

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

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THE THUNDERSTORMS OF MAY 29TH.

HAVING by the courtesy of numerous correspondents been favoured with copious details of the violent thunderstorms of May 29th, we have grouped them in counties, and laid down most of the particulars on the accompanying map, careful examination of which, coupled with the letter-press accounts, will render lengthened comment quite unnecessary.

The earliest note of any electrical disturbance is from Dartmoor Prison, where **T** is mentioned on the night of the 28th; it seems to have been confined to Cornwall and Devon during the early morning hours of the 29th; between 8 and 9 a.m. it was in Wales and Sussex, having split in two, or a second storm having started in the latter county, both storms seem afterwards to have gone to N. or N.E. at about 25 miles an hour—the former one dying out before it reached the coast, the latter hanging about the mouth of the Thames until late at night.

We have very little doubt that not half the accidents are reported, but the following analysis is somewhat formidable.

Men struck.....	16	Houses struck	10
„ killed	4	Barn „ ..	1
Beasts „	13	Oak tree „ ..	1
Sheep „	?12	Lamp post „ ..	?1
Churches struck.....	5		

BUCKS.

NEWPORT PAGNELL.—Heavy **T S**, with excessive **R** in evening— $1\frac{1}{4}$ in. of **R** fell in $1\frac{1}{2}$ hours.

CORNWALL.

BODMIN.—Terrific **T S** at 5.30 a.m., and .90 of **R** in 15 minutes.

DERBY.

CHESTERFIELD.—Oak split in two in morning. House struck and much damaged in Gladstone-street.

DERBY.—**T S** and .82 of **R**.

DEVON.

PLYMOUTH.—**T** early.

TORQUAY.—No storm.

BARNSTAPLE, SWIMBRIDGE.—Mr. Burden, of Kerscott Farm, had five young bullocks, worth £50, killed by **L** on Friday morning.

BARNSTAPLE.—T S 4 to 6 a.m. ; total R, .76.

DARTMOOR.—[On night of 28th] T and a shower of R, .08.

DORSET.

WEYMOUTH.—T before 9 a.m.

ESSEX.

BRENTWOOD.—Heavy R 1 to 4 p.m., and R from 6 to 7 p.m. ; total, 1.62 in.

WOODFORD.—The temporary Congregational Church at Buckhurst-hill was struck by L during the very severe storm, and the top of the roof was instantly in a blaze. Fortunately some workmen near immediately extinguished the fire.

To the Editor of the Meteorological Magazine.

SIR,—On Friday last, May 29th, a T S commenced within sight and hearing of this place, and lasted without intermission, I might say, for 8 hours, *i.e.*, from before 11 a.m. to near 7 p.m. I hardly think that one minute elapsed without the roll of T being heard or a flash of L being seen more or less near. The storm came from the S.E. or S. There was no heavy R here till about 3 p.m., when several sharp and near claps were heard, and the cloud passed off to the N.E. Another cloud with heavy R and sharp claps came up about 5 p.m., succeeded by others almost continuously till 6.30., when the storm began finally to pass off towards the N.E., during which time a rainbow was seen for about half an hour. I did not wait till the next morning to look at the rain gauge, but that evening measured the fall, which proved to be 1.74 in., the most of which fell in less than 4 hours, and the whole within 8 hours. The above fall, 1.74 in., exceeds by almost half an inch the greatest quantity that I had previously measured in 24 hours, viz., that of June 21, 1866, which was 1.25 in.—Yours truly,

EDWARD MAXWELL.

High Roding Rectory, Dunmow, Essex, 1st June, 1868.

HANTS.

I. OF WIGHT (NEWPORT).—Slight T at 8 a.m., and .03 of R.

SELBORNE.—Distant T and L in the E. in evening.

HERTS.

BERKHEMPSTEAD.—Distant T in S. and S.E., between 11 a.m. and 2 p.m., and L in the evening. No storm here.

HITCHIN.—No R.

KENT.

DOVER (EWELL).—Excessive R ; roads flooded and a wall washed down.

HERNE BAY.—T and slight R at 11 a.m. ; heavy T S from 8 to 9 p.m. R, .55.

SEVENOAKS.—Only the skirt of the T S, and .18 of R.

BROMLEY.—R, .35.

TUNBRIDGE WELLS.—At 11 a.m., T, L and slight R ; 4.30 p.m. L in E.

MARGATE (BIRCHINGTON).—Between 9 and 10 p.m. three men were at work in a brickfield between Margate and Birchington, when they were all struck down, and one was killed on the spot.

To the Editor of the Daily Telegraph.

"SIR,—The fall of hail continued for about fifteen or twenty minutes, and the whole of my garden was covered with stones of great size. After the fury of the storm had somewhat abated, I collected a number of the stones, and found them to be three-quarters of an inch, and in some instances one inch in diameter. Some were completely buried in the earth. I did not measure any for at least ten minutes after their fall, and they had lain on a table in the house three or four minutes. All the leaves of the flowers and plants are completely riddled, and large pieces of the branches and stems broken. Several of the hailstones were exceedingly beautiful both in form and markings, many being purely of a shell-like structure with all the furrows, and resembling a beautiful fossil. The fall of hail was accompanied by vivid flashes of forked lightning and crashing peals of thunder.—I am, Sir, yours, &c. T. W.

"Blackheath, May 30."

To the Editor of the Times.

"SIR,—All who examined the enormous hailstones which fell this afternoon must have been struck with the clearness with which their concentric formation was shown; many, of more than half an inch in diameter, exhibited seven layers. In some cases the layers of ice were alternately transparent and opaque. More than one had for a nucleus an ordinary hailstone, while the rest of its bulk was clear ice. Doubtless this fact, which thousands must have noticed, will tend to remove that long-cherished but evidently erroneous idea that hailstones are simply frozen raindrops, their construction being much more complicated.—Yours, &c.,

"Blackheath, May 29.

H. M. H."

To the Editor of the Meteorological Magazine,

SIR,—As it is interesting to watch the course of thunderstorms, I forward details of that of the 29th. Gloomy morning till 10.30 a.m., then distant T heard in S.E., and about 11 a.m. a few drops of R fell; T at intervals all the morning afterwards, but it cleared up, almost bright sunshine, with very few clouds, about noon. The heavy clouds seemed to pass from S.E. to S.W., and at 1 p.m. still fine here, but very heavy clouds and almost incessant L in the distance from S.W., to N.W. and N.E.; and about 1.15 p.m. the edge of a heavy cloud came over, and sharp R for about 2 minutes; then it quite cleared up again, but at 2.15 p.m. it looked very heavy in the north. It still kept fine here till about 4.30 p.m., when the storm gathered up again from the S. or S.E., and rained more or less till 6.10 p.m., very heavily for about 20 minutes about 5.30 p.m., with heavy crashes of T overhead and vivid L; this was by far the worst time (from 5 to 6), but all this time it looked lighter in the W. than what it was overhead. Although it came from S. and S.E., yet when it went away, it went to the E., and cleared up from the W. R up to 6.15, only .21 in.

There are several places in the road up to my house where the dust was not even licked up, and near Penge there was much less R, for the dust was yesterday evening quite thick in places. I hope we shall soon have some more R, for my garden is all cracks for want of it.

Yours very truly,

C. O. F. CATOR.

Beckenham, Kent, 30th May, 1868.

BECKENHAM (FOX GROVE).—Shower in the morning, another about 2, but at 4.30 the dust was hardly laid, and nearly all the R (.30 in.) fell between 4.45 and 6 p.m. T almost all day, and L until 10.45 p.m. Heaviest R (no H) about 6 p.m., immediately following the only very loud peal of T.

LEICESTER.

STAPLEHURST (LINTON PARK).—Slight TS in morning, and very heavy one about 7 p.m., when an inch of R with H fell in a very short time, flooding the roads very much; total R, 1·33 in.

KNAPTOFT HALL [RUGBY].—No storm, and only ·07 of R.

LEICESTER.—No storm, and only ·10 of R.

COALVILLE.—One of the pinnacles of Christ Church struck and much injured; the N. end destroyed and the roof opened in several places.

LOUGHBOROUGH.—Six beasts were killed by L on a farm at Dishley.

LINCOLN.

BOSTON.—Slight TS at 11 p.m.; R ·08.

GAINSBOROUGH.—TS and heavy R, ·60.

MIDDLESEX.

HAMPSTEAD (SQUIRE'S MOUNT).—R from 1.30 to 2.45 p.m., ·28 in.

LONDON (CHANCERY LANE).—T, L, and heavy R at 2.10 p.m., but only a few small H stones.

LONDON (BRYANSTONE STREET).—L struck a stack of chimneys, and threw them through the roof.

LONDON (STRATTON GROUND).—House struck.

LONDON (DORSET SQUARE).—T and L from 0.40 p.m. with little R; very loud claps of T, with very vivid L, from 1.22 p.m. till 2.15 p.m., with heavy R and H. The amount of R that fell during that short time was 0.95 inches. The traffic for some time was stopped through it, the roadways and footpaths being under water. A lamp post was split in two, near Edgware-road. Thermometer during the morning, 75°·2; wind, E.S.E., S.E. S.S.E., and S. The atmosphere continued to be very close all the afternoon; vivid L at 11 p.m., with distant T. The barometer was falling all the morning. H. E. SEGRAVE.

STAINES.—Slight TS; ·21 of R.

To the Editor of the Daily Telegraph.

"SIR,—About two o'clock, in the midst of the storm, a terrific clap of thunder seemed to shake the whole of this neighbourhood. On the rain abating I went out and found the stack of chimneys at house No. 11, Mitford-road, had been knocked down with such violence as to scatter the bricks all over the road for a distance of fifty to sixty yards right and left; some of the bricks are to be seen on the roof of the opposite house. The zinc cowls with a mass of brickwork lay in the forecourts of the house and the two adjoining ones. Fortunately there was no one in the front room upstairs at the time, and the window being wide open, the electric fluid, after smashing the mantelpiece and stove, passed out through the open window.—I am, Sir, yours, &c.,

Upper Holloway, May 30.

W. S."

HAMMERSMITH.—Two men knocked down by L, one much injured.

LONDON (BRIDGE STREET, BLACKFRIARS).—Man knocked down and stunned by L.

LONDON (HOUSE OF LORDS).—The Victoria Tower struck, but no damage done.

KENTISH TOWN (MANSFIELD ROAD).—Between 2 and 3 p.m. the L struck and shattered a flagstaff, threw down a coping-stone, and demolished a large window.

HACKNEY (1, CHURCH STREET).—At 2.30 the chimney stack was struck; the L ran down them and shattered the conservatory.

ON THE THAMES, NEAR ROTHERHITHE.—Two men on board the barque Constance were struck by L about two p.m.; one of them, who was clasping an iron bar, was dreadfully injured, being scorched on one side from head to foot. The other was blinded for several hours.

BROMLEY.—Two houses struck.

To the Editor of the Times.

"SIR,—A few details concerning the thunderstorm of this day may be acceptable, especially as an instrument designed last year, and already tested in various ways, has to-day proved its satisfactory action in the most violent rain. I allude to Pastorelli's storm rain-gauge, which shows not only minute by minute, but second by second, the amount and rate of the fall of rain.

"The morning was oppressively close; temperature at noon, 78°; no wind, but vane standing at N.E.; thunder first heard at 0h. 37m. p.m.; first lightning seen at 0h. 43m. p.m., and slight rain at 1h. 3m. p.m.; after 1h. 0m. the lightning was almost incessant in S.E. and S., with prolonged thunder. At 1h. 48m. heavy rain fell, and the following readings were taken from the above-named instrument:—

Time. p.m.		Total fall of rain.	Rate of fall per hour.	Time. p.m.		Total fall of rain.	Rate of fall of rain.
H. m. s.		in.	in.	H. m. s.		in.	in.
1 50 50	...	0.12	...	2 2 0	...	0.55	...
1 52 0	...	0.17	2.6	2 3 20	...	0.60	2.3
1 53 30	...	0.20	1.2	2 7 10	...	0.65	0.8
1 54 30	...	0.25	3.0	2 11 20	...	0.70	0.7
1 55 40	...	0.30	2.6	2 14 10	...	0.75	1.1
1 57 50	...	0.35	1.4	2 15 0	...	0.80	3.6
1 58 20	...	0.40	6.0	2 16 40	...	0.85	1.8
1 59 40	...	0.45	2.3	2 20 0	...	0.90	0.9
2 0 40	...	0.50	3.0	2 20 10	...	rain ceased.	

From this we find that the great downpour which occurred here at 1h. 58m. p.m., was at the enormous rate of 6 inches per hour, or 144 inches per day. Hitherto there has been no facile means of noting the rainfall at very short intervals; hence our knowledge of the rate at which rain falls in this and other countries is very limited. The only measurement by myself at all resembling the present was on the 13th of December, 1856, when 0.50 fell in 7½ minutes, being at the rate of 4 inches per hour for that period. I was not then able to measure at short intervals, or the *maximum* rate would doubtless have been greater than to day, since there was no period of 7½ minutes to-day in which the fall exceeded 0.30, or 2½ inches per hour.

I would not have troubled you with these details, but that I have had the satisfaction of seeing many other results of rainfall work applied to practical purposes, and think that this last is not less important (especially in drainage questions) than many of its precursors.

In conclusion, I may add that the storm appeared to come from the S., to pass S.E. of this station, in a S.W. current, moving very slowly against what slight breath of air there was. This view is corroborated by the fact that the rainfall here (0.91) was slightly less than at my future residence (62, Camden-square), 200 yards N.E., where it was 0.93 in. The hail was very slight.

"I am, Sir, your obedient servant,
"136, Camden-road, May 29.

G. J. SYMONS."

NORFOLK.

LYNS (HILLINGTON).—Much sheet L and very distant T.
YARMOUTH.—T.

NOTTINGHAM.

HARWORTH.—Church pinnacle shattered in the morning.

OXFORD.

BANBURY.—Distant T, and only .03 of R.

SALOP.

BRIDGENORTH.—“Morville Church was struck by lightning during the late severe thunderstorm, and sustained considerable damage. The electric fluid first struck the south-west pinnacle of the tower, breaking it in pieces and scattering the fragments of stone in all directions. One piece, weighing 20lb., was hurled the full length of the church, and fell upon the roof at the end of the nave, breaking the tiles. The lightning then flashed upon an iron pipe near the vestry chimney, and passed into the vestry, when it got into the nave of the church. Here it ran along the stone floor of the aisle, turning up in a peculiarly regular manner the cocoa-nut matting with which the aisle was covered, its pathway being marked by a scorched line. Branching off finally towards the north, it appears to have turned over a large piece of the flagstone flooring of the church. The earth beneath the flag was not affected in the slightest degree, nor were the pews in the vicinity, though the books were all found scattered about on the floor.”

SHIFNALL (HAUGHTON HALL).—T S in W. with heavy R.

SOMERSET.

BRIDGEWATER.—T S with heavy R between 5 and 7 a.m. ; at Weston Zoyland, a village 4 miles S.E. of Bridgewater, and on a hillock of red marl, in the midst of an extensive alluvial plain, it was very violent, and a heifer was killed.

STAFFORDSHIRE.

WOLVERHAMPTON.—Violent T S at 8.45 a.m.

SUFFOLK.

CAPEL.—L set fire to a barn and shed belonging to Mr. Allen, in the evening.

BURY ST. EDMUNDS.—A rather severe T S, but only .14 in. of R.

SURREY.

WANDSWORTH.—Horse killed.

STREATHAM.—Several sheep killed.

COBHAM (PYPORTS).—Heavy T S ; .78 of R.

KENNINGTON.—Violent T S, but no H.

EPSOM.—Man knocked down by L.

EWELL.—Two men were standing at the head of a mare in a wagonette, about 10 a.m. ; a flash of L knocked them all down, killed one instantly, and the other lingered only a few days.

SOUTHWARK.—At 0.50 p.m. the top of the steeple of St. Stephen's Church was struck and the tiles stripped off.

EPSOM.—A terrific T S passed over the Downs during the races, accompanied by heavy H. Two curious coincidences are reported :—(1) That the first race run after the storm was won by Mr. T. V. Morgan's “Electricity,” by “Thunderbolt,” ridden by Snowden. (2) That a booth known as “Hit or Miss” was struck, and some of the occupants knocked down.

SUSSEX.

BOGNOR.—L and very distant T.

BRIGHTON.—“The morning was calm and close, but with a cooling east breeze. At half-past 8, however, atmospherical disturbance began, and about fifteen minutes later a dense black cloud came up from the south-west. The effect on the sea was something like that of a tropical tornado, the calm water being lashed

into surf by the high wind that accompanied the cloud. When the wind struck the town it raised an enormous quantity of dust, causing great annoyance to the shopkeepers and tradesmen who had their doors and windows open. At the same time the pall-like cloud covered the sky, and in a surprisingly short space a darkness settled down that necessitated gas or candles in private houses, and prevented one seeing fifty or eighty yards out of doors. About nine o'clock the storm cloud burst in a very peculiar manner. A flash of lightning, a slight rumbling, then a single discharge like that of a great piece of ordnance. The storm afterwards raged for a full hour. In many cases the flash and thunder were almost concurrent, and literally shook houses till the windows and doors rattled. The globular form of the lightning was vividly apparent. In the earliest part of the storm the electric fluid struck Windlesham House, a large boys' school, conducted by Mr. H. C. Malden, on Furze Hill, at the top of Norfolk-road. The building is detached, and has two chimney stacks on the western side. Upon one of these stacks is a lightning conductor; but the fluid struck the other stack a few feet off. It carried away four long and heavy zinc flues from the top of the stack, and tore off the slates in two places on the roof. Descending one of the flues, it tore out a register stove and displaced a mantelpiece in an upper room. It went as far as the drawing-room grate, where it put the fender on one side and and threw the fire-irons out on to the floor. The clerks in the telegraph office at the Brighton Railway were compelled to leave the place. Inspector Carpenter, of the metropolitan police, ventured to enter the office, but was met by a flash of lightning passing from one instrument to another. He was partially stunned and temporarily blinded, and did not recover for a considerable time. Immediately the storm passed northward, and while the detached clouds were still following the same course, a brisk under current of wind came down from the same quarter, and continued till the afternoon. Last evening the weather was again exceedingly sultry."

WARWICK.

Mr. Plant writes to the *Birmingham Daily Post* :—

"By daybreak on Friday it was evident that the air was surcharged with electricity. There was a severe conflict between south-easterly and south westerly currents. Before 7 a.m. thunder was heard in the S.W. Rain commenced falling by 8.15 a.m., and before 9 a.m. a heavy thunderstorm burst immediately over the town. The lightning was frequent and vivid, and some of the peals of thunder followed the flashes almost instantaneously, and with crashing din. The turmoil lasted about three hours, and the rainfall was no less than 4-5ths of an inch. At the beginning of the storm the wind blew from the S.E., veering to W., and terminating E.N.E. There was an extraordinary phenomenon during the deluge of rain. From nine to ten, meteoric stones fell in immense quantities in various parts of the town. The size of these stones varied from about one-eighth of an inch to about three-eighths of an inch in length, and about half those dimensions in thickness. They resembled in shape broken pieces of Rowley ragstone. A similar phenomenon visited Birmingham ten years ago."

BIRMINGHAM—SALTLEY.—The fog signals in a store, also used as a workshop, exploded during the T S, but there seems some doubt as to whether the explosion was produced by L or not.

WORCESTER.

To the Editor of the Meteorological Magazine.

SIR,—As my monthly observations will not be published until Saturday next, I thought you would like to be in possession of the particulars of the storm which happened here on Friday (29th). I have only recorded a very few of such intensity. T was heard at intervals from 3.30 to 6 a.m., when it appeared to be clearing off; at 8.30 it became suddenly dark, and the elements greatly convulsed. A heavy tempestuous storm was ushered in by a flash of L of intense

brightness, immediately followed by a crashing peal of T, which continued at quick intervals, and at its highest pitch for upwards of an hour. At 8.45 a deluging downpour of water commenced, and continued without abatement until 9.30, when it settled down to a heavy storm, which lasted until midday, 1.01 in. of rain being then registered. The sun in a short time after broke through, the remainder of the day being beautifully fine.—I remain, yours truly,

GEORGE DIPPLE.

The Ford House, Bromsgrove, May 30th, 1868.

ORLETON.—T S commenced at 1 a.m. and ended at 10 a.m. T and L bright at 9 a.m. R at times, and some H.

STOURBRIDGE.—Violent T S from 8 to 11 a.m.

YORKS.

DONCASTER.—Violent T S; Mr. Bingley, of the Holmes, struck, but recovered.

KIRBY GRINDALYTH.—At a sheep washing, six were killed by L.

SCARBOROUGH.—T.

WALES.

HAVERFORDWEST.—T and a few drops of R.

RHAYADER.—T L and heavy R from 6.30 to 9 a.m. Total R .70.

SCOTLAND.

DEANSTON.—Distant T. (Probably local, see below.)

FOREIGN.

BRUSSELS, T. PARIS, heavy T S. TOULON, T.

CHAMBERY.—During the storm of Friday (29th) a soldier of the 47th Regiment, stationed at Chambery, was killed by the L while sitting under the branches of a chesnut tree to which he had run for shelter. Five comrades with him were stunned, and received various contusions but not serious ones.

There was neither T, L nor R connected with the storm under notice in Scotland, Ireland, nor even in the N. of England—at Arncliffe, York or North Shields.

WHAT IS FROST?

To the Editor the of Meteorological Magazine.

SIR,—It appears to me very reasonable to note down that a frost has occurred, whenever a radiating thermometer *on* grass or any other *living* vegetation indicates by self-registration that the temperature has fallen below 32°.

Damp cloths, wet mats, and many other artificial but good radiators of heat, are neither fair indicators of frost, nor proofs that vegetation has been exposed to a temperature below 32°.

On the 19th of last month, the max. temp. in the shade was 84°.2, and in the sun 100°, but on the morning of 21st, the temp. on grass fell to 28°! for the second time during the month.—Yours obediently,

C. L. PRINCE.

Uckfield, June 5th, 1868.

To the Editor of the Meteorological Magazine.

SIR,—The importance of the question, “Has there been a frost last night?” arises from the effect such frost (if any) would have on vegetation. The thermometer on the grass would be the correct indicator of frost in this sense. As a cultivator of grass, spring corn, potatoes, &c, whose checked growth answers the question at the head of this letter with the thermometer on the grass, and not always with that in the air, I would suggest that the former be adopted as the standard of frost.—Yours faithfully,

P. P. P.

Brynbell, St. Asaph, May 18th, 1868.

To the Editor of the Meteorological Magazine.

SIR,—I do not know if you desire each of your readers to send in his or her vote on the subject of, “What is a frost?” If so, I shall be glad to declare myself in favour of the “ground” observations, against those taken at a height of 4 ft. Although a 4 ft. elevation is, I believe, the “regulation” altitude, yet it is a somewhat arbitrary matter, after all; but if all were agreed to bind themselves to the dicta of the radiation thermometer, the great desideratum of *uniformity* would be attained. Still more: is it not almost absurd to deny the existence of a frost, because the protected instrument reads a few degrees above 32°, when vegetation near the ground is utterly destroyed? (Such was the case last May, in the Isle of Wight). I may here say that a 5 ft. elevation seems more desirable than 4 ft.: it is the stratum in which most of us breathe.

I am rather glad your correspondent has asked the question, “What is shade?” Perhaps it will lead to many observers taking measures to protect their instruments from *reflected* as well as direct heat of the sun, which alone can ensure *perfect* shade in a meteorological point of view.—I remain, yours truly,

E. G. ALDRIDGE.

Newport, I. W., May 18th, 1868.

P.S.—Some years ago (to illustrate the bad result of neglecting to guard against reflection), I remember placing a thermometer not far from a slate-hung wall, when the mercury rose to 90° or 94°. The instrument was “in shade,” popularly speaking, yet it marked many degrees too high, as I believe the *true* temperature was not more than 84°. (The slates were painted stone-colour.)—E. G. A.

To the Editor of the Meteorological Magazine.

SIR,—I must confess I was surprised at seeing the above inquiry in the *Meteorological Magazine*, for I was under the impression science had long ere this decided the matter. At least, such was my idea when the question presented itself to my mind some time ago; and not then knowing from whom to obtain any information upon the subject, I resolved to find out by experiment. At the outset, therefore, I deemed it essential to ascertain practically the proper distance from the soil at which thermometers should be exposed, so as to indicate

the true temperature of the air, as upon *this* I considered the matter to hinge. To that end, I erected a stout pole, of about 7 feet high, on an open lawn, at some distance from any object whatever; this pole I divided off into spaces of 6 inches, and between the hours of 10 and 12 on two or three successive nights, I made several experiments in the following manner:—A terrestrial radiation thermometer was exposed at a distance of 3 inches from the grass, near the foot of the pole, and two standard thermometers were at the same time attached to the pole at 6 and 12 inches from the soil respectively. After the lapse of half-an-hour readings were taken, and the two last-named instruments each raised one space—the lower thermometer always occupying the same position that the higher one had in the preceding experiment. After the lapse of another half-hour, readings were again taken, and so on until the summit of the pole was reached. In this manner, I found that (1) the differences between the readings of either of the two moveable instruments and those of the terrestrial thermometer increased gradually up to about 4 feet from the soil, whilst the differences between the two thermometers themselves decreased. Above that height, the differences in the former instance remained constant, whilst in the latter case there were none at all. Hence it appeared that at a distance of about 4 feet from the soil the temperature of the air was not influenced by terrestrial radiation, and, therefore, at that height the true temperature of the air should be determined. I considered, therefore, that there had been a legitimate frost when a thermometer situated as above so indicated.

Subsequent to the above experiments, I have had no reason whatever to change my views; on the contrary, the various meteorological phenomena which presented themselves to me as I took my daily observations, tended to strengthen them. I am of opinion, then, that at that point, and in that position, at which the most accurate and sensitive thermometer is entirely free from the direct influence of either sun, wind, rain, radiation, or reflection the *true* temperature of the air is to be ascertained. The problem to be solved is not so much *what frost is*, as *how it is produced*, for there are evidently two kinds—viz., that formed by the radiation of heat from the earth's surface, and that produced by the direct influence of the air itself. In the former case, I should consider it a *white* frost, in the latter a *black* one; and it does not follow that although at the time of observation there may be no visible signs of any frost, there has been none, for if the instruments employed be accurate, and have been undisturbed, their readings cannot mislead. Hoping that you will consider this letter worthy of a place in your valuable periodical, and apologizing for its length,

Believe me, yours truly,

A. M. FESTING, F.M.S.

Dublin, 18th May, 1868.

[A valuable note of independent investigations, proving the wisdom of having the shade thermometers at 4 feet. We thought the difference between a *black* and *white* frost was due to greater humidity of air in the latter case.—ED.]

NEW INSTRUMENTS.

To the Editor of the Meteorological Magazine.

SIR,—Under the head of “New Instruments,” in the *Meteorological Magazine* for this month, you call attention to the necessity of a more perfect shield than that now in use, for the stems of terrestrial radiating thermometers, whereby the cement used to make the etchings thereon perceptible may be preserved and the dew which usually collects may be avoided. These certainly are *desiderata*, as experience has shown me, for I have found that not only does the moisture which invariably collects, render it at times very difficult to take accurate readings, but it also has the effect of raising the cement very quickly, and on two or three occasions I have had to introduce fresh cement myself. These inconveniences might, however, be avoided by having the stem *in vacuo*, for those solar thermometers which are wholly so, are entirely free from the annoyances alluded to.—Yours truly,

A. M. FESTING, F.M.S.

*Aldborough House Barracks, Dublin,
18th May, 1868.*

[The plan is worthy of trial, but we fear that though the great heating power of the sun's rays penetrates with ease the vacuum bulb, the glass of which it is formed, however thin it be blown, would yet check the sensitiveness of a terrestrial radiation thermometer—still, as we have said, it is worth trying.—Ed]

HOW TO READ MEASURING GLASSES.

To the Editor of the Meteorological Magazine.

SIR,—From all I can learn there appears to be a sad want of uniformity among many observers, with regard to the mode of measuring rain; and would it not be advisable to come, if possible, to some definite understanding on this point; for with those who register daily, the difference, however slight, arising from the want of it, will accumulate in the aggregate to a considerable amount, so much so that with two observers who use the same sort of gauge, but measure without a previous understanding, the difference of rainfall at the year's end may amount to as much as an inch-and-half, or even more. I allude more especially to the small gauges with a graduated measuring glass, such as the 5-inch one issued by Casella.

Those who use this must well know how undefined the surface is in the glass, owing to the *side-suction*, which makes just the difference of .01 between the upper edge and the lower level, or true centre of the surface.

From the test I have made of this particular gauge, I find that the latter is the line intended to be the true level, but it would be well to have the opinion of others on this point, and if we cannot perfectly agree as to which is the right line to go by, at all events agree which to adopt, so that on comparing notes we may feel that we are standing on common ground.

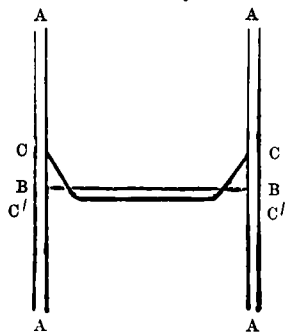
I have communicated with the Rev. C. H. Griffith, who is so well-known as a careful and experienced observer, and without entering here into his reasons, which would take up too much space, I may remark that he evidently inclines towards adopting the lower level, although some arguments may be adduced in favour of the other.

It may be right, while on the subject, to advert to another cause of difference in measuring, and that is the difficulty of holding the glass perpendicular while taking the account, and the slightest deviation (especially in one of small diameter) will of course make a difference in the level. With those whose gauges are three or four feet from the ground, a bit of board placed across the mouth of the gauge to place the glass on, (which can be hung when not in use at the side of the the post, will be found of great service. With those whose gauge is on the ground, a board nailed perfectly true across a couple of uprights, will answer the purpose. A spirit level should be used to test that, and also the surface of the gauge itself.—I remain, yours faithfully,

J. BROOKE.

Haughton Hall, May 4th, 1868.

[We believe that the opticians divide the glasses with mercury, which is, as we all know, repelled by the glass, while water is attracted; they (at least those we have consulted) say that they do not take either the line of contact of the glass and mercury, or the top level of the mercury, but an intermediate point about half-way, or rather nearer the top. The annexed exaggerated diagram shows that the correct practice with water measurement is the same as with mercury, that is to say, neither top nor bottom, but intermediate. Let A A A A be a section of a measuring glass, B B the level of the water uninfluenced by the glass, *i.e.* its true level, the surface will sometimes be found to be curved into c c'. Mr. Brooke takes c as the true level, but we think on consideration he will see that a point between c and c' would more nearly represent B—the true level.



There are two other points in the letter to which we would briefly refer:—(1) The elevation of c above c' is put by Mr. Brooke at 0.01 in., and multiplying that by the number of measurements in a year (assumed as 150), he obtains a possible difference of *an inch and a half, or even more*; but the difference is scarcely so great as 0.01, unless the glass is previously wetted, and therefore the total difference is rather less than $1\frac{1}{2}$ inches, and the *error* less than 0.75—one, however, even then still far too large.

(2) The concluding suggestion in Mr. Brooke's valuable letter is very good. Some years since we had a number of jars divided on both sides, so as to read across the glass, but our impression on trial was unfavourable, and we have not had any more so divided. Mr. Brooke's plan is much better. Col. Ward adopted it some years since.—Ed.]

MAY, 1868.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which -01 or more fell.	TEMPERATURE.				No. of nights below 32°.
		Total Fall.	Difference from average 1860-5	Greatest Fall in 24 hours.		Max.		Min.				
				Dpth.	Date.				Deg.	Date.	Deg.		Date.
		inches	inches.	in.				Deg.	Date.	Deg.	Date.	
I.	Camden Town	1.58	— .82	.93	29	6	87.6	19	35.6	7	0	
II.	Staplehurst (Linton Park) ...	1.92	— .32	1.33	29	6	87.0	19	37.0	7	0	
III.	Selborne (The Wakes)	1.59	— .39	.49	23	9	85.0	19	31.8	8	1	
IV.	Hitchin .....	.57	— 1.36	.29	23	5	79.0	19	31.0	6	1	
V.	Banbury .....	.88	— 1.34	.32	22	8	83.0	19	33.0	7	0	
VI.	Bury St. Edmunds (Culford) ..	.56	— .60	.22	23	5	85.0	19	28.0	6	1	
VII.	Bridport	1.61	— .42	.30	21	7	81.0	29	34.0	8	0	
VIII.	Barnstaple	1.91	— .53	.28	10	12	...	...	...	...	...
IX.	Bodmin	2.75	— .29	.90	23+	15	72.0	18	45.0	2	0	
X.	Cirencester	1.71	— .57	.70	19	7	66.0	19	47.0	7	0	
XI.	Shifnall	1.52	— .74	.50	19	9	77.0	19	29.0	7	1	
XII.	Tenbury (Orleton)	2.38	— .50	.77	19	11	78.0	19	35.3	7	0	
XIII.	Leicester (Wigston) .....	.53	— 1.59	.13	22	9	91.0	19	32.0	6	0	
XIV.	Boston .....	.39	— 1.55	.17	22	8	87.1	19	37.2	7	0	
XV.	Gainsborough	1.19	— .65	.60	29	8	87.0	19	35.0	6	0	
XVI.	Derby	1.35	— .81	.14	22	11	83.0	19	37.0	6	0	
XVII.	Manchester .....	.87	— 1.79	.20	29	9	86.0	19	37.0	6	0	
XVIII.	York	1.28	— .67	.35	29	8	81.5	19	35.5	6	0	
XIX.	Skipton (Arncliffe)	2.63	— .72	.71	23	15	74.0	20	37.0	6	0	
XX.	North Shields	1.04	— 1.60	.20	9	10	70.0	30	32.0	6	0	
XXI.	Borrowdale (Seathwaite)	6.98	— 2.56	1.33	24	19	...	...	...	...	...
XXII.	Cardiff (Town Hall)	1.79	— ...	.49	27	9	...	...	...	...	...
XXIII.	Haverfordwest	2.35	— .37	.85	23	8	75.0	18	37.0	1,3,6	0	
XXIV.	Rhayader (Cefnfaes)	2.58	— .27	.70	29	9	73.0	...	34.0	...	...
XXV.	Llandudno .....	.71	— 1.67	.15	10	9	77.2	19	37.3	6	0	
XXVI.	Dumfries	3.74	+ 1.35	.65	18	19	73.5	9	31.0	6	1	
XXVII.	Hawick (Silverbut Hall)	1.74	— ...	.30	23	16	...	...	...	...	...
XXVIII.	Ayr (Auchendrane House) ...	2.19	— .92	.51	23	16	73.0	29	30.0	5	1	
XXIX.	Castle Toward	3.99	— ...	.82	18	16	71.0	17	31.0	4	1	
XXX.	Leven (Nookton)	1.95	— .05	.33	15	16	70.0	29	30.0	6	1	
XXXI.	Stirling (Deanston)	2.90	+ .25	.37	23	20	68.0	29	26.5	6	2	
XXXII.	Logierait	2.44	— ...	.68	23	17	...	...	...	...	...
XXXIII.	Ballater	1.36	— ...	.33	23	16	71.0	20	27.5	6	1	
XXXIV.	Aberdeen	1.35	— ...	.45	23	19	68.0	29	29.5	6	1	
XXXV.	Inverness (Culloden)	1.14	— ...	.32	24	10	66.0	19	35.7	6	0	
XXXVI.	Fort William	6.22	— ...	1.25	23	23	...	...	...	...	...
XXXVII.	Portree	6.48	+ .83	1.12	28	21	63.5	19	33.0	5	0	
XXXVIII.	Loch Broom	2.26	— ...	.61	23	17	...	...	...	...	...
XXXIX.	Helmsdale	2.58	— ...	.82	21	15	...	...	...	...	...
XL.	Sandwick	1.51	— .75	.39	23	14	62.0	...	33.0	...	0	
XLI.	Cork	2.35	— ...	.49	18*	15	...	...	...	...	...
XLII.	Waterford	2.61	+ .36	.73	22	17	68.0	31	40.0	5	0	
XLIII.	Killaloe	3.08	— .10	.58	14	16	70.0	31	33.0	22	0	
XLIV.	Portarlinton	1.77	— 1.42	.41	23	19	63.5	17	34.0	4	0	
XLV.	Monkstown	1.10	— .81	.50	22	12	73.5	29	35.5	6?	0	
XLVI.	Galway .....	...	— ...	...	...	...	...	...	...	...	...
XLVII.	Bunninadden (Doo Castle) ...	3.23	— ...	.43	26	19	65.0	17	28.0	4	2	
XLVIII.	Bawnboy (Owendoon)	2.84	— ...	.43	14	22	72.0	17	33.0	3	0	
XLIX.	Waringstown	2.34	— ...	.35	14	17	72.0	28	33.0	4, 21	0	
L.	Strabane (Leckpatrick)	2.45	— ...	.41	23	17	71.0	20	30.0	4	3	

+ This really fell on 29th, but in accordance with the adopted rule, it having fallen before 9 a.m., is entered to 28th. *And 23rd.

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

METEOROLOGICAL NOTES ON THE MONTH.

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.

NOTE.—All references to the storm of the 29th are transferred to pages 65 to 72.

ENGLAND.

LINTON PARK.—A warm, dry, sunny month, with less T than usual. Most farming and other crops look well (hay excepted), and all are in a forward state.

SELBORNE.—The month has been hotter than any May I have ever recorded; everything very forward; crops, fruit, flowers, and vegetation in general much earlier than usual, and very productive and luxuriant. 19th the hottest day I ever knew in May.

BANBURY.—Fine warm month; mean temp. $56^{\circ}\cdot6$, being 4° above average.

CULFORD.—An exceedingly dry May, no rain having fallen till the 26th, when we had a slight shower, the total, as shown, was little more than half-an-inch, and fell on five days; mean temp. 56° .

BRIDPORT.—T on 19th.

BODMIN.—Mean temp. $58^{\circ}\cdot5$, being $3^{\circ}\cdot6$ above the average.

CIRENCESTER.—Mean temp. above the average; many cloudless days and nights; the sun's rays oppressive, although light winds prevailed; rather copious rains on the 19th and 23rd proved exceedingly beneficial to the late-sown crops.

HAUGHTON HALL.—A most beautiful May; little rain except with TSS; vegetation unusually forward, but checked towards the end of the month by the cool nights and want of rain. Cornrake first heard on 1st; turtle-doves arrived on 10th; chimney swallows on 30th, but no martens. Lilacs in blossom on 2nd, hawthorn on 15th, dog-rose on 28th; oaks in full leaf on 14th.

ORLETON.—A very brilliant month. Average temp. above that of 1864, and nearly 3° higher than the general average. TL on 8th; a violent TS burst over us at 8.15 p.m. on 19th, brilliant L and loud T for half-an-hour, with about half-an-inch of rain, passing from S.E. to N.W.

WIGSTON.—Mean temp. $58^{\circ}\cdot5$, being about 5° higher than the mean of May for the last 12 years; the rainfall was only about a quarter of the average for the same period.

BOSTON.—The month has been remarkable for its high temp. and dryness. On the 19th the ther. registered $87^{\circ}\cdot1$ in the shade, at 3 p.m., and the black bulb in vacuo in sun, $132^{\circ}\cdot2$. The rainfall was less than in any year since 1848, when it was only .18 in.; the pastures look brown and parched, and there is a great scarcity of water supply in the neighbourhood of this town. The wheat looks exceedingly healthy, and was in ear on the 26th; strawberries were gathered ripe on 28th, and there is every prospect of an early and good harvest.

DERBY.—Evaporation during the month very great; rain much wanted.

MANCHESTER.—Exceedingly dry month; rain much wanted.

ARNcliffe.—Peculiarly genial month; vegetation very forward.

SEATHWAITE.—A fine month, with alternate sunshine and showers. Vegetation generally about three weeks in advance of the average; great promise of excellent hay harvest; only one day on which the rain exceeded 1 in.

WALES.

HAVERFORDWEST.—Fine, beautiful month; warm, but never hot or oppressive, except on 17th and 18th, when the temp. was above 70° and the night temp. not below 54° . Gale on 11th, continuing squally till the 13th, succeeded by dense sea-fogs towards evening and night; R less than average, yet great promise of hay, and crops generally looking well; air sultry and warm towards the end of the month.

CEFNFAES.—Dry month; nights generally cold and frosty; winds high and boisterous, S.E. or N.W., the latter most prevalent.

LLANDUDNO.—A very dry month; from the 4th to the 9th (inclusive) the prevailing wind was E., during the rest of the month it was from the W. or S.W.; very heavy gale on 25th. Cuckoos and swallows very rarely seen or heard, and evidently much fewer than usual; 18th very hot, mean temp. being $64^{\circ}\cdot3$.

SCOTLAND.

DUMFRIES.—Beginning and end of month fine ; second and third weeks showery. TSS on 18th and 19th, very violent, that of the 18th did much damage, the Mansion-house of Murches being destroyed by fire from the L. During the month vegetation made great progress. Hawthorn in flower on the 8th, eleven days earlier than last year, and mean temp. $2^{\circ}7$ higher. Crops very forward, but oats injured by the grub.

HAWICK.—Cuckoo first heard on 1st ; landrail on 8th. Sharp frost, which killed laburnum blossom, and blackened the stems of potatoes, on the night of the 5th ; T on the 11th, 19th, and 25th ; H on 11th ; much L on 19th. The month on the whole has been genial ; there is a fine appearance of fruit, and the face of the country is beautiful.

AYR.—May is the second driest month of the year here, and the rainfall this May is considerably below the mean of the last twelve years. Vegetation and evaporation are in this month great consumers of water, and this is the first of the summer months, when the rivers here show a decided falling off. Vegetation unusually advanced, and continues very vigorous with forcing weather.

CASTLE TOWARD.—A favourable month for vegetation, having been more free from frosty nights than either last May or that of the year before, but it has failed to repair the damage done by the chilly and withering gale of the 29th of April. Chesnuts, sycamores, larches, peaches, &c., are much blasted ; many of them have lost all their foliage, larches are yet quite brown. T on 18th and 19th ; much R for a week after ; last few days mild, and crops looking well.

DEANSTON.—First week dry, but chilly and very stormy ; young foliage of trees much damaged, and even blown away, and blighted by the salt brought by the wind from the W. and S.W., which was also encrusted on the windows. Hedges and lime trees had not recovered at the close of the month. T and L on 11th and 18th, and distant T on 24th, 25th, and 29th.

LOGIERAIT.—A very fine month ; vegetation making rapid progress ; severe TS on afternoon of 11th ; cornrail heard on 6th.

BALLATER.—Rainfall below the average, the early part of the month being very dry. Sharp frost on 6th, temp. falling to $27^{\circ}5$. TS with H and R on the evening of the 11th. Cuckoo first heard on 9th ; cornrake on 19th.

ABERDEEN.—The warmest May we have had for at least 12 years, and the driest since 1860 ; temp. 3° above the average, rainfall below it. S., S.W., and W. winds more prevalent than usual, but pressure less. Hoar frost on 6th, injuring blossoms and potatoes ; a little S on the 5th. Vegetation from three weeks to a month in advance of last year, but want of R beginning to be felt severely in some districts, especially for the turnips.

FORT WILLIAM.—A fine day now and then, but the month on the whole wet and unpleasant, without any of the heat we hear of in England. R this month 6.22 in. ; the fall in May for the three preceding years has been 2.01 in., 2.06 in., and 4.43 in. TS on 11th and 18th.

LOCHBROOM.—With the exception of a feeling of cold and wet at the beginning, this is one of the finest months of May that could be imagined. Grass, cereals, and fruits are far in advance of their ordinary state at this date, but a change is surely coming, as the atmosphere is cooling rapidly.

SANDWICK.—Gale 40 miles per hour from 2 p.m. on 1st till 3 a.m. on 2nd, and another of 50 miles from 7 to 10 p.m. on 23rd. May has been finer, warmer, and drier than the mean. Vegetation is weeks in advance of ordinary years. The twilight is now too bright to allow us to see the aurora for a couple of months.

IRELAND.

MONKSTOWN.—82 per cent. of the R of the month fell on the 18th, 22nd, and 23rd. Almost all the fruit trees and crops seem to require R badly ; the wheat plant looks well, but oats are very poor ; the potatoes up to the present time seem in excellent health, and in some places they have been dug in small quantities ; this is much earlier than usual. There is a great scarcity of sparrows, swallows, and other small birds, and on the other hand wasps have already appeared, and are much larger and more vigorous than ordinary.

DOO CASTLE.—Latter end of this month wet, with a continual breeze from the

S.W. The small complement of R which fell in April, the dryness of the first fortnight in May, the continued breeze and absence of sun, have contributed to damage seriously the growth of crops ; at all events in this immediate locality fields of oats have been ploughed up and sown with barley, and in some instances resown with oats ; potatoes, except in rich and favoured spots, not blooming, and grass injured. Frost on 4th, which injured the potatoe stalks ; on the whole this has been a cold and ungenial month.

WARINGSTOWN.—The finest May I ever recollect in every respect ; winds from N.W. to S.W. ; temp. high.

LECKPATRICK.—Fine month for farming operations ; dry until the 18th ; from that date till the 27th 1·89 in. of R fell. Turnip sowing very general during the last week ; great destruction of oat crops by worms ; some oat fields in this neighbourhood were left without a sprout, and have been ploughed up for a turnip crop ; the damage has been confined to the grass lands which had been ploughed up. Latter part of the month has been cold.

APRIL COLD PERIOD.

To the Editor of the Meteorological Magazine.

SIR,—I beg leave to invite attention to the marked interruption which occurred at the usual period in the past month of April, in the regular rise of the temperature.

The mean temperature at Greenwich of the five days from the 9th to the 13th of April, as ascertained by Mr. Glaisher, for 50 years, is $44^{\circ}6$, which is $1^{\circ}2$ colder than the mean of the preceding four days, and $1^{\circ}4$ colder than the mean of the following four days.

At Arbroath, in Scotland, as appears from the last January number of the *Scottish Meteorological Society's Journal*, p. 145, the mean temperature for 22 years of the four days from the 11th to the 14th of April is $42^{\circ}5$, which is $1^{\circ}3$ colder than the four days before, and $2^{\circ}2$ colder than the four days which follow.

Here, the mean temperature (the mean of the max. and min.) of the five days from the 9th to the 13th of last April, was $39^{\circ}5$, which was $10^{\circ}9$ colder than the mean of the preceding four days, and $9^{\circ}1$ colder than that of the four days which followed.

And I learn from the observers at the Kew Observatory that the mean temperature there of the same five days was $39^{\circ}8$, which was $8^{\circ}9$ colder than the mean of the preceding four days, and $9^{\circ}4$ colder than the mean of the four following days.—Your obedient Servant,

D. A. FREEMAN.

Upper Tooting, 19th May, 1868.

UPROOTING OF TREES.

To the Editor of the Meteorological Magazine.

SIR,—I can answer one of your queries as to the blowing down of trees. It is a well-known fact, that all trees throw out their roots towards the point of the compass from which the *prevailing* wind blows. Here, for instance, you will find all the roots of the trees towards the S.W. ; in other parts of England from other points. I have seen the case you sketch hundreds of times. The trees on the W. side of the lane were held firmly by their roots, which run into the field ; those on the other side, on the contrary, having nothing but a bank to hold on by, were easily torn up.—Sincerely yours,

MICHAEL FOSTER WARD.

Bannerdown House, Batheaston, May 22, 1868.