XXVII. *On the Meteorology of the Lake District of Cumberland and Westmoreland, including the Results of Experiments on the Fall of Rain at various heights, up to* 3166 *feet above the sea-level.—Fourth paper, for the year* 1850. *By* JOHN FLETCHER MILLER, *F.R.S., F.R.A.S., Assoc. Inst. C.E. &c.*

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Introductory Remarks.

IN the month of December last I visited the Lake District, chiefly with the view of ascertaining approximately, the heights above the sea of some of the mountain gauges which I have hitherto been obliged to estimate. The heights of these stations were taken by means of an excellent aneroid barometer (previously compared with a standard), and a standard barometer read simultaneously, or nearly so, at the sea-level. By this method I found the height of Cockermouth above the sea to be 127 feet, Keswick 253 feet (Crosthwaite 258 feet), Bassenthwaite Lake and Lowdore (measured from Keswick) 214 and 224 feet respectively; Seathwaite (mean of two observations calculated from Lowdore) 368 feet; from Wastdale Head, 399 feet; and taken direct from the sea-level, 389 feet. I find the summit of Seatollar Common to be about 1590 feet, and the gauge 1388 feet above the sea, assuming the elevation of Seathwaite to be 368 feet; the gauge on Sprinkling Fell or the Stye, 948 feet, measured from Wastdale, and 936 feet by a simultaneous barometrical reading at the coast. Two distinct observations taken on the 16th and 17th of December, show the gauge near the top of Stye Head Pass to be 1443 and 1448 feet above the sea respectively, supposing the height of Wastdale Head village to be 247 feet. Mr. OTLEY states the summit of the Pass to be 1250 feet above the valley, or, taking Wastdale Head at 247 feet, 1497 feet above the sea; and an observation of Dr. DALTON's from the same base, gives 1506 feet, both of which correspond very nearly with my own results, as the gauge is somewhat *below* the highest part of the road leading over the Pass. I have hitherto stated the height of this station to be 1250 feet, but it appears I have misinterpreted my authority (Mr. OTLEY), whose calculation represents the height above the *valley*, not above the sea. The gauges on Brant Rigg and on Lingmell appear to be 924 and 1778 feet respectively above the sea. At the latter station, the barometer fell to 27·00 in., while in the valley it stood at 28·67 in., and at Whitehaven at 28·86 in. Temperature in the valley 48°; at 1778 feet, 32°·8, wet bulb 32°·2, heavy rain falling. I was prevented from ascending to any of the higher stations by the unfavourable state of the weather; indeed the barometrical observation at Brant Rigg, and also a second reading on Stye Head were taken at night, after

having been confined to the valley the whole of the day by torrents of rain; I have consequently not had an opportunity of ascertaining the altitude of Sprinkling Tarn, but in 1812 Dr. DALTON states it to be 1860 feet; and another observation, either by DALTON or OTLEY, gives 1943 feet above the sea. I have therefore allowed the elevation of 1900 feet, previously given in my tables, to remain unaltered for the present. A complete and authentic table of the heights of our principal lakes and mountains is much wanted. Of the elevations given in the Guide Books to the Lake District, some are probably not far from the truth, but others are undoubtedly very erroneous; thus, Ennerdale Lake, by the Whitehaven Waterworks' Survey, proves to be 356 feet above the sea, instead of 246 feet, as stated in one of these treatises, showing an error or miscalculation of 110 feet. This is, no doubt, an extreme instance; but the altitudes of several of our lakes and mountains are yet unknown; and a careful measurement or remeasurement of the whole of them with accurate instruments and under favourable circumstances, is very desirable, as the results would be more or less interesting and valuable both to the meteorologist and the geologist, the botanist and the tourist.

TABLE I.—Synopsis of the Fall of Rain in the Lake District of Cumberland and Westmoreland, in the year 1850.

No.	I.	III.	IV.	V.			VI.	VII.	VIII.	IX.	X.	XI.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XX.	Prevailing winds.		
	Whitehaven.			Cockermouth, &c.											Westmoreland†.			Borrowdale.				
1850.	High Street, 90 feet above the sea.	St. James's Church Steeple, 78 feet above the street.	The Flosh, three miles south of Whitehaven.	The Town, 127 feet above the sea.	Tarn Bank*, 207 feet above the sea.	Broughton Moor, 410 feet above the sea.	Fassenthwaite Halls, 210 feet above the sea.	Keswick, 258 feet above the sea.	Vale of Gillerthwaite, Ennerdale, 396 feet above the sea.	Loweswater, 336 feet above the sea.	Foot of Crummock Lake, 260 feet above the sea.	Gatesgarth, 290 feet above the sea.	Eskdale Head.	Wastdale Head, 247 feet above the sea.	The How, Troutbeck, 300 ? feet above the sea.	Ambleside, 190 ? feet above the sea.	Langdale Head, 250 ? feet above the sea.	Seathwaite, 368 feet above the sea.	Stonethwaite, 330 feet above the sea,	At Crummock Lake, two observations daily.	At Seathwaite, one observation daily.	At the Coast, two observations daily.
January.....	in. 2·995	in. 2·797	in. 3·63	in. 4·14	in. 3·23	in. 3·56	in. 3·10	in. 2·944	in. 4·89	in. 4·130	in. 4·49	in. 4·13	in. 5·68	in. 7·26	in. 4·744	in. 5·20	in. 7·07	in. 7·34	in. 5·20	E. var.	N.W. var.	S.W.
February ...	4·836	3·104	6·18	6·53	4·84	3·96	6·40	8·582	12·00	8·775	10·87	15·66	9·52	15·25	15·504	14·45	21·66	22·58	17·01	N.W. & S.W.	N.W.	S.W.
March	·969	·553	1·65	1·33	1·03	·59	1·45	1·268	4·13	2·365	3·31	3·38	3·59	3·55	1·624	1·73	3·04	4·13	3·42	Easterly.	E. & W.	Westerly.
April.....	3·113	2·304	4·08	2·46	2·79	2·07	3·30	4·760	7·14	5·255	8·01	10·34	8·25	9·34	8·523	6·64	11·51	15·62	9·63	S.E.	S.E. var.	S.W.
May	1·329	·823	1·37	2·08	1·60	1·50	2·26	2·721	3 00	2·935	4·27	6·20	3·45	4·78	3·377	2·91	5·46	7·14	5·89	S.W. var.	Westerly.	S.W.
June	2·012	1·233	2·63	4·17	2·38	2·40	3·74	3·910	6·30	6·000	5·40	5·79	4·69	5·97	4·845	3·99	6·76	6·83	4·43	S.W.	S.W.	S.W.
July	5·358	4·131	6·66	6·18	5·65	4·53	5·35	6·254	8·65	8·265	8·26	11 56	6·46	9·75	7·189	6·54	9·50	11·20	9·45	N.W.	S.E. & S.W.	N.W. var.
August	4·501	3·073	5·74	4·92	4·53	3·63	5·00	7·205	10·43	7·840	10·73	15·75	8 47	11·28	8·362	9·27	13·40	16·22	12·50	N.W.	N.W.	N.W.
September...	2·643	2·158	2·52	2·07	2·54	2·03	1·51	3·234	4·03	3·110	4·01	5·21	4·02	3·93	2·810	3·82	4·12	5·85	4·46	E. var.	E. var.	S.W.
October.....	3·364	2·213	4·86	3·69	4·53	2·83	3·66	5·582	6 00	6·045	7·58	8·52	8·27	11·60	6·556	6·58	14·92	12·94	9·33	N.W.	N.W. & S.W.	N.W. var.
November...	6·258	4·152	8·13	7·44	4·84	4·75	7·24	8·966	12·34	9·545	12·72	15·45	12·16	17·82	9·798	13·26	20·55	22·60	16·94	S.W. & N.W.	S.W.	S.W.
December...	3·095	2·095	3·83	2·73	3·06	2·50	3·96	4·102	5·72	4·533	6·01	6·85	7·13	8·23	6·476	5·46	8·57	11·51	7·55	S.W.	S.W. & N.W.	S.W.
1850.	40·473	28·636	51·28	47·74	41·02	34·35	46·97	59·528	84·63	68·798	85·66	108·84	81·69	108·76	79 808	79·85	126·56	143·96	105·81	S.W. & N.W.	N.W. & S.W.	S.W.
1849.	38·999	28·210	45·13	38·39	38·71	31·82	40·00	48·80	76·41	55·28	70·21	97·09	71·22	107·22	75·420	65·32	107·83	125·47	94·27	S.W.	S.W.	S.W.
1848.	47·342	36·344	60·82	52·37	.....	.....	47·06	66·407	97·73	76·668	98·07	133·55	86·78	115·32	91·347	77·58	130·38	160·89	130·24	S.W.	S.W.	S.W.
1847.	42·921	30·713	47·80	42·55	.....	.....	44·45	58·286	80·13	66·296	82 32	106·25	74·93	96·34	78 004	.....	112·95	129·24	106·21	W.	S.W.	S.W.
1846.	49·134	35·422	55·16	52·41	.....	.....	.....	67·678	83·87	79·249	96·47	121·90	.....	106·93	77·719	.....	127·40	143·51		S.W.	S.W.	S.W.
1845.	49·207	33·489	53·00	46·93	.....	.....	.....	62·202	76·88	69·542	87·48	124·13	.....	108·55	76·305	.....	136 00	151·87	.....	S.W. var.	.....	S.W. var.
1844.	36·723	27·862	39·31	.....	.....	.....	.....	40·629	54·62	49·829	61·46	.....	.....	80·01	51·986							
Mean of 7 years	43·514	31·525	50·35	46·73	39·86	33·08	44·62	57·467	79·18	66·523	83·09	108·84	78·65	103·30	75·798	74·25	123·52	142·49	109·13	S.W.	S.W.	S.W.

* Tarn Bank bears S.W. from Cockermouth, distant four miles; the Broughton Moor Station is three miles N.W. of Cockermouth, and $2\frac{3}{4}$ miles S.E. of Maryport.

† At Kendal, the fall in 1850 is 49·57 inches (average of twenty-eight years, 54·43 inches); at Selside, six miles from Kendal, 76·39 inches (average of three years, 73·87 inches); and at Bowness, near Windermere Lake, 64·28 inches.

Table II.—Wet Days.

1850.	Whitehaven.	The Flosh.	Cockermouth.	Tarn Bank, near Cockermouth.	Bassenthwaite Halls.	Keswick.	Loweswater Lake.	Crummock Lake.	Wastdale Head.	Troutbeck*.	Ambleside.	Langdale Head.	Seathwaite.	Stonethwaite.
January ...	12	15	9	12	11	13	12	12	16	9	13	13	12	12
February...	20	22	20	23	21	22	23	20	26	21	21	23	23	22
March.....	10	10	9	11	9	11	9	12	15	7	5	12	12	9
April	18	17	18	20	18	20	21	21	24	20	21	20	21	21
May	15	15	14	18	14	16	14	14	21	16	14	14	19	14
June	10	10	15	15	12	12	14	12	19	12	11	13	16	14
July.....	13	15	18	18	19	19	14	17	17	14	11	15	15	13
August ...	22	24	23	17	21	23	19	20	24	16	17	22	24	18
September..	11	10	10	9	10	12	12	12	13	9	8	11	12	10
October ...	19	20	19	17	18	20	22	22	25	22	22	22	24	24
November..	19	23	23	14	22	23	20	24	26	21	22	24	24	23
December..	20	20	21	19	19	18	18	18	22	18	17	22	21	19
1850.	189	201	199	193	194	209	198	204	248	185	182	211	223	199
1849.	189	185	191	.....	182	205	191	185	236	186	159	199	193	183
1848.	210	207	228	.....	196	229	217	207	243	201	.....	212	232	224
1847.	191	183	210	.....	199	204	190	199	226	188	.....	209	202	195
1846.	200	208	234	.....	.....	213	198	216	234	194	.....	213	219	
1845.	193	175	212	.....	.....	195	195	202	211	180	.....	.....	211	

Table III.—Showing the Quantity of Rain received by the Mountain Gauges in eleven months, between the 1st of February and the 31st of December 1850.

No.	XXI.	XXI.[2]	XXII.	XXIII.	XXIV.	XXV.	XIV.	XIII.	XXVII.	XXVI.	XIX.
							The Valley.		Borrowdale.		
1850.	Sca Fell Pike, 3166 feet above the sea.	Lingmell, 1778 feet above the sea.	Great Gabel, 2925 feet above the sea.	Sprinkling Tarn, 1900 ? feet above the sea.	Stye Head, 1448 feet above the sea.	Brant Rigg, 924 feet above the sea.	To the west, Wastdale, 247 feet above the sea.	To the south-east, Eskdale, height unknown.	The Stye, 948 feet above the sea.	Seatollar Common, 1388 feet above the sea.	The Valley, Seathwaite, 368 feet above the sea.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
February†..	10·50	12·00	12·82	17·60	13·32	12·00	15·25	9·52	29·40	21·20	22·58
March.....	Frozen.	Frozen.	Frozen.	Frozen.	Frozen.	Frozen.	3·55	3·59	5·06	4·27	4·13
April‡.....	10·00	11·07	9·00	17·00	17·05	12·22	9·34	8·25	20·30	14·34	15·62
May	5·48	4·44	5·28	7·30	6·05	3·95	4·78	3·45	8·36	6·85	7·14
June	6·00	5·95	5·84	7·59	6·15	5·51	5·97	4·69	8·41	8·00	6·83
July.....	9·56	9·36	9·57	12·78	10·98	9·74	9·75	6·46	13·31	10·46	11·20
August ...	11·16	11·77	10·23	17·26	13·59	8·99	11·28	8·47	20·27	18·21	16·22
September..	3·53	4·60	3·41	5·86	5·76	4·80	3·93	4·02	9·91	5·78	5·85
October ...	Frozen.	9·70	10·96	13·18§	17·10	10·84	11·60	8·27	17·11	13·32	12·94
November..	Frozen.	Frozen.	Frozen.	Frozen.	Frozen.	Frozen.	17·82	12·16	28·06	24·15	22·60
December..	24·08‖	23·61	20·17	29·23	25·53	23·05	8·23	7·13	14·14	12·26	11·51
Inches.....	80·31	92·50	87·28	127·80	115·53	91·10	101·50	76·01	174·33	138·84	136·62

* At Kendal, 168; at Selside, six miles from Kendal, 193; and at Bowness, near Windermere Lake, 217 wet days.

† The month of January 1850 was included in the Tables for 1849, in consequence of the gauges being frozen up at the close of the latter year.

‡ April 30. This morning the summits of Gabel and Sca Fell were capped with snow ankle deep, and it froze keenly. The receivers were iced over at both stations, but not so strongly as to prevent the water being measured off.

§ In October, the normal proportion betwixt Stye Head and Sprinkling Tarn is inverted. On inquiry, I find the quantities as given in the Table are correct.

‖ The Sca Fell gauge was frozen on the last day of the year; the receiver was brought down to the valley and the ice melted. The funnel was filled up with snow, which accounts for the relatively small quantity of water received by this gauge during the last quarter. The fall of snow is very much greater on Sca Fell than on Gabel, although the difference in altitude is only 241 feet.

TABLE IV.—For the Summer Months.

No.	XXI.	XXI.[2]	XXII.	XXIII.	XXIV.	XXV.	XIV.	XIII.	XXVII.	XXVI.	XIX.
1850.	Sca Fell Pike, 3166 feet above the sea.	Lingmell, 1778 feet above the sea.	Great Gabel, 2925 feet above the sea.	Sprinkling Tarn, 1900 feet above the sea.	Stye Head, 1448 feet above the sea.	Brant Rigg, 924 feet above the sea.	The Valley. To the West, Wastdale, 247 feet above the sea.	The Valley. To the South-east, Eskdale, height unknown.	Borrowdale. The Stye, 948 feet above the sea.	Borrowdale. Seatollar Common, 1338 feet above the sea.	Borrowdale. The Valley, Seathwaite, 368 feet above the sea.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
May	5·48	4·44	5·28	7·30	6·05	3·95	4·78	3·45	8·36	6·85	7·14
June	6·00	5·95	5·84	7·59	6·15	5·51	5·97	4·69	8·41	8·00	6·83
July	9·56	9·36	9·57	12·78	10·98	9·74	9·75	6·46	13·31	10·46	11·20
August ...	11·16	11·77	10·23	17·26	13·59	8·99	11·28	8·47	20·27	18·21	16·22
September..	3·53	4·60	3·41	5·86	5·76	4·80	3·93	4·02	9·91	5·78	5·85
October ...	8·64	9·70	10·96	13·18	17·10	10·84	11·60	8·27	17·11	13·32	12·91
Inches.....	44·37	45·82	45·29	63·97	59·63	43·83	47·31	35·36	77·37	62·62	60·18

TABLE V.—For the Winter Months.

1850.	Sca Fell Pike.	Lingmell.	Great Gabel.	Sprinkling Tarn.	Stye Head.	Brant Rigg.	The Valley. To the West, Wastdale.	The Valley. To the South-east, Eskdale.	Borrowdale. Seatollar Common.	Borrowdale. On the Stye.	Borrowdale. The Valley, Seathwaite.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
February...	10·50	12·00	12·82	17·60	13·32	12·00	15·25	9·52	21·20	29·40	22·58
March ...	Frozen.	Frozen.	Frozen.	Frozen.	Frozen.	Frozen.	3·55	3·59	4·27	5·06	4·13
April	10·00	11·07	9·00	17·00	17·05	12·22	9·34	8·25	14·34	20·30	15·62
November..	Frozen.	Frozen.	Frozen.	Frozen	Frozen.	Frozen.	17·82	12·16	24·15	28·06	22·60
December..	15·44	23·61	20·17	29·23	25·53	23·05	8·23	7·13	12·26	14·14	11·51
Inches.....	35·94	46·68	41·99	63·83	55·90	47·27	54·19	40·65	76·22	96·96	76·44

TABLE VI.—Temperature at Seathwaite, Borrowdale, 368 feet above the sea-level.

1850.	Absolute Max.	Absolute Min.	Mean of max.	Mean of min.	Approximate mean Temperature.	Mean at 9 A.M.	On Grass. Absolute min.	On Grass. Mean.	On Grass. Radiation. Max.	On Grass. Radiation. Mean.	Prevailing winds.
January	48°	19°	36°·88	29°·82	33°·35	32°·95	11°	23°·42	9°·8	6°·40	N.W. var.
February ...	49·5	29	45·48	38·90	42·14	41·14	19	31·87	16	7·03	N.W.
March	53	21	44·53	34·87	39·70	38·00	18	29·41	10·5	5·46	E. and W.
April	56	32	50·51	40·91	45·71	45·12	27	35·31	15	5·60	S.E. var.
May	68·5	30	54·98	43·80	49·39	48·29	19	35·58	14	8·22	Westerly.
June	73·3	42	61·99	52·53	57·26	56·66	37	46·65	13	5·88	S.W.
July	76	43	65·51	54·02	59·76	59·26	34	47·61	14	6·41	S.E. and S.W.
August	72	39·5	61·06	50·71	55·88	55·13	30·5	44·42	12·5	6·29	N.W.
September ...	61	39	57·46	47·50	52·48	51·18	31	42·60	15	4·91	E. var.
October	55	27	47·26	38·77	43·01	42·60	22	32·86	9·5	4·64	N.W. and S.W.
November ...	52	20·5	43·53	39·03	41·28	41·44	...†	.....	.....	.....	S.W.
December ...	51	22	43·47	36·00	39·73	40·48	...†	.....	.....	.....	S.W. and N.W.
1850.	59·6	30·3	51·05	42·23	46·64	46·02	.....	.....	.....	.....	N.W. and S.W.
1849.	61·8	31·1	51·78	41·81	46·79	46·18	21·5	35·67	12·4	6·23	S.W.
1848*.	62·4	30·5	52·15	42·06	47·10	46·76	20·5	35·18	12·9	6·91	S.W.
1847.	62·7	29·9	52·89	42·04	47·46	47·21					
1846.	63·0	33	53·77	44·05	48·91	48·13					

* On the 1st of May, 1848, the thermometers were removed from the garden wall (where they were affected by solar radiation) to the gable end of a building facing the north where the sun never touches them, but the change of position does not appear to have materially affected the *mean* of the maximum readings.

† The results of the thermometer on grass for November and December, are omitted for the reason assigned in the remarks.

Note.—The mercurial thermometer got deranged in August, and a duplicate sent to supply its place was also found to be separated in the column on its arrival at Seathwaite, and consequently useless. Considerable delay took place before the instruments were adjusted, and the registrar did not receive them again till the middle of December. From about the middle of August till the 17th of December, the maximum was obtained by frequent examination of the spirit thermometer in the course of the day; the mean of the maximum for 1850 is in consequence about 1°·5 too low.

The mercurial thermometer, prior to its getting out of order, was considered to be nearly free from index error, and the night thermometer has been compared with it throughout the scale, and reduced to the mercurial as a standard.

Table VII.

Temperature at Whitehaven on the West Coast, 90 feet above the sea-level, and seventeen miles distant in a direct line, bearing W.N.W. from the hamlet of Seathwaite, Borrowdale.

1850.	Absolute		Mean of Maximum.	Mean of Minimum.	Approximate mean Temperature.	Mean. at 9 A.M.	Naked Thermometers on Grassplot*.							
							Absolute Minimum.		Mean.		Radiation.			
											Maximum.		Mean.	
	Maximum.	Minimum.					On Grass.	On Wool on Grass.	On Grass.	On Wool on Grass.	On Grass.	On Wool on Grass.	On Grass.	On Wool on Grass.
January	48°5	21°5	37°62	30°85	34°241	33°87	12°	8°	25°94	22°74	11°8	15°5	4°91	8°11
February.....	52·5	33	46·00	40·00	43·000	42·55	29·7	26	37·00	34·91	8·3	12·0	3·00	5·09
March.....	52·5	25	45·89	37·30	41·590	40 59	16·2	8	32·35	28·65	10	16	4·95	8·65
April	63	35	54·47	42·83	48·650	49·01	26	19·5	37·73	35·04	10·5	16	5·10	7·79
May	70	32·5	57·35	43·75	50·550	52·00	26	18·5	37·86	34·03	13·5	17	5·89	9·72
June	78·5	44·5	65·55	53·46	59·505	60·53	41·5	37	48·33	45·62	12·5	15·5	5·13	7·84
July	84	47	68·14	55·53	61·835	62·93	42	33·5	51·36	47·88	9	14	4·17	7·65
August	72	42	64·92	52·51	58·715	59·45	33·5	30	46·84	44·10	12	15	5·67	8·41
September	66	39·5	61·83	48·50	55·165	55·55	28	24	42·71	40·01	13	18	5·79	8·49
October	61	32	53·30	42·38	47·846	47·43	26	20·5	37·86	35·16	9	14	4·52	7·22
November	57	24·5	48·90	42·50	45·700	45·38	16	13	37·25	35·74	8·5	12·5	5·25	6·76
December	52·5	25·5	45·61	39·21	42·412	41·97	15·5	12	33·35	31·33	11	17	5·86	7·88
1850.	63·1	33 5	54·13	44·07	49·104	49·28	26·0	20·8	39·04	36·26	10·7	15·2	5·02	7·80
1849.	62·3	33·7	53·24	44·15	48·696		23·5	18·8	38·04	35·05	14·0	18·4	6·11	9·09
1848.	62·9	32·6	53·77	43·79	48·785			20·2		35·73		15·9		8·06
1847.	62·3	33·7	53·85	43·50	48·679			20·5		35·95		15·1		7·45
1846.	64·8	36·1	55·95	45·75	50·858			23·1		38·30		14·6		7·45

* The results of the thermometers exposed to the sky at Whitehaven and at Seathwaite, are not strictly comparable. At Seathwaite, the thermometer on grass is a common spirit thermometer on a boxwood scale. Naked thermometers were used for a year or two, but the observations were so frequently interrupted by breakage, that it was deemed preferable to employ a less fragile instrument.

Remarks.

The fall of rain throughout the Lake District in 1850, is slightly above the average of the six preceding years. At Seathwaite, the depth is 1·77 inch over the average of this period. The largest daily falls in 1850, at the three principal stations, are grouped as under:—

	Wastdale.	Langdale.	Seathwaite.
	days.	days.	days.
Between ½ an inch and 1 inch	38	39	39
Between 1 inch and 2 inches	29	37	34
Between 2 inches and 3 inches	5	6	13
Between 3 inches and 4 inches	2	2	6
Between 4 inches and 5 inches	...	1	...
Days in 1850 exceeding 0·5 inch in depth	74	85	92

Temperature.—At Seathwaite, the average mean temperature of the last five years is 47°·38; mean of maximum, 52°·32; mean of minimum, 42°·43. At Whitehaven, on the west coast, seventeen miles distant in a direct line, bearing W.N.W. from Seathwaite, the mean of the maximum for the same period is 54°·18; mean of minimum, 44°·25; average mean temperature, 49°·22.

The mean difference between the two places is, in the maximum, 1°·86; in the minimum, 1°·82, and in the mean 1°·84, the temperature at Whitehaven being higher than at Seathwaite by these quantities. The mean temperature at Whitehaven from eighteen years' observations is 49°; at Greenwich, the mean for seventy-eight years is 48°·3; and at Somerset House for sixty-nine years, 49°·5.

The radiation of heat from the earth's surface at night, as indicated by self-registering thermometers fully exposed to the sky on grass, appears on the whole to be greater in the mountain valleys than at the coast, and particularly in summer; but, occasionally in the winter months, the results are strangely and unaccountably anomalous. Thus, in November 1850, the mean amount or effect indicated was only 0°·90, and in December the mean reading of the thermometer on the grass was identical with that at 4 feet above the surface. At Whitehaven, the amount in those months was 5°·25 and 5°·86. Yet the same instrument (which has been in use at Seathwaite since 1846) in nearly all the other months of 1850, shows a greater extent of radiation than at Whitehaven. Results almost equally abnormal were presented in the winter of 1846 and 1847, and as such they were omitted from the Tables for that year*. I have examined the thermometer employed at Seathwaite for indicating the direct effect of terrestrial radiation; the column is perfect, and I am satisfied it has no material index error, and that it is correctly read off; moreover, it is exposed in the same place throughout the year. The cause of its occasional anomalous indications in the winter months must therefore be left unexplained for the present.

* Philosophical Transactions, Part I. 1849, p. 85.

The Mountain Gauges.—The phenomena exhibited by the mountain gauges in the year 1850, do not seem to call for any particular comment, as the results are very generally in accordance with the deductions embodied in former papers which have appeared in the Transactions of the Royal Society; and at the present time I am more anxious to eliminate new facts and to accumulate a mass of accurate observations and well-digested results made and obtained both in normal and abnormal seasons and under various modifying circumstances, than to theorize upon or draw from them inferences or conclusions which extended experience may modify, contradict or destroy. The following Table shows the excess or deficiency per cent. of the principal mountain gauges over or under the quantity of rain received by the adjacent valley of Wastdale, both in the summer and winter months, in each year since the instruments were erected in 1846.

The positive sign signifies that the quantity is greater, and the negative sign that it is less than the fall in the valley in the same period.

Summer Months.

Year.	Sca Fell Pike, 3166 feet.	Lingmell, 1778 feet.	Great Gabel, 2928 feet.	Sprinkling Tarn, 1900 feet.	Stye Head, 1443 feet.	Brant Rigg, 924 feet.
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
1846*.	−13·5	...	− 7·5	+ 29·5	+12·0	−10·3
1847*.	−13·5	...	− 7·5	+ 29·5	+12·0	−10·3
1848.	− 1·0	...	− 6·0	+ 41·5	+20·5	−14·0
1849.	− 6·5	− 8·0	− 7·0	+ 17·3	+ 9·0	−18·5
1850.	− 6·2	− 3·2	− 4·3	+ 35·3	+26·1	− 7·3
Algebraical Sums.	−40·7	−11·2	−32·3	+153·1	+79·6	−60·4
Algebraical Means.	− 8·1	− 5·6	− 6·4	+ 30·6	+15·9	−12·0

Winter Months.

Year.	Sca Fell Pike.	Lingmell.	Great Gabel.	Sprinkling Tarn.	Stye Head.	Brant Rigg.
	per cent.		per cent.	per cent.	per cent.	per cent.
1846*.	− 42·5	...	− 38·5	+11·3	+ 4·5	−15·2
1847*.	− 42·5	...	− 38·5	+11·3	+ 4·5	−15·2
1848.	Leaked.	...	− 42·5	+ 1·5	+ 0·5	−14·6
1849.	− 43·5	−28·8	− 40·5	− 3·2	−21·2	−27·8
1850.	− 33·7	−13·9	− 22·5	+17·8	+ 3·2	−12·8
Algebraical Sums.	−162·2	−42·7	−182·5	+38·7	− 8·5	−85·6
Algebraical Means.	− 40·5	−21·3	− 36·5	+ 7·7	− 1·7	−17·1

The remarkable deficiency in the per-centage of rain both in the summer and winter months of 1849, is accounted for by the abnormal and relatively excessive fall of rain in the Vale of Wastdale in that year, as explained in my last report on the meteorology

* The per-centages in 1846 and 1847, show the mean of the two years, which were tabulated together.

of the Lake District. The *increase* in the per-centage in the winter months of 1850 is doubtless attributable to the fact of the deposition being almost entirely in the form of rain, the fall of snow on the mountains having been unusually small both in the early and latter months of the past year.

The most interesting and important circumstance connected with the experiments in 1850, is the discovery of a mountain station which promises to yield nearly one-third more rain than the celebrated hamlet of Seathwaite in Borrowdale, hitherto, and with good reason, considered to be the wettest spot in Great Britain. The new station is about a mile and a half distant from Seathwaite in a south-westerly direction, and 580 feet above it, or 948 feet above the sea-level, at the extreme southern termination of the valley; it is on the shoulder of Sprinkling Fell or the Stye, about 100 yards south of the road leading over the Stye Pass to Wastdale.

The actual quantity of water measured on Sprinkling Fell in *eleven* months of 1850, is 174·33 inches; but the receiver was found running over on four different occasions, by which I calculate 5 or 6 inches at least must have been lost to the instrument; hence, if we add 5·67 inches for overflow, and 9·49 inches for the computed depth in January (7·34 inches at Seathwaite), the result is 189·49 inches for the fall on the Stye in 1850, with 143·96 inches at Seathwaite*.

The wettest year since the commencement of the experiments is 1848, when 160·89 inches fell at Seathwaite; and, computing the fall at the new station for that year in the same proportion which the two localities bear to each other in 1850, we have 211·62 inches for the depth of rain on the Stye in 1848. An inspection of the following Table, which exhibits the fall at the coast during the last eighteen years, will show that the period (1844–50) over which the Lake District gauges have been in operation, has been far from a wet one.

Fall of Rain at Whitehaven (seventeen miles distant in a direct line from Seathwaite) during the last Eighteen Years, from 1833 to 1850 inclusive.

Month.	1833.	1834.	1835.	1836.	1837.	1838.	1839.	1840.	1841.	1842.	1843.	1844.	1845.	1846.	1847.	1848.	1849.	1850.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
January ...	·712	9·169	4·643	4·133	2·824	1·785	4·576	4·586	3·674	3·429	4·875	4·119	4·541	4·604	1·873	3·745	5·683	2·995
February...	4·235	5·303	7·597	3·626	5·278	·943	2·768	4·376	1·536	2·657	·863	3·499	2·830	2·007	1·827	7·815	2·045	4·836
March.....	2·928	2·560	5·751	5·742	1·209	4·474	6·229	·396	3·800	4·912	1·927	3·746	3·735	4·460	1·370	4·588	·837	·969
April	2·346	1·404	1·367	2·939	1·789	2·355	1·463	·580	3·803	·551	6·046	2·658	2·587	2·848	2·560	·495	1·488	3·113
May.....	2·257	2·483	3·964	·010	1·148	3·238	·843	3·781	2·955	2·293	2·016	·262	1·480	2·317	3·428	1·798	3·037	1·329
June	6·783	4·682	1·601	6·642	3·647	7·125	4·003	5·893	4·512	1·861	4·497	3·878	4·099	2·311	2·912	3·867	1·224	2·012
July	4·384	5·065	5·451	7·146	7·245	4·893	5·681	8·138	4·569	3·782	6·104	4·183	2·900	9·061	·776	3·630	5·478	5·358
August ...	2·090	4·755	1·813	5·886	2·157	5·148	5·655	6·175	7·879	1·813	4·875	1·999	6·995	4·066	4·496	5·054	3·771	4·501
September.	2·339	4·281	6·507	6·399	3·305	3·289	6·714	5·754	5·670	2·871	·390	5·809	3·653	2·857	3·738	2·266	2·814	2·643
October ...	4·240	3·937	6·217	4·049	5·832	4·574	4·209	2·452	8·344	2·388	6·748	4·335	6·744	7·982	5·407	5·772	5·252	3·364
November.	7·094	2·749	4·996	6·150	4·620	4·481	4·048	4·420	3·955	3·702	5·569	1·926	4·022	4·671	7·937	3·507	4·974	6·258
December.	9 048	3·315	4·228	6·253	6·278	1·641	2·787	·893	5·276	4·434	2·296	·309	5·621	1·950	6·597	4·805	2·396	3·095
Total	48·456	49·703	54·135	58·975	45·332	43·946	48·976	47·444	55·973	34·693	46·206	36·723	49·207	49·134	42·921	47·342	38·999	40·473
Wet Days.	203	200	215	230	189	167	198	210	220	167	210	172	193	200	191	211	190	190

Average number of wet days, 197.

* A new and capacious gauge was placed on the Stye early in January of the present year (1851).

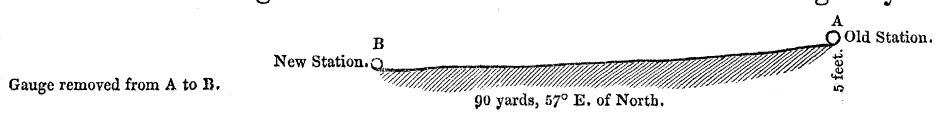
At Whitehaven, the average annual fall from 1844 to 1850 inclusive, is 43·543 inches; but in the eleven years preceding 1844, the average is 48·53 inches; and the average of the last eighteen years, from 1833 to 1850 inclusive, is 46·58 inches.

And if we analyse the period of seven years comprehended between 1844 and 1850, we find that only three of those years have exceeded the average; while of the remaining four, one year is characterized by drought, and the other three by unusual dryness. Even in the year 1848, when 161 inches fell at Seathwaite, the depth at Whitehaven was only 47·34 inches, or $\frac{3}{4}$ths of an inch above the average of eighteen years; whilst in 1835, the fall was 54·13 inches; in 1836, 58·97 inches; and in 1841, 55·97 inches.

It is not pretended that the gradation in quantity between Seathwaite and Whitehaven in any particular year will be the same in other single years, or that the differential mean of one term of years will correspond precisely with that of other terms of equal length, although I conceive that the proportion found to obtain for a group of ten consecutive years, will never be very widely departed from in future decennial periods; but we may, at least, fairly assume that a wet or a dry season at either station will bear a similar character at the other; and sufficient evidence has been adduced to show that the mean annual fall of rain in the Lake District has yet to be determined, by the incorporation of a future term of wet years with the comparatively dry period already on record. And this remark applies with still greater force to the maximum fall, as, judging from the records kept at the coast during eighteen years, no one of the last seven, during which the Lake District gauges have been in action, has any pretension to a character for excessive wetness.

Hence, the maximum annual depth in the mountain district of Cumberland may far exceed the computed fall of 211 inches at the Stye in 1848, enormous and almost incredible as is the quantity for a climate situated in the heart of the temperate zone. I may observe that the fall of rain at the coast in one year is rigidly comparable with any other year; the gauge having been in the same spot, or at least within a few feet of it, from the year 1832 up to the present time. Moreover, the same gauge and the same glass metre (graduated to the $\frac{1}{1000}$th part of an inch) have been used from the first; and the rain has been read off daily throughout the period.

In my paper printed in the Philosophical Transactions for 1848 (Part II.), allusion was made to the difference in the receipts of rain gauges within 100 yards of each other, when placed near the head of a valley. A still more remarkable instance is presented in the past year, but in this case the gauge is considerably elevated *above* the valley. On the 31st of August 1849, the gauge on Seatollar Common, 1338 feet above the sea, was removed 90 yards to the south-westward, nearly in a direct line, the difference in height between the old and new station being only 5 feet.



Below, are given the receipts of this gauge for the last five years, by which it will be seen that on the average of the three years ending with 1849, it has received 23·4 per cent. *less* than the valley; but in 1850, with the slight alteration in position just described, it has obtained 1·6 per cent. *more* rain than the valley, showing an annual increase of 25 per cent. consequent on the removal of the instrument 90 yards in linear distance, and a diminution of 5 feet in its height above the valley.

Year.	Seathwaite, 368 feet above the sea.	Seatollar Common, 1388 feet above the sea.	Deficiency per cent. at Seatollar Common.
	in.	in.	in.
1847.	129·24	104·55	−18·5
1848.	160·89	123·68	−23·1
1849.	125·47	108·97	
1849 to Aug. 31.	78·95	56·34	−28·7
1850.	143·96	146·18	+ 1·6

The records of the self-registering minimum thermometer on Sca Fell, in 1850, are as under:—

January and February, 31° below zero; March, 10° below zero; April, 10° below zero; May, 14°; June, 22°; July, observation lost; August, 9°; September, 7°; October, 7°; November and December, 15° below zero.

In the valley, the minima at 4 feet from the ground were,—in January, 19°; February, 29°; March, 21°; April, 32°; May, 30°; June, 42°; July, 43°; August, 39°·5; September, 39°; October, 27°; November, 20°·5; and December, 22°.

I have recently planted a minimum thermometer on the Gabel, and also one near Sprinkling Tarn, at the respective heights above the sea of 2928 and 1900 feet, and hope, in future, to obtain regular monthly readings at all the three stations.

The Observatory, Whitehaven,
February 6, 1851.

Erratum in Philosophical Transactions, Part I. *for* 1851.

Page 147, second line from top, *for* " severe *nights* " *read* " severe *droughts*."