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### THE RAINFALL OF NEW ZEALAND.

IT was a rather curious coincidence that after the article upon the Rainfall of Jamaica in this Magazine for October was in type, but before it was issued, we received from Sir James Hector, F.R.S., a table of rainfall in New Zealand\* exactly such as we had pointed out as being needed to complete Mr. Maxwell Hall's capital Jamaica atlas.

We reprint on the next page Sir James Hector's table, and we shall, in making a few general remarks, avail ourselves also of a paper read by Mr. J. T. Meeson, B.A., before the Philos. Soc. of Canterbury, May 7th, 1890, and published in the *Trans. of the New Zealand Institute*. Sir James Hector's table, being prepared in response to an order of the House of Representatives (July 13th, 1892), necessarily commences only with the date therein stated, viz., 1864. Observations were made in New Zealand long before that; certainly as early as 1844,† and we trust that Sir James will be able to complete his work by compiling a second table dealing with those earlier years. He was fettered also as to the stations to be included in his table, and therefore we miss some which otherwise would doubtless have been there.

There seem to be indications that in New Zealand official records only are relied upon; and if that is the case, we think that it is a pity. Reference to Sir James Hector's table shows that, as soon as the order of the Government at the end of 1880 stopped the payment, not half of the observers cared enough for science, or their colony, to continue their records. A monthly return for July, 1892, shows that there is now an elaborate system, with about 70 observers; we therefore presume that the decision of 1880 has been reversed; but the continuity of the broken records can never be restored. Even

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\* Annual Rainfall (Return of) in inches, for each year from 1864 to 1891 inclusive, with diagrams for the four principal stations. Parliamentary Paper, Wellington, 1892., fol.

† R. H. Scott. Presidential Address. *Quar. Jour. Roy. Met. Soc.*, vol. xi., p. 204.

now we do not see the station at Waipawa quoted, so we print the values from the originals kindly sent yearly to us in MS.

In the table on page 148 we have incorporated the values given by Mr. Meeson and by Sir James Hector—it will be seen that they are rarely identical, because in most cases the period of observation differs—but there are other cases in which it is evident that different values have been adopted for the same station and the same year. These cases should be investigated and the error pointed out, no matter how it arose. To quote one illustration. The values in Sir James Hector's table for Invercargill are those which have been published under four different names. The original observer, Mr. Rouse Marten, quoted them as from "Martendale" (we suppose the name of his house); Sir James, in 1871, quoted them as "Southland," which was the district in which "Martendale" was situated; Mr. Meeson in his paper quoted them as "Wallacetown"; and finally, in the return to Parliament they appear under "Invercargill";

*Annual Rainfall in New Zealand, 1864-91.*

	Mongonui.	Auckland.	Napier.	Taranaki.	Wanganui.	Wellington.	Nelson.	Canterbury.	Hokitika.	Dunedin.	Queenstown.	Invercargill.
Altitude	70 ft. in.	258 ft. in.	14 ft. in.	42 ft. in.	80 ft. in.	140 ft. in.	34 ft. in.	21 ft. in.	12 ft. in.	550 ft. in.	1070 ft. in.	79 ft. in.
1864	67·90	37·40	49·30	43·80	30·41	44·50	63·40	22·00	...	24·20	...	51·70
5	40·80	40·00	...	56·80	...	50·70	68·30	24·30	...	46·60	...	63·60
6	...	42·00	30·00	55·70	36·58	41·10	56·00	19·40	127·50	29·00	...	47·20
7	55·20	53·18	...	60·69	38·25	41·95	46·31	30·07	110·51	39·05	...	41·62
8	...	49·09	...	50·42	34·13	55·52	79·37	30·04	120·21	33·89	...	46·35
9	48·34	52·80	...	55·13	42·96	56·77	65·23	27·29	88·21	32·92	...	42·68
1870	52·87	44·83	32·41	54·72	35·03	48·21	48·43	28·36	116·68	39·20	...	53·95
1	57·64	47·51	35·89	72·12	51·09	64·06	55·67	27·94	122·44	22·15	...	39·03
2	46·90	42·10	23·94	63·64	40·42	50·94	78·61	19·74	123·21	27·39	28·88	40·11
3	63·72	41·27	42·38	53·12	39·00	54·99	65·44	26·33	96·17	35·83	32·30	37·48
4	56·95	35·02	37·94	57·22	36·76	53·50	71·55	22·79	104·48	28·74	30·19	44·65
5	52·53	51·31	38·26	66·96	44·34	65·83	69·07	32·31	130·79	42·63	31·76	44·18
6	58·64	44·02	38·39	48·18	33·88	43·37	60·64	23·99	116·33	38·26	30·93	40·59
7	54·47	40·38	33·45	52·00	33·97	51·93	48·52	23·72	136·66	37·46	35·59	43·15
8	40·14	37·16	21·10	56·73	41·98	54·60	51·90	13·54	154·45	45·23	60·02	54·02
9	58·92	46·13	53·14	60·18	33·65	57·44	61·42	23·18	128·29	42·10	22·42	33·26
1880	55·48	38·89	38·40	47·22	36·27	46·77	37·27	17·67	122·84	33·06	27·69	39·14
1	...	34·24	...	...	30·27	50·13	...	28·07	...	26·40	...	...
2	...	45·63	...	...	33·88	55·68	...	25·39	...	41·80	...	...
3	...	52·21	...	74·87	47·29	51·99	...	30·34	...	38·31	...	...
4	...	38·07	...	60·64	45·77	62·34	...	28·45	...	33·88	...	...
5	...	28·14	...	...	23·58	36·81	...	22·08	...	24·60	...	...
6	...	32·64	...	...	46·41	54·48	...	35·29	...	52·63	...	...
7	...	37·71	...	...	38·59	56·97	...	32·89	...	39·14	...	...
8	...	34·60	...	...	31·30	41·01	...	29·16	...	48·36	...	...
9	...	41·97	...	...	35·41	31·36	...	20·38	...	23·45	...	...
1890	...	46·10	27·62	68·19	32·84	45·23	...	14·84	...	27·98	44·52	...
1	53·57	36·04	30·36	73·10	35·47	35·13	...	20·57	...	32·73	28·89	68·50?

RAINFALL AT ASHCOTT, WAIPAWA, HAWKES BAY.  
By H. H. BRIDGE, Esq.

Lat. ... 39° 56' S.  
Lon. ... 176° 30' E.

Lat. ... 39° 56' N. Lon. ... 176° 30' E.		Height of { Above Ground ... 9 in. Rain Gauge { Above Sea Level... 700 ft.														
Year.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Jan.....	...	3·00	...	1·97	55	1·70	4·33	1·06	3·46	...	3·48	58	43	2·12	3·78	3·05
Feb.....	...	8·68	...	72	84	1·96	41	8·53	1·47	...	1·87	2·46	1·28	1·27	1·23	8·50
March...	...	2·58	...	6·05	17·39	32	3·38	3·46	6·17	...	2·06	88	3·70	76	1·18	2·30
April ...	...	1·17	...	1·84	87	29	4·39	7·16	25	...	5·15	1·51	2·28	51	2·32	2·59
May.....	...	4·44	...	9·33	3·10	75	1·07	4·74	4·25	...	2·24	7·46	2·82	3·17	3·47	2·07
June ...	...	2·18	...	10·33	3·84	4·44	8·89	1·59	7·12	...	3·19	8·27	1·66	6·09	3·62	1·34
July ...	7·52	...	...	3·56	5·53	4·72	3·86	4·96	2·44	...	21	3·02	3·88	4·73	5·77	1·93
Aug. ...	1·25	...	...	3·81	3·64	4·24	7·07	1·75	3·60	...	4·10	1·83	5·34	2·06	89	2·82
Sept. ...	3·71	...	...	2·74	68	2·19	1·42	2·90	5·61	...	3·53	2·94	1·74	6·52	4·67	3·71
Oct.....	1·12	...	...	1·49	2·86	1·95	4·61	5·98	4·14	...	2·72	8·96	2·67	2·99	2·36	2·24
Nov. ...	5·99	...	...	7·41	3·59	3·85	6·82	6·31	5·66	...	2·55	3·00	5·32	2·59	1·45	2·91
Dec.....	6·29	...	...	5·30	1·73	2·07	1·38	4·79	3·41	...	37	2·50	64	3·95	1·59	5·60
Total...				54·55	44·62	28·48	47·63	53·23	47·58		31·47	43·41	31·76	36·76	32·33	39·06

In four cases the sum of the daily entries differs from the monthly totals, and is—for March, 1880, 17·79; March, 1883, 3·36; July, 1883, 3·96; June, 1886, 6·19 in.  
The total for the three years not given above—viz., 1877, 1878, and 1885—is 96·31 in.; or on the average, 32·10 in. per annum.  
The mean 1877 to 1891 inclusive is given by Mr. Bridge as 39·15 in.

*Mean Rainfall at 28 Stations in New Zealand.*

PROVINCE.		STATION.	Lat. S.	Long. E.	Altitude	Meeson, 1890.	Hector, 1892.
			°	°	feet.	in.	in.
NORTH ISLAND.	Auckland.....	Mongonui.....	35 01	173 28	70	58.15 15 yrs.	54.00 16 yrs.
	„ .....	Auckland.....	36 50	174 51	258	43.21 23 „	41.80 28 „
	„ .....	Rotorua .....	38 24	176 36	...	(53.55) 1 „	...
	„ .....	Gisborne .....	38 40	178 10	...	49.72 7 „	...
	Taranaki .....	Taranaki .....	39 03	174 05	42	58.08 15 „	58.64 21 „
	Hawkes Bay..	Napier .....	39 29	176 55	14	37.26 15 „	35.51 15 „
	Wellington ..	Wanganui .....	39 56	175 06	80	38.12 7 „	37.39 27 „
	„ .....	Foxton .....	40 30	175 30	...	37.14 9 „	...
	„ .....	Wairarapa .....	41 15	175 17	...	(42.59) 1 „	...
	„ .....	Wellington .....	41 16	174 47	140	50.18 23 „	50.12 28 „
	„ .....	„ Reservoir..	...	...	...	(45.57) 2 „	...
	Nelson .....	Farewell Spit .....	40 30	172 44	...	(37.80) 2 „	...
SOUTH ISLAND.	„ .....	Pakawau, Golden Bay .....	40 35	172 30	...	108.30 9 „	...
	„ .....	The Brothers .....	...	...	...	(33.33) 1 „	...
	„ .....	Nelson .....	41 16	173 18	34	62.63 7 „	60.42 17 „
	Marlborough..	Blenheim .....	41 30	174 05	...	26.84 10 „	...
	„ .....	Cape Campbell .....	41 43	174 18	7	21.20 7 „	...
	Nelson .....	Waiau .....	42 50	173 30	...	(37.38) 1 „	...
	Westland.....	Hokitika .....	42 41	170 59	12	112.16 15 „	119.92 15 „
	Canterbury....	Bealey .....	43 02	171 31	2104	104.14 14 „	...
	„ .....	Christchurch .....	43 32	172 39	21	25.77 19 „	25.00 28 „
	Otago .....	Milford Sound.....	44 35	167 45	...	...	...
	„ .....	Queenstown.....	45 02	168 39	1070	36.61 8 „	33.93 11 „
	„ .....	Oamaru .....	45 03	171 05	...	22.70 6 „	...
	„ .....	Dunedin .....	45 52	170 31	550	33.61 23 „	35.25 28 „
	„ .....	Puysegur Point .....	46 12	166 32	...	(110.59) 1 „	...
	„ .....	Wallacetown* .....	...	...	...	43.67 15 „	...
	„ .....	Invercargill* .....	46 28	168 17	79	...	46.18 18 „
	„ .....	Bluff .....	46 33	168 10	...	(64.67) 1 „	...

\* See remark on page 146.

and in three different places we have found the fall for 1864 given as 51.00, 51.15, and 51.70 in. So with Hokitika, 1866 is given in one report as 129.12, and in another as 127.50 in. These differences are not of practical importance, and we neither think nor suggest that Sir James Hector is in any way responsible for them; but we do hope that the New Zealand Government will have *all* the old observations thoroughly examined, tabulated, and published.

One great deficiency in New Zealand rainfall returns is record of the height of the gauges above the ground. In early days several stations had two gauges, one on the ground, the other on a roof; there is nothing to show of which gauge the records were given, and we do not know why the results from both were not published.

With the information in Sir James's present table, it will be easy to deduce (from the short periods of observation at the many recently established stations) means quite near enough to the truth

for most practical purposes, and thus to give the colony a series of shaded maps like the beautiful Jamaica ones.

One subject on which we naturally examine such a table as that on page 146 is the limit of fluctuation in the yearly totals of rain. Is it at all similar to that in the British Isles? Here are the values for the five\* long records, and for comparison we prefix the ratios given by Mr. Symons in *British Rainfall*, 1883, and by Mr. Binnie, *Proc. Inst. C.E.*, March, 1892.

	Symons.	Binnie.	Auckland.	Wanganui.	Wellington.	Dunedin.	Mean for N.Z.
Wettest year.....	1·45	1·45	1·27	1·37	1·31	1·49	1·36
Driest year.....	·66	·66	·67	·63	·62	·63	·64
Two driest years .....	·74	·73	·71	·86	·72	·70	·75
Three driest years .....	·79	·78	·79	·89	·74	·79	·80
Total Fluctuation .....	·79	·79	·60	·74	·69	·86	·72

This proves that the New Zealand rainfall shows remarkable accordance with the fluctuation elsewhere. Except at Dunedin, they will probably have years slightly wetter than any that they have yet had. At Wellington, for instance, theoretically the wettest year should have a fall of  $72\frac{1}{2}$  inches; at present the wettest there has been 66 inches in 1875; but on the other hand, it is improbable that Wellington will ever have three years in succession drier than 1889, 1890, and 1891.

## OCTOBER RAIN AND FLOODS.

ONE HUNDRED and fifty feet of newspaper cuttings upon the subject, now mounted and lying before us, give ample evidence of great loss and suffering from floods during the past month. Most damage occurred in Yorkshire, but injury occurred also in other parts of the country—in Essex, Lincolnshire, North Wales, and the north of Scotland. We cannot give full details until we receive the materials for compiling *British Rainfall*, 1892, but meanwhile the following remarks and tables will indicate the general features.

In our last number we gave some details as to the rain on October 4th. The next important rains were in N. Wales, followed in the dry district of the N.E. of Scotland by heavy rains and snow, which combined to inflict serious injury on outstanding crops. Then came the Yorkshire rains of 13th to 15th, particulars of which we give in the following table, in which the stations are grouped *not* in the usual

\* We have omitted Canterbury, because we regret to find that that column is made up of the record of two stations.

order but, according to the river basins in which the various stations are situated.

*Rainfall, October 13th—15th. 1892.*

River Basins.	Stations.	13th.	14th.	15th.	Total.
		in.	in.	in.	in.
Witham .....	Horncastle (Hemingby).....	·85	·85	·94	2·64
Ancholme .....	Brigg .....	1·12	1·15	·79	3·06
Don .....	Doncaster (Magdalens) .....	·75	1·39	·69	2·83
Hull .....	Hull (Pearson Park) .....	·55	1·85	·57	2·97
Foulness .....	Market Weighton (Houghton)...	1·05	1·55	1·50	4·10
Calder .....	Wakefield Prison .....	·92	2·38	·84	4·14
" .....	Slaithwaite (Blackmoorfoot).....	·54	2·48	1·00	4·02
Aire .....	Leeds (Museum) .....	·91	2·84	·61	4·36
" .....	Skipton (Craven Herald Office)..	·33	1·85	·10	2·28
Esk .....	Guisborough .....	·60	1·40	·48	2·48
Wharfe .....	Oughtershaw Hall .....	1·08	3·26	·47	4·81
" .....	Arncliffe Vicarage .....	·70	2·59	·44	3·73
Ouse .....	Hawes (Hardrow Vicarage) .....	1·41	3·47	·60	5·48
" .....	Aysgarth Vicarage .....	1·12	3·36	1·02	5·50
" .....	East Layton [Darlington] .....	·23	1·63	·46	2·32
" .....	Ripon (Mickley) .....	·34	2·12	·55	3·01
" .....	Melmerby (Baldersby) .....	...	1·25	·30	1·55
" .....	Pately Bridge (Castlestead) .....	·85	3·25	·86	4·96
" .....	Knaresboro' (Farnham Hall) ...	·50	2·00	·58	3·08
" .....	Wetherby (Ribston) .....	·82	1·64	·65	3·11
" .....	York (Phil. Soc. Gardens) .....	·38	1·73	·50	2·61
Tees .....	Barnard Castle (Whorlton) .....	·25	1·32	·24	1·81
" .....	Mickleton .....	·12	1·53	·18	1·83

We have read through the newspaper cuttings, which we have received with respect to the floods produced by these rains. Rejecting duplicates, there are about *150 feet* of ordinary column width, and compressing that information into a page, is an impossibility. Moreover, although there is much that is of trivial or purely personal interest, there is a very large amount of very valuable information, which we hope to be able to utilize in *British Rainfall, 1892*.

At present, therefore, we must deal with isolated facts and generalities:—

At York, the flood was said to be the highest recorded in any month since 1831, and the highest in October since 1689; but as works were in progress in the Ouse, *just below* the City, it is possible that they artificially raised the level. At present we know nothing on this point. Upwards of 500 houses were reported to have been damaged, and many of the old records in the care of the Corporation were saturated.

At each of the following places the height is reported to have been unequalled for the number of years set against it:—Knaresboro', 128; York, 61; Bradford, 46; Wetherby, 30; Dewsbury, Keighley, Leeds, Pannal, Shipley, and S. Milford, 26; Malton, 14; Selby, 12; Pately Bridge, 11; Ripon, 10; Barnsley, Doncaster and Rotherham, 6 years. We have no reason to doubt the above figures, but accept no

responsibility for their accuracy; we shall be very thankful for any trustworthy information, as to the height of the recent or previous floods.

Few things are more uncomfortable than a flood in the dark. At Boroughbridge, Knottingley, Selby, Snaith and in parts of York, the gas supply failed, either from water getting into the mains, or from the works being inundated. In several cases there could be no service on Sunday, Oct. 16th; in some, because the church was flooded; in some, because there was no means of lighting it. The railways suffered slightly, one bridge broke, and in a few cases ballast was swept away, but no life was lost.

As far as we can gather, the chief mischief has been the flooding of thousands of the houses of the lower classes in nearly all parts of Yorkshire, and closely following thereupon, is the loss to farmers, (1) of uncarried crops, (2) of live stock. Of individual losers, it is not so easy to speak. At Pateley Bridge, an important incline, leading to a quarry, began to slide, and seems to have gone into the fields below. A pattern shop, with the entire stock of one firm, was swept into a river. Coal pits were flooded and the ponies drowned. Chemical works, tanneries, brickworks, dye works, &c., were put under water to the total destruction of the goods being operated upon. But happily, the loss of human life was almost nil, and the filthy Yorkshire rivers, were for once washed clean.

*Photography.*—We cannot pass from this subject without expressing our extreme pleasure at the number of gentlemen, both amateur and professional, who (in many cases at considerable personal discomfort) secured photographs of these floods. They, perhaps, looked upon their records as merely so many unusual views, but we can assure them that they have a value far beyond that. Disgracefully little is known respecting the discharge of our rivers, and as these photographs show every brick and stone in the bridges, the heights reached can be recovered and recorded within a few inches. We have already been favoured with sets from:—

Brotherton.....	Mr. W. A. Fox, per Mr. E. R. Waite, F.L.S.
Castleford .....	Mr. E. G. McBretney, F.I.C.
Ferrybridge .....	Mr. W. A. Fox, per Mr. E. R. Waite, F.L.S.
York .. .....	Mr. J. Noble.
Wakefield .....	Mr. Isaac Briggs, jun.

A friend has also purchased and sent us an interesting set of small views taken at York by Messrs. Smith & Co.

Mr. Creer, C.E., who formerly sent in the rain records kept under his superintendence at Lancaster, is now City Engineer at York, and we think his report to the Ouse Navigation Committee of the York Corporation so interesting that we reprint it *in extenso* from the *York Herald*.

#### REPORT OF THE CITY ENGINEER OF YORK.

“The flood in the river Ouse on Saturday and Sunday, the 15th and 16th October, was of such an unusual character that I have thought it desirable to draw up a short report on the subject, so that the details may be placed on record. The committee is aware that gauges are fixed at Ouse and Lendal

Bridges. These should have their zeros at 16.75 ft. above ordnance datum, this being the recognised summer level of the river. I find, however, on checking them, that they have been fixed about 2 inches too low. The Ouse Bridge gauge is read every day at noon, by Mr. Stephenson, collector of the river dues, and the result entered in his diary. The gauge at Lendal Bridge is read from my office, and recorded every morning at 9 a.m. (Sundays excepted); and during the summer months, when the gauge can be read across the river, it is read in the evening; during the winter months, when this is not possible, the level is obtained by measurement at the Common Hall landing. From the gaugings taken I find that on

Friday, the 14th,	at 9 a.m.,	the reading above summer level was 6 in.
Friday evening,	at 5 p.m.,	„ „ „ 2 ft. 3 in.
Saturday, the 15th,	at 9 a.m.,	„ „ „ 10 ft. 6 in.
Saturday,	at noon,	„ „ „ 11 ft.

Between Friday evening and Saturday morning the river rose at the rate of about  $6\frac{1}{4}$  in. per hour. Between 9 a.m. and 1 p.m. on Saturday, the rise was at the rate of about  $1\frac{1}{4}$  in. only. The flood ultimately rose between that hour and 10 a.m. on Sunday morning to about 16 feet at the Lendal Bridge gauge, the flood mark left on the Lendal Water Tower showing 15 ft. 11 in. above summer level.

I give hereunder a list showing the height above summer level to which the flood rose in various parts of the city on Sunday, the 16th October:—

	ft. in.		ft. in.
Love Lane, Fulford .....	14 1	North Street .....	15 8
New Walk End .....	14 3	Foss Islands Road .....	15 7
Blue Bridge Lane.....	14 5	Wellington Row .....	15 10
Castle Mills Lock.....	14 6	Ouse Bridge Inn (mark made	
Fishergate, near Castle Mills		by landlord) .....	15 8
Bridge.....	14 6	Water Works Office, Lendal	
Walmgate .....	14 8	Bridge .....	15 11
Fossgate, at Merchants' Hall..	14 6	Municipal Offices (basement)...	15 11
Skeldergate Bridge(Upper Side)	15 1	Marygate, at Hetherton Street	16 2
Tower Street.....	15 3	Scarborough Railway Bridge...	16 3
Skeldergate .....	15 6	Salisbury Terrace, Leeman Road	16 9

“The record of floods, as published in the press in tabulated form, does not agree with the flood marks existing in various parts of the city; this arises from the alteration in the summer level of the river by the construction and improvement of the weir at Naburn. As instances, take the following:—The published record of the flood in 1625 gives a height of 18 feet 8 inches. Fortunately, this flood is recorded on the Friars' Wall, near Tower Street, and shows that the water rose to a height of 17 ft. 10 in. above the present summer level, or 10 in. less than the published record. The flood of 1636 is also marked on the same wall, and shows the correct height to be 17 ft.  $1\frac{1}{2}$  in. above summer level, or  $10\frac{1}{2}$  in. below the published record of 18 ft. So with the flood of 1763, recorded on a brass plate in the Ouse Bridge Inn. This plate shows that the flood rose on the 31st December in that year to a height of 16 ft. 3 in. above the summer level, or 1 ft.  $2\frac{1}{2}$  in. below the published record of 17 ft.  $5\frac{1}{2}$  in. The records of 1625 and 1636 would not be affected by works at Naburn, as in those years, and up to 1757, the tide had an uninterrupted flow up to the city. In 1763 the case is different, as Naburn Lock and weir had been opened six years prior to this flood. I am not aware that any alteration was made in the height of the weir after its construction, until the year 1835. From inquiries made I am inclined to believe that the weir remained at the level at which it was constructed, until the last-mentioned year, when improved sluices were provided for dealing with floods, probably in consequence of the flood in 1831, and moveable deals fixed on the top of the stone work. The only mark of the 1831 flood that I have any knowledge of, is that at the Merchants' Hall, Fossgate; this, compared with our present summer level, gives a flood height of 15 ft. 7 in. at this place. In the recent flood the level of the Ouse was 1 ft. 5 in. higher at Lendal than at the



Merchants' Hall, and if this difference is added to the height shown on the board fixed at the Merchants' Hall, the level of the 1831 flood in the Ouse at Lendal would appear to be 17 ft. 1 in. above present summer level, and this agrees very nearly with the figures given by Mr. W. T. Walker, of the Marygate Tannery, viz., 17 ft. 2 in. In comparing old flood height records that have been measured from the summer level prevailing at the time, with recent floods, it should be borne in mind that in 1835 the summer level was raised 1 ft. 6 in., and in 1876 it was raised an additional 4 inches, or 1 ft. 10 in. in all above the summer level prior to 1835.

"It is very desirable that a correct official record should be kept of the varying height of the river, so as to ascertain the effect of the rainfall in producing floods, and the rate at which the rise takes place; this can only be done effectually by providing an automatic gauge which records on a diagram every variation in the height of the river; these gauges are extensively used in connection with water works, navigable rivers, and docks.

"The sluices fixed at Naburn some years since for the purpose of facilitating the discharge of flood waters, are useful for dealing with small floods, and enable you to lower the water below summer level, thus providing what may be termed an elongated reservoir for flood water that would, if not so provided for, add to the height of the flood. These sluices would, however, have little or no effect on such a flood as that on the 16th October. Mr. Symons, who has done an enormous amount of work in organising a system of observations on rainfall all over the country, estimates the increased volume of water passing York in consequence of the rainfall of the 13th, 14th, and 15th, at 80,000,000,000 gallons. If the sluices at Naburn were working under the most favourable circumstances, that is, with a clear fall from summer level above the Weir to low water below the Weir, they would in the three days be capable of discharging about one-fiftieth of this quantity; as a matter of fact the sluices were submerged most of the time, the water being level on both sides of the Weir, so that they were, under the circumstances prevailing at the time of the flood, of very little service.

"The improved system of draining now adopted for agricultural land, and the greater extent of land under drainage as compared with 60 years ago, leads me to believe that floods are likely to be more frequent and severe than formerly, although they are not likely to be of such long duration."

As regards the whole month, the table on p. 158 will show that in some districts October was a dry month, in others it was very wet; this was notably the case in the Eastern Counties, and the following table contains some striking values:—

STATION.	Total in October 1892.	Average in October, 1880-89.	Excess in October, 1892.	REMARKS.
	in.	in.	in.	
IV. Ipswich (Bishop's Hill).....	6.51	3.19	+3.32	Wettest month for 21 years.
„ Woodbridge (The Cedars) ..	7.32	3.31	+4.01	
„ Rendlesham Hall .....	6.96	3.31	+3.65	
„ Geldeston [Beccles] .....	7.39	3.49	+3.90	
„ Wymondham.....	7.46	...	...	
„ Yarmouth .....	9.27	...	...	
„ Blofield .....	7.62	...	...	
„ Fakenham (Cranmer Hall)	8.07	...	...	Wettest Oct. for 22 years.
VIII. Neston, Hinderton .....	7.66	3.30	+4.36	
XI. Colwyn Bay, Nant-y-Glyn ..	10.32	3.76	+6.56	
„ Llandudno .....	8.56	3.39	+5.17	
XVII. Keith, H.R.S. ....	10.17	3.45	+6.72	
„ Forres, H.R.S. ....	5.10	2.43	+2.67	
XVIII. Inverness (Culloden) ...	5.37	2.25	+3.12	
„ Cawdor [Nairn].....	5.82	2.73	+3.09	

## ON THE PRODUCTION OF RAIN.

By PROF. CLEVELAND ABBE.

*(Concluded from p. 137.)*

Bezold suggests that the heavy rains generally known as cloud-bursts are immediately preceded by, and may owe their origin to, a supersaturated state of the atmosphere, by reason of which a greater quantity of vapor is contained in the air than would, under other conditions, be possible at a given temperature. Following out this hypothesis, I conclude that, whatever molecular condition it be that permits the existence of a supersaturated atmosphere, it is evident that the removal, or annulment, of that condition must give rise to an immediate and heavy condensation. This principle may be extended to all ordinary rains as well as to the violent thunder showers and cloud-bursts.

The supersaturated condition must be considered as a case of adiabatic expansion\* accompanied by a delay in the occurrence of the appropriate condensation; as far as we at present know, this condition can occur only in those cases where all foreign substances, or dust particles, are absent, which might serve as nuclei for the formation of fog particles. A slowly rising and cooling atmosphere first condenses its moisture on the dust nuclei and forms minute droplets; these grow very slowly, by diffusion, up to a definite size proper to the prevailing temperature and vapor tension, but the intermediate air, in which these droplets are floating, keeps on cooling as a dust-free, supersaturated vapor. If the sun shines on these droplets its heat powerfully contributes to evaporate them and further saturate the surrounding air.

In general, therefore, the ascending portions of every cloud contain supersaturated, dust-free vapor separating the isolated droplets. When by further expansion and cooling the supersaturation has proceeded to such an extent that further condensation must occur, this latter molecular change permeates the supersaturated space with a rapidity comparable to that with which any other chemical change takes place, just as when the explosive union of chlorine and hydrogen, or of oxygen and hydrogen, starting at any one point, almost instantaneously permeates a mass of those mixed gases, or, as when combustion runs along a train of gunpowder. The vapor molecules from the supersaturated spaces are quickly brought together by their molecular attractions into heavy drops of warm water which are often distinct from the intermediate cooler droplets and descend rapidly from the clouds, while the latent heat of condensation is communicated to the adjoining air and is left behind in the cloud. Thus simultaneously with the formation and fall of the big drops there is a sudden expansion of that portion of the clouds from which they came; Bezold thinks that such expansion may

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\* *i. e.*, without adding or subtracting heat.

possibly be felt at the earth's surface as a sudden rise in the barometer, while it is also visible to the eye as a sudden expansion of the cloud into the so-called "thunder-head." I myself doubt whether there would be any appreciable barometric result, yet I consider that the sudden expansion and ascent of the white cloud and its subsequent rapid dissipation into the surrounding air, together with the simultaneous lightning, thunder, rain, hail, and ascending whirl of wind, all conspire to make it very plausible that there really existed a supersaturated condition at the moment immediately preceding.

If the temperature of the dew-point of the ascending air, or the temperature of supersaturation is below freezing, the condensation of the vapor may at once form, not drops, but large snowflakes, such as will fall rapidly to the ground, or the small hail that is ordinarily called sleet.

Correlated phenomena occur when a cloud consists of small particles of water cooled below the freezing point, as is known to be frequently the case. When for any reason these particles are suddenly converted into ice, as will happen when they are cooled low enough or when they jostle against each other, their temperatures at once rise to the freezing point, a large quantity of heat is set free, the cloud expands and rises and the droplets of water are converted into spiculæ of ice, or small snow-flakes; large flakes and hailstones are not to be explained in this manner.

There is some plausibility in the hypothesis that the critical electrical condition, which results in lightning, is directly due to the disruption of the condition of extreme supersaturation and the sudden formation of large drops of water, or the disruption of the condition of water cooled below the freezing point and the consequent sudden formation of ice or snow, but this remains to be investigated.

Therefore, according to this latest view of the subject, the problem of the artificial formation of rain will be partially solved and, sufficiently so for practical purposes, if some method is invented by which to bring about a sudden formation of a small percentage of large drops, out of the moist air that exists between the small particles of every cloud.

At present our attention, and experiments, should be directed toward understanding and completing the natural and obscure process involved in the formation of rain within the cloud and not toward the forcing of any unnatural process.

*Washington, D.C., May 20, 1892.*

## CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, APRIL, 1892.

STATIONS.  (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.	Aver. Cloud.	
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.		Days.
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	0-100	°	°	inches		
England, London .....	73·0	4	28·2	17	59·6	36·8	36·8	69	118·7	21·7	·99	9	3·3
Malta.....	72·5	25	49·9	21	65·8	55·5	53·4	81	131·6	43·5	2·32	9	5·3
Cape of Good Hope ...	80·7	29	44·1	18	69·1	54·2	...	...	...	...	2·34	5	4·6
Mauritius.....	83·7	4	69·0	9	82·1	72·9	70·5	81	134·5	63·7	5·68	14	5·7
Calcutta.....	102·7	26	71·2	16	94·3	77·3	76·0	74	155·5	68·4	1·65	3	3·0
Bombay.....	93·3	6	76·6	1	90·5	81·0	76·1	73	143·5	66·5	·00	0	2·3
Ceylon, Colombo .....	90·7	1	72·0	24	87·3	76·6	72·7	78	154·0	70·0	13·92	18	6·3
Melbourne.....	85·3	2	40·5	16	65·1	48·5	48·6	75	135·1	33·4	5·63	13	6·1
Adelaide .....	89·3	2	43·5	26	69·1	51·9	48·3	65	152·8	32·6	1·61	15	6·2
Tasmania, Hobart.....	...	...	...	...	...	...	...	...	...	...	...	...	...
Wellington .....	...	...	...	...	...	...	...	...	...	...	...	...	...
Auckland .....	73·0	7	49·0	28	68·9	57·4	58·3	85	128·0	38·0	2·02	12	5·9
Jamaica, Kingston.....	89·7	14	66·8	7	86·1	69·3	67·0	69	...	...	·81	5	6·1
Trinidad .....	92·0	13	64·0	10	84·1	67·4	70·3	79	157·0	54·0	7·59	23	...
Toronto .....	71·6	5	20·2	25	50·4	32·4	30·3	63	...	10·2	1·26	12	4·9
New Brunswick, Fredericton .....	60·7	3	18·9	25	50·5	30·1	26·7	55	...	...	·97	9	4·4
Manitoba, Winnipeg ...	64·0	22	7·0	8	41·9	22·7	...	...	...	...	1·91	8	4·9
British Columbia, Esquimaux.....	65·6	20	30·0	7	53·2	39·8	44·0	91	...	...	2·53	21	6·4

## REMARKS.

**MALTA.**—Mean temp. 59°·6. Mean hourly velocity of wind 12·9 miles. Sea temp. rose from 59°·8 to 62°·5. Thunderstorms on 2nd, 4th, and 21st. J. SCOLLES.

**Mauritius.**—Mean temp. of air 0°·8 above, of dew point 2°·2 above, and rainfall ·04 in. below, their respective averages. Mean hourly velocity of wind 8·7 miles, or 2·0 below average; extremes, 103·3 on 29th and 1·9 on 11th; prevailing direction E.S.E. Thunder and lightning on 11th, 12th, 27th, and 28th. A terrific hurricane swept over the island on 29th, causing great loss of life and property. The greatest velocity of the wind for 5 minutes was at the rate of 121 miles, and the maximum velocity for one hour 103 miles from 3.30 to 4.30 p.m. The barometer (at sea level) fell to 27·961 in. The centre passed over the island, and the wind was strongest from W.S.W. after the passage of the centre. C. MELDRUM, F.R.S.

**Melbourne.**—Mean temp. of air 1°·8, and of dew point 0°·9 below the average of 34 years. Humidity 3, amount of cloud 0·2, and rainfall 3·37 in., above the average. Prevailing wind W., strong on 6 days. Heavy dew on 9 days. Hoar frost on 2 days. R. L. J. ELLERY, F.R.S.

**Adelaide.**—The weather was very cold, the mean temp. being 3°·8 below the average, and the lowest on record for April. The rainfall was made up for the most part of very light showers, and is slightly less than the average. The southern portions of the colony experienced fair to moderate rains, but over the northern areas and inland the drought continued. C. TODD, F.R.S.

**Auckland.**—On the whole a warm and dry month. Mean temp. considerably above, but rainfall much below, the average of 25 years. T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL,  
OCTOBER, 1892.

[For the Counties, Latitudes, and Longitudes of most of these Stations,  
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger Hall.	4·69	XI.	Rhayader, Nantgwillt..	6·10
"	Birchington, Thor .....	5·39	"	Corwen, Rhug .....	7·20
"	Brighton, Prestonville Rd	5·52	"	Carnarvon, Cocksidia ...	5·98
"	Hailsham .....	6·16	"	I. of Man, Douglas .....	6·81
"	Ryde, Thornbrough .....	4·48	XII.	Stoneykirk, Ardwell Ho.	4·34
"	Alton, Ashdell .....	4·79	"	New Galloway, Glenlee	6·11
III.	Oxford, Magdalen Col...	3·09	"	Melrose, Abbey Gate...	4·52
"	Banbury, Bloxham .....	2·75	XIII.	N. Esk Res. [Penicuik]	5·00
"	Northampton, Sedgebrook	3·81	"	Edinburgh, Blacket Pl..	...
"	Cambridge, Fulbourne..	...	XIV.	Glasgow, Queen's Park.	3·77
"	Wisbech, Bank House..	5·32	XV.	Islay, Gruinart School..	5·90
IV.	Southend .....	4·42	XVI.	Dollar .....	5·64
"	Harlow, Sheering ... ..	3·95	"	Balquhider, Stronvar..	6·24
"	Rendlesham Hall .....	6·95	"	Coupar Angus Station..	3·80
"	Diss .....	6·61	"	Dunkeld, Inver Braan..	2·95
"	Swaffham .....	6·89	"	Dalnaspidal H.R.S. ...	6·68
V.	Salisbury, Alderbury...	4·94	XVII.	Keith H.R.S. ....	10·17
"	Bishop's Cannings .....	3·82	"	Forres H.R.S. ....	5·10
"	Blandford, Whatcombe.	6·09	XVIII.	Fearn, Lower Pitkerrie.	3·87
"	Ashburton, Holne Vic....	6·73	"	Loch Shiel, Glenaladale	6·87
"	Okehampton, Oaklands.	6·81	"	N. Uist. Loch Maddy ...	4·01
"	Hartland Abbey .....	4·14	"	Invergarry .....	4·40
"	Lynmouth, Glenthorne.	4·91	"	Aviemore H.R.S. ....	5·55
"	Probus, Lamellyn .....	5·80	"	Loch Ness, Drumnadrochit	6·50
"	Wincanton, Stowell Rec.	4·22	XIX.	Lairg H.R.S. ....	...
"	Weston-super-Mare .....	2·02	"	Scourie .....	5·83
VI.	Clifton, Pembroke Road	2·94	"	Watten H.R.S. ....	5·24
"	Ross, The Graig .....	1·89	XX.	Dunmanway, Coolkelure	3·62
"	Wem, Clive Vicarage ...	3·78	"	Fermoy, Gas Works ...	3·19
"	Cheadle, The Heath Ho.	3·97	"	Killarney, Woodlawn ...	5·13
"	Worcester, Diglis Lock	1·40	"	Tipperary, Henry Street	3·02
"	Coventry, Coundon .....	2·73	"	Limerick, Kilcornan ...	1·34
VII.	Ketton Hall [Stamford]	4·03	"	Ennis .....	2·35
"	Grantham, Stainby .....	4·73	"	Miltown Malbay .....	2·64
"	Horncastle, Bucknall ...	4·66	XXI.	Gorey, Courtown House	3·11
"	Workshop, Hodsock Priory	4·39	"	Mullingar, Belvedere...	2·64
VIII.	Neston, Hinderton .....	7·66	"	Athlone, Twyford .....	2·53
"	Knutsford, Heathside...	4·39	"	Longford, Currygrane...	2·23
"	Lancaster .....	...	XXII.	Galway, Queen's Coll...	2·39
"	Broughton-in-Furness..	5·93	"	Crossmolina, Enniscoe..	4·29
IX.	Ripon, Mickley .....	7·43	"	Collooney, Markree Obs.	4·42
"	Scarborough, South Cliff	6·81	"	Ballinamore, Lawderdale	2·43
"	East Layton [Darlington]	5·34	XXIII.	Lough Sheelin, Arley ..	1·82
"	Middleton, Mickleton..	5·16	"	Warrenpoint .....	4·06
X.	Haltwhistle, Unthank..	4·84	"	Seaforde .....	4·30
"	Bamburgh .....	5·99	"	Belfast, Springfield .....	4·59
"	Newton Reigny .....	5·01	"	Bushmills, Dundarave...	4·33
XI.	Llanfrechfa Grange .....	3·34	"	Stewartstown .....	2·69
"	Llandovery .....	4·36	"	Buncrana .....	5·57
"	Castle Malgwyn .....	5·93	"	Lough Swilly, Carrablagh	5·30
"	Builth, Abergwessin Vic.	7·69			

## OCTOBER, 1892.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which "01 or more fell.	TEMPERATURE.						No. of Nights below 32°.	
		Total Fall.	Difference from average 1880-9.	Greatest Fall in 24 hours		Max.		Min.		In shade.	On grass.				
				Dpth	Date			Deg.	Date			Deg.	Date.		
		inches.	inches.	in.				Deg.	Date	Deg.	Date.				
I.	London (Camden Square) ...	3·78	+ ·89	1·11	30	21	60·4	29	29·2	26	3	11			
II.	Maidstone (Hunton Court)...	5·39	+ 1·93	1·75	4	21	...	...	...	...	...	...			
	Strathfield Turgiss .....	4·32	+ 1·48	1·24	30	22	58·7	29	23·9	26	6	17			
III.	Hitchin .....	3·31	+ ·24	·74	30	24	60·0	29	25·0	25	7	...			
	Winslow (Addington) .....	3·59	+ ·50	·82	27	23	60·0	29	23·0	26	8	11			
IV.	Bury St. Edmunds (Westley)	5·57	+ 2·30	1·32	29	25	58·0	30	23·0	26	...	...			
	Norwich (Cossey) .....	7·21	+ 3·37	1·10	30	25	...	...	...	...	...	...			
V.	Weymouth (Langton Herring)	4·45	+ ·91	1·17	28	20	60·0	6	32·0	24	1	...			
"	Torquay, Babbacombe ...	4·71	+ ·25	·94	26	18	59·9	6	32·9	24	0	14			
"	Bodmin (Fore Street) .....	6·79	+ ·79	1·14	26	23	...	...	...	...	...	...			
VI.	Stroud (Upfield) .....	2·50	— ·53	·55	27	19	60·0	29	28·0	25	5	...			
"	Church Stretton (Woolstaston)	4·04	+ ·27	·84	3	19	56·0	4, 7b	28·0	26	4	14			
"	Tenbury (Orleton) .....	2·18	— 1·03	·44	27	19	59·0	4, 9b	21·5	9	15	...			
VII.	Leicester (Barkby) .....	3·79	+ ·64	1·03	2	22	60·0	6c	20·0	25	12	18			
"	Boston .....	4·51	+ 1·40	·68	13	21	60·0	14	26·0	26	5	...			
"	Hesley Hall [Tickhill] .....	4·63	+ 1·53	1·04	14	22	60·0	28d	23·0	26	5	...			
VIII.	Manchester (Plymouth Grove)	4·48	+ 1·11	·69	9	19	58·0	1, 28	26·0	26	8	15			
IX.	Wetherby (Ribston Hall) ...	5·40	+ 2·27	1·64	14	17	...	...	...	...	...	...			
"	Skipton (Arncliffe) .....	9·86	+ 3·83	2·59	14	22	56·0	29	22·0	26	7	...			
"	Hull (Pearson Park) .....	5·64	+ 1·99	1·85	14	25	61·0	29	26·0	26	6	9			
X.	Newcastle (Town Moor) .....	4·57	+ 1·45	·80	2	26	...	...	...	...	...	...			
"	Borrowdale (Seathwaite) .....	12·11	+ 1·52	2·06	27	22	...	...	...	...	...	...			
XI.	Cardiff (Ely) .....	2·47	— 2·07	·52	27	16	...	...	...	...	...	...			
"	Haverfordwest .....	4·39	+ ·76	1·14	27	25	57·2	29	22·3	26	7	13			
"	Aberystwith, Gogerddan .....	5·50	+ ·15	·77	6	21	...	...	20·0	25	15	...			
XII.	Llandudno .....	8·56	+ 5·17	1·59	3	25	58·8	28	...	...	...	...			
"	Cargen [Dumfries] .....	4·40	+ 1·14	·98	27	14	57·4	6	19·4	26	9	...			
XIV.	Jedburgh (Sunnyside) .....	5·00	+ 2·35	1·03	2	23	54·0	27	18·0	25	6	...			
XV.	Old Cumnock .....	3·13	— ·27	·66	27	20	...	...	...	...	...	...			
"	Lochgilhead (Kilmory) .....	4·49	— ·30	·86	27	16	...	...	19·0	24	13	...			
"	Oban (Craigvarren) .....	3·51	...	·67	5	13	57·6	14	26·0	25	3	...			
"	Mull (Quinish) .....	4·25	+ 1·04	·78	26	19	...	...	...	...	...	...			
XVI.	Loch Leven Sluices .....	4·70	+ 1·74	·80	4, 28	14	...	...	...	...	...	...			
"	Dundee (Eastern Necropolis)	3·80	+ 1·56	·90	27	20	56·9	1	25·0	25	5	...			
XVII.	Braemar .....	5·51	+ 1·90	1·39	5	24	57·0	28	16·3	25	5	17			
"	Aberdeen (Cranford) .....	5·13	...	·71	22	28	57·0	1	28·0	24e	3	...			
XVIII.	Strome Ferry .....	5·34	— ·33	·82	5	21	...	...	...	...	...	...			
"	Cawdor [Nairn] .....	5·82	+ 3·09	1·01	9	26	...	...	...	...	...	...			
XIX.	Dunrobin .....	3·78	+ ·47	·67	27	18	55·5	3	27·8	25	3	...			
"	S. Ronaldsay (Roeberry) .....	4·59	+ ·86	·93	5	27	55·0	4	32·0	24	1	...			
XX.	Darrynane Abbey .....	3·06	...	1·24	26	19	...	...	...	...	...	...			
"	Waterford (Brook Lodge) ...	2·36	— 1·46	·89	26	9	58·0	3	26·0	24	7	...			
"	O'Brien's Bridge (Ross) .....	1·71	...	·41	14	14	60·0	3	28·0	19	4	...			
XXI.	Carlow (Browne's Hill) .....	1·97	— 1·32	·32	28	16	...	...	...	...	...	...			
"	Dublin (Fitz William Square)	2·54	— ·84	·78	14	17	58·2	28	28·3	26	4	13			
XXII.	Ballinasloe .....	1·68	— 1·31	·42	26	14	56·0	28	24·0	26	10	...			
"	Clifden (Kylemore) .....	8·15	...	2·06	26	19	...	...	...	...	...	...			
XXIII.	Waringstown .....	3·44	+ ·73	·80	14	18	63·0	28	19·0	25	8	14			
"	Londonderry (Creggan Res.) ..	5·44	+ 1·77	·91	27	29	...	...	...	...	...	...			
"	Omagh (Edenfel) .....	3·72	+ ·62	·50	26a	24	56·0	27b	21·0	25	9	14			

a And 27. b And 28. c And 28, 29. d And 29. e And 25, 31.

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

# METEOROLOGICAL NOTES ON OCTOBER, 1892.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail. S for Snow.

## ENGLAND.

STRATHFIELD TURGISS.—A pleasant month on the whole, but with very heavy R towards the close. T on the 30th. Swallows last seen on October 1st.

ADDINGTON.—A cold month, with R on 23 days; heavy falls at the end, causing large floods. The 29th was the warmest day and the warmest night of the month, with a max. temp. of 60°, and a min. of 52°. The min. fell below 40° on 21 nights.

BURY ST. EDMUNDS.—Observations were commenced in 1857, and since that time there have been only two months with more R than this month—viz., October, 1865 (5·58 in.), and July, 1872 (5·92 in.)—and no other month has had so many wet days. S fell on 21st.

LANGTON HERRING.—A cold, wet month, the mean 9 a.m. temp. being 4°·1 below the average of 21 years, and the lowest in October during that time. From the 17th to the 26th the cold was unusually severe, but a change to mild weather occurred on the 27th. In the three days 26th to 28th, 2·60 in. of R fell. L on 1st and 2nd; gales on 8th and 9th; solar halo on 30th.

BABBACOMBE.—A very cold, rather wet, but sunny month. Mean temp. 46°·9, 3°·5 below the average of 15 years. It was generally showery from 1st to 11th, 14th to 16th, and 20th to 29th, with heavy R on 26th and 27th; cold from 1st to 5th, 7th to 14th, and 16th to 26th. No R was recorded in the five days from 15th to 19th, but 2·68 in. fell in the five days from 24th to 28th. The mean temp., the mean max., the absolute max., and the mean min. were all the lowest recorded in October; the average amount of cloud (5·0) was also the smallest in the same month. L on 1st, 2nd, 13th, 14th and 15th. Solar halos on 5 days.

BODMIN.—A very seasonable month, but with a large rainfall. Stormy, with very heavy R on 26th and 27th. The last three days very mild. Occasional frost.

WOOLSTASTON.—A wet month. Mean temp. 44°·0. S fell on the 22nd, followed by a week of frost.

TENBURY, ORLETON.—With two exceptions (1880 and 1887), the coldest October in 30 years, the mean temp. being 2°·3 below the average. The frost on 26th was the most severe in October since 1859. Much fog at the end of the month.

BOSTON.—Notwithstanding the heavy R of this month there has not been, owing to the excellent system of drainage in the Fens, any flooding as in other parts of the country. There have been one or two good freshets down the river, but the water has got quickly away and fallen in a few days to ordinary summer level. The condition of the land at the surface is very wet, interfering with the completion of the harvest, and the raising of the potatoes and other roots; the main drains and ditches, however, have not yet risen to their ordinary winter level.

MANCHESTER.—The weather on the whole was cold, wet, and very unsettled. Mean temp. 44°. T and L on the 1st. Dense fogs on the mornings of the 11th, 18th, and 31st; fogs on the 19th, 20th, and 27th.

## WALES.

HAVERFORDWEST.—R fell almost every night, although the total is not great. The temp. was always below the average until the 27th, when a warm wave passed over, accompanied by stormy weather, with heavy R; previous to which the weather was very bright, bracing, and intensely cold. A TS occurred about 8 p.m. on 2nd, lasting half an hour; the L was vivid and forked, of a beautiful blue colour; the T deafening, accompanied by very large H. Wind mostly N. or N.W. Temp. the lowest in October since 1881.

LLANDUDNO.—Heavy showers all day on 3rd, with T and L about 9 p.m.

## SCOTLAND.

**CARGEN.**—The mean temp. of the month ( $43^{\circ}\cdot 1$ ), and the low temperatures on the 25th ( $21^{\circ}\cdot 6$ ), and on the 26th ( $19^{\circ}\cdot 4$ ), are the lowest recorded here in October. This has been, so far, the coldest year experienced since observations were commenced; every month (with the exception of May, which had an average temp.) being below the average, and the summer and autumn exceptionally cold, with great want of sunshine.

**JEDBURGH.**—Weather very unsettled; much R, with N. and N.E. wind, and harvest operations much retarded. To the south and east of this place much corn is still in the fields. S on the 24th.

**OBAN, CRAIGVARREN.**—After the first week the weather became dry, and this lasting for some time, the crops were safely secured, though late and somewhat damaged.

**BRAEMAR.**—A dark, cold, and dismal month, with S and sleet. Crops all frozen, still upon the fields, and partly uncut; trees prematurely leafless. Duration of sunshine only  $39\frac{1}{2}$  hours.

**ABERDEEN, CRANFORD.**—The grain crops at the close of the month were in the most deplorable condition ever remembered. Oats cut quite unripe, the straw damaged by wet and wind. In the glens nothing has yet been cut.

**ROEBERRY.**—A very wet, cold month. Average max. temp.  $47^{\circ}\cdot 8$ ; average min.  $40^{\circ}\cdot 7$ .

## IRELAND.

**DARRYNANE ABBEY.**—The first week was showery; thence to the 24th fine, but cold, with easterly winds, followed by a gale, and heavy R on the 25th. The last few days were showery.

**WATERFORD, BROOK LODGE.**—Sharp frost on the 18th. Heavy gale from S.E. on the 27th. Mean temp.  $45^{\circ}\cdot 1$ , or  $3^{\circ}$  below that of October, 1891.

**O'BRIENSBRIDGE, ROSS.**—The month opened cold and wintry, and so continued until the 9th, when bright though cool weather set in, and continued to the 26th. The temp. was low during the month, the first sharp frost occurring on the 19th. R much below average, and altogether a very favourable month.

**DUBLIN.**—The coldest October recorded in at least 28 years. The month was characterised by an overwhelming prevalence of N.W. to N.E. winds. Only between the 26th and 29th were the polar winds replaced by a southerly current and high temp. So sudden was the upward movement of the therm. that the temp. stood  $30^{\circ}$  or upwards higher on the 27th than it had been on the 26th, and the air temp. on the 27th was  $14^{\circ}$  above that of the water in the Vartry mains. Mean temp.  $44^{\circ}\cdot 8$ ,  $4^{\circ}\cdot 9$  below the average, and the lowest recorded in October. High winds on 8 days, attaining the force of a gale on the 9th, 14th, 26th, and 27th. Foggy on 5 days. T and L on 2nd and 21st. H on 7 days.

**WARINGSTOWN.**—Though the R did not greatly exceed the average, the distribution rendered it a damp month, and delayed the conclusion of harvest. The frost on the 24th and 25th was the most severe on record so early in the year.

**EDENFEL.**—Polar winds prevailed without a break until the 26th, accompanied, according to experience, by low average temp., but contrary to experience, by persistently wet and unsettled weather. The keen and unusual frost on the 26th ( $18^{\circ}$  on the grass) was suddenly followed by a reversal of these conditions, and the month ended in generally soft and humid weather.