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THE FROST AND SNOW OF NOVEMBER, 1904.

WINTER commenced with unusual suddenness and intensity in the beginning of the last week of November, when more snow fell in London at any rate than during the whole of the winter 1903-4. After three weeks of mild, gloomy and in places foggy weather, a week of wintry conditions set in over the whole country. Coincident with the passage of a cyclonic system over the British Isles in an easterly direction on the 21st, there was a spell of sharp frost, accompanied in most places by snow. In London the temperature began to fall decidedly on the 21st, and from that date frost occurred nightly at Camden Square until the 29th. The lowest air temperature recorded was $24^{\circ}\cdot 1$ in the screen on the morning of the 26th and the lowest radiation temperature $16^{\circ}\cdot 5$ on grass on the 27th, though a lower grass reading might have been obtained on the 23rd had the thermometer not been covered by snow. The maximum temperature was as low as $33^{\circ}\cdot 2$ on the 24th, on which day the mean temperature only reached $28^{\circ}\cdot 8$. A slight sprinkling of snow fell in London on the morning of the 22nd, and from 10 to 11.30 p.m. on the 23rd it snowed heavily, rather more than an inch falling, and this continued to lie on the ground melting very slowly till the 30th.

The frost was felt with much greater severity over large tracts of Great Britain than in London, and several instances of temperatures below 10° have been reported. In the following notes we take advantage of the observations published by the Meteorological Office as well as those reported by rainfall observers. The earliest notably low readings occurred at Wick and Nairn, which registered 15° and 12° respectively on the morning of the 22nd. On the 23rd minimum readings were reported of 6° at Bromsgrove and 13° at Derby; on the 24th, 6° again at Bromsgrove and Winslow, 11° at Ross, 12° at Boston and 13° at Nottingham; on the 25th, $6^{\circ}\cdot 9$ at Polapit Tamar, near Launceston, and 15° at Nottingham; and on the 26th, $7^{\circ}\cdot 3$ at Braemar. At Hodsock Priory, Worksop, a reading of $-1^{\circ}\cdot 9$ on grass was recorded on the 24th, and at Winslow $2^{\circ}\cdot 0$ on the same day. The frost seems to have been felt in its greatest severity over the English Midlands, where it is generally referred to as the most severe in November for at least twenty years; at Bassingham, in western Lincolnshire, it is said to have been unparalleled since the Crimean

winter of 1854. The temperatures quoted above, though believed to be taken by accurate instruments, cannot all be absolutely relied on, and we may here repeat the warning that so few amateur observers regard—namely, that a minimum thermometer without a Kew certificate is not worth reading or recording. In spite of the severity of the frost, skating and curling were only possible in a few localities owing to the short duration of the cold weather.

Snow commenced in the north of Scotland on the 19th and in a few places in the extreme north on the 18th. It became fairly general over Scotland, the greater part of Ireland and the north of England on the 20th, continuing on the 21st and 22nd and coming further south each day. With the exception of a strip along the south coast of England, where no snow fell, practically the whole of the kingdom had a heavy fall on the 23rd, and in the Highlands and Northumberland it fell again on the 24th and in a few instances on the 25th. The total depth varied from nothing in the south and south-east of England and not much more than an inch in the neighbourhood of London to as much as 18 inches in the Lake District, where drifts 10 feet deep were heaped up in some places. Considerably more than a foot fell over the Derbyshire uplands, sometimes drifting to 6 and 7 feet, while in the valleys the average depth was about 8 inches. Some 20,000 quarrymen and outdoor workers are said to have been thrown out of employment in the Peak District. Over the northern counties of England and the south of Scotland 8 or 9 inches seems to have been general, and 14 inches is reported at Beltingham, near Haltwhistle, 13 inches at Langholm and a foot at Castle Douglas.

Railway traffic was seriously disorganized, the drifts reaching 5 and 6 feet in depth, and trains had in some cases to be dug out. Several parishes in Scotland missed the usual postal delivery on the 22nd, and at many places the storm formed almost a blizzard on the night of the 21st, and so rapid was the fall that near Arbroath, from 9 to 18 inches fell in an hour or two. In consequence, many sheep were lost on the hills, and shepherds were obliged to search for them with the help of long poles. The heavy fall was mainly confined to the inland country, and on the coast from Anglesey to Lancaster the amount was trifling. At Bamburgh, some ten miles south of Berwick, the ground was never white for more than a few hours at a time. In the southern part of England, and in Wales, the heaviest falls took place over Snowdonia, the Radnor Hills, where 5 inches fell, and in the Cornish peninsula, where 3 inches fell on the west coast, a locality in which snow is a rare phenomenon. At Liskeard 7 inches was the depth, and at Tavistock 3 or 4 inches. About 3 inches also fell at Birmingham, and at Alcester drifts were several feet deep on the 22nd. Little snow fell in North Devon (except on Exmoor), Somerset, Wilts, Dorset, South Hampshire, and the greater part of Kent, and from 1 to 2 inches was general over the remainder of the country. The fall was fairly uniform over Ireland,

varying from some 2 inches in the south-west to very little at Westport.

We have made an attempt to represent the snowfall on a map, but have not received a sufficient number of definite statements as to the depth which fell, to make it worth publishing. If those of our readers who have not reported the depth of undrifted snow on the ground between November 19th and 24th will send in the information it may be possible to complete the map for publication in *British Rainfall, 1904*.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

THE SEVERE COLD IN NOVEMBER, 1904.

YESTERDAY (November 24th) was the coldest day in my memory or registers, the nearest approach to such severity in November being November 24th, 1858. This, though very severe also, did not equal 1904 by several degrees. Other low temperatures here occurred on November 30th and December 1st, 1896, and November 27th and 28th, 1890, as the following comparison will show. The instruments in Stevenson's screen were tested by Mr. Marriott this year, and on the other two occasions had been recently properly corrected, so that you may consider them as very closely accurate :—

	Max.	Min.	Mean.	Grass.	Wind.	Snow or Rain. in.	Weather.
Nov. 30, 1896	35·0	20·5	27·75	17·7	N.E. 1	·00	Cloudless, freezing all day.
Dec. 1, 1896	38·8	21·0	29·90	20·5	N.E. 1	·17	Cloudy, rain even.
Nov. 27, 1890	32·0	22·8	27·40	18·0	N.E.E. 1	·018	Cloudless, snow evening.
„ 28, 1890	30·7	25·1	27·90	21·0	N.N.E. 1	·078	Thickly overcast.
„ 24, 1904	30·0	11·1	20·55	Grass ther. covered snow.	N.W. 1	·108	Ground covered 2 inches snow.
„ 25, 1904	37·0?	13·9	?	?	...	...	Ditto, warmer midday.

I notice in *Meteorological Magazine*, 1890, page 161, that the lowest temperatures in November at Camden Square are given, but that then in a small district in Surrey lower temperatures were recorded than here at Ross in 1904, especially at Shirley and Addington.

This year the region of lowest readings would probably lie in a small area with Worcester as its approximate centre; but the only readings I have noticed are at Worcester and Leicester, apparently one degree each colder than Ross.

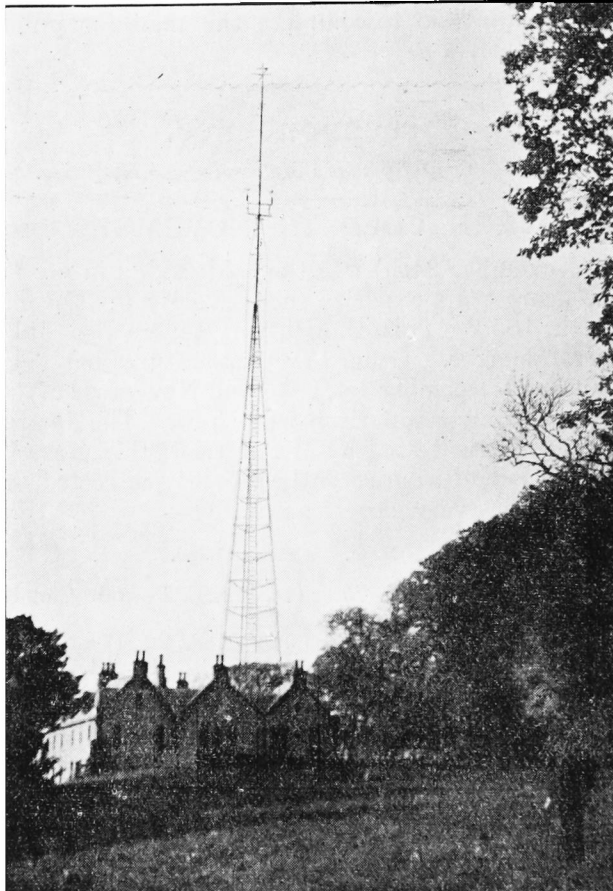
We had a heavy squall of rain passing rapidly over us about 3 to 4 p.m. on Tuesday, 22nd, and a fall of snow of about two inches Wednesday, 23rd, followed by the severe frost with fog on the 24th.

HENRY SOUTHALL.

The Graig, Ross, Herefordshire, Nov. 25th, 1904.

THE TALLEST ANEMOMETER POST.

ALONG with this I send you the photograph of a steel flagstaff I have erected at Riddell for my instruments, which might interest some of your readers if a photogravure was made of it for the Magazine.



STEEL FLAGSTAFF AT RIDDELL, LILLIESLEAF, N.B.

The flagstaff was exhibited at the last Glasgow Exhibition, and it seemed to me so suitable that I purchased and erected it at one corner of the bowling green in front of my house. It has been up a year now. It is most beautifully made, extremely graceful, and of the finest possible material. From the bowling green to the top is 130 ft., which, I am told, is the highest flagstaff in the United Kingdom. On the lower rail is the following inscription:—"In Memoriam. This flagstaff, a steel one, which was made in Canada

and exhibited at the Glasgow Exhibition of 1901, was purchased by Lieut.-General Sprot of Riddell, and erected by him on this site on the 22nd of August, 1903, to commemorate the Coronation of King Edward VII. on the 9th of August, 1902, and his coming to Edinburgh with his Queen and Court in May, 1903, and there holding a Levee at Holyrood."

Some 16 or 18 years ago I requested Messrs. Yeates & Son to make me two instruments—a weathercock (the history of which may be interesting) and an anemometer. These I placed on two long larch poles about 40 ft. high, 6 ft. apart, and for convenience coupled them together near the top by three bars, on which the men stood to erect the instruments and otherwise attend to them. Both these instruments are connected to dials on my business-room mantelpiece. The "Robinson" cups have a dial so arranged that when the electricity is at any time switched on, the velocity of the wind at the time is indicated on the dial, while the time is taken with the chronograph which is habitually carried by me.

It was in 1877 that I found myself as Assistant Adjutant and Assistant Quartermaster-General for Scotland quartered in Edinburgh, where, near the convent at Warrender Place, I bought a small house. All my life I have been taking notes in some way or another of rain and wind, and so forecasting for my own convenience by the aid of barometer, thermometer, &c., the probable weather. When I bought my new house it occurred to me I would like a weathercock (or vane) on the top, with a dial inside the house, and the first thing I thought of was a powerful vane turning a spindle going right down through the roof and turning the arrow on the dial by means of bevel wheels. But on second thoughts it seemed to me noisy and clumsy, so I worked out in my mind a weathercock so arranged with contact parts that by means of four electric wires the four points of the compass would be brought up on the dial.

Nowhere, however, could I find such a thing either in London or Edinburgh. At last the great Electric Exhibition took place in Paris, and the following year at Sydenham. Being by this time quartered at Kingston-on-Thames, in command of the South London Brigade, I hied me on my bike to the Crystal Palace one day with my sketches and specifications in my pocket, and at every likely stall made enquiry for what I was in search of; but as in Edinburgh and London, so there, no such thing I was assured had ever been heard of. Perhaps a year or so afterwards, at a show of some sort in the Agricultural Hall, I found an instrument approaching what I required, but not sufficiently perfect to be of any good, and the first successful one that ever came to my notice was erected in the entrance hall of the Constitutional Club. However, instead of four connections this was worked with eight points of the compass, and I rejected it because it seemed too complicated; and that it afterwards proved itself to be, for it soon got out of order, and though it has been repaired more than once, it is seldom or never

working properly. Ultimately I found just what I required depicted in one of Messrs. Yeates & Sons' illustrated catalogues. There are four letters, N., E., S. and W., and when a button is pressed up flies one or two of these letters ; if two fly up at a time, such as N. and W., that indicates north-west. So altogether I have eight points of the compass for my four wires and one return.

There is an ordinary weathercock with the four letters at the end of rods on the top of the flagstaff, which is now no longer used for flying a flag, and a little bit below the top is a pair of crosstrees on which the two before-named instruments are fixed, and it is arranged hereafter to erect two more wind instruments at the same level on crosstrees at right angles to those now up.

In addition to the above-named instruments I have on my mantel-piece a recording rain gauge which registers every hundredth ($\cdot 01$) of an inch of water that falls, so that at any minute on a dark winter's night it is easy to see what is going on outside, and this instrument has the further advantage that each time it records $\cdot 01$ in. it gives a loud "click," so that when I am sitting reading I not only am made aware that it is raining more or less heavily, but by paying attention for a short time can tell how fast it is raining without leaving my chair.

I trust that this letter will be of some interest to your readers.

J. SPROT (Lt.-General).

Riddell, Lilliesleaf.

THE CLOSING OF THE BEN NEVIS OBSERVATORIES.

As we intimated last month, the meteorological observatories on the summit of Ben Nevis, 4,400 feet above sea level, and at Fort William, practically at the level of the sea, were closed on October 1st, 1904. We look upon this as a misfortune, and can only avoid the old and unsatisfactory explanation that someone has blundered, by adopting the older and less satisfactory explanation that several people have blundered. The blunder has been made, and it has been intensified by some well-meaning, but ill-advised, writers and newspapers trying to make the cessation of the observatories a Scottish grievance. The Directors of Ben Nevis Observatory very properly repudiate any such suggestion. It was a splendid and public-spirited act on the part of the Scottish people to render so substantial and considerable a service to science as the founding and support of a high level observatory at the highest possible level ; but the fact that they did so does not make the observations of more value to Scotland than to England ; indeed, it would seem that they were of most value to Germany, for the German Weather Bureau alone appears to have utilised the daily results. We look upon the loss as a loss to science, and if any one set of conditions can be blamed for it we must blame the narrow views of the public of every section of the country, of Parliament and of the Govern-

ment in looking at scientific research in a local or a merely utilitarian light.

The harm has been done in the present instance: the records are broken beyond the power of "all the king's horses and all the king's men" to put together again, and there is time enough to think of starting afresh when we know how the recommendations of the Treasury Committee as to the Meteorological Office are to be treated by the Government. Meanwhile, we publish a full abstract of the last complete year's work of the abandoned observatories.

Report of the Committee of the British Association, consisting of LORD McLAREN, PROFESSOR A. CRUM BROWN (Secretary), SIR JOHN MURRAY, DR. ALEXANDER BUCHAN, and MR. R. T. OMOND. (Drawn up by DR. BUCHAN.)

The results of the observations made at the two Observatories during 1903 are detailed in the following Table.

1903	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	YEAR
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Mean Pressure in inches.

Ben Nevis Obs.	25.099	25.148	24.915	25.232	25.325	25.555	25.360	25.189	25.405	24.925	25.315	25.056	25.210
Fort William..	29.720	29.726	29.475	29.845	29.363	30.088	29.847	29.659	29.924	29.410	29.915	29.650	29.760
Differences..	4.621	4.578	4.560	4.613	4.538	4.533	4.487	4.470	4.519	4.485	4.600	4.594	4.550

Mean Temperatures.

Ben Nevis Obs.	22.7	27.3	24.6	24.5	33.4	38.7	39.3	37.6	37.3	31.7	28.3	24.2	30.8
Fort William..	38.5	43.2	41.5	42.7	49.7	55.9	55.1	53.9	53.6	47.8	43.5	38.5	46.8
Differences..	15.8	15.9	16.9	18.2	16.3	15.2	15.3	16.3	16.3	16.1	15.2	14.3	16.0

Extremes of Temperature: Maxima.

Ben Nevis Obs.	35.7	42.3	37.0	35.0	56.0	58.0	49.6	49.0	50.0	40.5	41.9	36.6	58.0
Fort William..	50.4	55.6	56.5	57.6	71.5	76.0	71.1	63.8	68.0	60.0	55.5	54.0	76.0
Differences..	14.7	13.3	19.5	22.6	15.5	18.0	21.5	14.8	18.0	19.5	13.6	17.4	18.0

Extremes of Temperature: Minima.

Ben Nevis Obs.	7.7	17.0	14.9	12.6	15.7	22.8	27.7	31.0	24.3	22.8	10.9	13.3	7.7
Fort William..	21.3	32.1	32.3	29.6	33.4	36.2	40.6	42.2	35.8	31.0	23.5	22.4	21.3
Differences..	13.6	15.1	17.4	17.0	17.7	13.4	12.9	11.2	11.5	8.2	12.6	9.1	13.6

Rainfall in inches.

Ben Nevis Obs.	33.45	36.24	37.95	8.36	6.61	6.44	13.26	20.97	10.72	18.66	17.27	6.81	216.74
Fort William..	16.12	17.04	17.25	3.81	4.49	2.97	6.60	11.95	7.15	13.05	7.85	5.61	113.89
Differences..	17.33	19.20	20.70	4.55	2.12	3.47	6.66	9.02	3.57	5.61	9.42	1.20	102.85

Number of Days 1 in. or more fell.

Ben Nevis Obs.	11	13	17	4	1	2	5	7	3	8	5	3	79
Fort William..	5	7	7	0	1	0	1	3	1	4	1	2	32
Differences..	6	6	10	4	0	2	4	4	2	4	4	1	47

Number of Days .01 in. or more fell.

Ben Nevis Obs.	22	27	28	22	19	18	23	29	18	29	22	23	280
Fort William..	21	26	31	13	16	12	21	27	21	29	22	20	259
Differences..	1	1	—3	9	3	6	2	2	—3	0	0	3	21

Mean Rainband (Scale 0—8).

Ben Nevis Obs.	1.4	2.4	2.0	2.0	2.3	3.6	2.7	2.6	2.5	3.3	2.5	1.5	2.4
Fort William..	3.6	4.8	3.9	3.1	3.8	4.7	4.7	4.7	4.0	4.5	4.0	3.4	4.1
Differences..	2.2	2.4	1.9	1.1	1.5	1.1	2.0	2.1	1.5	1.2	1.5	1.9	1.7

1903.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.	YEAR
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Number of Hours of Bright Sunshine.

Ben Nevis Obs.	16	5	11	40	79	137	76	23	67	16	21	18	509
Fort William..	22	10	39	120	135	178	141	91	126	26	21	15	934
Differences..	6	5	28	80	56	41	65	68	59	20	0	+3	425

Mean Hourly Velocity of Wind in Miles.

Ben Nevis Ob- servatory ...	22	17	17	11	11	9	11	12	20	18	9	19	15
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Percentage of Cloud.

Ben Nevis Obs.	88	98	95	80	82	74	86	95	80	96	89	83	87
Fort William..	73	88	85	74	73	68	75	83	66	89	80	77	78
Differences..	15	10	10	6	9	6	11	12	14	7	9	6	9

At Fort William the mean atmospheric pressure was 29·760 in., or ·098 in. below the average of thirteen years; whilst the mean at the top was 25·210 in., or ·090 in. below the average of twenty years. The mean difference for the two Observatories was 4·550 in., the mean monthly difference varying from 4·621 in. in January to 4·470 in. in August. At both places the mean for the year was considerably lower than any hitherto recorded, and only in June, September and November were the monthly means above their normals. The means for October were much lower than any yet recorded for that month, the deficiency at Fort William being as much as ·365 in. At the top the absolutely highest pressure for the year was 25·941 in. at 2 p.m. on May 26th, and the lowest 23·916 in. at 5 a.m. on February 27th. At Fort William the extremes were 30·572 in. at 10 a.m. on November 6th, and 28·326 in. at 6 a.m. on February 27th. The extreme range on Ben Nevis was, therefore, 2·025 in., and at Fort William 2·246 in.

The most remarkable features of the year as regards temperature were the low temperatures for April and the cold weather of the summer months. At both Observatories the April mean temperatures were the lowest recorded for that month since 1891, the shade minimum at Fort William registering frost from 12th to 18th, and on 22nd and 24th; whilst on Ben Nevis the minimum fell to 12°·6 on 17th, and the maximum rose above the freezing point on only 11 days of the month, the highest shade reading there being no higher than 35°·0, on the 6th and 9th. The absolutely highest temperature for the year at Fort William was 76°·0 on June 7th, and at the top 58°·0 on the same day; the lowest at Fort William being 21°·3 on January 13th, and at the top 7°·7 on January 10th.

In the next table are given the lowest observed hygrometric readings at the top of Ben Nevis (reduced by means of Glaisher's Tables):—

1903	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Dry Bulb	19·1	42·2	22·6	16·1	42·0	47·3	39·8	42·7	40·6	31·0	23·0	21·0
Wet Bulb	15·3	32·0	18·1	14·1	32·0	33·5	30·9	32·8	30·3	25·6	19·0	15·7
Dew-point.....	12·4	20·2	10·7	11·3	20·0	18·3	19·3	20·9	16·9	11·0	6·2	20·9
Elastic Force	·024	·109	·025	·041	·108	·099	·104	·112	·093	·071	·032	·016
Relative Humidity	23	41	21	46	40	30	42	41	37	41	26	14
Day of Month.....	8	9	3	18	29	5	8	1	16	18	18	29

Of these relative humidities, the lowest, 14 per cent., occurred on December 29th with a dew-point of $-20^{\circ}\cdot9$, that being the lowest dew-point for the year. From 9 a.m. on January 21st to noon on February 9th—that is for a period of 507 hours—the atmosphere was continuously in a saturated condition, the summit of the mountain being wreathed in fog or mist throughout the period, except for one short break of three hours. The next longest periods of continuous saturation were from April 3rd to 11th, from September 3rd to 10th, and from December 9th to 17th.

The rainfall for the year at the top was 216·74 in., or 55·97 in. above the average of 19 years; whilst the annual amount at Fort William was 113·89 in., or 35·31 in. above the average for the same period. At Fort William the year was the wettest hitherto recorded, but on Ben Nevis the amount was considerably below that for 1898, when the total was as much as 240·12 in. On Ben Nevis the totals for January, February, March and August were the largest hitherto recorded for these months, whilst the aggregate for the first three months was half the total for the year and considerably more than twice the average. At Fort William, also, about half the annual amount was registered during the first three months, whilst the aggregate for that period was more than twice the average. At the top of the mountain the greatest fall recorded on a single day was 4·78 in. on January 29th, the corresponding fall at Fort William being 1·78 in.; whilst the maximum daily amount at Fort William was 3·09 in. on January 25th, the fall at the top on that day being 3·03 in.

At the top of Ben Nevis the number of rainy days was 280, or 17 above the average, and at Fort William 259 days, or 25 above the average. The number of days on which 1 inch or more fell was much above the average at both observatories, Ben Nevis having no fewer than 79 such days, or 26 above the average, and Fort William 32, or 17 above the average. Of these days of heavy falls, as many as 41 occurred at Ben Nevis during the first three months of the year, and as many as 19 at Fort William. Considering also daily falls of between ·50 in. and ·99 in., and less heavy falls, we have the following table:—

Daily Falls of	Aggregate of Falls.		Number of Days.	
	Ben NevisObs	Fort William.	Ben NevisObs	Fort William.
1 in. and over	149·4 in.	51·3 in.	79	32
50 in. to ·99 in.....	39·0 „	32·1 „	52	46
Less than 50 in.	28·3 „	30·5 „	149	181
Total	216·7 „	113·9 „	280	259

Thus, on Ben Nevis nearly half, and at Fort William nearly one-third, of the number of rainy days had falls of ·50 in. or over, whilst at the top of the mountain such falls contributed six-sevenths of the total for the year. Again, at Fort William 45 per cent. of the annual amount, and at the high-level station nearly 70 per cent. was due to daily falls of 1 inch or over.

The sunshine recorder on Ben Nevis registered 509 hours out of a total

possible of 4,473 hours, or 11·4 per cent. of the possible sunshine, being 227 hours below the average of twenty years. This is the smallest annual amount recorded since the Observatory was opened, the next least sunny years being 1884 with 524 hours, 1886 with 571, and 1890 with 591. The amounts for February and March were the least on record for these months, and only in June, September and December were the totals above the average, and that by very small amounts. At Fort William the annual amount was 934 hours, being the smallest total in thirteen years and 185 hours below the average for that period. February, March and October had the smallest amounts on record for these months, the total of 10 hours in February being only one-fifth of the average for that month.

On Ben Nevis the mean percentage of cloud was 87, and at Fort William 78, both above the average. February, March, August and October were very cloudy months, the eye estimations of cloud amount agreeing with the small amount of sunshine registered by the sunshine recorder.

DR. W. N. SHAW ON THE GENERAL CIRCULATION OF THE ATMOSPHERE.

DR. W. N. SHAW makes a valuable contribution to the existing knowledge of atmospheric circulation in a paper read before the Royal Society during June of the present year.* His results are derived from observations made during an investigation of the trajectories of air by means of synoptic charts, and show that the paths of air taking part in cyclonic disturbances do not always originate, as is commonly supposed, in anti-cyclonic areas, but follow a track skirting high pressure areas and traversing sometimes a very large part of a belt of the Earth in a direction more or less parallel to a line of latitude, and that the general motion of the air in middle latitudes is more or less of the nature of a passage round the poles in an easterly direction. These suggestions are confirmed by the indications of the wind charts of the South Atlantic prepared by the Meteorological Council and also by the observations of cloud movements of Hildebrandsson.

Charts have been drawn upon Mercator's projection, showing for the month of January (1) the mean surface isobars; (2) the mean isobars at an altitude of 4,000 metres, as computed by M. Teisserenc de Bort from the mean surface temperatures; (3) the isobars indicating the pressure due to the weight of the atmosphere below 4,000 metres, arrived at by deducting the pressure above 4,000 metres from that at the surface; and (4) the mean temperature at the Earth's surface. In the chart showing the pressure of the upper stratum alone the effect of cyclonic distribution is, as might be expected, practically obliterated, so that no isolated low pressure areas remain and the general trend of the isobars is in a direction

* On the general circulation of the atmosphere in middle and higher latitudes, by W. N. Shaw, F.R.S. *Proc. R.S.* 74 (1904), 20-30.

parallel to lines of latitude, forming complete circum-polar rings. It is shown that the air movement at high altitudes is practically parallel to the isobars, any divergences being too slight to affect the considerations put forward.

The third chart, showing the distribution of pressure of the stratum of air below 4,000 metres, gives a very remarkable result. The general trend of the lines is similar to that for the upper air, but the direction of the gradient is in every case reversed. The only noticeable point of difference in the direction of the isobars in the two charts is that in the chart for the upper stratum alone the circulation is indicated as taking place round the geographical poles, whilst in the lower stratum it seems to take place round the poles of greatest cold. This distinction is only apparent in the northern hemisphere, where the pole of greatest cold is in northern Siberia, whilst in the southern hemisphere the two poles may be assumed to coincide.

The forces represented by the average pressure distribution for January may thus be separated into that due to the stratum above 4,000 metres, which would correspond to a steady air movement from west to east, and that due to the stratum below 4,000 metres, which would produce a steady motion in the opposite direction. The superposition of the two systems gives a line of minimum pressure with a westerly flow of air on the equatorial side and an easterly flow on the polar side. This line of minimum average pressure forms the track of circular storms on the surface of the Earth. The difference of the density of air at different temperatures, together with the instability due to the condensation of water vapour, would disturb any equilibrium which could be established, and the region of minimum pressure then becomes the scene of cyclonic movements and variable winds.

Since the distribution of pressure in the lower stratum is directly dependent upon surface temperature, whereas the influence of this factor upon the pressure of the upper stratum is naturally much less marked, the effect of changes in surface temperature may be considered as changing the character of the lower stratum and leaving that of the upper stratum practically unaltered. The former are easily calculable, and we are thus in a position to apply known factors to the combination of the two systems, which forms the actual pressure at the Earth's surface. This, as the author points out, may have very important consequences with relation to classifying the facts within our knowledge of weather changes in middle latitudes.

Another conclusion pointed out is the confirmation of Sir John Murray's suggestion of the existence of a high pressure area over the Antarctic continent, since the effect of the lower component would become intensified by the extreme cold immediately surrounding the South Pole.

It is pointed out that the division of the atmosphere into upper

and lower strata at an altitude of 4,000 metres is purely arbitrary, and that it was selected because the data were already worked out by M. Teisserenc de Bort, although it is an altitude in the region of clouds of an intermediate height, and probably does not correspond to any specific discontinuity of the atmospheric layer. The isobars are not susceptible of very great accuracy at high levels, and even at the surface are not entirely to be relied upon over the oceanic areas.

The author holds out the hope of showing in a future paper that storms in the region of minimum pressure in temperate latitudes may arise from special surface conditions, and that there is at least some evidence for the correlative origin of tropical hurricanes.

The results given in the paper were confined wholly to the distribution during the month of January, but an investigation from incomplete data for July showed results in many respects similar.



ROYAL METEOROLOGICAL SOCIETY.

AT the opening meeting of the session, on November 16th, Captain D. Wilson-Barker, President, in the chair, Lieutenant Charles Royds, R.N., of the *Discovery*, gave a most interesting address on "Meteorological Observing in the Antarctic," which he illustrated with numerous lantern slides. Lieut. Royds was the officer specially charged with the meteorological observations during the recent National Antarctic Expedition.

The ship arrived at her winter quarters on February 8th, 1902, and as soon as the water in the bay was frozen, the meteorological instruments were set up on the ice. This became to all intents and purposes a land station in latitude $77^{\circ} 50' S.$, and observations were carried on there from April 17th, 1902, until February 15th, 1904, when the ice broke up and allowed the ship to go free.

The observations were taken every two hours, those from 8 a.m. to 10 p.m. being taken by Lieut. Royds, and the night observations being divided between the eleven officers and members of the scientific staff, each one taking a night.

The highest temperatures recorded in each year were 39° on December 26th, 1902, and 42° also on December 26th, 1903. The lowest temperature registered during the stay in winter quarters was $-59^{\circ} 5$, on August 20th, 1903, while at Cape Armitage, a mile and a half to the south of the ship, the minimum on the same day was $-64^{\circ} 6$. The lowest temperature registered at Cape Armitage, however, was $-67^{\circ} 7$, at noon on July 19th, 1902.

The heaviest gale was on July 19th, 1902, when for ten hours the anemometer gave a velocity of 85 miles per hour. Blizzards were frequent and added considerably to the difficulties of observing, as the drifting snow choked up the instruments and the screens, and also stopped the self-recording instruments. A peculiarity of the

blizzards was the invariable rise of temperature; and they always came from the south and south-west.

It has sometimes been supposed that the sun seldom showed itself in the Antarctic regions. Lieut. Royds, however, said that this was utterly wrong, as day after day there were most glorious clear skies and continuous sunshine. In proof of this he showed a lantern slide of three cards from the Campbell-Stokes recorder which had traces of 24 hours' continuous sunshine.* The effect of the sun on the explorers' faces was very marked. During the winter, from living in artificial light, their faces turned yellow and various other colours. but when they went away sledging and were out in the sunshine for nine or ten hours every day, their faces turned absolutely brown and their lips cracked, while the skin blistered, and in many cases the face became swollen.

Lieut. Royds said that he had never seen such beautiful and striking examples of every sort of cloud as south of the Antarctic circle. Mirage was common, and so were halos and coronæ—some of which were very beautiful and complicated. Auroræ were not uncommon, but they were not so highly coloured nor so brilliant as those seen in the Arctic regions.

Mr. F. J. Brodie read a paper on the "Decrease of Fog in London during recent years." He had tabulated the number of days of fog reported at Brixton, the London station of the Meteorological Office, for the 33 years 1871—1903, and found that the mean annual number of fog days was 55, of which 45 occurred in the winter half of the year and only 10 in the summer half. December was the foggiest month with 9·5, the next being November with 8·5, January with 8·2, and October with 7·8. The clearest months were July with 0·4, June with 0·6, and May with 0·8. The greatest number of fog days were 86 in 1886, and 83 in 1887; and the least 13 in 1900, and 26 in 1903. Dividing the 33 years into three periods of 11 years each, the author showed that the mean for 1871—1881 was 55, for 1882—1892 it was 69, while for 1893—1903 it was only 41; there being thus a very marked decrease in the number of days with fog during the last 11 years.

The discussion on Mr. Brodie's paper was postponed till the next meeting, on December 21st.

During the evening the following gentlemen were elected Fellows of the Society:—Mr. G. W. Chilvers; Mr. G. M. Clark, M.A.; Rev. J. N. Cushing, D.D.; Mr. C. Dales; Mr. W. B. A. Dingwall; Mr. J. H. Field, B.A., B.Sc.; Mr. C. B. Goodyer; Mr. J. S. Hill, B.A., B.Sc.; Mr. E. Lewys Lloyd, M.R.C.S.; Mr. T. Midgley; Mr. G. F. Nightingale; Mr. G. Paul; Mr. R. W. Smith, Jun.; and Mr. C. H. Timmler.

* It may be mentioned that one of the officers of the *Terror*, which visited the Antarctic seas in 1840-43, was so impressed with the exquisite clearness of the fine days in the far South that he strongly advocated the selection of Victoria Land as the site of a station for observing the Transits of Venus.—*Ed. S. M. M.*

REVIEWS.

The Survey Atlas of England and Wales. Designed by and prepared under the direction of J. G. BARTHOLOMEW, F.R.S.E., F.R.G.S. Drawn, Engraved, Printed and Published by the Edinburgh Geographical Institute under the patronage of the Royal Geographical Society. 1903 [1904]. Size 18 × 12½. Price £3 10s.

GEOGRAPHY is so essential to the comprehension of climatology and is so intimately concerned in the relations of air, sea and land, that even although the Atlas before us contained no section dealing directly with climate we should still consider it an appropriate subject for a review in these pages. The Atlas consists of eighty-four plates of maps and plans with descriptive text. The earlier maps deal with England and Wales as a whole, and they present some features of remarkable interest. First comes a map showing by appropriate colouring the general build of the country, expressing the contrast between highland, hill and plain in a very effective way. It was found that while there was no feature of the surface of England too small to have a name of its own, some of the features which are prominent in this map were too large to have any one name throughout their whole extent, though their unity made it desirable that they should have one; accordingly some names had to be devised or adapted, and this was done with the approval of the Royal Geographical Society. Maps of monthly temperature and rainfall show the general seasonal changes in a satisfactory way, and could scarcely be improved upon on so small a scale as is necessarily adopted. Other striking general maps deal with geology, mineral productions, and, above all, population. The population map shows at a glance those parts of the country where people are most closely congregated, and those which are thinly inhabited or entirely unpeopled. The other maps of surface relief, mineral wealth and climate explain the reasons for the grouping of people in many cases. The chief utility of the Atlas, and this we have tested during the time when it was coming out in parts, lies in the great map of England in 67 plates on the scale of half-an-inch to a mile. Its unique feature is the system of colouring in soft and agreeable shades of green and brown to indicate the approximate height above sea level. Once this system is mastered its advantages will be too apparent to allow anyone to care for an uncontoured map again, and the system is carried out as faithfully in the little pocket "Touring Atlas of the British Isles," sold for a shilling or less, as in this great volume. The completion of this large map of England has greatly facilitated the work of identifying the sites of the rain gauges which each year sees added to the pages of *British Rainfall*, and for this we are more grateful than our readers can perhaps realise. The fine workmanship and accurate cartography of Mr. Bartholomew's publications were fitly acknowledged by the award of the *Grand Prix*—the highest distinction given—at the Universal Exposition at St. Louis.

Hourly Readings obtained from the Self-recording Instruments at four Observatories under the Meteorological Council, 1900. Thirty-second Year. New Series, Vol. I. London: Published for His Majesty's Stationery Office, 1904. Size 12 x 10. Pp. xiv. + 196. Price 25s.

THIS new series contains welcome improvements in the arrangement of the tables, greatly enhancing their utility, and more is promised. When the arrears have been overtaken it is intended to prepare the hourly readings for the press as soon as possible after the close of each month, and the sheets in the present issue are accordingly paged so that the observations for the month at the four Observatories (Valencia, Aberdeen, Falmouth and Kew) come together, but the results for the several Observatories can be grouped and bound separately if desired. The monthly observations for each Observatory are even marked "Price Sixpence," and we would suggest that while the arrears are being wiped off the separate publications of the months of 1905 be commenced up to date. When observations are already four years old we can make up our minds to wait a fifth year if by so doing the current year's record can be obtained with a minimum retardation. We should like to see a table of the hourly duration of rainfall, similar to that of sunshine, given as a supplement to the table of hourly amount of rainfall which only tells half the story; though we are happy to find that it now tells that half in an easy, straightforward manner, for it has escaped from the valley of the shadow of averages.

METEOROLOGICAL NEWS AND NOTES.

A METEOROLOGICAL STATION IN ST. JAMES'S PARK has recently been established by the Meteorological Council, near the Horse Guards Parade. It is equipped with a Halliwell self-recording rain gauge in addition to the ordinary instruments. Notice boards are also provided for the display of the records and the weather charts.

THE UTILITY OF RAINFALL OBSERVATIONS is not often so amusingly demonstrated as in the following extract from the *Daily Mail* of November 30th. One would think that with so much at stake both parties to such a contract would have been at the trouble to employ a proper instrument.

DISPUTE ABOUT A RAINFALL.—The question of rainfall at Paignton last Whit-Monday was the cause of a dispute which was decided at Totnes County Court yesterday, when the committee which arranged the Paignton gala and sports sued an insurance company for £36 15s. They effected an insurance with Lloyd's, the undertaking being that if more than .08 in. of rain fell between nine in the morning and four o'clock in the afternoon they would receive the difference between the gate receipts and £100. The plaintiffs, who took the gauge with a pencil and an ordinary rule, measured an eighth of an inch. The defendants doubted the possibility of such a heavy fall, as at Torquay, two miles away, only a hundredth of an inch was recorded. The jury gave a verdict for the plaintiffs, and the judge said that although the committee had adopted antiquated methods, the defendants made no effort to take the gauge themselves.

RAINFALL AND TEMPERATURE, NOVEMBER, 1904.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables in <i>British Rainfall</i> to which each station belongs.]	RAINFALL.				Days on which '01 or more fell.	TEMPERATURE.						No. of Nights below 32°.		
		Total Fall.	Diff. from average, 1890-9.	Greatest in 24 hours.			Max.		Min.		Shade	Glass			
				Depth.	Date.		Deg.	Date.	Deg.	Date.					
		inches.	inches.	in.											
I.	London (Camden Square) ...	1·70	— ·52	·39	10	11	58·8	9	24·1	26	9	18			
II.	Tenterden.....	2·04	— ·53	·95	10	11	59·0	11	25·0	26	10	14			
„	Hartley Wintney	1·42	— 1·06	·43	10	8	58·0	9	18·0	26, 27	14	16			
III.	Hitchin ..	1·36	— 1·06	·30	7	12	58·0	9	16·0	23	13	...			
„	Winslow (Addington)	1·50	— ·97	·34	10	10	60·0	3	6·0	24	14	18			
IV.	Bury St. Edmunds (Westley) ..	1·50	— 1·00	·37	23	12	59·5	3	17·0	24	...	...	
„	Brundall	2·00	— ·46	·52	26	15	59·0	9	23·0	24	12	17			
V.	Alderbury	2·57	— 2·45	·29	10	6	60·0	6	17·0	27	12	...			
„	Winterborne Steepleton ...	1·80	...	·72	7	12	58·3	12	21·9	27	11	19			
„	Torquay (Cary Green)	1·55	...	·48	7	10	59·8	6	28·0	25	5	11			
„	Polapit Tamar [Launceston] ..	4·52	+	·64	·88	10	19	58·8	14	6·9	25	13	15		
„	Bath	1·81	...	·48	7	8	58·2	9	21·0	24, 25	12	20			
VI.	Stroud (Upfield)	1·52	— 1·17	·40	10	9	55·0	3	21·0	26	9	...			
„	Church Stretton (Woolstaston) ..	1·20	— 1·58	·30	21	11	56·5	9	24·5	23	8	...			
„	Bromsgrove (Stoke Reformatory) ..	·99	— ·99	·28	6	6	55·0	3, 9	6·0	23, 24	17	...			
VII.	Boston	·57	— 1·28	·20	22	6	60·0	2	12·0	24	15	...			
„	Bawtry (Hesley Hall)	·80	— 1·14	·26	21	14	61·0	9	16·0	25	15	...			
„	Derby (Midland Railway) ...	1·25	— ·68	·27	10	17	56·0	9	13·0	23	12	...			
VIII.	Bolton (The Park)	3·72	+	·21	·85	8	16	54·6	9	21·5	24	...			
IX.	Wetherby (Ribston Hall) ...	2·25	+	·29	·84	7	15	...	...	...	...	...
„	Arncliffe Vicarage	7·04	+	·97	3·10	8	17	...	...	...	...	...
„	Hull (Pearson Park)	1·51	— ·78	·38	7	18	59·0	3, 5, 9	24·0	24	8	21			
X.	Newcastle (Town Moor) ..	3·14	+	·68	·78	21	14	...	...	...	...	...
„	Borrowdale (Seathwaite) ...	12·52	— 1·46	3·98	8	18	55·8	8	19·4	26	8	...			
XI.	Cardiff (Ely)	3·49	— ·47	·84	6, 10	19	...	...	...	...	...	...
„	Haverfordwest (High St.) ...	3·51	— 1·35	·78	10	17	57·2	9	21·2	27	7	18			
„	Aberystwith (Gogerddan) ..	3·18	— 1·77	·60	11	9	65·0	3	18·0	23, 26	12	...			
„	Llandudno	1·84	— 1·50	·40	27	15	57·0	9, 14	29·5	27	3	...			
XII.	Cargen [Dumfries]	3·10	— 1·44	·90	22	9	57·0	3	17·0	26	13	...			
XIII.	Edinburgh (Royal Observatory) ..	1·06	...	·38	9	13	56·4	13	24·5	26	6	15			
XIV.	Colmonell	5·30	+	·66	1·68	8	21	56·0	13	20·0	21	9	...		
XV.	Tighnabruach	5·81	...	2·30	8	21	50·0	3, 4	22·0	21	12	14			
„	Mull (Quinish)	4·35	— 1·62	·76	8	26	...	...	...	...	...	...
XVI.	Loch Leven Sluices	1·00	— 2·65	·25	9	9	...	...	...	...	...	...
„	Dundee (Eastern Necropolis) ..	·60	— 2·21	·15	9	13	61·5	3	21·0	26	12	...			
XVII.	Braemar	1·39	— 2·38	·47	23	16	55·0	3	7·3	26	15	...			
„	Aberdeen (Cranford)	1·41	— 1·95	·67	22	13	62·0	3	15·0	25	15	...			
„	Cawdor (Budgate)	1·67	— 1·07	·30	9	16	...	...	...	...	...	...
XVIII.	Glencarron Lodge	9·12	— ·80	·96	4	29	55·1	13	15·0	21	...	...	
„	Bendampf	6·70	— 2·30	·57	29	29	...	...	...	...	...	...
XIX.	Dunrobin Castle	2·20	— 1·09	·40	8	16	56·5	14	19·5	21	9	...			
„	Castletown	3·78	...	·35	7	26	56·0	17	21·0	21	11	...			
XX.	Killarney	4·34	— 1·47	·85	7	17	60·5	6	25·0	23, 27	...	...	
„	Waterford (Brook Lodge) ...	2·15	— 1·37	·92	6	13	59·0	9	21·0	27	10	...			
„	Broadford (Hurdlestown) ...	2·51	— ·74	·63	6	17	54·0	14	25·0	21	9	...			
XXI.	Carlow (Browne's Hill)	1·68	— 1·39	·56	6	11	...	...	...	...	...	...
„	Dublin (Fitz William Square) ..	1·08	— 1·48	·36	6	9	59·0	9	27·3	22	7	10			
XXII.	Ballinasloe	2·70	— ·87	·70	6	19	61·8	13	23·0	23	10	...			
„	Clifden (Kylemore House) ..	6·22	— 1·72	1·06	7	21	...	...	...	...	...	...
XXIII.	Seaforde	2·36	— 1·34	·56	10	21	56·0	9	25·0	21	8	10			
„	Londonderry (Creggan Res.) ..	4·73	+	·86	·58	8	25	...	...	...	...	...
„	Omagh (Edenfel)	3·41	— ·30	·85	6	23	55·0	8	20·0	21	7	10			

+ Shows that the fall was above the average; that it was below it.

SUPPLEMENTARY RAINFALL, NOVEMBER, 1904.

Div.	STATION.	Rain. inches	Div.	STATION.	Rain. inches
II.	Dorking, Abinger Hall	1·51	XI.	New Radnor, Ednol	2·59
„	Sheppey, Leysdown	1·10	„	Rhayader, Nantgwillt ...	4·03
„	Hailsham	1·47	„	Lake Vyrnwy	3·11
„	Crowborough	1·89	„	Ruthin, Plás Drâw.....	2·17
„	Ryde, Beldornie Tower.....	1·18	„	Criccieth, Talarvor.....	2·76
„	Einsworth, Redlands.....	1·35	„	Anglesey, Lligwy	2·29
„	Alton, Ashdell	1·26	„	Douglas, Woodville	3·37
„	Newbury, Welford Park ...	2·11	XII.	Stoneykirk, Ardwell House	3·65
III.	Harrow Weald	1·79	„	Dalry, Old Garroch	6·46
„	Oxford, Magdalen College..	1·46	„	Langholm, Drove Road....	3·83
„	Banbury, Bloxham... ..	1·51	„	Moniaive, Maxwellton House	3·52
„	Pitsford, Sedgebrook	1·33	„	Lilliesleaf, Riddell	1·86
„	Huntingdon, Brampton.....	1·47	XIII.	N. Esk Reservoir [Penicuik]	2·60
„	Wisbech, Bank House	·82	XIV.	Maybole, Knockdon Farm..	3·74
IV.	Southend	·92	„	Glasgow, Queen's Park	2·14
„	Colchester, Lexden	1·27	XV.	Inveraray, Newtown	5·42
„	Saffron Waldon, Newport...	1·54	„	Ballachulish, Ardsheal	6·23
„	Rendlesham Hall	1·01	„	Campbeltown, Redknowe...	4·82
„	Swaffham	1·60	„	Islay, Eallabus	6·13
„	Blakeney	1·67	XVI.	Dollar	1·67
V.	Bishop's Cannings	1·79	„	Balquhider, Stronvar	2·63
„	Ashburton, Druid House ...	2·60	„	Coupar Angus Station	·69
„	Okehampton, Oaklands.....	4·74	„	Blair Atholl.....	1·63
„	Hartland Abbey	3·23	„	Montrose, Sunnyside.....	·77
„	Lynmouth, Rock House ...	3·85	XVII.	Alford, Lynturk Manse ...	2·03
„	Probus, Lamellyn	2·54	„	Keith, H.R.S.	2·39
„	Wellington, The Avenue ...	2·18	XVIII.	Fearn, Lower Pitkerrie.....	1·79
„	North Cadbury Rectory ..	1·73	„	S. Uist, Askernish .....	...
VI.	Clifton, Pembroke Road ...	2·12	„	Invergarry	3·77
„	Moreton-in-Marsh, Longboro'	1·72	„	Aviemore, Alvie Manse.....	1·68
„	Ross, The Graig	1·23	„	Loch Ness, Drumnadrochit.	2·47
„	Shifnal, Hatton Grange.....	1·43	XIX.	Invershin	2·80
„	Wem Rectory	1·12	„	Altnaharra	4·49
„	Cheadle, The Heath House.	1·80	„	Bettyhill	4·23
„	Coventry, Kingswood	1·59	„	Watten, H.R.S.	2·20
VII.	Market Overton	1·16	XX.	Cork, Wellesley Terrace ...	1·65
„	Market Rasen	1·07	„	Darrynane Abbey	4·57
„	Worksop, Hodsock Priory..	·98	„	Glenam [Clonmel]	2·23
VIII.	Neston, Hinderton.....	1·78	„	Ballingarry, Hazelfort	2·29
„	Southport, Hesketh Park...	2·04	„	Miltown Malbay.....	3·45
„	Chatburn, Middlewood	5·09	XXI.	Gorey, Courtown House ...	1·35
„	Duddon Valley, Seathwaite Vic.	6·89	„	Moynalty, Westland	2·12
IX.	Langsett Moor, Up. Midhope	4·26	„	Athlone, Twyford	3·53
„	Baldersby	1·97	„	Mullingar, Belvedere.....	1·99
„	Scalby, Silverdale	2·87	XXII.	Woodlawn	3·54
„	Ingleby Greenhow	2·55	„	Westport, Murrisk Abbey..	4·07
„	Middleton, Mickleton	2·92	„	Crossmolina, Enniscoe	5·55
X.	Beltingham	3·74	„	Collooney, Markree Obsy...	5·39
„	Bamburgh.....	2·62	XXIII.	Enniskillen, Portora	3·24
„	Keswick, The Bank	4·18	„	Warrenpoint	1·39
„	Melmerby Rectory	3·88	„	Banbridge, Milltown	2·04
XI.	Llanfrehfa Grange.....	2·31	„	Belfast, Springfield	2·87
„	Treherbert, Tyn-y-waun ...	5·85	„	Bushmills, Dundarave	5·08
„	Llandovery, Tonn .....	...	„	Stewartstown	3·15
„	Castle Malgwyn	3·51	„	Killybegs	5·73
„	Llandefaelog-fach	3·37	„	Horn Head	5·60

METEOROLOGICAL NOTES ON NOVEMBER, 1904.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Temp. for Temperature; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunder-storm. R for Rain; H for Hail; S for Snow.

ENGLAND AND WALES.

LONDON, CAMDEN SQUARE.—Fair and sunny from 2nd to 4th, followed by a week of rough and wet weather during which almost the whole of the month's R fell. From 13th to 18th dense morning fogs prevailed, with high bar. and remarkably little air movement. Wintry conditions set in on 21st and continued till 28th with S on 22nd and 23rd. Duration of sunshine 35·0* hours and of R 39·1 hours. Mean temp. 42°·0, or 1°·0 below the average.

TENTERDEN.—Wet from 6th to 10th. Sunny from 12th to 15th and on 23rd and 26th. Fog all day on 18th. Frost from 21st to 29th. Duration of sunshine 85·5† hours.

HARTLEY WINTNEY.—The beautiful summer lingered on in mild and calm weather until the 21st, when a sharp snap of winter supervened with extreme cold until the end. Fog from 12th to 20th. Ozone on 16 days, mean 3·8.

HITCHIN.—Very dry and the coldest November since 1858.

TORQUAY, CARY GREEN.—R 2·18 in. below the average. Mean temp. 46°·4, or 1°·1 below the average. Duration of sunshine 96·9* hours, or 31·5 hours above the average. Mean amount of ozone 3·5.

CLIFTON.—Dull and dry till 5th, with N.E. winds and high bar. Then very wet till 10th, with westerly winds, reaching a gale on 8th and 9th. After heavy R on 21st severe frost set in suddenly and lasted till 28th, with fog on several days and about an inch of S on 23rd. R 1·30 in. below the average.

WORKSOP, HODSOCK PRIORY.—Sharp spell of frost from 21st to 29th was only equalled in November by that of 1890.

BOLTON.—Mild until 20th, but on 21st the wind shifted to N. and the temp. fell rapidly till 24th. Milder weather again on 29th. There was much fog, and during the latter part several falls of S occurred. Duration of sunshine 21·8* hours, or 3·8 hours below the average.

SOUTHPORT.—The ninth consecutive month with a deficiency of R. Mild generally until 20th and on 29th and 30th, but very cold during the intervening period. Duration of sunshine 3* hours below the average, and R 1·22 in. below the average. Underground water level unprecedentedly low for November.

LLANFRECHFA GRANGE.—Sharp frost from 21st to 29th and S on 23rd; otherwise mild with a good deal of fog.

SCOTLAND.

LANGHOLM.—R 1·50 in. below the average of 28 years. S fell heavily all day on 21st, amounting to 13 inches. Roads and railways were blocked and many sheep were lost in the hill districts by drifting.

COLMONELL.—On the 9th occurred the greatest flood for at least 15 years. On 21st 3 inches of S fell, the heaviest in 28 years' records. Mean temp. 43°·3 or 1°·6 above the average of 28 years.

MULL, QUINISH.—Singularity mild and calm, except from 20th to 24th, when there were N. winds and S showers.

* Campbell-Stokes.

† Jordan.

COUPAR ANGUS.—The cold snap commencing on 21st was the most severe since November, 1885. Mean temp. of the month $37^{\circ}\cdot 8$, or about 2° below the average. The mean temp. of the last 11 days was 14° lower than that of the first 19.

DRUMNADROCHIT.—About a foot of S between 19th and 27th, but no excessive frost and no drifting.

IRELAND.

CORK.—R $2\cdot 41$ below the average. Mean temp. $1^{\circ}\cdot 8$ below the average, that of the first 19 days being 48° and of the last 11 days 36° . Rather heavy S on 21st. Fog till 20th, but not dense.

DUBLIN.—Very open and generally fine until 19th, when a sudden change to wintry conditions began. Cold and frosty from 20th to 28th inclusive, then mild. S or sleet on 4 days. Fog on 7 days.

MARKREE OBSERVATORY.—On 21st S and H set in for 3 days, followed by heavy R on 26th.

OMAGH.—Damp and extremely mild until 20th, when a sudden change to squally polar winds was accompanied by the heaviest S since February, 1895, and the lowest temp. in November since 1878. This abnormal weather continued till 27th, but so heavy was the S that it required the mild temp. of many following days to reveal the grass again.

* * *Additional information as to the weather of November will be found in the article on p. 201.*

THE ELEVEN MONTHS' RAINFALL OF 1904.

Aggregate Rainfall for January—November, 1904.

Stations.	Total Rain.	Per cent. of Aver.	Stations.	Total Rain.	Per cent. of Aver.	Stations.	Total Rain.	Per cent. of Aver.
	in.			in.			in.	
London	18·87	91	Arncliffe	51·73	94	Braemar	23·13	73
Tenterden	21·66	90	Hull	19·82	86	Aberdeen	23·33	81
Hartley Wintney	21·49	94	Newcastle.....	21·49	92	Cawdor	20·42	74
Hitchin	19·53	92	Seathwaite ...	114·95	96	Glencarron ...	78·82	94
Winslow	20·48	94	Cardiff	39·88	113	Dunrobin	25·11	91
Westley	18·89	81	Haverfordwest	37·82	98	Killarney ...	46·11	94
Brundall.....	18·95	83	Gogerddan ...	40·06	100	Waterford ...	37·36	108
Alderbury	24·24	98	Llandudno ...	22·97	83	Broadford.....	35·38	118
Ashburton	45·55	104	Dumfries	35·44	90	Carlow	29·97	99
Polapit Tamar ...	39·60	120	Lilliesleaf	25·57	93	Dublin	20·69	83
Stroud	24·64	100	Colmonell	39·50	101	Mullingar	31·67	96
Woolstaston	24·13	91	Glasgow	31·24	96	Ballinasloe ...	35·79	108
Boston	18·37	98	Inveraray	62·73	98	Clifden	73·63	103
Hesley Hall	18·18	94	Islay	47·53	115	Crossmolina ...	54·90	118
Derby	18·52	89	Mull	53·37	107	Seaforde	31·51	96
Bolton	31·45	84	Loch Leven ...	29·80	93	Londonderry..	38·68	104
Wetherby	24·04	110	Dundee	22·90	93	Omagh	40·04	112

Climatological Table for the British Empire, June, 1904.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
London, Camden Square	76·7	30	43·1	4	70·1	49·4	50·2	78	126·1	38·3	·84	6	6·2
Malta.....	95·2	28	61·4	1, 3	83·4	67·6	64·9	72	143·6	56·3	·16	3	3·0
Cape Town ...	69·5	19	40·7	24	61·4	48·7	48·3	73	...	...	6·55	17	6·6
Durban, Natal	90·0	24	48·8	28	76·1	54·5	...	...	137·2	...	·66	5	2·3
Johannesburg	65·7	6	32·5	11	59·6	42·3	34·4	59	...	...	·31	4	1·1
Mauritius.....	76·6	27	54·5	30	75·3	60·9	59·8	76	133·7	46·3	3·56	17	5·1
Calcutta.....	101·2	6	74·2	14	90·4	78·7	77·8	84	157·0	73·0	10·25	19	7·7
Bombay.....	92·6	7	74·6	16	87·5	79·7	77·2	82	138·5	73·8	15·10	25	7·1
Madras	103·5	3	79·1	28	99·8	82·0	68·4	55	156·5	76·3	·61	10	6·9
Kodaikanal	66·2	11	50·6	11	61·3	52·8	51·1	84	133·6	46·0	2·60	22	8·3
Colombo, Ceylon.....	86·4	9	72·2	19	84·5	76·4	70·0	79	154·5	70·0	9·51	24	8·0
Hongkong.....	91·1	26	72·2	1	85·0	76·0	74·1	83	141·5	...	19·64	17	7·2
Melbourne.....	64·9	21	32·9	...	64·0	33·6	44·3	81	120·1	26·8	3·29	18	7·7
Adelaide	66·0	10	41·7	4	59·2	47·1	45·2	77	120·7	34·2	3·92	19	7·6
Coolgardie	72·1	8	35·7	28	60·7	44·8	44·0	72	140·2	32·1	1·40	12	6·4
Sydney	69·6	21	39·5	30	59·0	44·4	40·1	77	93·8	29·1	·19	11	2·2
Wellington	63·7	15	37·9	9	53·8	43·4	40·7	73	98·0	33·0	6·96	20	5·8
Auckland	62·0	2	38·0	30	57·2	47·9	46·2	79	115·0	34·0	6·07	24	6·5
Jamaica, Negril Point..	88·1	1	69·9	9	85·5	75·6	73·1	79	...	...	16·07	9	8·2
Trinidad	88·0	2a	67·0	b	86·1	69·5	72·1	79	161·0	63·0	6·23	14	...
Grenada.....	84·2	29	68·4	7	82·2	73·4	70·7	78	142·0	...	7·31	23	5·0
Toronto	82·9	25	44·1	23	72·1	53·6	55·1	76	112·0	37·0	2·77	13	5·7
Fredericton ...	83·1	24	35·0	12	71·0	46·9	45·9	54	...	...	2·05	7	4·9
Winnipeg	89·0	18	37·5	6	71·7	50·5	...	...	...	...	4·22	11	6·1
Victoria, B.C.	79·0	29	43·2	11	63·2	48·9	...	...	...	...	1·36	5	4·7
Dawson	74·6	3	33·0	16	66·2	42·9	...	...	...	...	1·71	7	4·5

a and 16, 23, 29. b several days.

MALTA.—Mean temp. of air 74°·4 or 2°·9 above the average. Mean hourly velocity of wind 8·0 miles, or 0·8 below average. Mean temp. of sea 71°·1.

MAURITIUS.—Mean temp. of air 1°·0, dew point 1°·3 below, and R 1·51 in. above averages. Mean hourly velocity of wind 9·4 miles, or 1·8 miles below average.

MADRAS.—Bright sunshine 117·8 hours.

KODAIKANAL.—Bright sunshine 68 hours.

COLOMBO.—Mean temp. of air 79°·8, or 1°·3 below, of dew point 4°·1 below, R 1·27 in. above, averages. Mean hourly velocity of wind 11·7 miles.

HONGKONG.—Mean temp. of air 79°·8. Sunshine 162·1 hours. Mean hourly velocity of wind 9·9 miles.

SYDNEY.—Mean temp. of air 2°·7 below, and R 5·30 in. below, averages.

WELLINGTON.—Mean temp. of air 2°·5 above, and R 1·98 in. above, averages.

AUCKLAND.—R 1·75 in. above average of 34 years.

TRINIDAD.—R 2·09 in. below the 40 years average.