Castle Bank...	·78	25
,, .	Sidmouth, U.D.C........	·59	...	*Mon* .	Abergavenny, Larchf'd	·36	14
,, .	Barnstaple, N. Dev.Ath	1·03	38	*Glam* .	Ystalyfera, Wern Ho....	2·45	53
,, .	Dartm'r, Cranmere Pool	1·80	...	,, .	Cardiff, Ely P. Stn.......	·58	19
,, .	Okehampton, Uplands.	·87	27	,, .	Treherbert, Tynywaun.	2·20	...
Corn .	Redruth, Trewirgie......	·70	23	*Carm* .	Carmarthen, The Friary	·59	17
,, .	Penzance, Morrab Gdn.	·39	14	*Pemb* .	Haverfordwest, Portf'ld.	...	...
,, .	St. Austell, Trevarna...	·59	18	*Card* .	Aberystwyth	1·00	...
Soms .	Chewton Mendip.........	·53	15	*Rad* .	BirmW.W.Tyrmynydd	1·07	26
,, .	Long Ashton............	2·04	72	*Mont* .	Lake Vyrnwy	1·83	53
,, .	Street, Millfield..........	...	...	*Flint* .	Sealand Aerodrome......	1·03	44
Glos .	Blockley	·60	...	*Mer* .	Dolgelley, Bontddu......	1·77	42
,, .	Cirencester, Gwynfa....	·73	28	*Carn* .	Llandudno	·33	15
Here .	Ross, Birchlea............	·28	12	,, .	Snowdon, L. Llydaw 9..	5·23	...
Salop .	Church Stretton.........	·67	27	*Ang* .	Holyhead, Salt Island...	·33	13
,, .	Shifnal, Hatton Grange	·56	25	,, .	Lligwy	·33	...
Staffs .	Market Drayt'n, Old Sp.	·48	18	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	·37	17		Douglas, Boro' Cem....	1·46	48
War .	Alcester, Ragley Hall...	·51	21	*Guernsey*			
,,	Birminghm, Edgbaston	·40	17		St. PeterP't.Grange Rd.	·91	45

Rainfall: July, 1935: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith	...	...	*Suth* .	Melvich	2·04	73
„ .	New Luce School	2·45	72	„ .	Loch More, Achfary	9·16	171
Kirk .	Dalry, Glendarroch	...	...	*Caith* .	Wick	2·61	99
„ .	Carsphairn, Shiel	3·91	74	*Ork* .	Deerness	3·20	125
Dumf.	Dumfries, Crichton, R.I.	1·35	44	*Shet* .	Lerwick	5·76	251
„ .	Eskdalemuir Obs	2·54	62	*Cork* .	Caheragh Rectory	·93	...
Roxb .	Branxholm	...	...	„ .	Dunmanway Rectory	·72	18
Selk .	Ettrick Manse	1·32	30	„ .	Cork, University Coll	·50	18
Peeb .	West Linton	1·86	...	„ .	Ballinacurra	·56	20
Berw .	Marchmont House	1·27	42	„ .	Mallow, Longueville	·86	34
E.Lot.	North Berwick Res	1·08	42	*Kerry*.	Valentia Obsy	1·37	36
Midl .	Edinburgh, Roy. Obs.	·62	22	„ .	Gearhameen	1·50	26
Lan .	Auchtyfardle	1·47	...	„ .	Darrynane Abbey	1·26	33
Ayr .	Kilmarnock, Kay Pk	2·04	...	*Wat* .	Waterford, Gortmore	·86	27
„ .	Girvan, Pinmore	2·19	60	*Tip* .	Nenagh, Cas. Lough	1·07	34
Renf .	Glasgow, Queen's Pk	1·86	64	„ .	Roscrea, Timoney Park	1·04	...
„ .	Greenock, Prospect H.	2·29	58	„ .	Cashel, Ballinamona	1·12	39
Bute .	Rothesay, Ardencraig	2·78	...	*Lim* .	Foynes, Coolnanes	1·59	52
„ .	Dougarie Lodge	1·73	...	„ .	Castleconnel Rec	1·26	...
Arg .	Ardgour House	6·93	...	*Clare* .	Inagh, Mount Callan	3·29	...
„ .	Glen Etive	...	...	„ .	Broadford, Hurdlest'n.	1·60	...
„ .	Oban	2·94	...	*Wexf* .	Gorey, Courtown Ho	·91	31
„ .	Poltalloch	4·88	119	*Wick* .	Rathnew, Clonmannon.	1·07	...
„ .	Inveraray Castle	3·87	78	*Carl* .	Hacketstown Rectory	1·25	36
„ .	Islay, Eallabus	2·69	79	*Leix* .	Blandsfort House	1·04	33
„ .	Mull, Benmore	8·60	86	„ .	Mountmellick	·91	...
„ .	Tiree	2·17	60	*Offaly*.	Birr Castle	·94	32
Kinr .	Loch Leven Sluice	...	...	*Dublin*	Dublin, FitzWm. Sq	·81	32
Perth .	Loch Dhu	...	...	„ .	Balbriggan, Ardgillan	·68	25
„ .	Balquhidder, Stronvar.	1·52	...	*Meath*.	Beauparc, St. Cloud	·73	...
„ .	Crieff, Strathearn Hyd.	·89	30	„ .	Kells, Headfort	·79	25
„ .	Blair Castle Gardens	·67	26	*W.M* .	Moate, Coolatore	·95	...
Angus.	Kettins School	1·31	51	„ .	Mullingar, Belvedere	·88	28
„ .	Pearsie House	1·88	...	*Long* .	Castle Forbes Gdns	·78	25
„ .	Montrose, Sunnyside	1·31	50	*Gal* .	Galway, Grammar Sch.	...	...
Aber .	Braemar, Bank	·68	26	„ .	Ballynahinch Castle	3·19	77
„ .	Logie Coldstone Sch	...	...	„ .	Ahascragh, Clonbrock.	1·03	30
„ .	Aberdeen, King's Coll.	2·91	103	*Mayo*.	Blacksod Point	1·74	55
„ .	Fyvie Castle	2·54	78	„ .	Mallaranny	...	...
Moray	Gordon Castle	2·35	73	„ .	Westport House	1·02	33
„ .	Grantown-on-Spey	...	...	„ .	Delphi Lodge	5·68	86
Nairn.	Nairn	1·29	48	*Sligo* .	Markree Obsy	1·06	31
Inv's .	Ben Alder Lodge	1·02	...	*Cavan*.	Crossdoney, Kevit Cas.	1·06	...
„ .	Kingussie, The Birches.	1·07	...	*Ferm* .	Enniskillen, Portora	...	...
„ .	Inverness, Culduthel R.	1·55	...	*Arm* .	Armagh Obsy	1·12	39
„ .	Loch Quoich, Loan	8·47	...	*Down*.	Fofanny Reservoir	1·94	...
„ .	Glenquoich	...	...	„ .	Seaforde	1·22	38
„ .	Arisaig, Faire-na-Sguir.	4·19	...	„ .	Donaghadee, C. Stn	·84	30
„ .	Fort William, Glasdrum	...	...	„ .	Banbridge, Milltown	·86	26
„ .	Skye, Dunvegan	4·04	...	*Antr* .	Belfast, Cavehill Rd	1·10	...
„ .	Barra, Skallary	2·72	...	„ .	Aldergrove Aerodrome.	1·06	38
R&C .	Alness, Ardross Castle.	1.12	37	„ .	Ballymena, Harryville.	1·80	52
„ .	Ullapool	2·92	92	*Lon* .	Garvagh, Moneydig	1·22	...
„ .	Achnashellach	7·22	140	„ .	Londonderry, Creggan.	1·45	40
„ .	Stornoway	2·44	81	*Tyr* .	Omagh, Edenfel	1·36	40
Suth .	Lairg	1·75	56	*Don* .	Malin Head	1·89	...
„ .	Tongue	2·10	69	„ .	Killybegs, Rockmount.	2·55	...

Climatological Table for the British Empire, February, 1935

STATIONS.	PRESSURE. Mean of Day M.S.L. mb.	PRESSURE. Diff. from Normal. mb.	TEMPERATURE. Absolute. Max. °F.	TEMPERATURE. Absolute. Min. °F.	TEMPERATURE. Mean Values. Max. °F.	TEMPERATURE. Mean Values. Min. °F.	TEMPERATURE. Mean Values. ½ Max. and ½ Min. °F.	TEMPERATURE. Mean Values. Diff. from Normal °F.	TEMPERATURE. Mean. Wet Bulb. °F.	Relative Humidity. %	Mean Cloud Am'nt 0–10	PRECIPITATION. Am'nt. in.	PRECIPITATION. Diff. from Normal. in.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Per-centage of possible.
London, Kew Obsy....	1007·4	− 8·6	58	30	48·4	39·2	43·8	+ 3·7	39·4	82	7·6	2·30	+ 0·76	14	1·9	19
Gibraltar..........	1021·8	+ 1·8	67	33	61·4	45·8	53·6	− 2·2	45·7	78	3·5	1·29	− 3·22	8	...	...
Malta..........	1015·2	− 0·9	64	43	58·1	50·0	54·1	− 1·2	49·9	79	5·8	0·89	− 1·31	9	6·4	59
St. Helena	1011·1	− 0·2	74	60	71·0	62·5	66·7	+ 0·8	63·8	91	8·2	5·74	...	21	...	...
Freetown, Sierra Leone	1013·3	+ 2·5	92	72	86·8	74·0	80·4	− 1·9	73·7	77	1·3	0·00	− 0·30	0	...	...
Lagos, Nigeria	1010·7	+ 1·0	91	71	87·9	76·1	82·0	− 0·5	76·5	89	6·0	1·24	− 0·66	5	6·6	55
Kaduna, Nigeria	1008·9	...	98	53	93·3	58·8	76·1	− 0·8	56·5	43	0·7	0·00	− 0·02	0	9·2	78
Zomba, Nyasaland	1010·3	+ 2·4	83	56	77·3	62·5	69·9	− 2·1	64·8	77	7·9	8·98	− 1·67	15	...	...
Salisbury, Rhodesia...	1011·6	+ 0·5	84	49	77·4	56·8	67·1	− 1·7	60·6	71	6·9	4·26	− 2·56	10	7·4	58
Cape Town	1014·6	+ 1·2	97	53	82·7	62·8	72·7	+ 2·4	61·7	64	1·8	0·23	− 0·35	2	...	...
Johannesburg	1012·8	+ 1·0	82	46	74·8	53·4	64·1	− 1·5	56·6	75	4·9	3·66	− 1·56	10	7·9	61
Mauritius	1009·4	− 1·6	88	72	84·7	74·3	79·5	+ 0·2	77·0	89	6·9	12·76	+ 4·36	24	7·0	55
Calcutta, Alipore Obsy.	1012·5	− 0·8	90	57	83·1	63·5	73·3	+ 2·1	64·3	87	2·9	1·29	+ 0·30	3*	...	...
Bombay	1012·0	− 0·7	90	62	82·8	67·1	74·9	− 0·8	66·3	75	0·6	0·00	− 0·03	0*	...	...
Madras	1012·0	− 0·9	90	65	85·5	68·7	77·1	− 0·6	71·7	83	4·6	0·00	− 0·30	0*	...	...
Colombo, Ceylon	1010·9	+ 0·1	90	69	86·8	72·1	79·5	− 0·9	74·6	75	5·5	2·78	+ 0·84	6	7·6	64
Singapore..........	1009·7	− 0·5	91	71	87·2	73·7	80·5	+ 0·3	75·3	77	6·3	5·31	− 1·31	11	7·3	61
Hongkong..........	1017·8	− 0·8	77	43	65·7	57·9	61·8	+ 2·7	57·2	79	7·8	1·13	− 0·70	7	3·9	34
Sandakan	1010·3	...	91	71	87·3	75·4	81·3	+ 1·1	76·4	80	6·8	5·78	− 5·19	14	...	...
Sydney, N.S.W..........	1013·5	− 0·4	92	52	79·1	64·8	71·9	+ 0·6	66·2	65	6·6	3·47	− 0·73	7	8·6	64
Melbourne	1014·8	+ 0·3	95	50	76·7	57·4	67·1	− 0·5	60·3	68	6·3	3·09	+ 1·38	13	6·7	50
Adelaide..........	1015·9	+ 1·7	104	48	84·1	60·1	72·1	− 1·9	59·8	41	5·5	0·02	− 0·70	2	8·8	66
Perth, W. Australia ...	1014·0	+ 1·0	106	49	84·5	63·2	73·9	− 0·2	61·1	49	3·4	0·36	− 0·09	7	10·1	77
Coolgardie	1012·6	+ 0·1	105	51	89·5	61·8	75·7	− 0·5	63·4	53	3·6	1·15	+ 0·30	4	...	...
Brisbane..........	1011·3	− 1·2	93	63	86·3	70·0	78·1	+ 1·6	71·7	66	6·1	5·59	− 0·75	19	8·7	66
Hobart, Tasmania......	1015·1	+ 1·9	88	46	68·8	56·0	62·4	+ 0·1	57·0	72	7·2	4·96	+ 3·48	18	5·5	40
Wellington, N.Z.	1018·5	+ 2·7	83	49	72·4	59·0	65·7	+ 3·1	61·5	76	7·0	3·40	+ 0·26	9	6·3	46
Suva, Fiji	1008·8	+ 1·0	94	69	87·3	75·3	81·3	+ 1·0	76·3	83	5·1	6·52	− 4·20	21	8·0	63
Apia, Samoa	1008·1	− 0·3	88	71	85·9	74·7	80·3	+ 1·3	76·6	79	6·3	4·24	− 11·05	17	7·9	63
Kingston, Jamaica	1015·6	+ 0·3	88	63	84·3	67·5	75·9	− 0·6	65·8	85	2·3	0·44	− 0·16	4	3·9	34
Grenada, W.I.	...	...	86	71	84	73	78·5	+ 1·4	73	74	4	2·22	− 0·56	14	...	...
Toronto..........	1017·5	− 0·5	48	− 5	28·8	15·9	22·3	+ 1·2	18·5	75	7·5	2·39	+ 0·01	12	3·2	31
Winnipeg	1020·3	− 1·5	45	−20	26·2	5·4	10·4	+10·3	...	...	5·2	0·15	− 0·59	5	4·7	47
St. John, N.B.	1013·2	− 0·7	43	−11	26·6	8·9	17·7	2·2	12·4	75	6·1	3·33	− 0·57	13	4·6	44
Victoria, B.C..........	1019·8	+ 3·2	54	30	48·0	39·3	43·7	+ 3·2	40·4	86	7·5	0·83	− 2·43	11	3·8	37

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

(27359) Wt. 18/32 1050 8/35 Hw. G.377/6

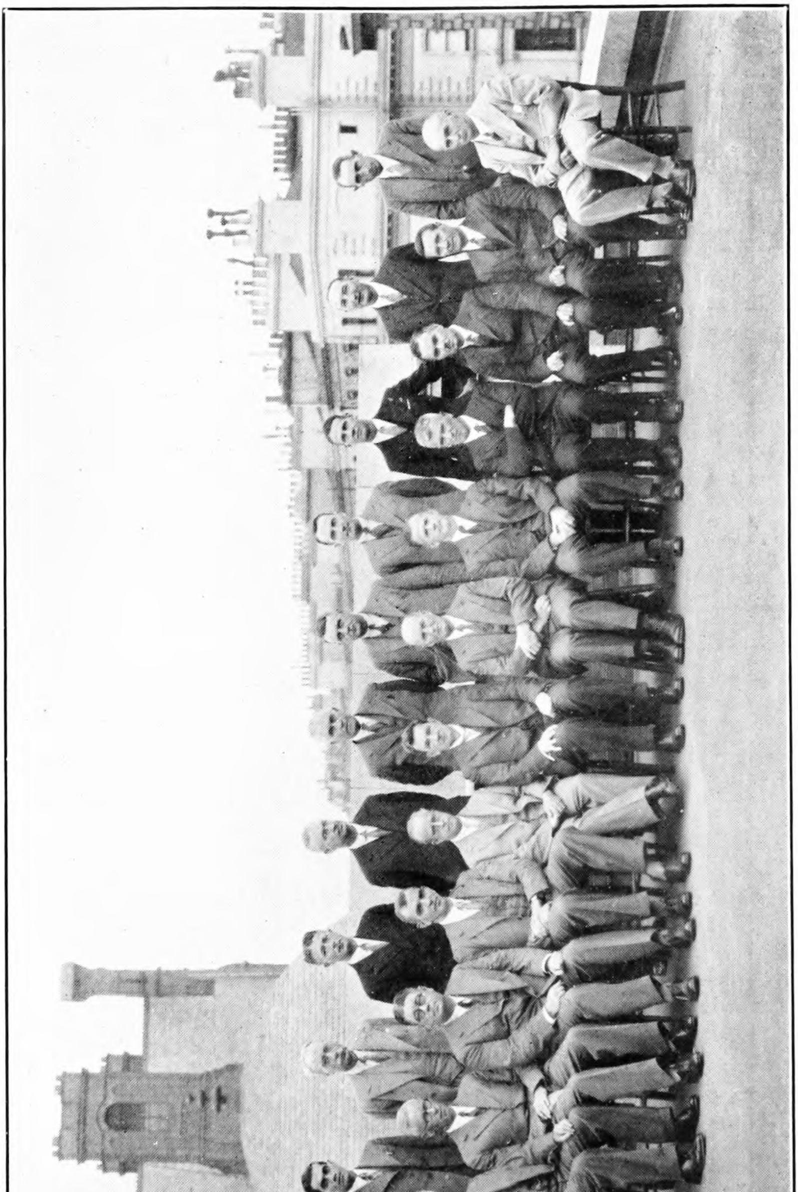

Photo by Harrods

CONFERENCE OF EMPIRE METEOROLOGISTS, LONDON, 1935.

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Conference of Empire Meteorologists, London, 1935

The meeting which terminated successfully at the Meteorological Office, South Kensington, on August 21st, was the third occasion on which representatives of the meteorological services of the British Empire had met to discuss the various meteorological problems which confront them.* The first Conference was convened by Sir Napier Shaw shortly after the Great War, but was somewhat limited in its scope as only six territories were represented. A more representative gathering assembled in London in 1929 and it was largely the success of this Conference which led to the third meeting which has just terminated.

On Monday, August 12th, twenty-nine delegates assembled at the Meteorological Office, South Kensington, and were welcomed on

* The photograph reproduced on the opposite page in which the majority of the members of the Conference appear was taken at the Meteorological Office, South Kensington, after the Saturday morning meeting. The names reading from left to right, are:—Seated: Dr. F. J. W. Whipple, Great Britain; Mr. N. R. McCurdy, Mauritius; Mr. C. W. Jeffries, Hongkong; Dr. T. Schumann, South Africa; Dr. E. Kidson, New Zealand; Sir George Simpson, Great Britain; Mr. J. Patterson, Canada; Dr. C. W. B. Normand, India; Mr. W. S. Watt, Australia; Mr. C. D. Stewart, Malaya; Mr. A. Walter, East Africa; Mr. G. K. Thornhill, Ceylon. Standing: Mr. R. D. Kreltszheim, Ceylon; Mr. R. G. K. Lempfert, Great Britain; Cdr. G. S. Ridgway, R.N. (ret.), Bermuda; Mr. G. W. Grabham, A.E. Sudan; Mr. D. W. Gumbley, Palestine; Capt. A. Bertram Smith, R.N.R., Trinidad; Mr. J. H. Churchill, Nigeria; Lt.-Cdr. S. H. Butler, R.N.R., Nigeria; Mr. L. J. Sutton, Egypt; Lt.-Col. E. Gold, Great Britain.

behalf of the Secretary of State for Air by Sir Henry Lyons, Vice-Chairman of the Meteorological Committee. In addition to Great Britain, twenty-five distinct territories were represented and it is gratifying to record that each Dominion and Colony which possesses an organised meteorological service was represented by the Director of the service. In this respect the Conference was even more representative than the 1929 meeting. It may be noted in this connexion that there had been considerable development in meteorology throughout the Empire since the last Conference. New meteorological services were then being established in British East Africa, Southern Rhodesia and Malaya, and the Directors of these services were now able to bring with them the results of six years' experience in their respective spheres. The development which had occurred since 1929 was reflected in the contributions which the various Dominions and Colonies made to the work of the Conference. Of the 68 memoranda which were circulated prior to the meeting as the basis of the discussions, no less than 42 were contributed by Empire services outside Great Britain.

The opening day of the Conference was devoted to the welcoming of the delegates by Sir Henry Lyons and to drawing up the programme of work. Mr. J. Patterson, Director of the Canadian Meteorological Service was unanimously elected President of the Conference and the success of the meetings which followed may be attributed in no small measure to his inspiration and tact and the energy with which he devoted himself to his task.

The development of Imperial Air Communications during the last ten years rendered it inevitable that aviation meteorology should figure largely in the work of the Conference and the whole of the second day was devoted to this subject. Mr. A. H. Self, Assistant Secretary, Air Ministry, addressed the Conference on the projected development of air mails throughout the Empire and gave an outline of the United Kingdom Government's proposals for the extension and development of existing air routes. He referred particularly to the part which meteorology would play in contributing to the safety and regularity of the projected air mail services. After a brief discussion on Mr. Self's address, Mr. F. Entwistle of the Meteorological Office, London, gave a brief account of the development which had taken place in Imperial Air Routes since the last Conference and referred to extensions in the meteorological services along certain sections of the England—India and England—South Africa air routes, which were in contemplation. A general discussion on the meteorological organisation along existing and projected Empire air routes followed and sub-committees were appointed to discuss the detailed organisation along certain sections of the routes. The remainder of the day was devoted to a discussion of the meteorological data required from various parts of the Empire for aviation purposes and particular attention was directed to charts of wind roses which had been prepared in the Aviation Services Division of the Meteorological Office, designed to represent the normal surface and upper winds in any month over various areas of the globe. Special problems such as the accretion of ice on aircraft and the meteorological aid required for blind flying were also discussed.

The third, and part of the fourth days of the Conference were devoted to problems connected with Synoptic Meteorology. An interesting discussion took place on the methods of forecasting from synoptic charts in the course of which the various delegates described their experience of the application of the modern method of air mass analysis to the problem of forecasting in their respective countries. The discussion brought out very clearly the sharp contrast between the problem of weather forecasting in temperate latitudes and the corresponding problem in tropical regions. Experience in the latter field is relatively limited, but it is evident as meteorological services develop and demands for meteorological information increase, many new and interesting problems will arise which will create a wide field for further survey and research. The discussions on synoptic meteorology included consideration of the methods of plotting data on synoptic charts and of the form and application of the International Code for the exchange of weather messages, particularly in tropical countries. A further subject which aroused considerable interest was the value in weather forecasting of observations from ships at sea and of upper air data. In certain countries daily observations of the temperature and humidity at different levels are made from aeroplanes for the use of the forecast services and the discussion turned mainly on the possible use of alternative methods of observation and the methods of reducing and plotting the data.

The afternoon of the fourth day was devoted mainly to the meteorological requirements of the Fighting Services. The Superintendents of the Army and Navy Services Divisions of the London Meteorological Office introduced the discussions on the meteorological requirements within the Empire of the respective services. These discussions were followed by a consideration of certain questions relating to the use of meteorological instruments. Mr. N. P. Sellick, Director of the Meteorological Service of Southern Rhodesia, opened a discussion on the sensitivity and accuracy of barometers, while Mr. J. S. Dines, Superintendent of the Instruments Division of the Meteorological Office, London, described recent work which had been carried out in England on the standardisation of meteorological instruments. The discussion on instruments was continued the following day when the methods used in making observations of upper wind by means of pilot balloons and the generation of hydrogen for filling balloons in countries where the transport of hydrogen cylinders presented difficulties, were dealt with.

The main subject of the fifth day of the Conference was Marine Meteorology. Captain L. A. Brooke Smith, Marine Superintendent of the Meteorological Office, London, gave an account of the working of the scheme by which weather reports from ships at sea are transmitted to land stations for the benefit of meteorological services and are exchanged between the ships themselves for navigation purposes. The scheme which had been put forward in 1929 by the International Conference for the Safety of Life at Sea, whereby 1,000 ships of all nationalities co-operate in a world-wide scheme for the transmission of weather reports by wireless, had been discussed very fully at the previous Conference of Empire Meteorologists held in the same year and the present meeting was concerned largely with the discussion of difficulties which had been felt in various parts of the Empire in the details of the working of the scheme. Captain Brooke Smith referred to recent arrangements which had been made for reports from ships registered in Great Britain and Northern Ireland, whereby the original instructions to the nautical authorities had been expanded in such a way as to provide a more effective service of weather reports than had been possible previously and expressed the view that these extended arrangements would meet most of the difficulties which had been experienced.

The two final days of the Conference were devoted to problems connected with Agricultural Meteorology and included discussions on the measurement of soil temperature and moisture, the climatological observations required for agricultural purposes and the time units employed for climatological purposes. Throughout these discussions the Conference had the benefit of the presence of Sir Napier Shaw and representatives of the Ministry of Agriculture and of home and Empire agricultural research establishments.

The foregoing resumé of the work of the Conference has been confined to the main subjects of discussion. Opportunity was also taken to deal with other problems of interest to meteorological services, such as the possibility of the exchange of personnel between the different Empire services and organised research in meteorology. Throughout the Conference the meetings were characterised by extreme cordiality and although few formal resolutions were passed it is beyond question that the discussions which took place will bear fruit in due course and will improve the effectiveness of the meteorological services of Great Britain and the Empire in the various branches of their work. Not the least important part of the Conference consisted in the informal discussions which took place as opportunity offered between the different delegates during which views were exchanged, difficulties discussed and constructive suggestions put forward. In the short period allotted for the Conference, there was naturally a vast field to be covered and a great deal of work to be accomplished. For this reason the social side was reduced to relatively narrow limits, but it was nevertheless pleasant and enjoyable. A happy opening to the Conference was provided by a reception on the evening of the first day by Sir George and Lady Simpson at the Meteorological Office, South Kensington. Sir George was naturally responsible for the arrangements for the

Conference and took an active and helpful part in all the meetings. On the evening of August 16th, Sir Philip Cunliffe Lister, Secretary of State for Air, presided at a dinner to the delegates given by H.M. Government and on Saturday afternoon, August 17th, the delegates and their friends were entertained at a garden party at Kew Observatory when they had an opportunity of seeing the work of the Observatory and of meeting members of the professional staff of the Meteorological Office.

Reference was made earlier to the active part taken and the stimulus provided throughout the Conference by the representatives of the Empire meteorological services. With the growing demand for meteorological information, particularly in view of the development of civil aviation, these services are bound to expand and increase. It is therefore possible to look forward with confidence to continued and increasing co-operation in meteorology throughout the Empire, which cannot but be stimulated by periodical conferences similar to the one which has just terminated.

F. ENTWISTLE.

Meteorology of Cirencester

From 1880–1913, systematic records of the weather conditions experienced at Cirencester were kept at the Royal Agricultural College. Fortunately, these records have been preserved, and it was considered that an article comparing the weather conditions experienced during the summer months (June to September inclusive) during the period of years 1880–1913, with those experienced during the summer months 1931–1934, might be of considerable general interest. With this object in view, a summary has been prepared, and comparisons made with the summer months during the years 1931–1934.

TABLE I.—RAINFALL (IN INCHES)

	June.		July.		August.		September.		Summer.	
	1880–1913.	1931–4.	1880–1913.	1931–4.	1880–1913.	1931–4.	1880–1913.	1931–4.	1880–1913.	1931–4.
Average ...	2·37		2·54		2·88		2·09		9·88	
Max. ...	4·73	4·29	7·15	4·12	6·69	5·98	6·65	3·73	15·67	16·95
Year ...	1903	1931	1880	1931	1912	1931	1896	1932	1882	1931
Min. ...	0·63	1·31	0·04	1·76	1·06	0·87	0·38	2·56	4·46	7·47
Year ...	1908	1932	1911	1933	1883	1933	1910	1931	1911	1933

Rainfall.—From the figures given above, it will be seen that the total rainfall for the summer of 1931 was 16·95 in. This was 1·28 in. more than the highest rainfall recorded during any summer during the whole period of years 1880–1913. During the whole period of years

1880–1913, there was only one June which recorded a higher total rainfall than that recorded during June, 1931 (i.e., June, 1903, when a total of 4·73 in. was recorded), and there was only one August which recorded a higher total rainfall than that recorded during August, 1931. The total rainfall of 0·87 in. recorded during August, 1933, was 0·19 in. lower than the lowest rainfall recorded during any August throughout the whole period of years 1880–1913.

Sunshine.—The summer of greatest sunshine during the years 1931–1934 was 864·7 hours during the summer of 1933. It is interesting to note that during the whole period of years 1880–1913, there were only three summers, viz., 1899, 1906 and 1911, when this total was exceeded. During the whole period of years 1880–1913, there was only one July (1911) which recorded more sunshine than July, 1934. There was only one August (1899) which recorded more sunshine than August, 1933. There were only two Septembers, viz., September, 1896 and 1909, which recorded a lower total number of hours sunshine than September, 1931. On July 8th, 1934, a total of 15·0 hours sunshine was recorded. During the whole period of years 1880–1913, there were only two days—June 9th, 1892, and June 30th, 1894—when this day's total sunshine was exceeded.

TABLE II.—SUNSHINE (HOURS)

	June.		July.		August.		September.		Summer.	
	1880–1913.	1931–4.	1880–1913.	1931–4.	1880–1913.	1931–4.	1880–1913.	1931–4.	1880–1913.	1931–4.
Average ...	194·1		195·0		181·0		144·0		714·1	
Max.	282·8	219·7	304·9	279·9	261·7	244·6	219·3	181·9	995·0	864·7
Year	1899	1932	1911	1934	1899	1933	1895	1933	1899	1933
Min.	103·4	176·5	105·6	132·0	101·5	143·1	84·4	96·1	532·4	547·9
Year	1909	1931	1888	1932	1912	1931	1896	1931	1888	1931

Temperature.—The summer with the highest mean maximum and mean minimum temperatures during the years 1931–1934, was 1933, when the mean maximum temperature was 71·2° F., and the mean minimum 51·2° F. There was only one summer, that of 1911, when a higher mean maximum temperature was recorded, and the mean minimum temperature of 51·2° F. recorded during the summer of 1933 was 0·1° higher than the highest mean minimum temperature recorded during any summer during the period 1880–1913. The lowest mean maximum and mean minimum temperatures recorded during the summers 1931–1934 were 63·7° F., and 49·4° F. during the summer of 1931. In the earlier period there were only two summers, viz., 1888 and 1912, when lower mean maximum temperatures were recorded. There were only two Augusts (1899 and 1911) which recorded higher mean maximum temperatures than August, 1933.

There were only three Septembers which recorded higher mean maximum temperatures than September, 1933. There were only two Septembers, viz., 1894 and 1912, which recorded lower mean maximum temperatures than September, 1931. There was only one July, that of 1901, which recorded a higher mean minimum

TABLE III.—TEMPERATURE (° F.)

	June.		July.		August.		September.		Summer.	
	1880–1913.	1931–4.	1880–1913.	1931–4.	1880–1913.	1931–4.	1880–1913.	1931–4.	1880–1913.	1931–4.
Average—Max.	66·0		69·2		68·0		63·6		66·7	
Min.	47·7		51·1		49·9		46·8		48·9	
Highest Max. ...	70·8	69·3	78·1	75·6	76·6	74·4	70·8	67·7	72·9	71·2
Year	1893	1933	1911	1934	1911	1933	1895	1933	1911	1933
Lowest Max. ...	61·0	65·5	62·9	65·7	61·2	64·6	58·2	58·9	62·7	63·7
Year	1907	1931	1888	1931	1912	1931	1894	1931	1912	1931
Highest Min. ...	51·0	49·9	55·5	54·0	54·1	54·6	50·5	50·0	51·1	51·2
Year	1881	1931	1901	1933	1911	1932	1880	1933	1880	1933
Lowest Min. ...	45·1	46·4	48·5	51·0	46·8	48·8	40·6	46·0	47·0	49·4
Year	1904	1932	1907	1931	1912	1934	1910	1931	1904	1931

temperature than July, 1933. The highest mean minimum temperature recorded during any August during the years 1931–1934 was 54·6°F. during August, 1932. This was 0·5° higher than the highest mean minimum temperature recorded during any August during the whole period of years 1880–1913. During the whole period of years 1880–1913, there was only one September, that of 1880, which recorded a higher mean minimum temperature than September, 1933.

THOMAS F. PROSSER.

OFFICIAL NOTICES

Airport

The term " Airport " expressed as a single word has been adopted officially by the Air Ministry for general use as denoting " a permanent civil aerodrome at which facilities for customs and immigration clearances are available so as to provide an appropriate port of entry and departure for aircraft to and from a country."

Discussions at the Meteorological Office

The series of meetings for the discussion of recent contributions to meteorological literature especially in foreign and colonial journals, will be resumed at the Meteorological Office, South Kensington, during the session 1935–6. The meetings will be held on alternate

Mondays at 5 p.m., beginning on Monday, October 14th, 1935, when Sir George Simpson, K.C.B., D.Sc., F.R.S., will open the discussion; the subject will be " Results of the recent Empire and International Meteorological Conferences."

The dates for subsequent meetings are as follows :—

October 28th, November 11th and 25th, December 9th, 1935; January 13th and 27th, February 10th and 24th, and March 9th, 1936.

The Director of the Meteorological Office wishes it to be known that visitors are welcomed at these meetings.

OFFICIAL PUBLICATIONS

The following publications have recently been issued :—

Annual Report *of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the year ended March* 31, 1935.

In its main lines the work of the Meteorological Office during the year under review has continued as in previous years, but the demands made on the Office have continued to grow and every division shows an increase in the amount of information supplied. The Aviation Services Stations report a total increase of 18,747 inquiries and 2,404 weather reports passed to aircraft in flight, on the corresponding figures for the previous year, these figures being exclusive of inquiries relating to weather and climate. Since the reorganisation of the Office after the war there have been separate divisions for forecasts and aviation but as the result of experience it has been decided that the most efficient method of work would be to combine the two divisions under one head with two senior officers as deputies, and on October 1st, 1934, the initial step in the reorganisation was made and the two divisions combined.

The year has been an important one in the history of the Naval Division since it has seen the attainment of the objective towards which the Division in close co-operation with the Admiralty has been working for many years—the creation of a forecasting service within the Fleet which shall be self-contained yet, in virtue of the fact that the Naval Division is so closely connected with its control and development, not independent of the State Meteorological Service. It is anticipated that the scheme will be in full operation by the end of 1936.

Other changes of importance during the year were in the Gale Warning Service and in the Fishery Barometer and Baragraph Service. From September 1st, 1934, the Meteorological Office will be responsible only for the preparation and issue of the necessary gale warning telegrams, while the Board of Trade will organise and administer the exhibition of the warnings. There are about 230 points around the coasts where cones are hoisted on suitable masts to warn shipping and the Board of Trade will, in future be responsible for the choice of sites and the supply of the necessary cones. The Fishery Barometer and Barograph Service, in accordance with the new regulations introduced on January 1st, 1935, is to be administered by the Meteorological Office through the local Fishery Officers of the Ministry of Agriculture and Fisheries and the Fishery Board of Scotland, each Fishery Officer being responsible for the supervision of the stations in his area.

During the year the Office has lost the services of Mr. D. Brunt, M.A., who resigned on appointment to the Professorship of Meteorology at the Imperial College of Science and Technology.

PROFESSIONAL NOTES.

No. 67. *The rates of ascent and descent of free balloons, and the effects of radiation on records of temperature in the upper air.* By L. H. G. Dines, M.A. (M.O. 336g).

This paper first discusses the vertical velocities of free rubber balloons of about one to two metres diameter ; being a continuation of the previous work on smaller balloons by Messrs. Th. Hesselberg and B. J. Birkeland. Secondly, it analyses the results of a number of records of temperature in the stratosphere in England, with a view to determining how far they are affected by direct radiation from the sun on the meteorograph. The conclusion is reached that at heights of 18 Km. and over, records obtained during daylight may be liable to appreciable error.

Correspondence

To the Editor, *Meteorological Magazine*

Halo phenomena of Spring, 1935 in New England

Complex halos were unusually common last spring in New England as well as in England. The display at midday, March 4th, seen both at Blue Hill and Mt. Washington, included the 22° halo, parhelia and upper and lower tangent arcs, a portion of the 46° halo and infralateral tangent arcs, and the parhelic circle, and, at Mt. Washington alone, upper anthelic arcs and a suggestion of paranthelia. Four years ago, Bergeron and I saw infralateral tangent arcs of the 46° halo, with 22° halo, parhelia and upper and lower tangent arcs, at Ustaoset, Norway (September 2nd, 1931, 10.15 a.m. to 12.30 p.m.). A brilliant lunar complex, seen on March 20th, 9–11 p.m., at Blue Hill, included the 22° halo, parselenae and upper and lower tangent arcs, the 46° halo and circumzenithal arc, all beautifully colored, also the parselenic circle, practically complete and a moon pillar. A corresponding solar display, without the pillar, was seen on April 4th, from 7 to 9 a.m.

A brilliant segment of a parhelic circle 20 to 25° in extent and 2½° wide, passed from north-west to north-east with the movement of the virga from iridescent altocumulus, March 14th, 11.25 to 11.35 a.m. This bright arc was white for the middle 1° and red on the borders (about $\frac{3}{4}$° above and below the white). The zenith distance of the sun and also of the arc was 46°, measured with a theodolite. This phenomenon was viewed by the several members of the Blue Hill Observatory staff. Being unable to find a description of a red bordered parhelic circle, I wonder if any readers of this note have seen one.

In Fig. 1, of the July *Meteorological Magazine*, is it not probable that A is the 22° halo, and B the elliptically joined upper and lower tangent arcs, which at solar altitude 50° are quite likely to give the impression of being a circumscribed halo (cf. Fig. 200 in Humphreys' "Physics of the Air", New York, 1929) ?

CHARLES F. BROOKS.

Blue Hill Meteorological Observatory, Milton, Massachusetts, U.S.A., August 10*th*, 1935.

Unusual Optical Phenomena

A correspondent at Stratton-on-the-Fosse, near Bath, writes that "Last Friday morning, July 26th, at 11.30 a.m., I saw in the sky something I have never seen before. What I saw was an immense circle in the sky, sharp and well defined, but entirely outside the sun, which was shining brightly all the time. The circle was due west of the sun at 11.30 a.m. Inside the circle was what perhaps was a 'mock-sun.' It was behind a lot of haze or fog, and was a bright undefined spot, with two or three bands of prismatic colours across it. The outer edge of the great circle was fairly sharply defined, and did not go off into haze as a solar halo does.

"The children in our village school called my attention to the circle, it was composed of what looked like thin white cloud—it was not a dense circle, but absolutely plain, all the same. The children say they saw it when going into school at 9.15 a.m. I watched it for about 10 minutes, and it never changed at all. One of the village boys told me that at 12.30 p.m. large clouds had come across most of the circle, and hidden it, but 'he could still see pieces of it'."

Mirage near Sealand

On August 6th, 1935, at about 1145 G.M.T., a well-developed mirage was observed near Sealand. A car travelling along a road which had recently been tarred was approaching the observer, and it appeared as though the car was in water up to the axles, while another car appeared to be resting on the top of the original car in an inverted position.

The phenomenon was observed at about eye level as I was ascending a slight incline. The mirage was in evidence while the car moved from 200 yards to within 40 yards of the point of observation.

The sky was less than a quarter covered with small cumulus clouds, the wind was WNW. about 10 m.p.h., and the temperature between 70° and 75° F.

GEO. R. READ.

Roker, Station Road, Gt. Saughall, Chester, August 17th, 1935.

Water Spout at Bude

This morning at 7.50 G.M.T., with the wind NW. force 3, a storm of rain drifted from the sea into Bude. The storm was brought by a ragged nimbus cloud above which were detached cumulus clouds. At the south-east end of the cloud, which was drifting very slowly east-south-east, was a long slender column of cloud, very distinct and reaching down to below my view, but (I should judge that) before it reached land it broke off as it rapidly grew shorter, the end being ragged all the time and by 7.58 G.M.T. the only trace of it was a snaky lighter patch on the nimbus cloud.

I take it to be a water spout, but the wind fresh and keen last night, 4–5 and 3 this morning, seems very slight for it. During the night there were heavy rain storms and occasional thunder and lightning to the south-west and north-west.

KARL DURSTON.

The School House, Bude, Cornwall, August 28th, 1935.

Funnel Clouds seen from Hastings

Between 13h. 10m. and 13h. 20m. G.M.T. on August 27th, 1935, two black elongated projections were noted hanging from the base of a heavy cumulonimbus cloud over the sea to the south; they were travelling towards the east slowly. The projection on the left quickly dissolved, appearing to contract into the base of the cloud. The other varied in length and breadth from minute to minute and was slightly inclined towards the left; it exhibited signs of rapid motion, especially at its tip, which seemed to quickly dissolve and then reform. Heavy rain was falling from the cloud immediately behind the projections. The movement of clouds overhead at 13h. indicated varied air currents. A species of fairly low cirrus nothus of white appearance was moving from south-south-west at that hour, but within five minutes had changed its direction to south-south-east. A layer of fractocumulus which was moving from west-north-west before 13h., was moving from south-west by 13h. 3m. The surface wind remained persistently from WNW and was light to moderate in force. Showers developed over the land a little later in the afternoon and distant thunder was heard at 16h. 55m. to north-north-west, while after dark, lightning was seen for several hours, to north-east and south-east.

A. E. MOON.

39, *Clive Avenue, Clive Vale, Hastings, September 2nd,* 1935.

Note on a Dust-Devil observed at Manston

A small dust-devil was observed near the Meteorological Office at 10h. 30m. G.M.T. on July 10th. This formed on a sandy path passing near the corner of a hangar, and moved along the path from the south-east at a speed estimated to be about 10 m.p.h.; the wind at the moment also had this speed and direction. When the dust-devil reached the main road at the end of the path, it was intercepted by a passing omnibus; nevertheless, it resumed its existence on the far side of the road, although owing to the smaller amount of dust there, it could only be observed momentarily. When first seen it was about 6 ft. high and the greatest diameter, near the top, was about 4 ft.; the rotation was clockwise. The meteorological situation was as follows: Wind, SE., 10 m.p.h.; cloud, large cumulus 1/10, cirrus 2/10; temperature, 73° F.; humidity, 60 per cent. The sun had been shining continuously from 6h. 30m.

A. F. CROSSLEY.
C. C. NEWMAN.

Meteorological Station, R.A.F., Manston, Kent, July 12th, 1935.

Dust-Devil in the Midlands

The formation of a dust-devil or dust whirl in England is probably a fairly rare occurrence and details of such a phenomenon may, therefore, be of interest. On Monday, August 5th, 1935, a small, though well-defined dust-devil, developed in a small depression on Brownhills Heath, Staffordshire. It was first observed at 1315 B.S.T., and was rotating in a counter clockwise direction relative to a vertical axis. The height of the whirl was about 20 ft., while the diameter increased from about 4 ft. at the base to 6 ft. at the top. A large amount of dust and vegetable debris together with pieces of, paper and cardboard, in some cases approximately 6 in. square, were drawn up into the whirl. The pieces of paper and cardboard described spiral paths the diameter of which increased with height. The speed of rotation was 120 revolutions per minute for two minutes after which it suddenly decreased and at the same time the material in suspension fell back to the surface indicating that the ascending currents had also decreased.

At the time of the observation conditions were favourable for the development of a superadiabatic lapse rate in the air layers near the ground. The wind was calm and the only clouds present were 3/10 of small cumulus with their base at 4,000 ft.

WILLIAM D. FLOWER.

15, *Brook Lane, Chester, August 16th,* 1935.

Fog Wreath on Cissbury Down

About 8h., B.S.T., on August 20th, the coastal lowlands near Worthing were covered by a shallow layer of mist, thin enough for the lower slopes of Cissbury Down to be seen somewhat indistinctly from the railway west of West Worthing. Above the mist the greater part of the hill stood out clearly, except for a narrow belt of quite dense fog resting on the southern and western flanks towards the top. Cissbury is an old camp, encircled by a deep dyke and earthwork, the notch of which can just be seen against the skyline on the west. The preceding night had been calm and clear ; the lowland mist was of the radiation type and there can be no doubt that the fog wreath on the hill marked the position of a belt of cold air where the drainage from the upper slopes was trapped in the old earthwork.

C. E. P. Brooks.

Epsom, Surrey, August 23rd, 1935.

Rain in advance of true " warm front " rain

In the May number of this magazine, there is a short comment by me on a note from D. Dewar, referring to a minor warm front ahead of the main one. A few other such cases can be found, but in my opinion the commonest cause of the phenomenon in question is to be sought rather in undulations on a single gently sloping surface of discontinuity, with the " advance " rain falling from above 6,000 ft., perhaps sometimes from above 10,000 ft. The banded structure of the rain area may indicate either true waves or elongated cells parallel to the wind shear up aloft. Thus, the cause is probably usually in the upper air, but occasionally convergence at a coast line in the lowest 2,000 ft. or so lifts up the frontal clouds considerably higher up. The case of May 8th, 1934, discussed by C. W. G. Daking,* appears to have been of this type. The Duxford observations showed an inversion at about 8,000 ft. at 6h. and 7,000 ft. at 12h., and the connexion of this with the front over Ireland gives a slope of about 1 in 270. In general a low angle of slope means light rain extending far ahead of the front, and Daking is justified in his contention that an additional factor is required to explain the moderate rain on the East Anglian coast (6 mm. at Felixstowe, and 4 mm. at Yarmouth up to 18h.). The obvious one is the sea breeze, of which the effect is shown on the charts. When a damp current crosses quite low hills, clouds are commonly formed right up to the middle troposphere, and in the same way convergence at low levels can lift a large overlying air mass. From the observed temperatures and humidities at Duxford at 12h., it can readily be shown that an ascent of 1,000 ft. would have caused no condensation below 6,000 ft., but would have produced rainfall of the required amount from above that level, over a belt some 30 miles wide. (At Lympne at 11h. the wind at 6,000 to 10,000 ft. was about 30 m.p.h. from west. If the whole air column, as observed at Duxford, ascended 1,000 ft., the possible rainfall would have been 1·3 mm., all from above 6,000 ft.† A rainfall

* *Meteorological Magazine,* 70, 1935, p. 40.

† Evaporation below 6,000 feet would have diminished the amount reaching the ground, but as the movement in the lower air was relatively small, this air would have become slowly saturated, and then the rain would have fallen freely.

averaging 1·3 mm. per hour over a belt 30 miles wide was thus possible.)

The angle of slope of a surface of discontinuity, and its changes, involve important and difficult theoretical questions. I have discussed the matter in a short paper I am contributing to the Royal Meteorological Society, which aims at clarifying the practical problem rather than at solving the extremely difficult theoretical problem. In my opinion the mathematical discussion of ideal fronts has not yet led to anything which can be applied practically. In many cases the horizontal temperature gradients within the air masses must also be taken into account. An upper current which carries rain far in advance of a warm front seems to be associated with a general temperature gradient, additional to the gradient due to the front itself.

C. K. M. DOUGLAS.

August 24th, 1935.

NOTES AND QUERIES

Beit Fellowship for Research in Meteorology

The Trustees of the Beit Fellowships have awarded, amongst others, a Beit Fellowship at the Imperial College of Science and Technology during the academic year 1935–6 to Mr. E. W. Hewson of the Mount Allison University, Sackville, Canada, and the University of Toronto, for research in Meteorology, more especially the detailed structure of discontinuities between air masses as occurring in England and Canada, under Professor D. Brunt. The fellowships are for one year, renewable for a second year. This is the first time a fellowship has been awarded for research in meteorology.

Incidence of Rainfall and Thunderstorms on the Coasts of the British Isles

A comparison of the incidence of rainfall and thunderstorms on the east and west coasts of the British Isles was recently made. The results seem of sufficient general interest to be placed on permanent record. The stations used for the east coast are Aberdeen, Scarborough (North Shields for thunder) and Kew; for the west coast Sumburgh Head, Stornoway, Valentia and Scilly. Sumburgh Head is included as representative of the west coast because of the

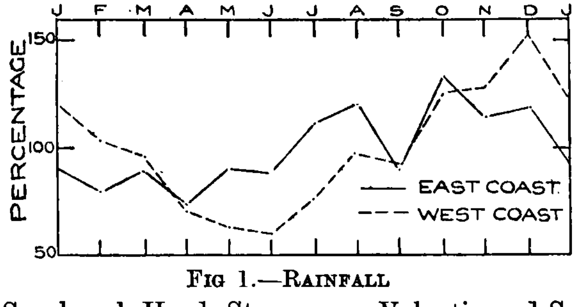

FIG 1.—RAINFALL

predominating Atlantic conditions there. Data are taken from the "Book of Normals".

The object of the comparison in rainfall was to determine how the seasonal variation on the two sides of the country differed. The year's average total rainfall for each station was divided by 12 and the normal monthly rainfall at a station expressed as a percentage of that figure. The means of percentages for (1) east-coast stations and (2) west-coast stations are shown in Fig. 1. Each station individually shows much the same variation as the mean for its group. The comparative dryness of the west coast in May, June, July and August is an outstanding feature.

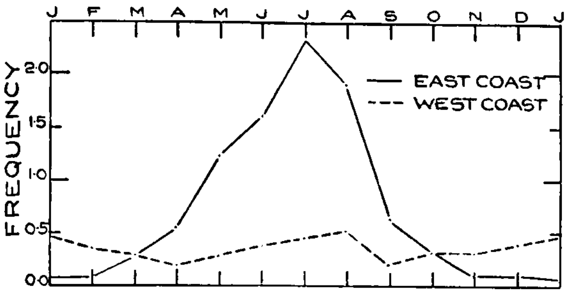

FIG 2.—THUNDERSTORMS

Fig. 2 shows the average number of thunderstorms each month at (1) east-coast stations and (2) west-coast stations.

M. T. SPENCE.

REVIEWS

A Manual of the Principles of Meteorology. By R. Mountford Deeley. Size 8vo, pp. xi + 285. *Illus*. London, Charles Griffin and Company, Ltd. 15*s*. net.

The title of this book is rather an ambitious one. In the preface the author states that the object of the book is to place before the general reader, in simple language, the author's conceptions of those conditions obtaining in the atmosphere of the earth which give rise to weather and climate. It does not, therefore, claim to give what we might call the generally accepted views of the nature of atmospheric phenomena, when these views differ from those of the author, and so a less ambitious title might have been more suitable.

The book is divided into fourteen chapters. The introductory chapter gives a general description of the astronomical facts relating to the motion of the earth round the sun, the distribution of land over the surface of the globe, and some general comments on the motion of the atmosphere. Subsequent chapters deal with the composition of the atmosphere, insolation, atmospheric temperatures, pressures, humidity and the relation of air density to water vapour content, leading up to a discussion of the winds of the globe, cyclones, anticyclones and climatic changes in the past. In many places the treatment of the fundamental facts appears to the present reviewer to be misleading. For example, we read on page 39 that on a plateau

3,000 metres high the sun's rays have lost 30 per cent. of their heating power, even when the air is bright and clear, and that on an average only about 24 per cent. of the heat radiations reach the earth's surface. These figures are not those with which the reviewer is familiar, and he feels that the author should give some explanation of the method by which such estimates are obtained. There are also such sentences as the following which are more than a little puzzling to the reader, " . . . the temperatures in the interior of cyclones and anticyclones up to considerable altitudes are such that it is impossible to explain the existence of these disturbances as being due to the specific weight of the column of air, and . . . one is inevitably led to explain them as the result of the influence of the general circulation." The reviewer has quite failed to make out precisely what is implied in this statement. Then on page 82 there is a statement that the surfaces of contact of currents of air of different origin and having greatly different temperatures and humidities show light fleecy clouds which change their forms with great rapidity. In contrast with this statement, the generally accepted view is that the heaviest rain and the thickest cloud sheets in a cyclone are to be found at such surfaces of separation of currents of different temperature and humidity. On page 99 the author writes " its position (the troposphere's position) being the result of heat rising from low levels meeting the heat energy descending from high levels." Such a statement requires far more elaboration to be understood by the reader, particularly the reader for whom the book was avowedly written. As put, it does not seem to have any particular meaning.

The reviewer could quote a number of other examples of statements which he finds either unacceptable or beyond his ability to understand, but enough has been quoted to show that the author does not adopt the views which are common among meteorologists. In later chapters, the author devotes considerable space to the solar relationships of weather, and puts forward a view that the cause of the cyclone and anticyclone is to be found in the localised heating of the upper atmosphere by corpuscles of an electrical nature coming from the sun. This theory would appear to be rather a desperate expedient to adopt until we are satisfied that the explanation is not to be found nearer the earth's surface than this theory would imply. In any case, such a theory still leaves the problem in an unsolved state, as it gives no indication why the absorption in question should favour now one part of the earth, now another.

The very brief mention of the work of V. Bjerknes does not allude to the association of weather with the fronts in a depression, an association which most meteorologists would regard as the most useful advance in meteorology in the present century. Nor is there any explanation of the fact that the diurnal and annual variations of temperature over the oceans are so much less than those over the land, which appears to the present reviewer to be one of the most important and fundamental factors in the meteorology of the atmosphere.

The author has spent a great deal of time and labour in the preparation of the book. The part which appeared to the present reviewer to be of most interest was the discussion in Chapter XI of the variations of pressure in high latitudes, in connexion with which the author has given a number of charts of the pressure over most of the northern hemisphere for a number of selected days, which bring out very strongly the variability of the pressure distribution from day to day. The main criticism which can be offered of the book as a whole is that it is far too much an expression of the personal opinions of the author, opinions which are not by any means always backed up by sound reasons. For the price of fifteen shillings the reader is entitled to expect that he shall receive at least an authoritative statement of the present position of meteorology, and the reviewer does not consider that Mr. Deeley's book fulfils this expectation.

D. BRUNT.

Meteorological conditions affecting aviation over the North-west Frontier. By Flt.-Lieut. R. G. Veryard, B.Sc., R.A.F., and A. K. Roy, B.A., B.Sc., India Meteorological Department NO–M/2, Delhi, 1934

This pamphlet by the meteorological officers responsible for the issue of forecasts to the Royal Air Force at Peshawar and Quetta, gives what is probably the most complete account of the climate and weather of the north-west frontier of India yet published. Although primarily written for aviation, it should prove a mine of information for many other purposes.

The account opens with a description of the geography of the region, a knowledge of which is essential to the understanding of its meteorology. Orographic effects are of extreme importance in this highly mountainous region in which are included the riverain plain of the Indus, the deep gorges of Chitral and some of the highest mountains in the world. There follows a summary of the climate of the region as a whole with special reference to seasonal variations of rainfall, cloud, visibility, winds, snow, thunderstorms and air density. This is amplified in the next section in which we are given a fuller description of various parts of the frontier having different climatic characteristics. We learn that the year may be divided into four periods : winter from December to April, summer monsoon from July to September, and two transition periods. The winter period is characterised by the frequent passage of depressions from the west which give much low cloud, rain, and snow. In the transition period from winter to summer weather is mainly dry but there are frequent dust storms and visibility is poor on account of dust haze. The summer monsoon gives much rain in the extreme north but only when an occasional depression from the Bay of

Bengal or the Arabian Sea reaches them is there much rain in the central and southern parts. During the transition from summer to winter weather is mainly fine. The description is accompanied by isobaric charts showing typical winter and summer depressions, by anemograms of duststorms and by a photograph showing the effect of large hail on an aeroplane and one of the Peshawar tornado of April, 1933.

Twenty-two pages at the end are occupied by tables. There are first of all tables giving monthly means and extreme values of pressure, temperature and rainfall for nine stations. Then there are frequency tables of surface and upper winds at Peshawar and Quetta together with mean monthly temperatures from the surface to 4·5 Km. above these places. Finally there are monthly rainfall normals for over ninety stations.

G. A. BULL.

BOOKS RECEIVED

Annali del R. Ufficio Centrale di Meteorologia e Geofisica Italiano, Serie terza, Osservazioni—1923. Ministero dell'agricoltura e foreste, Rome, 1934.

NEWS IN BRIEF

We learn that M. Gustaf Slettenmark has been appointed Director of the Swedish State Meteorological-Hydrographic Service in place of the late Dr. Axel Walten.* M. Slettenmark is the late Director of the Hydrological Section.

The Weather of August, 1935

Pressure was below normal over Canada, the United States, Greenland, Iceland, Spitsbergen, and most of southern Europe, the greatest deficits being 3·5 mb. near Salt Lake City, 5·0 mb. at Jan Mayen, and 2·1 mb. near Erzerum, while pressure was above normal over most of the North Atlantic and northern Europe, the greatest excesses being 4·5 mb. at 50° N., 30° W., and 3·5 mb. at Vardö. In Sweden temperature was about normal and the rainfall generally about half the normal.

The characteristic features of the weather of August over the British Isles were two warm dry spells during the first three weeks and the cool wet spell, especially in the south of England, during the last part of the month. Thunderstorms were frequent. From the 1st to 7th the British Isles was under the influence of an anticyclone centred between the Azores and Ireland, and warm quiet dry weather was experienced with much sunshine, except locally in Scotland and Ireland, where slight rain fell at times due to the approach of depressions which were moving across Iceland. Among the largest

* See *Meteorological Magazine*, 70, 1935, p. 49.

amounts of sunshine registered were 15·1 hrs. at Dovercourt on the 2nd, 14·7 hrs. at Leuchars on the 6th. Temperature rose in England during this time, being above 80° F. locally from the 5th to 8th; 88° F. was recorded at Greenwich on the 8th and 86° F. at Manchester, Mildenhall and Croydon on the 7th, and South Farnborough on the 8th. From the 8th to 12th shallow depressions passed across the country. Rain fell generally in Scotland and Ireland, except on the 12th, and thunderstorms accompanied in some cases by heavy rain, occurred in east England and the Midlands on the 8th and 9th and in south England on the 12th; 1·10 in. was measured at Felixstowe on the 8th. Sunshine records were, however, mostly good in England. On the 12th the anticyclone over the Atlantic extended north over Scotland and then moved south-eastwards, so that fair to cloudy, warm dry weather was experienced generally over the country until the 20th, except on one or two days when depressions to the north brought rain mainly slight and usually only in the north and west. Thunderstorms, however, occurred at many places in north and east England on the 17th or 18th; 2·62 in. fell at Staindrop (Durham) in a thunderstorm and 2·16 in. in $1\frac{1}{4}$ hours at Thetford (Norfolk) on the 18th. Fog occurred on the 17th and 18th along the coasts of the Irish Sea and in the extreme north. On the 20th to 22nd the weather became generally sunny in Great Britain and temperature rose, especially in England, 91° F. was reached at Greenwich and 89°F. at Cranwell and Hunstanton on the 22nd. In Ireland rain occurred on all three days and in Scotland there were showers on the 21st with a thunderstorm at Aberdeen. From the 23rd to 31st complex low pressure systems extended over the whole country except temporarily on the 24th and 25th, when a wedge of high pressure spread across the west and north. Much rain occurred generally, with thunderstorms in the south-east on the 23rd and 24th and more widespread from the 28th to 30th; 3·04 in. fell at Mevagissey (Cornwall) on the 23rd, 2·31 in. at Hawkshead (Lancashire) on the 26th, and 2·12 in. at Peaslake (Surrey) on the 24th. Fresh to strong winds were experienced in the western English Channel on many days and in the north on the 27th and 29th, while temperature was generally a little below normal and did not exceed 65° F. at most places on the 30th. Slight ground frost occurred locally on the 28th and 29th. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	83	−48	Chester ...	190	+36
Aberdeen ...	149	+10	Ross-on-Wye ...	194	+27
Dublin	165	+9	Falmouth ...	218	+20
Birr Castle ...	136	−2	Gorleston ...	226	+31
Valentia... ...	136	−14	Kew	191	+8

Miscellaneous notes on weather abroad culled from various sources

Five persons lost their lives in thunderstorms and floods in Spain about the 9th. A series of violent thunderstorms accompanied by heavy rain did much damage over a large part of France on the 12th, particularly at Amiens, Bordeaux, Châlons-sur-Saône and Nimes, and also swept across southern Piedmont and central Liguria on the night of the 12th and on the 13th; the torrential rain in the Ovada region caused a dam which protects Ovada to break, flooding an area 2½ miles by 1½ miles—it was estimated that 150–200 people lost their lives. Nine deaths were caused by a severe storm in the Budapest region on the 14th. A violent thunderstorm broke over Naples and the neighbourhood on the 20th—Castellammare was flooded after torrential rains and 12 people were killed. Thunderstorms were again experienced along the whole Riviera on the 25th and also in the hinterland, parts of Milan and Toulon were flooded and a waterspout in the Port of Genoa did extensive damage. A thunderstorm over Nice on the 28th put all the electric services out of action. (*The Times*, August 10th–30th.)

Snow was reported from many parts of South Africa on the 2nd. (*The Times*, August 3rd.)

The monsoon continued strong in the Punjab and Central and United Provinces during most of the month, but elsewhere it was mainly weak and more rain was needed in parts of Bombay and Deccan at the end of the month, though in Bombay City heavy rain caused damage to houses and in Chota Nagpur caused floods in parts of Bihar and west Bengal—more than 6 in. of rain is said to have fallen between 7 and 9 p.m. on the 13th at Jharia. By the 16th these floods were subsiding. Many people were killed in central and northern Luzon in the Philippine Islands by a typhoon and the floods which followed it. Heavy rain in Osaka and Kobe on the 9th and 10th caused floods over a wide area and four people were killed by landslides. A typhoon moving slowly north-east passed across south-west Japan on the 27th causing extensive damage by flood and wind over a wide area from Kiushu to Kobe. It then followed a circular track over the Sea of Japan to Kiushu and passed northwards over Shikoku towards Tokyo, which it reached on the 29th with greatly diminished force. (*The Times*, August 6th–September 2nd.)

Storms occurred in the neighbourhood of Adelaide on the 1st. Beneficial rains were experienced in most parts of Australia at the beginning of the month except in New South Wales, where there were mainly only light and scattered showers. (*The Times*, August 2nd–8th.)

General rains were experienced in the western grain-growing regions of Canada early but later the weather there was mainly cool and showery with hail and frost locally. A heat wave occurred in eastern Canada about the 19th. A severe gale occurred along the coasts of Newfoundland near St. John's on the 25th, when several small vessels with their crews were lost. Sudden storms occurred along the northern Atlantic coasts of the United States on the 1st and several days of rain caused severe floods in eastern Ohio about the 7th. Temperature was about or above the normal generally in the United States, while the rainfall was mainly below normal, except locally in the Ohio Valley. (*The Times*, August 3rd–September 2nd, and *Washington D.C., U.S. Dept., Agric., Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, August, 1935

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
	mb.		°F.	°F.	%	in.	hrs.	
1	1019·8	S.1	50	69	54	—	1·4	w early.
2	1021·1	ENE.3	50	72	43	—	12·2	w early.
3	1023·2	NNE.2	52	71	68	—	2·1	
4	1023·9	NW.2	52	75	54	—	5·5	
5	1026·7	NE.2	53	79	46	—	9·2	w early.
6	1029·0	NE.2	57	81	45	—	9·9	w early.
7	1024·2	NNE.2	59	84	44	—	8·7	w early.
8	1015·0	S.3	60	85	38	—	7·5	
9	1016·4	NW.3	63	72	69	—	6·3	
10	1020·2	SW.3	54	79	45	—	13·5	
11	1015·2	SW.3	57	80	45	—	10·0	w early.
12	1006·5	NNE.3	55	73	51	0·09	0·2	r_0r 18h.–23h.
13	1013·9	NE.4	52	68	41	—	11·3	
14	1018·4	WNW.3	47	68	52	—	4·9	w early.
15	1021·7	N.1	58	69	46	—	1·8	
16	1021·0	WSW.2	55	71	66	—	2·4	pr_0 13h.
17	1018·9	WSW.2	53	74	56	—	2·2	w early.
18	1018·4	WNW.3	60	72	55	0·03	2·0	r_0 1h.–2h. & 8h.
19	1019·9	WSW.2	57	77	58	—	6·2	
20	1021·8	N.1	61	81	47	—	10·7	
21	1014·6	S.3	59	83	38	—	12·1	w early.
22	1011·9	SW.3	59	84	44	—	12·6	
23	1010·5	ENE.1	58	69	94	0·41	0·0	tlrR 6h.–8h.
24	1007·8	WSW.2	60	65	95	0·54	0·0	r_0–rl h.–13h., 16h.–22h.
25	1016·9	S.2	54	71	59	—	5·9	F till 7h. 15m.
26	1009·9	SW.2	59	75	79	—	4·0	F till 8h. 30m.
27	999·5	WNW.3	59	64	52	0·26	6·3	tlR 3h.–5h.
28	998·2	NNW.2	44	65	49	—	8·7	w early.
29	1005·5	SW.3	48	64	53	—	8·2	w early.
30	1010·7	SW.4	53	63	65	0·59	0·7	r_0–r 13h.–21h.
31	1009·3	SW.4	56	69	67	0·07	4·8	r_0–r 0h.–1h., 4h.–5h.
*	1015·8	—	55	73	55	1·99	6·17	* Means or totals.

General Rainfall for August, 1935.

England and Wales ...	80	per cent. of the average 1881–1915.
Scotland	87	
Ireland	75	
British Isles	81	

Rainfall : August, 1935 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square..........	1·82	82	*Leics* .	Thornton Reservoir ...	1·83	65
Sur .	Reigate, Wray Pk. Rd..	3·97	162	,, .	Belvoir Castle............	1·39	53
Kent .	Tenterden, Ashenden...	3·70	162	*Rut* .	Ridlington	2·20	88
,, .	Folkestone, Boro. San.	4·40	...	*Lincs* .	Boston, Skirbeck.........	1·44	60
,, .	Eden'bdg., Falconhurst	3·96	151	,, .	Cranwell Aerodrome...	1·31	48
,, .	Sevenoaks, Speldhurst.	3·53	...	,, .	Skegness, Marine Gdns.	1·96	80
Sus .	Compton, Compton Ho.	3·44	111	,, .	Louth, Westgate.........	2·45	87
,, .	Patching Farm..........	4·17	165	,, .	Brigg, Wrawby St.......	1·30	...
,, .	Eastbourne, Wil. Sq....	4·31	174	*Notts* .	Worksop, Hodsock......	1·07	44
,, .	Heathfield, Barklye....	4·67	173	*Derby*.	Derby, L. M. & S. Rly.	1·25	48
Hants.	Ventnor, Roy.Nat.Hos.	3·74	188	,, .	Buxton, Terr. Slopes...	2·31	53
,, .	Fordingbridge, Oaklnds	3·10	118	*Ches* .	Runcorn, Weston Pt....	1·62	45
,, .	Ovington Rectory.......	3·62	134	*Lancs*.	Manchester, Whit. Pk.	2·00	58
,, .	Sherborne St. John......	3·03	125	,, .	Stonyhurst College......	1·64	32
Herts .	Royston, Therfield Rec.	1·09	42	,, .	Southport, Bedford Pk.	2·73	78
Bucks.	Slough, Upton............	1·86	86	,, .	Lancaster, Greg Obsy.	2·82	62
,, .	H. Wycombe, Flackwell	1·60	66	*Yorks*.	Wath-upon-Dearne......	1·90	79
Oxf .	Oxford, Mag. College...	1·67	74	,, .	Wakefield, Clarence Pk.	1·89	73
Nor .	Wellingboro, Swanspool	2·08	87	,, .	Oughtershaw Hall.......	3·54	...
,, .	Oundle	2·52	...	,, .	Harrogate, Harlow Mr.	1·88	64
Beds .	Woburn, Exptl. Farm...	2·09	90	,, .	Hull, Pearson Park......	1·91	65
Cam .	Cambridge, Bot. Gdns.	1·56	66	,, .	Holme-on-Spalding......	2·11	79
Essex .	Chelmsford, County Lab	2·20	101	,, .	West Witton, Ivy Ho.	2·43	83
,, .	Lexden Hill House......	1·17	...	,, .	Felixkirk, Mt. St. John.	3·26	114
Suff .	Haughley House.........	1·25	...	,, .	York, Museum Gdns....	2·23	88
,, .	Campsea Ashe............	1·63	82	,, .	Pickering, Hungate......	1·35	153
,, .	Lowestoft Sec. School...	2·42	110	,, .	Scarborough..............	1·24	45
,, .	Bury St. Ed., WestleyH.	1·14	44	,, .	Middlesbrough...........	2·29	84
Norf. .	Wells, Holkham Hall...	·67	28	,, .	Baldersdale, Hury Res.	1·48	42
Wilts .	Calne, Castle Walk......	2·30	...	*Durh* .	Ushaw College...........	2·23	77
,, .	Porton, W.D. Exp'l. Stn	1·87	83	*Nor* .	Newcastle, Town Moor.	2·24	77
Dor .	Evershot, Melbury Ho.	2·60	83	,, .	Bellingham, Highgreen	2·63	74
,, .	Weymouth, Westham.	2·64	123	,, .	Lilburn Tower Gdns....	4·20	149
,, .	Shaftesbury, Abbey Ho.	2·48	85	*Cumb*.	Carlisle, Scaleby Hall...	2·38	58
Devon.	Plymouth, The Hoe....	2·92	94	,, .	Borrowdale, Seathwaite	8·50	78
,, .	Holne, Church Pk. Cott.	3·20	72	,, .	Borrowdale, Moraine...	5·47	63
,, .	Teignmouth, Den Gdns.	2·78	122	,, .	Keswick, High Hill......	2·54	49
,, .	Cullompton	2·13	70	*West* .	Appleby, Castle Bank...	1·64	50
,, .	Sidmouth, U.D.C........	2·56	...	*Mon* .	Abergavenny, Larchf'd	1·34	45
,, .	Barnstaple, N. Dev.Ath	3·59	109	*Glam* .	Ystalyfera, Wern Ho....	2·95	48
,, .	Dartm'r, Cranmere Pool	3·60	...	,, .	Cardiff, Ely P. Stn.......	2·30	53
,, .	Okehampton, Uplands.	2·58	61	,, .	Treherbert, Tynywaun.	3·44	...
Corn .	Redruth, Trewirgie......	3·62	106	*Carm* .	Carmarthen, The Friary	1·88	40
,, .	Penzance, Morrab Gdn.	2·30	73	*Pemb* .	St. Ann's Hd, C. Gd. Stn.	1·40	44
,, .	St. Austell, Trevarna...	4·76	132	*Card* .	Aberystwyth	4·35	...
Soms .	Chewton Mendip.........	2·05	46	*Rad* .	BirmW.W.Tyrmynydd	2·16	40
,, .	Long Ashton...........	1·97	56	*Mont* .	Lake Vyrnwy	1·51	29
,, .	Street, Millfield..........	...	...	*Flint* .	Sealand Aerodrome......	1·41	49
Glos .	Blockley	1·38	...	*Mer* .	Dolgelley, Bontddu......	3·82	68
,, .	Cirencester, Gwynfa....	2·06	69	*Carn* .	Llandudno	1·81	64
Here .	Ross, Birchlea...........	1·39	54	,, .	Snowdon, L. Llydaw 9..	6·38	...
Salop.	Church Stretton.........	1·28	39	*Ang* .	Holyhead, Salt Island...	1·80	57
,, .	Shifnal, Hatton Grange	1·19	42	,, .	Lligwy	2·45	...
Staffs.	Market Drayt'n, Old Sp.	1·46	44	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	1·59	59		Douglas, Boro' Cem....	1·59	41
War .	Alcester, Ragley Hall...	1·14	41	*Guernsey*			
,, .	Birminghm, Edgbaston	2·16	80		St. PeterP't.Grange Rd.	1·44	61

Rainfall: August, 1935: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig	Pt. William, Monreith.	1·56	41	*Suth*	Melvich	4·31	145
„	New Luce School	1·95	44	„	Loch More, Achfary	7·27	124
Kirk	Dalry, Glendarroch	1·76	37	*Caith*	Wick	2·93	107
„	Carsphairn, Shiel	2·07	31	*Ork*	Deerness	3·80	132
Dumf.	Dumfries, Crichton, R.I.	3·15	83	*Shet*	Lerwick	3·57	118
„	Eskdalemuir Obs	5·04	98	*Cork*	Caheragh Rectory	...	...
Roxb	Hawick, Wolfelee	3·35	100	„	Dunmanway Rectory	3·07	65
Selk	Ettrick Manse	2·96	57	„	Cork, University Coll	2·68	79
Peeb	West Linton	1·86	...	„	Ballinacurra	1·60	43
Berw	Marchmont House	3·16	95	„	Mallow, Longueville	2·08	67
E.Lot	North Berwick Res	3·61	114	*Kerry*	Valentia Obsy	4·70	98
Midl	Edinburgh, Roy. Obs.	2·53	79	„	Gearhameen	5·20	68
Lan	Auchtyfardle	1·44	...	„	Bally McElligott Rec	3.50	...
Ayr	Kilmarnock, Kay Pk	1·90	...	„	Darrynane Abbey	5·03	116
„	Girvan, Pinmore	1·71	38	*Wat*	Waterford, Gortmore	1·03	27
Renf	Glasgow, Queen's Pk	2·52	71	*Tip*	Nenagh, Cas. Lough	5·72	145
„	Greenock, Prospect H.	2·94	54	„	Roscrea, Timoney Park	3·02	...
Bute	Rothesay, Ardencraig	2·22	...	„	Cashel, Ballinamona	2·20	62
„	Dougarie Lodge	1·34	...	*Lim*	Foynes, Coolnanes	3·63	94
Arg	Ardgour House	9·88	...	„	Castleconnel Rec	3·66	...
„	Glen Etive	8·63	115	*Clare*	Inagh, Mount Callan	5·69	...
„	Oban	4·02	...	„	Broadford, Hurdlest'n.	3·61	...
„	Poltalloch	5·38	110	*Wexf*	Gorey, Courtown Ho	1·62	49
„	Inveraray Castle	6·73	102	*Wick*	Rathnew, Clonmannon.	1·44	...
„	Islay, Eallabus	4·45	102	*Carl*	Hacketstown Rectory	2·20	54
„	Mull, Benmore	...	...	*Leix*	Blandsfort House	3·85	97
„	Tiree	5·04	120	*Offaly*	Birr Castle	3·23	85
Kinr	Loch Leven Sluice	3·51	92	*Dublin*	Dublin, FitzWm. Sq.	2·25	74
Perth	Loch Dhu	5·00	74	„	Balbriggan, Ardgillan	1·98	58
„	Balquhidder, Stronvar.	3·18	...	*Meath*	Beauparc, St. Cloud	2·51	...
„	Crieff, Strathearn Hyd.	2·31	55	„	Kells, Headfort	3·84	92
„	Blair Castle Gardens	2·30	68	*W.M*	Moate, Coolatore	2·79	...
Angus	Kettins School	1·50	41	„	Mullingar, Belvedere	3·81	91
„	Pearsie House	2·06	...	*Long*	Castle Forbes Gdns	2·90	71
„	Montrose, Sunnyside	1·82	65	*Gal*	Galway, Grammar Sch.	3·87	...
Aber	Braemar, Bank	2·61	76	„	Ballynahinch Castle	7·43	135
„	Logie Coldstone Sch	...	...	„	Ahascragh, Clonbrock.	2·42	58
„	Aberdeen, King's Coll.	2·38	87	*Mayo*	Blacksod Point	3·70	81
„	Fyvie Castle	1·94	61	„	Mallaranny	6·03	...
Moray	Gordon Castle	3·02	95	„	Westport House	3·73	92
„	Grantown-on-Spey	2·82	88	„	Delphi Lodge	9·94	115
Nairn	Nairn	2·98	124	*Sligo*	Markree Obsy	3·17	73
Inv's	Ben Alder Lodge	2·91	...	*Cavan*	Crossdoney, Kevit Cas.	3·49	...
„	Kingussie, The Birches.	3·60	...	*Ferm*	Enniskillen, Portora	...	...
„	Inverness, Culduthel R.	4·55	...	*Arm*	Armagh Obsy	2·80	77
„	Loch Quoich, Loan	14·30	...	*Down*	Fofanny Reservoir	2·35	...
„	Glenquoich	7·16	87	„	Seaforde	1·30	35
„	Arisaig, Faire-na-Sguir.	5·69	...	„	Donaghadee, C. Stn.	1·75	53
„	Fort William, Glasdrum	6·53	...	„	Banbridge, Milltown	...	...
„	Skye, Dunvegan	4·90	...	*Antr*	Belfast, Cavehill Rd	2·73	...
„	Barra, Skallary	4·71	...	„	Aldergrove Aerodrome.	1·43	40
R&C	Alness, Ardross Castle.	3·14	106	„	Ballymena, Harryville.	1·86	44
„	Ullapool	3·65	103	*Lon*	Garvagh, Moneydig	2·13	...
„	Achnashellach	5·36	80	„	Londonderry, Creggan.	2·59	56
„	Stornoway	3·63	91	*Tyr*	Omagh, Edenfel	3·04	71
Suth	Lairg	2·90	91	*Don*	Malin Head	2·96	...
„	Tongue	4·81	150	„	Killybegs, Rockmount.	3·80	...

Climatological Table for the British Empire, March, 1935

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.	Per cent-age of possi-ble.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.		°F.	%	0–10	in.	in.			
London, Kew Obsy	1021·4	+ 8·0	63	30	51·1	38·5	44·8	+ 2·4		38·5	85	8·3	0·37	− 1·32	6	3·5	30
Gibraltar	1018·8	+ 1·7	71	43	63·4	52·1	57·7	+ 0·1		51·2	80	6·3	1·66	− 3·08	8	...	...
Malta	1016·3	+ 2·1	63	43	58·2	50·1	54·1	− 3·0		50·5	79	5·8	4·38	+ 2·90	11	6·3	53
St. Helena	1010·9	− 0·4	73	62	69·5	63·1	66·3	0·0		64·0	97	9·1	2·51	...	20	...	...
Freetown, Sierra Leone	1012·5	+ 1·8	90	68	86·7	72·5	79·6	− 2·8		72·3	76	4·7	0·00	− 1·16	0	...	...
Lagos, Nigeria	...	...	92	71	89·0	77·8	83·4	0·0		78·0	83	7·5	8·36	+ 4·61	7	6·3	53
Kaduna, Nigeria	1006·1	...	101	54	96·6	66·7	81·7	+ 0·6		67·3	58	3·8	0·45	− 0·09	3	8·2	68
Zomba, Nyasaland	1011·2	+ 1·5	83	54	77·1	63·1	70·1	− 1·2		66·3	77	7·5	15·32	+ 6·24	17	...	...
Salisbury, Rhodesia	1012·2	− 0·2	85	46	78·4	57·0	67·7	− 0·5		60·7	72	5·3	4·53	− 0·17	13	6·8	56
Cape Town	1014·9	+ 0·4	93	46	76·5	57·6	67·1	− 1·0		57·5	74	4·2	0·84	− 0·04	7	...	...
Johannesburg	1013·4	− 0·2	85	46	71·6	52·5	62·1	− 1·3		54·3	71	5·1	4·69	+ 0·25	10	7·5	61
Mauritius	1012·1	+ 0·1	86	70	84·0	72·7	78·3	+ 0·3		74·8	80	5·8	3·62	− 5·75	18	7·8	64
Calcutta, Alipore Obsy.	1009·7	− 0·2	99	63	92·5	70·8	81·7	+ 1·5		70·5	81	3·2	0·99	− 0·39	2*	...	...
Bombay	1010·5	− 0·4	101	66	88·9	71·7	80·3	+ 0·8		69·1	66	0·9	0·00	− 0·02	0*	...	...
Madras	1010·1	− 0·8	95	66	89·0	72·5	80·7	− 0·4		74·7	77	4·2	0·00	− 0·34	0*	...	...
Colombo, Ceylon	1010·0	− 0·1	93	68	87·9	73·8	80·9	− 0·9		76·3	71	5·1	3·76	− 0·52	10	8·6	70
Singapore	1009·2	− 0·5	91	74	87·7	75·7	81·7	+ 0·5		77·4	78	7·5	8·10	+ 0·70	14	6·1	50
Hongkong	1014·7	− 1·3	82	57	71·3	62·8	67·1	+ 3·8		63·1	83	8·3	4·67	+ 1·73	12	3·4	29
Sandakan	1009·7	...	90	73	87·5	75·5	81·5	+ 0·5		77·7	82	6·9	3·97	− 4·50	14	...	...
Sydney, N.S.W.	1015·9	− 0·4	90	49	76·9	60·5	68·7	− 0·6		62·4	69	6·0	2·36	− 2·62	12	7·9	65
Melbourne	1016·1	− 0·8	90	43	72·6	53·1	62·9	− 1·6		56·8	66	6·5	1·60	− 0·58	12	6·3	51
Adelaide	1016·0	− 1·1	102	49	81·2	61·2	71·2	+ 1·4		58·7	46	6·2	2·46	+ 1·43	12	6·4	52
Perth, W. Australia	1014·2	− 1·1	104	49	81·2	60·4	70·8	− 0·4		59·3	56	2·9	0·16	− 0·65	2	9·4	76
Coolgardie	1014·2	− 0·6	105	45	81·3	56·8	69·1	− 2·8		60·1	61	4·5	1·00	+ 0·06	5	...	...
Brisbane	1015·1	+ 0·7	91	55	81·7	64·6	73·1	− 1·2		66·8	65	4·4	1·05	− 4·72	10	8·4	69
Hobart, Tasmania	1013·0	− 1·2	85	42	65·3	50·2	57·7	− 1·6		51·2	61	5·9	1·56	− 0·14	13	6·4	52
Wellington, N.Z.	1016·9	− 0·3	80	43	67·7	55·4	61·5	+ 0·9		57·7	73	7·5	3·79	+ 0·46	8	6·2	50
Suva, Fiji	1008·2	− 0·2	92	74	87·4	75·9	81·7	+ 1·6		76·7	83	7·5	11·34	− 3·15	26	5·4	44
Apia, Samoa	1008·7	− 0·5	88	74	84·7	75·5	80·1	+ 0·8		77·2	83	7·2	22·56	+ 8·58	27	5·4	44
Kingston, Jamaica	1015·6	+ 0·7	89	65	84·9	67·4	76·1	− 1·0		65·8	81	2·8	0·40	− 0·62	5	7·8	65
Grenada, W.I.	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...
Toronto	1017·2	− 0·1	68	10	43·2	27·9	35·5	+ 5·9		29·9	74	6·8	1·25	− 1·16	10	4·9	41
Winnipeg	1013·6	− 5·6	40	−13	26·4	9·6	18·0	+ 3·0		...	...	7·6	2·84	+ 1·68	14	4·0	34
St. John, N.B.	1012·9	− 1·2	46	−2	35·1	20·1	27·6	− 0·8		22·4	73	4·6	2·36	− 2·18	19	6·1	51
Victoria, B.C.	1013·0	− 2·9	57	31	47·2	37·1	42·1	− 1·4		39·5	80	6·1	2·94	+ 0·51	16	4·8	40

* For Indian stations a rain day is a day on which 0·1 in. or more [illegible]

(27872) Wt. 18/32 1050 9/35 Hw. G.377/

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The International Meteorological Conference at Warsaw, September, 1935.

A meeting of the International Meteorological Conference was due in 1935, and by the invitation of the Polish Government and of Dr. J. Lugeon, Director of the Meteorological Service of Poland, it was held in Warsaw from September 6th to 13th, under the Presidency of Prof. E. van Everdingen. The Conference was well attended by delegates from all parts of the world; the British delegation included Sir George Simpson, K.C.B., F.R.S., Director of the British Meteorological Office, Lt.-Col. E. Gold, Dr. C. E. P. Brooks and Miss D. G. Chambers, while the Empire was further represented by the Directors of the Meteorological Services of Canada, India, Malaya, Hong Kong, British East Africa, Southern Rhodesia, South Africa, Australia, New Zealand and Samoa.

Much of the work of the Conference is done by specially appointed Commissions, and meetings of most of these were held in Danzig or Warsaw before or during the Conference. Special interest attached to the work of the Commissions for Climatology and Synoptic Weather Information, both of which studied several difficult questions of international practice.

The Climatology Commission, which met at Danzig, was occupied mainly with the methods of observation and the publication of the results. The most widespread form for the publication of climatological data is the table of monthly and annual values. An international form of publication was agreed on as early as 1874, but since that date changes have been made independently in different countries, so that the various yearbooks are now no longer comparable. A revised form of publication was proposed by Dr. Hesselberg and adopted with some modifications. The headings of the form received detailed consideration. At present climatological tables are not always completely intelligible to anyone not acquainted with the language, and to get over this difficulty a series of letter indices has been agreed upon, such as P for Pressure, U for relative humidity, etc. These, and the use of uniform international weather symbols, should obviate the language problem.

On the subject of symbols, reference must be made to the question of thunder. The symbol T was adopted at Paris in 1896 to indicate days on which distant thunder was heard, but it has always been a source of confusion. Thunder cannot occur without lightning, and if the lightning is not seen, it is because of special circumstances such as time of day. The Climatology Commission therefore took the point of view that the real distinction should be between a thunderstorm over the station and a thunderstorm in the neighbourhood. Both should be indicated by the symbol for thunderstorm, but in the latter case it should be enclosed in brackets.

For many purposes monthly climatological data are required very soon after the close of each month, and for some years the Commissions for Climatology and Synoptic Weather information have been discussing a plan for the regular broadcasting of such data. The final details were completed at Danzig and Warsaw. The proposed transmissions will include in a suitable code pressure, temperature and rainfall, and for certain isolated stations the sea temperature and resultant wind. Marine data based on ships' observations will also be included. The data issued by each country will be collected into continental groups and a selection for each continent will be re-transmitted as world broadcasts from suitable stations. It is proposed for example, that Rugby should issue the data for western and central Europe, Washington those for North America, etc. The messages are to be issued as early as possible in the month following that to which they refer, and not later than the 5th.

To make full use of these monthly broadcasts normal values will be required for comparison. The Climatology Commission designated the period 1901 to 1930 as a standard period for these normals, and also recommended that as many countries as possible should publish climatological charts based on this period.

Most of the work of the Synoptic Commission was naturally concerned with matters of technical detail, but here also the goal was complete uniformity of international practice. As a result of the extension of air routes, many pilots now fly regularly from one country to another, and in order that they should be able rapidly to obtain all the information they require about wind, weather, cloud heights, etc., it is essential that the observations in all countries should be made and coded in a similar manner, and also entered on the working synoptic charts according to a uniform plan. For this purpose detailed instructions in the use of the codes have been drawn up as a basis for international usage, and a standard " station model " has been adopted for entering the information on the charts.

The work of the other Commissions, though no less important for international meteorology, was mostly too technical to be described in detail here, but brief reference must be made to the adoption by the Conference of the report of the Commission for Bibliography. This report contains a classification for meteorological literature, based on the extension of the Dewey Decimal Classification by the International Institute for Documentation, but entirely revised to meet the requirements of modern meteorology. It is proposed to bring this classification into use in the Meteorological Office Library on January 1st, 1936.

Most of the work of the main Conference consisted in the discussion, adoption or amendment of the reports of the various Commissions. The great and growing importance of meteorology in aviation however constantly raises new problems which cannot always await a meeting of the International Meteorological Conference or Committee. To deal with these problems, the Conference at Warsaw appointed a new Commission, the purpose of which is to keep in close touch with the requirements of aviation and to maintain and develop the necessary meteorological organisation.

Insoluble Matters brought down by Rain

By J. H. Coste of the Atmospheric Pollution Research Committee

It is well known that rain water, especially that brought down in or near towns, frequently contains particulate matter. Some of the solid matter found in rain-gauges is dust which has settled on the funnel in dry weather and has been washed into the collecting vessel by rain, whilst some is brought down with the rain itself. The nature of all this matter is of great interest from the point of view of the investigation of atmospheric pollution, and meteorologists who make observations of rainfall could greatly help the work of the Research Committee of the Department of Scientific and Industrial Research on Atmospheric Pollution by examining the solid matter entering their gauges.

The chemical examination made in the routine analysis of the water collected in deposit gauges used in the Committee's investigations only shows the total amount of insoluble matter and its content of tar and of matters lost on ignition ; that is, it divides the insoluble matter into tar, other organic matters with combined water, and mineral matter, without giving any information as to the proximate nature of the solid deposit. Further work would be welcomed, but the amount of work done on a sample of deposit is already large and further requirements would throw considerable work on the chemists who undertake it and expense on the contributing authorities.

Many of the voluntary observers who now undertake rainfall observations would probably be interested in the investigation of the particulate matter collected in their gauges. Whilst it is unlikely that more than a very few would be able to make a chemical examination of this matter, those who possess microscopes or have friends who are microscopists, may feel that the examination of the deposit which settles out when the rain water, after having been measured, is set aside would open up an interesting and useful field of microscopical work, the collected results of which would be of great value in relation to the investigation of atmospheric pollution.

Equipment.—Very little is required beyond the microscope and its accessories. The bare minimum is a conical glass vessel of suitable size in which the measured water can be poured and left for the insoluble matter to settle to the bottom and a pipette or dipping tube with which to draw off the deposit after the supernatent water has been carefully decanted or siphoned off. Some wine glasses, especially the old shape of champagne glass, are very suitable as sedimenting vessels or a small conical photographic measure may be used. The pipette may be a piece of glass tubing, with ends smoothed in a flame, and rather longer than the depth of the sedimenting vessel. This is manipulated by closing the upper end with the forefinger, or with a rubber teat. Medical men familiar with Sir Almroth Wright's tube and teat technique will be able to devise suitable apparatus, made of drawn-out glass tubing, and may be able also, to obtain useful measures of the volume of deposits by their height up glass tubes of known internal diameter.

The microscope need not be an elaborate one. Most of the structures to be looked for can be distinguished with a good 1-in. or ⅔-in. objective with a quite low eyepiece under illumination by transmitted light (mirror illumination) but examination of the dried deposit with dark field illumination is often convenient. For this purpose the old-fashioned Lieberkuhn would be very suitable. I have used the silvered side reflector and, alternatively, a half bull's-eye placed on the stage in such a position that the light from a lamp is focussed on the object from the side. This gives excellent dark field illumination with objectives up to ⅙ in. and can be made by cutting the lens from a torch lamp through an axial diameter. It is sometimes advantageous to put a slip of coloured (green) paper under the slide. A small magnet, which may be a magnetised gramophone needle mounted in a glass tube with sealing wax or shellac, is useful in identifying particles of magnetite.

What to look for.—Antony van Leeuwenhoek in his 147th letter to the Royal Society, wrote " On the 19th of September, 1701, it rained a little while about the forenoon, whereupon I caught some of the rain, as pure as I was able to, in a clean East Indian porcelain dish : . . . . . I discovered therein many little bits of dust, otherwise called particles, such as generally float in the air, consisting of very little bits of burnt wood, or charcoal, wherein I could make out the horizontal and ascending vessels ; also a little bit of straw, and many blackish particles which I imagine to be congealed particles out of smoke from the coals that our smiths and brewers burn : and among these was a pretty structure composed of round globules clotted together just like the little stars that we see in the snow in winter."

The rain water of to-day contains much the same things that the Dutch draper saw over 230 years ago.

Burnt wood can usually be detected by its obviously woody structure, which can easily be studied by crushing the middle of a burnt match (the working end seems to contain siliceous particles) ; the blackish particles, imagined by Leeuwenhoek to be congealed smoke, are really something of that sort, being soot. They have no definite structure . . . . Coke particles are also blackish and can be recognised by their obvious foam structure, and sharp outlines showing where gas cavities have been crushed leaving hollows which are clearly parts of spheres. The " pretty structure " was probably a cluster of globules of ash from a forge or other high temperature furnace. Single spheres, some glassy, others opaque with a warty surface, explainable by the bursting of gas bubbles before solidification of the matrix, and some glassy with inclusions of gas bubbles, indicate industrial pollution, often from power stations, especially where pulverised fuel is burnt. Sometimes almost black spheres are found. These, if rough, are usually coke ; if smooth a magnet may show them to be strongly ferromagnetic. Spheres always indicate the product of a high temperature, since for them to be formed the ash of the fuel must have been fused. The magnetite spheres referred to can only be formed if the temperature has reached about 1,600° C. Pollen grains which may be found in country districts, although more or less spherical, are obviously less dense than those of ash. I was in Arcachon in the spring of 1934 and was puzzled by the streets being apparently strewed with flowers of sulphur. When I found the same yellow dust also on the sand of the beach I collected a sample. The microscope showed that the yellow particles were the pollen of *pinus maritima* which is grown all over the district for the production of turpentine. Sand grains, although not always as sharp as in the drawing of a deposit from Kew Observatory, can usually be identified by their character. They frequently contain inclusions of other minerals. Sand from the sea and especially from dunes, is usually rounded owing to erosion. Vegetable hairs are often branched. Textile fibres may frequently be recognised as such by the fact of being dyed. Cotton fibres resemble flattened and twisted tubes. Wool fibres have a surface structure not seen in vegetable ones, silk is apparently structureless. It is easy and much better to examine known materials, which are easily obtained, rather than to rely on drawings or photographs, as most of the structures are better studied by focussing up and down so as to see different planes, thereby getting a notion of their three-dimensional form.

It will have been seen from the above that the nature of the solid matter brought down in rain, especially if considered in relation to the wind direction, should give an indication whether the dust in the air is that normal to the district or has been brought from other places, e.g., if in a rural district, besides vegetable tissues, charred wood, ash and a few textile fibres, much coke and many spheres are found, it is clear that pollution from an industrial district is being brought over the place of rainfall.

I attach a form suggested for entering results. It will be noted that the expression " sintered " means particles which are fused only superficially and have, therefore, not assumed the spherical form.

SOLID MATTER IN RAIN collected at ....
.... from .... to............................,
193....

Colour

Spheres—
- Colour
- Glassy
- Opaque, bubbly
- ,, coke
- ,, magnetic

Sintered—
- Colour
- Glassy
- Opaque, bubbly
- Magnetic

Irregular—
- Aggregates
- Coke
- Coal
- Magnetic
- Sand
- Charred Wood

Fibres—
- Textile
- Plant Hairs and Tissues
- Wood
- Unidentified (describe)

Not seen	—	Many	++
Few	(+)	Predominant	+++
Some	+		

OFFICIAL PUBLICATION

The following publication has recently been issued :—

GEOPHYSICAL MEMOIRS.

No. 65. *Transfer of heat and momentum in the lowest layers of the atmosphere.* By A. C. Best, B.Sc. (M.O. 356h.).

This memoir is divided into four parts and deals with various aspects of turbulence in the layer of the atmosphere nearest the ground. The first part describes the results obtained from two years' continuous records of temperature differences over the height intervals 2·5 cm. to 30 cm. and 30 cm. to 1·2 m. Average values and extreme values of these temperature differences are given. These results have also been combined with those obtained by Johnson* to give a picture of the temperature distribution from 2·5 cm. to 17·1 m. The times of maximum temperature and the diurnal range of temperature at various heights are discussed and values for the coefficient of eddy conductivity are obtained.

The second part discusses a number of experiments carried out with a hot wire anemometer to determine the vertical gradient of wind velocity between the heights 2·5 cm. and 5 m. under various conditions as to temperature gradient and wind velocity.

The experiments with a hot wire anemometer provided a large number of instantaneous readings of wind velocity. These have been analysed in the third part of the memoir to give the distribution of deviations from the mean velocity.

The results of a large number of experiments with two small bi-directional vanes to investigate the gustiness of the wind in the lateral and vertical directions are described in the last part. The effects of height up to 5 m., vertical temperature gradient and wind velocity are considered and the magnitude of eddy velocities is deduced.

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings are :—

October 28th, 1935. *On the causes of rainfall variations in Europe and their relations to other meteorological factors.* By R. Höhn. (Zwönitz, 1934.) (In German.) *Opener*—Dr. C. E. P. Brooks.

November 11th, 1935. *The layer of frictional influence in wind and ocean currents.* By C. G. Rossby and R. B. Montgomery. (Cambridge, Mass. Pap. phys. Oceanogr. Met., Vol. 3, No. 3, 1935.) *Opener*—Mr. A. F. Crossley, M.A.

Correspondence

To the Editor, *Meteorological Magazine*

Green Clouds seen from Edinburgh

The green clouds seen from Edinburgh by Lt.-Col. T. C. Skinner, as reported in the *Meteorological Magazine* for August, 1935, pp. 157–8, seem likely to have been coloured by diffraction owing to minute liquid particles as the sun shone through the thin cloud. This phenomenon of iridescent clouds, which appears to be more frequently seen in the north-eastern United States than in cloudier and milder Great Britain, has been described at length in the *Monthly Weather Review*, Washington, February, 1925, pp. 49–58.

The radiation of pink bands across the sky from a point where the sun happens to have reached after setting has been traced definitely here to shadows of dense clouds on or below the horizon,

* *London, Geophys. Mem.*, No. 46, 1929.

which cut out some of the general sunset illumination of the sky. The hard cumuli mentioned by Mr. Moon in the *Meteorological Magazine* for August, 1935, p. 158, when he observed such a phenomenon recently, suggest general conditions which may well have made possible the occurrence of similar, shadow-throwing clouds elsewhere at the time.

CHARLES F. BROOKS.

Blue Hill Meteorological Observatory, Milton, Massachusetts, U.S.A., September 2nd, 1935.

Forecasting Weather from Height of Barometer and Temperature of Wet Bulb

In connexion with the above question it is perhaps worth calling attention to the equations for " average numerical relations between pressure, rainfall and wind speed " as given on p. 16 of *Geophysical Memoirs*, No. 53. The data which the equations summarize exclude days on which marked discontinuities passed the stations, whilst, corresponding roughly to classification on a basis of wet-bulb temperature, there is separation into cases of tropical and polar air respectively. The data used relate to daily means or totals. Equations are given for Aberdeen, Kew and Eskdalemuir. The Kew equations, for example, for average rainfall (in mm.) in 24 hours are $R = \cdot 10\ (1035 - p)$ and $R = \cdot 05\ (1035 - p)$ for tropical and polar air respectively. The interesting point is that in all cases the factor in brackets, considered with reference to sea level pressure, is approximately $(1035 - p)$. The coefficients outside the brackets are ·05 and ·06 respectively for Aberdeen and ·16 and ·07 respectively for Eskdalemuir.

The influence of topography is evidenced in the relative sparseness of warm air rainfall at Aberdeen and its relative abundance at Eskdalemuir in the same pressure conditions. These linear equations do not apply closely even to the averages in the case of very low pressures and it is perhaps scarcely necessary to point out that in individual cases in general there is not close correlation with the results indicated by the formulae, which are intended simply to represent the averages.

Some frequency tables are given in the same memoir; where forecasting is the object, it is desirable to approach the subject from the aspect of frequencies as Lieut.-Commdr. Beatty has indeed done.

In the same way as the rainfall data suggest a cessation of precipitation (or upward air movement) as sea-level pressure tends to 1035 mb., so do the wind data suggest cessation of horizontal air movement for a sea-level pressure which for polar air is about 1060 mb. and for tropical air about 1050 mb.

A. H. R. GOLDIE.

August 21st, 1935.

Effect of Drought on the Run-off of Subsequent Rainfall

The drought of July and August, 1935, at Goff's Oak, Herts, with the exception of showers producing 0·09 in. on August 12th and 0·02 in. on July 27th, lasted from July 20th to August 22nd and was finally broken by the heavy rainfall of 0·90 in. associated with the thunderstorm on the morning of August 23rd.

During the drought the soil, which in this locality is mainly London Clay or Boulder Clay, had become so hardened by the sun that a pick-axe was required to pierce the surface. Beneath the turf the ground was a mosaic of fissures about ¼ to ½ in. in width and several inches in depth. The stream, Cuffley Brook, which drains an area of about five square miles above the bridge shown in Fig. 1, had ceased to flow by the end of June. This catchment area, all of which lies within a radius of three miles from the rain-gauge, is mainly open grassland with a little woodland in the west and north.

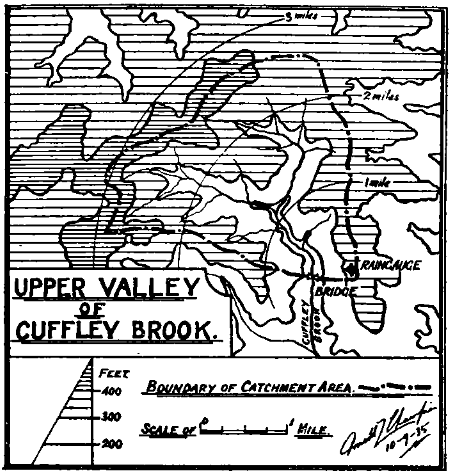


FIG. 1.

As shown in Fig. 2, there were ten rain-days between August 22nd and September 5th giving an aggregate fall of 2·48 in. This fall would amount to about 800,000 tons of water in the catchment area in Fig. 1, of which 290,000 tons fell during the 24 hours ending at 6h. on the 23rd, but the brook did not commence to flow under the bridge until about 21h. on September 5th; and then the stream was only about 12 in. in width and an inch or so in depth. The flow had stopped again by 6h. 30m. on the morning of the 6th.

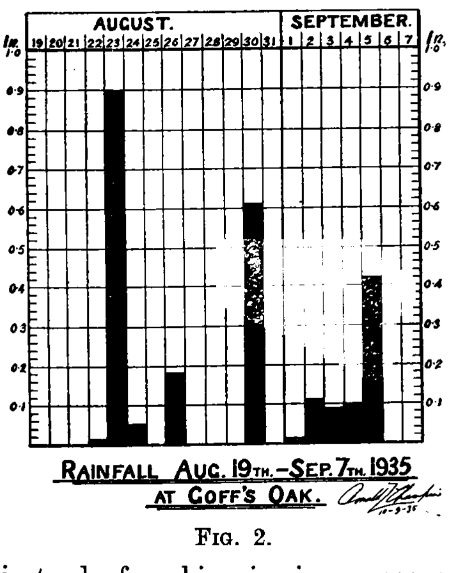


FIG. 2.

Even with a generous allowance for evaporation, it would seem, therefore, that the popular belief that heavy rain after a drought runs off instead of soaking in, is erroneous, at least as far as clay soil is concerned.

Since Cuffley Brook is one of the many tributaries of the river Lea, it follows that little of the ten days rainfall could have reached the latter. It would appear that towns relying on the larger rivers for their water supply, as also those relying on deep wells, may feel the effect of drought for some considerable time after the termination of the dry spell.

DONALD L. CHAMPION.

7, Robinson Avenue, Goff's Oak, Waltham Cross, Herts, September 10th, 1935.

Frequency of Calms in Winter

The high relative frequency of calms in winter, especially in December, at two inland places in the south-east of England as recently brought to light by Messrs. Champion and Ashmore is somewhat perplexing. I am inclined to think that December, more than most months, requires a good term of years to get a true picture, and I think it would be of interest to quote a passage from a recent paper by Dr. J. N. Carruthers " On the Flow of Water through the Straits of Dover as gauged by Continuous Current-Meter observations at the Varne Lightvessel (50° 56′ N., 1° 17′ E.)."* In the course of discussing the part played by wind in controlling the flow of water in the Straits, Dr. Carruthers refers to the extremely anomalous character of the months of December from 1926 to 1931—the six Decembers for which records of the water flow have been analyzed. Thus December, 1929, a month of stormy SW. winds, provided a stronger flow in the normal direction from English Channel to North Sea than any month of any name, whereas four out of the six Decembers in question gave a very small net or residual flow in that direction owing to the frequency of " hold-ups " and reversals. He proceeds " It is of interest to remark that a review in the *Geographical Journal* of February, 1931, p. 198, of an earlier paper by the present writer contained an expression of opinion that ' a longer term of years will show that a December of the stormy type of 1929 occurs more frequently than a notably fine one like 1926 or an intensely cold one like 1927 '. When we consider the seven Decembers, 1920–1926, included in our Dungeness wind table as well as the five, 1930–1934, in our Varne wind data table we find good reason to agree with this." Here we have testimony for coastal and open-sea stations in south-east England rather to the storminess than to the quietness of December. I should say from common experience of the London climate that dead calms actually are more frequent in winter than in summer, but that quiet weather with just a perceptible breeze is far more habitual and lasting in summer. Stagnation in winter is fog-breeding and fortunately does not as a rule last very long. Possibly the discrepancy is to be explained on these lines.

L. C. W. BONACINA.

35, Parliament Hill, London, N.W.3, September 4th, 1935.

* Ministry of Agriculture and Fisheries, Series II, Vol. XIV, No. 4, 1935.

Dust-Devils

These phenomena—more properly termed " miniature whirlwinds " —are not so rare in England as might be supposed. Given suitable conditions, hot sun and light wind, they are quickly formed, and usually as rapidly disperse.

On August 2nd at 13h. 36m. G.M.T. a whirlwind (dust-devil) of this kind entered the north corner of the bottom of my back garden which borders on the Downs, and carrying with it a column of chalk dust and small stones, travelled in a southerly direction, threw itself against the back of the house, the stones rattling against the windows like hailstones. The column was about 20 ft. high, judging from surrounding objects and the whole duration of the phenomenon was about 30 seconds.

The wind was quite calm both before and after the dust-devil had passed, shade temperature being 66° F.

DONALD W. HORNER.

St. Lawrence, Surrenden Road, Brighton, 6, September 24th, 1935.

NOTES AND QUERIES

Veer of Southerly Winds with Height in Egypt†

At Ismailia on the Suez Canal a new anemometer was recently erected on the aerodrome, 7 ft. above the Office roof and 22 ft. above the ground. The exposure is poor, the Office itself being surrounded by buildings between north-east and south-south-east and between south-west and west-north-west. The old anemometer stood about a mile to the northward, 50 ft. above the ground with a very free exposure. The two anemometers were run simultaneously for five months in winter and it was found that though the mean speed differed by an amount little more than could be accounted for by the difference in height, the direction record of southerly winds at the new site showed a backing of 20° to 30° compared with the old site. For winds from between NW. and NE. the difference is much smaller, sometimes zero and occasionally of opposite sign. The direction record of the new instrument is sometimes very oscillatory, especially with south-westerly winds, though it is not difficult to make out the mean direction. The discrepancy is not due to errors of orientation of the instruments. The explanation may be simply that at the new site the winds are deflected so as to blow along the main line of buildings, but an alternative explanation is that the difference of direction is due to the difference between the heights of the anemometers, and a rapid veer of southerly winds with height.

The behaviour of southerly winds in various parts of Egypt is known to be peculiar. Thus L. J. Sutton* gives the average veer of such winds as 69° for an increase of height of 1,280 ft., compared

* *Cairo Phys. Dept. Paper,* No. 17.

† Based on information supplied by Mr. J. Durward.

with an average veer for all winds of only 25°. The difference in the effective height of the anemometers at Ismailia is at least 30 ft., and if we assume that southerly winds veer rapidly in this interval, the difference in direction would be explained.

This hypothesis was tested by summarising (Table I) the directions shown by pilot balloon ascents at Ismailia during January to March 1934 (old site) and 1935 (new site) and comparing them with those at Heliopolis near Cairo (January–March, 1934–5).

TABLE I.—CHANGE OF DIRECTION OF SOUTHERLY WINDS WITH HEIGHT

	Ismailia.		*Heliopolis.*
	1934 (old site).	1935 (new site).	1934–5.
Surface	191°	179°	185°
0–500 ft.... ...	203°	203°	206°
500–1,000 ft. ...	216°	228°	242°

At Heliopolis ascents when the surface wind was from other directions show only a small change of direction in the first 1,000 ft. All the ascents considered were made before 8h. local time. The anemometer at Heliopolis is at a height of 40 ft. above the ground.

The effect at Heliopolis depends to some extent on the wind velocity but is not confined to light winds, as shown in Table II, which gives the average veer of southerly and westerly winds between the surface and a height of about 750 ft.

TABLE II.—VEER OF WINDS OF DIFFERENT SPEEDS

Surface wind speed (m.p.h.)	0–5	6–10	11–15	16–20	above 20
Veer of southerly winds ...	71°	61°	45°	36°	24°
Veer of westerly winds ...	37°	20°	26°	6°	—

The average surface speed of both southerly and westerly winds is about 10 m.p.h., but at 750 ft. southerly winds have an average speed of 15 m.p.h. and westerly winds of 19 m.p.h. Both the veer of southerly winds and the increased speed of westerly winds with height are equivalent to the super-position of a west wind of 9 m.p.h. on a surface wind of 10 m.p.h. from south and west respectively.

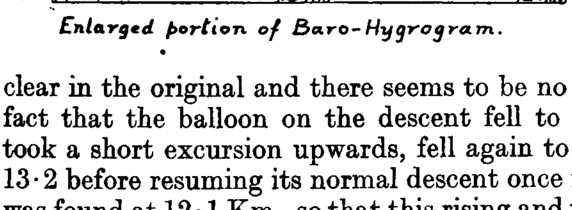
A westerly component of this nature would result from a temperature gradient from south to north, and such a gradient does exist at Heliopolis because the average minimum temperature at that station is 5–6° F. higher than over the cultivated area of the Delta to the northwards. The probable cause of this temperature difference is however a general drainage of cold air off the high ground to the south and south-east on to the low-lying cultivated surface, and this would itself cause a marked veer of southerly winds in the lowest layers. Possibly both factors enter into the phenomena. The abnormal veer does not continue after 10h. or 11h. and this explanation does not apply to Ismailia, where it continues throughout the day. At the latter station therefore the local exposure would seem to be the more probable explanation.

Unusual Feature of a Meteorograph Record obtained from within the Stratosphere

A sounding made from Sealand at 17h. 20m. G.M.T. on February 11th, 1935, in the ordinary course of the International days reached a maximum height of 16·2 Km. The balloon did not burst, but evidently developed a small leak which allowed it to float for many hours. It fell in Luxembourg, apparently about 12 hours after the start, having travelled 650 Km. in a direction 122° east of north.

From the peculiar behaviour of such floating balloons it seems probable that they develop a small leak after the rubber has become permanently strained to such a degree that there is little resiliance left to force the gas out ; they, therefore, descend with a very small vertical velocity.

Unfortunately, owing to an error, the record in the troposphere is missing ; in the stratosphere, however, it is reasonably good, and on the descending record of the hygrograph at the height 12·8–13·2 Km. a remarkable feature can be most clearly seen. The diagram shows an enlarged view of the portion of the record in question, height being indicated by the horizontal co-ordinate, the movement of the hygrograph scriber by the vertical one. The record is perfectly clear in the original and there seems to be no getting away from the fact that the balloon on the descent fell to about 12·9 Km., then took a short excursion upwards, fell again to 12·8 and then rose to 13·2 before resuming its normal descent once more. The tropopause was found at 12·1 Km., so that this rising and falling took place inside the stratosphere. On the record of temperature a confused mass of lines occurs at the same level, the details cannot be made out very well, and all that can be said is that there is nothing corresponding to the adiabatic fall of temperature which would be expected if a vertical current had lifted the instrument by the amount shown. The apparent variations of relative humidity have not much significance since the reversal of motion as regards height causes slight fictitious movement of the recording scriber in the direction at right angles.



Enlarged portion of Baro-Hygrogram.

It is difficult to conceive of any instrumental defect which could artificially produce a record like this, but it is equally difficult to imagine it as a real phonomenon in the atmosphere. A little further down on the descent, just below the tropopause, there are traces of something similar happening again, but the record is not so clear; a rise from 11·2 to 11·9 Km. is there suggested. A study of the International Section of the *Daily Weather Report* does not reveal any signs of thunderstorms in France at the time of the sounding.

A suggestion has been made by Colonel Gold that the balloon may have been covered with snow which fell off by instalments during the descent. This seems a possible explanation and one that would fit in with the characteristics of the record perfectly. We should have to postulate the balloon acquiring a heavy coat of snow on the ascent, carrying it up to a height of 16 Km. without much evaporation, bringing it down again to 13 Km. and then dropping portions of perhaps 10 to 50 grammes at a time. It is unfortunate that as the record of the troposphere is missing we cannot discover whether or not the balloon passed through heavy clouds from which such an accumulation of snow could have been derived.

L. H. G. DINES.

The Rainfall of Rotuma, Fiji

We have received from Mr. R. Osborn, of Suva, Fiji, details of a long rainfall record which has been maintained at Rotuma, Fiji, lat. 12° 30′ S., long. 177° 5′ E., height above M.S.L. 90 ft. The observer is Mr. A. E. Cornish. The record extends from 1912 onwards

	Rainfall.			Raindays. Average.*	Max. fall in 24 hrs.†
	Average.	Wettest.	Driest.		
	in.	in.	in.		in.
January	13·79	24·27	3·10	21	9·32
February ...	16·04	27·01	5·12	21	8·50
March	13·53	22·89	3·51	21	5·44
April	11·79	24·95	4·46	20	3·75
May	12·93	24·80	3·43	20	10·55
June	9·39	18·46	2·26	17	4·82
July	7·91	24·47	1·07	18	3·85
August	10·53	21·18	2·78	20	5·29
September ...	9·88	35·41	2·09	19	5·10
October	11·56	25·28	3·15	19	4·85
November ...	13·76	28·58	4·98	20	6·69
December ...	12·51	24·70	2·53	21	4·04
Year ...	143·62	168·13	101·28	237	—

* 1913–1932. † 1926–1932.

and for the 21 years ending 1932 gives an average rainfall of 143·6 in., which is high for Fiji, though there are wetter stations in the same group. The mean values are as shown in the above table.

REVIEWS

India Meteorological Department, Scientific Notes, Vol. VI. No. 61 —*Evaporation in India calculated from other Meteorological Factors.* By P. K. Raman, B.A., and V. Satakopan, M.A.

The values of the mean daily evaporation in each month at 80 stations in India have been calculated from a formula given below, which was found to give results in good accord with actual determinations of evaporation at eight stations. The data so obtained have been used for the construction of charts showing the distribution, month by month, of the mean daily evaporation over India and the charts are briefly discussed.

The formula used is a slight modification of one due to Carl Rohwer, namely :—

$$E = (1{\cdot}465 - 0{\cdot}186B)\,(0{\cdot}44 + 0{\cdot}118W)\,(e_s - e_d)$$

where E is the mean daily evaporation in inches of water,
B is the barometric pressure in inches of mercury,
W is the daily mean wind velocity at 4 ft. above ground level in miles per hour,
e_s is the pressure of saturated vapour at the temperature of the water surface, in inches of mercury,
e_d is the actual vapour pressure of the air, in inches of mercury.

The modification to the formula consists in the replacement of the term $e_s - e_d$ by $\left(\frac{100}{h} - 1\right) e_d$ where h is the mean relative humidity. The two formulae are identical if the temperature of the water surface is assumed to be equal to the air temperature.

A little consideration shows that however successful it may have been in America and India, the formula fails to represent the results obtained from an evaporation tank under the conditions prevailing at Camden Square. Here the factors involving B and W do not vary much with the season and the formula implies that the evaporation in any month is nearly proportional to $e_s - e_d$, or to the "saturation-deficit" if we assume that the mean water temperature is equal to the mean air temperature. At Kew Observatory the mean value of the saturation deficit is about 5·1 mb. in June and about 1·4 mb. in December. The formula indicates that the mean rate of evaporation in June should be about 3·6 times as great as in December; actual observations at Camden Square show that the rate in June is more than 30 times as great as in December.

By British standards, the values of the calculated evaporation in India are rather startling. For many stations the figure works out at over 100 in. a year and at one, Sholapur, it reaches 174·8 in.

E. G. Bilham.

Why the Weather? By Charles E. Brooks, Ph.D., with the collaboration of Eleanor Habler Brooks and John Nelson. Revised and enlarged. Size $8\frac{1}{4}$ in. by $5\frac{1}{2}$ in., pp. XVII + 295. *Illus.*, New York, 1935.

Dr. C. F. Brooks has the art of making brief but readable accounts of weather phenomena, and has contributed many such notes to the American press. In 1924 a selection of these was published in book form under the title "Why the weather?" and proved a valuable addition to popular meteorological literature. The volume has now been revised and enlarged by the addition of further notes. They are arranged in consecutive order according to season and subject and though they necessarily remain somewhat disconnected, the volume is quite readable. Each note being complete in itself, the comprehensive index also converts the book into a valuable glossary, and as such it is worth its place on the shelves of any meteorological library.

Elaborate analysis would be out of place in a newspaper article, and the book is primarily descriptive; the accounts of phenomena such as ice storms, cyclones and tornadoes are excellent, and should be especially useful to lecturers. The part played by the weather in everyday life is not forgotten, and there are some useful hints for the home-maker and housewife. The author is in fact highly successful in answering the query "How the weather?"; in giving the "Why?" he is always lucid and generally accurate but at times perhaps rather dogmatic. Pros and cons are difficult to weigh in half a page.

The definitions and conventions are of course American and do not always accord with those used in Great Britain. On a hill-side, we expose a rain-gauge with its rim horizontal, not parallel with the slope of the ground, and English readers will be puzzled by the definition of sleet as pellets of ice which rattle on the roofs and windows. There is no special term in America for a mixture of rain and snow. These differences of nomenclature are liable to cause confusion in international meteorology, but the popular usage is well-established in both countries and cannot be gainsaid.

A special word must be said of the illustrations, which are numerous—there are no fewer than 50 photographs—and uniformly excellent. Spectacular phenomena appear to be more frequent in America than in England, and the author has certainly made a representative collection. The publishers are to be congratulated on the attractive get-up and the absence of misprints.

Study of the Minor Fluctuation of the Atmospheric Pressure (1). By Tadao Namekawa. Reprinted from the Memoirs of the College of Science, Kyoto Imperial University, A, Vol. XVII, No. 6, 1934, pp. 405–30.

In this paper the author explains the short period fluctuations of pressure and wind recorded by the microbarograph and the anemograph, by relating them to waves formed at a horizontal surface of discontinuity. Such a "surface" of discontinuity is generally an inversion of temperature extending through a small vertical thickness, and for the purpose of this paper may be regarded as analogous to the surface of separation between two liquids of different densities, in an open containing vessel. That waves may develop at the common surface of the two liquids, whether the liquids be at rest or in relative motion horizontally, is well known and the mathematical treatment of the problem in this case is comparatively simple owing to the fact that liquids may be assumed to be incompressible. In the case of the atmosphere, however, changes of pressure involve changes of temperature and density. These complicate the wave problem and an exact solution cannot be obtained. The author, however, derives a solution by making certain assumptions, the validity of which is upheld by the agreement found later between the theory and observational facts.

The second part of the paper gives in detail a graphical method for the application of this formal solution to a particular case. The author shows that, given the height above ground and amount of the temperature inversion, the temperature distribution and the wind in the two air masses (all of which may be obtained by observation), then the period and velocity of propagation of any system of waves which may develop at the surface of separation can be calculated. Such waves will give rise to fluctuations of wind and pressure at the ground, and if sufficiently large, the fluctuations will appear on the autographic records, in particular the microbarogram. In the two cases discussed, general agreement is found between observation and theory.

Some interesting points emerge from the theoretical discussion. If the upper and lower air masses are moving with the same velocity pressure oscillations will not appear at the ground even though waves may develop at the inversion. In order that pressure waves may appear, the velocity difference must approximate to a certain critical value. The absence of microbarograph oscillations when an inversion is known to exist may be due to the non-adjustment of velocities in the two air masses. Circumstances may also arise in which fluctuations of wind at the ground are unaccompanied by pressure oscillations.

The paper is a courageous and successful attempt to solve what is an extremely difficult problem. It contains, however, a number of mathematical errors, which, together with the complexity of the method adopted for the graphical solution makes the reading difficult. The approximations and assumptions made at various stages might, with advantage, be more fully explained.

A. G. FORSDYKE.

BOOK RECEIVED

Noctilucent Clouds. By E. H. Vestine (Reprint from J. Roy. Astr. Soc., Canada. July–August and September, 1934).

OBITUARY

Miss E. F. Mellish.—We regret to learn of the death on August 23rd last of Miss E. F. Mellish of Hodsock Priory, Worksop. From 1927, following the death of her brother, Lt.-Col. Henry Mellish, Miss Mellish had maintained the valuable climatological observations at the Priory which date back to 1876 in respect to rainfall and to 1879–81 in respect to other elements. The value to climatology of a long and homogenous record such as that of Hodsock Priory can hardly be over-estimated, and it is pleasing to learn that the new tenant, Mr. Edward Dixon, intends to continue the observations as in the past.

We regret to learn of the death of Prof. Dr. Wilhelm Grosse, former Director of the Meteorological Observatory in Bremen.

NEWS IN BRIEF

Dr. Otto Hoelper " Privatdozent " for Meteorology at the Technische Hochschule at Aachen has become Director of the Meteorological Observatory at Potsdam.

Erratum

AUGUST, 1935, p. 171, line 41, *for* " 15·6 hrs. at Pembroke " *read* " 14·6 hrs. at Pembroke on the 30th."

The Weather for September, 1935

Pressure was below normal in the United States, eastern Canada and across the North Atlantic to northern, central and south-eastern Europe and western Asia, the greatest deficits being 9·1 mb. at Lerwick and 2·6 mb. in southern Texas. Pressure was above normal in Alaska, western and northern Canada, Greenland, Spitsbergen and over the western Mediterranean, Spain and the southern North Atlantic to Bermuda, the greatest excesses being 8·4 mb. at Jan Mayen, 6·6 mb. at Kodiak (Alaska) and 2·8 mb. at Lisbon. In Sweden, temperature was below normal in the north and middle but above normal elsewhere, while precipitation was considerably in excess.

In the British Isles the weather of September was very unsettled with frequent thunderstorms and during the middle of the month, severe gales. Rainfall was considerably above normal while sunshine totals were variable. Temperature was also above normal in the south, 70° F. being exceeded on several days and 60° F. on three or four nights. From the 1st to 6th a complex low pressure system covered the British Isles giving unsettled weather with heavy rain locally at times. Thunderstorms occurred at many places in England on the 1st, 2nd and 4th, but there were considerable bright periods ; 2·10 in. and 3·18 in. of rain fell at Borrowdale (Cumberland) on the 1st and 2nd respectively and 1·57 in. at Frome (Somerset) on the 3rd. On the 5th the anticyclone over Iceland began to spread south-eastwards and extended across the British Isles to France by the 6th. Generally fair to fine weather with early morning mist or fog prevailed from the 6th to 10th. Dunbar had 12·3 hrs. bright sunshine on the 6th, Thunderstorms were reported from the Channel Islands on the 9th and ground frosts locally in the north on the 8th. On the 10th a depression advancing from the Atlantic brought rain to Ireland and from then to the 21st complex low pressure systems passed across the country. During this period gales were frequent, rainfall was heavy at times and thunderstorms occurred in different parts of the country on each day from the 13th–17th and again on the 21st; 2·28 in. fell at Barnard Castle (Durham) on the 21st, 2·26 in. at Borrowdale (Cumberland) on the 18th (followed by floods) and 1·90 in. on the 18th and 1·46 in. on the 19th at Trecastle (Brecon). Much sunshine, however, was recorded on several days. Berwick-on-Tweed had 10·9 hrs. sunshine on the 13th and 19th, and Durham 10·9 hrs. on the 19th. On the 14th a line squall accompanied by hail and thunder moved across the country. From the 15th to 20th the winds in England and parts of Ireland remained generally fresh to strong in force, increasing to gales at times especially in the south on the 16th and 17th when extensive damage and several casualties were reported both along the south coasts and also from shipping in the English Channel and off south Ireland. Beaufort force 9 was recorded at Pembroke at 18h. on the 16th and at Scilly Isles and Pembroke at 1h. on the 17th. Among the highest gusts recorded were, on the 16th, 96 m.p.h. at 21h. 45m. at Scilly Isles and 92 m.p.h. at 21h. at Manston (Kent) and on the 17th 85 m.p.h. at 2h. 10m. at Pembroke. Early on the 19th another gale swept the whole country and was again strongest in the south but generally it was not so severe as the previous one. A gust of 67 m.p.h. was recorded at 0h. 35m. at Pembroke. Fog occurred at the mouth of the English Channel on the night of the 19th–20th and mist or fog more generally in the English Channel and south and south-east England on the 21st when a slight ridge of high pressure passed across the south of the country. From the 22nd to 27th depressions and ridges of high pressure passed alternately across the country, the depressions bringing heavy rain and local thunderstorms on the 22nd and 24th and hailstorms in the Midlands on the 22nd, 2·75 in. were measured at Oughtershaw (Yorkshire) on the 22nd and 1·79 in. at Cambridge on the 24th. The 23rd and 25th on the other hand were both fine cool sunny days generally; Bath had 11·2 hrs. bright sunshine on the 23rd and Inchkeith 10·9 hrs. on the 25th. Ground frosts were recorded in the north and west on the 24th and 25th and generally over the whole country on the 26th. With the approach of a new depression temperature rose considerably on the 27th and remained high until the evening of the 28th, 74° F. was recorded at Greenwich and 73° F. at Hull on the 27th. From the 27th to 30th conditions were again unsettled with a few scattered thunderstorms, moderate rain and short bright periods and occasional local mist or fog. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	117	+3	Chester ...	131	+7
Aberdeen ...	141	+17	Ross-on-Wye ...	149	+13
Dublin	124	−9	Falmouth ...	143	−17
Birr Castle ...	101	−18	Gorleston ...	159	+1
Valentia... ...	96	−28	Kew	151	+6

Miscellaneous notes on weather abroad culled from various sources

Severe storms were experienced in north France and Belgium on the 17th, especially along the north French coasts where much damage was done to the fishing fleets and several lives were lost. Storms also occurred along the Dutch coast on the night of the 24th. Thick fog was experienced off Brest on the night of the 27th. Unusually early heavy snowstorms paralysed traffic in Finland at the end of the month when oats and potatoes lay under 12 in. of snow. A violent storm caused much damage at Velez Malaga, Spain, about the 30th. (*The Times*, September 6th–October 1st.)

The disastrous floods in China continued to extend during the early part of the month when the Yellow River was swelling into Weishan Lake which in turn poured its overflow into the Pulao River. Many of the dykes on this river gave way between the 3rd and 8th inundating over 300 villages. On the 12th one of the main dykes on the Grand Canal collapsed and another large tract of northern Kiangsu was flooded with great loss of life. To the south of the flooded areas the country is suffering from drought. The monsoon continued active generally in India during the middle of the month ; at Colaba, Bombay, 11 in. more rain than normal had been recorded during the season while in the Deccan more rain was required. A typhoon swept over Kion Siou island and the east coast of Japan on the 25th and 26th ; 230 people were killed chiefly in landslips and 4 Japanese destroyers damaged. (*The Times*, September 4th–October 2nd.)

Early in the month the drought in the northern cattle country of South Australia was broken by plentiful rains and rain measuring ½ to 1½ in. fell in parts of Queensland ; later lighter falls occurred elsewhere in Queensland and in New South Wales. (*The Times*, September 10th–17th.)

A hurricane swept over Cuba on the night of the 1st and then passed across Florida Keys on the 3rd where much damage was done and nearly 300 people were killed. On the 4th it was travelling along the west coast of Florida where it did much damage to the citrus crops and by the 5th it was passing through Georgia but with its force much abated. On the 27th a hurricane passed close to Jamaica doing much damage to the banana crop there and then travelled north-west to Cuba passing over Cienfuegos on the 28th. From there it moved to the Florida Straits and then travelled north-east missing the coasts of Florida. By October 1st its centre was 300 miles north-east of Bermuda and its force much abated. In Cienfuegos

35 people were killed, and much material damage as well as damage to crops was done in Cuba, Caymanbrac, Grand Bahama and north-west Abaco. Fairly general but moderate rain occurred in the Argentine towards the end of the month. Temperature was mainly below normal in the United States, except in the extreme west, at first but later the warmth spread from the west across the country while the rainfall was generally deficient, except in the Atlantic and Gulf States during the week ending the 10th. (*The Times*, September 4th–October 1st, and *Washington D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, September, 1935

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp.		Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
			Min.	Max.				
	mb.		°F.	°F.	%	in.	hrs.	
1	1011·0	S.2	58	71	74	trace	0·9	tlr_0 19h.–20h.
2	1010·8	SW.3	59	68	69	0·10	7·7	pr during day.
3	1012·8	SW.4	54	70	55	0·02	8·0	pr_0 11h. & 21h.
4	1007·0	W.2	55	67	58	0·29	5·4	r early, rt 9h.–10h.
5	1011·1	SW.3	53	67	72	0·33	4·5	r_0 4h.–5h., r 18h.–23h.
6	1019·2	WNW.2	50	65	55	trace	10·8	w early.
7	1022·6	N.2	45	64	48	—	9·3	w early.
8	1023·1	ESE.3	48	67	52	—	10·1	w early.
9	1021·8	SE.2	52	64	63	—	0·7	
10	1024·7	SSE.2	47	65	52	—	6·7	w early.
11	1015·4	SE.2	48	68	53	—	7·7	w early.
12	1008·0	S.3	53	71	65	—	3·1	w early.
13	1012·1	SW.3	57	69	56	—	4·4	d_0 7h.
14	1010·3	SW.4	55	69	58	0·03	7·2	pr 13h.
15	999·2	SW.4	55	64	75	0·04	1·8	pr 9h.–13h.
16	1001·8	SW.3	52	63	61	0·09	3·6	r_0 18h.–23h.
17	994·6	SW.5	54	63	63	0·13	7·4	r early, pr_0 9h.–13h.
18	1010·6	SW.3	52	61	56	0·06	6·7	r 1h., pr 13h., r 23h.
19	1002·7	WSW.5	57	71	55	0·18	7·5	r–r_0 0h.–6h.
20	1016·4	SW.4	59	70	78	0·02	1·4	r_0 early.
21	1020·5	ESE.2	50	69	82	—	2·4	F early.
22	1008·8	W.4	60	67	77	0·11	2·0	rR 10h.–11h., r_0 21h.
23	1018·4	W.3	46	62	52	trace	9·6	r_0 1h.
24	1011·1	SSW.3	47	59	92	0·40	0·0	r–r_0 5h.–9h. & 11h.–
25	1016·3	WNW.4	50	58	48	—	9·2	[20h.
26	1019·4	SSW.2	39	60	62	0·01	1·9	r_0 20h.–24h.
27	1012·9	SW.3	55	70	77	0·01	3·6	r_0 0h.,18h.&21h. [22h.
28	1008·9	S.2	61	70	77	0·07	2·6	r_0 0h.–9h., tlr_0 21h.–
29	1011·5	WNW.3	53	59	92	0·46	2·4	r–r_0 2h.–13h. & 23h.
30	1003·6	SW.3	54	58	69	0·18	1·7	r–r_0 0h.–9h.,prh 12h.
*	1012·2	—	53	66	65	2·55	5·0	* Means or totals.

General Rainfall for September, 1935.

England and Wales ...	210	per cent. of the average 1881–1915.
Scotland	172	
Ireland	196	
British Isles	198	

Rainfall : September, 1935 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square..........	3·02	166	*Leics* .	Thornton Reservoir ...	4·80	265
Sur .	Reigate, Wray Pk. Rd..	4·28	206	,, .	Belvoir Castle............	4·23	226
Kent .	Tenterden, Ashenden...	3·83	179	*Rut* .	Ridlington	3·96	206
,, .	Folkestone, Boro. San.	3·45	...	*Lincs* .	Boston, Skirbeck.........	2·14	122
,, .	Eden'bdg., Falconhurst	4·47	197	,, .	Cranwell Aerodrome...	4·95	278
,, .	Sevenoaks, Speldhurst.	3·71	...	,, .	Skegness, Marine Gdns.	2.17	120
Sus .	Compton, Compton Ho.	4·70	168	,, .	Louth, Westgate.........	4·31	213
,, .	Patching Farm..........	5·12	213	,, .	Brigg, Wrawby St.......	3·58	...
,, .	Eastbourne, Wil. Sq....	5·93	237	*Notts* .	Worksop, Hodsock......	3·39	223
,, .	Heathfield, Barklye....	6·42	262	*Derby*.	Derby, L. M. & S. Rly.	4·16	252
Hants.	Ventnor, Roy.Nat.Hos.	4·18	169	,, .	Buxton, Terr. Slopes...	7·26	224
,, .	Fordingbridge, Oaklnds	3·43	159	*Ches* .	Runcorn, Weston Pt....	4·89	183
,, .	Ovington Rectory.......	5·10	223	*Lancs*.	Manchester, Whit. Pk.	5·23	219
,, .	Sherborne St. John......	3·76	183	,, .	Stonyhurst College......	8·76	229
Herts .	Royston, Therfield Rec.	3·92	208	,, .	Southport, Bedford Pk.	6·78	246
Bucks.	Slough, Upton............	3·61	205	,, .	Lancaster, Greg Obsy.	9·01	266
,, .	H. Wycombe, Flackwell	4·35	222	*Yorks*.	Wath-upon-Dearne......	3·74	237
Oxf .	Oxford, Mag. College...	4·37	260	,, .	Wakefield,Clarence Pk.	3·61	226
Nor .	Wellingboro, Swanspool	4·19	233	,, .	Oughtershaw Hall.......	11·10	...
,, .	Oundle	2·83	...	,, .	Wetherby, Ribston H..	5·64	313
Beds .	Woburn, Exptl. Farm...	3·98	222	,, .	Hull, Pearson Park......	4·21	245
Cam .	Cambridge, Bot. Gdns.	4·80	298	,, .	Holme-on-Spalding......	4·14	238
Essex .	Chelmsford, County Lab	3·16	184	,, .	West Witton, Ivy Ho.	5·56	258
,, .	Lexden Hill House......	3·05	...	,, .	Felixkirk, Mt. St. John.	4·31	237
Suff .	Haughley House.........	3·18	...	,, .	York, Museum Gdns....	5·20	320
,, .	Campsea Ashe............	4·25	222	,, .	Pickering, Hungate......	4·70	246
,, .	Lowestoft Sec. School...	3·59	183	,, .	Scarborough...............	3·61	202
,, .	Bury St. Ed., WestleyH.	4·54	228	,, .	Middlesbrough............	4·00	241
Norf. .	Wells, Holkham Hall...	3·47	183	,, .	Baldersdale, Hury Res.	7·93	317
Wilts .	Calne, Castle Walk......	5·89	...	*Durh* .	Ushaw College............	6·02	299
,, .	Porton, W.D. Exp'l. Stn	3·62	207	*Nor* .	Newcastle, Town Moor.	2·63	129
Dor .	Evershot, Melbury Ho.	5·47	206	,, .	Bellingham, Highgreen	4·24	177
,, .	Weymouth, Westham.	2·93	139	,, .	Lilburn Tower Gdns....	3·20	136
,, .	Shaftesbury,Abbey Ho.	3·45	142	*Cumb*.	Carlisle, Scaleby Hall...	4·54	168
Devon.	Plymouth, The Hoe....	4·19	164	,, .	Borrowdale, Seathwaite	18·00	191
,, .	Holne, Church Pk. Cott.	6·61	184	,, .	Borrowdale, Moraine...	17·91	239
,, .	Teignmouth, Den Gdns.	2·61	131	,, .	Keswick, High Hill......	9·05	214
,, .	Cullompton	4·18	186	*West* .	Appleby, Castle Bank...	6·07	240
,, .	Sidmouth, U.D.C........	2·86	...	*Mon* .	Abergavenny, Larchf'd	4·96	212
,, .	Barnstaple, N. Dev.Ath	4·61	171	*Glam* .	Ystalyfera, Wern Ho....	10·63	243
,, .	Dartm'r,Cranmere Pool	8·50	...	,, .	Cardiff, Ely P. Stn.......	8·29	267
,, .	Okehampton, Uplands.	7·16	221	,, .	Treherbert, Tynywaun.	14·97	...
Corn .	Redruth, Trewirgie......	4·66	149	*Carm* .	Carmarthen, The Friary	7·24	209
,, .	Penzance, Morrab Gdn.	3·51	120	*Pemb* .	St. Ann's Hd, C. Gd. Stn.	5·10	187
,, .	St. Austell, Trevarna...	4·41	138	*Card* .	Aberystwyth	7·39	...
Soms .	Chewton Mendip.........	6·49	211	*Rad* .	BirmW.W.Tyrmynydd	11·15	289
,, .	Long Ashton............	7·88	329	*Mont* .	Lake Vyrnwy	10·73	304
,, .	Street, Millfield..........	3·87	171	*Flint* .	Sealand Aerodrome......	4·64	225
Glos .	Blockley	5·26	...	*Mer* .	Dolgelley, Bontddu......	8·25	194
,, .	Cirencester, Gwynfa....	5·81	264	*Carn* .	Llandudno	4·65	218
Here .	Ross, Birchlea............	3·83	200	,, .	Snowdon, L. Llydaw 9..	20·08	...
Salop.	Church Stretton.........	4·53	223	*Ang* .	Holyhead, Salt Island...	6·00	224
,, .	Shifnal, Hatton Grange	3·62	188	,, .	Lligwy	7·64	...
Staffs.	Market Drayt'n, Old Sp.	3·88	191	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	3·41	193		Douglas, Boro' Cem....	5·81	176
War .	Alcester, Ragley Hall...	3·80	213	*Guernsey*			
,, .	Birminghm, Edgbaston	3·77	211		St. PeterP't.Grange Rd.	3·20	123

Rainfall: September, 1935: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	5·16	177	*Suth* .	Melvich	6·06	216
" .	New Luce School	5·12	143	" .	Loch More, Achfary	11·22	195
Kirk .	Dalry, Glendarroch	6·01	163	*Caith* .	Wick	4·09	164
" .	Carsphairn, Shiel	9·59	180	*Ork* .	Deerness	4·61	159
Dumf.	Dumfries, Crichton, R.I.	4·13	162	*Shet* .	Lerwick	3·59	119
" .	Eskdalemuir Obs	7·25	196	*Cork* .	Caheragh Rectory	8·12	...
Roxb .	Hawick, Wolfelee	...	...	" .	Dunmanway Rectory	8·85	216
Selk .	Ettrick Manse	7·64	211	" .	Cork, University Coll	6·80	254
Peeb .	West Linton	4·93	...	" .	Ballinacurra	7·19	285
Berw .	Marchmont House	2·59	107	" .	Mallow, Longueville	6·44	268
E.Lot .	North Berwick Res	2·36	113	*Kerry*.	Valentia Obsy	6·19	149
Midl .	Edinburgh, Roy. Obs.	3·24	158	" .	Gearhameen	10·40	170
Lan .	Auchtyfardle	5·47	...	" .	Bally McElligott Rec	4·75	...
Ayr .	Kilmarnock, Kay Pk	6·17	...	" .	Darrynane Abbey	5·73	161
" .	Girvan, Pinmore	4·46	116	*Wat* .	Waterford, Gortmore	6·74	247
Renf .	Glasgow, Queen's Pk	6·07	219	*Tip* .	Nenagh, Cas. Lough	5·39	192
" .	Greenock, Prospect H.	8·78	185	" .	Roscrea, Timoney Park	5·73	...
Bute .	Rothesay, Ardencraig	6·78	...	" .	Cashel, Ballinamona	5·60	228
" .	Dougarie Lodge	5·27	...	*Lim* .	Foynes, Coolnanes	6·13	219
Arg .	Ardgour House	13·26	...	" .	Castleconnel Rec	7·15	...
" .	Glen Etive	...	...	*Clare* .	Inagh, Mount Callan	8·70	...
" .	Oban	9·96	...	" .	Broadford, Hurdlest'n.	6·46	...
" .	Poltalloch	8·11	178	*Wexf* .	Gorey, Courtown Ho	5·06	204
" .	Inveraray Castle	14·85	231	*Wick* .	Rathnew, Clonmannon.	3·45	...
" .	Islay, Eallabus	8·15	195	*Carl* .	Hacketstown Rectory	4·55	163
" .	Mull, Benmore	17·30	150	*Leix* .	Blandsfort House	5·49	202
" .	Tiree	5·09	137	*Offaly*.	Birr Castle	5·67	247
Kinr .	Loch Leven Sluice	5·09	198	*Dublin*	Dublin, FitzWm. Sq	3·53	184
Perth .	Loch Dhu	11·00	192	" .	Balbriggan, Ardgillan	...	...
" .	Balquhidder, Stronvar.	10·29	...	*Meath*.	Beauparc, St. Cloud	4·94	...
" .	Crieff, Strathearn Hyd.	4·92	172	" .	Kells, Headfort	6·01	226
" .	Blair Castle Gardens	4·60	194	*W.M* .	Moate, Coolatore	5·60	...
Angus.	Kettins School	4·35	197	" .	Mullingar, Belvedere	5·83	218
" .	Pearsie House	5·62	...	*Long* .	Castle Forbes Gdns	8·26	287
" .	Montrose, Sunnyside	4·12	207	*Gal* .	Galway, Grammar Sch.	6·13	...
Aber .	Braemar, Bank	3·66	146	" .	Ballynahinch Castle	7·28	153
" .	Logie Coldstone Sch	3·03	130	" .	Ahascragh, Clonbrock.	7·29	235
" .	Aberdeen, King's Coll.	4·24	191	*Mayo*.	Blacksod Point	5·68	146
" .	Fyvie Castle	5·07	194	" .	Mallaranny	7·63	...
Moray	Gordon Castle	3·71	148	" .	Westport House	6·10	172
" .	Grantown-on-Spey	4·43	179	" .	Delphi Lodge	10·64	141
Nairn.	Nairn	3·56	162	*Sligo* .	Markree Obsy	6·20	183
Inv's .	Ben Alder Lodge	7·21	...	*Cavan*.	Crossdoney, Kevit Cas.	6·19	...
" .	Kingussie, The Birches.	4·89	...	*Ferm* .	Enniskillen, Portora	4·34	...
" .	Inverness, Culduthel R.	3·96	...	*Arm* .	Armagh Obsy	3·78	154
" .	Loch Quoich, Loan	17·00	...	*Down*.	Fofanny Reservoir	6·78	...
" .	Glenquoich	...	...	" .	Seaforde	5·47	199
" .	Arisaig, Faire-na-Sguir.	6·15	...	" .	Donaghadee, C. Stn	4·05	170
" .	Fort William, Glasdrum	11·67	...	" .	Banbridge, Milltown	2·91	118
" .	Skye, Dunvegan	7·89	...	*Antr* .	Belfast, Cavehill Rd	4·92	...
" .	Barra, Skallary	4·00	...	" .	Aldergrove Aerodrome.	3·28	132
R&C .	Alness, Ardross Castle.	4·26	146	" .	Ballymena, Harryville.	5·66	182
" .	Ullapool	6·66	177	*Lon* .	Garvagh, Moneydig	4·47	...
" .	Achnashellach	11·64	160	" .	Londonderry, Creggan.	5·83	177
" .	Stornoway	6·76	171	*Tyr* .	Omagh, Edenfel	5·61	184
Suth .	Lairg	4·58	162	*Don* .	Malin Head	5·22	...
" .	Tongue	6·40	202	" .	Killybegs, Rockmount.	5·41	...

Climatological Table for the British Empire, April, 1935

STATIONS.	PRESSURE. Mean of Day M.S.L. mb.	PRESSURE. Diff. from Normal. mb.	TEMPERATURE. Absolute. Max. °F.	TEMPERATURE. Absolute. Min. °F.	TEMPERATURE. Mean Values. Max. °F.	TEMPERATURE. Mean Values. Min. °F.	TEMPERATURE. Mean Values. ½ Max. and Min. °F.	TEMPERATURE. Mean Values. Diff. from Normal °F.	TEMPERATURE. Mean. Wet Bulb. °F.	Relative Humidity. %	Mean Cloud Am'nt 0–10	PRECIPITATION. Am'nt. in.	PRECIPITATION. Diff. from Normal. in.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
London, Kew Obsy.	1010·1	− 4·3	61	33	54·0	41·2	47·6	+ 0·3	42·4	81	7·5	2·69	+ 1·24	21	3·8	27
Gibraltar	1017·5	+ 1·1	82	47	71·1	52·9	62·0	+ 1·1	51·7	78	3·8	1·74	− 0·95	4	...	...
Malta	1015·4	+ 2·0	76	46	64·3	54·8	59·5	− 1·4	54·4	75	4·6	0·22	− 0·64	3	9·8	75
St. Helena	1012·1	+ 0·1	73	59	68·6	61·7	65·1	− 0·2	62·5	91	9·2	4·60	...	25	...	...
Freetown, Sierra Leone	1012·7	+ 1·9	95	70	88·3	74·3	81·3	− 1·1	74·1	72	2·2	0·82	− 3·24	3	...	...
Lagos, Nigeria	1010·8	+ 1·4	93	68	88·9	76·9	82·9	+ 0·1	77·5	83	7·2	6·27	+ 0·19	15	6·3	52
Kaduna, Nigeria	1006·5	...	103	62	95·1	71·2	83·1	+ 1·6	69·3	57	3·9	1·65	− 1·43	4	7·8	63
Zomba, Nyasaland	1012·7	+ 0·2	83	54	75·8	59·3	67·5	− 1·8	62·4	72	5·8	0·72	− 2·94	6	...	...
Salisbury, Rhodesia	1014·8	− 1·1	83	45	75·7	51·1	63·4	− 2·3	56·7	63	3·1	0·01	− 0·98	1	8·3	71
Cape Town	1016·4	0·0	93	48	73·5	57·0	65·3	+ 2·1	57·3	81	5·5	2·70	+ 0·83	9	...	...
Johannesburg	1015·9	− 0·6	79	37	68·6	48·7	58·7	− 1·3	50·3	64	3·6	0·82	− 0·92	7	7·5	65
Mauritius	...	...	86	65	81·9	71·6	76·7	+ 0·9	74·3	85	6·4	16·10	+ 11·63	21	6·4	55
Calcutta, Alipore Obsy.	1006·6	+ 0·3	106	67	95·2	75·5	85·3	− 0·3	75·8	79	4·3	2·34	+ 0·16	3*	...	...
Bombay	1009·1	+ 0·3	90	72	88·2	75·6	81·9	− 1·2	73·8	74	3·2	0·02	− 0·03	0*	...	...
Madras	1007·6	− 0·8	102	75	93·0	79·0	86·0	+ 0·7	78·2	70	5·6	0·00	− 0·63	0*	...	...
Colombo, Ceylon	1009·3	+ 0·6	90	72	88·0	76·0	82·0	− 0·7	78·3	75	6·6	3·69	− 6·04	14	8·5	69
Singapore	1008·3	− 0·6	91	71	86·7	75·5	81·1	− 0·5	77·6	78	7·7	3·27	− 4·36	15	5·1	42
Hongkong	1011·3	− 1·3	85	57	74·3	67·1	70·7	− 0·1	67·8	87	9·1	2·45	− 3·20	8	2·6	20
Sandakan	1008·6	...	91	72	89·2	75·0	82·1	− 0·1	77·9	80	6·6	7·31	+ 2·82	9	...	...
Sydney, N.S.W.	1013·7	− 4·7	88	45	73·1	55·7	64·4	− 0·3	58·1	71	5·2	0·97	− 4·55	10	7·8	69
Melbourne	1014·5	− 5·0	89	44	67·6	52·3	59·9	+ 0·4	55·3	77	8·1	5·94	+ 3·77	20	3·0	27
Adelaide	1017·3	− 2·6	91	43	71·0	55·1	63·1	− 0·8	56·5	62	6·7	1·66	− 0·07	21	5·0	45
Perth, W. Australia	1018·6	+ 0·2	84	47	76·8	57·2	67·0	+ 0·2	56·8	60	4·4	2·07	+ 0·42	9	8·3	73
Coolgardie	1018·8	+ 0·2	99	43	75·6	52·1	63·9	− 1·1	56·0	54	4·1	0·90	− 0·06	3	...	...
Brisbane	1015·3	− 2·3	89	49	78·5	59·4	68·9	− 1·4	62·4	64	3·7	3·62	− 0·15	14	7·8	68
Hobart, Tasmania	1012·6	− 2·2	83	40	61·6	49·6	55·6	+ 0·4	51·0	79	7·6	8·50	+ 6·65	20	3·7	34
Wellington, N.Z.	1015·3	− 2·8	74	47	64·3	52·6	58·5	+ 1·4	55·4	77	6·0	1·79	− 2·09	12	6·2	56
Suva, Fiji	1010·6	0·0	89	69	85·0	73·4	79·2	+ 0·6	74·4	85	6·4	12·78	+ 0·57	26	5·1	44
Apia, Samoa	1009·5	− 0·4	88	71	85·6	74·5	80·1	+ 1·2	76·1	77	5·3	4·02	− 6·13	17	7·7	65
Kingston, Jamaica	1013·1	− 1·0	90	65	86·2	69·7	77·9	− 0·5	68·9	75	2·9	0·01	− 1·23	1	8·8	70
Grenada, W.I.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Toronto	1014·4	− 1·7	68	25	51·0	36·4	43·7	+ 1·6	38·1	70	5·8	0·73	− 1·56	9	6·2	46
Winnipeg	1019·7	+ 3·0	66	5	54·0	28·4	41·2	+ 3·5	28·6	83	5·8	1·00	− 0·40	5	7·0	51
St. John, N.B.	1010·5	− 2·9	58	18	47·0	25·8	36·4	− 2·6	33·3	69	5·7	2·64	− 0·87	9	6·4	47
Victoria, B.C.	1015·9	− 1·6	67	34	55·7	41·4	48·5	+ 0·6	43·6	64	4·5	0·38	− 1·14	6	8·6	63

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

(28253) Wt. 18/32 1000 10/35 Hw. G.377/6

to face p. 225]

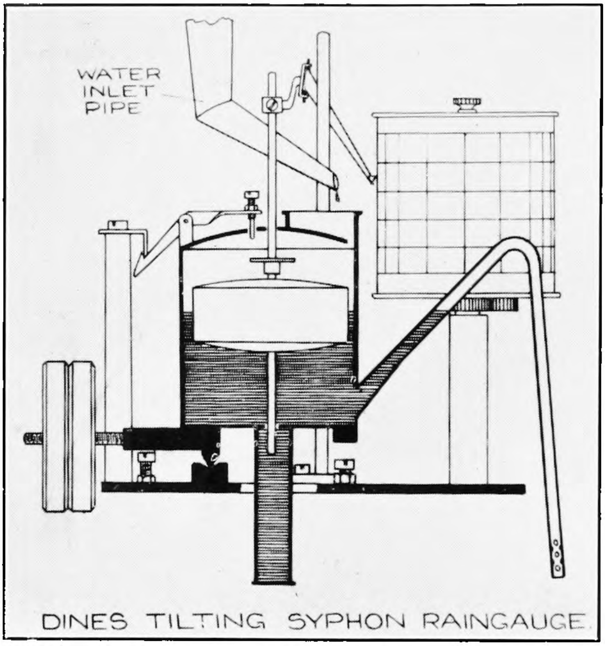


FIG. 1 (see p. 237).

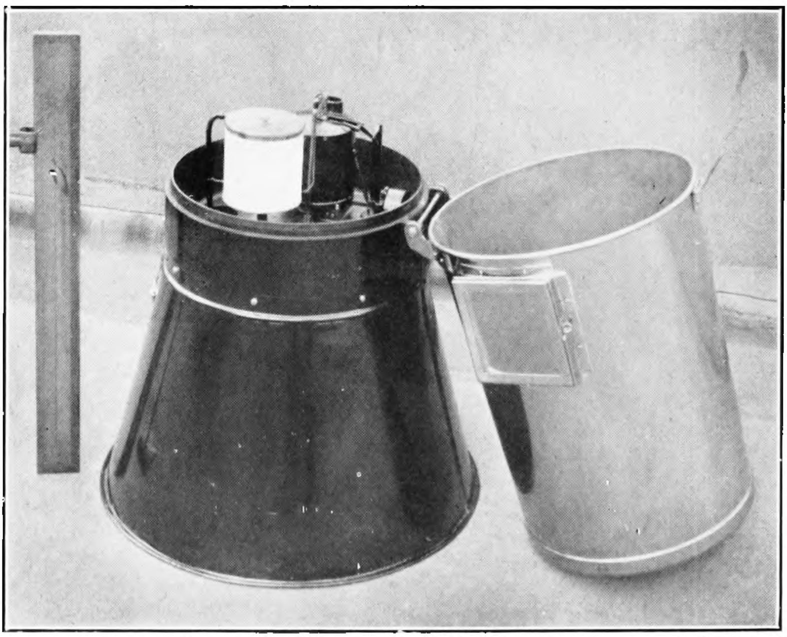


FIG. 2.—DINES TILTING SYPHON RAIN-GAUGE (see p. 237).

M.O. 381.

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The Gale of October 18th–20th, 1935

By T. W. V. JONES, B.Sc.

The gale which swept the British Isles on October 18th, 19th and 20th, 1935, was noteworthy both for its violence, especially in Scotland, and for the time of year at which it occurred. Although deep depressions accompanied by winds of gale force are quite common in the British Isles during the winter months, it is rather unusual to experience gales of extreme violence during the month of October; and the wind velocities which were measured during this particular storm would have been exceptional for any time of the year.

The cause of the gale was a very large and intense depression, with extremely low pressure at the centre, which moved from a position south of Iceland across the north of Scotland to the Baltic, deepening as it travelled across Scotland. The average rate of travel of the depression was about 30 m.p.h. At 7 a.m., on Saturday, October 19th, the centre of the depression was almost exactly over Wick, and the pressure recorded there at that time was 952·6 mb.

During the night of October 17th–18th, the British Isles were under the influence of a feeble ridge of high pressure, the northern extension of an anticyclone centred on the Atlantic about 500 miles eastward of the Azores. In general, the night was fair with moderate westerly winds, and a slowly rising barometer.

The first indications of the oncoming depression were given at 7 a.m., on October 18th, when pressure began to fall in the west of the country and the wind backed to S. or SW. on the north-western and western coasts. By 10 a.m., it was obvious that the approaching depression was of considerable intensity ; in three hours the pressure had fallen 6 mb. at Malin Head on the northern Irish Coast, continuous rain had commenced at Stornoway and the wind on the north-western and western coasts had become generally southerly and fresh or strong ; and on the extreme west coast of Ireland had already reached gale force. By 1 p.m., further large falls of pressure had taken place (10 mb. in three hours at Stornoway) and rain had spread to the whole of northern and western Scotland.

During the rest of the day and night the wind continued to increase over the whole of the British Isles ; and the direction which had been mainly southerly or south-westerly became westerly as the depression moved eastward. At 9 p.m., in the evening a wind of Beaufort force 9 (50 m.p.h.) was reported from Eskdalemuir, in Dumfriesshire. At 1 a.m. on the 19th winds of gale force or above were general over the whole country both inland and on the coast, with the exception of the extreme south and east. During that night and the early hours of the morning winds of Beaufort force 9 or above were reported from Pembroke, Point of Ayre (Isle of Man), Stornoway, Blacksod Point, Sealand and Abbotsinch.

Throughout Saturday, October 19th, the depression continued to move away in an easterly direction but the pressure gradient in the rear of the depression was very steep and the gales continued, if anything with increased force, over most of the country, the wind being more gusty and squally owing to the supply of polar air which gradually spread over the whole of the British Isles, from a direction between west and north-west. The rise of pressure in the rear of the centre of the depression as it moved away was of course very rapid ; in the three hours between 3 p.m. and 6 p.m. on the 19th the pressure rose 8·0 mb. at Stornoway.

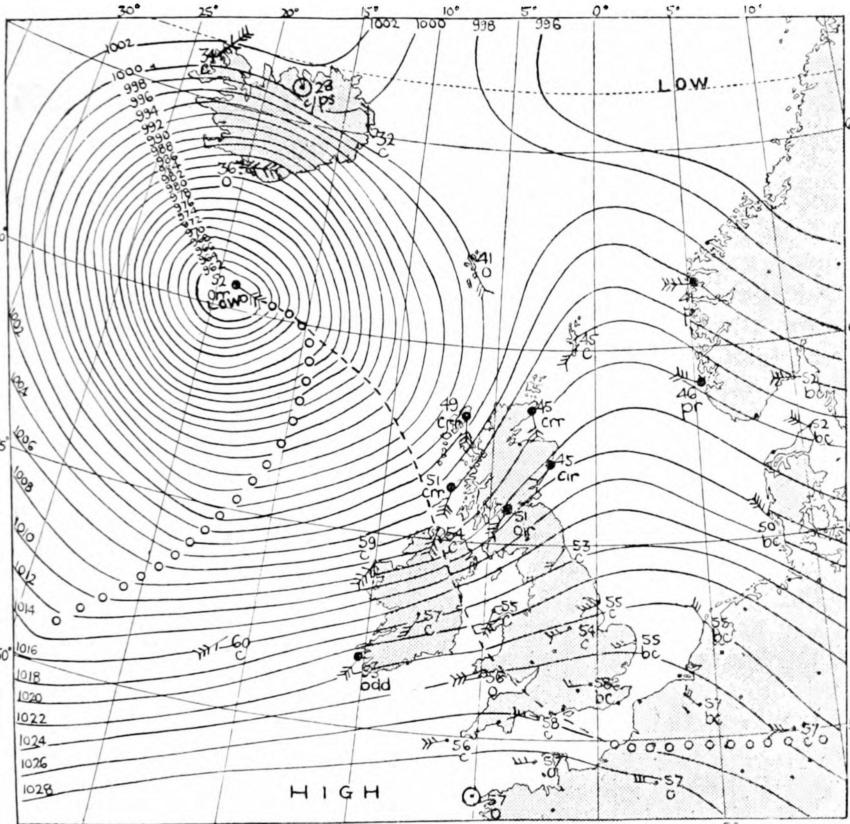
By 7 a.m., on Sunday morning, October 20th, the centre of the depression was situated over southern Sweden and although winds of gale force were still being reported from a number of coastal stations in the north of the British Isles the winds were quickly moderating and by midday had veered almost to north and were not more than fresh in force.

As would be expected with a vigorous and deepening depression of this type there was at first a well marked warm sector. The warm front reached the western coasts during the forenoon of October 18th and passed across Ireland and Scotland during the day ; the cold front, behind which a marked veer of wind took place, was lying roughly down the western Scottish and western Irish coasts at 6 p.m. on the 18th and passed across the country during the evening and night, moving considerably faster than the warm front ; so that by the morning of Saturday the 19th, the central part of the depression was occluded.

Amongst the highest gusts recorded by anemometer stations during the gale were the following:

Abbotsinch	92 m.p.h.	Manchester	73 m.p.h.
Holyhead	76 m.p.h.	Eskdalemuir	69 m.p.h.
Pembroke	73 m.p.h.	Boscombe Down	61 m.p.h.
Sealand	73 m.p.h.		

The very great fall of pressure which accompanied the passage of the centre of the depression is well illustrated by the fact that at 1 a.m. on Friday, October 18th, the barometer reading at Wick was 1013·7 mb.; while at 7 a.m. on the 19th the pressure recorded there was 952·6 mb.; a fall of 61 mb. in 30 hours.



SYNOPTIC CHART 13H. FRIDAY, OCTOBER 18TH, 1935

The rainfall measured during the period of the gale was in most places not exceptional; although amounts exceeding 1 in. were recorded during the 48 hours ending at 7 a.m. on October 20th at some stations in Scotland and northern England; and at Dalwhinnie during this period the total fall amounted to 60 mm. (2·36 in.)

Shipping suffered severely from the storm; and undoubtedly the greatest tragedy was the loss of the Glasgow Steamer *Vardulia* with her crew of 37. This ship had to be abandoned in a sinking condition on the night of October 19th, about 400 miles west of the Hebrides; and although an intensive search for her boats was carried out by a number of vessels for several days, no trace of them could be found. Two coasters were driven ashore in the Clyde and another grounded in the Tay, whilst according to *The Times* of October 22nd, the estimated damage to small craft at Clyde resorts was about £50,000. Structural damage was reported from all parts of the country; but more especially from Scotland and northern England, and in Scotland communication was considerably interrupted owing to damage to telephone and telegraph lines. A number of persons were killed or injured as the result of accidents attributed either directly or indirectly to the gale.

The Exceptional Gales of September 16th–17th, 1935

By L. F. Lewis, B.Sc.

The gale which raged over southern England from September 16th to 17th, 1935, was exceptionally severe for the time of year. Among notably high speeds recorded in gusts were 98 m.p.h. at Pendennis Castle, 96 m.p.h. at St. Mary's, Scilly, 92 m.p.h. at The Lizard and at Manston, 88 m.p.h. at Cardington, 81 m.p.h. at Calshot, 80 m.p.h. at Larkhill (Salisbury Plain), 77 m.p.h. at Lympne and 72 m.p.h. at Dover. The writer has examined the analysis of the anemograph records for the above stations published in Tables XI and XV of the *Annual Summary to the Monthly Weather Report* back to 1920 (or to the year in which the analysis was first published, if the instrument was installed at a later date) and has not found in any September, speeds comparable with those mentioned above. In some cases the speed is the highest ever recorded: for example, at Larkhill* the speed, 80 m.p.h., has not previously been reached in any month since the wind analysis was first published in 1921; at Calshot, 81 m.p.h. was equalled on December 29th, 1929, but has not been exceeded since at least before 1921 and at Dover† 72 m.p.h. is the highest since before 1924. The speeds at Scilly (96 m.p.h.) and at Pendennis Castle (98 m.p.h.) were exceeded on January 12th, 1930, December 6th, 1929 and March 8th, 1922. In fact this gale of mid-September, 1935, was comparable with some of the most severe winter gales ever experienced in southern England.

The gale was very destructive both on land and sea. Telegraph wires were broken down, hundreds of trees were felled and extensive damage was done to vegetation of all kinds. Much correspondence has been published in *The Times* with reference to the cause of the

* The instrument at Larkhill was not in operation during the stormy period of November, 1929 to January, 1930.

† The instrument at Dover was defective during the gales of November, 1928.

destruction of the leaves on the trees. Some writers believe that it was due to the deposit of salt carried by the wind but others (including Dr. Vigurs of Newquay) believe that the injury was due to the actual mechanical beating of the wind and of the leaves one against another. At sea, many ships were wrecked and some lives were lost both on land and sea.

It is interesting to find that on the occasion of each of the noteworthy gales of March 8th, 1922*, December 6th, 1929†, January 12th, 1930‡ and September 16th-17th, 1935, the prevailing pressure distribution was similar. In each case a depression was situated off north-west Scotland, while a secondary development occurred off our south-west coasts. The latter disturbance became intense and moved north-east or east-north-east across England, giving rise to the exceptionally high wind speeds experienced.

An interesting effect of the gale of September 16th–17th was the deposit on windows in Cornwall. The deposit was very thick and was sometimes described as grey and sometimes dark brown. The trajectory of the air which was at Scilly at 1 a.m. on the 17th has been traced and before reaching Cornwall the air travelled more than 500 miles across the North Atlantic. This fact rules out the possibility of the deposit coming from either a desert or the industrial areas of England. White or greyish deposits were probably salt carried by spray after the heavy rain had ceased. Transport of salt in this way is well known. The brown deposit presents more difficulty but the most likely suggestion seems to be that it consisted of oil or other waste scum brought in from the sea. It is said that the coastguards at St. Ann's Head are sometimes covered with oily filth when spray is carried over by strong westerly winds.

OFFICIAL PUBLICATION

The following publication has recently been issued :—

GEOPHYSICAL MEMOIRS.

No. 67. *Some measurements of the variation of potential gradient with height near the ground at Kew Observatory.* By F. J. Scrase, M.A., B.Sc. (M.O. 356j.)

This memoir describes some observations of the variation of potential gradient up to a height of 10 m. made by a differential method employing a double stretched-wire collecting system. It was found that on the average the potential gradient decreased by about three per cent. in 10 m.; the change was more uniform in turbulent air than in comparatively stagnant air. On the average the density of the volume charge was small enough to be accounted for by the normal excess of positive small ions. In still air a charge of the order of + 0·1E.S.U./m.^{3} was observed between 5 and 10 m. and it is

* See *Meteorological Magazine* **57,** 1922, p. 102.
† *Ibid* **64,** 1929, p. 280. ‡ *Ibid* **65,** 1930, pp. 1–6.

probably the large ions which are effective in such conditions; the necessary excess of positive large ions is, however, so small compared with their total number that for most purposes we may regard positive and negative to be equally numerous.

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings are :—

November 25th, 1935. (a) *The size and size distribution of fog particles* and (b) *A study of the evaporation of small water drops.* By H. G. Houghton (Physics, Minneapolis, Vol. 2, 1932, pp. 467–75; and Vol. 4, 1933, pp. 419–24.) *Opener*—Mr. S. F. Witcombe, B.Sc.

December 9th, 1935. *Practical experiences and some results gained from soundings with registering balloons and registering apparatuses in the stratosphere.* (Beitr. Phys. frei. Atmos. Leipzig, Vol. 22, 1935, pp. 249–60.) *Opener*—Mr. F. J. W. Whipple, Sc.D.

Correspondence

To the Editor, *Meteorological Magazine*

An unusual Optical Phenomenon. An Arc of Lowitz?

I am enclosing an account of an optical effect observed by my father, who was at Grayshott at the time, on August 28th last.

At 17h. 40m. the west and north-west sky contained a considerable amount of cirrostratus cloud, of which the structure was only faintly perceptible. On a horizontal line through the sun, to the north of it, in the place where one would expect a parhelion of 22°, a "shaft" of light was visible. It was vertical. Its length was about 2°–3°; its width probably less than 1°. It possessed iridescent colours, well defined but not brilliant. It could not have been part of the halo of 22° as it showed no curvature whatever—it was perfectly straight.

My father said it was an elongated parhelion, but I am inclined to think that he had been favoured with the rare chance of seeing an arc of Lowitz, since the distortion took place vertically, and not in the direction of the parhelic circle. The arc of Lowitz must have been out of shape—in fact Besson ("Sur la Théorie des Halos") states that this rarely takes the proper shape of a double fan of light, but is generally seen as a distorted parhelion. S. E. ASHMORE.

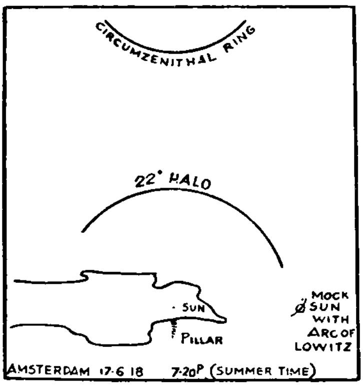
Field Cottage, Llanishen, Cardiff, September 18th, 1935.

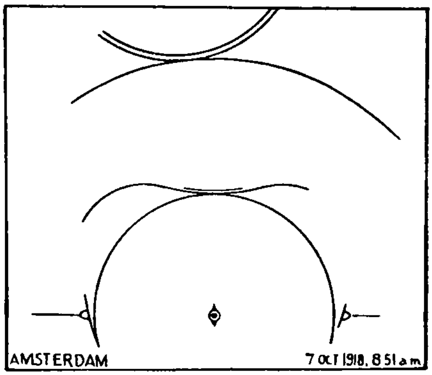
[The observations recorded by Mr. Ashmore remind me of a phenomenon which I saw six years ago, on May 22nd, 1929. The note from which the following quotation is taken is dated, in typescript, May 29th, 1929, a week after the event, but the note was, I believe, written with much less delay.

"When I left the Observatory at 18h. 5m. the upper part of a

22° halo was visible but no parhelion. The northern parhelion appeared soon after I got on an omnibus at Richmond. The parhelion was formed in a cloud much lower and denser than that producing the halo and no part of the halo was within a good many degrees of the parhelion. About five minutes later when the omnibus was at Kew Gardens, the parhelion became more brilliant and was drawn out in a band of colour inclined at about 15° to the vertical, the length being considerably greater than the width. The red of this band was much brighter than the dull red of the halo. The band was only visible for about half a minute; the parhelion persisted for ten minutes, though growing fainter."

The arcs of Lowitz were observed in Holland on three days in 1918. Sketches made by a practical observer, Mr. M. Pinkhof, at Amsterdam on two of three days, June 17th and October 7th are reproduced in *Hemel en Dampkring* 1918 and in *Onweders, Optische Verschijnselen, enz in Nederland*, 1918, pp. 67 and 71. The ones in the latter publication are reproduced again here. The first





Reproduced from Onweders, Utrecht, 1918, p. 67 and p. 71

sketch recalls my observation, for only the upper part of the ordinary halo is shown. The arc of Lowitz is shown on the right of the sun, which is hidden by dense cloud. The length of the arc is said to have been about 2°.

On October 17th, 1918, Pinkhof observed a halo complex which included both arcs of Lowitz. The arc on the left was 7° long, it passed through the parhelion and reached the halo. It is not stated whether the arc was straight or curved. It is clear, however, that these arcs should not be regarded as touching the halo. In the drawing made by Lowitz at St. Petersburg in 1794 the arcs now known by his name meet the halo at an angle.

The theory referred to by Mr. Ashmore is obviously at fault for the arcs when seen are well defined. There is, I think, good reason for calling the phenomenon seen by Mr. Ashmore, Senior, an arc of Lowitz even though this may be the first time that a vertical arc has been recorded.—F. J. W. WHIPPLE].

Cirrus Cloud at an unusually Low Altitude

Shortly before 8h. B.S.T. on October 2nd, 1935, I observed here some cirrus cloud which seemed to be at an unusually low altitude.

At that time there were about 5/10ths of altocumulus covering most of the sky west of a line from north to south. Below this cloud, which appeared to be of typical altocumulus structure but with considerable shading, was a small amount of cirrus uncinus to north-westward with a radial point in the west. Both this cloud and the altocumulus seemed, as far as I could judge, to be moving from north-west and at about the same speed. The snowy-white cirrus uncinus was clearly distinguishable from the greyish cloud layer above it, and the contrast became sharper as some of the cirrus cloud reached the zenith.

At 10h. the altocumulus had covered about 7/10ths of the sky and had become darker and thicker. There was then no sign of cirrus below it.

Conditions at the surface at 8h. were: wind westerly, force 2, screen temperature 45°F.

C. STUART BAILEY.

Longbridge, 76, Woodcote Valley Road, Purley, Surrey, October 2nd, 1935.

Irisation

An excellent example of irisation was observed at Cranwell at approximately 15h. on October 15th, 1935.

The cloud at that time consisted of small patches of stratocumulus and altocumulus with considerable cirrus and cirrocumulus, the sky being 7/10ths covered. The particular cloud involved was a patch of cirrocumulus, size about 1/20th of the total sky in view, at 9° north-west of the sun. The whole patch was tinted red, green, blue and yellow and the effect was a beautiful mother-of-pearl. The blue and yellow faded very quickly after the first observation but the red and green remained for some considerable time.

A nephoscope reading taken at the time produced the result 30 m.p.h. at 300°.

L. L. ALEXANDER.

Meteorological Station, Cranwell, October 16th, 1935.

Partial Cloud Dispersal by an Aeroplane

The letters by R. E. Watson and others in the July issue of the *Meteorological Magazine* on " Partial Cloud Dispersal by an aeroplane " recall an incident at this station in about the late autumn or early winter of last year. Late in the afternoon fog suddenly began to develop on the aerodrome. I should estimate it was about 15 ft. deep, when an aeroplane came in to land. Actually although lost to view the pilot did not land at the first attempt, but suddenly came up out of the fog, made a half circle of the aerodrome and then landed successfully. On inquiry it was discovered that during the first approach the pilot cut a lane in the fog and then returned to make a perfect landing in this clear lane.

The great similarity in the conditions and in the dimensions between the cloud patch mentioned by Mr. Watson and the aerodrome fog here is very striking. I suggest that in these cases where condensation is just commencing through such a very restricted vertical thickness, the airscrew draws in some of the "outer" air which at least is not yet at condensation point (and would in general be somewhat warmer than the fog-laden air) and the condition of the resultant mixture in and around the aircraft is such that, at least temporarily, evaporation replaces condensation. It is suggested that some "outside" air with different characteristics is necessarily involved in these cases of cloud and fog dispersal. If it is assumed that an average airscrew of about 11 ft. diameter affects the air in its path over a diameter about 15 per cent greater, it will be seen that in both the above cases, an adequate supply of "outer" air is assured. Had the cloud at Abingdon been as much as 50 ft. thick, would any partial dispersal of the cloud have occurred if the machine had flown through the centre of it ?

From a study of the opposite effect to dispersal, that of cloud formation by aeroplanes at this station, Mr. J. S. Smith and myself conclude that the turbulence of the slipstream, with the pressure reductions associated with it (in spite of the heat of the exhaust gases), is calculated to form cloud under suitable conditions in a layer of damp air which is of the order of 500 ft. thick, even after cloud which was originally present there has dispersed, as well as in other conditions.

F. H. Dight.

Meteorological Station, R.A.E., S. Farnborough, Hants, October 17th, 1935.

Dust-devils

Proof of the comparative frequency of small whirlwinds in the British Isles is their prominence in folk-lore. In Ireland and Scotland they are attributed to the fairies, also in the former country to the dead.

Cicely M. Botley.

Guildables, 17, *Holmesdale Gardens, Hastings, October 22nd,* 1935.

Thunderstorms associated with a Warm Front

The occurrence of a thunderstorm at a well marked warm front of a depression is sufficiently rare to merit an account of the conditions under which it was experienced. Such a thunderstorm occurred at Cranwell from 15h. 46m. G.M.T. on September 24th, 1935.

The weather conditions during the day were as follows :—slight rain commenced at 6h. 25m., and intermittent rain occurred until

10h. 50m. when the cloud base lowered from 1,500 to 600 ft. and the visibility decreased from $2\frac{1}{2}$ to $1\frac{1}{4}$ miles. From that time slight continuous rain was experienced until the onset of the thunderstorm, the cloud base remaining at 500 ft. although the visibility improved to $2\frac{1}{2}$ miles at 14h. 10m. A thunderstorm developed to the north-west of Cranwell at 15h. 46m. and heavy rain occurred. At 17h. 45m. the clouds began to decrease and rain ceased at 18h. 2m.

Light to moderate winds occurred during the day, the direction being southerly, backing to SE. after 9h., and then veering to southerly after 13h. At 16h. the wind decreased from 11 m.p.h. to less than 5 m.p.h., the direction being variable until 16h. 35m., when it became mainly SSE. with a gust of 34 m.p.h. from WSW. Later the wind gradually veered from southerly at 19h. to westerly at 23h., the force increasing from moderate to fresh. During the day the temperature rose slowly and steadily from 49° at 11h. to 55° at 15h. Little change of temperature occured during the thunderstorm, but later the temperature rose to 57° at 18h. Pressure fell throughout the day, with a temporary check in the fall about 16h. Until the commencement of the thunderstorm about 7mm. of rain were recorded, while from 15h. 46m. to 17h. 45m. about 20 mm. of rain fell.

The upper winds over England were from SSW. to WSW. at 7h. and 13h. but had become WNW. at Holyhead by 17h.

At 13h. a warm front extended from Manchester to west of Calshot and a cold front from Holyhead to Plymouth. At 18h. the warm front extended from Spurn Head down the east coast of England with a cold front from Manchester across Salisbury Plain. Upper air temperatures at Duxford showed a rise from 36° to 44° at 5,000 ft., from 27° to 28° at 10,000 ft. and from 10° to 14° at 15,000 ft. between 6h. and 12h. on September 24th, and falls from 44° to 35° at 5,000 ft., from 28° to 22° at 10,000 ft. and from 14° to 7° at 15,000 ft. between 12h. on the 24th and 6h. on the 25th.

It would appear that the thunderstorm resulted from the incursion of colder air above the warm front in this quickly moving depression.

R. P. Batty.

Meteorological Station, Cranwell, October 23rd, 1935.

Geophysical Memoirs No. 65

Professor Köhler has drawn my attention to an unjustifiable assumption in *Geophysical Memoirs* No. 65. " Transfer of heat and momentum in the lowest layers of the atmosphere."

In order to illustrate the use of " power laws " I have quoted on p. 20 a formula derived by Köhler for the distribution of temperature and have deduced that the variation of time of maximum temperature with height is given by a " power law ". This power law I then compared with a power law found empirically and from this comparison deduced that the coefficient of eddy conductivity varies as $z^{1.62}$. The particular formula quoted however, was not established for heights as low as those considered in the memoir and accordingly the final deduction mentioned above, that the coefficient of eddy conductivity varies as $z^{1.62}$ was not valid.

Nevertheless I think it is still of interest in view of the good agreement with the similar result obtained on p. 27 of the memoir.

A. C. BEST.

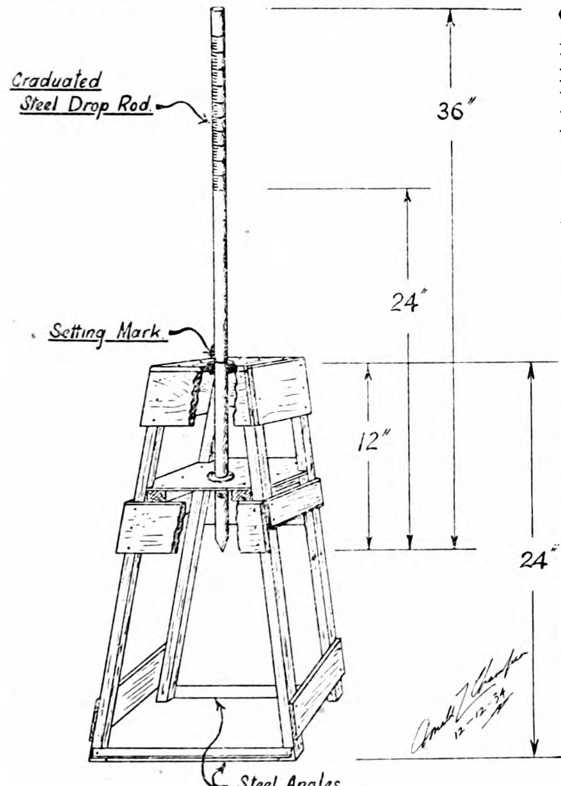
Meteorological Station, Croydon, October 10th, 1935.

NOTES AND QUERIES

Scalar Values of the State of the Ground

For some months past an attempt has been made to obtain scalar values of the hardness of the surface soil at Goff's Oak, Herts, and the results obtained may be of interest.

The instrument used, Fig. 1, is of simple construction, consisting of a mild steel drop rod $\frac{3}{4}$ in. in diameter, 36 in. in length, weighing $4\frac{1}{2}$ lbs. This rod is arranged to slide freely in a vertical plane through steel bushes let into a timber trestle. The trestle is fitted with steel angles at its base to minimise wear and is so constructed that the surface of the upper bush shall be fixed at 24 in. from the underside of the steel angles. The pointed drop rod has a setting mark engraved at a distance of 12 in. from the point and a scale of inches and tenths is engraved on the upper end, the zero mark being 12 in. from the setting mark.

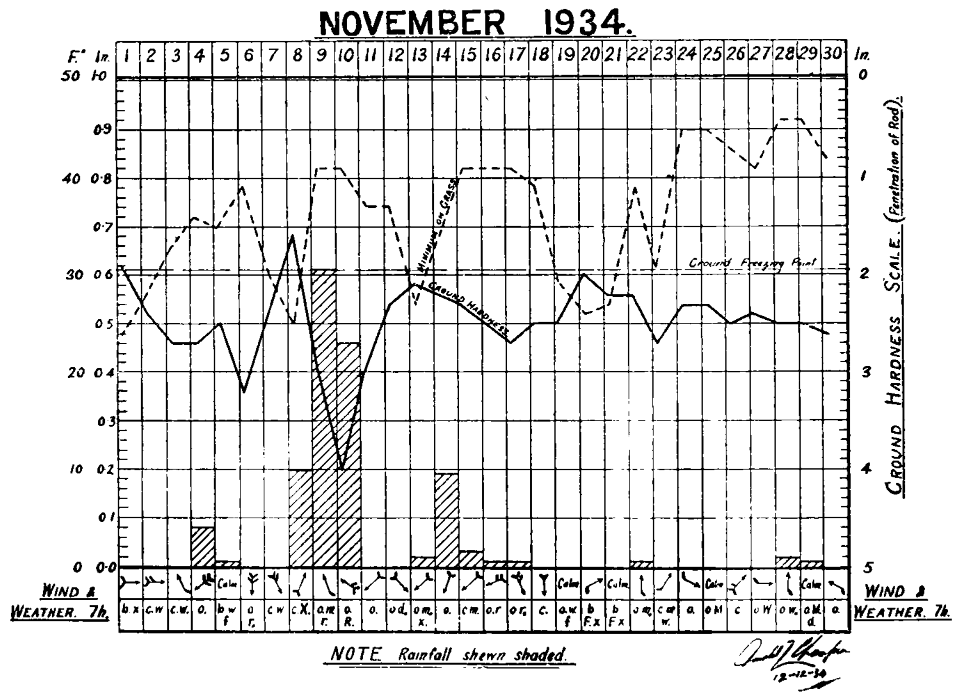


A patch of soil was dug out to a depth of 15 in., passed through a sieve of $\frac{3}{8}$ in. mesh to remove loose stones, replaced, carefully levelled off and left some months to settle and kept free of weeds.

The instrument is operated as follows. The trestle is placed on the prepared ground and the rod is raised so that the setting mark coincides with the plane of the upper surface of the top bush. The rod is then released, and falling into the soil, the depth of penetration of the point is read off from the scale, the upper surface of the top bush being the index. The hardness of the ground is taken as being inversely proportional to the depth of penetration. At first, the mean of three trials was taken as the correct reading, but after many observations it was found that the readings obtained from any three trials, made at the same time, differed but little from each other and the method was abandoned in favour of only one trial per observation.

The instrument is kept indoors when not in use and is placed in a different position for each observation to avoid piercing the soil in the same place each day. The area of the prepared soil is such that some considerable time elapses before the same spot is pierced, during which period the soil becomes automatically levelled again by the weather.

Since the height of the drop (12 in.) and the weight and diameter of the rod are constants, it follows that the readings from day to day give comparable values of the soil hardness.



The attached chart for the month of November 1934, Fig. 2, shows the penetration each day at 7h. G.M.T. in conjunction with the rainfall, grass minimum, wind and weather, etc. The grass minimum temperature (°F.) and rainfall (in.) in the preceding 24 hours are shown by the scales on the left-hand side, the penetration of the rod in inches by the scale on the right-hand side. The effect of rainfall in softening the soil (Boulder Clay) is apparent throughout the month, particularly on the morning of the 10th ; but even light falls have effect if there is little wind to dry the surface as on the morning of the 23rd. The converse effect of frost is conspicuous on the mornings of the 8th and 20th.

This instrument gives fair results for clay soils, but probably other soils would become tamped down by continued use of the rod over a small area. However the curve shown in Fig. 2 demonstrates the fact that comparative results are obtainable from day to day at stations where the surface soil is clay or similar material.

DONALD L. CHAMPION.

The Dines Tilting Syphon Rain-gauge

In order that self-recording rain-gauges may give a continuous record during prolonged periods of heavy rain it is customary to provide them with an automatic syphoning device which empties the float chamber when the pen reaches the top of the chart. This syphoning device is a frequent cause of trouble and many attempts have been made to devise a system which shall be entirely reliable. Considerable complications have sometimes been introduced in this endeavour but it cannot be said that these complications have been altogether justified by the results obtained and of late years the tendency has rather been to rely upon a simple syphon, very careful attention being given to the design of the syphon tube to ensure that it shall function in a reliable manner. Modern gauges do not give much trouble in this way but from time to time the action does fail and in the endeavour to obtain an entirely satisfactory gauge much thought has been given to the design of self-recording rain-gauges in the Meteorological Office during the past few years. Experience shows that failure is most likely to occur when the rainfall is light. In these circumstances the column of water in the rising tube approaches the top of the syphon very slowly and may dribble over instead of " breaking " cleanly and abruptly. What is required therefore is some means of ensuring that the syphon will be started in a positive manner under all conditions.

Amongst the designs which came up for consideration was one by the late Mr. W. H. Dines in which the float chamber was mounted on knife edges which were so positioned that when the chamber became full it overbalanced on the knife edges, tilting over towards the side on which the syphon outlet tube was mounted. The tilting action caused a surge of water to flow through the tube which started the syphon in a positive manner thus fulfilling the requirement mentioned above. When the chamber emptied it fell back into its former position under the action of gravity and so was ready for a repetition of the operation. This gauge was described in the *Meteorological Magazine* for July, 1920. Two or three gauges were made up in the workshop at Benson Observatory and were in use for several years and gave on the whole satisfactory results. It was found however that the point of tipping was somewhat irregular which made it difficult to measure up the charts. When this design was considered it was suggested by Sir George Simpson, Director of the Meteorological Office, that if the tilting of the float chamber were controlled by a catch, this catch being released by a trigger when the float reached a specified point, the action of the gauge would be rendered more regular. A gauge to which this additional device was fitted was accordingly made up at Kew Observatory and showed very satisfactory results in a prolonged test. Equally satisfactory results had not been obtained from other types of gauge which were under trial at the same time and it was, therefore, decided to concentrate attention on the Dines tilting syphon rain-gauge. Detailed drawings were prepared in the Instruments Division and six gauges purchased from Messrs. J. J. Hicks of Hatton Garden. These gauges have now been put through a thorough test and have confirmed the anticipations of satisfactory working which had been formed from the test on the experimental model. The design has therefore been adopted as the standard Meteorological Office pattern recording rain-gauge. A diagram showing the principle of the gauge is given in Fig. 1 together with a photograph of the completed gauge in Fig. 2; these form the frontispiece of this number of the magazine. The rule on the left in the photograph is a 2-foot rule from which it will be seen that the gauge is of somewhat massive proportions. This is due partly to the desire to make it as robust as possible and partly to the fact that an open scale record giving ten times the natural scale was desired. In order to obtain this scale it was considered expedient to fit a funnel of 11·31 in. diameter having an area twice that of an 8 in. funnel. The charts issued by the Meteorological Office are ruled for millimetres, the syphon operating after 5mm. of rain have fallen. Since 5 mm. differs little from 0·2 in. the gauge can be used without modification for charts ruled in inches, the adjustments which are provided being sufficient to enable syphoning to take place after 0·2 in. of rain instead of 5 mm. A description of the gauge appears in the 1934 edition of the " Meteorological Observer's Handbook ", page 126.

REVIEWS

The cycles that cause the present drought. By Halbert P. Gillette. A paper read June 26th, 1935, at the Annual Meeting of the American Meteorological Society at Los Angeles, California.

This brief paper contains much food for thought. The author begins by analysing graphically a series of long records of growth rings of Arizona pines (1410–1866) and of Sequoias from California (1305 B.C.–A.D. 216), and of thickness of the varves or annual clay-laminae formed by the recession of the last ice-sheet in Canada (1824 years), all of which show convincing evidence of a cycle of about 152 years. The same cycle appears in Nile flood levels from 1735 to 1919 and New England rainfall from 1750 to 1934, though as these two curves extend over less than two cycles the evidence is not so convincing.

These long series of data were then analysed for periodicities by an arithmetical summation method, and thirteen cycles were found, ranging in length from just under 2 years to 152 years 1 month. Generally speaking, the " amplitude " (defined as the percentage departure of the cyclograph peak or valley from the mean) increases with increasing length. This is probably due to the fact that the shorter the cycle the more often it is repeated during the period available, and hence the less chance there is of a spurious periodicity passing as real. The amplitude of the 2-year cycle is only 4 per cent, which is negligible, increasing to 15 per cent for the 69·7 year cycle and 13 per cent for that of 100·7 years. The author gives no confirmation of this part of his results, but further evidence is required before these cycles can be accepted as genuine, especially those which have not been found previously by rigid analysis of instrumental data. Cycles of 2, 3·1 and 23–24 years are already well known from many parts of the world. Curiously, the 11-year sunspot cycle is missing from the series.

The 152-year cycle, with a sudden jump in amplitude to 25 per cent is in a different category, and the graphs alone are sufficient proof. Moreover, the author finds support in historical data from California and Australia. He then introduces the idea that the amplitude of the cycles is not constant, but itself goes through a regular cycle which is several times the length of the basic cycle. Thus the 2-year cycle (35/18 years) has itself an amplitude cycle of 35 years, that of the 19/6-year cycle is 19 years and so on. The author does not state how these " amplitude cycles " were found, and the " fit " with the basic cycle expressed as a fraction is much too good to be true.

152 years 1 month is 1825 months, and hence it is inferred that this periodicity should have an amplitude cycle of 1825 years. The exact length of this major cycle depends on the odd month, but a little consideration should make it obvious that the true length may equally well be either 152·0 or 152 years 2 months giving inferred amplitude cycles of infinity or 913 years ! However, he adds, " Evidence of the correctness of this inference is to be found in groups of exceptionally high recessional moraines at intervals of about 1825 years ". Roughly the same interval is claimed for Finland. There seems no reason however why this long interval should not be an independent periodicity or recurrence, unrelated to the cycle of 152-years. In western Europe for example there is no evidence of a marked 152-year periodicity, but the two periods

of greatest storminess and rainfall appear to have been about 600 B.C. and A.D. 1,200.

From his results the author concludes that the recent droughts in America represent the troughs of the 152- and 69·7-year periodicities, and hence are likely to continue for many years, so that plans should be laid accordingly. Time will tell; meanwhile the author should present his data in much greater and more critical detail.

C. E. P. BROOKS.

Weather Studies, No. 1. Unofficial Meteorology. Lecture by Sir Napier Shaw, LL.D, Sc.D., F.R.S., at Falmouth, July 20th, 1933, on the occasion of the Centenary of the Royal Cornwall Polytechnic Society. Size 10 in. × 6 in., pp. 26. *Illus.* Huddersfield, Thunderstorm Census Organisation, 1934. 1*s.* net.

In re-issuing this lecture originally published in the *Hundredth Annual Report of the Royal Cornwall Polytechnic Society*, Mr. Morris Bower performs a service by introducing it to a wider public. The lecture is quite short but covers a range of subjects in Sir Napier's usual entertaining style. Particularly skilful is the presentation of certain salient facts of meteorology in a way that will ensure their being impressed on the memory of many a reader who may have often read and forgotten them in a duller setting. The value of the pamphlet is much enhanced by the power of the illustrations to grip the imagination. Among these we have a most useful pictorial summary of the results of upper air research, pictures of snow crystals and dust particles, diagrams relating to the weather elements at Falmouth and Kew, and above all a selection of exceedingly beautiful cloud photographs, many of them from Mr. Cave's collection. Yet we note with satisfaction that Sir Napier refers to the photographic camera not as one of the requisites but as one of the perquisites of unofficial meteorology. Photography is costly both in time and money, and however desirable as an adjunct should never take the place of the diligent use of the amateur meteorologist's own eyes. A meteorologist should notice everything when in the open air—even to the faintest suspicion of a shower far away on the horizon, and should aid a retentive weather memory by making notes and descriptions of what he observes.

A photograph of a walnut tree at Benson with its spring foliage injured by frost is stated to have been taken by the late Mr. W. H. Dines on May 31st, 1922. We query this date as it fell near, or within, the hottest spell of May weather on record. There may, of course, have been a localised valley frost capable of damaging foliage at that time, but the date is more likely to have been May 31st, 1923.

L. C. W. BONACINA.

[Severe frost was experienced at Benson on May 13th, 1922, when 25° F. was registered in the screen and 20° F. on the ground.—ED., *M. M.*]

Earthquakes and Mountains. By Harold Jeffreys, F.R.S. Size 7½ in. by 5 in., pp. x + 183. *Illus.* London, Methuen & Co., Ltd., 1935, 7*s.* 6*d.* net.

In the preface to this monograph we read that " This book has been written with the object of providing an account of the modern study of the Physics of the Earth in general language, for the benefit of those interested in natural phenomena and their causes. To a large extent it summarises my larger book " The Earth " (1929), but attention is given to much work that has been published later."

Geophysics embraces many branches of science on the borderland between mathematics, physics and geology, and the author neglects no opportunity of showing how the results obtained from the different sources are related. The first of the seven chapters is introductory giving an account of the mechanical properties of solids and fluids. The chapters on earthquakes, radioactivity and the earth's history, and on the mechanics of geology, are given considerably more space than those dealing with gravity and the shape of the earth, the strength of the earth, and the bodily tide and tidal friction.

The chapter on earthquakes is of great value as a supplement to G. W. Walker's " Modern Seismology",* which is still the standard English introduction to the subject but does not include the recent developments. This chapter contains in 35 pages descriptions of the causes leading up to the earthquakes, of the effects of the shocks upon buildings, of the various waves which are propagated over and through the earth, and of the instruments used to record these waves. The records not only serve to locate the shocks but yield information about the distribution and properties of the materials within the earth. The most important deduction of this kind is that the earth is not solid throughout, but that nearly 3,000 Km. below the surface an inner core is reached which is probably composed of a heavy metal in the liquid state.

In the descriptions of seismographs the author, perhaps, lays too much stress upon the need for a long free period. Such periods were required with earlier instruments which had only a moderate magnification, but in some modern types the magnification has been increased and shorter periods are practicable. It has been found that, even for distant earthquakes, certain features of the wave motion are brought out clearly by instruments with periods of about a second, but not by those with longer periods. Also, in pointing out that the bearing of an epicentre computed from two horizontal seismographs at any station is ambiguous by 180°, the value of the vertical component in discriminating between these directions is overlooked.

Throughout the whole work the results and theories are set out in a readable and attractive manner, and the book will be appreciated by geophysicists as well as by the more general reader for whom it was written. A. W. LEE.

* Monographs on Physics. Longmans, Green and Co., 1913.

Aerologische Beobachtungen und Terminbeobachtungen in Angmagssalik während des Internationalen Polarjahres, 1932–1933. K. Ned. Meteor. Inst. 106A. Ergebnisse Aerologischer Beobachtungen 22A. 's Gravenhage, 1934.

In addition to its aerological work at Reyjavik, Holland set up a magnetic and meteorological station at Angmagssalik, in east Greenland. This publication includes ground observations for the whole Polar Year, and 254 pilot balloon observations made in the summer of 1933. A noticeable feature is the large number of winds at high levels from some easterly point. At a height of 4 Km. the proportion was 68 out of 131, or 52 per cent, and at 8 Km. 35 out of 63, or 56 per cent. The higher percentage at 8 Km. was probably accidental, since 20 of the 35 east winds were in the period July 21st to 29th, but it is noteworthy that there was no case of an easterly component at 4 Km. being reversed higher up. Even above 2½ Km. there were only a few reversals, involving quite small vector changes of wind.

C. K. M. Douglas.

BOOKS RECEIVED

A statistical study of the maximum temperatures at Poona. By R. J. Kalamkar, Ph.D., India Meteor. Dept., Sci. Notes **5**, No. 59.

Erratum

October, 1935, p. 215, line 17. The formula should read:—

$$E = (1{\cdot}465 - 0{\cdot}0186B)(0{\cdot}44 + 0{\cdot}118W)(e_s - e_d).$$

The Weather for October, 1935

Pressure was below normal over Europe (except the south-west), south-west Asia, Greenland, the Arctic regions and most of south-western United States, the greatest deficits being 11·5 mb. at Lerwick and 0·7 mb. near Salt Lake City. Pressure was above normal elsewhere in North America, the southern North Atlantic, north-west Africa, and north-west Siberia, the greatest excesses being 11·0 mb. at Kodiak (Alaska), 8·5 mb. at Horta (Azores) and 9·0 mb. at Waigatz. In Sweden generally temperature was slightly, and rainfall considerably above normal.

The main features of the weather of October over the British Isles were the frequency and severity of the gales, the sunshine deficiency especially in Scotland, and the high minimum temperatures on many nights, especially on the nights of the 27th–28th and 28th–29th. Depressions moving across the country gave generally unsettled weather from the 1st–6th, with strong winds at times and gales on the 1st. The 1st was a generally sunny day, 10·1 hrs. bright sunshine were recorded at Falmouth and 9·2 hrs. at Ballinacurra (Co. Cork), but later though there were sunny intervals rain was widespread and heavy in places and thunderstorms were experienced locally on the 1st and 3rd to 6th; 2·90 in. fell at Mary Tavy (Devon) on the 5th and 1·76 in. at Inverness on the 4th. Mist or fog occurred at a few places. A wedge of high pressure on the 7th gave much sunshine generally that day, 10 hrs. at Weymouth, Bournemouth and Littlehampton, but this improvement was only temporary and from the 8th to 11th a depression crossing the country occasioned gales in the south and further heavy rain at times, 2·17 in. fell at Lligwy (Anglesey) and 1·92 in. at Holne (Devon) on the 9th, while thunderstorms were experienced locally. From the 11th to 17th pressure was high in the south, but the north came under the influence of depressions passing across Iceland to north Norway. In the north there was occasional rain and moderate winds increasing to gale force at times ; in the south the 11th and 12th were sunny days, Ventnor, Worthing and Eastbourne each had 10 hrs. bright sunshine on the 12th, but after that the conditions were mainly mild and cloudy, with occasional slight rain. From the 18th–20th a depression passed eastwards across the Shetland Isles deepening considerably on the 19th so that strong winds and gales occurred in all parts of the country.* Fresh snow was reported on the mountains in Inverness on the 18th. In the rear of this depression the winds became northerly and snow was reported from many parts of Scotland and the Midlands on the 20th and 21st and hail in Ireland. From the 20th–26th temperature was low generally and frost was widespread. The night of the 20th–21st was markedly cold, a screen minimum of 23° F. being reported from Marlborough and Penrith, while the grass minimum fell to 13° F. at S. Farnborough. Fog also was prevalent in England from the 21st–26th, while over the country generally, light or moderate rain occurred at times, more frequently in the north and west, with some sunny intervals. During the night of the 26th temperature rose considerably and continued above normal until the end of the month. On the night of the 27th–28th, minimum temperatures did not fall below 58° F. at many places in the Midlands and south and east England ; the following night also was almost as warm. During this time there was some rain most days with occasional gales at exposed places. Among the largest falls were 2·62 in. at Dungeon Ghyll (Westmorland) on the 28th and 1·90 in. at Lake Vyrnwy (Montgomery) on the 30th. Thunderstorms occurred locally in Scotland, north England and north Ireland on the 28th–31st. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	56	−23	Chester ...	77	−18
Aberdeen ...	80	−16	Ross-on-Wye ...	93	−7
Dublin	108	+11	Falmouth ...	102	−11
Birr Castle ...	78	−13	Gorleston ...	125	+8
Valentia... ...	77	−15	Kew	97	+4

* See p. 225.

Miscellaneous notes on weather abroad culled from various sources

Several sailing vessels were wrecked and 20 people drowned in a storm in the Black Sea about the 1st. Snow fell in abundance in Switzerland and Austria at the beginning of the month and most of the Alpine passes were blocked. Violent storms accompanied by heavy rain caused havoc in south-eastern France about the 4th and many rivers overflowed their banks while a landslip occurred near Vienne. Serious floods were experienced about the 8th near Klagenfurt (Carinthia) as the result of heavy rain which made the Drave overflow and washed away several bridges. A gale swept across Belgium and western Germany on the 10th. Persistent rains caused serious damage to the countryside in northern Italy during the first half of the month, and floods and landslides were reported from Venetia. The Alpine passes were reopened to traffic after the 4th but were almost all blocked again by the 22nd as snow had fallen down to 3,500 ft. Severe storms swept over Southern Italy on the 21st, 5 people were killed in the syracuse district and part of Naples was flooded. Snow had blocked the mountain passages between Andorra and France and between Spain and the valley of Aran by the 24th when snow was also falling in the Dolomites and other parts of northern Italy. A cloudburst on the 23rd near Simitli (Petritch, Bulgaria) caused two tributaries of the Struma to flood the railway and roads and 17 men were drowned. Torrential rain caused much damage in the Alps on the 29th. Gales were experienced in the Black Sea, Sea of Mamora and in the neighbourhood of Alexandria on the 30th, while a dense sandstorm occurred in the Suez Canal, and storms and heavy rains destroyed railway culverts in the Sinai desert. (*The Times*, October 2nd–November 2nd.)

Three people were killed when the Constantine-Algiers express left the rails near Chateaudun du Rhummel on the 11th, owing to a subsidence caused by heavy rain. (*The Times*, October 12th.)

The floods in northern Kiangsu and northern Honan continued to spread during the early part of the month while famine prevailed in southern Honan in consequence of drought. Brief but unprecedently heavy rain showers giving what was reported to be the heaviest total since the Observatory was established occurred in Tokyo on the 27th and parts of the town were flooded. (*The Times*, October 8th–28th.)

Heavy and widespread rain occurred generally in Australia about the 20th greatly improving the agricultural and pastoral prospects. (*The Times*, October 22nd.)

The first blizzard of the season lasting 2 days occurred in Alberta and Saskatchewan near the end of the month. Incessant rains and high winds occurred in Jamaica on the 20th and the eastern end of the island suffered severely. On the same day a hurricane struck southern Haiti causing widespread floods. Early on the 22nd this hurricane passed across the eastern end of Cuba, accompanied by torrential rain and the river Cauto overflowed but only one person was reported killed. Temperature was much below normal generally over the United States except in the west at the beginning of the month but about the middle it was mainly above normal especially in the Mississippi Valley but below normal in the west. Rainfall was mainly deficient except locally later in the month. Copious rains in the cereal zone of the Argentine between the 13th and 16th brought the drought to an end but later the Parana and the rivers in Paraguay and Uraguay overflowed and many cattle were drowned. (*The Times*, October 17th–November 1st.)

Some severe gales were experienced in the North Atlantic.

Daily Readings at Kew Observatory, October, 1935

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
	mb.		°F.	°F.	%	in.	hrs.	
1	998·0	SSW.3	47	58	72	trace	6·6	pr_0 during day, tl 15h.
2	996·0	SSW.3	43	57	73	0·09	1·5	r_0 14h–21h.
3	985·9	S.3	47	54	78	0·30	1·7	r_0 7h., r–r_0 12h.–24h.
4	988·3	SE.2	50	59	86	0·28	3·4	r early, pr 11h.–23h.
5	994·5	SW.3	49	59	74	—	2·0	pr_0 16h.
6	1006·3	NW.2	43	56	81	—	1·3	F early & late.
7	1014·3	SW.1	40	59	71	—	6·3	F early.
8	1005·2	SW.4	45	54	93	0·22	1·4	r 8h.–13h.
9	1006·8	SW.4	46	57	73	0·02	0·1	r_0 2h.–3h. & 18h.–23h.
10	1003·2	W.5	55	58	50	0·45	7·3	r_0–r 0h.–8h.
11	1014·0	WNW.3	46	59	60	0·01	9·0	pr_0 13h.
12	1023·9	W.2	39	57	63	—	8·7	
13	1027·2	SW.3	40	57	70	—	1·8	
14	1025·9	SW.2	49	60	84	—	0·1	
15	1025·3	SW.3	53	60	82	—	0·0	
16	1025·5	SW.3	55	62	83	trace	0·0	r_0 23h.
17	1026·4	SW.3	49	60	68	—	4·9	d_0 early.
18	1025·6	W.2	47	58	64	—	3·8	
19	1000·8	W.5	50	55	44	0·04	8·1	r_0 2h. & 5h.
20	1009·3	N.4	45	49	53	—	2·3	
21	1014·6	NNW.2	29	48	46	0·03	7·9	x early, r_0 22h.–24h.
22	1012·4	NNE.2	39	48	72	0·01	0·2	r_0 0h.
23	1010·6	S.3	35	52	53	—	8·6	x early.
24	1010·5	ESE.3	44	51	60	0·07	0·0	r_0 2h.–7h., pr_0 18h.
25	1016·4	N.3	42	52	53	—	7·6	Fx early.
26	1023·7	W.2	31	51	73	—	0·1	
27	1015·4	W.4	50	60	73	—	0·0	r_0 13h.
28	1016·8	WNW.2	57	62	75	0·05	0·0	r_0 19h.–22h.
29	1008·7	SW.4	56	60	73	—	0·4	r_0 14h. & 23h.
30	1005·2	SW.5	42	54	65	—	0·9	pr_0 21h.
31	995·9	SW.4	51	59	75	0·40	1·4	r3h.–6h., r-$r_0$13h.-18h.
*	1010·7	—	46	56	69	1·98	3·1	* Means or totals.

General Rainfall for October, 1935.

England and Wales ...	129	per cent. of the average 1881–1915.
Scotland	183	
Ireland	119	
British Isles	139	

Rainfall : October, 1935 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond	Camden Square	2·72	103	*Leics*	Thornton Reservoir	4·09	146
Sur	Reigate, Wray Pk. Rd.	4·08	123	,,	Belvoir Castle	3·08	114
Kent	Tenterden, Ashenden	4·14	119	*Rut*	Ridlington	3·03	108
,,	Folkestone, Boro. San.	4·03	...	*Lincs*	Boston, Skirbeck	2·57	94
,,	Eden'bdg., Falconhurst	4·50	125	,,	Cranwell Aerodrome	2·34	82
,,	Sevenoaks, Speldhurst.	3·67	...	,,	Skegness, Marine Gdns.	2·60	95
Sus	Compton, Compton Ho.	5·28	115	,,	Louth, Westgate	3·96	122
,,	Patching Farm	4·83	122	,,	Brigg, Wrawby St.	3·39	...
,,	Eastbourne, Wil. Sq.	4·69	113	*Notts*	Worksop, Hodsock	...	...
,,	Heathfield, Barklye	5·11	123	*Derby*	Derby, L. M. & S. Rly.	3·47	133
Hants	Ventnor, Roy.Nat.Hos.	4·02	102	,,	Buxton, Terr. Slopes	10·12	206
,,	Fordingbridge, Oaklnds	6·61	159	*Ches*	Runcorn, Weston Pt.	3·87	113
,,	Ovington Rectory	5·92	146	*Lancs*	Manchester, Whit. Pk.	5·24	159
,,	Sherborne St. John	4·08	116	,,	Stonyhurst College	10·84	241
Herts	Royston, Therfield Rec.	2·79	103	,,	Southport, Bedford Pk.	4·97	140
Bucks	Slough, Upton	2·59	93	,,	Lancaster, Greg Obsy.	6·66	162
,,	H. Wycombe, Flackwell	3·07	94	*Yorks*	Wath-upon-Dearne	3·53	127
Oxf	Oxford, Mag. College	3·69	132	,,	Wakefield, Clarence Pk.	4·65	162
Nor	Wellingboro, Swanspool	3·30	131	,,	Oughtershaw Hall	12·55	...
,,	Oundle	2·50	...	,,	Wetherby, Ribston H.	4·87	162
Beds	Woburn, Exptl. Farm	2·84	106	,,	Hull, Pearson Park	3·58	120
Cam	Cambridge, Bot. Gdns.	1·95	83	,,	Holme-on-Spalding	3·84	128
Essex	Chelmsford, County Lab	2·70	110	,,	West Witton, Ivy Ho.	5·04	135
,,	Lexden Hill House	2·42	...	,,	Felixkirk, Mt. St. John.	3·79	132
Suff	Haughley House	2·15	...	,,	York, Museum Gdns.	4·80	178
,,	Campsea Ashe	3·04	116	,,	Pickering, Hungate	3·22	106
,,	Lowestoft Sec. School	2·30	82	,,	Scarborough	3·91	125
,,	Bury St. Ed., WestleyH.	2·41	89	,,	Middlesbrough	3·78	126
Norf.	Wells, Holkham Hall	3·79	135	,,	Baldersdale, Hury Res.	...	...
Wilts	Calne, Castle Walk	4·42	...	*Durh*	Ushaw College	3·77	110
,,	Porton, W.D. Exp'l. Stn	5·32	170	*Nor*	Newcastle, Town Moor.	4·07	127
Dor	Evershot, Melbury Ho.	5·62	122	,,	Bellingham, Highgreen	5·27	134
,,	Weymouth, Westham.	4·67	128	,,	Lilburn Tower Gdns.	3·62	98
,,	Shaftesbury, Abbey Ho.	3·73	96	*Cumb*	Carlisle, Scaleby Hall	6·06	181
Devon	Plymouth, The Hoe	5·04	127	,,	Borrowdale, Seathwaite	24·50	215
,,	Holne, Church Pk. Cott.	7·33	111	,,	Borrowdale, Moraine	17·73	196
,,	Teignmouth, Den Gdns.	3·58	93	,,	Keswick, High Hill	10·36	185
,,	Cullompton	4·15	100	*West*	Appleby, Castle Bank	4·93	142
,,	Sidmouth, U.D.C.	3·69	...	*Mon*	Abergavenny, Larchf'd	3·96	94
,,	Barnstaple, N. Dev.Ath	6·44	142	*Glam*	Ystalyfera, Wern Ho.	9·70	141
,,	Dartm'r, Cranmere Pool	10·50	...	,,	Cardiff, Ely P. Stn	6·26	130
,,	Okehampton, Uplands.	7·64	127	,,	Treherbert, Tynywaun.	13·96	...
Corn	Redruth, Trewirgie	4·66	89	*Carm*	Carmarthen, The Friary	6·85	120
,,	Penzance, Morrab Gdn.	5·40	116	*Pemb*	St. Ann's Hd, C. Gd. Stn.	3·94	94
,,	St. Austell, Trevarna	5·79	110	*Card*	Aberystwyth	8·09	...
Soms	Chewton Mendip	5·39	112	*Rad*	BirmW.W.Tyrmynydd	9·33	141
,,	Long Ashton	6·34	168	*Mont*	Lake Vyrnwy	11·79	207
,,	Street, Millfield	4·39	135	*Flint*	Sealand Aerodrome	3·62	120
Glos	Blockley	3·36	...	*Mer*	Dolgelley, Bontddu	10·83	178
,,	Cirencester, Gwynfa	5·30	160	*Carn*	Llandudno	5·64	168
Here	Ross, Birchlea	3·80	115	,,	Snowdon, L. Llydaw 9.	24·20	...
Salop	Church Stretton	5·19	143	*Ang*	Holyhead, Salt Island	4·72	118
,,	Shifnal, Hatton Grange	2·90	103	,,	Lligwy	8·36	...
Staffs	Market Drayt'n, Old Sp.	4·40	144	*Isle of Man*			
Worc	Ombersley, Holt Lock.	2·72	102		Douglas, Boro' Cem.	5·93	128
War	Alcester, Ragley Hall	3·30	120	*Guernsey*			
,,	Birminghm, Edgbaston	3·37	121		St. PeterP't. Grange Rd	4·46	99

Rainfall : October, 1935 : Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	6·64	168	*Suth* .	Melvich	6·86	187
,, .	New Luce School	8·18	176	,, .	Loch More, Achfary	17·96	230
Kirk .	Dalry, Glendarroch	8·89	169	*Caith* .	Wick	4·56	154
,, .	Carsphairn, Shiel	14·42	203	*Ork* .	Deerness	6·46	170
Dumf.	Dumfries, Crichton, R.I.	6·75	181	*Shet* .	Lerwick	6·35	161
,, .	Eskdalemuir Obs	10·38	192	*Cork* .	Caheragh Rectory	3·61	...
Roxb .	Hawick, Wolfelee	6·02	158	,, .	Dunmanway Rectory	3·52	59
Selk .	Ettrick Manse	8·57	156	,, .	Cork, University Coll	2·10	54
Peeb .	West Linton	8·25	...	,, .	Ballinacurra	2·06	51
Berw .	Marchmont House	4·43	116	,, .	Mallow, Longueville	3·22	89
E.Lot.	North Berwick Res	4·58	155	*Kerry*.	Valentia Obsy	4·89	88
Midl .	Edinburgh, Roy. Obs.	6·38	233	,, .	Gearhameen	9·30	101
Lan .	Auchtyfardle	8·00	...	,, .	Bally McElligott Rec	4·16	...
Ayr .	Kilmarnock, Kay Pk	8·13	...	,, .	Darrynane Abbey	5·15	102
,, .	Girvan, Pinmore	9·73	195	*Wat* .	Waterford, Gortmore	2·96	76
Renf .	Glasgow, Queen's Pk	10·16	312	*Tip* .	Nenagh, Cas. Lough	4·34	128
,, .	Greenock, Prospect H.	12·78	237	,, .	Roscrea, Timoney Park	4·03	...
Bute .	Rothesay, Ardencraig	11·38	...	,, .	Cashel, Ballinamona	3·39	94
,, .	Dougarie Lodge	8·80	...	*Lim* .	Foynes, Coolnanes	4·61	124
Arg .	Ardgour House	18·70	...	,, .	Castleconnel Rec	4·62	...
,, .	Glen Etive	...	...	*Clare* .	Inagh, Mount Callan	9·22	...
,, .	Oban	10·11	...	,, .	Broadford, Hurdlest'n.	4·23	...
,, .	Poltalloch	12·62	255	*Wexf* .	Gorey, Courtown Ho	3·23	91
,, .	Inveraray Castle	22·92	326	*Wick* .	Rathnew, Clonmannon.	2·30	...
,, .	Islay, Eallabus	11·28	236	*Carl* .	Hacketstown Rectory	2·97	78
,, .	Mull, Benmore	18·60	144	*Leix* .	Blandsfort House	3·48	99
,, .	Tiree	...	...	*Offaly*.	Birr Castle	3·88	133
Kinr .	Loch Leven Sluice	6·39	186	*Dublin*	Dublin, FitzWm. Sq	2·30	86
Perth .	Loch Dhu	17·10	239	,, .	Balbriggan, Ardgillan	...	...
,, .	Balquhidder, Stronvar.	15·19	...	*Meath*.	Beauparc, St. Cloud	3·38	...
,, .	Crieff, Strathearn Hyd.	6·18	157	,, .	Kells, Headfort	...	...
,, .	Blair Castle Gardens	5·63	182	*W.M* .	Moate, Coolatore	3·62	...
Angus.	Kettins School	4·68	148	,, .	Mullingar, Belvedere	4·26	137
,, .	Pearsie House	6·92	...	*Long* .	Castle Forbes Gdns	3·80	117
,, .	Montrose, Sunnyside	3·83	139	*Gal* .	Galway, Grammar Sch.	4·96	...
Aber .	Braemar, Bank	6·47	172	,, .	Ballynahinch Castle	7·93	132
,, .	Logie Coldstone Sch	...	...	,, .	Ahascragh, Clonbrock.	4·81	132
,, .	Aberdeen, King's Coll.	3·13	104	*Mayo*.	Blacksod Point	6·78	136
,, .	Fyvie Castle	3·95	103	,, .	Mallaranny	8·20	...
Moray	Gordon Castle	3·49	110	,, .	Westport House	7·81	173
,, .	Grantown-on-Spey	5·64	190	,, .	Delphi Lodge	14·09	148
Nairn.	Nairn	4·73	201	*Sligo* .	Markree Obsy	6·09	150
Inv's .	Ben Alder Lodge	9·64	...	*Cavan*.	Crossdoney, Kevit Cas.	4·30	...
,, .	Kingussie, The Birches.	7·67	...	*Ferm* .	Enniskillen, Portora	5·05	...
,, .	Inverness, Culduthel R.	7·63	...	*Arm* .	Armagh Obsy	3·33	122
,, .	Loch Quoich, Loan	...	...	*Down*.	Fofanny Reservoir	6·97	...
,, .	Glenquoich	...	...	,, .	Seaforde	3·73	105
,, .	Arisaig, Faire-na-Sguir.	8·35	...	,, .	Donaghadee, C. Stn	...	...
,, .	Fort William, Glasdrum	14·40	...	,, .	Banbridge, Milltown	2·98	108
,, .	Skye, Dunvegan	9·80	...	*Antr* .	Belfast, Cavehill Rd	6·05	...
,, .	Barra, Skallary	...	...	,, .	Aldergrove Aerodrome.	4·15	138
R&C .	Alness, Ardross Castle.	8·23	214	,, .	Ballymena, Harryville.	7·00	190
,, .	Ullapool	7·92	163	*Lon* .	Garvagh, Moneydig	6·70	...
,, .	Achnashellach	15·10	188	,, .	Londonderry, Creggan.	8·83	240
,, .	Stornoway	7·53	145	*Tyr* .	Omagh, Edenfel	5·33	145
Suth .	Lairg	6·26	168	*Don* .	Malin Head	7·82	...
,, .	Tongue	6·70	160	,, .	Killybegs, Rockmount.	5·64	...

Erratum : Marchmont House, September, for 2·59/107 read 2·61/108.

Climatological Table for the British Empire, May, 1935

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy.	1019·0	+ 3·1	74	30	59·5	44·1	51·8	− 1·6	44·7	77	6·7	1·39	− 0·33	10	6·1	40
Gibraltar	1014·2	− 1·9	79	51	70·4	55·6	63·0	− 2·5	55·2	83	5·2	4·70	+ 3·13	11	...	...
Malta	1014·2	− 0·3	83	56	69·1	59·9	64·5	− 1·4	58·9	74	5·5	0·00	− 0·41	0	8·6	62
St. Helena	1013·6	+ 0·4	74	57	66·1	58·9	62·5	− 0·6	59·8	93	9·4	3·41	...	27	...	...
Freetown, Sierra Leone	1013·5	+ 2·3	92	68	87·2	74·4	80·8	− 0·7	76·4	80	7·2	10·83	− 0·64	16	...	...
Lagos, Nigeria	1011·3	+ 0·7	89	72	87·1	76·3	81·7	− 0·1	77·3	85	8·3	13·99	+ 3·24	16	6·3	51
Kaduna, Nigeria	1007·4	...	99	66	89·8	70·7	80·3	+ 0·9	73·0	78	6·7	8·02	+ 2·32	13	8·2	65
Zomba, Nyasaland	1014·6	− 0·5	86	56	76·0	59·4	67·7	+ 1·9	61·4	73	5·4	0·72	− 0·32	4	...	...
Salisbury, Rhodesia	1017·2	− 1·1	81	36	73·6	48·2	60·9	+ 0·3	53·9	59	1·1	1·41	+ 0·93	3	9·3	82
Cape Town	1018·8	+ 0·7	86	39	67·9	51·2	59·5	+ 0·6	52·0	86	3·9	3·71	− 0·04	9	...	...
Johannesburg	1018·8	− 0·9	73	28	62·8	43·0	52·9	− 1·5	44·7	61	3·1	0·17	− 0·59	2	8·5	78
Mauritius	...	...	82	59	79·0	66·4	72·7	+ 0·1	68·4	72	4·8	1·41	− 1·62	12	7·1	63
Calcutta, Alipore Obsy.	1002·0	− 1·5	108	75	99·8	81·5	90·7	+ 4·6	80·7	77	4·7	0·42	− 5·14	3*	...	...
Bombay	1007·5	+ 0·1	94	75	91·3	79·3	85·3	− 0·5	77·3	75	3·9	0·00	− 0·55	0*	...	...
Madras	1003·7	− 1·7	109	75	100·4	82·5	91·5	+ 1·7	79·0	61	5·6	0·00	− 1·84	0*	...	...
Colombo, Ceylon	1008·9	+ 0·5	90	71	87·1	78·1	82·6	− 0·2	79·0	79	8·0	14·18	+ 3·24	23	5·9	48
Singapore	1008·6	− 0·1	90	71	85·9	75·7	80·8	− 1·2	77·8	84	7·7	6·84	+ 0·20	17	5·9	49
Hongkong	1008·6	− 0·5	89	68	82·3	74·3	78·3	+ 0·9	73·8	79	7·4	4·73	− 7·34	13	4·6	35
Sandakan	1008·8	...	92	73	89·8	75·5	82·7	+ 0·2	77·5	81	6·2	8·48	+ 2·15	14	...	...
Sydney, N.S.W.	1019·6	+ 1·0	77	45	66·8	49·9	58·3	− 0·5	52·7	73	4·8	2·07	− 3·11	11	6·7	65
Melbourne	1020·5	+ 1·3	70	36	60·6	44·9	52·7	− 1·4	48·4	79	6·2	1·56	− 0·60	15	4·0	40
Adelaide	1021·3	+ 1·3	77	41	64·2	48·5	56·3	− 1·6	51·0	70	6·9	2·58	− 0·20	17	4·4	43
Perth, W. Australia	1019·1	+ 0·7	83	46	70·9	54·4	62·7	+ 2·0	55·1	64	4·9	4·52	− 0·45	16	6·0	58
Coolgardie	1019·0	− 0·4	87	38	72·0	46·4	59·2	+ 1·5	52·7	59	4·5	0·12	− 1·21	3	...	...
Brisbane	1016·2	− 2·4	78	43	73·5	52·6	63·1	− 1·5	56·2	65	2·8	1·55	− 1·26	5	8·1	76
Hobart, Tasmania	1016·8	+ 1·5	64	36	56·1	43·1	49·6	− 0·9	44·9	77	6·2	0·87	− 1·03	15	4·0	41
Wellington, N.Z.	1015·3	− 0·3	64	37	55·6	45·4	50·5	− 2·3	47·6	77	6·0	3·50	− 1·18	19	4·4	44
Suva, Fiji	1013·1	+ 0·4	87	68	81·1	71·7	76·4	− 0·1	71·4	81	6·8	8·94	− 1·13	23	4·8	43
Apia, Samoa	1011·0	− 0·1	87	71	84·9	74·3	79·6	+ 1·2	76·1	80	5·6	4·84	− 1·23	14	7·1	62
Kingston, Jamaica	1013·1	0·0	90	75	87·1	72·2	79·7	0·0	71·8	71	1·5	0·23	− 4·16	3	7·0	54
Grenada, W.I.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Toronto	1017·0	+ 2·1	79	32	61·1	42·8	51·9	− 1·9	45·0	65	4·4	1·70	− 1·09	8	8·9	61
Winnipeg	1019·4	+ 5·6	79	30	61·6	39·9	50·7	− 1·3	40·3	70	5·4	1·72	− 0·28	8	8·1	53
St. John, N.B.	1010·9	− 3·0	68	32	56·4	40·1	48·3	+ 0·6	43·3	69	5·9	1·34	− 2·37	11	6·9	46
Victoria, B.C.	1018·6	+ 1·9	70	43	61·3	46·2	53·7	+ 0·7	49·4	73	4·3	0·26	− 0·87	7	10·8	71

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

(28744) Wt. 18/32 1050 11/35 Hw. G.377

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Colour

By E. C. Barton, F.P.S.L.

Colour is an effect produced in our eyes by certain constituent parts of white light, which come to us chiefly from "coloured" surfaces, that have the power of absorbing the other ingredients of the light that falls on them. White light is generally held to be "colourless", but it is actually a mixture of all the colours, as may be readily proved by repeating the experiment through which Newton first demonstrated the fact. If, as in that celebrated experiment, a narrow sunbeam is admitted into a darkened room through a slit in the shutter and allowed to fall on a suitably held prism, the sunbeam will be broken up into its constituent parts and projected on the opposite wall as a band of colours, and this colour band, as it issues from the first prism, if received on a second prism, will be found to become reunited and again form a band of white light.

This band of colours, commonly known as the "spectrum", has been the subject of deep study, especially since the discovery of its bearing on wireless problems, the transmission of both radio messages and of light having been found to consist of waves in the same medium—"ether."

The propagation of water waves on the ocean and of rhythmical air waves from a musical instrument, have long been known and they are of such a material kind as to be readily understood by investigators, but the transmission of waves through a solid such as glass or across a vacuum, demands the conception of a medium such as must exist between us and the stars, and be infinitely more attenuated than the rarest gas. It must also permeate all space, including the interior of both fluids and solids.

During the growth of our knowledge on the subject of ether waves, technical terms have come into use, which are chiefly derived from older studies of waves in their more familar forms of water waves and musical air waves. Thus waves from Daventry are said to measure 1,500 meters from " crest to crest " as though they referred to ocean waves, while Newcastle (with an ether wave frequency of 1,400 per second) is said to operate " at an octave above " that of Rome (with a wave frequency of 700), the word octave being taken from the musician who thus describes the relationship of two notes, one of which vibrates at twice the rate of the other.

Of all the types of vibration known to science, ether waves have the greatest range, extending over no less than 50 octaves, whereas ordinary water waves, from ocean billows down to half-inch ripples on a pond, cover only 14 octaves, and our range of musical hearing covers only 8 octaves, from the mosquito's sibilant song down to the deepest note of a long organ pipe. Ether waves not only transcend all other wave types in the matter of range, but also in regard to utility. Beginning with the longest ether waves at the lower end of the octaves, we find those used in radio-telegraphy, which range from miles down to inches in " crest to crest " measures. At the other end we find the X-ray waves, which measure only billionths of an inch, while intermediate between these extremes are found the " warmth waves."

Of all this great range of wave lengths, only a very small section—one octave—is devoted to the production of light. In this octave the shortest waves are those which produce the sensation of violet colour, while the longest give us the sensation of red. Between the violet and the red waves, the colours change gradually with every increase in length, through blue, green, yellow and orange, while just outside the visible octave, beyond the red, come the so-called " infra-red " waves, which are invisible to us, but are useful for seeing photographically through fog and haze. Just outside the octave at the other end are the " ultra-violet " waves, which are remarkable for their chemical activity.

Although coloured surfaces have been mentioned above as the main source of our colour sensations, there are other sources which are of great importance from a meteorological point of view, and therefore must now be considered. Chief amongst them is the colouration produced by " transparent " media, and especially by the passage of light through air. No substance, solid or fluid, is so transparent as to offer a perfectly free passage to light. In every case there is some loss, and the loss is greater for one particular set of wave lengths than for others.

Curiously enough, the primary cause of blue colouration in the midday sky is identical with that which produces red sunsets. In both cases the colouring arises from the light-scattering action of small air particles, which takes place in a manner that has been popularly explained by Lord Rayleigh and illustrated by a number of experiments. One of his experiments amounted to a repetition of the wave action commonly seen on a rush-fringed pond, when a gentle breeze has covered its surface with a mixture of little waves and still smaller ripples. As the mixture approaches the rushes, a difference in their behaviour will be observed, the little waves passing through the line of rushes with apparent ease, while the much smaller ripples are arrested and scattered in every direction, but chiefly sideways. This experiment represents, on a visible scale, the behaviour of air particles in scattering the smaller waves of blue and violet light, while allowing the coarser vibrations of the red to pass unhindered, or nearly so. If this scattering did not take place, and the shorter waves belonging to the blue end of the spectrum came through from the sun as successfully as the red, there would be no such thing as a blue sky. The direct rays of the sun would reach us in greater quantity and would appear less yellow in tint than at present, but on a cloudless day the sky would be inky black and so would all shadows. This condition of things would go on until suddenly the sun would disappear below the horizon and black night be upon us in a few seconds.

Fortunately these conditions do not prevail. Even at midday when the sunlight has only a few hundred miles thickness of air to traverse the blue wavelets scattered by the air particles at an angle of 30 or more degrees, are so abundant as to give to the heavens a bright blue colour from that angle down to the horizon. In moist climates such as that of Great Britain, this effect is much enhanced by the presence of water particles which on some days aid in sidetracking the short wave rays to such an extent that the distant hills become invisible. The red and infra-red waves, being less affected by the water vapour particles, are able to get through, and this has led to the invention of emulsions sensitive to infra-red rays for the purpose of photographically seeing such distant objects as the coast of France across the English Channel on a hazy day.

As mentioned above, the direct midday rays of the sun are slightly tinged with red and yellow, but it is toward the end of the day when the sun's rays have to pass through several thousand miles of denser air that they are completely stripped of their short-wave components, and only the red rays succeed in reaching us. If it were then possible to see the earth from a distance—say 100,000 miles away in space—we should then see New York in full sunshine while Bordeaux was lit by the " slanting rays " of the sun with one side of its towers bright red in colour. Further east France would be sunless and immersed in the "earth shadow", but Mont Blanc would still stand out vividly, appearing as a red glowing mass rising out of the "earth shadow" now covering the rest of France with darkness.

This illumination of high mountains by the red rays from the sinking sun is such a well-known phenomenon and such an immediate result of the purging of blue rays suffered by the rays from the setting sun, that little need further be said about it, but there are other phenomena connected with sunsets that are not so readily explained and yet must be mentioned here.

The first is the "counter twilight" (known in Germany as "Gegendämmerung"), which is seen in the east while the sun is sinking in the west and just disappearing from our sight. If a balloonist could rise to an altitude of fifty miles above the ground, the sun would then appear to him as standing well above the horizon and only faintly red, because he would be seeing the sun through a thousand miles of very thinly attenuated air (mostly one-hundredth of its density at our level). This means that the rays lighting up air particles to the east of us at his level will still have a fair amount of blue light in them although already tinged with sunset red. Hence comes the peculiar purple disk that appears at that moment in the east. Above us the sky is still blue, because we have above us some 400 miles of air and of this the upper half is still lit by white light as at midday. When the sun has sunk some degrees below our horizon, the process which made the "counter twilight" in the east, with its accompanying purple disk, is now transferred to the west. The blue sky above us now darkens rapidly, and above the departed sun there appears a large purple disk. Two green patches also appear one at each side of the purple disk and these are difficult to explain. They may be due to the transference of our blue sky production from overhead to the western horizon, where it is seen mingling with the yellow rim that surrounds the purple disk.

More striking than that of blue sky is the colour manifestation of the rainbow, which long remained a mystery, but was eventually made plain by the before-mentioned prism experiment of Newton. The rainbow may be considered as a large scale extension of the prismatic spectrum, its colours being due to the prismatic effect of countless water drops on rays from the sun. Remembering that the rainbow is always formed in a position "away from the sun", it is evident that the light rays must enter the drop of water and then be reflected once or twice internally so as to emerge from the drop in our direction. In doing so it does not emerge "squarely" from the drop's surface. It enters at a slight angle and emerges at the same angle to the small area through which it passes. These two small patches of surface may be considered flat enough to act as facets on a prism producing a colour zone as in Newton's experiment. When we look at a certain coloured part of the bow (say the green) we are receiving rays of that colour emitted from millions of drops that lie in that direction. From each drop there come out red and other colours as well as the green rays, but they proceed in other directions and therefore do not reach our eyes from that part of the bow. Those rays which emerge from the drop after one internal reflection form part of the more brilliant inner rainbow. Those which happen to make two reflections before emerging form part of the outer bow. Not only is this outer bow much fainter than the inner, but its colours follow in inverse order, the innermost and outermost colours of both bows being violet, while the red of one bow comes next to the red of the other bow.

The rise of modern industrial cities with their great output of smoke has provided us with another instance of the scattering of light by small particles. Here again the scattering of blue waves by small particles would, on a distant hillside, make the smoke appear blue, but is so active in robbing the sun's rays of their blue constituents as to allow only the red rays to reach the city dweller's eyes, although the smoke pall through which the sun's rays have to pass measures only a few hundred feet in thickness.

A similar effect arises in the sea wherever the water holds any appreciable quantity of mud in suspension, as in the Thames estuary. Here we find that the amount of material in suspension is intimately connected with the salinity of the water. A tumblerful of muddy water taken from the fresh water of the Mississippi mouths will remain muddy for many hours, but the addition of a pinch of salt will clear the water within a few minutes. Owing to the great evaporation from the waters of the Mediterranean, their salinity is high, so that no mud particles, however fine, can remain suspended in them. In consequence, only the blue and violet rays scattered by the water particles can come to our eyes. In the North sea, where the evaporation is low and the influx of river water is great, the salinity is low while the quantity of suspended matter is high, and the individual particles are so large as to give not only a yellowish tint, but also a certain opacity, which is in striking contrast to the transparency of the more saline Mediterranean waters.

Formerly sky and cloud colouring played a great part in weather forecasting but, owing to the high degree of precision attained by official forecasting to-day, the methods of the older weather prophets have lost their importance, although some of the old sayings are extremely interesting on account of the insight shown by these old observers. One notable example is that of the old rhyme concerning the morning rainbow as a " warning " of rain. Remembering that a rainbow always appears on the side " away from the sun " and that an evening bow could therefore not exist unless the sun was well down in the west, and furthermore that its rays would then be ineffective in rainbow making unless the intervening air were cloud free, the Kentish shepherd would know from the evening rainbow that skies were cloudless from Land's End to London and a dry night was assured for his flock.

Having now investigated colour from the spectacular side, it may well be considered from the economic aspect. In this realm its most important function is that of maintaining plant life, colour being of paramount importance in bringing about the chemical exchanges by which plants obtain the carbon required for building up their fibrous structures. In this chemical work, only the red and violet rays seem to play a part, the leaves, wherein most of this work is performed, being protected against the green, yellow and blue rays by the green covering, which allows the passage of red and violet rays for internal use, while scattering the rest, which would presumably spoil the processes. Concerning the subsequent changes of colour to autumn tints, little is known, but it may be inferred that a red covering protects the plant against frost by lowering the radiation of red and other " warmth " waves.

Another curious function of colour, which has only recently been discovered, is the influence of violet light and also of ultra-violet rays on the formation of calcareous structures in animals. It has been put to practical use in Alpine sanatoria for the building up of bones where they have been wasted by tubercular disease. More recently these rays have been successfully applied to increasing the supply of eggshell material to laying hens in winter.

A Slide-Rule for Hygrometric Calculations

E. G. BILHAM, B.Sc., D.I.C.

Hygrometric calculations may be divided into three well-defined classes, (*a*) the determination of vapour pressure, dew point, relative humidity and moisture content from readings of dry- and wet-bulb thermometers, (*b*) the inter-conversion of different forms of expression of the hygrometric state of the atmosphere ; e.g. we may require to determine the moisture content, being given the temperature and the relative humidity, and (*c*) calculations relating to changes in the conditions ; e.g. we may require to determine the change of relative humidity resulting from a given rise of temperature in an air-mass whose initial temperature and relative humidity are known.

Hitherto it has been customary to use tables such as Glaisher's or the official " Hygrometric Tables (M.O. 265) " for calculations in class (*a*). It is not very convenient to use tables for calculations in class (*b*) or class (*c*) because the tables are usually constructed with dry-bulb temperature and depression of wet bulb as arguments. Consequently it is usual to perform such calculations with the aid of a table of saturation vapour pressures and an ordinary slide-rule.

John Welsh, Superintendent of Kew Observatory from 1852 to

1859, appears to have been the first to realise that ordinary psychometric reductions could be done very readily on a specially designed slide-rule*. One of Welsh's slide-rules is preserved at Kew Observatory, and another rule agreeing with his description in certain respects, but not in others, has been discovered in the Meteorological Office, South Kensington. Welsh's rule is of special interest because alternative scales are provided for the purpose of taking account of variations of atmospheric pressure. This refinement has now been abandoned by the compilers of hygrometric tables for use near sea level and has not been attempted in the slide-rule now to be described.

The following table shows the essential formulae commonly employed in hygrometry, together with the units used in "Hygrometric Tables (M.O. 265)" and on the new slide-rule.

Formulae.	Notation and Units.
Vapour Pressure. (i) $e = w_{t'} - A\,(t - t')$.	e = vapour pressure in millibars. w = saturation pressure in millibars at the temperature shown by the suffix. t = dry-bulb temperature in degrees Fahrenheit. t' = wet-bulb temperature in degrees Fahrenheit.
Dew Point is the temperature t_d for which (ii) $e = w_{t_d}$	t_d = dew point temperature in degrees Fahrenheit.
Relative Humidity (per cent.). (iii) R.H. $= 100 \times e/w_t$ *Moisture Content*†. (iv) $\delta = 216{\cdot}7 \times e/T$ *Saturation Deficit***. (v) $(w_t - e) = w_t\,(100 - \text{R.H.})/100$	A = Psychrometric constant. δ = density of water vapour in gm./m^3. $T = 273 + 5\,(t - 32)/9$ = dry-bulb temperature on absolute scale.

(i) is the simplified form of Regnault's formula adopted in "M.O. 265" and in the tables used in France (Angot), Germany (Assmann) and Norway (Birkeland). As a basis for the design of the rule the following values of A, taken from the Introduction to "M.O. 265" were regarded as appropriate.

	Wet bulb above 32° F.	*Wet bulb below* 32° *F*.
Stevenson screen	0·444	0·400
Aspirated psychrometer	0·368	0·368
Still air	0·667	0·69

Turning to Fig. 1 it will be seen that the rule comprises a stock,

* Welsh, J., *London Rep. Brit. Ass.* 1851. Transactions of Sections, p. 42.

† Computers' Handbook, Introduction p. 16.

** This formula is intended for the computation of saturation deficit when the dry-bulb temperature and relative humidity are known. Saturation deficit can be determined direct from dry- and wet-bulb readings, but the slide-rule is not well suited to that purpose.

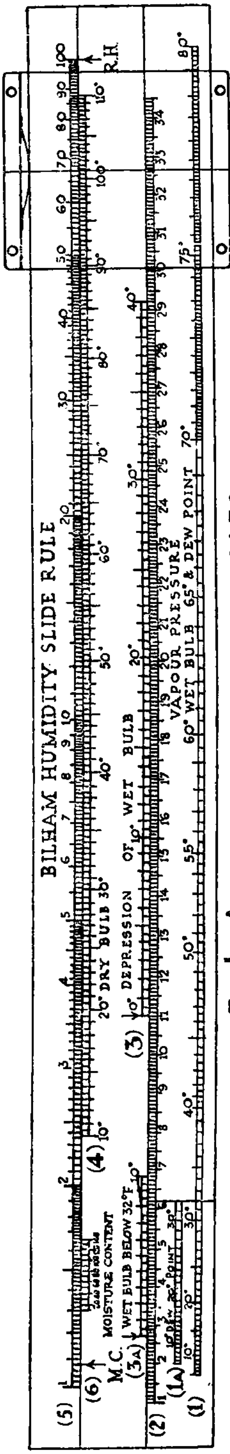

FIG. 1. ARRANGEMENT OF SCALES

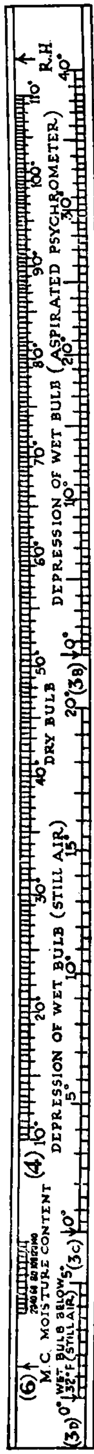

FIG. 2. SCALES ON REVERSE SIDE OF SLIDE

a slide and a cursor. The solution of equation (i) is performed on the lower half of the rule by means of two uniformly divided scales (2) and (3), together with a temperature scale (1), on which the graduations are placed so that saturation pressures appear vertically above them on scale (2). One division on scale (3) is 0·444 times the length of one division on scale (2). Scale (3A) is a supplementary scale in which one division is ·400 times the length of one division on scale (2) and is provided for use when t' is below 32° F. By reversing the slide (Fig. 2) scales appropriate to an aspirated psychrometer (3B), or to still air (3C and 3D), are rendered available. These scales are coloured red to avoid confusion with the standard scales on the front of the slide. The scales on the upper half of the rule are logarithmic scales and are provided for the purpose of determining the relative humidity and moisture content from a knowledge of the vapour pressure (e) and dry-bulb temperature (t). These scales are also used for miscellaneous calculations of classes (b) and (c).

The *modus operandi* of the rule may best be understood by an example; we will take the case, dry bulb (t) 62·3°F., wet bulb (t') 56·2° F., $t - t' = 6{\cdot}1°$ F.; required to find the vapour pressure, dew point, relative humidity and moisture content; the readings are assumed to have been taken in a Stevenson screen.

First set the cursor line over the wet-bulb reading 56·2° on scale (1); (under the cursor line the value of $w_{t'}$ will now appear on the uniform scale (2) but as this is not required it is not read off). Next move the slide until the value of $(t - t')$, namely 6·1° on scale (3), is under the cursor line; (this length on scale (3) is equivalent to $A\ (t - t')$). The zero index of scale (3) then points to 12·7 on scale (2), and this by equation (i) is the value of (e) the vapour pressure in millibars. Place the cursor line over this index and the line will then intersect the value of the dew point, namely 51° F. on scale (1). Now place the cursor line over the value of vapour pressure (namely 12·7 mb.) on scale (5), which is an ordinary logarithmic scale ranging from 1 to 100. Move the slide until the value of the dry-bulb temperature 62·3° on scale (4) comes under the cursor line. Scale (4) is a logarithmic scale in which the argument is the saturation pressure w_t at temperature t; consequently this operation is equivalent to dividing e by w_t. The index marked R.H. is so placed that it shows on scale (5) the value of this quotient multiplied by 100; that is to say it shows the relative humidity, namely 66 per cent. The cursor line is still over the value of e, 12·7 mb.; move the slide until the value of t (rounded to 62°) on scale (6) comes under the cursor line; scale (6) is a logarithmic scale in which the argument is the factor $216 \cdot 7/T$, equation (iii), and the index marked M.C. is so placed that it shows on scale (5) the result of multiplying e by this factor, that is to say, it shows the moisture content in gm./m³, namely 9·5.

If the wet-bulb reading had been below 32° F. we should have used scale (3A) in place of scale (3) and should have read off the dew point on scale (1A) instead of scale (1). The need for a special dew point scale in these circumstances arises from the fact that in "Hygrometric Tables, M.O. 265" it is assumed that when t' is below 32° F. the wet bulb is covered with ice; consequently saturation pressures over ice appear on scale (2) above the corresponding temperature on scale (1). The dew point is defined, however, as the temperature at which e is the saturation pressure over water. Consequently to get agreement with "M.O. 265" we must provide the supplementary scale (1A) the graduations of which correspond to saturation pressures over water on scale (2).

Working instructions :—For vapour pressure and dew point*.

1. Set cursor line over wet-bulb reading on scale (1).
2. Move slide until value of depression of wet bulb $(t - t')$ on scale (3) is under cursor line. (Use scale (3A) if wet-bulb reading is below 32° F.).

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* These instructions apply to readings of thermometers in a Stevenson screen without artificial aspiration. When readings are made with aspirated thermometers use scale (3B) (coloured red on reverse of slide) instead of scales (3) and (3A). When readings are made in still air use scales (3C) and (3D).

3. Index of scale (3), marked with an arrow, then shows vapour pressure on scale (2). (The value is shown by index of scale (3A) when wet-bulb reading is below 32° F.). Read off value to 0·01 mb.
4. Dew point is obtained by setting cursor line over index of scale (3) and reading off on scale (1). (When wet bulb is below 32° F. set cursor line over index of scale (3A) and read off on scale (1A)).

For relative humidity.

5. Set cursor line over value of vapour pressure (obtained from 3), on scale (5).
6. Move slide until dry bulb reading on scale (4) is under cursor line. Index marked R.H. then shows relative humidity on scale (5).

For moisture content.

7. Having set cursor line as in 5 move slide until dry-bulb reading on scale (6) comes under cursor line. Index marked M.C. then shows moisture content in grams per cubic metre on scale (5).

Miscellaneous Calculations. The following examples illustrate the use of the rule in solving various classes of problems which frequently arise in meteorology and industry.

1. Air at 70° F., relative humidity 75 per cent.; determine (*a*) the moisture content, (*b*) the dew point and (*c*) the saturation deficit in millibars.

(*a*) Set R.H. index at 75 and place the cursor line over 70° on scale (4). This gives the vapour pressure 18·8 mb. on scale (5). Now bring 70° on scale (6) under the cursor line and read the M.C. index; this gives the moisture content, viz. 13·8 gm./m^3.

(*b*) Move the slide until R.H. index reads 100; the temperature for which 18·8 mb. is the saturation pressure is now under the cursor line, and this is the dew point, viz. 61·6° F.

(*c*) Set R.H. index to 25 (= 100 − relative humidity) and place cursor line over 70 on scale (4); the cursor line reading on scale (5), viz. 6·3 mb., is the saturation deficit.

2. Air at 45° F., relative humidity 90 per cent., is warmed to a temperature t °F. without adding or removing water; determine the new value of the relative humidity for various values of t.

Set R.H. index to 90 and place cursor line over 45° on scale (4). This gives the vapour pressure 9·2 mb. on scale (5) which is unaltered during the warming. Bring any desired value of t on scale (4) under the cursor line and the R.H. index will then show the corresponding value of the relative humidity, e.g. $t = 50°$, R.H. = 75 per cent.; $t = 60°$, R.H. = 52 per cent.; $t = 65°$, R.H. = 43·5 per cent.

The slide rule is obtainable from J. J. Hicks, 8, Hatton Garden, E.C.1, and the template necessary to make the rule is available in the Meteorological Office. A design for a "tropical pattern" with extended scale is also available.

OFFICIAL PUBLICATION

The following publication has recently been issued :—

PROFESSIONAL NOTES

No. 69. *The frequency of days with specified duration of sunshine.* By E. G. Bilham, B.Sc., D.I.C. and Lilian F. Lewis, B.Sc.

The paper discusses the incidence of sunshine in regard to the percentage frequency of days with (*a*) no sunshine, (*b*) more than 3 hours, (*c*) more than 6 hours, (*d*) more than 9 hours, (*e*) more than half the possible duration. Data in the first four categories are given for eighteen stations, and in the fifth category for six selected stations.

The results show that at most stations about half the days throughout the year have more than 3 hours of sunshine, and that in May, June and July about half the days have more than 6 hours. At Kew Observatory the frequency of days with more than half the possible sunshine varies from 11 per cent. in December to 41 per cent. in May.

Discussions at the Meteorological Office

The subject for discussion for the next meeting is :—

January 13th, 1935. *Comparison of the revealing powers of white and coloured headlight beams in fog.* By W. S. Stiles (The Illumination Engineer, April, 1935.) *Opener*—Dr. J. S. Owens.

Royal Meteorological Society

The opening meeting of this Society for the present session was held on Wednesday, November 20th in the Society's rooms at 49, Cromwell Road, South Kensington, Lt.-Col. E. Gold, D.S.O., F.R.S., President, in the Chair.

The Council of the Royal Meteorological Society has awarded the Symons Gold Medal for 1936 to Professor Dr. Wilhelm Schmidt, Director of the Central Institution for Meteorology and Geodynamics, Vienna. The medal is awarded biennially for distinguished work in connexion with meteorological science and will be presented at the Annual General Meeting of the Society on January 15th, 1936.

The following papers were read and discussed :—

R. C. Sutcliffe, B.Sc., Ph.D.—Surface resistance in atmospheric flow.

The formula for surface resistance to atmospheric flow, $F = \kappa\rho V_s^2$ where V_s is the velocity of the surface wind, ρ the density, and κ a non-dimensional constant, was proposed by G. I. Taylor, on an analogy with flow in pipes. In pipes the value of κ is 0·004, and Taylor gave a mean value of 0·0025 for κ in the case of flow of air over the ground. In this paper the value of κ is deduced from actual observed distributions of wind velocity at different heights, obtained by pilot balloons, no assumption being made as to the nature of eddy-viscosity. The mean value of κ so deduced is 0·006 over land, and 0·0004 over the sea.

J. Edmund Clark, Ivan D. Margary and C. J. P. Cave.—Report on the Phenological Observations in the British Isles, December, 1933 *to November,* 1934.

1934 fell little behind 1933 in favourable weather conditions, although this was less marked in the yearly totals. The better distribution of rainfall usefully re-acted against the droughts. The relatively favourable conditions in northern districts were even more pronounced. The normal 20 days lateness of north Scotland over south-west England fell to 9 days, while all parts south of the Humber were 3 days late. For the first time in 44 years the isakair table shows all Scotland and north-east England early, nearly all the rest of Great Britain being late. Hence Table VI, giving mean dates of flowering of selected plants, has a general value similar to the normal. Insect and bird tables confirm this. Also the spring migrant-spread across Ireland was most rapid. Farm and garden crops were excellent and autumn gardens brilliant up to the killing frosts that ended October.

M. T. Spence, B.Sc.—Temperature changes over short distances as shown by records in the Edinburgh district.

Temperature records for six meteorological stations in and around Edinburgh are examined and some of the differences in the records are discussed in relation to topographical and other features of the locality. It is found that, in summer, at the time of maximum temperature, the vertical gradient of temperature in a valley may average some four times the dry adiabatic " lapse-rate ". Rather big temperature differences are also found between the coast and a valley some four miles inland. The bearing of trees and hedges on the results is considered.

Correspondence

To the Editor, *Meteorological Magazine*

Water Spout seen from an Aeroplane

On November 3rd, whilst on a flight from Bengazi to Sirtie, across the southern portion of Sirtie Bay, I had the fortune to witness the complete formation and dispersion of a water spout.

The local conditions were—wind SW., 5-10 m.p.h. on the surface and W., 15 m.p.h. at 2,000 ft. My compass course was 270° and ahead appeared a long roll of nimbus cloud, from horizon to horizon, north-west to south-east. From the base of this cloud roll, which appeared to vary between 1,000 ft. and 1,500 ft., heavy rain was falling in patches but between the storms it was possible to see the sun shining on the water and coast line further west. The top of the cloud roll was ragged and appeared to be above 10,000 ft.—an extremely rough estimate.

At 8h. 1m., G.M.T., from the most dense part of the cloud in front of the heaviest rain and on my left a cone of cloud appeared to be hanging from the front of the base which was approximately 1,000 ft. At the same time spray appeared to be rising some distance forward of the cloud as if heavy seas were breaking against a partly submerged rock.

Realising that a water spout was forming and moving in a southerly to northerly direction, I altered my course to south-west, making to pass the spout to the south and also for a gap between two rain storms.

The point of the cloud cone was descending all the time and the spray which now appeared as a clockwise swirl of water was rising higher. An approximation of the heights was made at 700 ft. for the cloud cone and 100 ft. for the highest flung spray. There seemed to be no perceptible rise of spray or descent of the cone after this, but the space between the two points became opaque until they were joined by a thin line of swirling mist some 30 ft. in average thickness. This line became denser until it was almost as dark as the cloud and had in it spiral streaks of a much lighter colour.

During this time the spout had been passing from left to right across the nose of the aircraft and the column between the cone and the spray appeared to be vertical. Now on passing southward of the disturbance it was observed that the cone of cloud actually protruded forward and downward from the cloud base at an angle of some 70° from the vertical and that from about 1/3 of its length it was bent at a further angle of 50° to 60°, so that the column entered the spray almost vertically.

In the next few minutes the disturbance on the sea surface, which appeared to be travelling some 15 m.p.h. faster than the cloud base, had stretched the column to such an extent that the opaqueness about 1/3 of the height of the column above sea-level had begun to disappear and my final view of the phenomenon was of the cloud cone withdrawing to the cloud base and the swirl subsiding.

The whole period during which the spout was under observation was 16 minutes. Heights were estimated from the aircraft's altimeter and directions taken roughly from the pilot's compass.

ERNEST R. B. WHITE.

Gales of September 16th-17th, 1935.

It may be of interest to your readers to know that the effect of the gale here was similar to that in Cornwall. All windows facing south-west to west, not only here but as far inland as Newport, 8–9 miles away, were thickly coated with a greyish deposit which was salt to the taste, sparkled in the sun when dry and was difficult to wash off. The *County Press*, in a report on the storm, noted that the effect was the same in a violent storm about 60 years ago.

I think we may assume that the reason why the same thing does not happen in every violent storm is that, after a few showers at the beginning of the gale, the weather remained dry, so that the salt haze was carried along on the wind instead of being conducted to earth by moisture.

How air may be forced up to such a height as to cover the country for miles inland was apparent when, during one of the dry gales this autumn I saw clots of brownish sea-foam, flying through the air to the outskirts of Niton, having been carried over the face of the cliffs which rise to a height of 530 ft. or more.

The total destruction of foliage of hedges and trees must be regarded as due to the action of the salt carried by the wind for this reason :—all the foliage affected immediately wintered in an orderly way. Had the leaves been merely bruised, they would have hung on, drooping, until the normal time of wintering.

The sheltered woods I happened to see kept their summer green until the end of October.

R. S. BRETON.

Pan Cottage, Niton, Isle of Wight, December 3rd, 1935.

Frequency of Calms in Winter

From the note by Mr. L. C. W. Bonacina in the October issue of this magazine, it would appear that the high frequency of calms in winter is far less apparent at stations in the eastern English Channel than at either Grayshott or Waltham Cross.

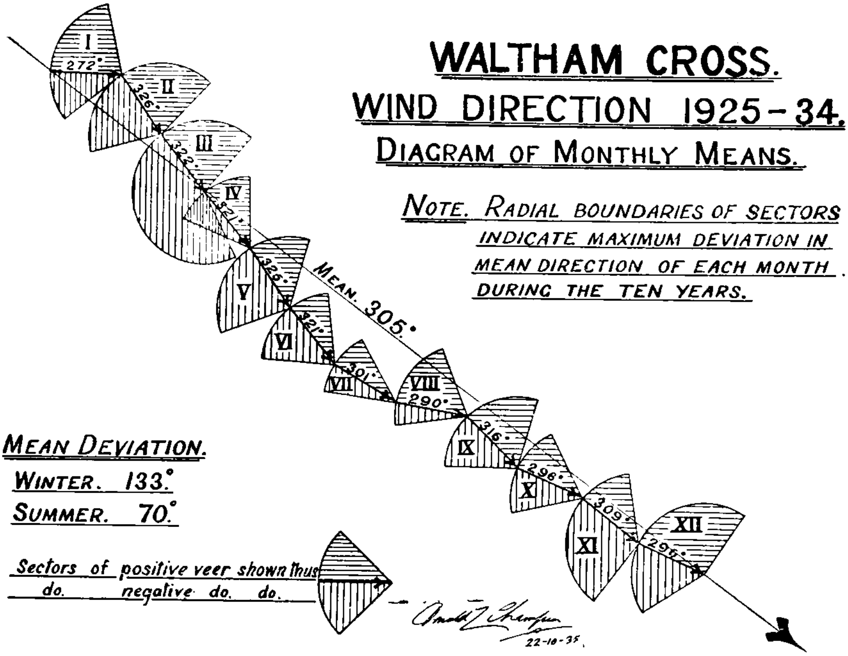
As a possible explanation, it may be that in winter, owing to the lower temperature and therefore greater density of the surface air, which has been chilled by radiation and contact with the ground (compared with corresponding air at the same pressure in summer), the pressure gradient may require to be slightly higher to impart to it a given velocity, than would otherwise be the case.

The influence of the sea at coastal stations in warming the surface air may partly explain the lower frequency of calms in the English Channel, there being less chance for the formation of inversions of temperature over the sea in winter than at valley stations inland; and for this reason the air over the sea would be the more easily disturbed by a small pressure gradient.

Regarding Mr. Bonacina's remark about breezes in summer being " just perceptible," the following data may be of interest.

I believe it is reasonably correct to assume that winds of moderate velocity are more steady in direction than the light airs associated with the calmer conditions of slack pressure gradient. If this is so, the higher frequency of calms in winter at Waltham Cross is supported by the higher constancy of directional flow in summer months.

In the attached diagram, the mean wind direction of each month during the 10 years 1925–34 is shown, together with the greatest mean deviation for any year during that period. It will be seen that in December the mean veer from the mean direction varied from + 78° to − 58°, an angular difference of 136°; whereas in July the mean veer of any year was within the limits of + 30° and − 22°, a range of only 52°. The maximum possible deviation is



180°, therefore for the period in question the mean variability of wind direction in July was only 28 per cent. against a corresponding variation of 75 per cent. in December.

The actual values of mean direction for each month are probably much affected by the local topography,* and this must not be overlooked in considering the deviations. However, the comparative constancy of air flow in summer is as well marked as the high frequency of calms in winter.

DONALD L. CHAMPION.

7, Robinson Avenue, Goff's Oak, Waltham Cross, Herts, October 22nd, 1935.

Sun pillar seen from Worthy Down

A sun pillar, remarkable for its intense flame colour and well defined shape, was visible from this station on November 21st, 1935. It appeared just after sunset, 16h. 8m. and lasted until 16h. 20m. The sky, down to an elevation of about 7°, was covered by a layer of altocumulus and altostratus. Between this and the horizon to the south-west were clear patches and cirrus and cirrostratus clouds.

* See *Meteorological Magazine*, **67**, 1932, p. 129.

The sun pillar extended from the horizon to where it was interrupted by the altocumulus and altostratus layer at an elevation of 7°, direction 240°.

W. L. LINEHAM.

Meteorological Station, Worthy Down, Hants, November 22nd, 1935.

NOTES AND QUERIES

History of the British Flora in relation to Changes of Climate

On March 28th, 1935, the Royal Society held a " Discussion on the Origin and Relationships of the British Flora ", an account of which has been published in the Proceedings*. It makes interesting reading ; a succession of speakers traced the history of our flora from the early Tertiary through the vicissitudes of the Ice Age and the subsequent fluctuations to the present day. Throughout, the importance of climatic changes appears, sometimes expressly, at others only by implication.

The story begins in the Eocene with a tropical flora which Mrs. E. M. Reid derives, along with the climate which permitted it to flourish in the Thames Estuary, from Malaya by means of an elongated Mediterranean, the Tethys Sea (which a reporter of a former discussion appropriately rendered as the " tepid sea "). There followed a gradual cooling to which the flora reacted by migration, until as described by Prof. P. G. H. Boswell and Miss M. E. J. Chandler, the recurring advances of the ice sheets obliterated the entire flora over large areas of this country and reduced the remainder to a sparse gathering of northern species. The flora is sometimes described as Arctic, but Mr. A. J. Wilmott does not accept this view, since some of the species found in the so-called " arctic beds " will not now grow north of the Scottish lowlands. He finds the general flora of the Ice Age to resemble the present flora of Finland, and suggests that " the climate in southern England was warm enough to bring the glaciers to a standstill, and the evidence of the sub-glacial streams and large outwashes of gravel indicate summer warmth ". Prof. E. J. Salisbury on the other hand regards the conditions as having been quite unsuitable for the survival of the majority of species.

Whatever may be the decision about the more humble plants, there is little doubt that most of our forest trees at least were exterminated during the Ice Age. This results from the microscopic investigation of the pollen grains so remarkably preserved in peat bogs and similar deposits. These, as described by Dr. H. Godwin, show that in the lowest layers pine and birch alone were present. Later hazel, oak and elm appear, shortly followed by the alder, which quickly became dominant. Dr. Godwin writes : " The same general preponderance of alder pollen is found through so many British pollen diagrams that we can only conclude the former presence

* *London, Proc. R. Soc., B.* **118**, 1935, pp. 197–241.

of very widespread alder woods, and this suggests in turn that large parts of our primitive woodlands were seriously waterlogged before human activities were responsible for their clearance and drainage ". Towards the close of our forest history (but still pre-Roman) there was a recrudescence of pine and birch which, if it forms a constant horizon, as appears to be the case, has " important climatic implications ". The exact climatic interpretation of the succession of trees* is a very difficult problem, which was rather outside the scope of the discussion. But these post-glacial changes, as Sir George Simpson pointed out, were of a different order of magnitude from those which produced the Ice Age.

An interesting point which emerged from the discussion is that two at least of the inter-glacial periods passed in their earlier stages through a similar floristic history to that of the post-glacial. Mr. Dewey said that the " sequences of fossil plant assemblages . . . of the Mindel-Riss inter-glaciation (of Denmark) correspond flora by flora with those of the Riss-Wurm, and show the gradual replacement of the arctic by the cold-temperate and that by warmer-temperate plants, and then the reversal of climatic conditions ". The culmination point was the dominance of deciduous trees characterised by the oak. In the post-glacial we have already reached and perhaps began to pass this culmination. It has often been said that we are still in the Ice Age. Will future generations be faced with the return of sub-arctic conditions ?

C. E. P. Brooks.

Thunderstorms at Ramleh, November 7th-8th, 1935

Several unusually severe thunderstorms occurred here in the night of November 7th–8th. The day had been mainly fair and warm. No low clouds were observed but there was a good deal of cirrus and cirrostratus throughout the day. The sky was entirely covered with the latter cloud at 18h. G.M.T.† (20h. local time) when there was a fine lunar halo. The wind distribution differed but little from the normal, the usual light north-westerly sea breeze being succeeded by a period of calm in the late afternoon.

Lightning was first seen in the south about 20h. 30m. and in a few minutes the flashes were extremely vivid and almost continuous, so that it was possible to read newsprint on an unlighted verandah. The first thunderstorm broke at 20h. 50m. and appeared to be overhead with lightning from all quarters. The record of the autographic rain-gauge shows that about 18 mm. of rain fell in 10 minutes at the height of this storm. The rain ceased at 21h. 50m., but at 22h. 15m. fell again with renewed intensity ; 20mm. were recorded in half an hour, of which 8 mm. fell in 5 minutes. There was no appre-

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* Brooks, C. E. P. Post-glacial climates and the forests of Europe. *London, Q.J.R. Meteor. Soc.*, **60**, 1934, pp. 377–95.

† All times quoted are Greenwich Mean Time.

ciable rain from 23h. 5m. to 1h. 20m. but the remarkable lightning display continued with frequent thunder. At 1h. 20m. rain again set in and fell heavily until 3h., about 30 mm. being recorded in this period. The rain ceased finally at 5h. and the low nimbus and nimbostratus cloud gave place to a cloud sheet of altostratus with some altocumulus. The total rainfall measured at 6h. was 78·0mm. This was, with a single exception (December 9th, 1926, with 124·9 mm.), the heaviest day's rain recorded at Ramleh in 14 years' observations.

Sharp squalls occurred during the more severe phases of the storms, gusts up to 41 m.p.h. being recorded. The wind completely "boxed the compass" twice during the night, backing from N. at 21h. 30m. through W., S. and E. to N. by 23h. 15m. and then veering completely through 360° to N. again by 2h. After this it became fairly steady south-easterly at 8 to 12 m.p.h.

The effects of the electrical phenomena and of the unusually heavy rainfall were serious. At the wireless station all aerials except one were earthed but many electrical discharges were heard coincident with lightning flashes. Wet ropes on masts acted as conductors and lightning was observed passing to earth by this means. Power transmitters were put out of action and, when transmission became possible, resort was made to battery supplied stand-by sets. What appeared to be electrical discharges were seen on the metal wires suspended for the purpose of supporting mosquito nets and a knife on a wooden locker was observed to jump off on to the floor during the storm.

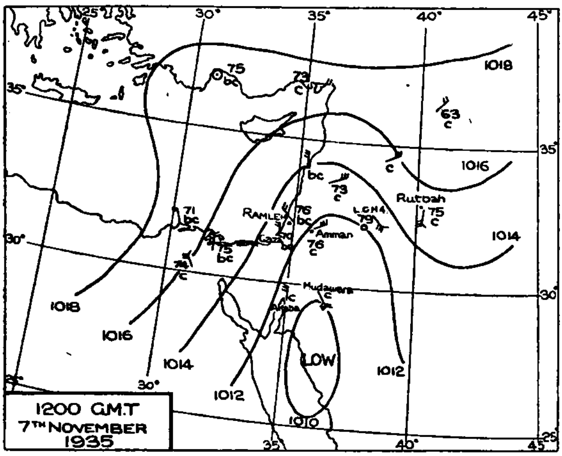
Extensive flooding occurred over a wide area and resulted in loss of life in some places. All the ground between the camp and Ramleh village was flooded, the water being more than knee deep in places. This flooding subsided rapidly, however, and the road between the camp and Ramleh became passable three hours after the rain ceased. Three children, two boys and a girl, were drowned in the floods in the Khalsa district. Five kilometres of the road between Metulla and Beweiziya were washed away and further rains hampered the work of reconstruction. It is stated that 40 shacks and 30 houses were washed away in the village of Khalsa and 20 shacks were swept away in the village of Beweiziya. At Maghar village a Bedouin child was swept out of a tent by the flood and drowned. As is usual during heavy rains the Wadis between Lydda and Nebi Danyal (to the north-east of Ramleh) were flooded and became impassable for three days.

Traffic on the Palestine Railways was held up by flooding of the track in several places. At kilo. 39 on the Jaffa-Jerusalem line there was a considerable accumulation of water on the south side. The opening in the bridge across the Wady Sarar here has a superficial area of eight square metres, but this was inadequate to release the flood water which came right up to the rail level and washed away 100 metres of track. This same Wady Sarar crosses the main line, Kantara-Haifa, just north of Yibna village. Some time ago the track in this section was raised by one metre but in spite of this the flood water reached rail level and the area under water was greater than on any occasion since the construction of the railway.

H. E. CARTER.

Meteorological Station, Ramleh, Palestine, November 12th, 1935.

[The isobaric situation over Palestine at 12h. G.M.T., 14h. local time, on November 7th, 1935, is shown on the attached map. There was a shallow depression over the northern end of the Red Sea. In front of this depression a well marked south-east to south current extended from the Red Sea over Trans-Jordan and western Iraq; behind, there was a colder north-north-west current of northerly origin.



SYNOPTIC CHART

In a warm southerly current from the Red Sea, cloud of the cirrostratus and altostratus type frequently occurs over the desert area between Long. 35° and 40° E. and Lat. 29°–35° N., due partly to topography and partly to the forced ascent over a colder easterly current over Syria and a colder northerly current to the westward. As a result of this forced ascent, rain and thunderstorms, sometimes of unexpected intensity, occur in the above mentioned area, especially in May and October or November.

In this particular case the surface of separation between the two currents was probably just east of Ramleh and the exceptional rainfall was very local, only 0·4 mm. being reported from Gaza, 40 miles south by west of Ramleh. Further east, 4 mm. were reported from Landing Ground H4 and a trace from Rutbah. —J. DURWARD.]

REVIEWS

A suggested totalising anemometer for oceanographers. By J. N. Carruthers, D.Sc., F.Inst.P. Reprinted from the Hydrographic Review, Vol. XII, No. 1 (No. 23 of the series). Monaco, 1935.

In a recent issue of the *Hydrographic Review,* Dr. J. N. Carruthers of the Fisheries Laboratory, Lowestoft, describes an instrument which he has devised for giving the integrated run of the wind from different directions during a given period. The instrument was designed primarily for the use of oceanographers who are interested not so much in the wind force and direction at any particular hour as in the integrated wind over a period, this being the factor which is effective in the control of ocean currents. The operating part of the instrument consists of two parts, a Dines vane of streamline type and a small Robinson cup anemometer. The Dines vane is mounted on a mast and is directly connected by a vertical rod to a large upright cylindrical chamber open at the top and divided by radial partitions into eight equal segments. This radial chamber thus turns with the wind vane. Above the chamber near its circumference is an inlet pipe through which water passes. This inlet pipe does not rotate with the chamber but remains fixed in position and the water will thus fall into one or other of the compartments into which the chamber is divided, the actual compartment depending upon the wind direction. The cup anemometer which is mounted on a pole alongside the wind vane closes an electrical contact after a given number of cup revolutions and the resulting current energises an electromagnet which lifts a measured quantity of water from a reservoir and discharges it through the tube into the rotating chamber. It will be seen that the amount of water discharged in a certain time is proportional to the number of miles of wind which have passed the anemometer head in this time. If the wind direction has fluctuated during the period this water will be distributed amongst several compartments of the chamber. When an observation is taken the water is drawn from these compartments and the quantity found in each is a measure of the number of miles of wind from the corresponding direction. It would appear simpler to raise the water by direct mechanical means by the revolution of the cups and it is probable that such a method would be quite satisfactory. The author adopts the electrical method in order to avoid slowing down the movement of the cups by imposing any unnecessary resistance to their turning. While the introduction of electrical operation may perhaps be regarded as a somewhat non-essential refinement in another direction the design of the instrument seems to lack refinement, since no steps appear to have been taken to avoid the effect of evaporation from the chambers. Although the accuracy obtained may not be equal to that which would be given by computing the run of the wind from the hourly records of a Pressure Tube anemometer yet it is believed the instrument may find useful application not only by oceanographers but by others who are interested in the prevailing wind rather than in the wind movements hour by hour.

J. S. DINES.

India Meteorological Department, Scientific Notes, Vol. V, No. 60.—*A study of the atmospheric horizontal visibility at Bangalore.* By A. Ananthapadmanabha Rao.

The author has analysed the visibility observations made at Bangalore over a period of two years, and correlated them with humidity, wind force and direction, and type of cloud, and determined their seasonal and diurnal variations, etc. Such analyses as these do not often reveal anything new in the way of visibility theory—convection clouds, for instance, are usually associated with good visibility everywhere—but they are (or should be) of considerable use to the local forecaster in telling him quantitatively how the obscurity of the atmosphere will probably react to the general weather situation. Given a correct general forecast, the accuracy of prediction of local variations in visibility should improve as knowledge of local conditions increases.

In the present case, not only have we an analysis calculated to be of use to the forecaster, but we find evidence of an effect which, if it has been noticed before has not had much attention paid to it. Perhaps it is perculiar to, or most marked at, such places as Bangalore, for which not many analyses have appeared. As humidity decreases from 100 per cent the frequency of good visibility increases to a maximum in the range 71 to 80 per cent humidity and decreases with further decrease of humidity. The obvious explanation in terms of dust is given. One feels that this should be verified by experiment, and the exact conditions and places where the effect will and will not occur should be investigated in further detail.

M. G. Bennett.

OBITUARY

Professor Sir John C. M'Lennan, K.B.E., F.R.S.—We much regret to learn of the death of Prof. M'Lennan due to a heart attack while travelling in France on October 9th. Prof. M'Lennan was born of Scottish parents in Ontario on April 14th, 1867, and after his graduation at the University of Toronto he joined the Cavendish Laboratory at Cambridge under Sir J. J. Thomson. In 1899 he returned to Toronto University, becoming assistant professor in 1902, and in 1904 Director of the physical laboratory there, which he did much to help build and which bears his name. Here he installed excellent apparatus especially for spectroscopy in which he was particularly interested. About this time he carried out many experiments on the "natural ionisation" in closed vessels, tracing the effects to minute quantities of radioactive materials. He also found that the penetrating radiation over land was greater than over water and deduced from this that a large part of the penetrating radiation came from radium.

During the War Prof. M'Lennan took an active part in the research work of the Admiralty and organised the extraction of helium from natural gases near Calgary. After the War he returned to Toronto and continued his work on spectroscopy, for which he was awarded a Royal Medal of the Royal Society in 1927. In 1928 he gave the Bakerian Lecture to the Society on "The Aurora and its spectrum," and in this he described how he and G. M. Shrum had proved in the laboratory that the notable green line in the spectrum was due to oxygen suitably mixed with argon. In 1923 M'Lennan liquefied helium at Toronto. Later he installed a cryogenic laboratory at Toronto in which he carried out numerous successful experiments on superconductivity in metals and certain alloys and chemical compounds.

He retired in 1932. Lord Rutherford, writing of his work in England since then, says, "largely through his (M'Lennan) influence the Union Minière of Brussels generously lent 5 gm. of radium to make a thorough investigation of the effects of mass radiation on cancerous growths. . . . This work is being carried out at the Radium Institute. M'Lennan threw himself whole-heartedly into this new line of work. . . . . His services to this investigation in radium beam therapy are indeed great."

M'Lennan was President of the Royal Society of Canada in 1924, and in 1926 was awarded the Flavelle Medal by that Society. In June, 1935, a K.B.E. was conferred upon him in recognition of his fundamental discoveries in physics and his scientific services.

BOOK RECEIVED

The Climate of the Netherlands A (continued). Precipitation. Second part. By Dr. C. Braak, K. Ned. Meteor. Inst., No. 102. Med. en Verh. 34a, 'sGravenhage, 1933.

This second part contains the revision of the tables of Vol. 15, the letterpress of which was revised in the first part; a review of this appeared in the *Meteorological Magazine*, **69**, 1934, p. 47.

Erratum

NOVEMBER 1935, p. 227, line 4 *for* " Eskalemuir 69 m.p.h. " *read* " Eskdalemuir 87 m.p.h."

The Weather for November, 1935.

Pressure was below normal over Greenland, Iceland, western, central and south-west Europe (except south Spain), the Bermudas, south-east United States and California, the greatest deficits being 10·2 mb. at Reykjavik, 2·2 mb. at Bermuda and 1·0 mb. in south Texas; elsewhere pressure was above normal, the greatest excesses being 16·3 mb. at Moscow, 15·3 mb. at Ekaterinburg, 10·4 mb. at Kodiak (Alaska) and 9·1 mb. near St. John's, Newfoundland. Temperature was above normal over Spitsbergen, northern and central Europe (about 9° F. in Norrland (Sweden)), but below normal in Portugal. Precipitation was in excess at Spitsbergen and in Sweden, but deficient in northern Norway.

The outstanding features of the weather of November over the British Isles were the excessive rainfall (except in north-west Scotland), the high temperatures during the first week of the month and the frequent strong winds. Minimum temperatures were generally high in the south, but in Ireland temperature was below normal most of the month. From the 1st to 6th complex low pressure areas passing across the British Isles gave mild unsettled weather with rain on many days but bright intervals. Much sun occurred in the west and north on the 1st and generally on the 6th, 8·0 hrs. at Dublin on the 1st and 7·8 hrs. at Edinburgh on the 6th. Thunderstorms were experienced in Ireland on the 1st and 3rd and at Ross-on-Wye on the 6th, and snow on the mountains in Scotland on the 1st. Rain fell on most days and gales were reported at times in the south-west and north on the 2nd–5th. Temperature was high during this time, the 3rd being the warmest day when 64° F. was reached at Cranwell, Barton and London, while at a few places on the south coast minimum temperature did not fall below 55° F. on the night of the 2nd–3rd. From the 6th–9th temperature was below normal while a complex shallow depression with centres moving across the country gave variable winds, strong at times with a gale in east Scotland on the 8th. Slight rain fell locally in the north and west with moderate rain becoming heavy on the 7th in the south, 1·79 in. at Patching (Sussex) and 1·53 in. at Guernsey. Fog occurred generally during this period and ground frosts. From the 10th to 15th depressions were centred to the north-west of the British Isles, giving mild (except in Ireland) unsettled weather with bright intervals but much rain, especially in the south-west, 2·26 in. at Holne (Devon) and 1·93 in. at St. Briavels (Gloucestershire) on the 14th. Fog occurred at times and thunderstorms at isolated places on the 12th and 15th. Snow fell on the hills in Ireland and Scotland on the 11th and 12th and hail generally even in the Channel Islands. On the 16th–18th a small vigorous depression was centred over the south of the country giving gales and heavy rain locally in England, 2·65 in. at Creech (Dorset) on the 16th and 1·85 in. at Tyn-y-Groes (Carnarvon) on the 17th. Floods occurred in many parts of the south and Midlands. On the 19th the depression to the west of the British Isles became less deep and extended south-east so that pressure was low to the south and high to the north and by the 23rd the anticyclone had extended over the whole country. Rain fell generally on the 19th–21st, but the 23rd and 24th were dry sunny days; Weymouth had 7·8 hrs. bright sunshine on the 23rd and Ventnor 7·7 hrs. on the 24th. Temperature fell generally during this period, the coldest days being the 24th and 25th ; a maximum temperature of 35° F. was recorded at Dumfries and Penrith on the 24th and of 37° F. at Shoeburyness on the 25th, and a grass minimum temperature of 12° F. at Collumpton on the 25th, and of 13° F. at Eskdalemuir on the 24th. Fog occurred on many days between the 19th and 25th. By the 25th the deep depression to the west of Iceland was advancing eastwards, and from then to the end of the month extensive disturbances were passing across the country bringing unsettled weather, mild at times but cold later, with a few bright intervals but frequent rain. Snow occurred generally in Scotland on the 26th, 29th and 30th, and in north England and the Midlands on the 30th. Thunderstorms were reported locally on the 29th and 30th and gales in the south-west on the 30th. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	53	+ 8	Chester ...	49	− 8
Aberdeen ...	47	−13	Ross-on-Wye...	59	− 7
Dublin	104	+34	Falmouth ...	97	+18
Birr Castle ...	74	+13	Gorleston ...	49	−21
Valentia... ...	60	− 4	Kew	51	− 2

Miscellaneous notes on weather abroad culled from various sources

Abnormal weather occurred in the Mediterranean about the 1st doing damage to shipping. Mild weather with thunderstorms and rains of unusual violence was experienced on the Riviera on the 10th. Heavy and continuous rain in south-east France from about the 10th to 16th caused the rivers Rhône and Saône to rise and serious flooding occurred especially round Avignon. Several deaths were reported and landslips occurred near Fourvoirie destroying part of the Grande Chartreuse distillery, while many roads were closed. On the 17th the Paillon also overflowed ; Nice was flooded and landslips occurred in the neighbourhood. After this, fine weather prevailed but on the 21st further storms and heavy rains caused the Rhône to rise again and increased the floods for a short time. Much damage was caused in Switzerland by floods due to torrential rain on the 11th and 12th. Twenty-six lives were lost when a steamer sank on the 11th in the entrance to the Gulf of Smyrna during a northerly gale. Heavy rain in Portugal about the 19th caused serious floods especially at Viano do Castelo. Gales occurred off the coasts of Brittany on the 19th, a north-easterly gale in east Roumania on the 20th and gales along the south-east coast of France and the coasts of Corsica on the 21st. Severe weather with much snow prevailed in extreme north Italy about the 21st. Violent storms followed by torrential rain were experienced in Calabria (south Italy) on the 21st flooding much of the district ; 98 people were killed, several landslips occurred and many houses collapsed. Torrential rain fell again in the same region on the 24th. Thick fog occurred in Paris on the 24th. Winter navigation opened at Leningrad on the 25th and navigation closed at Oulu on the 29th. (*The Times*, November 4th–30th).

Communications between Mandalay and Rangoon were cut off by widespread floods on the 8th. A severe storm occurred off the east coast of Korea early in the month. The *Silverhazel* was wrecked in a tropical storm about 350 miles from Manila on the 9th, the winds continuing strong in force for about 3 days. A severe gale was experienced off north Formosa about the 20th. Floods occurred between Basra and Baghdad about the 25th. (*The Times*, November 9th–26th.)

The total rainfall for the month was considerably below normal over Australia except in a few isolated places, but above normal in most parts of Tasmania (cabled report from Australia).

A hurricane passed across southern Florida to the Gulf of Mexico on the 4th and four people were killed. A severe storm passed along the east coast of the United States on the 17th doing damage to shipping while the high seas caused floods. In the United States temperature was considerably above normal in the eastern regions during the first part of the month but gradually the cold weather of the west spread eastwards, while towards the end of the month temperature rose in the west. Rainfall was mainly above normal at first becoming deficient later. (*The Times*, November 5th–19th and *Washington, D.C., U.S. Dept. Agric. Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, November, 1935

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	Remarks. (see vol. 69, 1934, p. 1).
	mb.		°F.	°F.	%	in.	hrs.	
1	1006·1	SW.4	51	58	76	0·40	0·2	r 6h., 7h. r R 10h.–
2	1013·8	S.3	44	58	88	0·06	—	r–r_0 0h.–9h. [11h.
3	1008·3	SSE.3	52	62	73	0·04	5·9	r–r_0 23h.–24h.
4	1000·3	SSE.3	50	57	69	0·14	2·3	r–r_0 0h.–6h. [20h.
5	1001·3	SW.1	42	51	89	trace	—	F till 12h. r_0 17h. &
6	1008·2	SSW.3	38	50	73	—	3·0	r_0 13h. [22h.
7	997·7	ENE.3	38	47	85	1·02	—	r–r_0 7h., 9h., & 12h.–
8	998·8	S.3	37	47	87	0·24	—	F till 10h. r 10h.–23h.
9	993·3	SSW.3	44	51	73	0·10	3·4	r 9h.–10h. pr_0 23h.
10	1003·5	S.4	44	52	84	0·11	1·3	pr_0 morning. r–r_0 18h.
11	1009·3	SW.2	37	50	86	—	4·2	r_0 19h. [–22h.
12	1004·1	SW.2	45	49	74	0·22	4·0	r–r_0 1h.–6h. & 19h.–
13	1001·8	SW.3	39	47	79	0·40	2·5	r–r_0 2h.–9h. [23h.
14	1010·4	SSW.4	39	52	79	0·02	—	r_0 14h.–17h. & 20h.
15	1001·6	S.4	49	51	91	0·03	2·8	r 11h.–13h. & 21h.–
16	1001·7	SSE.3	41	49	77	0·41	1·6	r_0–r 1h.–18h. [22h.
17	980·4	WNW.3	45	49	92	0·63	—	r–r_0 0h.–21h.
18	998·4	W.3	45	49	80	0·02	0·1	r_0 5h., 7h. & 16h.–18h.
19	1004·2	SSE.4	37	51	64	0·05	0·4	r–r_0 19h.–24h.
20	997·7	ENE.3	46	51	88	0·16	—	r–r_0 0h.–3h., 14h.–19h.
21	1006·0	Calm	41	46	88	0·01	—	ir_0 14h.–20h. [& 24h.
22	1010·9	NE.2	44	47	85	—	—	
23	1013·5	NE.3	40	45	62	—	3·0	•
24	1019·9	NNW.2	33	43	68	—	5·8	x early.
25	1022·7	SW.2	29	40	84	—	0·1	x early. m all day.
26	1014·6	SW.4	31	49	68	—	2·2	x early. r_0 21h.
27	1016·7	WSW.3	37	47	75	—	3·2	
28	1000·9	SW.4	41	56	90	0·09	0·7	r–r_0 1h.–7h.
29	1009·3	WSW.3	41	50	69	—	3·8	r_0 17h. [22h.
30	1000·2	SW.4	42	47	77	0·21	—	r_0 9h.–12h. & 18h.–
*	1005·2	—	41	50	79	4·36	1·7	* Means or totals.

General Rainfall for November, 1935.

England and Wales ...	179	per cent. of the average 1881–1915.
Scotland	114	
Ireland	132	
British Isles	154	

Rainfall : November, 1935 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square..........	3·83	162	*Leics* .	Thornton Reservoir ...	5·13	227
Sur .	Reigate, Wray Pk. Rd..	5·92	190	,, .	Belvoir Castle............	4·27	191
Kent .	Tenterden, Ashenden...	6·44	213	*Rut* .	Ridlington	4·30	187
,, .	Folkestone, Boro. San.	6·23	...	*Lincs* .	Boston, Skirbeck.........	3·84	192
,, .	Eden'bdg., Falconhurst	7·25	204	,, .	Cranwell Aerodrome...	4·88	261
,, .	Sevenoaks, Speldhurst.	6·15	...	,, .	Skegness, Marine Gdns.	3·15	146
Sus .	Compton, Compton Ho.	8·65	227	,, .	Louth, Westgate.........	4·92	191
,, .	Patching Farm..........	7·64	214	,, .	Brigg, Wrawby St.......	3·82	...
,, .	Eastbourne, Wil. Sq....	7·06	202	*Notts* .	Worksop, Hodsock......	4·05	206
,, .	Heathfield, Barklye....	8·60	232	*Derby*.	Derby, L. M. & S. Rly.	4·90	227
Hants.	Ventnor, Roy.Nat.Hos.	8·55	266	,, .	Buxton, Terr. Slopes...	7·14	153
,, .	Fordingbridge, Oaklnds	8·20	240	*Ches* .	Runcorn, Weston Pt....	3·93	142
,, .	Ovington Rectory.......	8·44	254	*Lancs*.	Manchester, Whit. Pk.	4·56	173
,, .	Sherborne St. John......	5·24	184	,, .	Stonyhurst College......	4·81	107
Herts .	Royston, Therfield Rec.	4·02	172	,, .	Southport, Bedford Pk.	3·50	111
Bucks.	Slough, Upton............	4·55	205	,, .	Lancaster, Greg Obsy.	4·25	107
,, .	H. Wycombe, Flackwell	5·02	195	*Yorks*.	Wath-upon-Dearne......	4·12	202
Oxf .	Oxford, Mag. College...	3·88	176	,, .	Wakefield, Clarence Pk.	4·87	230
Nor .	Wellingboro, Swanspool	3·62	168	,, .	Oughtershaw Hall.......	8·33	...
,, .	Oundle	3·07	...	,, .	Wetherby, Ribston H..	5·16	221
Beds .	Woburn, Exptl. Farm...	3·48	155	,, .	Hull, Pearson Park......	3·73	170
Cam .	Cambridge, Bot. Gdns.	3·05	158	,, .	Holme-on-Spalding......	4·20	193
Essex .	Chelmsford, County Lab	4·29	191	,, .	West Witton, Ivy Ho.	6·75	196
,, .	Lexden Hill House......	3·96	...	,, .	Felixkirk, Mt. St. John.	5·13	209
Suff .	Haughley House.........	3·48	...	,, .	York, Museum Gdns....	4·09	196
,, .	Campsea Ashe............	4·20	189	,, .	Pickering, Hungate......	4·08	164
,, .	Lowestoft Sec. School...	3·07	131	,, .	Scarborough..............	4·25	172
,, .	Bury St. Ed., Westley H.	3·81	166	,, .	Middlesbrough...........	3·73	176
Norf. .	Wells, Holkham Hall...	3·20	149	,, .	Baldersdale, Hury Res.	6·02	163
Wilts .	Calne, Castle Walk......	6·70	...	*Durh* .	Ushaw College............	5·01	197
,, .	Porton, W.D. Exp'l. Stn	6·48	247	*Nor* .	Newcastle, Town Moor.	3·69	168
Dor .	Evershot, Melbury Ho.	9·67	227	,, .	Bellingham, Highgreen	4·15	121
,, .	Weymouth, Westham.	7·15	231	,, .	Lilburn Tower Gdns....	3·96	118
,, .	Shaftesbury, Abbey Ho.	6·38	197	*Cumb*.	Carlisle, Scaleby Hall...	3·13	104
Devon.	Plymouth, The Hoe....	8·05	220	,, .	Borrowdale, Seathwaite	14·50	113
,, .	Holne, Church Pk. Cott.	11·07	172	,, .	Borrowdale, Moraine...	11·30	110
,, .	Teignmouth, Den Gdns.	5·79	181	,, .	Keswick, High Hill......	5·09	90
,, .	Cullompton	5·85	170	*West* .	Appleby, Castle Bank...	3·01	91
,, .	Sidmouth, U.D.C........	5·41	...	*Mon* .	Abergavenny, Larchf'd	6·62	173
,, .	Barnstaple, N. Dev.Ath	5·55	141	*Glam* .	Ystalyfera, Wern Ho....	10·40	158
,, .	Dartm'r, Cranmere Pool	11·00	...	,, .	Cardiff, Ely P. Stn.......	6·29	151
,, .	Okehampton, Uplands.	8·67	163	,, .	Treherbert, Tynywaun.	13·09	...
Corn .	Redruth, Trewirgie......	6·98	143	*Carm* .	Carmarthen, The Friary	9·15	184
,, .	Penzance, Morrab Gdns.	7·17	157	*Pemb* .	St. Ann's Hd, C. Gd. Stn.	4·86	128
,, .	St. Austell, Trevarna...	7·96	162	*Card* .	Aberystwyth	4·94	...
Soms .	Chewton Mendip.........	8·71	204	*Rad* .	BirmW.W.Tyrmynydd	10·07	151
,, .	Long Ashton.............	6·19	195	*Mont* .	Lake Vyrnwy	7·40	133
,, .	Street, Millfield..........	5·96	...	*Flint* .	Sealand Aerodrome......	3·57	...
Glos .	Blockley	5·65	...	*Mer* .	Dolgelley, Bontddu......	7·76	125
,, .	Cirencester, Gwynfa....	6·47	217	*Carn* .	Llandudno	3·43	119
Here .	Ross, Birchlea...........	5·76	228	,, .	Snowdon, L. Llydaw 9..	18·92	...
Salop .	Church Stretton.........	7·00	238	*Ang* .	Holyhead, Salt Island...	6·02	145
,, .	Shifnal, Hatton Grange	5·40	229	,, .	Lligwy	5·91	...
Staffs .	Market Drayt'n, Old Sp.	4·78	182	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	4·97	218		Douglas, Boro' Cem....	5·92	124
War .	Alcester, Ragley Hall...	5·07	219	*Guernsey*			
,, .	Birminghm, Edgbaston	5·80	244		St. PeterP't.Grange Rd.	7·93	189

Rainfall: 1935: November, Scotland and Ireland

Co.	STATION.	In.	Per cent of Av.	Co.	STATION.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	5·97	138	*Suth* .	Melvich	4·09	102
,, .	New Luce School	6·81	133	,, .	Loch More, Achfary	5·60	65
Kirk .	Dalry, Glendarroch	7·78	130	*Caith* .	Wick	4·56	145
,, .	Carsphairn, Shiel	9·59	121	*Ork* .	Deerness	5·20	132
Dumf.	Dumfries, Crichton R.I.	6·29	181	*Shet* .	Lerwick	2·90	68
,, .	Eskdalemuir Obs	5·98	103	*Cork* .	Caheragh Rectory	6·15	...
Roxb .	Hawick, Wolfelee	4·08	105	,, .	Dunmanway Rectory	6·61	107
Selk .	Ettrick Manse	6·04	111	,, .	Cork, University Coll.	4·58	114
Peeb .	West Linton	5·12	...	,, .	Ballinacurra	4·33	108
Berw .	Marchmont House	3·75	125	,, .	Mallow, Longueville	5·03	134
E.Lot.	North Berwick Res	3·78	169	*Kerry*.	Valentia Obsy	8·36	153
Midl .	Edinburgh, Roy. Obs.	3·80	170	,, .	Gearhameen	13·20	136
Lan .	Auchtyfardle	5·93	...	,, .	Bally McElligott Rec.	6·52	...
Ayr .	Kilmarnock, Kay Pk	4·50	...	,, .	Darrynane Abbey	7·23	142
,, .	Girvan, Pinmore	6·46	121	*Wat* .	Waterford, Gortmore	4·90	132
Renf .	Glasgow, Queen's Pk	4·35	117	*Tip* .	Nenagh, Cas. Lough	5·06	126
,, .	Greenock, Prospect H.	5·83	91	,, .	Roscrea, Timoney Park	4·08	...
Bute .	Rothesay, Ardencraig	5·75	...	,, .	Cashel, Ballinamona	4·32	123
,, .	Dougarie Lodge	5·98	...	*Lim* .	Foynes, Coolnanes	5·73	143
Arg .	Ardgour House	8·47	...	,, .	Castleconnel Rec.	4·51	...
,, .	Glen Etive	10·07	97	*Clare* .	Inagh, Mount Callan	8·92	...
,, .	Oban	3·00	...	,, .	Broadford, Hurdlest'n.	4·08	...
,, .	Poltalloch	6·10	110	*Wexf* .	Gorey, Courtown Ho.	4·47	128
,, .	Inveraray Castle	10·11	120	*Wick* .	Rathnew, Clonmannon.	5·05	...
,, .	Islay, Eallabus	7·53	140	*Carl* .	Hacketstown Rectory	5·05	129
,, .	Mull, Benmore	...	...	*Leix* .	Blandsfort House	4·77	143
,, .	Tiree	...	...	*Offaly*.	Birr Castle	4·03	130
Kinr .	Loch Leven Sluice	4·09	114	*Dublin*	Dublin, FitzWm. Sq.	3·46	130
Perth .	Loch Dhu	7·20	83	,, .	Balbriggan, Ardgillan	5·30	184
,, .	Balquhidder, Stronvar.	8·22	...	*Meath*.	Beauparc, St. Cloud	6·00	...
,, .	Crieff, Strathearn Hyd.	4·79	110	,, .	Kells, Headfort	4·41	130
,, .	Blair Castle Gardens	4·33	123	*W.M* .	Moate, Coolatore	3·82	...
Angus.	Kettins School	3·87	125	,, .	Mullingar, Belvedere	4·40	129
,, .	Pearsie House	4·65	...	*Long* .	Castle Forbes Gdns	4·28	119
,, .	Montrose, Sunnyside	4·53	171	*Gal* .	Galway, Grammar Sch.	14·84	...
Aber .	Braemar, Bank	4·76	124	,, .	Ballynahinch Castle	0·02	168
,, .	Logie Coldstone Sch	3·99	130	,, .	Ahascragh, Clonbrock.	4·98	123
,, .	Aberdeen, King's Coll.	4·26	144	*Mayo*.	Blacksod Point	5·58	107
,, .	Fyvie Castle	4·44	128	,, .	Mallaranny	8·23	...
Moray	Gordon Castle	2·47	86	,, .	Westport House	7·01	143
,, .	Grantown-on-Spey	2·28	76	,, .	Delphi Lodge	13·19	127
Nairn.	Nairn	2·63	111	*Sligo* .	Markree Obsy	4·68	111
Inv's .	Ben Alder Lodge	4·75	...	*Cavan*.	Crossdoney, Kevit Cas.	4·74	...
,, .	Kingussie, The Birches.	3·22	...	*Ferm* .	Enniskillen, Portora	4·25	...
,, .	Inverness, Culduthel R.	2·69	...	*Arm* .	Armagh Obsy	3·88	137
,, .	Loch Quoich, Loan	9·75	...	*Down*.	Fofanny Reservoir	12·00	...
,, .	Glenquoich	...	...	,, .	Seaforde	5·49	145
,, .	Arisaig, Faire-na-Sguir.	...	...	,, .	Donaghadee, C. G. Stn.	4·62	151
,, .	Fort William, Glasdrum	7·38	...	,, .	Banbridge, Milltown	3·22	117
,, .	Skye, Dunvegan	4·81	...	*Antr* .	Belfast, Cavehill Rd.	5·19	...
,, .	Barra, Skallary	5·84	...	,, .	Aldergrove Aerodrome.	3·85	119
R&C .	Alness, Ardross Castle.	...	...	,, .	Ballymena, Harryville.	4·79	118
,, .	Ullapool	3·28	62	*Lon* .	Garvagh, Moneydig	5·77	...
,, .	Achnashellach	3·42	37	,, .	Londonderry, Creggan.	4·33	106
,, .	Stornoway	3·32	57	*Tyr* .	Omagh, Edenfel	5·79	152
Suth .	Lairg	3·29	82	*Don* .	Malin Head	3·73	...
,, .	Tongue	2·42	53	,, .	Killybegs, Rockmount.	3·08	...

Climatological Table for the British Empire, June, 1935

STATIONS.	PRESSURE. Mean of Day M.S.L. mb.	PRESSURE. Diff. from Normal. mb.	TEMPERATURE. Absolute. Max. °F.	TEMPERATURE. Absolute. Min. °F.	TEMPERATURE. Mean Values. Max. °F.	TEMPERATURE. Mean Values. Min. °F.	TEMPERATURE. Mean Values. ½ Max. and Min. °F.	TEMPERATURE. Mean Values. Diff. from Normal °F.	TEMPERATURE. Mean. Wet Bulb. °F.	Relative Humidity. %	Mean Cloud Am'nt 0–10	PRECIPITATION. Am'nt. in.	PRECIPITATION. Diff. from Normal. in.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
London, Kew Obsy....	1013·3	— 3·4	84	42	69·6	54·1	61·9	+ 2·7	55·8	83	6·9	3·87	+ 1·72	18	6·9	42
Gibraltar..................	1017·7	+ 0·4	92	58	79·0	61·7	70·3	— 0·2	60·0	80	3·1	0·17	— 0·37	3	...	...
Malta.......................	1017·0	+ 1·8	91	60	80·9	68·1	74·5	+ 1·8	66·7	67	1·9	0·00	— 0·09	0	12·4	85
St. Helena	1015·9	+ 0·6	72	55	62·5	56·6	59·5	— 1·0	57·6	93	9·1	5·14	...	21	...	...
Freetown, Sierra Leone	1014·3	+ 2·3	88	68	84·8	72·0	78·4	— 1·9	75·3	86	8·8	32·86	+ 12·82	29	...	...
Lagos, Nigeria	1013·0	+ 0·6	87	69	83·7	73·9	78·8	— 0·7	74·7	89	8·8	21·18	+ 2·70	20	4·1	33
Kaduna, Nigeria	1008·8	...	92	64	85·7	68·8	77·3	+ 0·8	71·7	85	7·1	9·32	+ 2·23	20	7·1	56
Zomba, Nyasaland	1017·3	— 0·2	78	50	69·7	56·9	63·3	+ 0·4	56·1	73	6·9	0·33	— 0·15	4	...	...
Salisbury, Rhodesia...	1021·0	— 1·1	73	36	67·3	41·2	54·3	— 2·6	48·4	60	2·3	0·45	+ 0·40	3	8·1	73
Cape Town	1021·8	+ 1·7	79	38	64·5	47·5	56·0	+ 0·3	48·1	72	4·7	1·54	— 2·96	9	...	...
Johannesburg	1022·6	+ 0·1	68	27	59·5	39·7	49·6	— 1·1	38·5	44	0·1	0·00	— 0·14	0	9·4	90
Mauritius	1018·2	— 0·8	80	61	75·7	66·0	70·9	+ 1·5	66·9	76	6·4	4·80	+ 2·00	17	5·7	52
Calcutta, Alipore Obsy.	999·9	+ 0·2	100	74	95·3	80·9	88·1	+ 3·0	80·5	80	7·5	4·05	— 7·86	9*	...	...
Bombay	1004·2	+ 0·2	93	73	89·7	79·2	84·5	+ 0·5	78·5	83	7·6	27·69	+ 7·82	17*	...	...
Madras	1003·0	— 0·8	108	76	99·2	81·8	90·5	+ 0·5	76·6	59	7·2	1·23	— 0·74	3*	...	...
Colombo, Ceylon	1009·0	+ 0·4	87	72	84·8	76·4	80·6	— 1·0	77·5	83	8·4	11·39	+ 4·07	25	5·0	40
Singapore................	1009·0	+ 0·1	88	73	85·3	76·2	80·7	— 0·8	77·9	81	8·3	7·84	+ 0·97	15	5·3	43
Hongkong................	1006·4	+ 0·6	90	76	86·9	78·7	82·8	+ 1·4	78·3	81	8·3	14·43	— 1·27	24	5·1	38
Sandakan	1009·0	...	92	73	88·5	75·4	81·9	+ 0·2	76·9	83	6·5	12·64	+ 5·14	25	...	...
Sydney, N.S.W..........	1018·6	+ 0·7	71	40	62·6	46·0	54·3	— 0·4	48·0	70	4·8	4·82	+ 0·08	12	5·8	59
Melbourne	1020·2	+ 1·7	67	36	56·2	44·0	50·1	— 0·3	45·8	85	7·5	2·10	+ 0·04	19	2·4	25
Adelaide	1021·3	+ 2·2	67	40	60·0	46·9	53·5	0·0	48·7	74	7·2	2·68	— 0·42	18	3·6	37
Perth, W. Australia ...	1023·0	+ 5·0	78	41	63·7	49·2	56·5	— 0·3	50·4	71	6·1	4·13	— 2·81	14	4·9	49
Coolgardie	1022·8	+ 3·9	72	33	61·2	41·1	51·1	— 1·7	47·2	79	5·9	1·27	+ 0·01	6	...	...
Brisbane..................	1019·0	+ 0·7	77	41	70·0	50·2	60·1	— 0·1	52·8	63	4·3	0·06	— 2·73	2	6·9	67
Hobart, Tasmania......	1016·5	+ 2·2	59	32	52·0	40·8	46·4	— 0·6	42·2	75	6·4	2·42	+ 0·19	11	3·7	41
Wellington, N.Z.	1006·1	— 8·8	61	32	53·0	42·7	47·9	— 1·6	45·5	82	6·9	2·80	— 1·97	16	3·2	35
Suva, Fiji	1013·7	+ 0·1	86	67	81·0	71·1	76·1	+ 1·4	71·7	87	6·9	4·67	— 2·04	17	4·4	40
Apia, Samoa	1011·6	0·0	87	70	84·6	73·2	78·9	+ 1·1	75·2	77	4·9	2·71	— 2·64	9	8·2	73
Kingston, Jamaica	1013·6	— 0·2	90	70	87·7	72·9	80·3	— 1·0	72·9	79	5·6	1·79	— 2·31	4	6·6	50
Grenada, W.I.	...	...	87	70	85	73	79	0·0	74	79	6	3·89	— 4·36	24	...	...
Toronto..................	1013·0	— 1·7	83	42	72·6	54·7	63·7	— 0·1	57·0	73	5·6	3·42	+ 0·76	16	8·1	53
Winnipeg	1009·9	— 1·9	84	29	67·5	48·0	57·7	— 4·6	49·4	77	6·0	4·15	+ 1·04	14	7·0	43
St. John, N.B.	1014·3	— 0·8	75	43	65·5	49·1	57·3	+ 0·8	53·9	83	7·5	4·35	+ 1·08	15	6·2	40
Victoria, B.C............	1016·5	— 0·3	83	44	65·0	50·3	57·7	+ 0·7	52·8	75	5·9	0·67	— 0·17	11	9·3	58

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Pressure, weather and rainfall of 1935

Variations of Pressure near the British Isles during 1935

During the year 1935 charts have been drawn for each half-month giving the average pressure distribution over the region between the west coast of North America and western Siberia, with a view to studying the changes in the general barometric situation of a more gradual kind than those seen in the *Daily Weather Reports*. These charts are of some interest, in that they show, more clearly than monthly charts, how a certain general type of distribution can persist for six weeks or more, and then rapidly give place to quite another type.

The year opened with a westerly type, low pressure over the Greenland-Spitsbergen region and high pressure south or south-west of the British Isles. This type persisted for six weeks, the pressure difference between Scilly and Jan Mayen increasing from 21·4 mb. in January 1st–15th to 27·8 mb. in January 16th–31st and 31·6 mb. in February 1st–14th; during the last period pressure at Spitsbergen was only 984 mb. In the second half of February (see chart) the type was similar, but the centre of lowest pressure lay north of Thorshavn (981 mb.) and the whole of the British Isles was below 1000 mb. In March 1st–15th (see chart) the distribution changed completely to a southerly type, with high pressure over Scandinavia and low over the North Atlantic. This was short-lived however, the period from

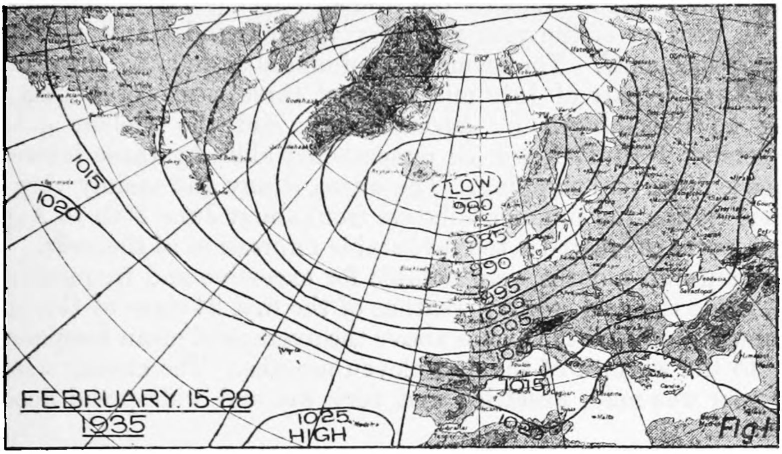
March 16th to April 15th showing a reversion to something approaching that of February 15th–28th, a long belt of low pressure extending from mid-Atlantic to Norway across the northern part of the British Isles while an anticyclone lay over France and Spain.

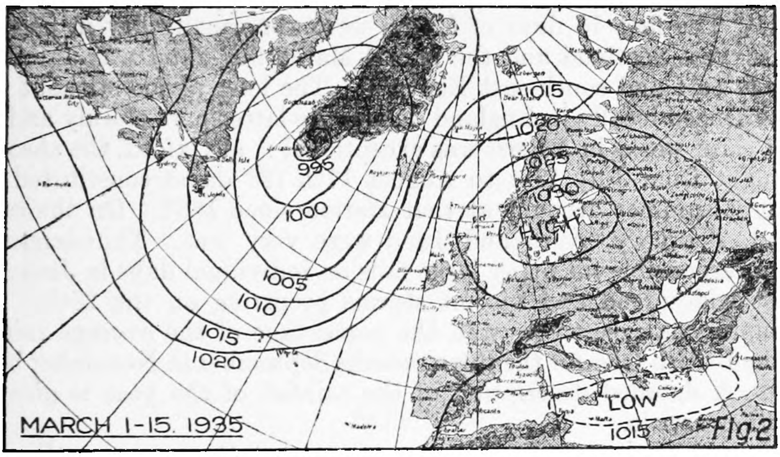
In the second half of April the pressure was extraordinarily uniform over the whole of Europe and the eastern Atlantic, while both halves of May showed an anticyclone, persistent though not intense, centred near Thorshavn and covering the British Isles, giving a fine warm month. In the first half of June this distribution was completely reversed, a shallow depression covering the British Isles and Scandinavia. June 16th–30th was another period of uniform pressure, but from July 1st to August 15th a tongue of high pressure from the Azores anticyclone extended to the east-north-east across the British Isles, and this period of six weeks during which the general pressure distribution scarcely changed brought the remarkably fine weather of the height of summer. From August 16th to September 15th conditions were somewhat less favourable, a shallow depression extending, first south-east from Greenland and then eastwards from the mid-Atlantic. From September 16th to October 15th the low pressure centre lay directly over the north of Scotland, with a marked gradient for westerly winds over England, giving a very stormy period, while from October 16th–31st the depression, though centred somewhat further north, was intensified. There were two autumn gales of exceptional severity on September 16th–17th and October 18th–20th. The chart for October 16th–31st closely resembled that for February 15th–28th and rather curiously the chart for November 1st–15th (see chart) is not dissimilar in appearance from that for March 1st–15th. Both high and low pressure however were some 1,500 miles further east in November than in March, so that the British Isles came under the influence of the depression instead of the anticyclone, and the weather here was exceptionally wet and stormy instead of exceptionally dry. The second half of November was similar to the first half, but with some approach to the type of October 1st–15th. December 1st–15th showed the Azores high again extending towards the north-east, but this promise was not maintained and the latter half of the month showed an intense elongated depression occupying the North Atlantic between 48° and 60° N. In the centre of this depression pressure was only about 990 mb., and the area below 1000 mb. included both Newfoundland and the British Isles. At the other extreme pressure was very high over eastern Russia, giving a strong flow of air from south-west over the greater part of Europe.

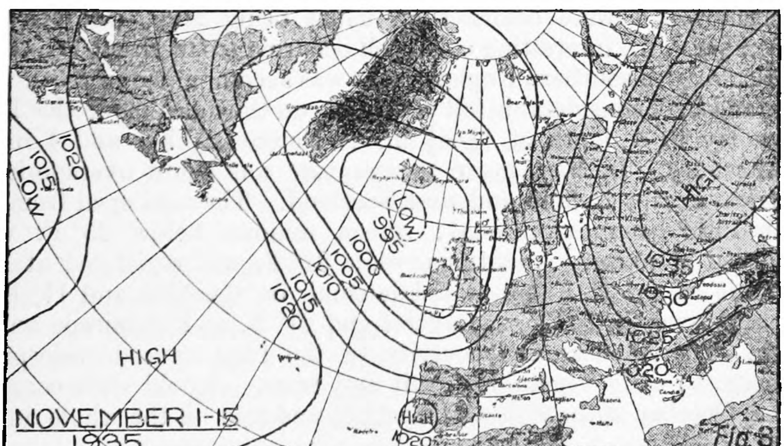
C. E. P. BROOKS.

The Weather of 1935

Full information for December is not yet available but there is no doubt that rainfall and temperature for the year 1935 exceeded the







Charts Showing Pressure Isoanomalies

average for the country generally. Sunshine was variable but somewhat above average on the whole.

The weather of the year was very variable and many interesting features occurred. The severe frost of mid-May and the long drought of the latter part of July and the first three weeks of August will long be remembered by agriculturists, and the violent gale of September 16th–17th will be remembered alike by those interested in agriculture and shipping. The warm, sunny and mainly very dry period during the summer holidays from about June 20th to August 22nd, perhaps created a too favourable impression of the year. The three autumn months were notable for excessive and frequent rainfall, while the cold, wintry weather of the first 24 days of December somewhat reduced the excess above the average of mean temperature due to the warmth of the first eleven months. The closing week of the year was mild, unsettled and very wet and widespread flooding resulted.

The first six months were alternately markedly dry and excessively wet. The first 18 days of March were abnormally dry in parts of north-west Scotland and the period March 5th–22nd was unusually dry in east and south-east England. The long period without rain experienced locally in England during the latter part of July and the first three weeks in August was exceptional: at Oxford, the absolute drought from July 21st to August 17th (28 days) constituted the longest summer drought at that station since 1887. On the other hand, February, April and June were very wet. Thunderstorms were responsible for many large falls on individual days in June, the most widespread and violent storms occurring on the 25th. The autumn was excessively wet, the percentage of the average rainfall of the British Isles for the three months September to November being 160. A detailed description of the rainfall of the year is given in another article.

Mean temperature for the year exceeded the average, the only months which were colder than usual being May, October and December. An interesting cold spell occurred from March 8th–11th, particularly in southern England. It was accompanied in south-west England by a considerable fall of snow: on the morning of the 11th, snow lay to a depth of 4½–6½ in. at Newton Abbot and 4 in. at Shaftesbury. In May, mean temperature was below average in all districts except Ireland and west Scotland. The cold spell from the 12th–19th* was exceptional: screen minima below 25° F. were recorded at numerous stations, while 21° F. was registered at Dalwhinnie on the 13th and at Eskdalemuir on the 15th and 17° F. at Rickmansworth, 20° F. at Cantref and 21° F. at Dalwhinnie on the 17th. The lateness and severity of the frost caused widespread damage to early vegetables, fruit and trees. A cold spell occurred from October 20th–26th and weather was cold on the whole during

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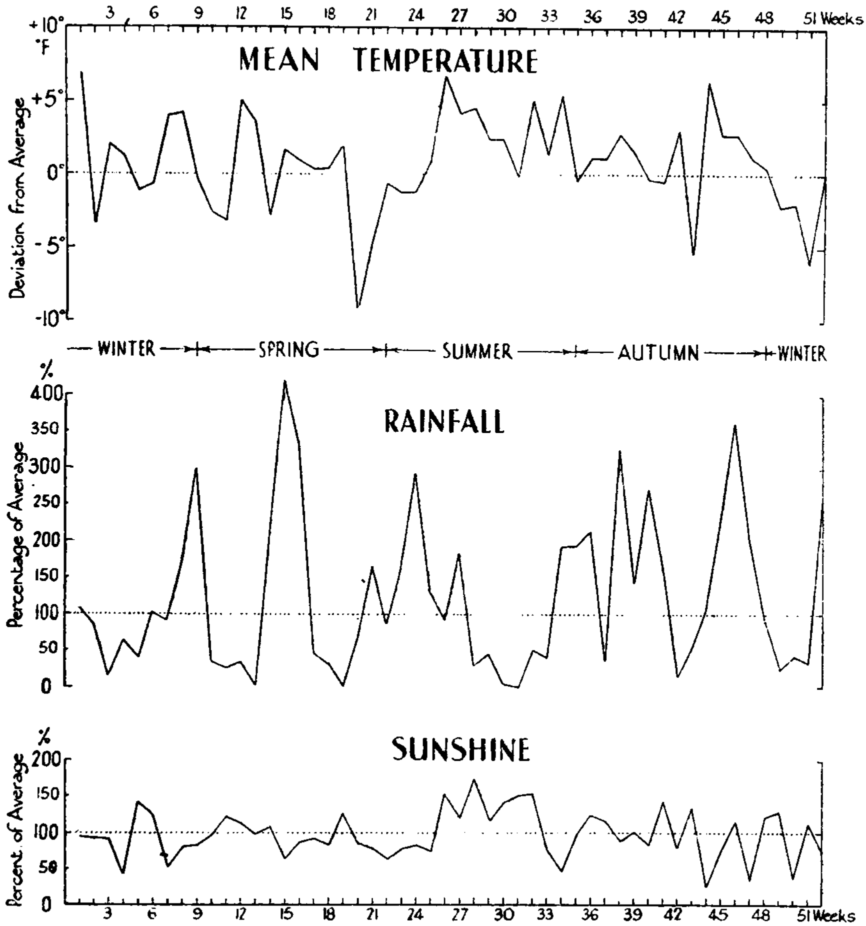
* See *Meteorological Magazine, 70,* 1935 pp. 105–9.

the first 24 days of December. The latter period was accompanied at times by severe frost and much fog, and widespread snow occurred between the 14th and 24th. On the other hand, February was unusually mild and the latter part of June, July and August were excessively warm. Notable warm spells included the last ten



The Weather of 1935 in south-east England

Weekly variations from long period averages computed from observations at five representative stations

days of June, July 9th–16th and 22nd–28th, August 5th–11th and around August 22nd. Among high maxima may be mentioned 88° F. at Manchester on June 22nd, at Brighton and London (Camden Square) on June 24th and at Huddersfield on June 29th, 92° F. at Attenborough, 91° F. at Worcester and 90° F. at Wakefield and Huddersfield on July 13th and 89° F. at numerous stations in the eastern half of England on August 22nd.

In general, the sunniest months were May and July and the dullest

June and October, but considerable variations occurred in different districts in individual months. For example, January was exceptionally sunny in west Scotland and notably dull in north Ireland, while November was the dullest month in north-east England. A remarkable excess of sunshine was registered in west Scotland, north-west England, and north Ireland in May. The totals at Eskdalemuir and Stonyhurst were the largest recorded in any month since observations were first taken in 1909 and 1881 respectively. The excessive sunshine in July was noteworthy and at some stations it was the sunniest July on record.

No description of the year's weather would be complete without some reference to gales. During a severe gale from January 24th–26th a gust of 100 m.p.h. was registered at Butt of Lewis. In February, gales were widespread and frequent but not of exceptional severity. Perhaps the most notable, on account of the season in which it occurred, was the gale of September 16th–17th. In southern England it was very violent and was comparable with the most severe winter gales on record in that part of the country. Another exceptional gale occurred from October 18th–20th. It was especially violent in Scotland and a gust of 101 m.p.h. was recorded at Bell Rock Lighthouse. Detailed descriptions of the gales of September 16th–17th and October 18th–20th are given in the *Meteorological Magazine* for November, 1935.

The diagram on page 281 shows the weekly variations in temperature, rainfall and sunshine in south-east England in 1935. The variations are given in the form of deviation from the average of temperature and percentages of the average of rainfall and sunshine. The district value is the arithmetic mean of the values for the following stations :—Kew Observatory, Margate, St. Leonards, Southampton and Marlborough. The curves clearly show the cold spell in May, the long warm, dry, sunny spell during the summer, the wet autumn and the cold of the greater part of December. The rainfall curve indicates the alternating very dry and very wet periods during the first six months, notably the excessively wet April.

L. F. LEWIS.

The Rainfall of 1935

The general rainfall for 1935 over England, Wales and Scotland exceeded the average, but there was a small deficiency over Ireland. The wettest individual stations, in relation to the average, occurred in the south of England between London, Ventnor and Salisbury, where falls of 135 per cent. were recorded locally. On the other hand, there was as little as 80 per cent. in Co. Carlow. The alternation of dry and wet months, which commenced in November, 1934, continued until August, 1935, both July and August giving less than the average. Subsequently in each of the autumn months, September, October and November, the rainfall was appreciably in excess of the average. December gave less than the average in both Scotland and Ireland, although exactly the average amount over England and Wales.

Provisional estimates of the general rainfall for 1935 are given below, both in actual inches and as percentages of the average, together with similar values for 1934, 1933 and 1930.

	1935.		1934.		1933.		1930.	
	in.	%	in.	%	in.	%	in.	%
England and Wales ...	40·1	114	33·5	95	28·6	81	41·4	117
Scotland	54·8	109	55·4	110	40·3	80	54·6	109
Ireland	42·6	98	45·5	105	33·5	77	50·4	116
British Isles	45·5	110	41·4	100	33·3	80	47·7	115

Over England and Wales and the British Isles as a whole, 1935 ranks as the wettest year since 1930, while over both Scotland and Ireland 1934 was wetter than 1935.

General values for each month are set out in the table below, both as percentages of the average and in actual inches of rainfall.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	%	%	%	%	%	%	%	%	%	%	%	%
England and Wales ...	65	158	38	186	60	149	30	80	210	129	179	100
Scotland	81	126	71	144	48	146	75	87	172	183	114	72
Ireland	45	125	53	116	46	196	36	75	196	119	132	72
British Isles	65	144	49	162	55	158	41	81	198	139	154	88
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
England and Wales ...	1·9	4·1	1·0	3·9	1·4	3·6	0·9	2·7	5·3	5·1	6·3	3·9
Scotland	4·0	5·2	2·9	4·3	1·5	4·1	2·8	3·9	6·9	9·0	6·0	4·2
Ireland	1·8	4·4	1·8	3·2	1·3	5·5	1·2	3·2	6·1	4·8	5·7	3·6
British Isles	2·5	4·6	1·6	4·1	1·4	4·2	1·3	3·1	6·1	5·9	6·5	4·2

The total rainfall for the year was less than the average over small areas in England, including the north-east of Northumberland, as well as near Penrith, Lancaster, Bideford, the Wash and the Thames Estuary. Falls exceeding 110 per cent. were widespread. More than 120 per cent. occurred over small areas near Barnard Castle, York, Huddersfield and Ipswich as well as over much of the south of England from Bristol to Folkestone. Falls exceeding 130 per cent. were confined to areas around Salisbury Plain, from Dorking to Tunbridge Wells, and at Ventnor and Littlehampton.

Over Wales the variation was from rather less than the average in the extreme south-west to 123 per cent. at Lake Vyrnwy in Montgomeryshire. Falls of more than 110 per cent. were widespread over central Wales.

Less than the average occurred over large areas in Scotland, including the Outer Hebrides and the south-east from Crieff to Berwick-on-Tweed. Falls exceeding 110 per cent. were not so widespread as over England and Wales. More than 120 per cent. occurred in Argyll and Sutherland and near Glasgow and Inverness. At Inveraray, in Argyll, as much as 131 per cent. was recorded.

Over most of Ireland the totals approximated closely to the average. There was less than the average over the south-east from Co. Kerry to Wicklow, with rather less than 80 per cent. near Carlow. Less than the average also occurred over a large area from Co. Longford to the north-east coast, while as much as 110 per cent. was recorded in Connemara and Londonderry.

Over the British Isles generally, the driest months were July, May and March, and the wettest November, September and October. The last four months of the year contributed half the total rainfall. February was the fourth wettest month of the year. At Borrowdale, in Cumberland, the total for the 15 days, February 10th to 24th, was 17·01 in. or twice the average for the whole month. This total included falls of 6·25 in. and 6·41 in. for the 15th–16th and 18th–20th respectively. Over the country as a whole June was as wet as December, an unusual state of affairs. At Cashel, in Co. Tipperary, the total for June was three times the average. Some rain occurred on every day from the 1st to 21st, the total for the three days, the 24th to 26th, being 2·23 in. or the average for the whole month. A remarkable change was experienced in August at Ventnor, for while the total for the 62 days, June 21st to August 21st, was only 0·54 in., that for the 8 days, August 23rd to 30th, was 3·35 in. Dry weather was general during the 62 days, June 21st to August 21st. Thus, at Hull, the total was only 0·47 in. A number of stations in England and Wales recorded the wettest September since that of 1918. At Inveraray, in Argyllshire, as much as one inch was recorded on as many as 12 days during October and the total was the largest recorded there in any month in records back to 1881. Up to the end of August the rainfall over the country was in general less than the average. Thus while 1935 gave early promise of rivalling 1933 and 1934 for low totals, the persistent rains of the last four months resulted in the year ending with widespread floods, especially in the Midlands and south of England.

J. GLASSPOOLE.

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings are :—

January 27th, 1936. *Practical experiences and some results gained from soundings with registering balloons and registering apparatus in the stratosphere.* (Beitr. Phys. frei. Atmos., Leipzig, Vol. 22, 1935. pp. 249–60). *Opener.*—Mr. F. J. W. Whipple, Sc.D.

February 10th, 1936. *Practical rules for prognosticating the movement and the development of pressure centres.* By S. Pettersen (U.G.G.I., Ass. Met., Proc.-Verb., Lisbon, 1933 II, 1935, pp. 35–66). *Opener.*—Mr. W. D. Flower, B.Sc.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, November 18th, in the Society's rooms at 49, Cromwell Road, South Kensington, Lt.-Col. E. Gold, D.S.O., F.R.S., President, in the Chair.

Mr. A. Hampton Brown has retired from the position of Assistant Secretary to the Society after serving on the office staff for forty years. Miss E. N. Kidner, B.A., succeeds him.

The following papers were read and discussed :—

A. King.—The great fireball of 1934, *October* 11*th, and an instance of streak-drift.*

The fireball, probably brighter than the full moon, first appeared over east Yorkshire at a height of 94 miles and ended, after a flight of 58 miles, over north Lincolnshire at a height of 51 miles. The speed was 21 miles per sec. and the radiant at ∞, 252·3°, 8, + 75·8°. The parabolic orbit deduced from the corrected radiant gave rise to the suspicion that the object may have been connected with Comet Giacobini-Zinner. A streak was left along the track between the heights of 77 miles and 56 miles. The upper portion quickly vanished, and the part from 69 miles high to the end (56 miles high) drifted in a generally north-east direction with rates as under for the respective heights :—

Height.	Speed of drift.
miles.	m.p.h.
69	130
60⅓	162
56	150

R. M. Poulter.—Configuration, air mass and rainfall.

Starting with the proportions of the year's rainfall attributable to warm fronts, occlusions and cold fronts, a relation is obtained between average annual rainfall and the altitude and slope of the land in the British Isles.

Gordon Manley, M.A., B.Sc.—The climate of the northern Pennines ; the coldest part of England.

The northern Pennine moorlands comprise the most consistently elevated and chilly part of England. Very few observations are available, however, as regard temperature, although an interesting record, showing great extremes, was maintained near Alston from 1880–6. Rainfall is better known ; other climatic features of especial note include occasional peculiarly violent thunderstorms and the well-known " helm-wind ". The writer has established a station at which temperatures have been taken in a standard screen since early in 1932 ; this is at a keeper's cottage on the exposed moorland of Upper Teesdale just to the south-east of Crossfell. The altitude (1,840 ft.) makes the station the highest at which a continuous record has been kept in England. In general, although mean temperatures differ by about 5·5°F., no more than might be expected, from a group of northern lowland stations, the maxima are decidedly lower (7·0°) while the minima are not so much lower (3·3°) ; and the mean daily range of temperature on the uplands is less than that in the valleys. This is to be expected; but exceptional extremes occur on particular occasions which appear to be due to the position of the moorland basin in which the station lies. As a whole the figures confirm the prevailing impression of bleakness associated with a windy and damp upland and correspond well with records at sea-level in southern Iceland.

A. H. R. Goldie, M.A., F.R.S.E.—Some characteristics of the mean annual circulation over the British Isles.

The westerly component of the mean annual drift of air over the northern part of the British Isles has, during the last 30 years, attained maxima at intervals mostly of four years. Using this element as an index for classifying the years, the writer sets out the special features which in various corresponding years, have affected weather, temperature, rainfall, sunshine and gales in the British Isles.

It is shown that years in which the westerly component of air drift reached a maximum have been characterized on the average by warmer and drier conditions and their summers individually by sunnier conditions than other years of the series ; years preceding a maximum (so far as the available statistics enable the point to be explored) appear mostly to have been characterized by a high duration of winds of gale force and by maximum " latitude-exchange" of air.

Attention is called to the fact that Lockyer, over 30 years ago, noted the existence of a 3·8 year period in atmospheric pressure in India, Australasia and South America, and that more recently Elton, from biological researches, and Kershaw, from consideration of sunshine data, have remarked on the probability of a climatic factor with a period of about four years.

S. Chapman, M.A., D.Sc., F.R.S.—The lunar atmospheric tide in the Azores, 1894–1932.

This paper is a continuation of the series on lunar atmospheric tides.

Correspondence

To the Editor, *Meteorological Magazine*

Winter Smoke Deposit Measurement

Yesterday, December 16th, snowfall in Leeds froze hard at night, the sky being very clear and radiation, therefore, high. About 10 a.m. December 17th all throughout Roundhay, undisturbed snow was patterned with a liberal deposit of smuts more or less evenly distributed. These were very evidently all from morning-fire smoke emission in the district. As the smuts had held to the snow where they had fallen, and their disintegrated products were very plainly visible against the white background; the occurrence was equivalent to the arrest of a normal daily process in that weather, and provided a static cross-section, as it were, for observation of such daily process.

The neighbourhood where these countless smuts were observed is one of the highest, and probably the cleanest, in Leeds, and open to moorland breezes from NW., and fresh, relatively clean winds from many points of the compass.

An average count of the smut deposit in the snow gave rather more than one smut per square inch, and a similar distribution was quite general so far as the snow persisted towards the city. The disappearance of snow in the lower districts prevented computation there, which would probably have proved heavier.

Smuts about 0·5 cm. diameter or major axis, were studied as they lay in the snow. After falling, they at first lay lightly adherent on the snow surface. Owing to their insulation protection under the warmer morning atmospheric condition, the snow underneath them gradually melted, and the smut fell into the small hole formed. In doing so, it broke up into smaller portions under its own movement, and around the lip of each hole as a centre, was a small galaxy of disintegrated smut. That this was the general procedure was shown by the fact that these small distinct collections of smut-components marked the position of every smut-fall in the snow except the most recent.

The most important aspects of this observation are :—(i) it shows very plainly one way in which smoke after aggregating to form smut agglomerates, then disintegrates and breaks down to form dust, and (ii) since the air was still, and conditions typical for cold weather in the neighbourhood, and smuts were held *in situ* by snow as they fell, it is now easy to calculate the typical winter smoke deposit per morning per unit area in this district, by finding average smut weight. And, of course this will approximate the heaviest deposit for the whole year.

The observation is put on record in the hope that this simple, naturally-provided, counting method may be used in numerous other districts to estimate the winter smut-fall, as soon as further snow showers provide the opportunity. A large body of useful data towards the prevention of atmospheric pollution might thus be gathered and made available. As, normally, the smut deposit per unit area would be elusive and difficult to determine, such a natural opportunity ought not to be ignored or lost, in view of the increasing need for data to overcome atmospheric pollution.

On December 18th, the ground being colder with continued frost, the new daily smut deposit, still evident and countable in every direction against the white background, had not been broken up by the snow's melting.

S. C. BLACKTIN.

20, *Denton Avenue, Roundhay, Leeds*, 8, *December 17th*, 1935.

Christmas Frost in Co. Tipperary

It is very unusual in southern Ireland to have what may be called an "old-fashioned" Christmas, but, although this year there was some thaw on Christmas Day itself, the few days previous provided the hardest weather known in Co. Tipperary for 20 years, being chiefly notable for severe frost and thick fog. Several accidents were reported on the roads.

At Cashel some frost was recorded in November, including 8° on the 24th, but the actual wintry spell was confined to December, and there was nothing extraordinary until the 17th, which began a real arctic week. The minimum screen temperature for each day was as follows :—17th, 24° ; 18th, 32° ; 19th, 22° ; 20th, 22° ; 21st, 17° ; 22nd, 18° ; 23rd, 29° ; while the maximum never exceeded 40° in the week. The fog was thickest from the 19th to 23rd, and, added to the frost, made roads almost impassable. At times it was not possible to see more than 50 yards, although there were some bright intervals. Ponds were covered with about 6 in. of ice, which did not clear off for some days after the commencement of the thaw on the 23rd. Snow in the district, however, was confined to mountains and hills, which were generally covered by dense masses of cumulus cloud.

To compare this spell with others, temperature at Ballinamona was never lower than 20° since 1918, when the screen was fixed in its present position. In other parts of Ireland, during the recent frost, temperature in Cork fell to 18° in the screen, and 15° on the ground, while in Co. Longford many roads were completely blocked by snow.

On the whole, it seems probable that this week was the most severe recorded in Ireland for about 50 years, though isolated frosts may have been worse on other occasions.

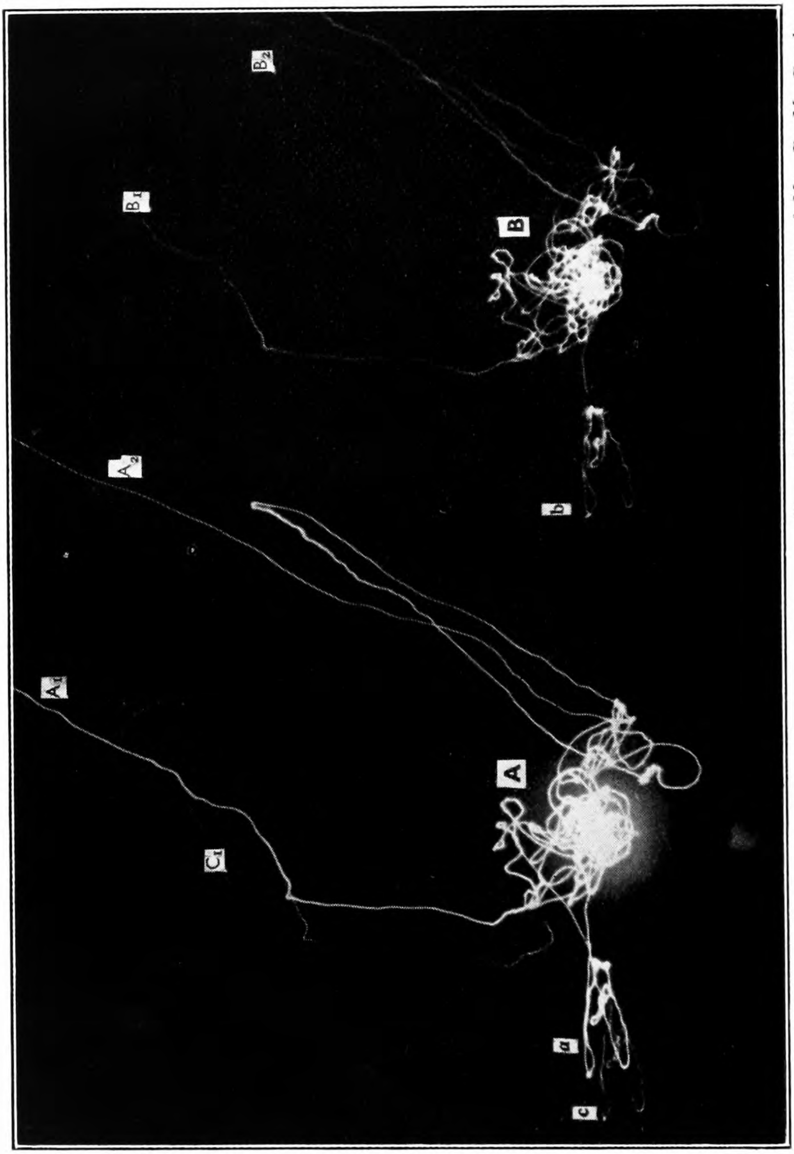
E. W. MONTAGU MURPHY.

Ballinàmona, Cashel, Co. Tipperary, December 31st, 1935.

Cloudburst at Syra

Syra suffered, at about noon on December 25th, from a cloudburst accompanied by lightning which did considerable damage to wells, crops and agricultural land generally, by washing away supporting walls of terraces, etc. Many sheep were drowned and lightning struck and killed some more. The storm approached very slowly from west by south and fell almost solidly on the west coast between Phoenika (Krasi Bay) and Kini, doing the greatest amount of damage on the flats of Galissá. By the time it reached Hermoupolis (the town of Syra) its force was spent and was no more than heavy rain.

In appearance it resembled a line squall, the cloud having a straight sharply defined front, but there was a complete absence of wind. The barometer remained steady. Temperature in the low 60°'s. The cloud (nimbus) was at about 1,000 feet. The day had been fine with detached clouds and light airs. Afterwards it rained, on and off



Reproduced by the courtesy of Mr. R. M. Poulter

SPURIOUS LIGHTNING PHOTOGRAPH

until 22h. when the sky cleared and a northerly breeze sprang up. Within living memory a rain storm of such violence has not been observed here.

J. M. CHAPLIN.

British Vice-Consulate, Syra, December 27th, 1935.

NOTES AND QUERIES

Lightning Photographs

From time to time not only in the British Isles but in other parts of the world photographs are produced purporting to be records of remarkable lightning discharges : sometimes attempts are made to base electrical theories on the records obtained. So great a proportion of these photographs are unwittingly spurious, deceiving sometimes their authors, that the accompanying illustration has been expressly prepared to serve as a cautionary sign to guide future investigators away from the trap.

Photographers will know and others may be interested to know that to obtain a photograph of lightning during a storm a camera loaded with film or plates is pointed in the direction of the lightning flashes with the shutter opened and ready to receive an impression of the next flash. By some mistake or misjudgment the flash may be missed, but on development the negative sometimes shows a record more wonderful than even the photographer hoped for : such a result is shewn in the illustration.

When this photograph was taken there was no thunderstorm, the sky being overcast with nimbostratus cloud. The camera was held in the hand with the shutter open as might be the case when waiting for a lightning flash, but all that were visible were a street-lamp, a light in a house, and a reflection of the street-lamp in a window. These recorded faithfully the unsteady movement of the photographer's hand, not once but in triplicate. A is the wandering image of the street-lamp, C the path of its reflection and B the light in the house.

As the camera was brought into position with the shutter open the images entered the field at A_1, B_1, and C_1 and then traced the three similar patterns, parts of which are shewn well at a, b and c. It is this faithful repetition that reveals the spurious nature of the photograph. The image of the reflection (C_1) was not as complete as the other two records because the movement of the camera brought the lens out of range of the reflecting window. The images of the lamps left the field at A_2 and B_2.

R. M. POULTER.

Retirement of Mr. Zambra

The retirement of Mr. Mark Zambra from active participation in the affairs of the well known firm of Messrs. Negretti & Zambra on October 1st last will be a matter of interest to a wide circle of meteorologists. The firm deals with an extensive range of scientific and industrial instruments, but Mr. Zambra had always identified himself closely with the meteorological side of their work and in the course of his 38 years' association with the firm had become known to many meteorological observers throughout the country in addition to official meteorologists. The association of the latter with Mr. Zambra has always been of the happiest and they will join with all who knew him in wishing him many years of happiness in the country home in Kent to which he has retired.

REVIEWS

Tätigkeit des Schweizerischen Forschungsinstitutes für Hochgebirgsklima und Tuberkulose in Davos vom 1 April, 1931 bis 31 März, 1933, Davos, 1934.

Zur Klimatologie der Abkühlungsgrösse (mit neuen Beobachtungsergebnissen aus der Schweiz). By W. Mörikofer. Reprinted from Acta Davosiana, Davos, 1, 1933, No. 3.

Ueber das Klima im Zimmer und seine Beziehungen zum Aussenklima, mit besonderer Berücksichtigung von Feuchtigkeit, Staub- und Ionengehalt der Luft. By K. Egloff. Dissertation, Eidgen,. Techn. Hochschule, Zürich, No. 766, 1933.

To many the beauty of the Alps is associated directly or indirectly with health, and though medical climatology and meteoropathology are fast becoming fashionable studies in many countries, research in such subjects seems peculiarly appropriate to Switzerland and has long been pursued in places such as Davos. The report of the research institute there for the years 1931 to 1933 includes lists of numerous papers published during the period.

Dr. Mörikofer's "Zur Klimatologie der Abkühlungsgrösse" contains some interesting comparisons between the average cooling power of the atmosphere in various places. The annual values at most of the Swiss stations considered are shown to vary but little even though temperature conditions are far from similar. Appreciable differences exist, however, in the seasonal variations. Thus during the day-time in summer at Basel it is little more than half that at Davos, though the corresponding values for the year as a whole differ by no more than a sixteenth. Some of the tables include figures for a few places in other countries north of Switzerland. These indicate much greater cooling powers more especially in winter when, for instance, it is about twice as great at Helsingfors as in the Swiss mountain stations and still higher at Dresden. A frequency table further illustrates the fact that thermally agreeable weather is more abundant in sheltered high alpine localities than in the lowlands or German mountain stations of medium altitude.

Publications dealing with indoor climate are comparatively rare though as Dr. Egloff points out in the introduction to his thesis "Ueber das Klima im Zimmer und seine Beziehungen zum Aussenklima ", most people spend the greater part of their lives indoors. This may be one of the doubtful blessings of civilization and there would appear to be much wisdom in the author's assumption that indoor conditions should approximate to those outside, care being taken to exclude only the inimical extremes of weather while all beneficial factors should be retained as far as possible.

The investigations were carried out in a sanatorium in Davos, two rooms being specially set aside for the work, but additional observations mainly of dust and condensation nuclei were made in several other buildings in Davos and in some other parts of Switzerland. The observations in the special rooms included temperature, humidity, cooling power, illumination, dust content, condensation nuclei and ion content. In all, some 30,000 observations were made during the year 1932–3, and the opportunity was also taken to test certain air conditioning apparatus.

A few only of the many interesting results can be mentioned here. The annual range of absolute humidity indoors is parallel to that in the open but the values are somewhat higher. In heated rooms the vapour pressure increases linearly with increasing temperature. It is suggested that this may be due to water vapour drawn from the walls but cannot be occasioned by the external air. Relative humidity varies but little in the open throughout the year but owing to the heating it decreases greatly indoors during the winter.

The number of dust and soot particles in the open air at Davos was found by an Owen's dust counter to be 117 per cm^3 on an average for the year, the number of soot particles in winter being many times as great as that of the dust particles in summer. Figures for fourteen other localities are given by way of comparison ranging from less than one, based upon a small number of observations, at Weissfluhgipfel (3,000m.) to over 10,000 per cm^3 in Paris and 20,000 per cm^3 in London (Westminster). This table (p. 37) is somewhat misleading as while care is taken to refer to the paucity of observations in some Swiss localities no reference is made to fog in connexion with the entry of 20,000 for London. Although this figure may be doubled in some of our densest fogs it is obviously not to be regarded as representative of the average state.

The increase, due to smoke in winter mornings, was observed in closed rooms as well as out of doors, as will be seen from the following table of mean values for December and January.

	8h.	10h.	12h.	18h.
		Particles per cm^3		
I. In the open ...	284	418	226	107
II. In unaired room ...	351	397	249	203
III. In aired room ...	351	400	182	126

It is stated that in case II the room was not aired all day long, whereas in case III it was aired between 8h. and 10h. and again between 12h. and 14h. for periods varying between 30 and 60 minutes. Both rooms were apparently closed throughout the evening and night. It would be interesting to know how much lower the morning figures would have been had III been aired well before the 8h. observations were made. Apart from the results obtained in the experimental (unoccupied) rooms, counts were also made in various other buildings, care being taken to make synchronous observations in the open so that the indoor values could thus be fairly expressed as percentages of the latter. At first sight it is surprising to find both a schoolroom and a cinema among the few places with less than 100 per cent. The explanation, however, appears to be that a considerable proportion of the dust particles inhaled by the occupants is retained in their lungs and respiratory passages. This fact has of course long been known but may be better realised from such comparisons.

The results of the condensation nuclei measurements in the open air at Davos proved to be extraordinarily high, even slightly higher in winter than in the comparatively low lying town of Zürich. They obviously cannot, therefore, be regarded as indicative of the degree of purity of the air, but it is suggested that owing to the absence of wind and the dryness of the air at Davos they are not readily dissipated nor able to form droplets. In a closed room the number was appreciably smaller than outside even immediately after airing. The explanation offered is not that the nuclei fail to enter the room but that they are quickly deposited. The number was proved to decrease if the humidity was raised artificially.

Ion content measurements in the open could not conveniently be made simultaneously with those indoors but some made in the previous year were available for comparison and in general it was concluded that much similarity exists both in the annual and the diurnal range of the number of light ions. There appeared, however, to be a slight lag and decidedly less amplitude in the diurnal range indoors. The annual range of heavy ions indoors was much less than in the open but showed a clear maximum in winter. The proportion of heavy to light (N/n) varied between 16·3 in January and 2·5 in July. The opposite numerical trends of light and heavy ions indoors were particularly marked in the diurnal range curves while the total sum was found to vary considerably. On some occasions intermediate ions were considered separately and were found to have a similar daily range to the heavy ions, of which they amounted on an average to 69 per cent. It is suggested that such high proportions may be characteristic of mountain air. The influence of weather upon the number and kind of ions is dealt with briefly and as regards Föhn conditions it is stated that the proportion of positive to negative light ions was only found to be less than unity in 25 per cent. of the cases investigated, in fact almost as seldom as in the absence of Föhn. In general no relationship was established between the electrical state of the atmosphere and the condition of healthy and sick persons. This negative result is of interest in view of suggestions made by some other writers.

As regards the air conditioning tests, the " Lucagra " apparatus was found capable of raising relative humidity in room by 15 per cent.—on one occasion by as much as 25 per cent. Increase in humidity is only advocated as a means of lessening the amount, or still better, the development of dust in the air. Immediately above the apparatus a decrease of 50 per cent. was observed but this was by no means representative of the room as a whole.

L. D. SAWYER.

BOOK RECEIVED

Humidity records obtained at Agra with hair elements and with wet and dry elements in a Dines' Meteorograph. By S. P. Venkiteshwaran, India Meteor. Dept., Sci. Notes **5,** No. 57.

OBITUARY

Sir Richard Glazebrook, K.C.B., K.C.V.O., F.R.S.—We regret to learn of the death on December 15th at the age of 81 of Sir Richard Glazebrook. He was born at Liverpool on September 18th, 1854, and educated at Dulwich College and Liverpool College, whence he obtained a scholarship to Trinity College, Cambridge, in 1872. He was elected a Fellow in 1877. In 1880 he was appointed a demonstrator at the Cavendish Laboratory, where he was associated with W. N. Shaw (now Sir Napier Shaw) in organising the teaching of practical physics. One outcome of this association was the well known " Textbook of Practical Physics " by Glazebrook and Shaw. In 1882 he was elected a Fellow of the Royal Society, of which he sat on the Council for many years, acting as Vice-President in 1919–20 and as Vice-President and Foreign Secretary from 1924–8. He was also President of the Institution of Electrical Engineers, the Physical Society (twice) and of the Optical Society and was a member of the Gassiot Committee appointed by the Royal Society, from its formation in March 1910 until 1921.

In 1898 he became Principal of University College, Liverpool, but in the following year he was selected as the first Director of the National Physical Laboratory, which was to be established at Bushy House, Teddington, and which he had himself to organise and create. When formally opened in 1902 the National Physical Laboratory consisted of only two departments, physics and engineering ; its usefulness has been proved by the vast expansion which it has undergone since its inception. In addition to this great task of organisation and administration, Glazebrook devoted much time to the work of the Electrical Standards Committee of the British Association, of which he was Secretary. He was also Chairman of the Advisory Committee for Aeronautics from 1909, the year of its formation, until 1920, and of its successor, the Aeronautical Research Committee, from 1920 to 1933. His interest in the many problems of aeronautics was very great, and after his retirement from the National Physical Laboratory in 1919 he was until 1923 Zaharoff Professor of Aviation and Director of the Aeronautics Department of the Imperial College of Science and Technology. He thus inspired and guided aeronautical research in this country from the beginning of flying right through the rapid advance during the war years and almost up to the present day.

Glazebrook wrote a number of text-books on various branches of physics, but to meteorologists he is best known as the editor of the "Dictionary of Applied Physics", one of the most useful reference books for a meteorological library. He was the recipient of many honours from the Royal Society and other learned bodies; he was made a C.B. in 1910, Knighted in 1917, K.C.B. in 1920 and K.C.V.O. in 1934.

NEWS IN BRIEF

Professor Dr. E. G. Mariolopoulos has been appointed Director of the Observatoire National d'Athènes in place of the late Professor Dr. D. Eginitus.*

A discussion on "Ice Ages" will be held at the Royal Astronomical Society, Burlington House, on January 31st at 4.30 p.m. The discussion will be opened by Sir George Simpson, C.B., F.R.S.

The Weather of December, 1935

Pressure was below normal over Europe (except northern Scandinavia and Russia), over the North Atlantic to the eastern coasts of North America, and over western coasts of the United States and Alaska, the greatest deficits being 10·1 mb. at Kew and Bayonne and 5·1 mb. at Kodiak, Alaska. Pressure was above normal over western Asia, Russia, north Scandinavia, Spitsbergen, Iceland, Greenland and the central parts of North America, the greatest excesses being 15·7 mb. at Ekaterinburg and 4·8 mb. near Winnipeg. In Sweden temperature was generally above normal and rainfall twice to three times the normal in the north but about normal in the south.

The main characteristic of the weather of December over the British Isles was the cold spell from the 14th to 24th. Rainfall was mainly deficient and sunshine above normal in the north and west, while the reverse was general in the south-east. At Stornoway the total sunshine, 54 hours, was the greatest for December since records began there in 1881. There was much mist and fog generally. From the 1st to 8th, low pressure systems crossing the country gave unsettled weather, stormy at first, gales being reported from the western coasts on the 1st and 2nd. Rainfall was slight to moderate, being heaviest on the 1st and 4th, 1·31 in. at Patching, Sussex on the 4th, but there were many fair intervals, especially on the 2nd, when 6·9 hours bright sunshine were recorded at Lowestoft. Thunderstorms occurred locally on the 1st and 2nd, while snow was reported from Scotland and north England from the 1st–4th. Much mist and fog developed from the 4th–7th, and on the 7th in parts of the eastern districts,

* *See Meteorological Magazine* 69, 1934, p. 102.

where the fog persisted all day, temperature rose only slightly above the freezing point, a maximum of 29° F. was recorded then at Gorleston. From the 9th–13th the country came under the influence of an anticyclone which developed over Scandinavia. Some drizzle, slight snow and mist were experienced at times, chiefly in the eastern districts, but conditions were mainly dry and dull with little diurnal temperature variation, though sunny periods occurred on the 9th and in the north and west on the 10th and 11th. From the 14th–18th low pressure systems crossed the country. Snow occurred in Scotland, north Ireland and England as far south as Oxford. Temperature was generally low and in many parts the roads became ice bound on the 16th. During the 19th–24th the country lay between two depressions centred to north-east and south-west respectively. Temperature became still lower during this period and severe frost was widespread ; among the most notable low temperatures recorded were, on the ground, 2° F. at Dalwhinnie on the 23rd and 9° F. at Ross-on-Wye on the 21st, Oxford on the 24th, and Abbotsinch and Eskdalemuir on the 23rd and 24th ; and in the screen, 6° F. at Dalwhinnie on the 23rd and 11° F. at Peebles on the 20th. Fog was experienced generally during this time in England and south Scotland, being particularly severe on the 23rd. Maximum temperatures were exceptionally low in districts where the fog continued all day ; a maximum of 18° F. was recorded at Abbotsinch on the 23rd and of 25° F. at Stonyhurst on the 20th and at Cambridge, Ross-on-Wye, Upper Heyford and Eskdalemuir on the 23rd. There were, however, a few sunny intervals chiefly in the west and north, Penzance had 7·3 hours bright sunshine on the 21st. Snow occurred at a few places on several days and as far south as Bath on the morning of the 24th. On the 24th an intense depression moved slowly from the Atlantic and remained centred to the north-west until the 29th. Another depression was centred off the south-west coasts on the 30th and 31st. Mild conditions spread eastwards on the evening of the 24th and temperature continued above normal until the end of the month. Rain occurred on most days, being heaviest in the west and south, 1·50 in. at Winchcombe (Gloucester) on the 27th and Peaslake (Surrey) on the 30th, and floods were experienced in many parts of the south and Midlands, but there were some bright periods chiefly on the 29th. Gales and strong winds were frequent in the south-west but elsewhere there was much mist or fog. The year ended with conditions unsettled, misty, and mild. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	54	+32	Chester ...	38	− 6
Aberdeen ...	46	+ 9	Ross-on-Wye ...	63	+15
Dublin	68	+22	Falmouth ...	68	+12
Birr Castle ...	44	+ 1	Gorleston ...	35	− 8
Valentia... ...	49	+11	Kew	34	− 3

Miscellaneous notes on weather abroad culled from various sources

Storms prevailed at Syra on the 3rd. Gales accompanied by heavy rain swept over most of France on the 1st and serious floods occurred in central France, Brittany, Gironde and Vendée. Further storms were experienced between then and the 5th causing the Rhône and Saône to flood again. Abundant snow fell in Switzerland and northern Italy about the 4th and 5th ; the snow was 10 ft. deep in the Great St. Bernard. A northerly gale was reported from Constantza (Roumania) on the 11th. A sudden drop of temperature followed by a snowstorm occurred on the Riviera on the 13th. Severe cold was experienced from Paris to the southern French coasts on the 14th with snow generally, but on the 15th the weather became mild with mist and rain. Severe cold was again experienced in France about the 21st and 22nd, especially in the east and centre, and flooding occurred in the valleys of the Tarn, Lot, Aveyron and Garonne. Snow fell abundantly in Switzerland on the 21st and 23rd, but on the 25th the mild Föhn wind blew up to the 5,000 ft. level ; rain fell heavily on the 26th and many avalanches occurred on the 27th. The thaw about the 26th following a long period of frost and snow caused floods, landslips and avalanches in north Italy. Navigation closed at Yzpila and Jacobstadt (Finland) on the 23rd. Severe storms swept over Spain during the Christmas holidays, eight people were drowned by floods in the province of Avila, and parts of Madrid were flooded. On the 29th and 31st heavy rain and floods also occurred in the valley of the Douro. Heavy rain accompanied by strong winds were experienced in France on the 28th and 29th causing still further floods in the valleys of the Rhône, Saône, Ardèche, Loire and Garonne. Forty people were reported to have lost their lives in Skutari (Albania) as the result of floods ; floods also occurred at Elbassan and Berat. By the 31st snow was falling generally again in Switzerland. (*The Times*, December 3rd–January 1st.)

Heavy rain occurred in the neighbourhood of Baghdad at the end of the month. (*The Times*, January 1st.)

In many parts of the Transvaal rain fell about the 5th bringing relief from the prolonged drought there. The rains were preceded by violent duststorms which did much damage ; there was also much damage by lightning. Drizzle on the 26th damped down the flames of the great fire on Table Mountain, and the change of wind helped extinguish it. (*The Times*, December 3rd–28th.)

The total rainfall for December over Australia was generally below normal, considerably so in parts of Queensland, but in New South Wales and Tasmania it was above normal locally. SE. to E. gales were experienced between Victoria and New Zealand between about the 26th and 30th. (Cable and *The Times*, December 18th–31st.)

A hurricane passed through the New Hebrides from the 11th to 14th and across Vanikoro Island on the 16th–17th doing much damage (telegram).

Fog was prevalent at Vancouver early in the month. Landslips occurred on Bay of Islands, Newfoundland, on the 6th following on heavy rain. Severe cold was experienced in central Canada about the 22nd. Seven people were drowned at Houston (Texas) in floods caused by heavy rains on the 10th. The distribution of temperature and precipitation over the United States during the month was variable, but towards the close there was a spell of severe cold accompanied by blizzards in the central and eastern States. (*The Times*, December 6th–27th, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, December, 1935

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
	mb.		°F.	°F.	%	in.	hrs.	
1	980·5	W.4	45	46	61	0·02	1·4	r_0 4h–8h., 18h.
2	986·4	WNW.4	38	46	61	—	5·8	
3	989·8	W.2	35	42	73	—	—	x early.
4	997·9	WNW.4	35	44	65	0·05	1·9	r_0–r 7h., 9h–11h.
5	1006·4	N.2	32	41	66	0·02	4·6	r_0–r 2h–4h. fx18h.
6	1005·4	Calm.	32	42	90	0·01	—	r_0 5h.–11h.
7	1013·5	W.1	32	37	98	0·13	—	f till 18h. r 22h.–24h.
8	1010·5	WSW.2	35	47	83	0·10	2·1	r 17h.–18h., 24h.
9	1019·2	N.4	40	44	81	0·02	1·1	r_0 0h.–8h., 13h.
10	1029·9	NE.6	41	43	59	trace	—	d_0 18h.–22h., r_0 23h.
11	1028·1	NE.5	40	43	82	0·01	—	ir_0 1h.–9h. 13h., 15h.,
12	1027·7	NE.3	40	41	78	—	—	[d_0 21h.
13	1025·3	N.3	35	39	69	—	—	
14	1017·8	S.1	36	38	63	—	—	
15	1002·3	WSW.2	32	45	91	0·11	1·8	r_0s_0 0h.–3h. r 3h.–8h.
16	999·4	W.5	34	46	64	0·04	2·7	pr 2h., 11h. r 15h.
17	1001·7	N.2	30	37	85	trace	0·2	fx till 11h.
18	1013·7	SW.2	33	36	85	—	0·1	f 21h. [r_0s_0 18h.
19	1007·0	N.1	31	37	89	0·03	—	r_0 1h. r_0f 9h.–13h.,
20	1008·4	WSW.1	31	36	100	—	0·2	f 9h.–21h.
21	1008·8	WSW.1	27	36	91	—	2·4	x all day, f 11h.–13h.
22	1008·1	SW.2	26	37	69	0·01	4·1	x all day.
23	1007·1	NNW.1	25	29	99	0·01	—	Fx all day.
24	989·7	E.3	27	43	96	0·17	—	rs 6h.–8h., r 8h.–10h.
25	985·2	SSW.3	42	49	88	0·16	0·6	r–r_0 1h.–6h., 16h.–17h.
26	976·2	SW.4	46	51	92	0·06	0·3	r_0 0h.–9h.
27	979·7	S.2	48	52	92	0·29	0·9	r–r_0 3h.–9h., 13h.–14h.
28	986·8	SW.3	47	51	94	0·31	—	r–r_0 1h.–6h., 10h.–12h.
29	1002·1	SW.4	41	47	82	0·08	2·3	r_0 18h.–24h.
30	989·9	S.4	45	51	87	0·22	1·3	pr_0 9h.–13h., r_0–r 15h.–
31	991·2	SSW.4	47	50	93	0·28	—	r–r_0 7h.–16h. [24h.
*	1003·1	—	36	43	81	2·15	1·1	* Means or totals.

General Rainfall, 1935.

	Dec.	Yr.	
England and Wales	100	114	per cent. of the average 1881–1915.
Scotland	72	109	
Ireland	72	98	
British Isles ...	88	110	

Rainfall : December, 1935 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square	2·63	110	*Leics* .	Thornton Reservoir	4·28	160
Sur .	Reigate, Wray Pk. Rd.	4·26	134	,, .	Belvoir Castle	2·82	115
Kent .	Tenterden, Ashenden	3·98	128	*Rut* .	Ridlington	3·06	124
,, .	Folkestone, Boro. San.	3·31	...	*Lincs* .	Boston, Skirbeck	2·50	116
,, .	Eden'bdg., Falconhurst	3·89	118	,, .	Cranwell Aerodrome	2·25	102
,, .	Sevenoaks, Speldhurst.	3·83	...	,, .	Skegness, Marine Gdns.	1·73	79
Sus .	Compton, Compton Ho.	4·39	105	,, .	Louth, Westgate	2·50	90
,, .	Patching Farm	5·27	157	,, .	Brigg, Wrawby St.	2·58	...
,, .	Eastbourne, Wil. Sq.	3·33	95	*Notts* .	Worksop, Hodsock	2·61	111
,, .	Heathfield, Barklye	5·45	147	*Derby*.	Derby, L. M. & S. Rly.	3·65	140
Hants.	Ventnor, Roy.Nat.Hos.	4·47	135	,, .	Buxton, Terr. Slopes	5·93	105
,, .	Fordingbridge, Oaklnds	5·45	138	*Ches* .	Runcorn, Weston Pt.	3·56	113
,, .	Ovington Rectory	4·88	123	*Lancs*.	Manchester, Whit. Pk.	3·26	101
,, .	Sherborne St. John	3·38	103	,, .	Stonyhurst College	3·59	74
Herts .	Royston, Therfield Rec.	2·24	97	,, .	Southport, Bedford Pk.	2·88	89
Bucks.	Slough, Upton	2·65	105	,, .	Lancaster, Greg Obsy.	2·48	57
,, .	H. Wycombe, Flackwell	2·91	96	*Yorks*.	Wath-upon-Dearne	2·22	93
Oxf .	Oxford, Mag. College	2·87	124	,, .	Wakefield, Clarence Pk.	2·46	101
Nor .	Wellingboro, Swanspool	2·87	122	,, .	Oughtershaw Hall	3·46	...
,, .	Oundle	2·33	...	,, .	Wetherby, Ribston H.	2·83	115
Beds .	Woburn, Exptl. Farm	1·95	83	,, .	Hull, Pearson Park	2·24	93
Cam .	Cambridge, Bot. Gdns.	1·73	90	,, .	Holme-on-Spalding	2·55	104
Essex.	Chelmsford, County Gdns	...	...	,, .	West Witton, Ivy Ho.	2·12	58
,, .	Lexden Hill House	2·57	...	,, .	Felixkirk, Mt. St. John.	2·71	112
Suff .	Haughley House	2·08	...	,, .	York, Museum Gdns.	2·43	108
,, .	Campsea Ashe	2·34	102	,, .	Pickering, Hungate	2·39	95
,, .	Lowestoft Sec. School	...	...	,, .	Scarborough	2·48	104
,, .	Bury St. Ed., Westley H.	2·43	101	,, .	Middlesbrough	1·92	99
Norf. .	Wells, Holkham Hall	1·85	90	,, .	Baldersdale, Hury Res.	...	...
Wilts .	Calne, Castle Walk	3·91	...	*Durh* .	Ushaw College	2·22	89
,, .	Porton, W.D. Exp'l. Stn	4·43	141	*Nor* .	Newcastle, D. & D. Inst.	1·82	83
Dor .	Evershot, Melbury Ho.	6·64	129	,, .	Bellingham, Highgreen	1·83	50
,, .	Weymouth, Westham.	4·60	132	,, .	Lilburn Tower Gdns.	2·74	104
,, .	Shaftesbury, Abbey Ho.	3·94	109	*Cumb*.	Carlisle, Scaleby Hall	1·78	55
Devon.	Plymouth, The Hoe	5·99	120	,, .	Borrowdale, Seathwaite	8·00	52
,, .	Holne, Church Pk. Cott.	8·97	106	,, .	Borrowdale, Moraine	5·18	42
,, .	Teignmouth, Den Gdns.	4·82	114	,, .	Keswick, High Hill	3·44	51
,, .	Cullompton	5·03	115	*West* .	Appleby, Castle Bank	1·89	48
,, .	Sidmouth, U.D.C.	4·98	...	*Mon* .	Abergavenny, Larchf'd	5·64	126
,, .	Barnstaple, N. Dev.Ath	4·22	95	*Glam* .	Ystalyfera, Wern Ho.	4·56	55
,, .	Dartm'r, Cranmere Pool	9·30	...	,, .	Cardiff, Ely P. Stn.	3·78	74
,, .	Okehampton, Uplands.	7·01	99	,, .	Treherbert, Tynywaun.	6·78	...
Corn .	Redruth, Trewirgie	6·16	98	*Carm* .	Carmarthen, The Friary	4·00	70
,, .	Penzance, Morrab Gdns.	5·40	95	*Pemb* .	St. Ann's Hd, C. Gd. Stn.	2·61	58
,, .	St. Austell, Trevarna	5·97	98	*Card* .	Aberystwyth	2·17	...
Soms .	Chewton Mendip	5·33	99	*Rad* .	BirmW.W.Tyrmynydd	6·51	79
,, .	Long Ashton	4·41	114	*Mont* .	Lake Vyrnwy	4·69	68
,, .	Street, Millfield	4·05	...	*Flint* .	Sealand Aerodrome	3·12	...
Glos .	Blockley	3·80	...	*Mer* .	Dolgelley, Bontddu	4·10	60
,, .	Cirencester, Gwynfa	3·82	114	*Carn* .	Llandudno	1·67	58
Here .	Ross, Birchlea	3·51	118	,, .	Snowdon, L. Llydaw 9	7·84	...
Salop.	Church Stretton	4·06	121	*Ang* .	Holyhead, Salt Island	3·48	84
,, .	Shifnal, Hatton Grange	2·27	88	,, .	Lligwy	2·56	...
Staffs.	Market Drayt'n, Old Sp.	2·86	103	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	2·84	108		Douglas, Boro' Cem.	5·08	103
War .	Alcester, Ragley Hall	3·48	141	*Guernsey*			
,, .	Birminghm, Edgbaston	3·59	133		St. PeterP't.Grange Rd.	8·29	202

Rainfall: 1935: December, Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	5·61	123	*Suth* .	Melvich	4·13	96
,, .	New Luce School	5·94	107	,, .	Loch More, Achfary	6·22	67
Kirk .	Dalry, Glendarroch	4·54	64	*Caith* .	Wick	3·08	100
,, .	Carsphairn, Shiel	6·26	67	*Ork* .	Deerness	3·94	94
Dumf.	Dumfries, Crichton R.I.	2·63	65	*Shet* .	Lerwick	5·05	105
,, .	Eskdalemuir Obs	2·94	42	*Cork* .	Caheragh Rectory	...	...
Roxb .	Hawick, Wolfelee	1·92	46	,, .	Dunmanway Rectory	5·23	65
Selk .	Ettrick Manse	2·32	38	,, .	Cork, University Coll.	4·29	84
Peeb .	West Linton	1·60	...	,, .	Ballinacurra	4·00	78
Berw .	Marchmont House	1·80	64	,, .	Mallow, Longueville	3·59	73
E.Lot.	North Berwick Res.	1·57	73	*Kerry*.	Valentia Obsy	4·27	64
Midl .	Edinburgh, Blackfd. H.	1·13	48	,, .	Gearhameen	7·50	60
Lan .	Auchtyfardle	1·91	...	,, .	Bally McElligott Rec.	3·31	...
Ayr .	Kilmarnock, Kay Pk.	2·97	...	,, .	Darrynane Abbey	4·13	70
,, .	Girvan, Pinmore	3·41	57	*Wat* .	Waterford, Gortmore	3·19	70
Renf .	Glasgow, Queen's Pk.	2·83	67	*Tip* .	Nenagh, Cas. Lough	2·00	43
,, .	Greenock, Prospect H.	4·37	55	,, .	Roscrea, Timoney Park	2·02	...
Bute .	Rothesay, Ardencraig	4·04	...	,, .	Cashel, Ballinamona	2·60	61
,, .	Dougarie Lodge	3·72	...	*Lim* .	Foynes, Coolnanes	2·67	56
Arg .	Ardgour House	5·70	...	,, .	Castleconnel Rec.	1·91	...
,, .	Glen Etive	4·98	40	*Clare* .	Inagh, Mount Callan	4·29	...
,, .	Oban	5·40	...	,, .	Broadford, Hurdlest'n.	1·55	...
,, .	Poltalloch	5·01	79	*Wexf* .	Gorey, Courtown Ho.	2·10	55
,, .	Inveraray Castle	6·60	66	*Wick* .	Rathnew, Clonmannon.	2·26	...
,, .	Islay, Eallabus	5·07	85	*Carl* .	Hacketstown Rectory	2·71	66
,, .	Mull, Benmore	...	...	*Leix* .	Blandsfort House	2·27	62
,, .	Tiree	...	...	*Offaly*.	Birr Castle	1·48	45
Kinr .	Loch Leven Sluice	2·21	56	*Dublin*	Dublin, FitzWm. Sq.	1·38	56
Perth .	Loch Dhu	5·35	53	,, .	Balbriggan, Ardgillan	2·50	87
,, .	Balquhidder, Stronvar.	4·55	...	*Meath*.	Beauparc, St. Cloud	3·26	...
,, .	Crieff, Strathearn Hyd.	2·92	65	,, .	Kells, Headfort	3·19	84
,, .	Blair Castle Gardens	1·56	41	*W.M* .	Moate, Coolatore	2·18	...
Angus.	Kettins School	2·85	86	,, .	Mullingar, Belvedere	2·61	71
,, .	Pearsie House	...	...	*Long* .	Castle Forbes Gdns	2·17	55
,, .	Montrose, Sunnyside	2·41	87	*Gal* .	Galway, Grammar Sch.	2·21	...
Aber .	Braemar, Bank	1·73	49	,, .	Ballynahinch Castle	5·49	73
,, .	Logie Coldstone Sch.	2·21	79	,, .	Ahascragh, Clonbrock.	2·28	49
,, .	Aberdeen, Observatory.	3·19	99	*Mayo*.	Blacksod Point	2·54	41
,, .	Fyvie Castle	4·12	120	,, .	Mallaranny	3·67	...
Moray	Gordon Castle	2·61	97	,, .	Westport House	3·35	58
,, .	Grantown-on-Spey	...	...	,, .	Delphi Lodge	6·66	55
Nairn.	Nairn	1·63	73	*Sligo* .	Markree Castle	4·00	83
Inv's .	Ben Alder Lodge	2·39	...	*Cavan*.	Crossdoney, Kevit Cas.	2·98	...
,, .	Kingussie, The Birches.	1·10	...	*Ferm* .	Enniskillen, Portora	...	...
,, .	Inverness, Culduthel R.	1·63	...	*Arm* .	Armagh Obsy	2·33	74
,, .	Loch Quoich, Loan	6·17	...	*Down*.	Fofanny Reservoir	6·58	...
,, .	Glenquoich	...	...	,, .	Seaforde	4·52	110
,, .	Arisaig, Faire-na-Sguir.	3·27	...	,, .	Donaghadee, C. G. Stn.	3·02	95
,, .	Fort William, Glasdrum	4·66	...	,, .	Banbridge, Milltown	2·60	90
,, .	Skye, Dunvegan	4·21	...	*Antr* .	Belfast, Cavehill Rd.	4·69	...
,, .	Barra, Skallary	4·17	...	,, .	Aldergrove Aerodrome.	2·52	73
R&C .	Alness, Ardross Castle.	2·74	66	,, .	Ballymena, Harryville.	4·12	93
,, .	Ullapool	2·96	47	*Lon* .	Garvagh, Moneydig	3·69	...
,, .	Achnashellach	3·97	40	,, .	Londonderry, Creggan.	3·91	89
,, .	Stornoway	2·77	44	*Tyr* .	Omagh, Edenfel	3·69	87
Suth .	Lairg	3·97	99	*Don* .	Malin Head	3·31	...
,, .	Tongue	4·17	84	,, .	Killybegs, Rockmount.	2·50	...

Climatological Table for the British Empire, July, 1935

STATIONS.	PRESSURE. Mean of Day M.S.L. mb.	PRESSURE. Diff. from Normal. mb.	TEMPERATURE. Absolute. Max. °F.	TEMPERATURE. Absolute. Min. °F.	TEMPERATURE. Mean Values. Max. °F.	TEMPERATURE. Mean Values. Min. °F.	TEMPERATURE. Mean Values. ½ Max. and ½ Min. °F.	TEMPERATURE. Mean Values. Diff. from Normal °F.	TEMPERATURE. Mean. Wet Bulb. °F.	Relative Humidity. %	Mean Cloud Am'nt 0–10	PRECIPITATION. Am'nt. in.	PRECIPITATION. Diff. from Normal. in.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Per-cent-age of possi-ble.
London, Kew Obsy....	1020·0	+ 4·2	85	49	75·0	57·6	66·3	+ 3·6	57·7	77	5·1	1·63	− 0·54	7	8·8	54
Gibraltar..........	1016·2	− 0·6	97	63	83·7	68·8	76·3	+ 1·5	66·5	77	3·4	0·00	− 0·03	0	...	...
Malta..........	1015·6	+ 0·9	89	70	83·3	72·4	77·9	− 0·4	71·0	73	2·2	0·02	− 0·03	1	12·1	85
St. Helena	1016·8	+ 0·6	63	52	60·1	54·1	57·1	− 1·4	54·6	92	9·1	3·47	...	22	...	...
Freetown, Sierra Leone	1015·3	+ 2·6	87	64	82·1	71·5	76·8	− 1·8	74·8	91	9·2	41·20	+ 5·62	28	...	...
Lagos, Nigeria	1013·8	+ 0·6	86	72	82·2	74·3	78·3	+ 0·3	74·8	89	9·2	16·09	+ 5·59	25	2·7	22
Kaduna, Nigeria	1009·9	...	89	66	83·3	68·8	76·1	+ 2·5	71·1	90	8·5	8·63	− 1·99	19	4·9	39
Zomba, Nyasaland	1019·5	+ 1·0	81	48	70·6	53·6	62·1	+ 0·1	55·9	69	4·5	0·61	+ 0·26	3	...	...
Salisbury, Rhodesia...	1021·9	0·0	78	34	69·9	43·1	56·5	+ 0·4	49·2	61	1·8	0·00	− 0·03	0	9·1	81
Cape Town	1021·8	+ 0·5	81	35	62·2	46·9	54·5	− 0·2	47·5	85	5·2	4·60	+ 0·98	15	...	...
Johannesburg	1023·2	+ 0·4	68	33	62·0	41·7	51·9	+ 1·5	40·2	51	2·2	0·01	− 0·32	1	9·3	87
Mauritius	1020·2	− 0·2	76	55	73·4	61·9	67·7	− 0·6	64·4	76	5·2	2·27	− 0·22	23	7·0	64
Calcutta, Alipore Obsy.	997·5	− 1·7	93	77	90·3	79·9	85·1	+ 1·4	80·0	87	8·2	6·58	− 6·12	14*	...	...
Bombay	1003·0	− 0·9	88	74	85·0	76·8	80·9	− 0·5	77·3	87	9·5	24·10	− 0·17	25*	...	...
Madras	1003·5	− 1·0	101	74	96·0	80·4	88·2	+ 0·6	74·9	63	8·6	2·21	− 1·63	7*	...	...
Colombo, Ceylon	1009·3	+ 0·2	86	71	84·0	76·2	80·1	− 1·1	76·6	81	7·7	2·81	− 1·62	10	6·1	49
Singapore	1008·8	− 0·1	88	72	86·3	78·5	82·4	+ 1·1	77·4	79	8·0	3·09	− 3·70	12	6·9	56
Hongkong	1002·7	− 2·0	91	75	86·7	78·6	82·7	+ 0·2	78·9	83	7·8	22·21	+ 7·79	20	5·1	38
Sandakan	1008·2	...	91	73	88·4	75·4	81·9	+ 0·1	76·4	83	7·2	8·12	+ 1·40	17	...	...
Sydney, N.S.W..........	1017·1	− 1·2	67	39	62·5	45·7	54·1	+ 1·4	47·9	73	4·6	1·52	− 3·28	13	6·5	64
Melbourne	1016·3	− 2·6	64	33	57·2	41·6	49·4	+ 0·7	44·4	81	5·6	1·88	+ 0·02	16	4·6	47
Adelaide	1016·2	− 4·1	67	38	60·1	45·1	52·6	+ 0·8	46·7	72	7·2	2·58	− 0·06	14	4·2	42
Perth, W. Australia ...	1015·7	− 3·3	67	40	62·5	48·1	55·3	+ 0·1	50·1	81	6·4	10·61	+ 4·05	25	5·3	52
Coolgardie	1015·9	− 3·9	71	32	61·5	39·2	50·3	− 0·9	47·1	80	3·6	1·19	+ 0·32	8	...	...
Brisbane	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hobart, Tasmania..........	1012·1	− 1·6	60	32	53·3	41·0	47·1	+ 1·4	42·1	77	5·6	1·25	− 0·93	17	4·4	47
Wellington, N.Z.	1016·7	+ 2·8	60	35	50·3	41·6	45·9	− 2·1	43·5	80	6·6	4·32	− 1·31	14	3·9	41
Suva, Fiji	1012·3	− 1·7	87	67	80·0	70·4	75·2	+ 1·8	70·8	87	6·5	8·55	+ 3·62	16	5·1	46
Apia, Samoa	1010·6	− 1·3	87	71	84·7	74·6	79·7	+ 2·5	76·1	79	4·5	3·05	+ 0·07	16	8·1	71
Kingston, Jamaica	1013·8	− 0·9	96	71	89·6	73·8	81·7	0·0	73·6	79	3·1	0·21	− 1·41	4	8·7	67
Grenada, W.I.	...	...	89	72	86	75	80·5	+ 1·3	75	79	5	6·97	− 2·46	23	...	...
Toronto..........	1014·7	+ 0·3	93	57	82·9	64·9	73·9	+ 4·8	66·4	77	4·1	3·59	+ 0·75	12	9·6	64
Winnipeg	1012·3	0·0	90	53	82·4	62·3	72·3	+ 5·9	63·6	86	4·6	1·92	− 1·18	9	10·0	63
St. John, N.B.	1015·1	+ 1·5	82	50	70·6	54·3	62·5	+ 2·1	58·6	82	6·6	2·13	− 1·50	12	7·2	47
Victoria, B.C..........	1016·9	− 0·4	90	48	66·7	52·3	59·5	− 0·6	54·9	75	4·4	0·95	+ 0·53	9	9·8	62

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