Symons's Meteorological Magazine.

No. 540. JANUARY, 1911. Vol. XLV.

THE RAINFALL OF 1910.

In our Rainfall Table this month the column of Rainfall from January 1st gives the total rainfall of the year at 55 stations, which were carefully selected so as to represent in as comprehensive a manner as possible all parts of the kingdom. The year has had one of the wettest Februaries, and one of the driest Septembers on record, and by the end of October, itself a dry month, the total for the ten months had assumed almost exactly the average value. But November was wet, and December, as shown in the earlier columns of our Table on p. 241, was very wet in the south of England, though dry in the north and in parts of Scotland and Ireland. A large part of the south of England had more than twice the average fall in December, and at Market Overton the fall was nearly three times the average amount. Our map of the Thames Valley and its surroundings shows a remarkably heavy fall in the southern portion. Looking at this map, it is easy to understand that in the first ten days, when the rain was heavy and almost incessant, the river rose rapidly and serious floods prevailed; for in December there is no check from evaporation or absorption by vegetation, and the wetness of the last days of November had saturated the ground and closed the paths for percolation, so that the surface water had all to run off over the surface into the rivers, and the rivers unable to carry off the flood, overspread their banks and poured the water back to the land. By the end of the year there was a large excess of rainfall to chronicle; and 1910 showed 8 per cent. more rain than the average for the British Isles as a whole, Wales having an excess of 17 per cent., southern England an excess of 16 per cent., Ireland an excess of 9 per cent., northern England and Scotland an excess of less than 5 per cent.

The following Table is a summary of the percentages published in our Monthly Tables.

Here it is seen that February was relatively the wettest month in England and Wales, Ireland and the British Isles as a whole, while April was by far the wettest month in Scotland. The driest month in all parts of the country was September.

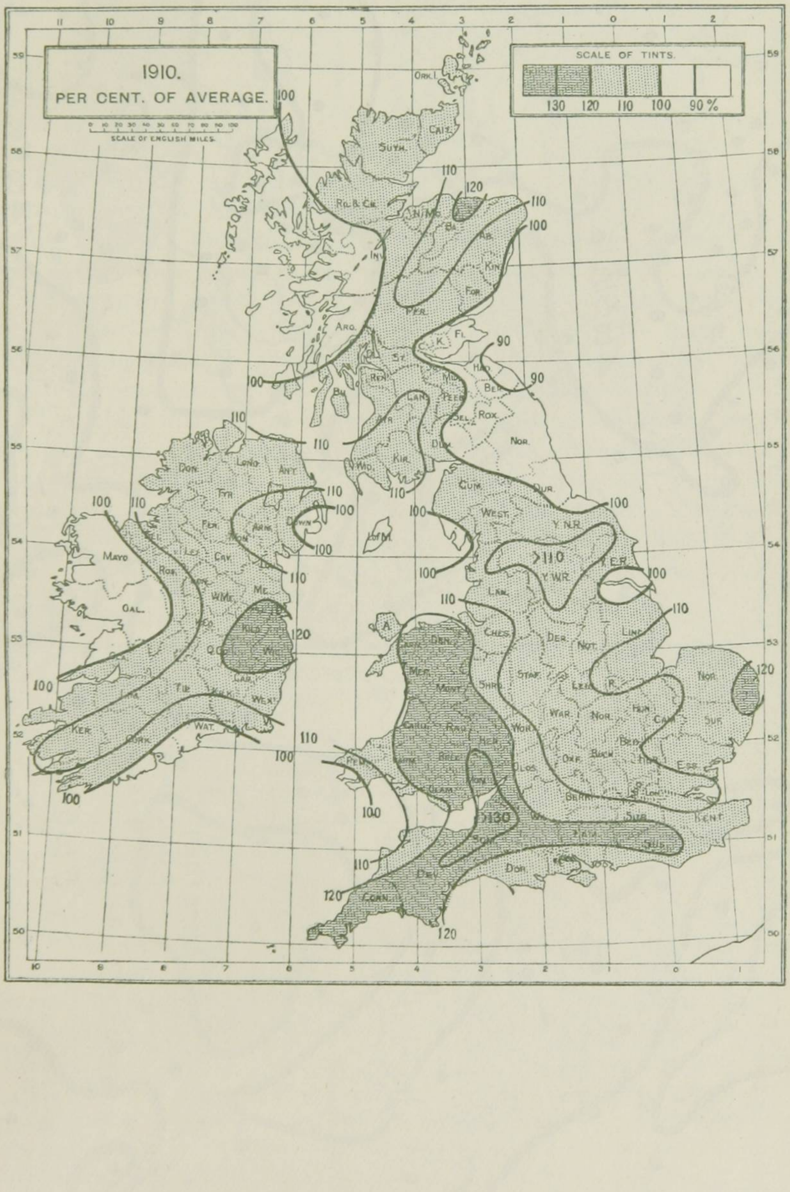
General Rainfall of 1910 expressed as per cent. of the Average.

Month.	England and Wales.	Scotland.	Ireland.	British Isles.
January	122	109	115	117
February	165	133	183	161
March	48	75	88	65
April	125	184	109	136
May	118	98	95	107
June	110	68	161	113
July	109	121	108	111
August	120	143	148	133
September	26	41	32	31
October	89	58	61	74
November	142	123	109	129
December	159	101	113	132
Year 1910	111	102	109	108

The figures showing the relation of the rainfall of the year to the average when plotted on a map show that rainfall a little less than the average occurred at the south-western extremity of Wales, in a narrow strip of the south of Ireland, in part of Clare and the whole of Cos. Galway and Mayo, in Argyll, the west of Inverness and the western islands, in the south-east of Scotland (relatively the driest region, part of Berwickshire having a deficiency of more than 10 per cent.), the north-eastern counties of England and a patch on the Humber. There were also dry patches in the north-east of Ireland and the north-west of England, perhaps including the Isle of Man. A considerable part of central Ireland and Scotland had an excess of more than 10 per cent., and so had all of England except the centre. The relatively wettest area was in Somerset, where the excess exceeded 30 per cent., and this high fall probably extended into Monmouth. Practically the whole of Wales except the extreme west had more than 20 per cent., and this excess also stretched along a belt of country in Dorset, Wiltshire, Hampshire and Sussex. These and other relationships appear upon the map facing this page, which is only a preliminary sketch liable to correction.

The relation of two dry years followed by a wet year which prevailed since 1889 has now completely broken down. Two consecutive wet years for England and Wales have been recorded for the first time since 1883, and it seems possible that the swing of the pendulum is carrying us into a period of predominating wet years, corresponding to the wet period of 1874-1883. There was no more reason to suppose that the dryness of the last 27 years would continue any more than the dry spell before 1872, which was broken up in 1874. The year 1872 as a solitary year of almost unprecedented rainfall before the wet spell had its counterpart, if our suggestion holds good, in the solitary year of almost unprecedented rainfall, 1903.

RAINFALL OF 1910 IN RELATION TO THE AVERAGE.



THAMES VALLEY RAINFALL — DECEMBER, 1910.

Watershed of River Thames above Teddington, and River Lee above Feildes Weir.

Rainfall Stations reporting

Isohyetals.

TEMPERATURE AND RAINFALL AT CAMDEN SQUARE IN 1910.

THE curves of shade temperature for 1910 drawn from the twelve points given by the monthly means present some features so unusual that we reproduce them together with the curve of the rainfall as a plate which appears as the frontispiece of the present volume. The smooth flow of the average curves in a dotted line is in marked contrast to the abrupt dips and rises of the curves for 1910, (continuous lines) the most marked features being the dip in July, the rises in October and December, and the dip in November, between them.

The averages employed in the following table, upon which the diagram is based, are, in the case of the mean temperature, for the 50 years 1858-1907, and, in the case of the maximum and minimum temperature, for the 40 years 1858-1897.

In the first six months of the year the persistence of moderate excesses over the average is noteworthy, April alone having a mean temperature below the average, owing, it will be observed, entirely to low maxima. In this month, however, the most noteworthy reading was the shade minimum of 25°·9 on the 23rd, which was, with two exceptions, the lowest daily reading in April on record here. The chief interest of the year's temperature values lies in the second half, four of the months being noteworthy for great departures from average conditions. July stands out prominently on the diagram with a deficiency of 3°·7 in mean temperature, the fourth greatest deficiency in 53 years, whilst its mean maximum temperature, 68°·5 or 5°·6 below the average, ranks third on the list,

Temperature and Rainfall at Camden Square in 1910.

1910	Mean Temperature.		Mean Maximum Temperature.		Mean Minimum Temperature.		RAINFALL.	
	1910.	Difference from Average.	1910.	Difference from Average.	1910.	Difference from Average.	1910.	Difference from 50 years' Average.
	°	°	°	°	°	°	in.	in.
January...	39·8	+1·2	45·1	+2·1	34·6	+1·3	1·57	— ·41
February..	42·2	+2·5	48·3	+2·8	36·3	+1·6	2·96	+1·34
March......	43·2	+0·9	51·5	+1·3	35·4	—0·1	·97	— ·72
April.......	47·6	—0·5	56·1	—2·0	39·8	+0·1	2·24	+ ·60
May.......	54·9	+1·0	65·0	+0·3	46·3	+1·9	2·22	+ ·35
June........	61·8	+1·5	72·3	+1·0	53·2	+2·3	2·17	— ·13
July........	59·9	—3·7	68·5	—5·6	53·1	—0·9	2·53	+ ·18
August....	61·8	—0·5	70·9	—1·7	54·2	+0·9	1·64	— ·69
September	57·1	—0·7	66·2	—1·1	49·6	—0·1	·58	—1·63
October ...	53·8	+3·8	60·6	+3·1	48·3	+5·0	2·00	— ·67
November	38·6	—4·7	45·4	—3·3	32·3	—5·4	3·19	+ ·89
December.	44·5	+4·9	48·7	+4·7	40·0	+5·6	3·29	+1·18
YEAR ...	50·4	+0·4	58·2	+0·1	43·6	+1·0	25·36	+ ·29

the extraordinary absence of hot days reflecting the unprecedentedly low duration of sunshine. November showed an even greater depression below the average than July, the mean temperature being the lowest yet recorded with a single exception, and the mean minimum the lowest ever recorded in that month. The number of frosts recorded both in the screen and on the grass was also the greatest ever observed.

October and December stand equally prominently on the other side of the account. The mean temperature in October had been exceeded four times, but the mean minimum once only, the latter being 5°·0 above the average. The lowest reading during the month, 41°·6 on the 21st, was unprecedentedly high, being as much as 9°·6 above the average lowest. In December the mean temperature was 4°·9 above the average, and 5°·9 above the mean temperature of the preceding month, the normal condition being a fall of 3°·7 from November to December. Three previous Decembers show higher mean temperature values, three higher mean maximum, and four higher mean minimum temperatures. The high mean was the result of consistent mild conditions and an abnormal absence of frost, which was registered on three days only. The combination of extremes resulted in the year as a whole reaching the average values for temperature.

THE WEATHER OF DECEMBER.

By FRED. J. BRODIE.

THE vagaries exhibited by the thermometer in the closing quarter of 1910 were indeed remarkable. That one of the mildest Octobers on record should have been followed by one of the coldest Novembers was regarded as a striking and unusual combination of circumstances. Soon after the commencement of December it was evident that the see-saw movement was still in progress, and as a climax to the strange sequence of events, the concluding month of the year proved one of the mildest the present generation has witnessed. Over a large portion of the country the records of the past 40 years supply in fact only two other instances of so open a December. Both in 1898 and 1900 the closing month of the year was as warm and in some places a trifle warmer than in 1910. As regards the night temperatures there were, however, many parts of England in which the past month achieved a record.

The month opened with a short spell of easterly and north-easterly winds with heavy rain in the south of England, due to the presence of a small barometrical depression, over the north of France. As the disturbance passed away to the south-westward the weather improved, and on the nights of the 3rd and 4th a slight frost was experienced in our western and northern districts. Between the 5th and 7th, when other depressions appeared over our western coasts, the wind became southerly and the mid-day temperatures exceeded 50° in many parts of Great Britain, a reading of 55° being recorded at Dungeness on the 5th, and a reading of 57° at Cirencester on the 7th.

Between the 8th and 17th several cyclonic disturbances arrived from the Atlantic, and although very few of them passed directly across the United Kingdom, their influence was seen in a long spell of wet stormy weather, the rainfall in Wales and the southern half of England being sufficientlv heavy to cause serious and widespread flooding. The prevailing winds at this time were mainly from between south-east and south-west, and temperature was continuously high both in the daytime and at night.

The warmest spells oocurred between the 8th and 11th and on the 15th and 16th. On the earlier occasion the thermometer rose above 50° at many places in the west and north, and touched 57° on the 9th at Llandudno; on the 15th and 16th it reached 55° at a number of stations in the south and east of England and touched 57° at Geldeston. In the rear of a deep barometrical depression which passed eastwards across the United Kingdom and the North Sea on the 16th and 17th, an anticyclonic ridge extended temporarily from the southward, and on the night of the 19th a rather sharp frost occurred in many parts of Great Britain, the thermometer on the grass falling to 25°, or less in several places, and to 20° at Llangammarch Wells. Shortly before Christmas a south-westerly, merging into a decided westerly, type of weather was experienced, and on the 23rd or 24th the thermometer rose to 55°, or slightly above it over a large portion of the United Kingdom, a reading of 56° being recorded as far north as Gordon Castle, and a reading of 57° at Aberdeen. In the closing week the prevailing winds were north-westerly and the weather became more seasonable, night frosts occurring very commonly in nearly all parts of the country. The sharpest, and in fact the only sharp frosts of the month, occurred on the nights of the 27th and 28th, when the sheltered thermometer fell below 25° at a large number of places situated in nearly all parts of the country and below 20° at some of the central stations in Scotland and Wales. On the surface of the grass the readings were, of course, a few degrees lower; at Tunbridge Wells the thermometer sank to 15°, while at Llangammarch Wells it registered a minimum of 8° At Leith the absolute shade minimum temperature for the month was as high as 33°, this being the first time in the course of 40 years in which the thermometer at Leith had failed, in December, to fall below the freezing point.

The duration of bright sunshine last month was below the average in most places, and considerably below it at some stations in the south of England. At Oxford the total duration, 30 hours, was little more than three fourths of the average. At Westminster the duration, 11 hours, was only 2 hours short of the normal. In the north of Scotland rather more than the average quantity was registered.

THE NEW DAILY WEATHER REPORT.

WITH the beginning of the new year the Daily Weather Report of the Meteorological Office has assumed a new form embodying several mprovements, and the increased accommodation in the new office at South Kensington has made it possible to economise time in preparation by carrying out the lithography of the Report on the premises. In the new arrangement of the Report the first page remains as before, a list of observations at about 70 stations. The second and third pages are entirely recast. The isobaric maps for 7 a.m. and 6 p.m. on the previous day are enlarged and placed side by side, and the 6 p.m. map distinguishes the area within which rain had fallen in the 24 hours from 7 a.m., thereby relieving the large map on p. 3. Below this pair of maps under the heading of "Weather Prospects" come the forecasts for the 24 hours commencing at noon on the day of issue, for twenty seperate areas of the British Isles, the boundaries of which are given on a small map. It says something for the increased knowledge of geography on the part of the public that the reader can be assumed to know the position of his own home on the map, sufficiently closely to tell in which division it lies; possibly the assumption is too great. A modest heading "The Further Outlook" reserves a small space for announcing the rare types of weather of a persistent character. Page 3 contains a map of the weather of the day of issue at 7 a.m., extending to the whole breadth of the page, and presenting the greater part of the Atlantic Ocean and the whole of western Europe. This large map combines the information previously given on two smaller maps; the isobars are the more important features and are boldly drawn far over the ocean on the strength of the observations from Iceland, the Azores and Madeira. Greenland appears temptingly in the north-west, and we remember hopefully that the earliest suggested route for a Trans-Atlantic cable on the "Telegraph plateau," touching at Greenland, is again being spoken of. The extension of the isobars is occasionally helped by wireless telegrams from Atlantic liners, though it is still rare for these dispatches to arrive in time to be of use. Isotherms are shown on the same map in bold dotted lines which cannot be confused with the isobars; and winds and weather are also indicated. Below this map "Notes on the general situation" at 7 a.m., and "General inferences" drawn from the observations, are given, The last page, in addition to observations for the previous day at supplementary British and Foreign stations, and such radio-telegraphic information as may have been received from the Atlantic, has a new section headed "London Observations," giving for Greenwich Observatory, the City (Bunhill Row), Westminster (St. James's Park), and Hampstead (the new Observatory on the Heath), the humidity at "3 p.m. yesterday and 9 a.m. to-day," the maximum and minimum temperature, weather, rainfall and duration of sunshine for the preceding 24 hours. The Kew Observatory observations are given in the first page, so that the

London area is well represented, though not excessively so considering its importance.

We fear that the nature and usefulness of the Daily Weather Report are not known and appreciated as they ought to be by the public ; indeed no serious meteorological publication seems capable of exerting much popular appeal ; but for educational purposes at least the value of the Report is enormous. The knowledge that it deals with the weather of the very day on which it is studied gives a freshness to the interest that can never be aroused by less prompt publications.

THE BROCKEN SPECTRE ON SNOWDON.

By W. Piffe Brown.

Most persons have heard of the so-called "Spectre of the Brocken," but comparatively few know that the apparition is to be seen in our own country. Given certain conditions, viz. :—(1) a mountain peak or ridge clear of opaque mist ; (2) transparent vapour, or humidity, on the peak or ridge ; (3) bright sunshine, and (4) some opaque mist in a suitable position, and the vision appears. It is often seen from the peaks and ridges of Snowdon and some adjacent mountains. A recent display was exceptionally fine, and merits some record.

In the middle of September the weather was unusually fine, there had been no rain for a fortnight, easterly winds prevailed, and on several days there was much "black haze," so much that the scenery was obscured, and no sun or sky was to be seen. These conditions ruled on the 16th when I and a companion started to ascend Snowdon. We reached the summit at 4 p.m., and, when within a few yards of it, we emerged from the obscurity of the haze into a clear atmosphere, with a cloudless blue sky and bright sunshine above.

Immediately below the summit there was a zone of humid white mist, and beyond this, as far as the eye could see, nothing was visible but black haze, not a peak or ridge, near or far, was in sight ; we stood, as it were, on a small islet in a boundless sea of mist and haze. We thought of the spectre and, placing ourselves in position, were not disappointed. A clear outline of the peak—with the buildings, ordnance cairn, stump of flag-pole, ourselves and one stranger, the only persons there—was projected on the white mist just below, and the whole was surrounded by the usual circular mist-bow, smaller and fainter than an ordinary rainbow, but showing the complete circle,

We left the summit shortly after 5 o'clock, the sun was then within an hour of setting, and becoming involved in the haze, the figures on the mist were slowly fading.

The appearances seen on the mist are not simple shadows, they are similar to dark figures thrown on a screen by means of lenses in a magic lantern. The bow is caused by the sun's rays passing through the transparent vapour on the peak, just as the ordinary rainbow results from the rays passing through a shower of rain.

ROYAL METEOROLOGICAL SOCIETY.

THE monthly meeting of this Society was held on Wednesday evening December 21st, at the Institution of Civil Engineers, Great George Street, Westminster, Mr. H. Mellish, President, in the chair.

Capt. C. H. Ley gave a report on the balloon experiments which he had carried out at Blackpool during the early part of the year. It was hoped that these experiments would throw light on (*a*) periodic oscillations of stratum as apart form variations due to altitude, (*b*) vertical currents or rising winds, and (*c*) local eddies or other phenomena. The proposal was to employ balanced pilot balloons, which, floating in a current with no upward or downward hydrogen-velocity, would represent the motion of a particle travelling in that current. If possible, two or more flights were to be obtained on the same day, so that the variations under the same conditions at short intervals could be observed. Difficulties, however, arose which prevented the scheme being carried out as originally planned. Ultimately a hydrogen balloon or twin-system of hydrogen balloon and heavy satellite was so valved as to have a large free lift at first, but to lose gas continuously under the action of a leak until a certain point is reached at which the valve closes, when, in accordance with previous adjustment it is nearly in equilibrium.

From an analysis of the trajectories and of the method used the following general results have been deduced :—(1) Sudden variations of less than 25 feet per minute in the vertical velocity otherwise unaccounted for, may be disregarded ; (2) Most trajectories are more or less sinuous ; (3) The sinuosities often take the form of kinks in one direction only, the main direction being returned to ; (4) Oscillations of vertical velocity nearly always accompany these sudden deflections of trajectory ; (5) Oscillations of horizontal velocity often occur without deflection ; (6) Depression of velocities often occurs over a river area with violent oscillation near the margin ; and (7) The microbarograph often shows some peculiar correspondence of pressure changes with the trajectory oscillations.

Capt. Ley also read a paper on "The Meteorological Significance of Small Wind and Pressure Variations." This is practically a continuation of the above report. Capt. Ley compared the "yawings" of the wind at Blackpool with the small variations of atmospheric pressure as recorded by the microbarograph. Yawings occur when the variations of velocity and direction are in the same phase ; but when the phases are opposite or widely divergent, the result is often dissimilar, variations usually forming irregular closed or half-closed figures on the vector diagrams. Such figures possibly represent irregular vortex systems. After analysing several instances Capt. Ley said "if the time between the commencement of marked wave-motion and that of the general change of wind at Blackpool is noted, and the distance to the extreme north-west coast of Ireland viâ the North Channel measured, and an allowance made for transmission of oscillations at the velocity of sound, we are able to form a rough estimate of the speed of approach of the depression. Thus that of July 23rd would be between 50 and 60 miles per hour, and that of July 26th about 40 miles per hour. Thus these wavilinear oscillations occurring in the freer winds, appear to have a distinct meteorological significance. An instrument placed at Blackpool is very well situated for recording them before they suffer much interference. Indeed it seems to me that the orographic features, which Dr. Shaw called attention to, resemble a gigantic receiver, or ear, whose helix is on the Cumberland coast and lobe at Snowdon or Anglesey, whilst the sensitive membrane is in the central region on the coast-line. An instrument placed at Blackpool or Southport is near the drum of this ear, and actually hears the low voice of a depression as it beats in to the Irish coast from the Atlantic."

Mr. C. J. P. Cave, Mr. E. Gold, Mr. J. S. Dines, Mr. W. W. Bryant, Mr. R. Corless, and Mr. R. Inwards, took part in the discussion, and Capt. Ley replied.

A paper by Dr. Wilhelm Schmidt, of Vienna, on "Atmospheric Waves of Short Period," was also read. The author described the Variograph, an apparatus which he had designed for recording the rate of small variations of atmospheric pressure. This gives records somewhat similar to the microbarograph. Dr. Schmidt analysed the records obtained from two of these instruments at Innsbruck during the occurrence of some Föhn winds.

The following new fellows were elected, Mr. E. T. Adams, Mr. A. D. Barron, Mr. M. C. Carr-Gomm, Assoc.M.Inst.C.E., Mr. L. P. Causton, Dr. C. Chree, F.R.S., Mr. G. R. G. Conway, M.Inst.C.E., Mr. J. B. Espiner, Mr. F. S. Harvey, Assoc. M.Inst. C.E., Mr. J. H. Johnson, M.Inst.C.E., Mr. E. A. Lees, Assoc.M.Inst.C.E., Mr. J. E. Middleton, Capt. G. A. Millington, Mr. F. M. Preston, Assoc.M.Inst. C.E., Mr. W. D. L. Raw, Mr. T. R. Saunders, Assoc.M.Inst.C.E., Mr. W. Simpson, M.Inst.C.E., Mr. D. E. Smith, Mr. M. J. Stephan, and Mr. E. Timothy.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

TRANSVAAL METEOROLOGICAL OBSERVATIONS.

I MUST express some regret for unavoidable delay in this comment upon Mr. Innes's letter in your November number.

Pages 16—21 of the last annual report of the Transvaal Observatory contain barometric pressures for Johannesburg, at 7 a.m., 2 p.m., and 9 p.m., for each day of the year. The readings are expressed in millimetres, reduced to 30°F. Pages 22—27 contain the pressures expressed in inches, reduced to 30°F., at 8 a.m., 1.30 p.m., and 7 p.m., for each day for Pretoria. Page 97 gives mean hourly pressures for Johannesburg for each month, expressed in millimetres, reduced to 0°C. Pages 99 and 100 give annual means, expressed in inches, reduced to 32°F., for a number of barometer stations (including the Johannesburg Observatory), with a set of plus and minus numbers showing by how much the monthly means differed from the annual means. Thus four different systems of reduction are employed, *i.e.*, (1.) millimetres and 30°F.; (2.) inches and 30°F.; (3.) millimetres and 0°C.; (4.) inches and 32°F. What help the last can possibly be in the interpretation of the first and third is not easy to see. No doubt it is sometimes difficult for an astronomical observatory to cope adequately with its meteorological "side shows"; but if one system or the other were used, preferably inches and 32°F., since there is no reason why the Transvaal should be out of step with all the rest of British South Africa, it would be much easier for future generations of investigators.

CONTRIBUTOR.

[Mr. Innes, the Director of the Transvaal Observatory, informs us that the site was selected not for astronomical purposes, for which he considers it in some respects ill-suited, but with a special view to kite-flying and other researches on the upper atmosphere, for which it is well adapted. Our recollection of a visit paid to the Observatory in 1905, is that at that time there were no astronomical instruments, and if astronomy is now being studied there, surely it, and not meteorology, is entitled to the quaint simile of a "side show." We are in entire agreement with CONTRIBUTOR as to the importance of using one uniform system of recording barometric heights, and hope that before long the Union of South Africa will have a united and accordant meteorological system.—ED. *S.M.M.*].

RAIN SPELLS.

FROM 30th November to 18th December (19 days) rain was registered daily aggregating 5·44 inches. The following, by way of comparison, may be interesting records.

Years.	Periods.	Days.	in.
1900	13—28 Feb.	16	3·58
1903	21 Feb.—7 Mar.	15	2·87
1903	20 Sept.—14 Oct.	25	4·32
1904	25 June—21 Feb.	28	5·90
1906	26 Oct.—9 Nov.	15	4·15
1907	5—25 Oct.	21	4·02
1908	20 Aug.—5 Sept.	17	4·10
1908	4—21 Dec.	18	1·89
1909	27 Sept.—18 Oct.	22	3·15
1910	4 Feb.—1 Mar...	26	3·70
1910	30 Nov.—18 Dec.	19	5 44

C. C. HAVILAND.

Ridgemount, Frimley Green, Surrey, 21st December, 1910.

RAINFALL AND WIND DIRECTION.

A SHORT time ago I had a discussion with a friend here on the direction of the wind, the amount of rainfall with each direction, and the number of fine and rain days. To satisfy myself on these points I compiled a table taken from the records I have kept for the last ten years, and this table I append as it may be of interest.

Annual rainfall and number of rain days with the direction of the wind. Average of ten years.

	N.	N E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Rainless Days	17	20	12	13	3	25	13	36	14
Rain Days....	12	14	9	24	15	66	20	36	16
Total.........	29	34	21	37	18	91	33	72	30
Rain ...... in.	1·30	1·57	1·51	4·95	3·18	9·55	2·51	3·28	2·21
Average per Rain Day	·108	·112	·168	·206	·212	·145	·125	·091	·138

MORRIS BIRKBECK.

Shortheath, Farnham, Surrey, 12th November, 1910.

LOW RADIATION TEMPERATURES.

AN instance of remarkably strong radiation occurred at the Hampstead Scientific Society's Observatory, on the highest point of the Heath, on Friday, December 30th, 1910; at 4.20 p.m. the dry-bulb in the screen read 38°·9 and the wet-bulb 38°·2, while the grass minimum was as low as 26°·7, showing a depression of 12°·2. There was a faint breeze from the north at the time, and about two-fifths of the sky was cloudy, although it was clear immediately overhead. During the ensuing night the screen minimum was 32°·2 and that on the grass 21°·9. Depressions of ten degrees seem to be quite common, but I have not previously noted a difference of twelve degrees at so early an hour in the evening.

E. L. HAWKE, F.R.Met.Soc.

2, Akenside Road, Fitzjohn's Avenue, Hampstead, N.W., January 1st, 1910.

CYCLONES AND THE SUN'S ROTATION PERIOD.

By F. W. HENKEL, B.A., F.R.A.S.

IT has long been known that there is an intimate connection between the variations in magnetic intensity, declination and magnetic storms and solar activity. The eleven year sun-spot period corresponds with that of the larger variations of magnetic declination, as was shown by Sabine, Gautier and Wolf, soon after the detection of the former by Schwabe. Balfour Stewart and others from the Kew Observations brought out this correspondence very clearly; but there seems to be a slight lag in point of time, the magnetic changes following the sunspot changes of about 5 months previously, whilst Mr. Ellis, from the long series of Greenwich Observations, has shown the association to be undoubted, though not extending to absolute parallelism in every detail. The curves of auroral frequency and sunspots are also intimately connected, whilst the irregular variations known as magnetic storms are synchronous with unusual solar disturbances, development of sun-spots, large faculæ, &c. The "magnetic storm" of September, 1909, was thus characterised.

As it seems natural to suppose that the amount of heat received by the Earth from the Sun should vary with the state of the latter's surface, there have not been wanting attempts to show a connection between the greater or less spotted condition of the Sun and terrestrial variations of temperature. Nevertheless, such attempts have hitherto met with but little success, and contradictory results have been arrived at by different authorities. In the first place, though the spots themselves radiate less heat than the general surface of the Sun, and thus their direct tendency is to make the Earth cooler; on the other hand, since they are probably due to, or accompanied by, eruptive action, the hotter gases from below bursting upwards with extra abundance during seasons of maxima, this latter will increase the emission of heat from the Sun, perhaps to an even greater extent. Observations made by German observers discussed by Jelinek, showed no difference that could be assigned to that cause. Mr. Stone at the Cape, and Dr. Gould at Cordoba, in Argentina, considered that a distinct, though very slight diminution of temperature was shown, at the time of sun-spot maximum, from observations at their stations. According to Dr. Gould, the difference between maximum and minimum amount to about 1°·75 F. Mr. Stone's result was only about half as much. On the other hand, observations in India, Edinburgh, and other places, seem to show that the sun is slightly hotter at times of spot maxima. The influence of sun-spots upon storms and rainfall, however, seems to be somewhat more pronounced; though here too we may use the words of the late Professor Young, and say, that "in the astronomical world one party holds that the state of the sun's surface is a determining factor in our terrestrial meteorology, making itself felt in our temperature, barometric pressure, rainfall, cyclones, crops, and *even our financial condition* (Jevons);

whilst the other party contends that there is, and can be, no sensible influence upon the earth produced by such slight variations in solar light and heat." From a comparison between the number of cyclones observed in the Indian Ocean, the late Dr. Meldrum, for many years Director of the Royal Alfred Observatory, Mauritius, attempted to show that the number of these disturbances was greatest at the time of sun-spot maximum. His Table is given below :—

Years.		No. of Cyclones in each year.	Total number of Cyclones.
Maxima	1847	4	15
	1848	6	
	1849	5	
Minima	1855	4	8
	1856	1	
	1857	3	
Maxima	1859	5	21
	1860	8	
	1861	8	
Minima	1866	5	9
	1867	2	
	1868	2	
Maxima	1870	3	14
	1871	4	
	1872	7	

By including other great storms, Meldrum arrived at a similar result, but the number of observations is scarcely sufficient to lend conviction ; moreover, the variations from year to year are very considerable. Attempts have been made to confirm this relationship by tabulating the rainfall at stations on or near the Indian Ocean. However, the results of the late Mr. Symons from the British rainfall of more than a century, do not show any evidence of the connection between sun spots and the rain, an immense number of rainfall observations were tabulated by him, but the result was "equivocal"; whilst the results of observations in the United States and elsewhere "are in direct conflict to the theory." Meldrum's general conclusion was that the average rainfall for the whole Earth is about 38·5 inches, the range between maximum and minimum is about 4 inches, the maximum occurring about a year after the sun-spot maximum.

About five years ago, Mr. Maunder, of Greenwich, from a discussion of the Magnetic disturbances as recorded at the Royal Observatory for the period 1882 to 1903, showed that these disturbances tended to recur at intervals corresponding to one or more synodic rotations of the Sun (about 27¼ days), with a frequency much greater than could be ascribed to chance. From this it followed that these magnetic disturbances are intimately connected with the solar rotation, and the action, whatever its nature, does not proceed from the Sun as a whole, but from limited portions of the surface, and seems to proceed in a definite and restricted direction. The discovery of this "Interval

Relation," as he called it, led him to enquire whether any meteorological phenomena tended likewise to recur in a similar manner. Though it is, of course, obvious that the Sun's general action upon terrestrial meteorology is of paramount importance, yet any action from limited regions along restricted lines would be liable to be masked by the much greater effects of season and climate. A magnetic disturbance, if sufficiently intense, is instantaneously manifested over the whole planet, but a meteorological one would probably take an appreciable time to develop. The number of striking changes is so great, that it is only under exceptional circumstances that a sufficiently simple record can be found for the "Interval Relation" to be detected, if it exist. For these and other reasons he has examined several lists of tropical cyclones, to ascertain, if possible, whether they manifested such a relation. Father Algué's work on the "Cyclones of the Philippines" did not prove suitable for the enquiry; the cyclones recorded were too numerous, and their dates of origin too uncertain, Sir John Eliot's "Handbook of Cyclonic Storms in the Bay of Bengal" seemed to give some indications, but not of a very decided character. The case was different, however, with the list of "Cyclones in the Southern Indian Ocean," compiled by the late Dr. Meldrum, whose work we have already referred to in connection with the supposed relationship between these phenomena and sun-spot periodicity; 109 cyclones for the period 1856—1867 were examined, and found to present several remarkable series. The longest succession of cyclones following each other at the required intervals, is the following: 1865—December 8th; 1866—Jan. 6th, February 2nd, March 3rd, March 30th. Mr. Maunder remarks that, if we suppose the actual commencements of the storms of January 6th and March 3rd had really been a little before the midnights of January 5th and March 2nd respectively, but were not recorded until after those midnights, an error which might be due to the scattered positions of shipping in the Indian Ocean, or to a failure to allow for difference of longitude, the sequence would be absolutely regular. Even so the probability that there is an accidental relation is exceedingly small, for no other cyclones were catalogued at Mauritius during the half-year, October, 1865, to March, 1866, the cyclone season in Mauritius being limited to the eight months October to May. Another somewhat less striking sequence occurred in 1862:—January 2nd, January 28th, February 23rd, March 23rd. There were, however, several other cyclones during the same period; and, indeed, a third sequence ran its course during the same period, viz.:—1861—December 26th; 1862—January 23rd, February 21st.

Since the Moon's sidereal period (27·3 days) has nearly the same length as the Sun's synodic rotation, a single sequence might conceivably be as well connected with the former as the latter; but the influence due to the Moon must be strictly periodic in character, whilst an influence depending on the Sun's synodic rotation cannot be so in the main. It is only when we have irregularity, when there are certain regions where action is greater or less than that of the general surface, and this is long continued, that the rotation period can be brought out. During the last 50 years, much labour has been devoted to analysing meteorological and magnetic observations, with a view to finding a period in them corresponding to that of the Sun's rotation, notwithstanding the well-known fact that out of 6,000 groups of sun-spots observed at Greenwich during 33 years, only 468 were seen at a second rotation, and *one* only survived to be seen in a sixth apparition, they being such transitory phenomena. If, however, we search for an *interval*, not for a *period*, we get more satisfactory results, and out of a total of 135 cyclones (including "Bengal"), no less than 93 fall into sequences of cyclones arranged according to "day of rotation."

Usually the sequences have been limited to intervals of not more than 3 rotation periods, but sometimes, as in the first case given (1865-6), we have 5 cyclones following at this interval. A cyclone does not always recur at the end of a single rotation, the tendency is, perhaps, rather for the recurrence to take place at the end of two or three rotations. Since the cyclone season is limited at Mauritius, it is evident that in many cases no return could be expected. There were 82 possible cases of the return of a cyclone at the end of one rotation, and 15 returns were registered; 69 possible cases at the end of two rotations, and 31 occurred; 50 possible cases at the end of three, of which 30 happened.

In addition, the cyclones registered for the Bay of Bengal, during the quiet season for Mauritius, supplement the Mauritius sequences in quite a number of cases, and this is the more remarkable, since the area of the Bay of Bengal is so much more restricted, and the cyclones recorded there are much fewer in number. With regard to the possible cause of these recurrences, whether due to a "stream line" from the Sun striking the Earth or otherwise, it does not follow that there is any connection between cyclones and sun-spots, nor can it be expected that the meteorology of the whole Earth should respond in the same way that its magnetism does to solar activity. The hemisphere in darkness may be expected to escape wholly or partially whatever action the "stream line" may produce. For this reason, seeing that the mean synodic period, after which the Sun and Earth are relatively in the same presentment as at first, is $27\frac{1}{3}$ days, a region presented to the Sun on the first occasion would probably be turned away from it either on the second or third occasion, or perhaps on both. We find in the first sequence noted (1856-7): Cyclones, 1856—November; 1857—January 28th, March 23rd, an interval of three rotations separates the first and second, and two the second and third. The longest sequence of all, however (1865-6), shows the cyclones following at intervals of a single rotation. A full confirmation of the case would be afforded if the intervals in the sequences could be filled up by cyclones occurring in the Pacific or Atlantic Oceans, but so far the comparison has not been made.

REVIEWS.

Quelques Recherches sur les Centres d'Action de l'Atmosphère par H. HILDEBRAND HILDEBRANDSSON. III.—IV. Sur la compensation entre les types des saisons simultanés en différentes régions de la Terre. [Some Researches on the Centres of Action of the Atmosphere. III. & IV. On the compensation between the types of seasons occurring simultaneously in different parts of the Earth.] Reprinted from the Transactions of the Royal Swedish Academy of Science. Vol. 45. Nos. 2 and 11, 1909 and 1910. Size $12\frac{1}{2} \times 10$. Pp. 12 and 22. Plates.

IN these important papers Professor Hildebrandsson pursues his researches into the relation of the meteorological conditions in distant places at the same time. In his previous memoirs he showed that there was a sort of compensation between certain regions which he named centres of action, in such a way for example that the variations of barometric pressure and rainfall at the Azores and Iceland are almost always in opposite directions, especially in winter, the same being true of Siberia and Alaska, and of Tahiti and Tierra del Fuego, while on the other hand there is a marked agreement between the variations of pressure at the Azores and in Siberia in winter.

The analogies and contrasts have been studied farther by Sir John Eliot, Dr. Gilbert Walker and Sir Norman Lockyer. The work of the last named authority shows that the relation between Bombay and Cordoba is not always uniform, and in some cases the differences of mean annual pressure are represented by +(?) or —(?) over considerable areas. These discrepancies Professor Hildebrandsson traces to the differences between the two regions being in opposite directions at different seasons. The work of Professor Pettersson, of Stockholm, and Professor Meinardus, of Berlin, points to the temperature of the water of the North Atlantic as an important influence in modifying the temperature of the air in north-western Europe, and Professor Hildebrandsson considers it probable that we must attribute the principal cause of the different types of European seasons to the condition of the ice in the polar seas The slight variability of climate in the tropics lends support to this view.

Memoir No. III. contains tables and curves showing the relations between various places, and we think it right to occupy a considerable amount of space in quoting the general result of each set of comparisons. The temperature, pressure and rainfall curves referred to are those for particular seasons in successive years of a long series.

1. The temperature curve at the North Cape for summer is opposite to that for the following spring at Grimsey in Iceland.

2. The curve of spring air temperature at Godthaab in Greenland is similar to that at Grimsey for March of the previous year.

3. The temperature curve of the air at Upernivik, Greenland, for winter is the inverse of that at St. John's, Newfoundland, for the following July.

4. A chilled sea-surface leads to lower air temperature and higher pressure; and the variation of pressure in spring at Thorshavn (Faröes) is the opposite of that of the simultaneous temperature at Debreczin in Hungary. At the same time the curve of temperature at Barnaul in Siberia is the inverse of that at Upsala in Sweden.

5. For autumn the same opposition is remarked between the temperature curves at Barnaul and Thorshavn.

6. For the winter half-year (October to March) the curves of rainfall at Thorshavn and Barnaul are opposed; but those at Thorshavn and Zi-ka-wei, in the east of China, are almost identical.

7. For the winter half-year the rainfall curves at Thorshavn and the mean of Vienna and Trieste are opposed.

8. For the middle of winter, however (January and February) the temperature curves at Thorshavn and for the centre of northern Asia, Barnaul and Yeneseisk, are rather in accord than in opposition.

9. The winter rain curve at Java is almost identical with the barometer curve for the following summer at Bombay.

10. On the other hand, there is an opposition in the rainfall curve for summer at Barnaul and Yeneseisk on the one side and Mauritius on the other.

11. In the winter half-year there is an opposite tendency in the barometer curves at St. Helena and at Ponta Delgada in the Azores.

Memoir No. IV. goes more fully into the question, and shows :—

1. For January—February the temperature over the sea between Iceland and Norway is almost always in accord with that of the whole of the north of Europe between the North Cape and Hamburg.

2. On the contrary, the temperature curves at Thorshavn and Berufjord are opposed to those at San Fernando, Lisbon and Algiers.

3. In a middle zone the temperature of winter is sometimes in accordance with the north European and sometimes with the south European system.

4. The observations at Stykkisholm in Iceland are not representative of the typical Icelandic centre of action, but rather of the intermediate zone between that and the south European centre.

5. In North America the same opposition between the curves of atmospheric conditions between north and south is apparent. The whole northern region between California and British Columbia on the west, and Greenland and Newfoundland on the east, has in general a curve of winter temperature opposite to that of the southern region extending from Mexico on the west to Bermuda on the east, and from Toronto on the north to Key West on the south.

6. Comparing European and American curves we see that if the winter is cold in the north of Europe it is mild in the south of Europe and in the north of America, but severe in the United States east of the Rocky Mountains and in Mexico; and *vice versa*.

7. There must be an intermediate zone between the two centres of action in North America as in Europe, and Winnipeg undoubtedly belongs to this zone in winter.

8. For winter the same opposition occurs in rainfall curves as in temperature curves between the United States and southern Europe.

9. Exceptions to the foregoing relations may arise from the fact that rain in summer or in hot climates lowers the temperature of the air, whereas rain in winter or in cold climates raises the temperature.

10. In summer the high pressure of the Azores centre of action is more influential in Europe than the low pressure of the Iceland centre of action, still, the western coasts of north-western Europe are under the direct influence of the sea, and their temperature curves are in accord with those of Thorshavn.

11. The direct influence of the sea diminishes as one goes inland, and in fact the summer temperature of the whole Baltic region and the north of Germany depends on the general cooling of the previous winter, *i.e.*, on the temperature of the preceding winter between Norway and Iceland.

12. In the south of Europe the summer temperature curves are in opposition with those of the Baltic region, *i.e.*, of the preceding winter at Thorshavn.

13. There is in summer an intermediate zone extending from Greenwich, across central Europe to Vienna and Debreczin in Hungary.

14. The same opposition exists between the temperature of the northern and southern parts of North America in summer as in winter.

15. In summer the temperature curve in southern Siberia is the inverse of that in the neighbourhood of Iceland for the preceding winter, and thus also the inverse of the temperature curve of northern Europe. Thus in summer there is opposition between the north of Europe on the one side and southern Europe and Siberia on the other.

The attempt to enquire into similar relationships in the Southern Hemisphere is hampered by the absence of trustworthy records of sufficient duration; but a comparison of the observations at Punta Arenas in Magellan Strait with those at Cordoba and Santiago seems to show that the same opposition in the form of the seasonal temperature curve seems to prevail between the temperate and the sub-tropical zones in South America. The attempt to find a relationship between the temperature and the rainfall of North and South America has not been successful. There are, however, resemblances between the winter half-year's rainfall for Java and the following summer half year's rainfall at Santiago de Chile; and also a resemblance between the pressure curves for the summer half-year in South America, those for Southern Australia for the preceding winter half-year, and for Cape Town for the winter months of the preceding year. The impression suggested is that these phenomena are propagated like a wave from the Cape of Good Hope to Australia and thence with accelerated speed to South America.

Professor Hildebrandsson points out that the marked opposition between the rainfall at Stykkisholm and Brussels for the 21 years, 1857-1878, which diminished later and disappeared about 1900, as Professor Hann observed, is due to the fact that neither station is in a typical centre of action, but each in a transitional zone. The whole research is of profound interest, not only because of its importance in the theory of meteorology, but because it opens up prospects of the possibility of long-range weather forecasts on a satisfactory basis. It is a striking reply to the criticism of some mathematical physicists that new observations are not wanted so much as discussions of existing observations. The fact is that long homogeneous series of observations are the most valuable and the rarest of all scientific data, and any criticism which disheartens an observer and causes him to break a conscientious record of many years' standing, perhaps carried on by several generations, is a harm no mathematician can heal.

Weather Instruments and how to use them. By D. W. HORNER. London, Witherby & Co., 1910. Size $7\frac{1}{2} \times 5$. Pp. 48. Price 6d.

A SIMPLE outline of the requirements for elementary meteorological observations, designed to meet the needs of the amateur who is taking them up as a hobby without previous knowledge. Mr. Horner very wisely enforces the desirability of proceeding along the lines which have met with official sanction, thereby securing the uniformity which is essential in all climatological work, but he recommends deviations from these in one or two instances with which we cannot agree. We cannot join him in approving Six's thermometer as a scientific instrument, and we consider that the author was rarely fortunate to have used one of these for fifteen years without any mishap.

Mr. Horner's little book should help in popularizing the habit of making meteorological observations, of which those concerning rainfall are the simplest and most useful, and we hope that it will induce many to proceed further with this fascinating study.

Oxford Wall Maps. Mean Annual Rainfall of the British Isles. By DR. H. R. MILL. Scale 1 : 1,000,000 (about 16 miles to an inch). Oxford, Clarendon Press, 1910. Size 59 × 39. Price 7s. 6d.

THIS map is one of a series of wall maps designed by Professor Herbertson to exhibit the physical conditions of the British Isles. It is an advance on the Average Rainfall map, published in the Minutes of Proceedings of the Institution of Civil Engineers in 1904, but refers to the average of the same period, 1870—1899.

RAINFALL TABLE FOR DECEMBER, 1910.

STATION.	COUNTY.	Lat. N.* ° ′	Long. W. [*E.] ° ′	Height above Sea. ft.	RAINFALL OF MONTH Aver. 1875—1909. in.	RAINFALL OF MONTH 1910. in.
Camden Square	*London*	51 32	0 8	111	2·13	3·29
Tenterden	*Kent*	51 4	*0 41	190	2·77	4·39
Steyning	*Sussex*	50 53	0 20	80	3·45	3·81
Southampton (Cadland)	*Hampshire*	50 50	1 22	52	3·23	5·08
Hitchin	*Hertfordshire*	51 57	0 17	238	2·11	4·47
Oxford (Magdalen College)	*Oxfordshire*	51 45	1 15	186	2·06	4·16
Bury St. Edmunds (Westley)	*Suffolk*	52 15	*0 40	226	2·14	4·35
Geldeston [Beccles]	*Norfolk*	52 27	*1 31	38	2·07	4·02
Polapit Tamar [Launceston]	*Devon*	50 40	4 22	315	4·46	7·46
Rousdon [Lyme Regis]	,,	50 41	3 0	516	3·68	6·21
Stroud (Upfield)	*Gloucestershire*	51 44	2 13	226	2·71	5·07
Church Stretton (Wolstaston)	*Shropshire*	52 35	2 48	800	2·99	6·95
Coventry (Kingswood)	*Warwickshire*	52 24	1 30	340	2·66	4·21
Market Overton	*Rutland*	52 44	0 41	475	2·41	6·89
Boston	*Lincolnshire*	52 58	0 1	25	1·88	4·22
Worksop (Hodsock Priory)	*Nottinghamshire*	53 22	1 5	56	2·17	3·53
Macclesfield	*Cheshire*	53 15	2 7	501	3·35	2·87
Southport (Hesketh Park)	*Lancashire*	53 38	2 59	38	3·10	2·81
Wetherby (Ribston Hall)	*Yorkshire, W.R.*	53 59	1 24	130	2·27	2·90
Arncliffe Vicarage	,, ,,	54 8	2 6	732	6·75	7·95
Hull (Pearson Park)	,, *E.R.*	53 45	0 20	6	2·32	2·89
Newcastle (Town Moor)	*Northumberland*	54 59	1 38	201	2·46	2·04
Borrowdale (Seathwaite)	*Cumberland*	54 30	3 10	423	15·14	21·41
Cardiff (Ely)	*Glamorgan*	51 29	3 13	53	4·70	6·10
Haverfordwest	*Pembroke*	51 48	4 58	95	5·18	7·11
Aberystwyth (Gogerddan)	*Cardigan*	52 26	4 1	83	4·66	5·73
Llandudno	*Carnarvon*	53 20	3 50	72	2·84	4·24
Cargen [Dumfries]	*Kirkcudbright*	55 2	3 37	80	4·84	6·95
Marchmont House	*Berwick*	55 44	2 24	498	2·83	2·04
Girvan (Pinmore)	*Ayr*	55 10	4 49	207	5·48	6·79
Glasgow (Queen's Park)	*Renfrew*	55 53	4 18	144	3·95	3·52
Inveraray (Newtown)	*Argyll*	56 14	5 4	17	8·57	8·70
Mull (Quinish)	,,	56 34	6 13	35	6·59	5·03
Dundee (Eastern Necropolis)	*Forfar*	56 28	2 57	199	2·67	2·70
Braemar	*Aberdeen*	57 0	3 24	1114	3·13	4·80
Aberdeen (Cranford)	,,	57 8	2 7	120	3·43	3·44
Cawdor	*Nairn*	57 31	3 57	250	2·53	1·85
Fort Augustus (S. Benedict's)	*E. Inverness*	57 9	4 41	68	5·62	3·96
Loch Torridon (Bendamph)	*W. Ross*	57 32	5 32	20	9·70	7·97
Dunrobin Castle	*Sutherland*	57 59	3 56	14	3·09	3·46
Wick	*Caithness*	58 26	3 6	77	3·11	3·42
Killarney (District Asylum)	*Kerry*	52 4	9 31	178	6·92	5·11
Waterford (Brook Lodge)	*Waterford*	52 15	7 7	104	4·32	4·08
Nenagh (Castle Lough)	*Tipperary*	52 54	8 24	120	4·34	3·49
Miltown Malbay	*Clare*	52 52	9 26	400	4·84	4·72
Gorey (Courtown House)	*Wexford*	52 40	6 13	80	3·42	6·21
Abbey Leix (Blandsfort)	*Queen's County*	52 56	7 17	532	3·41	4·75
Dublin (FitzWilliam Square)	*Dublin*	53 21	6 14	54	2·27	5·57
Mullingar (Belvedere)	*Westmeath*	53 29	7 22	367	3·39	4·28
Ballinasloe	*Galway*	53 20	8 15	160	3·69	3·55
Crossmolina (Enniscoe)	*Mayo*	54 4	9 18	74	6·11	2·43
Collooney (Markree Obsy.)	*Sligo*	54 11	8 27	127	4·34	2·68
Seaforde	*Down*	54 19	5 50	180	3·77	5·69
Bushmills (Dundarave)	*Antrim*	55 12	6 30	162	3·87	3·43
Omagh (Edenfel)	*Tyrone*	54 36	7 18	280	3·91	3·56

RAINFALL TABLE FOR DECEMBER, 1910—*continued.*

RAINFALL OF MONTH (*con.*)					RAINFALL FROM JAN. 1.				Mean Annual 1875–1909. in.	STATION.
Diff. from Av. in.	% of Av.	Max. in 24 hours. in.	Max. in 24 hours. Date.	No. of Days	Aver. 1875—1909. in.	1910. in.	Diff. from Aver. in.	% of Av.		
+1·16	154	·52	1	20	25·11	25·36	+ ·25	101	25·11	Camden Square
+1·62	159	·76	12	22	27·64	31·04	+3·40	112	27·64	Tenterden
+ ·36	110	·77	15	18	33·58	39·89	+6·31	119	33·58	Steyning
+1·85	157	·61	14	21	31·87	33·73	+1·86	106	31·87	Cadland
+2·36	212	·63	14	23	25·16	27·74	+2·58	110	25·16	Hitchin
+2·10	202	·99	14	20	24·58	25·82	+1·24	105	24·58	Oxford
+2·21	203	1·12	1	21	25·40	29·02	+3·62	114	25·40	Westley
+1·95	194	1·19	1	27	23·73	30·44	+6·71	128	23·73	Geldeston
+3·00	167	1·18	12	29	38·27	49·05	+10·78	128	38·27	Polapit Tamar
+2·53	168	·86	8	23	33·54	37·76	+4·22	113	33·54	Rousdon
+2·36	187	·80	15	27	29·81	34·94	+5·13	117	29·81	Stroud
+3·96	233	1·42	1	25	32·41	36·69	+4·28	113	32·41	Wolstaston
+1·55	158	·73	15	25	28·98	29·89	+ ·91	103	28·98	Coventry
+4·48	286	2·28	1	28	27·10	32·25	+5·15	119	27·10	Market Overton
+2·34	225	1·23	1	23	23·35	26·23	+2·88	112	23·35	Boston
+1·36	163	·92	1	22	24·46	24·87	+ ·41	102	24·46	Hodsock Priory
— ·48	86	·39	15	24	34·73	37·89	+3·16	109	34·73	Macclesfield
— ·29	91	·35	15	27	32·70	35·04	+2·34	107	32·70	Southport
+ ·63	128	·60	3	24	26·87	30·82	+3·95	115	26·87	Ribston Hall
+1·20	118	1·91	23	26	61·49	69·33	+7·84	113	61·49	Arncliffe
+ ·57	125	·48	1	21	26·42	25·63	— ·79	97	26·42	Hull
— ·42	83	·43	3	22	27·94	27·38	— ·56	98	27·94	Newcastle
+6·27	142	3·05	9	28	129·48	134·24	+4·76	104	129·48	Seathwaite
+1·40	130	1·01	23	25	42·28	50·56	+8·28	120	42·28	Cardiff
+1·93	137	1·30	8	24	46·81	45·67	—1·14	98	46·81	Haverfordwest
+1·07	123	·79	16	28	45·46	54·51	+9·05	120	45·46	Gogerddan
+1·40	149	·86	16	26	30·36	36·68	+6·32	121	30·36	Llandudno
+2·11	144	1·18	16	22	43·47	56·21	+12·74	130	43·47	Cargen
— ·79	72	·42	16	22	33·76	28·86	—4·90	85	33·76	Marchmont
+1·31	124	·88	13	29	49·77	54·60	+4·83	110	49·77	Girvan
— ·43	89	·50	6	24	35·97	38·53	+2·56	107	35·97	Glasgow
+ ·13	102	1·24	23	30	68·67	68·21	— ·46	99	68·67	Inveraray
—1·56	76	·51	21	28	56·57	52·21	- 4·36	92	56·57	Quinish
+ ·03	101	·46	4	19	28·64	28·70	+ ·06	100	28·64	Dundee
+1·67	153	...	...	...	34·93	40·57	+5·64	116	34·93	Braemar
+ ·01	100	·43	9	25	32·73	31·58	—1·15	96	32·73	Aberdeen
— ·68	73	·27	24	11	29·33	31·45	+2·12	107	29·33	Cawdor
—1·66	70	·72	21	25	44·53	42·22	—2·31	95	44·53	Fort Augustus
—1·73	82	1·27	20	20	83·61	83·02	— ·59	99	83·61	Bendamph
+ ·37	112	·56	31	20	31·90	33·46	+1·56	105	31·90	Dunrobin Castle
+ ·31	110	·50	31	28	29·88	32·41	+2·53	109	29·88	Wick
—1·81	74	·82	16	29	54·81	58·85	+4·04	107	54·81	Killarney
— ·24	94	1·16	15	21	39·57	39·60	+ ·03	100	39·57	Waterford
— ·85	80	1·05	15	26	39·43	40·98	+1·55	104	39·43	Castle Lough
— ·12	98	1·47	15	29	45·11	44·73	— ·38	99	45·11	Miltown Malbay
+2·79	182	·97	15	22	34·99	39·63	+4·64	113	34·99	Courtown Ho.
+1·34	139	·93	15	26	35·92	42·97	+7·05	120	35·92	Abbey Leix
+3·30	245	·77	1	25	27·68	35·44	+7·76	128	27·68	Dublin
+ ·89	126	·95	15	22	36·15	41·19	+5·04	114	36·15	Mullingar
— ·14	96	1·03	15	28	36·64	36·05	— ·59	98	36·64	Ballinasloe
—3·68	40	·40	16	25	52·87	52·01	— ·86	98	52·87	Enniscoe
—1·66	62	·46	15	27	42·71	53·38	+10·67	125	42·71	Markree
+1·92	151	·90	9	27	38·91	38·62	— ·29	99	38·91	Seaforde
— ·44	89	·46	16	28	37·56	41·13	+3·57	109	37·56	Dundarave
— ·35	91	·65	15	25	39·38	43·74	+4·36	111	39·38	Omagh

SUPPLEMENTARY RAINFALL, DECEMBER, 1910.

Div.	STATION.	Rain inches	Div.	STATION.	Rain inches
II.	Warlingham, Redvers Road	4·79	XI.	Llangyhanfal, Plâs Draw....	6·66
,,	Ramsgate	3·38	,,	Dolgelly, Bryntirion	11·54
,,	Hailsham	3·77	,,	Bettws-y-Coed, Tyn-y-bryn	7·41
,,	Totland Bay, Aston House.	4·21	,,	Lligwy	4·48
,,	Stockbridge, Ashley	5·28	,,	Douglas.........................	...
,,	Grayshott........................	7·18	XII.	Stoneykirk, Ardwell House	5·88
,,	Reading, Calcot Place.......	4·29	,,	Dalry, The Old Garroch ...	10·36
III.	Harrow Weald, Hill House.	3·82	,,	Langholm, Drove Road......	6·14
,,	Pitsford, Sedgebrook.........	5·91	,,	Moniaive, Maxwelton House	7·12
,,	Huntingdon, Brampton......	5·70	XIII.	StMary'sLoch,CramiltLdge	5·56
,,	Woburn, Milton Bryant.....	4·82	,,	Edinburgh, Royal Observty.	·99
,,	Wisbech, Monica Road......	4·01	XIV.	Maybole, Knockdon Farm..	3·66
IV.	Southend Water Works.....	2·89	XV.	Campbeltown, Witchburn...	6·08
,,	Colchester, Lexden...........	3·05	,,	Glenreasdell Mains...........	4·95
,,	Newport	3·56	,,	Ballachulish House...........	8·65
,,	Rendlesham.....................	4·86	,,	Islay, Eallabus	5·18
,,	Swaffham	3·94	XVI.	Dollar Academy	2·11
,,	Blakeney	3·20	,,	Balquhidder, Stronvar	9·20
V.	Bishops Cannings	4·97	,,	Coupar Angus	3·65
,,	Winterbourne Steepleton ...	7·86	,,	Blair Atholl....................	4·24
,,	Ashburton, Druid House ...	12·77	,,	Montrose,SunnysideAsylum	2·99
,,	Honiton, Combe Raleigh ...	8·32	XVII.	Alford, Lynturk Manse ...	5·09
,,	Okehampton, Oaklands......	8·82	,,	Keith Station	3·72
,,	Hartland Abbey	5·51	XVIII.	Glenquoich, Laon	...
,,	Lynmouth, Rock House ...	7·06	,,	Skye, Dunvegan..............	6·67
,,	Probus, Lamellyn	8·19	,,	N. Uist, Lochmaddy.........	4·84
,,	North Cadbury Rectory ..	6·59	,,	Alvey Manse	1·70
VI.	Clifton, Pembroke Road ...	5·77	,,	Loch Ness, Drumnadrochit.	2·50
,,	Ross, The Graig	5·79	,,	Glencarron Lodge	9·60
,,	Shifnal, Hatton Grange......	4·78	,,	Fearn, Lower Pitkerrie......	1·58
,,	Blockley, Upton Wold	5·19	XIX.	Invershin	3·46
,,	Worcester, Boughton Park.	4·24	,,	Altnaharra	...
VII.	Market Rasen	3·52	,,	Bettyhill	3·52
,,	Bawtry, Hesley Hall.........	3·27	XX.	Dunmanway, The Rectory..	6·48
,,	Derby, Midland Railway ...	4·82	,,	Cork	4·62
,,	Buxton..........................	6·92	,,	Mitchelstown Castle	4·70
VIII.	Nantwich, Dorfold Hall......	3·72	,,	Darrynane Abbey	6·05
,,	Liscard	3·49	,,	Glenam [Clonmel]	4·30
,,	Chatburn, Middlewood	4·67	,,	Nenagh, Traverston	5·13
,,	Cartmel, Flookburgh	4·32	,,	Newmarket-on-Fergus,Fenloe	3·20
IX.	LangsettMoor, Up. Midhope	6·51	XXI.	Laragh, Glendalough	14·56
,,	Scarborough, Scalby	3·08	,,	Moynalty, Westland	4·10
,,	Ingleby Greenhow	3·49	,,	Athlone, Twyford	3·40
,,	Mickleton........................	2·56	XXII.	Woodlawn	2·60
X.	Bardon Mill, Beltingham ...	2·11	,,	Westport, St. Helens	3·48
,,	Ilderton, Lilburn Cottage...	2·19	,,	Achill Island, Dugort	4·12
,,	Keswick, The Bank	7·99	,,	Mohill	3·21
XI.	Llanfrechfa Grange...........	6·36	XXIII.	Enniskillen, Portora	2·73
,,	Treherbert, Tyn-y-waun ...	14·65	,,	Dartrey [Cootehill]...........	4·03
,,	Carmarthen, The Friary.....	7·23	,,	Warrenpoint, Manor House	5·41
,,	Castle Malgwyn [Llechryd].	7·92	,,	Banbridge, Milltown	3·53
,,	Plynlimon........................	5·50?	,,	Belfast, Springfield	5·09
,,	Crickhowell, Ffordlas.........	5·00	,,	Glenarm Castle....	6·38
,,	New Radnor, Ednol	11·49	,,	Londonderry, Creggan. Res.	3·31
,,	Rhayader, Tyrmynydd	12·39	,,	Killybegs	5·48
,,	Lake Vyrnwy	8·40	,,	Horn Head	2·62

METEOROLOGICAL NOTES ON DECEMBER, 1910.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Temp. for Temperature; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow; F for number of days Frost in Screen; f on Grass.

LONDON, CAMDEN SQUARE.—The extreme cold of November was followed by a singularly mild December, temp. remaining high throughout. On one day only, the 27th, did it fail to reach 40°, and on 18 days the shade max. exceeded 50°. The persistency of the R was also remarkable, the duration amounting to 81·4 hours, the greatest recorded in December in the past 31 years. The duration of sunshine was 13·1* hours, of which more than half occurred on two days, the 18th and 25th. Mean temp. 44°·5, or 4°·9 above the average, and excepting 1868, 1898 and 1900 the highest for December in 53 years' record. Shade max. 54°·6 on 16th; min. 26°·8 on 28th. F 3, f 8.

TENTERDEN.—Duration of sunshine, 41·6† hours. Shade max. 54°·0 on 5th; min. 28°·0 on 28th and 31st. F 5, f 11.

TOTLAND BAY.—The wettest December during the past 25 years, and the warmest since 1900. Great destruction along the coast line by high seas on 16th. Duration of sunshine 53·4* hours. Shade max. 54°·0 on 16th; min. 29°·7 on 28th, F 2, f 2.

PITSFORD.—R 3·79 in. above the average. Mean temp. 41°·7. Shade max. 52°·3 on 15th; min. 25°·6 on 28th. F 5.

NORTH CADBURY.—The wettest month in the record. Much the warmest December since 1900, and very much warmer than November. Shade max. 54°·0 on 16th; min. 25°·0 on 28th. F 2, f 7.

HODSOCK PRIORY.—Very mild, with no S or winter weather, but with an excess of R during the first half. Shade max. 54°·8 on 23rd; min. 26°·3 on 28th. F 6, f 17.

SOUTHPORT.—Mean temp. 44°·0, or 4°·7 above the average and 5°·1 higher than for November, a circumstance unapproached since 1868. Mean daily range of temp. only 6°·0, or less than in any month in 40 years' record. Duration of sunshine 39·2* hours, and of R 70·0 hours. Shade max. 52°·6 on 5th; min. 28°·2 on 28th. F 1, f 8.

HULL.—Excepting from 26th to 28th the weather was mild generally, but few fine periods were experienced, being usually dull and gloomy, with frequent R. Shade max. 57°·0 on 24th; min. 28°·0 on 28th. F 6, f 10.

HAVERFORDWEST.—Great damage done by heavy gale on 16th, when the wind reached a force of 70 miles per hour. Duration of sunshine, 32·7* hours. Shade max. 53°·9 on 16th.

LLANDUDNO.—Shade max. 56°·5 on 9th; min. 30°·2 on 28th. F 1.

CARGEN.—Mean temp. 4°·0 above the average of 50 years, and 6°·5 above the mean for November. Shade max. 52°·0 on 23rd; min. 23°·0 on 28th. F 3.

EDINBURGH.—Shade max. 52°·7 on 23rd; min. 28°·9 on 28th. F 2, f 6.

COUPAR ANGUS.—Persistently wet, but without heavy falls. Shade max. 54°·5 on 23rd; min. 21°·5 on 1st.

FORT AUGUSTUS.—Shade max. 52°·0 on 23rd; min. 23°·0 on 28th. F 7.

CORK.—Shade max. 50°·0 on 12th; min. 28°·0 on 1st and 28th. F 4, f 8.

DUBLIN.—A mild, wet month. R fell daily to 16th, but the second half was finer though continuing mild. Mean temp. 44°·5, or 3°·7 above that for November. Shade max. 55°·4 on 23rd; min. 30°·2 on 28th. F 1, f 3.

MARKREE.—Shade max. 53°·2 on 23rd; min. 23°·5 on 1st. F 5, f 5.

WARRENPOINT.—Shade max. 53°·0 on 23rd; min. 33°·0 on 27th. F 0, f 2.

---

* Campbell-Stokes. † Jordan.

Climatological Table for the British Empire, July, 1910.

STATIONS. (Those in *italics* are South of the Equator.)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain Depth.	Total Rain Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	79·2	28	47·3	19	68·5	53·1	53·5	82	124·8	42·2	2·53	17	8·6
Malta	92·7	20	63·9	7	81·8	69·9	67·7	79	154·4	...	·00	0	1·1
Lagos	...	...	...	...	...	...	...	...	...	...	...	...	...
Cape Town	79·2	2	40·9	14	63·9	50·4	50·9	82	...	...	4·30	19	3·2
Durban, Natal ...	82·8	19	49·0	12	73·7	54·3	...	...	132·5	...	·39	5	2·7
Johannesburg	69·8	23	28·1	9	61·2	40·8	35·3	64	119·7	26·8	·00	0	1·1
Mauritius	78·0	22	54·9	12	75·1	62·8	60·1	76	142·2	47·7	4·01	22	5·8
Calcutta...	94·8	13	74·8	26†	89·8	78·5	77·5	84	...	73·5	11·14	14	8·3
Bombay...	89·1	21	76·4	6	85·6	78·8	76·0	82	133·1	73·8	7·42	22	7·5
Madras	102·4	6	73·9	28	94·0	78·1	73·4	74	142·5	72·4	8·08	14	5·7
Kodaikanal	68·2	13	48·1	11	62·2	52·2	52·4	88	136·3	41·8	10·94	28	7·8
Colombo, Ceylon ...	87·6	14*	72·2	23	85·3	76·1	73·7	80	158·1	67·8?	2·77	12	7·0
Hongkong	90·7	17	74·6	1	87·0	78·8	75·8	81	142·8	...	13·91	13	5·8
Melbourne	60·9	12	31·8	18	54·9	42·7	42·4	79	102·5	29·7	2·47	20	7·3
Adelaide	65·1	12	36·8	18	58·3	45·7	46·0	78	127·5	27·7	4·05	20	6·3
Coolgardie	64·2	25	32·0	27	56·8	40·6	41·0	74	133·0	29·0	1·69	20	6·0
Perth	65·9	8	41·1	15	60·3	48·1	47·9	79	114·9	33·2	10·59	26	5·5
Sydney	65·5	2	42·0	19	59·5	46·8	43·5	78	112·1	34·0	8·69	18	4·7
Wellington	58·8	16	36·0	25‡	51·8	42·3	37·4	69	95·0	27·0	2·76	18	8·0
Auckland	63·0	23	39·5	30	57·5	46·9	47·5	84	128·0	33·0	6·32	30	6·5
Jamaica, Kingston ...	92·3	27	70·7	11	89·7	72·3	68·7	70	...	...	1·49	5	4·4
Grenada	86·6	17‖	72·0	29	84·0	74·7	71·4	77	139·0	...	8·64	25	5·0
Toronto	93·3	9	51·5	29	82·4	59·8	...	...	110·2	43·7	3·90	11	3·9
Fredericton	89·0	11	43·9	5	77·7	54·6	...	75	...	...	4·70	12	6·0
St. John's, N.B. ...	76·5	26	49·7	5	67·5	55·0	...	...	...	...	3·88	11	...
Victoria, B.C.	86·7	10	45·3	27	71·4	51·2	...	65	...	...	·01	1	2·0
Dawson	86·5	29	38·0	25	73·5	47·9	...	...	...	...	·82	11	5·9

* and 16. † and 28. ‡ and 29. ‖ 19 and 31.

MALTA.—Mean temp. of air 75°·0. Average bright sunshine 11·8 hours.

Johannesburg.—Bright sunshine 298· hours.

Mauritius.—Mean temp. of air 0°·7, of dew point 0°·7, and R 1·77 in., above averages. Mean hourly velocity of wind 10·1 miles, or 1·9 below average.

KODAIKANAL.—Bright sunshine 111 hours.

COLOMBO.—Mean temp. of air 77°·5 or 3°·0 below, of dew point 0°·3 above, and R 1·79 in. below, averages. Mean hourly velocity of wind 6·4 miles.

HONGKONG.—Mean temp. of air 82°·3. Bright sunshine 261·9 hours or 60 hours above average, and R 1·13 in. above average. Mean hourly velocity of wind 10·9 miles.

Melbourne.—Mean temp. of air 0°·3 above, and R ·63 in. above, averages.

Adelaide.—Mean temp. of air 0°·5 above, and R 1·49 in. above, averages.

Perth.—Mean temp. of air slightly below, and R about 4·00 in. above, averages.

Sydney.—Mean temp. of air 0°·9 above, and R 4·08 in. above, averages.

Wellington.—Mean temp. of air 0°·6 below, and R 3·20 in. below averages. Bright sunshine 116·7 hours. Fogs on 10 days.

Auckland.—Rainfall 1·75 in. above 45 years' average.