

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCXCIII.]

JUNE, 1890.

[PRICE FOURPENCE,
or 5s. per ann. post free.]

THE GREAT DEVONSHIRE RAINS OF MAY 25TH.

We have so constantly tried to induce rainfall observers to believe that six inches of rain may fall on one day, and so rarely succeeded, that it is a great satisfaction to have a case in which, though more might have been done, the totals are accurately known—the inner vessels ran over, but the outer ones saved the overflow—and the two gauges in Tiverton collected respectively 4.85 in. and 5.20 in., of which as nearly as we can tell about four inches came down in two hours. We will in the first place give the reports which these two correspondents have kindly sent us, and also the notes from all the stations where the fall exceeded two inches.

To the Editor of the Meteorological Magazine.

SIR,—I have tested the rain gauge, and find that the outer can would hold nearly 7 inches of water without running over. We measured the contents very carefully at 9 a.m. on Monday (26th), as usual, and recorded 5.20 in. The rain commenced here at 2.15 p.m. on Sunday (25th), and was soon followed by a hail storm of unusual severity, lasting for two hours, and causing great damage, cutting through our verandah, which is canvas painted, and riddling it as if shot through by bullets. It otherwise did immense damage to garden frames, &c. The heavy rain, accompanied by terrible lightning, lasted until 4.30 p.m., when the latter subsided, but the rain continued, off and on, up till 10 o'clock, but not with any *violence* after 4.30 p.m. The devastation caused in and around Tiverton is extraordinary.

Yours very truly,

M. DICKINSON.

Broomhill, Tiverton, May 31st.

P.S.—The bottle in our rain gauge overflowed into the tin, but, it being watertight, the overflow was quite safe, and carefully measured.

SIR,—The storm on Whitsunday begun at 2.15 p.m., with lightning, followed almost immediately by loud thunder, heavy rain, and soon by large hail. The worst of the storm lasted about 2 hours, but rain

continued to fall heavily, with occasional thunder, not so near, for an hour more, and distant thunder and showers of rain occurred at intervals all the evening.

The storm began very suddenly ; at 1.55 it was hot and bright, as in the morning, 82° in the shade, and no one had umbrellas. At 2.15 a few large drops were falling, and before 2.20 the thunder had begun.

The gauge was visited at 5.15 p.m., when it was still raining slightly, a jug being taken to bring in the rain for measurement. It was then found that the bottle (which we have since twice measured and found to hold 3.27 inches) had run over, and the overflow was preserved in the outer case. The bottle was emptied into the jug, but so nearly filled it that the overflow water was not then touched, and the emptied bottle was replaced. In the morning the bottle was found to contain 0.35 in., and the case 1.23 in. The fall, therefore, was, between—

2.15 and 5.15	... ..	4.50
5.15 and 9 a.m. (26th)	... ..	.35
		4.85
Total to be entered to 25th	... ..	4.85

The damage is now estimated at £750 to roads, and £1,000 to private property.

The streets were re-laid in the winter, and rolled in with a steam roller, and they have only been washed bare ; but as soon as you pass into a road you see the wreck of the storm, The chief damage is (to roads) E. and W. On the N. and S. the river Exe received the water from the hills, and carried it off without flooding, but the Lownam river and a small stream that flows into it, the Ailsa brook, overflowed and did much damage.

West of the town, in two directions, three steep roads meet just before the streets begin, and in both cases the main road is more like the moraine of a glacier in miniature than a civilized road. The granite blocks edging the footpath are washed up and tossed on the heaps of gravel and stones where the road was, and in one case a broken culvert completes the scene of ruin.

Owing to illness in the house I have not seen the roads on the E., but hear that they are quite as bad, with trees torn up, and a hedge washed into the middle of Tidcome-lane, which is also blocked by a broken culvert.

The damage to houses was chiefly caused by the water pipes and shoots overflowing, being choked by the large hail ; the streams pouring from these caused the floods in the streets, where the gratings were also stopped.

The flood in St. Peter-street (ours) went down by 5.0 p.m., but the water in Westexe was still high at 8.30. That part of the town below the bridge is much lower than ours.

Yours truly,

H. S. GILL.

Tiverton, June 2nd, 1890.

SIR,—Morning of 25th very close and sultry, about 2 p.m. distant T in the E., which became heavy and continuous by 3 p.m. About 3.30 a few enormously large drops or splashes of water fell at intervals, and shortly after a heavy downpour set in, 0.18 in. falling in 15 minutes. About this time a remarkably brilliant flash of L was accompanied by a nearly simultaneous deafening report. L became incessant and T heavy and continuous, but the R was not remarkable, and the storm subsided considerably by 4.45 p.m.

At 6 p.m. another very black storm came over from the E., and at 6.45 a very heavy downpour set in, and in about an hour, 1.56 in. of R was registered. By 8.30, the R had nearly ceased, and a black cloud in the W.N.W. (from which L was frequent) marked the re-treating storm.

The total rainfall for the five hours during which these storms lasted was 2.07 in., as recorded by the registering pluviometer, 10 ft. above the ground.

The records of the various gauges are as follows :—

1890, May 25th.—A. 2.13 inches = old 5 in. gauge, 1 ft. above ground.
 C. 2.21 „ = 5 „ 4 „ „
 D. 2.12 „ = new 5 „ „
 E. 2.07 „ = 8 in. Richard recording gauge.

No rain was registered May 24th and 26th.

The barometer gave no indications of the approach of these storms, the barograph trace showing a very gentle decline. Between 2 and 7 p.m. the trace is considerably shaky, as if from the jar of the thunder, and a decided disturbance is shown about 5.15 p.m.

C. GROVER,
 (Asst. to C. E. Peek, M.A.)

Rousdon Observatory, Lyme.

SIR,—Thunderstorms are not of frequent occurrence here, but we had one yesterday of exceptional duration and rainfall. T was first heard about 2 p.m. The first drops of R fell at 3 p.m., and R ceased shortly after 8 p.m. At 9 p.m. I measured the fall and found it to be 2.77 in.

The fall was not quite continuous and varied much in intensity, but the gauge being far from the house I could not take the measurements at successive periods as I should have liked to do. The hour from 6 to 7 would, I believe, have shewn a most unusual rate of fall.

The heaviest falls I have previously registered were :—July 14, 1875, 2.72 in., a steady downfall for about 20 hours, without T, and December 26, 1886, 2.53 in., a violent gale, finishing with S of unusual density.

Extensive damage is reported from Lyme and Uplyme this morning.

Yours very truly,

E. L. AMES.

Clevelands, Lyme, Dorset, May 26, 1890.

SIR,—We had 2·14 in. of R on the 25th. It rained heavily from 3 to 4 p.m., but the tremendous storm was from 6·30 to 7·30 p.m., when the H and T were awful.

Great Trill, Axminster.

F. J. SPARKS.

From Tiverton to Exeter is about 12 miles, and before we proceed to a general summary of the storm we think that the following note on the state of the Exe, at a little N. of Exeter will be illustrative. We have already seen that at Tiverton the rain began at 2.15 p.m., and that by 5.15 the exceptional features had passed, and the water was clearing out of the streets. Evidently, therefore, the rush into the Exe at Tiverton may be said to have been from about 4 to 6 p.m. Allow the flood to pass from Tiverton to Exeter at 5 miles an hour, then the maximum flood at Bramford Speke should be from about 6 to 8 p.m. Now for the report of Miss Gamlen's gardener. "The river was a little puddled at about 6 p.m., but in a quarter of an hour it came down like mud for two hours; I never saw anything like it. Three pigs, hedgehogs, cats, rats, a tub of barley meal, corked bottles, boxes, tins, all sorts of things floated down. At 8 p.m. it was at its height."

As regards rainfall, it was far heavier in Tiverton than anywhere else of which we have yet heard. It was, as all such storms are, very local; for instance, even at Cove, which is in Tiverton parish, but about four miles N. of the Town, the fall was only ·90 in.

We may perhaps as well dispose of the rainfall at once. There was a slight TS, with from $\frac{1}{4}$ to $\frac{1}{2}$ in. of R in the S.W. of Ireland. At Swansea in S. Wales there was a local heavy R, 1·53 in. falling in 1 hr. 33 min. There were TSS with slight R over much of Cornwall and Devonshire, but though we have been favoured with many returns, the only places at which we have yet heard of an inch falling on the 25th are—

Lyme Regis (Rousdon Obs.)	2·21 in.	Lyme Regis (Holm Cleve)	...3·70 in.
" "	(Clevelands) ... 2·77 "	Cullompton.....	1·08 "
Axminster (Great Trill)	... 2·14 "	Tiverton (St. Peter's Street)	4·85 "
" "	1·20 "	" (Broomfield)	5·20 "
" (Furzebrook)...	1·03 "		

Reference to a map will show that these returns are (with only one exception, Cullompton, which was only just over an inch and which is about midway between) from two small areas, one of about four miles square to the W. and N. of Lyme Regis, the other about one mile square over Tiverton. As regards Lyme Regis, it is impossible to speak positively, as two observers there allowed their gauges to run over.

As regards the time and progress of the storms the facts are as confusing as is usual. The following very interesting table, prepared by Mr. Greenwood Penny, of High Bickington, Torrington, was published in the *Devon and Exeter Gazette*, and we reprint it as a useful lesson upon the subject.

Locality.	Commencement of Storm.	Killed by Lightning.			
		Man.	Horses.	Sheep.	Bullocks.
Axminster	Afternoon				
Barnstaple	2 30 "				
Black Torrington	2 30 p.m.			6	
Bradworthy	2 30 p.m.	.....	.....	21	2
Bramford Speke.....	Afternoon	.....	.....
Bude	1 p.m.				
Crediton	2 p.m.				
Dawlish	3 p.m.				
Dunkeswell	Afternoon				
Exeter	1 a.m. and again evening				
East Budleigh		0.30 p.m.			
High Bickington	3 p.m.				
Holsworthy	2.15 p.m.				
Halsdon .....		.....	.....	4	
Huish	3 p.m.	.....	..	4	
Little Torrington	1 p.m.	.. ..	1		
Moretonhampstead .....	.....	1	.. ..	4	
Petersmarland	3 p.m.				
Powderham	1 a.m.				
Sandford.....	3 p.m.				
Stratton	1.30 p.m.				
Tiverton	2 p.m.				
Topsham.....	2 p.m.				
Witheridge	2.30 p.m.				

OTHER CASUALTIES. —Holy Trinity Church tower, Barnstaple struck 6.30 p.m. Holsworthy church tower struck 3 p.m, Mr. Payne's house at Merton struck. Outbuildings struck and burned, property of Mr. Oatway, Tawstock, near Barnstaple. House struck at Topsham (Mr. F. Underhill's). Angel Hotel and outhouses struck at Witheridge. Trees struck in many localities.

Summing up, Mr. Penny said that "the above table, compiled chiefly from reports which appeared in your columns, may be of interest in showing at a glance, the area covered by the thunderstorms of Whit-Sunday, the time of their occurrence in various localities, and the disasters occasioned by lightning alone. It will be seen that the storm of Sunday afternoon was preceded by another in the early hours of the morning, over Exeter, Exmouth, and Powderham, where the hail is reported to have done considerable damage. Another storm developed over Holsworthy at about 5 a.m., but Sunday forenoon appears to have been universally bright and fine, the temperature being unusually high for the time of the year. The second, and by far the more destructive storm, developed over the greater part of Devonshire between the hours of 1 and 4 p.m., reports of its severity having reached from Barnstable (North), Dawlish (South), Axminster (East), and from Bude and Stratton, Cornwall (West). In Mid-Devon, especially in the neighbourhood of Tiverton and Holsworthy, the severity of the storm is reported to have been almost unprecedented. The generally received opinion that summer thunderstorms arise from the rapid condensation of vapour, and consequent development of electricity, from a warm humid atmosphere by the chilling influence of cold air currents and changes of wind in its higher regions, seems to be borne out by the facts. So

extremely rapid was its formation that it came upon us in apparently calm, settled, bright summer weather, with scarcely an hour's warning. We have no records of its commencement anywhere before mid-day, and at 3 p.m. it was raging furiously over nearly the whole county. Here at High Bickington the sky was cloudless at mid-day. At 3 p.m. distant thunder was heard, the sky being then overcast to the S.E. At this hour I noticed the rapid formation of cumuli clouds in the clear sky, which soon coalesced in large rolling masses, darkening the whole heavens. In another half-hour the storm was raging in all its fury, and continued with intermissions until late in the evening. The barometer which had been steady at about 29.5 during the previous twenty-four hours, rose slightly when the storm was at its height."

But the above leaves much uncertain: take, for instance, the Lyme Regis storms. Mr. Cuthbert Peek's observer speaks of them distinctly as coming from E. and passing to W.N.W., but while the first of these was E. of Lyme Regis, torrents of rain were flooding Tiverton, which is N.W. of Lyme. Evidently, therefore, the Tiverton storm was either formed locally or came from the opposite direction. Our impression is that we shall arrive at a true knowledge of the path of storms, only by one or other, or both of two methods (1) by enormously increasing the number of observers—say to one in every alternate village, or (2) by fixing the paths of the storms by trigonometrical observations from lofty observatories like Mr. Prince's.

We need not add details as to flooded cellars, washed away gardens and fowls, nor where the pigs seen floating past Exeter had come from—all who know anything of rainfall know that with four inches of rain in three hours mischief always occurs.

OZONE AND WIND.

To the Editor of the Meteorological Magazine.

SIR,—The determination of ozone in the atmosphere, as at present conducted, is still, I suppose, somewhat lacking in exactness and certainty. Assuming, however, that the daily observations of this substance at Greenwich, published in the *Weekly Return* of the Registrar-General, are an approximation to the truth, the following analysis which I have made of the data for last year (1889) may be not without interest, even if it contain nothing very novel.

The presence of ozone was recorded, I find, on less than half the days, there being 193 days with no ozone. The quantities are represented by figures, ranging to about 17. The days with ozone were:—

0 to 1	==	46	Brot. up	142	
1 to 2	==	24	6 to 7	==	7
2 to 3	==	31	7 to 8	==	4
3 to 4	==	17	8 to 9	==	6
4 to 5	==	12	9 to 10	==	3
5 to 6	==	12	10 and above	==	10
Carried up		142	Total	.....	172

Thus the maximum is in the lowest category, then follow the third, the second, &c.

Now, taking out the ten highest records, and comparing with the direction of the wind, we get the following list:—

Date.	Ozone.	Wind direction.							Hor. movement, dep. from average. (miles.)
		W.S.W.	S.W.	S.S.W.	S.	S.S.E.	S.E.	E.S.E.	
1. March 8.....	17.5	...	...	x	...	x	...	...	+123
2. July 10.....	15.8	...	x	x	x	...	x	...	+ 76
3. May 31.....	12.8	...	...	x	x	...	...	...	+ 75
4. May 30.....	12.0	...	...	x	x	...	...	...	+116
5. April 4.....	11.2	...	...	x	...	...	...	...	+ 3
6. Oct. 19.....	11.2	...	x	x	x	...	x	x	+ 74
7. March 7.....	10.5	...	...	x	...	x	x	...	+149
8. April 20.....	10.5	x	x	x	...	...	...	...	+111
9. April 22.....	10.5	x	x	x	...	...	...	...	...
10. July 25.....	10.5	x	x	...	...	...	...	...	+206

Three things may here be noted:—

(1). The highest records are, with one exception, in the period March to July (the exception being in October). There was most ozone in the spring and early summer.

(2). The wind-directions on those days are all included in the arc W.S.W. (by S.) to E.S.E. We find in the above list that W.S.W. occurs 3 times, S.W. 5, S.S.W. 9, S. 4, S.S.E. 2, S.E. 3, and E.S.E. 1. Thus the maximum appears to have been with S.S.W.

(3). The horizontal movement of the air was in each case in excess (in one case there is no record). Doubtless the amount of movement affects the record considerably.

We may now look at the cases of no ozone. On most of those 193 days some wind-direction in the northern half of the circle is recorded (W. by N. to E.), though there may be other directions. There are, however, a certain number of cases of no ozone (34), in which the wind-directions were exclusively within the arc indicated above—viz., W.S.W. (by S.) to E.S.E.

Now we find, on examination, that in the great majority of those cases there was a *deficiency* (generally considerable) of wind. Eliminating these, we have a residuum of the following cases of no ozone, with wind in the ozone-yielding arc (as we may call it), and in excess of the average velocity:—

January 18 .....	...	S.W.	S.S.W.	.....	+ 6
February 16	W.S.W.	S.W.	S.S.W.	.....	+58
August 28 .....	..	S.W.	S.S.W.	.....	+74
December 10	W.S.W.	S.W.	...	.....	+88

Thus it seems that we may have a considerable amount of south-westerly wind and no ozone. It may be noted, however, that none

of these four days were in the spring and early summer, in which we find the highest proportion of ozone.

We may, again, look at the matter thus: Here is a table which shows (1) the monthly relative proportion of south wind at Greenwich last year (including reductions); (2) the daily average of the amount of ozone in each month; (3) the number of days in each month on which ozone was observed:—

	S. wind (days.)	Ozone (daily average.)	Ozone (days observed.)
January.....	10	0·4	8
February	4	0·3	8
March	8	2·5	17
April	13	3·6	20
May	10	3·5	24
June	8	0·7	7
July	9	2·6	21
August	11	2·1	23
September.....	6	0·7	9
October	12	2·4	15
November.....	8	0·3	7
December	12	1·0	13

Any one who will take the trouble to make out curves of these figures will find a fair general correspondence. A. B. M.

WIND CHANGES—PRE-INSTRUMENTAL METEOROLOGY.

To the Editor of the Meteorological Magazine,

SIR,—In your review of Mr. Prince's "Summary of a Meteorological Journal," you suggest, as a possible cause of the change from S.W. to N.E. in the direction of our Sussex winds, that additional building may have affected the indications of his vane. But this will not explain the phenomenon, which is a real and objective one. My own register shows precisely the same thing, and my vane, as you know, is at the top of a pretty tall mast in the middle of an acre of paddock, where it has remained unchanged, in locality and surroundings, for more years than I care to count. It is really very curious to go through back records and see how absolute the change has been. I cannot fancy that so notably-marked a phenomenon can be confined to Sussex. It must have some terrestrial—or even cosmical—cause, and, if this be so, should be evident in other localities.

The other matter on which I wished to write was suggested to me by a passage in your article on "Pre-instrumental Meteorology," which set me hunting up some records of storms and floods in our "Sussex Archæological Collections."

I have copied two or three of the most notable accounts from the "S.A.C." volumes, and enclose them.

Very sincerely yours,

WILLIAM NOBLE.

Forest Lodge Maresfield, Uckfield, May 14th, 1890.

THE GREAT STORM OF DECEMBER 8TH, 1703.

“The great storm of November 27th (Dec. 8th N.S.) 1703, in which Bishop Kidder (a Maresfield man) and his wife were killed in bed, at Wells, by the falling of a chimney stack, and Winstanley's Eddystone Lighthouse disappeared, was much felt in Sussex. Houses were untiled at Midhurst, four or five stacks of chimneys blown down at Cowdray, Osborn church steeple blown down. ‘The Shoreham Market-house, an ancient and very strong building, was blown flat to the ground, and all the town shattered.’ It tore the lead off Brighthelmstone Church, and overthrew two windmills. The hedges were salt twenty miles from the sea, and the grass on the Downs about Lewes so salt that the sheep would not eat it; while “the miller of Berwick, three miles from the sea, while attempting with his man to secure his mill, was so washed with flashes of sea water, which he represented as beating against them like the breaking of waves against the rocks, that they were almost strangled therewith, and forced to give over their attempt, and in consequence the mill was considerably damaged.”

HEAVY THUNDERSTORM, MAY 22ND, 1728.

“May 11th (22nd N.S.) 1728, at Hurstpierpoint. A dry day until towards night, then rain, thunder, and lightning, and a very great storm and tempest. May 13th (24th N.S.). The storm on Saturday proved to be very great, especially the hail, which was prodigious. Many of the stones were as big and some bigger than hens' eggs. The windows of some houses about here were almost all broken. The corn was much injured.”—*Diary of Thomas Marchant*, “*Sussex Archaeological Collections*,” Vol. XXV., p. 19.

HEAVY THUNDERSTORM, MAY 16TH, 1797.

“May 16th, 1797. On Sunday, the 7th of this month, I was engaged to officiate, at 3 o'clock in the afternoon, at St. Michael's in Lewes, for Mr. West. I had entered my carriage at half-past 1 to go there, not conceiving it possible I could be prevented, but a storm of thunder and lightning and hail came on with great violence, as we were coming from Chailey Church, after morning service. I thought it too violent to continue any time, and had no doubt of going to Lewes, but it kept increasing, and the rain came in such torrents, that before half an hour the flood was immense. The sheep stood belly deep in the Green before the house, and the orchard and lawn and the lower island pond were one sheet of water, and the rain so continued until past 3 o'clock, when the deluge was beyond description, and the water on the lawn was twelve feet deep, as I myself measured it, from where it had stood, at against the old road that intersects it. Had I have attempted to have gone to Lewes the flood at Bevan's Bridge would have rushed in at the chariot windows; indeed, it would have been useless to have attempted to pass, for at 7 in the evening a man and horse were

swimming there. But the very extraordinary part is that there was no rain at Lewes ; and there the congregation was all assembled, and waiting for me with great impatience. The hail was large, and broke some panes of glass, but did no other material mischief ; in truth, it was such a flood as was never known before, and as never covered anything like the ground, or fell in so short a time, at most three hours. I never saw anything like it, except some years ago in London, when the people waded knee deep in Piccadilly, and when so much of Tower Hill was torn up that they talked of an earthquake, and there was neither then nor now any wind."—*From an old Account Book kept by the Rev. Sir Henry Poole, Bart., of the Hooke, Chailey, Sussex.*—*Sussex Archaeological Collections, Vol. XII., p. 3.*

During the same flood the stone parapet of Uckfield old bridge was carried away, and some persons standing on the bridge were drowned.

"AREAS OF RAREFACTION" OR "DEPRESSIONS."

To the Editor of the Meteorological Magazine.

SIR,—Replying to Mr. Ryves, I beg to say that I do not see that the inclination of the axis of a cyclone has much to do with the question at issue, which, he says, "is not how a system of low pressure is 'filled up' but how it *originates*."

Twenty months ago, when I asked of the Hon. Ralph Abercromby, as a super-eminent meteorological authority, what originates the diminished aerial pressure in cyclonic disturbances, he shook his head and owned he did not know. And I am afraid that neither Mr. Ryves nor myself are yet able to help him with a theory, "crude" or other.

Mr. Ryves should not say that I assert cyclones "are caused by local heat," though I have said that heated ground warms contiguous air. Heating, likely enough, may be a cause, or concomitant, of cyclonic disturbances, but I have not said so in either of my letters.

If Mr. R. H. Scott's "Pits [that] are what are called barometrical depressions or cyclonic systems" gyrate earthwards, as liquid eddies do, they will, by forcing the air downwards, tend to elevate the barometric mercurial column, not depress it. If these wind-whirls eddy upwards they will tend to originate and evolve aerial "mounds" skywards, not pits. If not, why not? in both cases.

The quotation from Sir John Herschel does not state what originates the "wind" driven over mountain ranges, which is what is wanted. If the air never varies in density or velocity I do not see that the range crossed will break it into very perceptible waves ; but, granted that it does so, then the undulations will be generated continuously, like waves in the rapids of Niagara, as in the case of diurnal maxima and minima, and we will require some other *fitful* originator of cyclonic disturbances, which occur only occasionally.

Waiting Mr. Ryves' next letter,

I am, &c.,

HENRY MUIRHEAD.

Cambuslang, 17th May.

SIR,—Being neither a meteorological authority, such as Mr. Ryves or Dr. Muirhead would invoke, nor a worshipper of any principality, I can offer no opinion here on the controversy concerning “depressions” to which your correspondents would attach any value. Neither shall I deal in this letter with the origin of terms or expressions, interesting as this may be to the historian of science after his kind, or to the etymologist and lexicographer after their kind. But is it not a little hard upon students of meteorology that we should have pages of correspondence on a necessarily much-studied branch of our subject, practically treating that branch as if it were nearly new. Projects of ventilation are useful in their way, and it is, in general, a pity that we get so little of them; but on well-exposed rising ground, under a strong breeze they seem slightly out of place. Now, after full attention has been devoted to the works of Faye, Hazen, and other oppositionists, the fact remains that the character of the current of scientific theory, on the subject vaguely treated of by your correspondents, is strong enough to be, to most of us, unmistakable. Whether, in the present state of our knowledge, Sir John Herschel would be grateful for the reference made to a statement of his, or whether living writers will be grateful for inferences drawn from their works, is a point with which we are not concerned. Beyond other varieties of the human species we (students of meteorology) suffer long and are very kind. But there is a limit even to our tender-heartedness, the probable position of which limit I should like to indicate.

What would be thought of the airing of, say, the subject of “Panmixia” in the pages of a biological periodical, without any reference to the works of, *e.g.*, Prof. Weismann? In dealing with a subject on which many authors might advantageously be referred to, it may seem invidious to mention only one. But I shall, as your correspondents give to great names the honour really due to them, mention one, and, for the sake of brevity, one only. I do not claim for Mr. Ferrel the title which he is himself, I believe, anxious to repudiate, of “the Newton of Meteorology,” and I even consider that certain of his conclusions require, and will receive (I hope at his own hands) some modification. But I must ask whether correspondents have or have not, studied Ferrel’s “Researches,” “Recent Advances,” or, in any case, his latest “Popular Treatise on the Winds.” If not, they are writing on a subject to which they have given inadequate attention. And, on either supposition, they should be aware, and show themselves to be aware, that many of your readers, and (as I hope) many Fellows of the Royal Meteorological Society, possess and employ sources of information—such as those I have alluded to—which cannot with safety be utterly ignored.

I am, sir, yours very faithfully,

W. CLEMENT LEY.

May 20th, 1890.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, OCT., 1889.

STATIONS. <i>(Those in italics are South of the Equator.)</i>	Absolute.				Average.				Absolute.		Total Rain.		Aver.	
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	Cloud.	
	Temp.	Date.	Temp.	Date.										
England, London	60·6	16	35·5	13	55·9	43·1	45·1	88	96·8	31·8	inches	3·75	22	7·1
Malta	84·8	26	58·0	17	78·6	66·3	63·3	78	135·5	51·7	·65	3	3·8	
<i>Cape of Good Hope.</i> .....	...	...	...	...	...	...	...	...	...	...	...	...	...	...
<i>Mauritius</i>	79·0	16a	63·6	1	78·0	66·8	61·7	72	135·8	55·7	1·20	21	5·4	
Calcutta	90·4	1	64·7	31	86·4	74·7	75·1	84	156·0	58·1	5·76	9	4·6	
Bombay	92·2	13	70·0	29	86·5	75·5	73·5	79	143·0	60·1	3·80	7	4·9	
Ceylon, Colombo	87·4	6	72·0	...	85·6	76·1	71·1	76	150·0	63·5	14·99	19	6·2	
<i>Melbourne</i>	84·5	14	37·8	12	67·7	50·7	48·7	70	144·9	30·7	2·86	11	6·7	
<i>Adelaide</i>	88·1	22	42·0	9	73·3	53·7	50·8	63	144·2	34·8	3·61	12	5·3	
<i>Wellington</i>	68·0	30	41·0	26, 27	61·2	47·8	46·1	74	127·0	34·0	3·20	16	3·9	
<i>Auckland</i>	74·0	31	47·0	13	64·7	51·6	49·8	74	135·0	35·0	3·20	11	5·2	
Jamaica, Kingston	93·8	8	67·8	5	89·7	71·2	71·9	76	...	...	4·20	...	...
Trinidad	91·0	7b	66·0	25, 26	89·0	70·4	72·5	77	159·0	60·0	6·30	19	...	
Toronto	61·5	1	22·6	24	49·8	35·6	34·9	73	...	9·8	1·89	14	6·6	
New Brunswick, Fredericton	60·1	1	16·8	24	50·1	34·5	38·4	83	...	...	5·17	13	6·5	
Manitoba, Winnipeg ...	72·5	10	8·5	22	49·5	27·6	33·0	78	...	...	·86	10	5·5	
British Columbia, Victoria	67·0	4	36·0	15	58·7	48·9	...	...	...	...	2·08	16	...	

a And 28, 31. b And 25, 26.

REMARKS, OCTOBER, 1889.

MALTA.—Mean temp. 71°·0; mean hourly velocity of wind 9·2 miles. Sea temp. fell from 77°·5 to 72°·0. TS on 17th, L on 20th and 31st. J. SCOLES.

Mauritius.—Mean temp. of air equal to, of dew point 0°·2 above, and R ·70 in. below, their respective averages. Mean hourly velocity of wind 11·6 miles, or 0·2 mile below average; extremes 30·5 on 4th, and 1·9 on 1st. Prevailing direction E. S. E. C. MELDRUM, F.R.S.

CEYLON, COLOMBO.—L seen on 1st and 2nd. J. C. H. CLARKE, Lt.-Col. R.A.

Melbourne.—Mean temp. of air 2°·2, of dew point 2°·5, amount of cloud 0·7, and R ·06 in. above the average. Prevailing winds N. and S., strong on 7 days. Heavy dew on 7 days; TS on 4th. R. L. J. ELLERY, F.R.S.

Adelaide.—Another wet month, R being 2½ inches in excess of the average of 32 years; the total since January 1st (28·43 in.) is the greatest on record for a similar period since 1839. Bar. about an average, and mean temp. 1°·6 above average. C. TODD, F.R.S.

Wellington.—Showery during the early part of the month, and at intervals up to the 26th, then fine for the remainder. Prevailing N.W. wind, and stormy on 20 days from that quarter. R. B. GORE.

Auckland.—Early part of the month stormy and rainy; middle and close fine and dry. Bar. pressure, mean temp., and R, all close to the average, but slightly above. T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL,
MAY, 1890.

[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.	1.58	XI.	Castle Malgwyn	4.22
„	Margate, Birchington...	1.92	„	Builth(LlanwrtydWells)	2.35
„	Littlehampton	1.77	„	Rhayader, Nantgwillt..	3.30
„	Hailsham	2.45	„	Carno, Tybrith	2.02
„	Ryde, Thornbrough	2.46	„	Corwen, Rhug	2.49
„	Alton, Ashdell.....	1.99	„	I. of Man, Douglas	3.21
III.	Oxford, Magdalen Col...	1.75	XII.	Stoneykirk, ArdwellHo.	2.94
„	Banbury, Bloxham	1.78	„	New Galloway, Glenlee	4.01
„	Northampton	1.60	„	Melrose, Abbey Gate ..	1.62
„	Cambridge, Fulbourne..	1.89	XIII.	N. Esk Res. [Penicuick]	2.05
„	Wisbech, Bank House..	2.30	XIV.	Ballantrae, Glendrishaig	2.86
IV.	Southend	1.50	„	Glasgow, Queen's Park.	2.75
„	Harlow, Sheering	1.61	XV.	Islay, Gruinart School..	1.69
„	Rendlesham Hall	1.86	XVI.	Dollar.....	1.27
„	Diss	1.86	„	Balquhider, Stronvar..	3.28
„	Swaffham	2.03	„	Dunkeld, Inver Braan..	2.41
V.	Salisbury, Alderbury ...	2.01	„	Dalnaspidal H.R.S. ...	3.43
„	Warminster	1.82	„	Arbroath Cemetery.....	..
„	Bishop's Cannings	2.71	XVII.	Keith H.R.S.	1.51
„	Ashburton, Holne Vic. ...	2.01	„	Forres H.R.S. ....	.56
„	Hatherleigh, Winsford.	2.01	XVIII.	Fearn, Lower Pitkerrie.	.96
„	Lynmouth, Glenthorne. ...	4.43	„	Loch Shiel, Glenaladale	3.62
„	Probus, Lamellyn	2.50	„	N. Uist. Loch Maddy ...	1.16
„	Launceston, S. Petherwin	1.64	„	Invergarry	2.97
„	Wincanton, Stowell Rec.	1.90	„	Aviemore H.R.S.	1.22
„	Taunton, Lydeard Ho... ..	1.48	„	Loch Ness, Drumnadrochit	1.21
„	Wells, Westbury	1.87	XIX.	Lairg H.R.S.	1.05
VI.	Bristol, Clifton	2.12	„	Scourie .....	.99
„	Ross	1.92	„	Watten H.R.S.	1.83
„	Wem, Clive Vicarage ...	2.10	XX.	Dunmanway, Coolkelure	5.49
„	Cheadle, The Heath Ho. ...	1.98	„	Fermoy, Gas Works ...	3.91
„	Worcester, Diglis Lock	2.47	„	Tipperary, Henry Street	3.75
„	Coventry, Coundon	2.53	„	Limerick, Kilcornan ...	2.75
VII.	Ketton Hall [Stamford]	2.72	„	Miltown Malbay	3.89
„	Grantham, Stainby	2.10	XXI.	Gorey, Courtown House	3.29
„	Horncastle, Bucknall ...	2.18	„	Navan, Balrath	1.76
„	Mansfield	2.62	„	Mullingar, Belvedere ...	2.98
VIII.	Neston, Hinderton	3.82	„	Athlone, Twyford	2.01
„	Knutsford, Heathside ...	2.80	„	Longford, Currygrane...	2.06
„	Lancaster, South Road. ...	2.52	XXII.	Galway, Queen's Coll..	2.39
„	Broughton-in-Furness ...	2.61	„	Clifden, Kylemore	3.86
IX.	Wakefield Prison	2.29	„	Crossmolina, Enniscooe..	2.27
„	Ripon, Mickley	2.61	„	Collooney, Markree Obs.	1.37
„	Scarborough, West Bank	1.92	„	Ballinamore, Lawderdale	..
„	EastLayton[Darlington]	1.92	XXIII.	Warrenpoint	1.62
„	Middleton, Mickleton..	1.63	„	Seaforde	1.72
X.	Haltwhistle, Unthank..	3.40	„	Belfast, New Barnsley .	2.16
„	Shap, Copy Hill	2.08	„	Bushmills, Dundarave...	1.79
XI.	Llanfrechfa Grange .....	..	„	Stewartstown	1.86
„	Llandoverly .....	..	„	Buncrana	1.56

MAY, 1890.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					TEMPERATURE				No. of Nights below 32°	
		Total Fall.	Difference from average. 1880-9	Greatest Fall in 24 hours.		Days on which .01 or more fall.	Max.		Min.		In shade.	On Grass.
				Dpth	Date.		Deg.	Date	Deg.	Date		
I.	London (Camden Square) ...	1.25	— .65	.41	9	13	77.6	25	39.1	31	0	0
II.	Maidstone (Hunton Court)...	1.61	+ .23	.55	10	12	...	...	...	...	...	...
III.	Strathfield Turgiss	2.18	+ .31	.78	9	12	78.2	24	34.6	31	0	8
III.	Hitchin	1.92	— .03	.56	10	11	72.0	24	38.0	1	0	0
III.	Winslow (Addington)	2.00	— .10	.40	9	13	78.0	24	33.0	31	0	6
IV.	Bury St. Edmunds (Westley)	2.26	+ .51	.85	10	8	...	...	...	...	...	...
IV.	Norwich (Cossey)	1.57	— .10	.54	9	7	...	...	...	...	...	...
V.	Weymouth (LangtonHerring)	1.74	+ .13	.31	16	12	76.0	25	41.0	28 ^f	0	...
V.	Barnstaple	2.76	+ .56	1.05	26	15	79.0	25	38.0	28	0	...
V.	Bodmin (Fore Street)	5.04	+ 2.51	1.40	3	19	...	...	...	...	...	...
VI.	Stroud (Upfield)	2.06	+ .02	.84	9	14	78.0	25	35.0	30	0	...
VI.	ChurchStretton (Woolstaston)	2.76	— .11	.56	19	18	71.0	24	37.0	31	0	1
VI.	Tenbury (Orleton)	2.22	— .33	.66	19	14	76.3	24	33.0	31	0	3
VII.	Leicester (Barkby)	1.85	— .12	.45	10	14	78.0	24	29.0 ^g	27	4	12
VII.	Boston	2.04	+ .32	.75	10	12	80.0	22	33.0	1, 31	0	...
VII.	Hesley Hall [Tickhill].....	2.61	+ .57	.53	10	12	76.0	24	33.0	1	0	...
VIII.	Manchester (Plymouth Grove)	2.32	— .03	.68	29	10	78.0	24	39.0	26 ^g	0	0
IX.	Wetherby (Ribston Hall) ...	2.07	+ .12	.48	12	8	...	...	...	...	...	...
IX.	Skipton (Arncliffe)	3.43	— .29	1.02	16	14	75.0	24	33.0	11	0	...
IX.	Hull (People's Park)	3.05	+ 1.17	.78	10	14	...	...	...	...	...	...
X.	North Shields	1.68	+ .07	.50	11	14	68.5	12 ^b	32.0	31	1	1
X.	Borrowdale (Seathwaite).....	7.96	— .65	1.60	16	16	...	...	...	...	...	...
XI.	Cardiff (Ely) .....	...	...	...	...	...	...	...	...	...	...	...
XI.	Haverfordwest	4.54	+ 2.18	1.18	15	19	77.6	24	34.8	30 ^f	0	4
XI.	Plinlimmon (Cwmsymlog) ...	1.74	...	.36	15	11	...	...	...	...	...	...
XI.	Llandudno	1.91	— .02	.42	16	12	74.0	24	43.3	27	0	...
XII.	Cargen [Dumfries]	3.18	+ .66	.91	11	15	73.8	23	33.6	31	0	...
XII.	Jedburgh (Sunnyside).....	1.49	— .41	.48	8	11	72.0	23	32.0	14	1	...
XIV.	Old Cumnock	3.28	+ .84	.83	11	17	76.0	24	26.0	30	1	...
XV.	Lochgilphead (Kilmory).....	2.45	— .90	.70	16	16	...	...	...	...	...	...
XV.	Oban (Craigvarren)	2.77	...	.68	29	20	75.2	25	39.3	27	0	...
XV.	Mull (Quinish)	2.07	— .88	.54	16	17	...	...	...	...	...	...
XVI.	Loch Leven Sluices	1.60	— .96	.40	12	8	...	...	...	...	...	...
XVI.	Dundee (Eastern Necropolis)	2.10	+ .44	.65	16	10	70.6	23	34.8	27	0	...
XVII.	Braemar	2.16	— .25	.55	5	18	73.0	25	28.2	2	2	7
XVII.	Aberdeen (Cranford)	3.40	...	.80	15	20	72.0	21	38.0	1, 3 ^h	0	...
XVIII.	Strome Ferry	1.98	— 1.37	.46	14	15	...	...	...	...	...	...
XVIII.	Culloden .....	.68	— .82	...	...	...	71.0	24	38.0	15	0	7
XIX.	Dunrobin	1.42	— .68	.42	16	16	66.0	24	37.0	30	0	...
XIX.	S. Ronaldsay (Roeberry).....	...	...	...	...	...	...	...	...	...	...	...
XX.	Cork (Blackrock)	3.85	+ 1.45	.54	17	21	69.0	23 ^c	29.0	3, 12	0	...
XX.	Dromore Castle	5.67	+ 1.99	.90	2	21	72.0	25	38.0	3	0	...
XX.	Waterford (Brook Lodge) ...	3.19	+ .96	.50	17	18	72.0	24	36.0	3	0	...
XX.	O'Briensbridge (Ross)	1.90	...	.31	18	18	71.0	31	38.0	1	0	...
XXI.	Carlow (Browne's Hill)	2.85	+ .51	.47	15	19	...	...	...	...	...	...
XXI.	Dublin (FitzWilliam Square)	2.44	+ .51	.46	3	17	65.7	23	39.1	31	0	0
XXI.	Ballinasloe	1.65	— 1.04	.17	6, 19	20	67.0	24 ^d	32.0	31	1	...
XXII.	Waringstown	1.68	— .76	.36	29	17	76.0	24 ^d	34.0	2	0	1
XXIII.	Londonderry (Creggan Res.)..	1.82	— .70	.66	29	18	...	...	...	...	...	...
XXIII.	Omagh (Edenfel)	1.75	— .72	.45	29	17	68.0	3 ^e	35.0	31	0	...

a And 25. *b* And 22. *c* And 24, 28. *d* And 25. *e* And 24, 25. *f* And 31. *g* And 27, 30. *h* And 30.

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

METEOROLOGICAL NOTES ON MAY, 1890.

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 fine May with sufficient changes of heat and cold and wet and dry to maintain the fickle character of the month. Horse Chestnut in flower on the 8th, pink lilac on the 10th, laburnum on the 18th, small white butterfly flying on the 1st, orangetip butterfly on 17th.

ADDINGTON.—Beautiful weather from 1st to 3rd, and 22nd to 30th; nights generally cold throughout. Potatoes and kidney beans blackened by frost on the 31st. T on 7th, 11th and 19th; on 19th .25 in. of R fell in 12 minutes.

BURY ST. EDMUNDS.—The month was favourable for agriculture, frosts being slight and few. A magnificent TS occurred on the evening of the 19th, with heavy rain, .54 in.

LANGTON HERRING.—R of May about the average, but for the first five months of the year, 10 per cent. below the average. The mean temp. at 9 a.m., $55^{\circ}4$, was $1^{\circ}7$ above the average. Only once in 18 years did the temp. in May reach 75° , while this year it reached 74° on the 23rd and 24th, and 76° on the 25th, on which day there was a violent TS. T also on 8th and 24th. Solar halos on 2nd, 7th and 29th.

BODMIN, FORE STREET.—A very cold and wet month. Two very hot days, the 24th and 25th, on the latter day a TS occurred about 7.30 p.m., with a downpour of R, .15 in. falling in a few minutes.

STROUD, UPFIELD.—T heard on 2nd, 11th 19th, and 20th; L seen on 19th and 25th.

WOOLSTASTON.—A genial growing month. Frequent T and L during the first week. Mean temp. $52^{\circ}2$. H on 14th.

ORLETON.—A pleasant month, with fewer cold days than usual, the mean temp. being $1^{\circ}6$ above the average of 29 years. T and L on 2nd, 6th, and 19th, with very heavy R from 8 to 9.30 p.m. on the latter date.

MANCHESTER, PLYMOUTH GROVE.—A very fine month. Summer weather from 21st to 25th. Cold winds from 26th to 31st. Prevailing wind, S.E.; mean temp. $55^{\circ}1$; L on 12th.

ARNcliffe.—A dry month, half the R falling on two nights, 11th and 16th.

WALES.

HAVERFORDWEST.—The wettest month of the year, except January. No frost in the shade. Continual R up to the 20th, especially heavy from the 15th to the last mentioned date, after which a sudden burst of great heat prevailed, followed by a TS of great intensity on the 25th. The storm fell with its greatest violence to the N.W. and N. of the county, accompanied by a deluge of R, while at Haverfordwest only .02 in. fell. The month ended fine, but with a great and sudden fall of temp. after the great storm. Wind principally from S.E. throughout the month.

SCOTLAND.

CARGEN.—Mean temp. of the month ($52^{\circ}9$) $2^{\circ}2$ above the average. Some very cold nights were experienced towards the end of the month and on the morning of the 31st potatoes were partially frosted down. The extremes between day and night temp. were often great, the range on the 28th being 33° in about 12 hours. Easterly winds prevailed for $17\frac{1}{2}$ days; sunshine just the average for the month. T and L on 6th and 18th, T on 7th.

JEDBURGH.—Much N., E., N.E., and S.E. wind with little sunshine. Grass and cereal crops thrive, and the blossom on fruit trees was remarkably abundant.

OBAN.—A fine growing month, warm, with an ample sprinkling of showers.

CULLODEN.—Another very dry month; cereals progressing well.

IRELAND.

CORK.—On the whole a pleasant month with spells of showery weather, which were very favourable to vegetation. No frosts. Mean temp. $53^{\circ}3$, $0^{\circ}5$ below the average of 14 years.

WATERFORD, BROOK LODGE.—T and L on the 24th, T on the 25th.

ROSS, O'BRIENSBRIDGE.—A beautiful month; no frost; abundant and brilliant sunshine; wind moderate, mostly N.E. T and L on 20th and 21st.

DUBLIN.—Although changeable and generally showery, the month was favourable from a public health point of view, and from that of agriculture. Until the 20th B fell in frequent showers; after that date, however, a succession of bright, spring-like days occurred, giving a wonderful impetus to vegetation. Mean temp. $52^{\circ}8$. Lunar halo on 31st. Fog on 16th. High winds on 10 days, H on 14th, L on 24th.

ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this Society was held on Wednesday evening, May the 21st at the Institution of Civil Engineers, 25, Great George-street, Westminster, Mr. Baldwin Latham, F.G.S., President, in the chair.

Mr. W. Friese-Greene and Mr. F. H. Phillips were elected Fellows of the Society.

The following papers were read:—

(1). "Rainfall of the Globe," by Mr. W. B. Tripp, M.Inst. C.E., F.R.Met.Soc. This was a comparative chronological account of some of the principal rainfall records. The earliest record quoted is that of Paris, which commenced in 1689. The English records are taken from 1726. The rainfall observations in the southern hemisphere do not extend over a very long period; at Adelaide they were commenced in 1839, but they do not go back further than 1866 for New Zealand. The greatest fall in any particular year at the stations given by the author was 160.9 in. at St. Bernard, in 1839, and the least 3 in., at Sandiego, in California, in 1863. By combining the stations in the northern and southern hemispheres, the author finds that in recent times the years with the highest average rainfall were 1878, 1879, and 1883, and the years with the lowest average were 1854 and 1861.

(2). "Mutual influence of two pressure plates upon each other, and comparison of the pressures upon small and large plates," by Mr. W. H. Dines, B.A., F.R.Met.Soc.

(3). "On the variations of pressure caused by the wind blowing across the mouth of a tube," by Mr. W. H. Dines, B.A., F.R.Met.Soc.

In these two papers the author gives the results of some experiments on wind pressure which he has made, mostly on the whirling machine at Hershams, Surrey. From these experiments it seems probable that a decrease of pressure per square foot, with an increase of size of plate, may be taken as a general rule.