M.O. 359.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 68

Mar. 1933

No. 806

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE

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The Great Snowstorms of February, 1933

CONTRIBUTED BY THE FORECAST DIVISION, METEOROLOGICAL OFFICE

A series of intense and prolonged snowstorms, one of the worst within living memory, occurred in most districts of the British Isles during the period Thursday, February 23rd to Sunday, February 26th, 1933, and it is proposed to give a preliminary account of the storms and of their meteorological aspects.

According to the daily Press the storms were the worst experienced since the well-known snowstorms of January 17th-21st, 1881. It will not be possible to confirm that opinion until further information regarding the recent storms has been received. The snowfall on January 18th, 1881, was so severe as completely to cut-off the milk supply of London. That day has become known as "Black Tuesday."

From the meteorological point of view the two series of storms were quite unlike one another, and the distribution of snowfall was also different in the two cases. The depression which was associated with the 1881 storm was an "Atlantic" depression, of the type which has been so intensively studied during recent years by the Norwegian School of Meteorologists; that is to say it had a well-marked "warm sector" on its southern side, consisting of air which had been drawn from low latitudes over the Atlantic. The depression was centred near the Channel Islands on the morning of January 18th, and it travelled slowly but steadily eastwards along the Channel along a well-defined

(1022) 107/27 1,050 3/33 M. & S. Gp.303

track.* An article in *British Rainfall*, 1881, by Sowerby Wallis, describes the effects of the storm. The snow on that occasion fell continuously during the 18th until about noon on the 19th in an easterly gale at a temperature which for the most part was much below freezing point. In consequence the snow was very fine and dry, and was rapidly blown into deep drifts in railway cuttings, roads, etc., with the result that railway and postal services were disorganised for the greater part of a week. The area of the intense snowfall was limited to the area south of an irregular line from Liverpool to Flamborough, over a considerable part of which a quantity of snow equivalent to an undisturbed depth of at least a foot is estimated to have fallen.

The recent storms were of an entirely different character. Following a period during which pressure was high to the west of the British Isles, there occurred on about February 17th an extension northwards to Iceland of the high pressure system which brought down a steady supply of cold air from the Arctic Sea. The whole of the British Isles was covered with this polar air on Thursday morning, February 23rd, when, in spite of the fact that the current was apparently homogeneous and cold up to considerable heights a general fall of the barometer was seen to be in progress, especially in northern districts. At 1 p.m. on February 23rd a small centre of low pressure was situated over the extreme north of Ireland, and a feeble cyclonic circulation was set up around it, with some falls of snow and sleet in the north of Ireland. This disturbance was embedded in the general current of polar air, and at the surface there was no equatorial air within many hundreds of miles. It was at once recognized that here was one of those mysterious "depressions in polar air" the nature of which is at present obscure. The forecasting of the subsequent history of these disturbances is a matter of great uncertainty, but in this case it seemed clear that the system would deepen and continue to move slowly southwards in the general northerly wind, and that appreciable falls of snow would occur. The following forecast was accordingly supplied to the B.B.C. for broadcasting at 6 p.m.

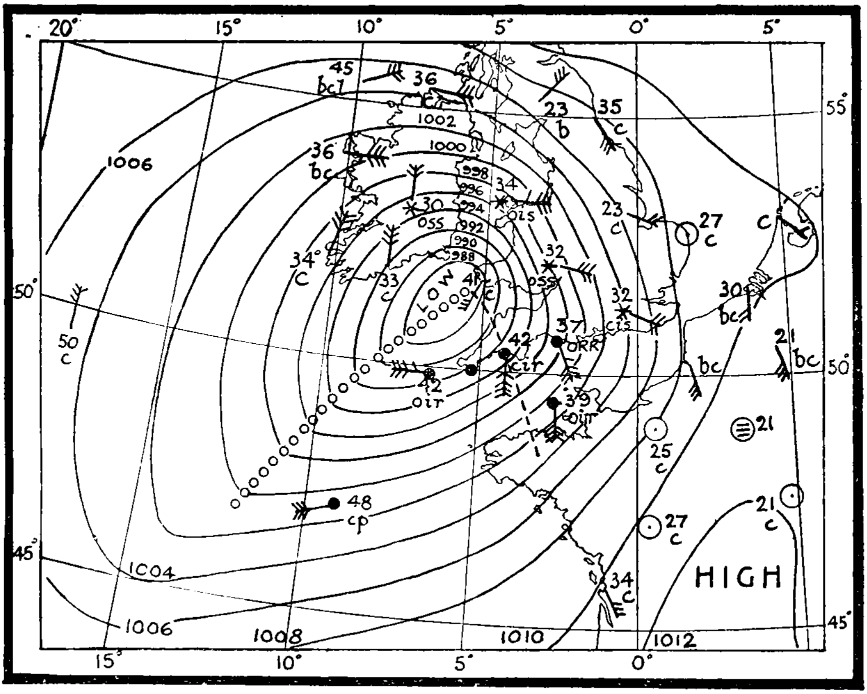
> *Weather Forecast for to-night and to-morrow.*—A complex low pressure system is developing over the British Isles and the North Sea, and the most important centre is moving slowly southward over Ireland and deepening considerably. Snow is expected in many parts of the country, and road traffic is likely to be affected in several districts. In Ireland, Wales, and south-west England there will be heavy snowfall inland to-night, but there will be sleet or rain near the south-west seaboard. In Scotland and northern England there will be occasional snow,

* See "Forecasting Weather," 2nd Edition, p. 100, for a weather map of this snowstorm.

especially near the east Coast. In south-east England and the Midlands weather will be fine at first with sharp frost and local fog, but there is a considerable likelihood of snow to-morrow.

Outlook for Saturday.—Wintry weather continuing, with snow at times in many districts.

Reference to dislocation of road traffic on account of weather conditions is a new departure in weather forecasts, and but for the proverbial difficulty in predicting the amount of snowfall, the reference would have been more decidedly, and, as it transpired, even more accurately worded than it was. By next morning at 7 a.m. the depression had deepened considerably; it was centred at the entrance to St. George's Channel and the cyclonic circulation embraced the whole of the British Isles. A weather chart for this period is reproduced. On this chart



SYNOPTIC CHART 7h. FRIDAY, FEBRUARY 24th, 1933
Quasi warm front is indicated by - - - - - - - - - - -
Quasi cold front is indicated by oooooooooooooo

are shown a "warm" front and a "cold" front, but these fronts cannot be regarded as at all typical, for the air in the sector between them, though rather warmer than that outside the sector, was definitely of polar origin. It had, however, come from the Atlantic just to the west of Ireland, where it is seen that temperatures reported from ships were at about 50°F. The area of the sector between the warm and cold fronts probably provided the avenue whereby the water vapour, which was then falling as snow over the west of England and over Wales, was finding its way into the depression. It seems likely that no great development of this kind could have occurred in the polar air but for the fact that this relatively warm and humid "maritime polar" air from the Atlantic had been drawn into the circulation. Probably the detailed structure of the depression was more complex than might be gathered from the drawing of simple warm and cold fronts. The warm sector proved misleading as a guide to the subsequent motion of the system. Actually the centre moved slowly westward to a position off south-west Ireland, the total westward movement in 48 hours being fully 450 miles. This led to an immediate thaw in southern England, which spread slowly over the whole of the British Isles. Depressions which develop in polar air have a marked tendency to move in a slow irregular manner. They have fairly frequently caused snowstorms in the past, notably in March, 1909 and 1916, and April, 1908, 1917 and 1919. The development of March 5th to 8th, 1909, showed some resemblance to that of February 23rd to 26th, 1933. The majority of recent cold spells have been of easterly rather than of northerly type, and have led to no developments of the kind we are discussing. On February 28th-29th, 1924, there was an extreme development in polar air off northern Scotland, pressure falling to 960 mb. at the centre, and there was a very severe snowstorm in northern Scotland and a lesser storm elsewhere. If polar-air depressions grow to any size they are apt to become stationary sufficiently far west to cut off the direct supply of polar air to the British Isles, and so cause a thaw, at least on the low ground.

In the recent case the pressure at the centre of the disturbance was about 1,006 mb. on the evening of the 23rd and 986 mb. next morning, and for the following two days. It is perhaps worth remarking on the apparent tendency for a greater deepening by night than by day.* The three-dimensional structure of polar air depressions is a matter for research in the future, but meanwhile there are certain known facts to which attention may be called. The features normally found over European depressions, namely, a cold troposphere, low pressure in the upper troposphere, and a low and warm stratosphere, are also found in well-marked polar currents, and thus probably exist before a polar air depression forms. If the lapse-rate of temperature in the troposphere is sufficiently unstable for saturated air, there is a possibility of a large fall of surface pressure being caused by the ascent of warm damp air. If pressure remains unchanged at 8 kilometres and the mean temperature of the column of air up to that level rises 10° F., then surface pressure falls about 22 mb.

* * * * * *

For a more detailed acount of the snowstorm in different

* See *Meteorological Magazine* 66, 1931, p. 39.

districts, we may consider firstly the northerly spell preceding the main storm, then the storm of the 23rd-24th, and finally the later phases. The northerly spell began when a ridge of high pressure moved south-east from Greenland on February 10th and formed into a large stationary anticyclone off west Ireland, but really wintry weather only commenced on the 17th, when pressure became highest in east Greenland. From that day onwards snow fell daily in some part of the country, mainly in the form of showers. As usual in a northerly type, the districts most affected were northern Scotland, north Wales, north-east England and the eastern coastal zone. Instability showers are formed when a cold current crosses a warm sea, and these drift a short distance inland and are intensified by orographic features or by convergence of surface winds at a coast line.* Instability showers do not form readily over land in winter, so that most of southern England escapes lightly with northerly winds. Most of the Scottish Lowlands are effectively screened by the Highlands. On the night of the 21st there was a moderately heavy snowfall in Norfolk, Suffolk, and east Kent, and in the latter region several roads were blocked with drifts, which were reported in the Press to be seven feet deep in some cases.

The main storm commenced in Ireland and Wales on the evening of the 23rd, and was continuous for more than 24 hours over the greater part of both countries (with the exception of the north) and drifted in an easterly wind which increased to gale force. During the night of the 23rd a rainfall equivalent of 1·69in. fell at Pembroke. Over a considerable area in south Wales the level fall probably reached or exceeded two feet. Many villages were isolated, and railway traffic was badly delayed, the Irish Mail from Fishguard arriving at Paddington 13 hours late. Many telegraph wires were broken down by the weight of snow, and photographs in the Press showed the wet nature of the snow near the south coast of Wales. In Wales and Ireland the statements in the Press that the storm was the worst for 50 years were quite probably justified. A letter from Hacketstown Rectory, Co. Carlow, reports a "record" snowfall with numerous 6- to 10-foot drifts. Over most of southern England the storm was less severe than that of December, 1927. It was, however, severe over a large area in the south-west, though on the south coast only sleet and rain were reported. During the 24th the storm spread eastward, and then extended northward slightly beyond the Scottish border, and included northern Ireland. A fair degree of severity was maintained in the Midlands and north, and trains were delayed by heavy drifting, which was helped by the fact that the temperature was still below the freezing point. Towards the east the severity of the storm fell off rapidly, and the east coast had

* See *London Q.J.R. Meteor. Soc.* 48, 1922, p. 357.

little snow. In London there was a moderate fall which lay on open spaces, but had almost disappeared by next morning.

On the 25th and 26th there was sleet and rain in the south, but further considerable snowfall in many other districts. The change from rain and sleet to snow took place surprisingly far south, considering the strength of the south-easterly wind. It was not only a question of height above sea level, since snow fell on low ground also, for example at Ross-on-Wye at 7h. on the 26th, and also at Cranwell, where 8 inches were lying. At 13h. on that day it was still snowing at Birmingham. No doubt the air at low levels was quickly cooled as it penetrated inland, both by the snow on the ground and by snow falling into the surface layer from above.

In Yorkshire the fall was heavy and continued till the evening of the 26th, when no less than 28 inches were lying at Harrogate. Conditions were already severe in this region before the main storm, and the total snowfall was probably as heavy as in south Wales. A number of villages were isolated in Yorkshire and Derbyshire. At Buxton the average depth was estimated to be fully two feet.

The total precipitation in the three days was large, especially in southern districts and in Yorkshire, and illustrates the possibilities of maritime polar air. At Stoner Hill, Petersfield, there was continuous precipitation from 7 a.m. on the 24th until 8 a.m. on the 27th, with the exception of two intervals of 3 and 2 hours respectively. The total amount for the rainfall days 24th to 26th was 4·35 inches. Other large aggregates for this period were 4·74 inches at Selbourne (Hants), 4·12 inches at Hoddington (Hants) and Harrogate, 3·38 inches at Winchester, 3·31 inches at Boscombe Down, 2·75 inches at Ross and South Farnborough, and 2·79 inches at Ilkley. Rain and melting snow caused flooding in several districts, including the Thames Valley.

Thunderstorms occurred locally in south-west districts on the 25th and again on the night of the 27th and on the 28th. Gales occurred on most coasts between the 24th and 26th. Calshot recorded a gust of 85 m.p.h. during the morning of the 24th, and another of 81 m.p.h. early on the following morning.

The Snowstorm in Breconshire

The snowfall here on February 24th was a record for more than 20 years. All roads were completely impassable to traffic. Towns in the hills had huge drifts 10 and 14 ft. deep in places. I registered 1·61 inch in the rain-gauge—the snow was 18 inches on the level in the valley. I was up on the mountains all that morning with local farmers looking for sheep and, although I am about in all weathers, never remember anything like the conditions. The wind was terrific and the drift absolutely choking—it was so bad that one could only see about 20 yards and we were forced to shelter in the rocks on the way down as one couldn't face the drift without choking. I estimated the wind on the summit of the mountain as about Force 9, in the valley only Force 7. All the sheep were smothered and we had to leave them and shelter ourselves. We were almost snowed up when we ventured back, the drifts being 16 feet in the hollows, and it took us nearly 4½ hours to go three miles. I think we were lucky to get back.

R. G. SANDEMAN.

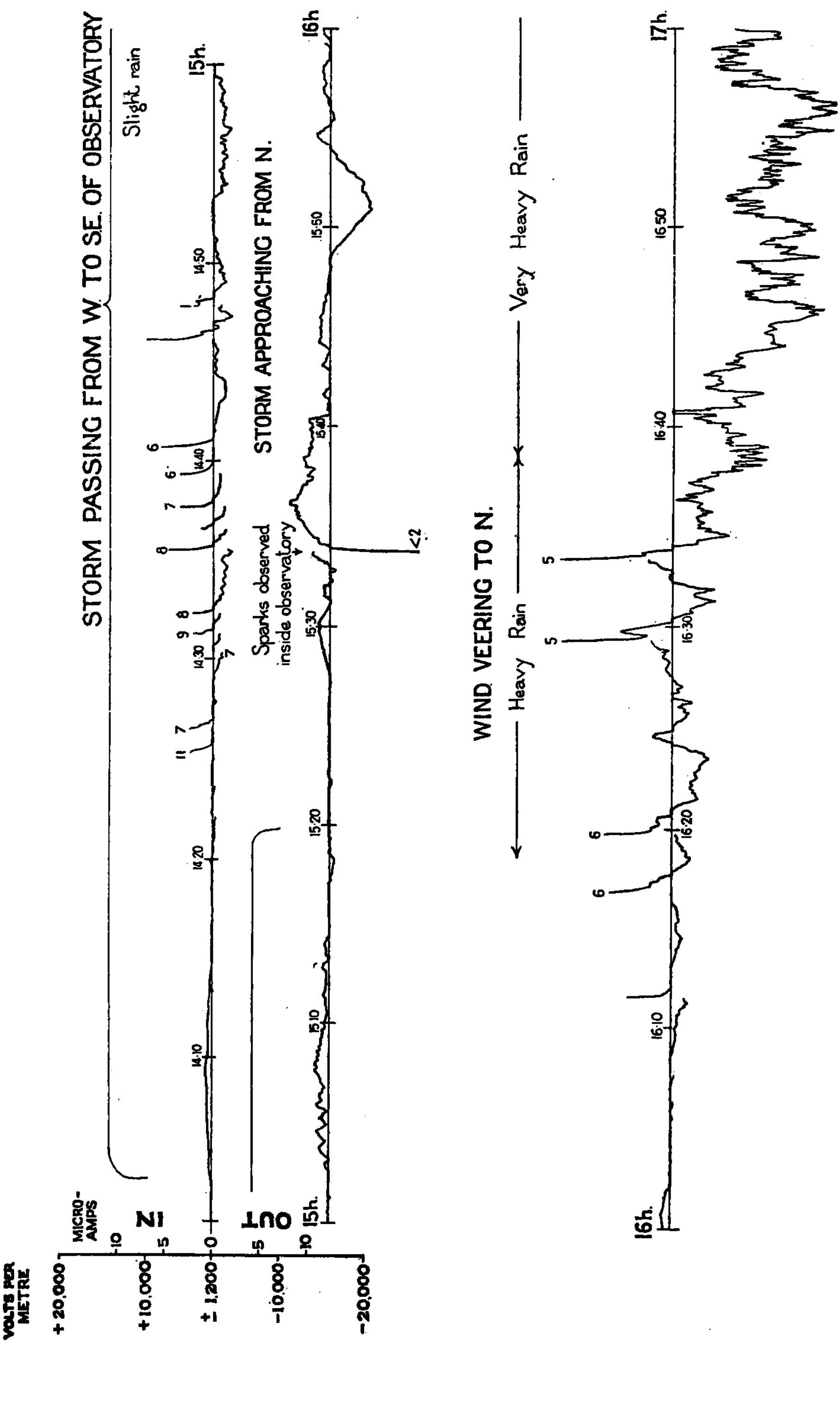
Dan-y-Parc, Crickhowell, Breconshire. March 2nd, 1933.

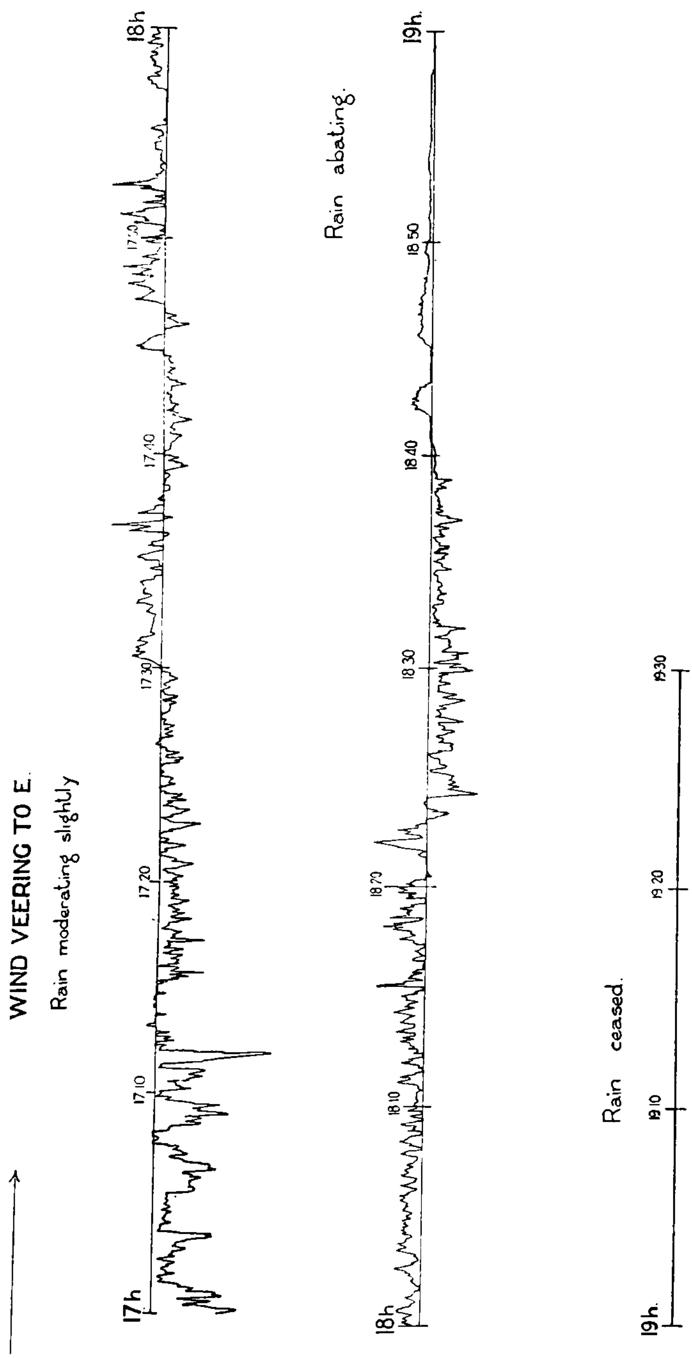
Electrical Discharge from an Elevated Point during the Thunderstorm of February 10th, 1933

By L. H. STARR, M.Sc.

For some months a continuous record has been obtained of any electrical discharge from a needle point fixed at the top of a pole, thirty feet high, situated in the paddock at Kew Observatory. By means of insulated cable, the needle point is connected to one terminal of a galvanometer, the other terminal of which is earthed. Movements of the galvanometer coil, due to currents entering or leaving the point, are recorded photographically on a traversing clock drum rotating once every two hours. Minute and hour marks are added by the intermittent lighting of a small lamp, which is switched on by a relay in the circuit of the Morrison clock. Thus, for a normal day, the record consists of a series of twelve straight lines with short transverse time marks. Any deviation, due to discharge current can be readily detected. Point discharge does not in general commence until a certain minimum gradient of potential is exceeded. It is believed that the critical gradient is that which maintains at the point a field, which causes electrons or ions approaching the point to accelerate to a velocity at which they ionise the air through which they pass. With our thirty-foot pole, the potential gradient "in the open," which must be surpassed to produce discharge is approximately 1,200 volts per metre. The record is arranged so that strong positive (*i.e.*, normal) potential gradient causes a deflection above the zero line. This corresponds with a capture of positive ions or with a discharge of electrons from the point. A deflection below zero occurs in strong negative fields and represents a capture of negative ions or electrons by the point.

The illustration on pages 36 and 37 is a reproduction of the record obtained during the thunderstorm of February 10th. In the original the records for successive periods of two hours


STORM PASSING FROM W. TO S.E. OF OBSERVATORY
Slight rain
STORM APPROACHING FROM N.
Sparks observed inside observatory
WIND VEERING TO N.
Heavy Rain
Very Heavy Rain
VOLTS PER METRE
+20,000
+10,000
± 1,200
-10,000
-20,000
MICRO-AMPS
IN
OUT
15h.
16h.
17h.
14:10
14:20
14:30
14:40
14:50
15:10
15:20
15:30
15:40
15:50
16:10
16:20
16:30
16:40
16:50



POINT DISCHARGE RECORD, KEW OBSERVATORY, FEBRUARY 10TH, 1933.

Time scale of actual record : 1 hour = 36 cm.
Calibration of galvanometer : 1 cm. = 4·8 micro-ampères.

overlapped. The value of the deflections in micro-ampères is given and a second scale shows the potential gradient at ground level corresponding to different values of discharge current. The scale of potential gradient was deduced from the simultaneous record of an electrograph designed for recording strong fields. Time marks, except those at the hour and ten-minute intervals, have been omitted in the reproduction. The sudden discontinuities in the record are associated with lightning flashes. When available, the number of seconds in the interval between the lightning and the subsequent thunder has been inserted. All times are G.M.T.

The first development of the storm was observed to the west of the Observatory, at about 14h. 10m.; the storm centre passed to the south and, by 15h. 20m., it had retreated to south-east, the nearest point on its track being a little over a mile to south-south-west. Heavy rain could be seen below the cloud base, but a few drops only fell near the Observatory. All lightning observed was between cloud and ground, and the flashes were most frequent from 14h. 30m. to 14h. 50m. A few of the recorded flashes were not observed. At 15h. 34m., when the main storm was approaching slowly from the north, another cloud, situated less than half a mile away, gave a single lightning flash. Sparks were observed inside the Observatory in two rooms; in one the spark was from the lead-in of the telephone, in the other from that of the wireless set. Thunder was almost immediate. The discharge record indicates that the electrification of this cloud, and possibly of other nearby clouds, must have continued to be considerable, but attention was now focussed on the approaching storm to the north and no special note was made of these clouds. Reflections from lightning to the north were first observed at 16h. 5m. and these increased rapidly in intensity, recurring at intervals of four to six minutes. Although no direct lightning tracks were visible, the last flashes at 16h. 30m. and 16h. 34m. appeared to reach overhead and to be about one mile distant. No further lightning occurred, but the rain, which had been slight and intermittent during the first storm, and slowly increasing during the approach of the main development, now became torrential, and continued so with squalls until 17h. 15m., afterwards moderating slowly to cease at 19h. 15m.

If the record is now examined, it will be seen that the point discharge and corresponding field changes were fairly straightforward during the initial storm. Discharge, indicating a high positive gradient, commenced while the active centre of the cloud was some three or four miles away. As the cloud approached, discharge ceased except for shortlived disturbances caused by lightning, which produced temporarily intense positive fields. A negative field followed with large positive changes accompanying lightning. As the cloud passed to south-east, a high positive field returned and subsequently the field diminished until the discharge ceased for a few minutes.

It will be seen that the single flash at 15h. 34m., the one which produced sparks inside the observatory, occurred during a period of high positive field and produced an intense reversal temporarily; a still higher positive value was rapidly assumed. The fields due to this, and possibly to other local clouds, which were not carefully observed, masked electrically the approach of the main storm, but the discharge with positive fields at about 15h. 55m. and the single lightning flash at 15h. 59m. are probably due to the latter. A reversal of field followed and, although no actual lightning tracks were visible, the record shows at each flash a positive change of field, small in the case of those between 16h. and 16h. 10m. but later much larger and preceded occasionally by a reversal from a negative value to a positive value. The last of these flashes was at 16h. 34m. The outstanding feature of the record is, however, the intense negative gradient, at times reaching 20,000 volts per metre, which occurred during the very heavy rain. The maximum discharge current, recorded at 16h. 56m., was 16 micro-ampères. Subsequent discharges were of a very complex character and continued until the rain abated at 19h.

The practice has been adopted of estimating the quantity of electricity passing through the needle point in periods of two hours. The unit is the millicoulomb, which is the quantity carried by a current of one micro-ampère flowing for $16\frac{2}{3}$ minutes. For the storm of February 10th, the integrated quantities flowing into and out of the needle point are shown in the following table :—

	Quantities flowing	
	Into Point	*Out of Point*
Time.	*millicoulombs.*	
14h.-16h.	2·20	1·71
16h.-18h.	2·23	16·64
18h.-20h.	1·61	1·62

The net discharge for the whole storm is 13·93 millicoulombs out of the point.

Any final discussion of the meaning of such a record as this cannot yet be undertaken. Attention may, however, be drawn to the relation between surface potential gradient and lightning. It might have been anticipated that the usual effect of lightning would be to reduce the strength of the electric field. It will be seen from the record that this is by no means the case. Very intense fields at the earth's surface do not precede lightning; they appear to be produced by it. But these intense fields are shortlived and a field nearly equal to that existing before the lightning is generally established after about fifteen seconds. Further, the most intense steady surface-gradients are not generally accompanied by lightning; they occur during vigorous precipitation.

The investigation has been undertaken to estimate the importance of point discharge as a component of air-earth current. From the record described above, it would appear that the information afforded concerning potential gradient may prove of even greater interest.

The Beginning of Spring

A note in the "Calendar of Nature Topics"* a few weeks ago remarked on the proverbial association of the beginning of spring with St. Valentine's day. This is five weeks earlier than the astronomical beginning of spring. Even in a notoriously fickle climate this seems an unnecessarily large discrepancy and some consideration is suggested of the question when spring may be said, on the average, to begin.

Spring is defined by the *Oxford Dictionary* as the "season in which vegetation begins, season preceding summer (esp. from about March 21st to June 22nd)."

In the meteorological calendar spring begins on March 1st and includes the months of March, April and May. This definition has two obvious advantages: it gives to spring almost exactly one quarter of the year, and the coincidence with the calendar months greatly facilitates the computation of "seasonal" averages. The astronomical definition of spring as the period between the spring equinox and the summer solstice retains the former advantage but discards the latter; moreover, it seems a contradiction to include the longest day of the year—"midsummer day," at the end of spring. Nature however does not—in this instance—proceed by fixed quanta, and it is an interesting subject of discussion which definition of spring best fits "the season in which vegetation begins." The beginning of vegetation is, however, an extremely vague date. The snowdrop blooms in January and the crocus is associated with St. Valentine.

In western Europe phenological charts have been used for 50 years or more to show the march of spring northward and eastward, an early example showing a period of over 72 days required for the progress of spring from the shores of the Gulf of Corinth to northern Norway. A more recent investigation† shows that in 1930 the beginning of spring was 72 days later in Hammerfest than in Palermo. These "spring charts" are based on observations of dates of the earliest flowering of various

* Nature, London, 131, 1933, p. 214.

† "Der Frühlingseinzug am Zürichsee" von Hans Frey (Küsnacht), Neujahrsbl. Nat. Ges. Zurich, 1931.

plants, and a difficulty lies in finding a representative selection of plants which can cover a large enough range of latitude, also the appearance of the selected flowers does not necessarily give the season in which vegetation begins. The temperature of 6°C. or approximately 42°F. is supposed to be of significance for plant life; it was regarded by continental botanists of the last century as the critical temperature above which the growth of vegetation begins and is maintained in a European climate, and 42°F. was chosen as the base line temperature for the computation of "accumulated" temperature.

A convenient meteorological date for the beginning of spring therefore might be that on which the smoothed curve of the annual course of temperature rises above 42°F. The data for Kew Observatory, which from a previous investigation* are in suitable form may be examined from this point of view. It appears that the smoothed curve of the temperature for the period 1871-1929 passes above the 42° line on March 11th, whereas for 1871-1900 the date is March 17th, and for 1901-1929, March 2nd; thus in the second period spring was 15 days earlier than in the first. There are no comparable phenological data for the whole period in question, but the table compiled by Messrs. Clark and Margary,† which shows the average date of flowering of 13 plants in a 35-year period, is of interest. This table shows that the average date for all districts was three days earlier in 1916-1925 than in 1891-1900. If only the five districts with the longest records are considered the apparent advance of the flowering season is reduced to one day. Temperature is only one of the numerous factors affecting the phenological events, and in 1893, when the earliest spring recorded by the phenologists occurred, the early part of the year was less noteworthy with regard to temperature than to the other meteorological elements. The study of weather in relation to plant life is one in which much remains to be done. In particular, it is not known to what extent duration of daylight is important, irrespective of temperature.

The problem is simplified in those countries where some spectacular natural event such as the débâcle or break-up of ice in the rivers makes an obvious end to the rigours of winter. In southern Russia and southern Canada this occurs about the middle of March, and since it nearly coincides with the disappearance of the snow cover and a rapid rise of temperature it is a highly appropriate herald of spring. Taking all these factors into consideration, we see that in our latitudes spring can hardly be said to open so early as March 1st. The weight of evidence seems to place the average date of commencement a few days later, but certainly earlier than the spring equinox.

* *London, Q.J.R. Meteor. Soc.* LVI, 1930, p. 375.

† *Ibid.* p. 50.

The date varies widely from year to year, however, and in some years spring is certainly " in the air " by the end of February, while in other years it is delayed until April.

Bearing in mind the usual description of spring weather in this country as " treacherous," one is not surprised to find on reference to temperature data that the daily mean temperature appropriate to March 21st may be attained any time between January and May. It is not intended, however, to define the " treachery " of the weather as a matter of range of mean temperature—in the last 60 years at Kew Observatory the mean temperature for 24 hours on March 21st has varied between 53°F. and 29°F., a range of 24°, whilst July 15th has varied from 77°F. to 53°F. and February 15th from 53°F. to 21°F. Thus, if we attempt to improve on the astronomer's definition of spring as beginning on the same date all over the northern hemisphere, it is necessary to proceed with caution.

Since for meteorological purpose we need a fixed date, however, the convenience of including three complete calendar months is sufficient to outweigh the slight prematureness of March 1st, and we may allow spring to borrow a few days from winter.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, February 15th, at 49, Cromwell Road, South Kensington, Prof. S. Chapman, F.R.S., President, in the Chair.

The Presidential Address, which should have been delivered at the annual general meeting on January 18th, was postponed until this meeting owing to the illness of the President. Professor Chapman took as his subject " Atoms, Molecules and the Atmosphere."

While the molecular constitution of air can be ignored in considering most meteorological problems of the lower atmosphere, it is of great importance for the phenomena of the upper atmosphere. The remarkable advances made in recent years in our knowledge of the intimate constitution of matter bear closely on many problems of upper-atmospheric physics. For this reason a broad summary of modern views on atomic and molecular structure was given, bearing on their states of excitation, ionization and dissociation, on the spectra that they emit, and on the effects of impacts between particles of various kinds, electrons, atoms, molecules and ions. Brief mention was made of some atmospheric phenomena in which such considerations are of importance—the spectre of the aurora, and of absorption bands produced by oxygen, ozone and water; the dissociation of oxygen in the upper atmosphere; and the ionization of the upper air.

Correspondence

To the Editor, *The Meteorological Magazine.*

Curious Cirrus Cloud

The clouds described below were observed near Hindhead, Surrey, on January 6th. During the morning, light cirrus travelled over the sky from north-west, and at 10h. 15m. in the west about 40° up I saw two very well defined, roughly parallel cirrus bands. They were fibrous in texture, breaking at the east end into a faint cirro-cumulus structure. They had altered little by 10h. 45m., when observation was rendered impossible by proximity of the sun. The bands remained roughly parallel throughout. No other cloud than cirrus was seen that day until after noon. Aircraft were about between 10 and 11, but the duration and appearance of the cloud lead me to conclude that smoke was not responsible for the phenomenon.

S. E. Ashmore.

22, *Soho Road, Handsworth, Birmingham. January 8th,* 1933.

The Low Temperatures of January and February, 1933—their probable cause

The marked fall of temperature which occurred in the second fortnight of January over almost the whole of Europe, again raises the question of the probable cause of abnormal variations of temperature.

Though the immediate cause of these variations is the displacement of certain centres of high and low barometric pressure, which determines the direction of the winds, we cannot stop here, but must investigate the cause of these displacements of the great atmospheric centres of action; further, this cause must also explain variations of temperature, since with the same direction of the winds and almost the same barometric pressure the temperature may be very different; for example, from December 15th to 20th, 1932, with high pressure over central and western Europe, and low pressure centres over the Atlantic, the weather was very mild (64°F. at Bordeaux on December 16th, 17th and 18th). On the other hand, from January 15th to 25th, 1933, with high pressure over Europe and low over the Atlantic, temperature was very low.

Thus, atmospheric conditions, being almost identical, cannot explain such differences of temperature as those between the second fortnight of December and the second fortnight of January; the cause cannot be found even in the wind direction, since in January east winds were cold but in December night temperature at Bordeaux with east winds was about 45°F. We must seek elsewhere.

Very curious coincidences occur between variations of temperature on the one hand, and on the other, variations in the phenomena of the sun's surface, spots, faculæ, etc., as observed daily at the Observatory of Talence for more than 30 years. Similar observations now cover a period of nearly 60 years, and have shown the following relationship between solar phenomena and the temperature of western Europe:

Every recrudescence of sunspots or of faculæ is followed by a rise of temperature.

Inversely, every diminution of sunspots or of faculæ is followed by a fall of temperature.

This is precisely the coincidence which occurred in December and January last. In December the appearance of large spots on the sun (one of which was visible to the naked eye from December 10th to 15th) was followed by relatively high temperatures, especially after a recurrence of the spots from December 18th to 20th. The latter, in consequence of the rotation of the sun in about 25 days, reappeared from January 3rd to 16th, but decreased after the 10th. Following this diminution and the complete disappearance of these spots after January 16th, temperature fell considerably over almost the whole of Europe and the western Mediterranean. There was a new formation of spots from January 26th to 28th, and another rise of temperature. These coincidences conform to the rule given above and bring out what might be described as the " individual action " of sunspots on our temperatures.

Another large group of spots was visible on the sun during the first fortnight of February and was accompanied by high temperatures. This group of spots disappeared on February 13th and temperature fell again. The table given below shows the variation of sunspots with temperature in our countries :—

		Number of Spots (Total of 5 days)	Temperature (Bordeaux) (Mean of 5 days)
1933.	January 15th-20th	3	3·4
	,, 21st-25th	0	−2·9
	,, 26th-31st	6	6·7
	February 1st-5th	16	11·2
	,, 6th-10th	16	11·6
	,, 11th-15th	5	5·2
	,, 16th-20th	0	2·8

These variations are similar to those of November and December. If the cause of the appearance and disappearance of the spots, faculæ and other phenomena of the sun were known a method of forecasting, which is not possible at present, could be based on these phenomena.

Nevertheless, as the sun rotates in about 25 days we know that an immense group of spots which turned the western edge of the sun on February 12th and 13th will reappear on the eastern edge on February 27th or 28th. There is therefore a great probability that temperature will rise at this time and that the first days of March will have relatively high temperatures. Consequently a return of cold is probable towards March 10th when these spots will disappear again, except for modifications caused by the appearance of new spots.

A periodicity of 100 years in the return of solar periods can give useful indications of the probable return of certain seasons after an interval of a century. Thus, the cold winter of 1929 corresponds with those of 1829 and 1729; the cool and rainy summer of 1927 corresponds with that of 1827; the unpleasant years 1930 to 1932, to 1830 to 1832, the hot August of 1932 to August, 1832, the cold January of 1933 to that of 1833, etc. This secular correspondence can be readily explained by the fact that a century comprises nine solar periods of an average length of 11·1 years; in spite of the unequal duration of solar cycles (ranging from 9 to 13 years), cycles of the same length recur at the same date from one century to another.

If these periods were rigorously similar from one century to another, one could announce that 1933 would present the same character as 1833, which was not a warm year, but this indication could only be precise if we knew the cause of the appearance and disappearance of phenomena on the surface of the sun. At least, we can say that the marked atmospheric variations which occurred during the first two months of winter have coincided with definite phenomena at the surface of the sun and indicate the real cause of these variations. It is to be regretted that the sun does not hold its rightful place in meteorological observations.

HENRI MÉMERY.

Observatoire de Talence (Gironde). January 31st and February 21st, 1933.

Reviews

The effect of Indian Mountain Ranges on Air Motion. By S. K. Banerji, D.Sc. (Reprinted for private circulation from Indian Journal of Physics, Vol. v, Part vii, pp. 699-745.) Calcutta University Press, 1931.

In an earlier paper, reviewed in this magazine last year, Dr. Banerji investigated the effect of the Indian mountain ranges on the sea-level isobars (assumed to be true stream lines for the level of about 0.5 Km.) during the months of the south-west monsoon. The present paper gives " a more detailed analysis of the various points that were only very briefly discussed in the first paper." With various simplifying assumptions, an extensive analysis is given by which the theoretical stream lines in the monsoon current can be drawn over India, and these stream lines are shown to agree closely with the " observed stream lines " at the 0.5 Km. level. It may be noted, however, that if we take as "observed stream lines" at the 0.5 Km. level, the scheme recently given by Wagner,* instead of the system of sea-level isobars, the agreement is not so close.

A short section is devoted to consideration of the vertical motions; the figure computed for the rainfall of June to September over the Western Ghats—7,600 inches—vastly exceeds any figures observed in India, even the celebrated Cherapunji having a mere 300 odd inches, in those four months, so that the utility of discussing a mean monsoon season is doubtful. In the further discussion promised, it is to be hoped that Dr. Banerji will concentrate his powerful analytical attack more on the three-dimensional aspects of the problem.

S. T. A. MIRRLEES.

Books Received

Monthly Rainfall of India for 1927, 1928 *and* 1929. Published by the various Provincial Governments and issued by the Meteorological Department. Calcutta, 1929, 1930 and 1931.

Obituary

Captain Robert Lee Faris.—We regret to learn of the death on October 5th, 1932, at Washington, D.C., of Capt. R. L. Faris, Assistant Director of the United States Coast and Geodetic Survey. Captain Faris was born at Caruthersville, Missouri, on January 13th, 1868, and received the degree of civil engineer from the University of Missouri in 1890. During the early part of his career he was mainly engaged on the extension of the transcontinental triangulation along the 39th parallel across the Rocky Mountains and on hydrographic work when he was in charge of magnetic observations at sea. From 1906-14 he was Inspector of Magnetic Work and Chief of the Division of Terrestrial Magnetism.

Professor Harlan Wilbur Fisk.—We regret to learn of the death, on December 26th of Prof. H. W. Fisk, Chief of the Section of Land Magnetic Survey in the Department of Terrestrial Magnetism of the Carnegie Institution. He was born at Geneva, Kansas, on September 25th, 1869, and after training in mathematics and astronomy he was appointed Professor of Mathematics at Fargo College, North Dakota. Here he became interested in terrestrial magnetism, and after some voluntary surveying work he joined the Department of Terrestrial Magnetism in October, 1906. His surveying activities included Bermuda and the West Indies, Central America and the northern parts of South America. He was also interested in the effect of eclipses on the earth's magnetic field and in secular variation. In 1929-32 he was secretary of the Section of Terrestrial Magnetism and Electricity in the American Geophysical Union.

**Beitr. Geophysik, Leipzig,* Vol. 30, 1931, p. 196.

News in Brief

The Fourteenth Annual Soirée of the Meteorological Office was held at the Royal Hotel, Woburn Place, London, on February 24th from 7 to 11.45 p.m. Despite the inclemency of the weather, a large and cheerful company assembled. The greater part of the time was occupied in dancing, and in addition there were games, prizes and a greatly appreciated entertainment by the well-known comediennes Elsie and Doris Waters. The ball-room lent itself readily to conversation, and in the short interludes between dances as well as in the refreshment interval, many scattered members of the staff—and their wives—were able to renew old acquaintance, while it was a great pleasure to welcome also a few former colleagues. The evening was generally voted a great success.

The twelfth annual dinner of the staff of the Meteorological Office, Shoeburyness, was held at the Queen's Hotel, Westcliff, on Saturday, February 18th, 1933.

The Weather of February, 1933

Pressure was above normal over most of Russia, Spitsbergen, extreme north of Scandinavia, northern North Atlantic, most of the British Isles, Alaska, British Columbia, west and south United States and in the neighbourhood of Bermuda, the greatest excesses being 14·4mb. at Stykkisholm, 14·2mb. at Julianehaab and 12·8mb. at Waigatz. Pressure was below normal over most of Canada, north-east United States, southern North Atlantic and most of Europe, the greatest deficits being 6·2mb. at Bornholm and 4·7mb. at 60° N., 110°W. Temperature was above normal in Spitsbergen and Scandinavia except in northern Lapland where it was as much as 5°F. below normal and below normal in central and south-west Europe. Precipitation was deficient in Spitsbergen and in excess in Switzerland; in Sweden it was 70 per cent. above normal in Scania and central Lapland and 40 per cent. below normal in Orebro, Skaraborg and Linköping.

The weather over the British Isles was mild at first, becoming cold about the 10th with severe snowstorms later. Sunshine records for the month were generally considerably above the normal. From the 1st to the 9th depressions passed to the north-west of the British Isles with associated secondaries and the weather was mild and unsettled with bright intervals. The 2nd was a sunny day over the whole country with 7·9 hrs. bright sunshine at Rothamsted, 7·7 hrs. at Dundee and Clacton and 7·6 hrs. at Stonyhurst. Rain occurred on most days, with snow, sleet or hail locally in Scotland on the 2nd, while gales were experienced in the north and west on the 2nd, 8th and 9th and a thunderstorm at Lerwick on the 2nd. Mist or fog occurred locally. Maximum temperatures reached 58°F. at Nottingham, Cambridge, Hull, Dublin and Waterford, and minima exceeded 50°F. in south Ireland on one or two occasions. On the 10th, northerly winds in the rear of a large depression caused a marked fall of temperature to spread over the country, while a small secondary moving south-east across the British Isles brought snow and sleet showers generally in Scotland and during the night of the 10th-11th over eastern England as well. Thunderstorms were experienced at Tottenham, Kew and Croydon during the afternoon of the 10th.* On the 11th, the Atlantic anticyclone had extended across the British Isles and the 11th and 12th were both cold sunny days, 8·7 hrs. of bright sunshine were experienced at Holyhead on the 11th and 9·0 hrs. at Ross-on-Wye on the 12th. From the 13th to 23rd pressure remained high from Iceland to the Azores and low to the east of the British Isles, and the weather was mainly cold and sunny. From the 13th to 17th there were only light showers of rain and a slight sprinkling of snow locally over the whole country but from the 17th to 23rd snow fell to a considerable depth in the north and east and light snow showers occurred in the south even as far as Guernsey. Sunshine records were good over the country generally during this period and especially on the 22nd and 23rd when over 9 hrs. bright sunshine were recorded at several places. On the evening of the 23rd a depression formed over north Ireland and moved later to a position off south Ireland, deepening considerably. Snowstorms occurred over the greater part of the British Isles and were especially severe in Wales, the Midlands and northern England† and strong south-easterly winds increasing to gale force at times were experienced in the Midlands and south. By the 26th southerly winds had brought milder weather and the rainfall on that day combined with the melting snow caused floods in many parts of southern England. The 27th and 28th were also mild days with occasional rain, heavy locally, but bright intervals. At Fofanny (Co. Down), 3·10 in. fell on the 28th. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	58	0	Liverpool	89	+21
Aberdeen	70	— 3	Ross-on-Wye	95	+24
Dublin	74	+ 1	Falmouth	86	+ 3
Birr Castle	66	— 1	Gorleston	77	— 4
Valentia	86	+17	Kew	76	+16

The special message from Brazil states that the rainfall in the northern and southern regions was irregular in distribution with averages 0·28 in. above normal and 0·31 in. below normal

* See p. 35. † See p. 29.

respectively, but in the central regions very scarce with average 1·71 in. below normal. Four anticyclones passed across the country and a continental depression developed in the south. The crops were generally in good condition. At Rio de Janeiro pressure was 0·2mb. above normal and temperature normal.

Miscellaneous notes on weather abroad culled from various sources. Following the thaw at the end of January ten days of spring weather prevailed in Switzerland during which the snow melted rapidly up to the 5,000-ft. level. By the 13th however, wintry weather had returned. Snow fell heavily about the 18th and ski-ing conditions were generally excellent during the rest of the month. Near Avila, Spain, several trains were detained by heavy snowfalls about the 20th, there being 5 ft. of snow in the station of La Cañada, near the tunnel through the Sierra Guadarrama. Gales were experienced in Sicily about the 23rd. Snow fell to a depth of half an inch at Cannes in the early morning of the 24th but quickly disappeared in the bright sunshine during the day. (*The Times*, January 31st-February 25th.)

It was unusually cold over Morocco round about the 22nd and motor cars were blocked by snow on one of the Atlas passes. (*The Times*, February 23rd.)

A heat wave passed over Brisbane early in the month, but about the 16th the overdue rains had spread there as well as to other parts of Queensland. (*The Times*, February 15th-16th.)

Communication was re-established about the 12th with Sandy Point, the fishing village on the west coast of Newfoundland, which had been cut off by a gale and high tides during the previous week. Temperature was above normal in the eastern part of North America during the first days of the month but the intense cold spell experienced in the west soon spread also to the east. During the week ending the 14th mean temperature was as much as 29°F. below normal at Yellowstone Park (Wyoming) and Grand Junction (Colorado) while −46°F. was registered at White River, Ontario, on the 9th. Severe snowstorms also accompanied the cold spells, many trains being snowbound and telegraph wires broken. During the following two weeks temperature rose considerably above the normal especially in the west. Precipitation was generally below normal in the western United States and variable in the eastern States. (*The Times*, February 10th-13th, and *Washington, D.C., U.S. Dept. Agric. Daily Weather Map and Weekly Weather and Crop Bulletin.*)

General Rainfall for February, 1933

England and Wales ...	160	per cent of the average 1881-1915.
Scotland	123	
Ireland	109	
British Isles	140	

Rainfall: February, 1933: England and Wales.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square	1·46	87	*Leics.* .	Thornton Reservoir ...	2·95	177
Kent .	Tenterden, Ashenden...	1·99	101	,, .	Belvoir Castle...........	3·14	188
,, .	Folkestone, Boro. San .	1·94	...	*Rut* .	Ridlington	2·85	174
,, .	St. Peter's, Hildersham	...	...	*Lincs*	Boston, Skirbeck	1·64	112
,, .	Eden'bdg., Falconhurst	2·68	121	,, .	Cranwell Aerodrome ...	1·72	115
,, .	Sevenoaks, Speldhurst	...	...	,, .	Skegness, Marine Gdns	1·03	67
Sus .	Compton, Compton Ho.	4·58	173	,, .	Louth, Westgate	2·39	124
,, .	Patching Farm	2·13	96	,, .	Brigg, Wrawby St. ...	2·35	...
,, .	Eastbourne, Wil. Sq.	1·92	86	*Notts* .	Worksop, Hodsock ...	3·25	211
,, .	Heathfield, Barklye ...	2·88	122	*Derby* .	Derby, L. M. & S. Rly.	2·91	180
Hants .	Ventnor, Roy. Nat. Hos.	3·56	169	,, .	Buxton, Terr. Slopes	4·66	124
,, .	Fordingbridge, Oaklnds	4·46	179	*Ches* .	Runcorn, Weston Pt...	3·29	177
,, .	Ovington Rectory	6·48	249	*Lancs* .	Manchester, Whit Pk.	3·07	160
,, .	Sherborne St. John ...	4·44	202	,, .	Stonyhurst College ...	4·82	144
Herts .	Welwyn Garden City...	1·84	...	,, .	Southport, Hesketh Pk	2·88	137
Bucks .	Slough, Upton	3·21	189	,, .	Lancaster, Greg Obsy.	4·08	141
,, .	H. Wycombe, Flackwell	2·61	...	*Yorks* .	Wath-upon-Dearne ...	3·43	209
Oxf .	Oxford, Mag. College...	2·92	185	,, .	Wakefield, Clarence Pk.	4·30	251
Nor .	Pitsford, Sedgebrook...	2·77	166	,, .	Oughtershaw Hall......	7·63	...
,, .	Oundle.....................	1·57	...	,, .	Wetherby, Ribston H.	5·24	303
Beds .	Woburn, Crawley Mill	1·61	109	,, .	Hull, Pearson Park ...	3·08	185
Cam .	Cambridge, Bot. Gdns.	...	...	,, .	Holme-on-Spalding ...	4·14	...
Essex .	Chelmsford, County Lab	1·14	77	,, .	West Witton, Ivy Ho.	5·40	189
,, .	Lexden Hill House ...	·95	...	,, .	Felixkirk, Mt. St. John	5·66	334
Suff .	Haughley House.........	1·37	...	,, .	York, Museum Gdns.	4·11	272
,, .	Campsea Ashe...........	1·67	121	,, .	Pickering, Hungate ...	4·12	237
,, .	Lowestoft Sec. School	...	...	,, .	Scarborough	3·31	197
,, .	Bury St. Ed, Westley H.	1·88	125	,, .	Middlesbrough	3·04	234
Norf .	Wells, Holkham Hall	1·91	129	,, .	Balderdale, Hury Res.	...	...
Wilts .	Devizes, Highclere......	3·75	189	*Durh* .	Ushaw College	4·69	295
,, .	Calne, Castleway	3·15	154	*Nor* .	Newcastle, Town Moor	3·20	202
Dor .	Evershot, Melbury Ho.	5·02	160	,, .	Bellingham, Highgreen	4·07	160
,, .	Weymouth, Westham .	4·01	185	,, .	Lilburn Tower Gdns...	3·95	198
,, .	Shaftesbury, Abbey Ho	3·88	168	*Cumb* .	Carlisle, Scaleby Hall	2·56	115
Devon .	Plymouth, The Hoe...	3·77	127	,, .	Borrowdale, Seathwaite	...	...
,, .	Holne, Church Pk. Cott.	6·80	124	,, .	Borrowdale, Moraine...	13·47	...
,, .	Teignmouth, Den Gdns.	4·30	165	,, .	Keswick, High Hill...	5·35	108
,, .	Cullompton..............	4·45	159	*West* .	Appleby, Castle Bank	2·51	85
,, .	Sidmouth, Sidmount...	4·32	173	*Mon* .	Abergavenny, Larch...	5·31	166
,, .	Barnstaple, N. Dev. Ath	3·50	129	*Glam* .	Ystalyfera, Wern Ho.	6·95	135
,, .	Dartm'r, Cranmere Pool	5·90	...	,, .	Cardiff, Ely P. Stn. ...	5·04	168
,, .	Okehampton, Uplands	6·02	138	,, .	Treherbert, Tynywaun	10·67	...
Corn .	Redruth, Trewirgie ...	4·05	107	*Carm* .	Carmarthen Friary ...	3·94	106
,, .	Penzance, Morrab Gdn.	3·59	107	*Pemb* .	Haverfordwest, School	3·79	109
,, .	St. Austell, Trevarna...	4·31	112	*Card* .	Aberystwyth	3·42	...
Soms .	Chewton Mendip	3·99	118	*Rad* .	Birm W. W. Tyrmynydd	6·51	124
,, .	Long Ashton	3·93	167	*Mont* .	Lake Vyrnwy...........	8·27	182
,, .	Street, Millfield.........	...	...	*Flint* .	Sealand Aerodrome ...	2·32	149
Glos .	Blockley	3·35	...	*Mer* .	Dolgelley, Bontddu ...	5·94	133
,, .	Cirencester, Gwynfa ...	3·83	169	*Carn* .	Llandudno	2·83	136
Here .	Ross, Birchlea...........	3·89	193	,, .	Snowdon, L. Llydaw 9	10·65	...
,, .	Ledbury, Underdown..	3·04	167	*Ang* .	Holyhead, Salt Island	2·05	84
Salop .	Church Stretton.........	3·66	181	,, .	Lligwy....................	2·40	...
,, .	Shifnal, Hatton Grange	3·35	207	*Isle of Man*			
Staffs .	Market Drayt'n, Old Sp.	2·50	145		Douglas, Boro' Cem. ...	4·24	130
Worc .	Ombersley, Holt Lock	2·91	177	*Guernsey*			
War .	Birminghm, Edgbaston	3·89	230		St. PeterP't. Grange Rd	3·72	151

Erratum: St. Peter's, Hildersham, January, for ·56 \| 32 read 2·17 \| 125.

Rainfall: February, 1933: Scotland and Ireland.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent of Av.
Wigt .	Pt. William, Monreith	3·96	129	*Suth* .	Melvich	4·79	160
,, .	New Luce School	...	...	,, .	Loch More, Achfary	7·58	115
Kirk .	Dalry, Glendarroch	5·75	113	*Caith* .	Wick	3·46	152
,, .	Carsphairn, Shiel	7·72	117	*Ork* .	Pomona, Deerness	3·98	132
Dumf .	Dumfries, Crichton, R.I	2·54	82	*Shet* .	Lerwick	3·52	111
,, .	Eskdalemuir Obs.	7·00	141	*Cork* .	Caheragh Rectory	2·59	...
Roxb .	Branxholm	3·27	124	,, .	Dunmanway Rectory .	2·95	55
Selk .	Ettrick Manse	4·06	88	,, .	Cork, University Coll.	2·25	60
Peeb .	West Linton	3·31	...	,, .	Ballinacurra	2·48	66
Berw .	Marchmont House	2·90	139	*Kerry* .	Valentia Obsy	2·06	40
E.Lot .	North Berwick Res.	1·63	104	,, .	Gearahameen	5·40	...
Midl .	Edinburgh, Roy. Obs.	1·15	69	,, .	Killarney Asylum	...	...
Lan .	Auchtyfardle	3·55	...	,, .	Darrynane Abbey	2·99	65
Ayr .	Kilmarnock, Kay Pk. .	...	...	*Wat* .	Waterford, Gortmore	3·83	119
,, .	Girvan, Pinmore	3·26	76	*Tip* .	Nenagh, Cas. Lough	3·52	113
Renf .	Glasgow, Queen's Pk. .	2·73	93	,, .	Roscrea, Timoney Park	2·12	...
,, .	Greenock, Prospect H.	4·38	87	,, .	Cashel, Ballinamona	3·43	107
Bute .	Rothesay, Ardencraig.	4·87	...	*Lim* .	Foynes, Coolnanes	4·77	150
,, .	Dougarie Lodge	6·53	...	,, ,	Castleconnel Rec.	3·17	...
Arg .	Ardgour House	8·31	...	*Clare* .	Inagh, Mount Callan	3·90	...
,, .	Glen Etive	...	...	,, .	Broadford, Hurdlest'n.	3·05	...
,, .	Oban	5·53	126	*Wexf* .	Gorey, Courtown Ho.	5·09	181
,, .	Poltalloch	5·33	127	*Kilk* .	Kilkenny Castle	3·65	144
,, .	Inveraray Castle	7·98	117	*Wick* .	Rathnew, Clonmannon	5·92	...
,, .	Islay, Eallabus	6·14	146	*Carl* .	Hacketstown Rectory.	3·92	131
,, .	Mull, Benmore	...	...	*Leix* .	Blandsfort House	4·15	155
,, .	Tiree	3·56	103	,, .	Mountmellick	5·26	...
Kinr .	Loch Leven Sluice	2·90	102	*Offaly*.	Birr Castle	2·32	101
Perth .	Loch Dhu	6·65	89	*Kild'r.*	Monasterevin	...	...
,, .	Balquhidder, Stronvar	4·07	...	*Dublin*	Dublin, FitzWm. Sq.	3·40	180
,, .	Crieff, Strathearn Hyd.	3·52	100	,, .	Balbriggan, Ardgillan.	2·52	129
,, .	Blair Castle Gardens	4·31	154	*Meath.*	Beauparc, St. Cloud	3·60	...
Angus.	Kettins School	3·99	170	,, .	Kells, Headfort	3·68	136
,, .	Pearsie House	4·00	...	*W.M* .	Moate, Coolatore	3·95	...
,, .	Montrose, Sunnyside	2·06	112	,, .	Mullingar, Belvedere	3·34	120
Aber .	Braemar, Bank	3·34	117	*Long* .	Castle Forbes Gdns.	3·30	116
,, .	Logie Coldstone Sch.	3·25	156	*Gal* .	Ballynahinch Castle	3·60	70
,, .	Aberdeen, King's Coll.	3·71	180	,, .	Galway, Grammar Sch.	1·52	...
,, .	Fyvie Castle	5·30	236	*Mayo* .	Mallaranny	4·65	...
Moray	Gordon Castle	3·48	181	,, .	Westport House	3·45	87
,, .	Grantown-on-Spey	3·02	142	,, .	Delphi Lodge	5·65	67
Nairn.	Nairn	1·99	111	*Sligo* .	Markree Obsy	3·14	92
Inv's .	Ben Alder Lodge	4·84	...	*Cavan.*	Belturbet, Cloverhill	1·79	107
,, .	Kingussie, The Birches	2·67	...	*Ferm* .	Enniskillen, Portora	...	...
,, .	Loch Quoich, Loan	13·10	...	*Arm* .	Armagh Obsy	2·86	129
,, .	Glenquoich	9·00	87	*Down* .	Fofanny Reservoir	5·93	...
,, .	Inverness, Culduthel R.	2·04	...	,, .	Seaforde	3·22	106
,, .	Arisaig, Faire-na-Sguir	4·75	...	,, .	Donaghadee, C. Stn.	3·54	153
,, .	Fort William, Glasdrum	...	...	,, .	Banbridge, Milltown	2·82	136
,, .	Skye, Dunvegan	4·08	...	*Antr* .	Belfast, Cavehill Rd.	3·55	...
,, .	Barra, Skallary	3·32	...	,, .	Aldergrove Aerodrome	3·04	126
R & C .	Alness, Ardross Castle	3·51	106	,, .	Ballymena, Harryville	3·54	109
,, .	Ullapool	5·01	117	*Lon* .	Londonderry, Creggan	3·16	99
,, .	Achnashellach	7·71	106	*Tyr* .	Omagh, Edenfel	3·37	113
,, .	Stornoway	3·43	77	*Don* .	Malin Head	3·96	...
Suth .	Lairg	4·73	152	,, .	Milford, The Manse	2·68	82
,, .	Tongue	5·58	160	,, .	Killybegs, Rockmount.	3·39	68

Climatological Table for the British Empire, September, 1932

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.	1013·2	— 4·2	75	42	64·6	51·1	57·9	+ 0·8	52·9	91	6·6	2·32	+ 0·45	15	3·4	27
Gibraltar	1015·9	— 1·4	89	54	79·8	64·6	72·2	— 0·3	63·8	83	4·3	1·30	— 0·09	6	..	..
Malta	1016·7	+ 0·4	91	66	83·8	71·3	77·5	+ 1·5	71·7	79	3·3	1·17	— 0·10	4	9·7	78
St. Helena	1017·4	+ 0·8	60	51	57·2	52·5	54·9	— 2·5	53·5	96	9·9	3·59	..	24	..	..
Freetown, Sierra Leone	1015·2	+ 3·0	87	71	82·4	72·6	77·5	— 1·6	74·5	89	8·3	23·84	— 4·64	28	..	..
Lagos, Nigeria	1013·6	+ 1·4	85	71	81·6	73·6	77·6	— 1·1	73·4	86	9·6	4·11	— 1·48	11	3·6	30
Kaduna, Nigeria	1013·9	— 0·4	89	..	83·5	..	..	..	70·9	88	8·7	13·83	+ 2·33	20	5·0	41
Zomba, Nyasaland	1011·1	— 2·6	89	52	83·6	60·4	72·0	+ 2·5	..	54	2·6	0·00	— 0·34	0	..	..
Salisbury, Rhodesia	1013·3	— 1·4	89	44	81·1	56·3	68·7	+ 2·3	55·8	41	1·4	0·35	+ 0·07	1	8·7	73
Cape Town	1019·3	0·0	77	45	64·8	50·7	57·7	— 0·2	52·4	84	6·3	2·23	— 0·01	12	..	..
Johannesburg	1013·7	— 1·0	80	38	73·9	50·9	62·4	+ 3·0	47·6	34	2·7	0·80	— 0·16	5	9·6	81
Mauritius	1020·9	+ 0·7	79	60	76·5	64·4	70·4	+ 0·3	64·0	73	6·3	2·31	+ 1·01	24	7·5	63
Calcutta, Alipore Obsy.	1002·7	— 1·8	92	75	89·2	79·2	84·2	+ 1·0	79·9	91	7·3	10·33	+ 0·32	18*	..	..
Bombay	1006·2	— 1·8	92	73	87·5	77·2	82·3	+ 1·4	77·3	86	6·4	11·13	+ 0·45	11*	..	..
Madras	1005·8	— 0·7	97	72	92·7	77·4	85·1	— 0·1	75·8	72	5·8	4·45	— 0·40	5*	..	..
Colombo, Ceylon	1010·4	+ 0·5	87	73	84·8	76·6	80·7	— 0·5	77·1	79	7·2	7·16	+ 2·40	20	6·3	52
Singapore	1009·3	— 0·5	91	70	86·8	74·4	80·6	— 0·5	77·1	80	7·1	9·74	+ 2·95	16	5·6	46
Hongkong	1008·2	— 0·1	88	75	83·9	77·1	80·5	— 0·5	75·6	79	7·9	4·34	— 5·35	12	4·5	36
Sandakan	..	..	..	..	..	..	..	..	77·1	81	7·0	..	..	..	..	..
Sydney, N.S.W.	1018·4	+ 2·3	79	44	65·0	51·6	58·3	— 0·9	55·2	77	7·8	7·95	+ 5·09	23	5·6	47
Melbourne	1019·7	+ 3·9	73	39	63·3	46·0	54·7	+ 0·6	50·6	75	7·1	0·81	— 1·63	13	5·0	43
Adelaide	1018·9	+ 1·4	78	42	67·1	48·8	57·9	+ 0·8	53·3	64	6·0	2·01	— 0·04	14	6·5	55
Perth, W. Australia	1019·2	+ 1·2	82	39	67·8	49·6	58·7	+ 0·5	53·2	66	3·7	1·58	— 1·84	10	8·3	70
Coolgardie	1018·4	+ 1·3	85	31	71·4	45·2	58·3	— 0·4	50·3	49	2·1	0·35	— 0·32	2	..	..
Brisbane	1016·8	— 0·8	82	47	73·7	54·4	64·1	— 1·1	58·3	62	4·2	3·00	+ 0·95	12	7·9	66
Hobart, Tasmania	1018·8	+ 7·8	66	36	58·2	44·5	51·3	+ 0·3	46·9	69	6·1	1·63	— 0·44	11	5·4	46
Wellington, N.Z.	1023·2	+ 8·6	65	38	53·5	43·9	48·7	— 2·9	46·6	79	8·2	1·05	— 2·92	15	4·4	37
Suva, Fiji	1013·7	— 0·6	90	65	82·4	71·0	76·7	+ 2·2	72·4	79	6·5	3·39	— 4·30	17	5·6	47
Apia, Samoa	1011·3	— 0·9	88	70	84·7	73·1	78·9	+ 0·7	76·1	74	4·7	6·27	+ 1·16	9	7·7	64
Kingston, Jamaica	1011·3	— 0·9	94	72	90·2	73·5	81·9	+ 0·4	73·4	81	2·9	1·01	— 3·02	8	8·6	70
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1018·2	+ 0·4	87	38	70·7	53·4	62·1	+ 1·8	55·5	81	2·9	3·04	+ 0·37	10	8·1	65
Winnipeg	1016·0	+ 2·2	88	30	68·2	43·9	56·1	+ 2·4	43·8	81	4·1	1·89	— 0·33	7	..	..
St. John, N.B.	1017·0	— 0·4	78	38	66·1	50·9	58·5	+ 2·6	54·4	82	6·3	3·21	— 0·53	16	5·6	44
Victoria, B.C.	1020·2	+ 3·8	76	44	65·8	49·4	57·6	+ 1·5	54·0	81	3·5	0·56	— 1·25	5	8·6	68

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