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ON JULY, 1888, IN NORWAY, AND ON WEATHER ZONES IN NORTHERN EUROPE.

In several stray notes in *British Rainfall*, and in this magazine, we have called attention to the fact that, not infrequently, extremes of rainfall of opposite kinds occur simultaneously in the N.W. of Scotland, and in the S.E. of England. That is to say, that if a season be exceptionally wet in the S.E. of England, it will very possibly be a dry one in the Hebrides, or *vice versa*.

As the weather of any given spot is the product of the cyclonic or anti-cyclonic systems which have passed over it, we see at once that such facts as we have mentioned might be expected to result from the cyclonic systems following an unusual trajectory. We have not yet had time to ascertain whether the great atmospheric movements during July did, or did not, follow their usual path. Probably many of our readers will think that they did not; some persons have asked us where the summer of 1888 has gone to. The following letters from the Earl of Ducie and Mr. Kettlewell answer the question by showing how dry and fine was the weather in Norway this last July, and both writers carry it further, by pointing out that July, 1887, was extremely wet there, thus making another contrast with south British weather.

Those who are in the habit of reading the *Daily Weather Reports* are familiar with the name of Haparanda, a little fishing town near the top of the Gulf of Bothnia, as the station which most frequently has the lowest temperature (often many degrees below Zero) of any station whence returns are received. And it is quite reasonable that this should be the case, for its latitude is no less than $65^{\circ} 52' N$. The table, which follows the letters above mentioned, shows the remarkable, if not unprecedented, fact that in July, 1888, the average daily maxima were $1^{\circ} \cdot 8$ higher, and the 8 a.m. temperatures $0^{\circ} \cdot 7$ higher at Haparanda than in London. The values for Christiansund, which is about 200 miles further from the North Pole than Haparanda, are not so remarkable; but both records confirm and illustrate the exceptional facts reported by our correspondents.

To the Editor of the Meteorological Magazine.

SIR,—I venture to call your attention to the weather which has prevailed on this coast up to the present date, from about June 10th. The contrast with the weather in England is remarkable. Were it confined to this season only, one would scarcely notice it; but, for the last three years, in the month of July and into August, it has been exactly the converse of English weather. In 1886 and 1887 the summer was so wet here that the hay was saved with difficulty, and the oats did not ripen.

I have been on this coast, and within 30 miles of Florö, since July, 4th, and during that time I have met with only one day on which there has been rain, and then only local, under a high mountain, and for a few hours.

July 10th to 20th we have had great heat, 70° to 80° Fahr., and all other days, except July 8th and 9th (when there was a strong Polar wind with scud), have been bright and fine. Every day the bar., which has been at about 29.70 in. has fallen 5 to 7 100ths during the day, rising again at night. As I write, there is no sign of change. The greatest heat has been with calms or light S.E. airs.

The country is dried up; hay crop very small; oats and barley are withering, and will have to be cut and dried for winter forage. Many deciduous trees are withered, and the leaves fly about as in the autumn.

The birch and mountain-ash seedlings, which grow on the turf-covered roofs of sheds, boat-houses, and the poorer sort of houses, are dead and dried up.

All this is in a district where the average annual rainfall is 75 inches, and where in 1886 and 1887 a day without rain was noted as an exceptional occurrence.

The peasants say that for 30 years such a drought has not been known.

I send these details merely to call your attention to the contrast with English weather which occasionally occurs here.

Can it be that zones of moisture of some hundreds of miles in width cross the Atlantic with a varying range N. or S.?

Your obedient servant, DUCIE.

Yacht Monarch, R. Y. S., July 22nd, 1888.

Florö, } $61^{\circ} 36' 0''$ N. lat.;
Norway { $5^{\circ} 2' 0''$ E long.

SIR,—I have just returned from Norway, where I have, as usual, been staying at a place about 60 miles S.W. from Thronthjem. I have again been much struck with the contrast between the weather there and here. I arrived there on July 1st. I was told that for three weeks or more the weather had been very dry and generally hot. This statement was borne out by the condition of the ferns, mosses, &c., which were withering from want of moisture. I left on the 1st of August, and, during my stay, there was very little rain,

although the weather was sometimes cold and cloudy. From the 13th to 19th, both inclusive, it was very hot, one day as high as 86° in the shade. We had a shower on the 2nd, a thunderstorm on the 6th; on the 7th and 11th a little rain; a shower on the 15th; rain on the 25th and 27th, and a little on the 31st. Altogether the rainfall for the month cannot have exceeded $2\frac{1}{2}$ inches. I hear that a rain gauge which was kept by an Englishman about 35 miles from where I stay, showed over 12 inches of rain for the month of July last year. I hope to be able to get some particulars from him both of this year and last, if you would like to have them. Our rainfall here for the month of July just past was 8.79 in.!

I am, yours faithfully,

W. W. KETTLEWELL.

Harptree Court, East Harptree, Bristol, Aug. 10th.

Date.	8 A.M.				MAX.			MIN.			
	Yacht R.Y.S. Monarch.	Haparanda.	Christiansund.	London.	Haparanda.	Christiansund.	London.	Haparanda.	Christiansund.	London.	
1	55	54	49	53	63	50	66	32	45	45	YACHT MONARCH R.Y.S. 61° 36' N. Lat. 5° 2' E. Long. Mean 8a.m. 58° 8
2	54	57	47	57	66	52	59	43	43	51	
3	56	50	51	59	59	55	68	46	43	54	
4	62	55	53	59	62	61	66	46	46	52	
5	58	62	50	59	72	52	66	46	48	53	HAPARANDA, N. end of gulf of Bothnia. 65° 52' N. Lat. 24° 3' E. Long. Mean Max. 67° 3 ,, Min. 47° 9 ,, 57° 6 ,, 8a.m. 58° 5
6	57	62	49	56	77	52	62	45	46	52	
7	51	59	48	53	61	48	57	55	45	51	
8	53	50	47	56	52	54	67	48	43	51	
9	53	48	49	60	59	55	67	45	43	50	CHRISTIANSUND. N.W. Coast of Norway. 63° 7' N. Lat. 7° 46' E. Long. Mean Max. 57° 5 ,, Min. 47° 3 ,, 52° 4 ,, 8a.m. 52° 4
10	59	53	51	53	...	59	62	43	46	49	
11	59	57	48	44	68	54	54	46	46	44	
12	57	60	51	50	66	54	55	48	46	43	
13	57	61	50	55	75	55	71	52	46	45	LONDON. 51° 32' N. Lat. 0° 5' W. Long Mean Max. 65° 5 ,, Min. 52° 4 ,, 59° 0 ,, 8a.m. 57° 8
14	60	67	52	62	75	57	71	52	45	55	
15	58	64	56	58	72	66	61	59	48	55	
16	62	64	61	61	73	68	66	54	52	55	
17	65	62	65	57	72	73	68	50	57	50	
18	65	67	67	62	73	77	71	50	61	56	
19	67	69	62	59	77	64	70	50	57	56	
20	67	64	53	61	73	57	65	52	50	57	
21	59	54	51	60	75	55	66	54	46	55	
22	57	59	51	64	64	54	72	52	46	56	
23	58	54	50	62	66	57	69	46	45	56	
24	62	59	53	62	63	...	69	50?	48	55	
25	58	57	...	60	64	59	62	48	...	57	
26	59	57	50	60	63	55	70	46	46	54	
27	60	59	49	59	64	49?	69	46	48	52	
28	57	56	47	61	63	52	65	45	43	57	
29	58	54	48	57	63	55	68	46	41	53	
30	62	57	55	59	72	66	71	45	46	54	
31	58	61	60	53	66	61	58	45	55	51	
Mean	58.8	58.5	52.4	57.8	67.3	57.5	65.5	47.9	47.3	52.4	

THE RAIN AND THUNDER STORMS OF JULY AND AUGUST, 1888.

THE rains which accompanied the thunderstorms of the closing days of July and the commencement of August, were of such exceptional magnitude in the S.E. of England, that we have collected special returns from a large number of stations in Sussex, Surrey, Kent and Essex, and have compiled a brief account of the most remarkable.

With the electrical phenomena—which, by the way, were apparently not so exceptional as the pluvial—we do not purpose dealing, adhering to the plan adopted with regard to the June thunderstorms, of leaving that branch of the subject in the able hands of the Thunderstorm Committee of the Royal Meteorological Society.

We give in tabular form the more important records from stations in the south eastern counties on July 30th, 31st, and August 1st, A few extracts from the numerous letters with which we have been favoured by our regular correspondents, apologising and regretting that we are unable to print them *in extenso*, and conclude with extracts from the public press, giving details of the floods on August 2nd.

Beginning in the south, we have the 31st of July with several falls exceeding three inches in the neighbourhood of Hastings, and these are good evidence in support of our oft-repeated statement that there is no part of the British Isles where a fall of four inches in less than 24 hours may not be expected. A feature of this storm, perhaps as important as the quantity of rain, is its intensely local character, which the following letter from Mr. Wood, who as a resident is more familiar with the neighbourhood than we are ourselves, clearly describes :—

“DEAR SIR,—I beg to hand you return as requested. The August 1st measurement (entered to July 31st) was a most extraordinary rainfall with respect to its partiality in this district. Mine, as you see, was $\cdot 70$ in. ; Buckshole, to the west of me and a greater distance from the shore, $3\cdot 40$ in. ; The Grove, also westward and inland, $3\cdot 40$ in. ; London Road, between Buckshole and The Grove, but *nearer the shore*, $2\cdot 31$ in. ; Bexhill, situated similar to London Road, $1\cdot 50$ in. It seems, therefore, that the great fall (which was from 1 to 5 a.m. on August 1st) was heaviest about two miles from the shore, and lightest as the shore was approached ; The Grove and Buckshole being the farthest from the shore, were the heaviest. London Road, which is nearer, was lighter ; and mine, being nearest, the lightest of all. I was driving round the country, about three miles from the shore, on the next day, and between Buckshole and The Grove, where the fall was heaviest, old solid coach roads were completely torn up and at places gullied out to a most

marked extent. The fall was quite unprecedented in this district. — Faithfully yours, A. H. WOOD. *The Hollies, Hastings.*"

This storm, or an almost simultaneous one, was producing a fall of even greater intensity at a station 10 miles due N., Sandhurst Rectory, just on the boundary of Kent and Sussex. The Rev. G. Ridout, the rector, writes:—At 2 a.m. on August 1st there was a smart shower, followed soon after 5 a.m. by a heavy fall of rain, which became quite tropical in its character from 5.30 to 7.30 a.m., in which period the rainfall was three inches. The readings of the two gauges at 9 a.m. were 3.46 in. and 3.50 in., and at 9.30, .50 in. more was recorded. More than double the amount recorded in any 24 hours during the preceding 11 years." This fall also was very local, for of the half-dozen stations within six miles, none recorded two inches, and at the nearest station, Benenden, not four miles distant, less than one inch fell.

Travelling northward, we come to the storm of July 30th, and the table exhibits nearly all the remarkable features; two falls exceeding two inches, and one exceeding three inches. Floods were produced in the lower parts of the east end of London, more especially in the Isle of Dogs and the neighbourhood of the docks. These are the usual accompaniments of a heavy rain over east London, and though we would not underrate the vast amount of suffering caused to great numbers of the poorer sections of the community, we must accept them as the natural result of building habitations on reclaimed marshes, where nature never intended man to dwell. The results were aggravated by the frequent rains which had marked the earlier part of July, and were repeated by the great rain of August 1st, the description of which will conclude our article.

SHOOTER'S HILL.—"July 30th, heavy thunderstorm from 3 to 7.30 p.m., passing backwards and forwards, very near sometimes, and rain tropical in intensity occasionally. August 1st, rain from about 8 p.m. to 6.30 a.m. on 2nd."

The storm rain of August 1st was one of the summer rains of exceptional magnitude. In Essex, more than two inches fell over an area of 700 square miles, roughly bounded by London, Shoeburyness, Chelmsford, and Harlow; and more than one inch fell over the greater part of Middlesex and Kent, and a considerable area in Surrey; four stations recorded upwards of three inches, and at North Ockendon and Upminster Hall, both near Romford, the gauges overflowed, after catching 4.56 in. and 4.50 in. respectively. Such a vast volume of water necessarily produced great floods, especially as the ground was thoroughly saturated, more than an inch having fallen over a great part of the district only two days before. The Cann, Roding, Bourn brook or Rom, and the Ingerburn being the chief natural drains of the district were the streams on which most flooding occurred.

Rainfall in S.E. England, July 30—August 1.

County.	Station.	July		August	Total, 3 days.
		30th.	31st.	1st.	
		in.	in.	in.	in.
SUSSEX ...	St. Leonard's (London Road)		2·31	·46	...
	" " (The Grove)	·02	3·40	·03	3·45
	Hastings (The Hollies)	·04	·70	·19	·93
	" (Buckshole)	·02	3 40	...	3·42
	" (High Beach, Hollington) ...	·03	3·25	·01	3·29
KENT	Battle (Whatlington)	·03	1·31	·04	1·38
	Hawkhurst (Sandhurst Rectory)	·16	3·50	·55	4·21
	Cranbrook (Hartley)	·13	1·90	·65	2·68
	Bickley (Highfield)	1·63	·70	1·12	3·45
	" Park	1·54	·78	1·17	3·49
SURREY ...	Forest Hill (Newfield House)	1·18	·35	·73	2·26
	" " (Border Lodge) ..	1 59	·33	1·17	3·09
	West Norwood	1·61	·38	1·43	3·42
KENT	Eltham	1·16	·56	1·21	2·93
	Shooters Hill	1·28	·52	1·25	3·05
	Greenwich (Royal Observatory)	2·49	·33	1·44	4·26
	Deptford (Kent W. W.)	2 54	·29	...	...
	" (Pumping Station)	3·17	...	1·77	...
ESSEX	Erith (Crossness)	·31	2 13	...	2·44
	Gravesend (Park Place) ..	·19	·49	1·80	2·48
	Southend (Avenue Road)	·30	·41	2·83	3·54
	Romford (North Ockendon Rectory)...	1·01	·26	+4·56	+5·83
	" (Upminster Hall)	1·62	·17	+4·50	+6·29
	Ilford (Little) ..	1·92	·30	1·80	4·02
	" (Great Gearies)	1·35	·24	2·14	3·73
	Woodford (The Harts)	·27	·28	2·10	2·65
	" (Hagger Lane)	·41	·17	2·16	2·74
	Brentwood (Sawyer's Hall Farm)	1·50	·50	3·00	5·00
	" (Dudbrook House)	1·70	·21	2·72	4·63
	Ingatstone (Margaretting)	1·79	·27	3·20	5·26
	Epping (The Hemnalls)	·15	2·43	...	2·58
	Chelmsford (Writtle)	1·06	·24	2·07	3·37
	" (High Street)	1·45	·27	2·21	3·93
	" (Roxwell)	1·33	·20	2·02	3·55
	" (Broomfield)	*1·26	·24	1·88	3·38
	Harlow (Sheering)	·51	·14	1·99	2·64
	Dunmow (High Roding)	1·23	·18	1·32	2·73

* 29th and 30th.

With the amount of loss occasioned we have no concern, but we have extracted rather largely from the public press, to preserve as far as possible a record of the limits of the flood, and we would express the earnest hope that the authorities of Chelmsford will permanently mark on their new bridge the height of the flood which destroyed its predecessor, after it had stood for about fifty years.

NORTH OCKENDON.—“August 1st, very little rain had fallen in the day, but at 7 p.m. the storm began without thunder; by 7.30 there was thunder, which continued till 0.30 a.m. on 2nd; by

8.15 p.m. 1.61 in. of rain had fallen ; a fresh receptacle was then put under the rain gauge, which on the morning of the 2nd I found to be brim full, and evidently had run over ; this receptacle contained 2.95 in., so that I registered 4.56 in., and in all probability a great deal more rain fell."

UPMINSTER HALL.—"From various reasons I believe the fall to have been considerably over four-and-a-half inches. It began to rain hard between 7 and 8 p.m. on 1st, and at 9 it was coming down in sluices: this continued until 2 a.m., when it occasionally eased into hard rain. At 4.15 a.m. I went to the gauge, and found it had overflowed ; the quantity it contained, making the total up to that time 4.43 in. ; after that .07 in. more fell. At 2 a.m. a mile from here the water was roaring over the bridges and roads a hundred yards wide, and nearly six feet deep, and all the hollows or dips in the roads were filled with water. The peculiar thing about the storm was the constant and very vivid lightning, and the way the water came down, as if a large tub had suddenly been emptied on one spot. At 9.30 a.m. on 2nd, the Cranham Road, about half a mile from here, was 4 ft. deep in water. On July 30th, 1.07 in. of rain fell in half an hour."

LITTLE ILFORD.—"July 30th, between 4 and 7 p.m., 1.85 in. fell with thunder. August 2nd, the River Roding burst its embankments."

INGATESTONE, MARGARETTING.—"From 8 p.m. on August 1st, to 2 a.m. on August 2nd, a terrible thunderstorm raged. The rain which fell during the actual thunderstorm was not much heavier than that which fell during the day, but was very heavy throughout. There was no hail."

BRENTWOOD, DUDBROOK HOUSE.—"Commenced raining early on morning of 1st, and never ceased till after 5 a.m. on 2nd."

THE FLOODS OF AUGUST 2ND.

At Erith, the sewers were unable to carry off the water, and it washed away a portion of the road and carried about 100 tons of earth on to the South Eastern Railway, which was soon flooded to the depth of several feet. The 10.30 a.m. down train, after leaving Erith Station, ran off the rails where the accumulation of earth and water blocked the line.

Owing to the immense amount of rain, the Ravensbourne and Quaggy are overflowing at New Cross, Deptford and Lewisham, and many houses are flooded in their basements. In the Isle of Dogs, one of the large open fields at the back of the West Ferry-road is a veritable lake, with four feet of water at one end and two at the other. In the lane leading from the Midland Railway dock to Manchester-road, the water rushed over the pavement into the front areas of the houses with such force that the gardens were swept down into the front rooms.

Plaistow and Stratford are in much the same condition. A house in Grafton-road, Plaistow, had six feet of water in the cellars. The fields abutting on the Great Eastern from Bow to Stratford are more or less under water, and so are many portions of Epping Forest. Across Hackney Marshes and round about Temple Mills, all the houses in the hollows are flooded, and the same applies to the lower parts of Tottenham and Clapton. The condition of the poor people living around Victoria Dock is deplorable, many streets being

impassable; the basements of the houses in Barking-road and several adjoining streets are inundated, and the West Ham fire engines and gangs of men are employed pumping the water out.

The heavy rain has been attended with serious results on the Great Eastern Railway. In the early hours of the morning the water rushed down the hill sides abutting on Epping Forest, and the main line of the Great Eastern Railway between Ilford and Chadwell Heath was, by 5 o'clock, completely submerged. In some parts the water is reported to have risen to a height of four feet over the rails. The through traffic with the east coast was absolutely stopped, and the trains had to be worked by way of Bishop Stortford. In the course of the morning the water rapidly subsided, and about 2 p.m. the main line traffic was resumed.

A portion of the London and Tilbury Railway near Plaistow Station was flooded, traffic to London being suspended early in the morning.

At Ilford, a substantial wooden bridge leading to the volunteer butts, close to the railway line, was washed away. At Ilford Bridge the water on each side flooded the neighbourhood, and in some parts of the town cut off the occupants of cottages, who had to get to their business or home again by the use of rafts or boats, the water being up to the window sills of the downstairs rooms. On the London side of the road the water rushed down a builder's yard and gained access to the backyards of about 150 houses, flooding also the front of about 20 in the roadway as well. Farther down the main road was flooded, and 40 or 50 market waggons were stopped. St. Mary's Churchyard was flooded, while at the brickfields and at the paper mills there was about eight feet of water. Railway traffic was impeded till past 9 o'clock, while between Ilford Station and Chadwell Heath the water was so deep that the fires of the engines were extinguished.

The river Rom* overflowed, flooding Romford. The water came down from the uplands on the north and the railway formed a prolific conduit on the east. High-street, North-street, South-street, and the London-road as far as the "Slater's Arms" inn, quickly became powerful streams, and the flood extended into the market place beyond the police-station, while for miles the course of the river Rom was marked by a broad expanse of water. From the railway a large stream flowed into the Junction and Eastern-roads, flooding gardens and houses and adding to the volume in the lower part of the town. In the district many cattle, horses and pigs, were drowned, haystacks demolished, and farm crops destroyed. At Messrs. Ind, Coope and Co's brewery the water was 3ft. deep at the highest point in the yard, and 5ft. to 6ft. in the lower parts. About 4,000 barrels, both full and empty, were washed out of their premises and covered a vast stretch of water. The loss of one life is reported. that of a man who was on a raft which upset. About 6 a.m. the flood began to subside, but at 10 a.m. the main street was still under water. In South-street the water stood at a height of 3ft. in the post office and the shops, and in North-street it reached a higher level. According to the *Stratford Express*, the highest flood hitherto known in Romford occurred in 1841, when the water mark was from 12in. to 15in. below that attained by this latest visitation. Railway traffic was much interrupted, no train being able to pass Chadwell Heath on the down line and Haroldwood on the up line after 2 a.m. At Squirrels Heath the railway track was covered with 5ft. of earth and sand. A single line was opened at 10 a.m.

The Ingatestone Gas Works were so flooded that all the fires were put out, and on Wednesday night no gas could be got.

At Chelmsford, about 3 a.m., people living in the lower part of the High-street, Moulsham and London-roads, and, later on, in Springfield-road, the Friars, Baddow-road, and the Barrack-square, were aroused by the floods rushing into their basements.

* All the maps to which we can readily refer call this the Bourne Brook.—Ed.

The river, overflowing at the back of the new London-road, came sweeping up through Dr. Bodkin's house and orchard, poured across the London-road, and submerged the Friars-place, the basements of the houses there being several feet deep in water.

After passing the iron bridge the swollen Cann* tore down the garden hedges and palings, flooding, as we have said, the houses in the High-street. On the other side it poured into the congregational chapel, filling the school-room below; it then carried away about 40 yards of the wall on the right hand side and threw an immense volume of water into Barrack-square.

Coming again to the High-street, a swift stream came up through the Queen's Head gateway, soon covering the road many feet deep. Another stream came up Vickridges-square, and, converging with the first, rushed down the Springfield-road as far as Chelmer Bridge. French's-square was covered several feet deep and the houses suffered. The houses in Museum terrace suffered badly, their gardens were swamped and destroyed and the water flooded the basements quite up to the ceilings. At the club the basements and kitchens were entirely filled, and in the billiard-room the water almost came up to the top of the billiard tables.

Naturally the attention of the authorities was directed to the bridges, and they were anxiously watched. The iron bridge in the New London-road, which was built about 1840, was early doubted. The stream was rushing through within six inches of the footway, shaking the bridge a good deal. Soon after seven o'clock the current, which had done great damage in Dr. Down's garden, tore down the wall, which sent the stream across to the large willow which stood on the Institute side. The current undermined the tree, and in a few minutes it was torn up and dashed against the bridge and then dropped sideways. The effect of this was disastrous, as it diverted the full force of the water to the buttress, where it speedily made a breach, and the whole mass of iron and roadway fell into the stream. On the other side of the High-street the water penetrated as far as Mr. Hicks's shop. Along the Springfield-road as far as Mr. Munnion's the houses were deeply flooded. The gardens of Western-terrace, New London-road, were submerged and the basements flooded. In the Baptist chapel, New London-road, a high water mark is left on the seats. In Wolsley-road, New Writtle-road, the water rose above the mantle-pieces on the ground floor. Van Dieman's Land was flooded deeply, and the lane leading thence to Mildmay-road was like a river up to the Board of Health gates. The Baddow-road was submerged several feet deep nearly up to the Army and Navy Inn; even the high path was covered. The fields stretching down to the navigation looked like an immense lake. The flood extended up Moulsham-street as far as Mr. Remington's house. In the Friars the current carried away the wall of the Bristol School and some of the back gates of Western-terrace.

The floods at Barnes Mill and Sandford Mill were a foot deeper than has been known for 20 years.

ARE THUNDERSTORMS MORE FREQUENT IN TOWNS THAN IN THE OPEN COUNTRY?

When Snow Harris was planning his system of lightning conductors for the then new Houses of Parliament, he deemed it necessary strongly to protect the ventilating shaft of the House of Commons. A coke fire is usually kept burning in this shaft during the session,

* The southern branch of the Chelmer, which joins that river at Chelmsford.

for the purpose of maintaining a ventilating force, so that the column of hot rarefied air ascending from this shaft to a considerable height would be likely to act as a line of least resistance, and so determine the course of a lightning stroke. A case of this kind occurred in August, 1887, at Birmingham, where a chimney shaft, 140 feet high, was discharging a hot current into the air. During a storm, two men sought refuge in a hut at the base of the shaft which was not furnished with a conductor. The lightning struck the chimney, passed through the hut, and killed the men.

So also, when a flock of sheep or other animals are huddled together during a storm, a similar column of warm, rarefied air is produced and this accounts for the frequency with which animals are struck. M. D'Abbadie gives a case which occurred in Ethiopia, in which 2,000 sheep were killed by a flash of lightning. In August, 1858, a flock of 140 sheep was struck by lightning at Salceo in Italy and 120 were killed. The shepherd was not touched, and the shepherd boy escaped, but a kid which he held in his arms was killed. Hence arises the curious question whether human beings are less liable to be struck than the so-called lower animals? The latter would send up a more heated steamy current of warm air than the former; but still, it is difficult to account for the death of the kid in the boy's arms while the boy escaped. A case more easy of solution was related to me by Mr. P. Dudgeon, of Cargen, Dumfries. On the 19th May last a man was leading home two horses just taken from the plough. The horses were struck and killed, the man was not injured by the lightning, but was hurt by one of the horses falling on him. He was leading the horses on the near side of the pair. In this case the day was hot and oppressive (79° F. in the shade), so that the horses must have been very warm, and sent up with the heated air from their bodies a considerable column of moisture. The man probably did not share in this rarefied air, and so escaped from the lightning only to be injured by the fall of the horse.

Bearing in mind the above details, the questions that I wish to submit to your readers are (1) whether London has not a larger share of thunderstorms than the surrounding country? (2) whether such storms are not of longer continuance, recharging like the residual charge in a Leyden jar, so that the storm is more prolonged than in the country? (3) Whether large towns generally are not more liable to thunderstorms than the simple country, from the fact of their throwing up heated columns of vitiated air? (4) Are there any statistics to show the frequency of storms of lightning at different stations in Great Britain?

C. TOMLINSON, F.R.S., &c.

Highgate, N., 21st August, 1888.

THE EARTHQUAKE IN DUMFRIESSHIRE ON JULY 19TH.

SIR,—You may have noticed in the papers that the shock of an earthquake was felt in many parts of Dumfriesshire on the morning of the 19th inst. It appears that it was also felt across the watershed at the head of Eskdalemoor, a range 1,500 to 2,000 feet high. Plotting on a map all the places from which the shock is reported gives a roughly oval area about 35 miles by 15 miles, its major axis lying nearly N.E. and S.W. between Hawick and Dumfries. The shock, as far as I can make out (for the time people gave me differed a little), occurred very nearly at 4 a.m. The wave apparently crossed the country very nearly from E. to W. or from W. to E., it is impossible to say which. A great number of people from all parts of the country were assembled at Dumfries on the 20th to attend a presentation of Colours to the Militia Regiment, so I had a good opportunity of making personal enquiries about the earthquake, and give below what I ascertained. I asked many of my friends to make enquiries in their respective neighbourhoods, if they could hear of any pendulum clocks having been stopped by the shock, and at the same time to ascertain, if they met with such a case, in what direction the pendulum swung. If I can get any information on this point I will communicate with you after.—I remain, yours truly,

PAT. DUDGEON.

21st July, 1888, *Cargen, Dumfries.*

Gribton.—Sleepers awakened by bed shaking.

Blackwood.—Shock distinctly felt, but slight (the present occupier familiar with earthquake shocks, having resided for some time in India, where he had experience of them).

Isle.—Sleepers awakened by bed-shaking.

Jardine Hall.—Room shaken and noise distinctly heard.

Fourmerkland (near above).—Bed very distinctly shaken.

Kirkmichael.—Sleepers awakened by bed-shaking.

Dormont.—Rumbling noise awoke sleeper, shock immediately followed; doors and windows shaken, crackling sound heard after shock was over as if walls were settling. Dormont is a large and substantial house, and the gentleman at present occupying it has had large experience of earthquake shocks in Japan and China, and immediately recognised it as one.

Burnfoot.—Sleepers awakened, a sound heard as if a number of cattle were running past the house.

All the above places are substantial houses, the residences of country gentlemen, and what I have noted is as nearly as possible what was told me by the occupiers.

For other details I enclose some slips of local papers.

EARTHQUAKE IN DUMFRIESSHIRE.—On Thursday morning, shortly before four o'clock, what is believed to have been an earthquake

shock was distinctly felt over most of Annandale and Eskdale. A rumbling noise roused many sleepers, who felt their beds gently oscillating. At Mr. Patterson's, Dalmakethar, Applegarth, a portion of the ceiling of one room fell, while the oscillation was very distinct. At the house of Mrs. Todd, Underwood House, Tundergarth, the family and servants were awakened by hearing the sounds of unusual movements amongst quantities of china. The shock was also distinctly felt at Scroggs, in the same parish, and at Blackford House, St. Mungo. At Wamphraygate Farm, Wamphray, Mr. Mackie and his household were alarmed by the loud noise and jingling of utensils, and leaped out of bed. The shock and reverberating sound only lasted a few seconds. Reports have been received from the upland districts of Annandale indicating that the earthquake was more severely felt there than in the lower localities. At Hazelbank the noise was very loud. Mr. Hay, Boreland, Hutton, who has had experience of earthquake shocks in New Zealand, says the shock lasted about a minute. His house distinctly vibrated, and the crockery rattled. At Johnstone and other places in Eskdalemuir the shock created much alarm.—Our Langholm correspondent writes: There was considerable gossip on Thursday morning in the town about a shock of earthquake having been felt early that morning, point being given to the stories by a statement that some houses had fallen in the parish of Westerkirk. This statement failed to receive confirmation, but accounts from both town and country go to show that there was a slight shock felt about a quarter to four in the morning.—The shock was also slightly felt in various parts of Nithsdale. At Auldgirth, Mr. Fergusson, teacher, both heard a peculiar noise and felt the oscillation; and several persons in the immediate neighbourhood of Dumfries make a similar report.

THE EARTHQUAKE IN THE SOUTH OF SCOTLAND.—Dr. Brydon, Hawick, referring to the earthquake shock experienced in Lockerbie, says:—It will be interesting to know that it was also felt in upper Teviotdale about the same time. At half-past three the shepherd of Rashiegrain, the highest-up house in Teviotdale, the farm on which is the classic Teviot stone, was awakened by the rattling of the plates on his dresser, the howling of his dogs, and the lowing of the cattle about the place. His first impression was that it was thunder, but on looking out there were no thunder-clouds, nor anything to indicate this. It was a calm, still night, with a little haze along the valleys. The valley of the Borthwick lies some six or seven miles northward, and there, at Howpasley, and other homesteads, similar manifestations were experienced. Eskdalemuir in Dumfries, and Teviotdale in Roxburgh, are separated from each other by a high range of hills, running north and south; and on either side for a long distance the rock formation belongs to the Lower Silurian.

SUPPLEMENTARY TABLE OF RAINFALL, AUGUST, 1888.

[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	2·22	XI.	Castle Malgwyn	4·52
„	Margate, Birchington... ..	...	„	Rhayader, Nantgwillt..	6·71
„	Littlehampton	2·56	„	Carno, Tybrith	4·27
„	Hailsham	1·74	„	Corwen, Rhug	2·91
„	Ryde, Thornbrough	2·06	„	Port Madoc	6·21
„	Alton, Ashdell	2·36	„	I. of Man, Douglas	2·89
III.	Oxford, Magdalen Col... ..	1·97	XII.	Stoneykirk, ArdwellHo.	3·50
„	Banbury, Bloxham	2·28	„	New Galloway, Glenlee	4·72
„	Northampton	1·87	„	Melrose, Abbey Gate...	2·83
„	Cambridge, Beech Ho.	2·09	XIII.	N. Esk Res. [Penicuik]	3·05
„	Wisbech, Bank House..	2·52	XIV.	Ballantrae, Glendrishaig	4·75
IV.	Southend	4·25	„	Glasgow, Queen's Park.	2·17
„	Harlow, Sheering	4·13	XV.	Islay, Gruinart School..	3·59
„	Rendlesham Hall	1·53	XVI.	St. Andrews, PilmourCot	1·76
„	Diss	2·42	„	Balquhiddel, Stronvar..	5·11
„	Swaffham	3·50	„	Dunkeld, Inver Braan..	2·49
V.	Salisbury, Alderbury ...	1·40	„	Dalnaspidal H.R.S. ...	3·39
„	Warminster	1·61	XVII.	Keith H.R.S.	2·49
„	Bishop's Cannings	1·95	„	Forres H.R.S.	1·35
„	Ashburton, Holne Vic... ..	3·64	XVIII.	Strome Ferry H.R.S....	5·06
„	Hatherleigh, Winsford.	3·69	„	Fearn, Lower Pitkerrie.	2·22
„	Lynmouth, Glenthorne.	3·60	„	Loch Shiel, Glenaladale	11·28
„	Probus, Lamellyn	3·67	„	S. Uist. Ardkenneth ...	3·00
„	Launceston, S. Petherwin	3·83	„	Invergarry	4·73
„	Wincanton, Stowell Rec.	1·59	XIX.	Lairg H.R.S. ....	...
„	Taunton, Lydeard Ho... ..	2·22	„	Forsinard H.R.S.	2·52
„	Wells, Westbury	2·36	„	Watten H.R.S.	3·67
VI.	Bristol, Clifton	2·55	XX.	Dunmanway, Coolkelure	6·36
„	Ross	2·40	„	Fermoy, Gas Works ...	2·92
„	Wem, Clive Vicarage ...	3·95	„	Tipperary, Henry Street	2·97
„	Cheadle, The Heath Ho.	3·41	„	Limerick, Kilcornan ...	2·41
„	Worcester, Diglis Lock	1·87	„	Miltown Malbay	4·17
„	Coventry, Coundon	2·45	XXI.	Gorey, Courtown House	2·50
VII.	Melton, Coston	2·26	„	Navan, Balrath	2·62
„	Ketton Hall [Stamford]	2·19	„	Mullingar, Belvedere ...	2·46
„	Horncastle, Bucknall ...	2·06	„	Athlone, Twyford	2·14
„	Mansfield, St. John's St.	2·52	„	Longford, Currygrane...	3·89
VIII.	Knutsford, Heathside ...	3·54	XXII.	Galway, Queen's Coll...	2·57
„	Walton-on-the-Hill	3·10	„	Clifden, Kylemore	8·72
„	Lancaster, South Road.	3·32	„	Crossmolina, Enniscoe..	5·08
„	Broughton-in-Furness ..	4·95	„	Collooney, Markree Obs.	4·30
IX.	Shipley, Esholt Vic. ...	...	XXIII.	Rockcorry	4·16
„	Ripon, Mickley	3·05	„	Warrenpoint	2·75
„	Scarborough, West Bank	2·91	„	Seaforde	2·86
„	EastLayton[Darlington]	1·48	„	Belfast, New Barnsley .	4·17
„	Middleton, Mickleton ..	1·82	„	Cushendun	6·39
X.	Haltwhistle, Unthank... ..	2·76	„	Bushmills	5·17
„	Shap, Copy Hill	3·08	„	Stewartstown	3·81
XI.	Llanfrehfa Grange ...	2·93	„	Buncrana	4·18
„	Llandoverly	6·64			

AUGUST, 1888.

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.	Differ- ence from average. 1870-9	Greatest Fall in 24 hours.			Max.		Min.				
				Dpth	Date.		Deg	Date	Deg	Date			
		inches	inches.	in.							In shade.	On grass.	
I.	London (Camden Square) ...	3·61	+	·87	1·39	1	14	84·6	10	43·9	19	0	0
II.	Maidstone (Hunton Court)...	2·19	—	·05	·74	1	12	...	...	...	...	...	...
"	Strathfield Turgiss	1·75	—	·67	·59	1	15	80·4	10	40·8	19	0	0
III.	Hitchin	2·30	+	·02	·58	28	13	80·0	10	42·0	31	0	0
"	Winslow (Addington)	1·97	—	·98	·48	20	13	84·0	10	40·0	14	0	0
IV.	Bury St. Edmunds (Culford)	2·62	+	·45	·60	21	14	90·0	10	36·0	15	0	0
"	Norwich (Cossey)	2·00	—	·62	·59	28	13	...	...	...	...	...	...
V.	Weymouth (Langton Herring)	1·79	...	...	·56	20	16	72·0	9	44·0	18	0	0
"	Barnstaple	4·58	+	·48	·94	28	15	74·0	10	41·0	18	0	0
"	Bodmin	2·82	—	2·02	·51	28	20	68·0	7	46·0	1, 2	0	0
VI.	Stroud (Upfield)	1·82	—	1·35	·57	28	13	83·0	9	45·0	18	0	0
"	Church Stretton (Woolstaston)	4·68	+	·60	1·34	28	16	78·5	9	43·0	17	0	0
"	Tenbury (Orleton)	2·81	—	·91	·88	28	16	81·3	10	37·3	14	0	0
VII.	Leicester (Barkby)	2·38	—	·17	·91	28	15	86·0	9	35·0	14	0	0
"	Boston	2·25	—	·36	·62	28	14	85·0	9	36·0	19	0	0
"	Hesley Hall [Tickhill]	1·95	...	...	1·06	28	16	82·0	9	38·0	15	0	0
VIII.	Manchester (Ardwick)	2·20	—	1·72	·93	28	16	74·0	9, 10	46·0	1	0	0
IX.	Wetherby (Ribston Hall) ...	1·92	—	·71	1·04	29	9	...	...	...	...	...	...
"	Skipton (Arncliffe)	5·76	—	·04	1·10	4	22	73·0	9	39·0	18	0	0
"	Hull (People's Park)	2·41	—	·61	·92	28	19	...	...	...	...	...	...
X.	North Shields	2·03	—	1·06	·71	4	14	71·0	8	40·5	1	0	0
"	Borrowdale (Seathwaite)	9·30	—	1·74	1·83	4	20	...	...	...	...	...	...
XI.	Cardiff (Ely)	4·26	—	1·07	1·00	28	16	...	...	...	...	...	...
"	Haverfordwest	4·82	—	·15	1·38	28	19	67·5	3, 7	37·0	17	0	1
"	Plinlimmon (Cwmsymlog) ...	6·45	...	...	1·20	28	18	...	...	...	...	...	...
"	Llandudno	2·94	—	·25	·57	28	18	69·8	7	43·5	2	0	0
XII.	Cargen [Dumfries]	3·08	—	1·19	·68	4	18	69·0	22	37·0	1	0	0
"	Jedburgh (Sunnyside)	1·90	—	1·47	·46	26	16	68·0	25	37·0	19	0	0
XIV.	Old Cumnock	3·59	—	·55	·67	12	22	72·0	25	34·0	30	0	0
XV.	Lochgilthead (Kilmory)	4·24	—	·98	·74	3	18	...	...	...	...	...	...
"	Oban (Craigvarren) .....	...	...	...	...	...	...	...	...	...	...	...	...
"	Mull (Quinish)	5·69	...	...	·83	31	20	...	...	...	...	...	...
XVI.	Loch Leven Sluices	2·20	—	1·88	·50	13	9	...	...	...	...	...	...
"	Dundee (Eastern Necropolis)	1·80	—	1·47	·45	20	14	74·4	25	40·2	19	0	0
XVII.	Braemar	1·97	—	2·46	·42	1	25	66·4	25	33·0	16	0	8
"	Aberdeen	2·05	...	...	·35	22	19	69·0	25	35·0	19	0	0
XVIII.	Lochbroom	2·93	...	...	·70	13	24	...	...	...	...	...	...
"	Culloden	1·56	—	1·44	...	...	...	70·0	25	40·0	3	0	2
XIX.	Dunrobin	2·09	...	...	·25	23	13	67·0	22	40·5	1	0	0
"	Kirkwall (Swanbister) .....	...	...	...	...	...	...	...	...	...	...	...	...
XX.	Cork (Blackrock)	3·62	—	·21	1·15	19	20	73·0	15	41·0	13	0	0
"	Dromore Castle	5·19	...	...	·96	23	18	75·0	15	42·0	1	0	0
"	Waterford (Brook Lodge) ...	3·12	...	...	·97	19	18	74·0	6	36·0	18	0	0
"	O'Briensbridge (Ross)	2·92	...	...	·88	19	20	72·0	...	41·0	19	0	0
XXI.	Carlow (Browne's Hill)	3·01	—	·72	·63	19	20	...	...	...	...	...	...
"	Dublin (Fitz William Square)	1·27	—	1·91	·23	19	12	71·4	7	42·0	18	0	0
XXII.	Ballinasloe	2·81	—	1·22	·65	1	23	71·0	9	36·0	18	0	0
XXIII.	Waringstown	3·16	—	·28	1·00	26	19	73·0	11	39·0	1	0	0
"	Londonderry (Creggan Res.) ..	5·00	...	...	1·62	12	25	...	...	...	...	...	...
"	Omagh (Edenfel)	4·18	+	·53	·58	11	22	67·0	21	43·0	1, 13	0	0

a And 29. b And 21. c And 10. d And 15, 16, 19. e And 18. f And 28. g And 16, 18.

h And 31.

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

METEOROLOGICAL NOTES ON AUGUST, 1888.

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

ENGLAND.

STRATHFIELD TURGISS.—A wet, cold, and cloudy month. Very trying for haymakers, some hay not carried at the close; crops mostly injured, chiefly by lack of sun. Gale on 28th.

ADDINGTON.—The early part of the month was an improvement on the weather of July, and a good deal of hay was secured in moderate condition; but the latter part was very unsettled, and some hay remained out at the close. The cutting of wheat and oats began in the last week.

LANGTON HERRING.—Although R fell on 19 days the total was 40 in. below the average of 13 years. It was the coldest August in 17 years—the mean temp. being 2°·9 below the average—and the twelfth successive cold month. Slight TSS occurred on the 2nd and 9th, but we escaped the heavy rains which fell in some parts. Great want of sunshine prevented fruits ripening.

BODMIN.—Another cold, dull month; mean temp. 59°·8.

STROUD UPFIELD.—Very little sun; heavy electrical clouds about, all the month, and L at night.

WOOLSTASTON.—An ungenial month, with no sunshine; most unfavourable for harvest operations.

ORLETON.—A cloudy, gloomy, wet and cold month, with the exception of the 7th to 10th, 14th and 31st, which were beautiful days. The mean temp. was nearly 3° below the average of 27 years, and was lower only in 1885. The sky was generally overcast and gloomy, with frequent small R, and occasional heavy showers. T was heard on 5 days, and TSS, with heavy R, occurred on 21st and 28th, that of the latter date causing a flood on the river Teme. Pressure was below the average, and the wind was frequently rough.

BARKBY.—A very cloudy month, with low temp. Oats cut on 13th; wheat on 18th; winter beans on 25th. In some cases winter beans, oats and wheat will be got before the first crop of hay, showing the extraordinary character of the year. Much T.

ARNcliffe.—Very wet, dark and cold.

HULL.—From the 1st to the 20th the weather was generally cloudy, with occasional showers, but during the remainder of the month, R fell almost daily. T on 3 days.

WALES.

HAVERFORDWEST.—R fell frequently in small quantities during the first 12 days; it was then very fine, though cold, to the 18th; and the remainder of the month was very wet, and at times stormy. A heavy storm of R and wind occurred from 27th to 29th, causing heavy floods and doing considerable damage to the corn, but though the heavy crops were beaten down in many places, owing to the low temp., no sprouting occurred. The coldest August registered mean temp. 57°·5. Much hay still out.

SCOTLAND.

CARGEN.—Another cold, gloomy month, the mean temp. being 3°·4 below the average; every month since January has had a temp. below the average, and the total duration of sunshine shows a deficiency of 264 hours. T on 4 days.

JEDBURGH.—Ungenial throughout, with many wet days, and a marked absence of sunshine. Corn crops very good, but late; root crops healthy and good.

LOCHBROOM.—Though R fell on 24 days, the total is small, and it was a good growing month, but crops are meagre and very late.

CULLODEN.—Temp. below the average, and R at long intervals. Harvest late, but crops looking well.

IRELAND.

CORK.—Excepting four fine days, from 13th–17th, the weather was showery and often cold. T on 9th and 21st.

DROMORE.—A very wet month, hay and oats damaged.

WATERFORD.—The weather of the month was very broken, though the total R was half-an-inch below the average, mean temp., $57^{\circ}3$. T and L on 1st and 21st.

O'BRIENSBRIDGE.—Six successive bright days about the middle of the month were of incalculable value in repairing previous damage to hay crop and enabling farmers to secure a large quantity in fair condition; the remainder of the month was nearly as bad as in 1879.

DUBLIN.—Rather cool, very breezy and showery. Mean temp., $58^{\circ}2$, decidedly below the average; mean humidity 84; mean amount of cloud 5.4.

WARINGSTOWN.—On the 26th, 1.00 in. of R fell in three showers, not in all lasting over two hours.

EDENFEL.—With the exception of a short spell in the beginning of the third week, the month was gloomy, wet and sunless, rendering hay-saving even more difficult than in 1879, and retarding the maturing of all cereals to a serious extent.

COLD NIGHTS IN AUGUST, 1888.

To the Editor of the Meteorological Magazine.

SIR,—I have to report a rather low night temperature, at this station for August, 1888, and especially so during four nights in the middle of the month, namely:—

		Min. in Shade.		Min. on Grass.
August 15	... ..	$45^{\circ}0$	.....	$37^{\circ}2$
„ 17	.....	$47^{\circ}0$	.....	$42^{\circ}2$
„ 18	.....	$45^{\circ}2$	.....	$37^{\circ}0$
„ 19	.....	$40^{\circ}4$	.....	$36^{\circ}3$
Mean		$44^{\circ}4$		$38^{\circ}2$

For 18 nights the minimum readings were below the *mean*, as compared with the average for August for 10 years, 1879–88. I find, however, two *single* nights in the 10 years as low:—In August, 1885 and 1887 thus—14th of August, 1885, $39^{\circ}5$ and $36^{\circ}8$; and 15th August, 1887, $42^{\circ}0$ and $36^{\circ}0$, but not three or four nights in succession.

The mean of August *min.* for 10 years is $52^{\circ}9$ in shade, and $49^{\circ}3$ on grass. This past August the means were $51^{\circ}6$ and $47^{\circ}7$ respectively, showing a defect of $1^{\circ}3$ in shade, $1^{\circ}6$ on grass.

SAM. H. MILLER.

Lowestoft, Sept. 1, 1888.

ERRATUM IN *MET. MAG.*, AUGUST.

Table of Rainfall and Temperature, July, p. 110—London, Camden-square, max. temp., $72^{\circ}7$ on 19th, min. temp., $42^{\circ}8$ on 11th; *not* $75^{\circ}9$ and $55^{\circ}7$ as printed.