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THE THUNDERSTORMS OF JULY, 1884.

As intimated in our last, we now present a first instalment of the list of damages by the thunderstorms of last month. We know that it is very imperfect, as very few of our correspondents seem to have noticed the editorial plea for information appended to the interesting letter by the Rev. W. Clement Ley. Still the list is terribly heavy, and when we arrive at the close, and try to sum up the actual pecuniary loss (irrespective of course of the many human lives to which no price could be attached), we think that its amount will be larger than most persons would imagine.

Much of the information rests upon the authority of country newspapers; it may therefore be well to state that nearly thirty years since we devoted three years to forming similar tables, *but* we sent every paragraph to the clergyman or other responsible person in each parish, so that any stretching or misstatement might be detected. We have not done so now for two reasons (1) because not one per cent. of the paragraphs in 1857-59 proved to be the least exaggerated, and (2) because the experience then gained shows that the errors are not serious enough to be worth the time necessary to hunt them out.

We reserve all comments until the list be finished, and in the meanwhile shall be glad of additional facts.

FRIDAY, JULY 4th.

BERKSHIRE.

Aston, Wallingford.—C. Bearley and T. Streakes were killed while at work in a field; their clothes were completely burned. A horse was killed in the neighbourhood.

BUCKINGHAMSHIRE.

Addington, Winslow.—Very sharp TS at 1.30 p.m., some trees struck.

Olney.—Tree struck.

OXFORDSHIRE.

Banbury.—Several trees struck; at Town's End four or five standing together were destroyed.

Deddington.—W. H. Smith was sheltering under a tree, and just going to eat the dinner which his wife had brought him, when he was killed, though his wife sustained no serious injury.

Magdalen Coll. Oxford.—T and R.

Oxhill.—Messrs. Parker had a cow killed.

South Newington, Deddington.—Mr. Tustain had a cow killed.

Upton, Burford.—Mr. Berridge had a horse killed.

NORTHAMPTONSHIRE.

Althorp House, Northampton.—Three horses killed.

Benefield, Oundle.—Several sheep killed.

Braybrook, Rothwell.—Cattle killed.

Brigstock, Thrapstone.—Mr. Ashwell had two sheep killed.

Chacombe, Banbury.—A tree struck at the Priory, and a sheep belonging to Mr. Hirons killed.

Cold Ashby, Daventry.—A cottage struck and bedstead scorched, though the child in it was uninjured.

Cottesbrook, Rothwell.—A horse while drawing a grocer's cart from this village to *Creaton* was struck dead. Nothing is reported respecting the driver.

Delapré Park, Northampton.—Five valuable horses belonging to Mr. J. A. S. Bouverie were sheltering under a tree; although little damage was done to the tree, four of the horses were killed, and the fifth was injured.

Drayton, near *Daventry.*—Three sheep belonging to Mr. Wearing were killed.

Easton Neston, Towcester.—Very severe storm, the most so since August 13th, 1866. Tree struck.

Farndon, Market Harboro'.—Public house struck.

Gayton, Towcester.—Messrs. Lovell's house struck.

Guilsborough, Daventry.—Part of a chimney knocked off a cottage.

Hemington, Oundle.—Trees struck.

Hulcote, Towcester.—A horse belonging to Mr. Jennaway killed while grazing.

Little Bowden, Market Harborough.—A bullock killed.

Lower Boddington, Banbury.—A cow belenging to Mr. Andrews killed.

Northampton.—Chimney of 76, Hunter-street, struck; the lightning appeared to pass down a metal bedstead, and then to ignite the skirting-board against which it stood. Chimney of factory in St. Edmund's-road damaged, also (slightly) the roof of the barracks, and several dwelling-houses and trees struck.

Oundle.—Heavy TS, and ·33 in. of R in 45 minutes.

Peterborough.—Many sheep and cattle killed in this neighbourhood.

Raunds, Higham Ferrers.—A tree struck at Mr. Askham's, a groove being ploughed out from one of the branches to the earth. Several men were sheltering beside a loaded waggon of hay, to which four horses were attached, all the horses were struck down, two being

killed, and of the others one had to be slaughtered; the men were very slightly injured.

Staverton, Daventry.—A valuable cow was killed, and an elm at Catesby House injured. A strong sulphurous odour was very perceptible during the storm.

West Haddon, Daventry.—TS passed from S to N, between 2.30 and 3.30 p.m.

Wollaston, Wellinboro.—A malting in Long-street was struck about 3 p.m., ignited, and entirely destroyed.

HUNTINGDON.

Ramsey.—A tree shivered at Park Farm, and a cow killed. A hay-stack near Puttock Bridge ignited and destroyed.

Sawtry, Whittlesea.—Four beasts killed here, and a number of cattle and sheep killed in other places.

BEDFORDSHIRE.

Turvey, Bedford.—At 3 p.m. an ash-tree in the hedge between Mr. Paine's and Mr. Whitworth's meadows was completely stripped and set fire to. It continued burning until the Monday.—[Even if we assume that it ceased to burn at midnight on Sunday, it still leaves 33 hours for it to have continued alight.—ED.]

CAMBRIDGE.

Conington, Caxton.—A large oak tree splintered.

Stonea, near March.—Eighteen sheep belonging to Mr. Morton killed.

Whittlesea.—Ricks set on fire.

STAFFORDSHIRE.

Heath House, Cheadle.—TS.

WARWICKSHIRE.

Bilton, Rugby.—Some posts and rails in a field split, two beasts belonging to Mr. Fuller killed. and the top struck off a tree opposite the post office.

Birdingbury.—Two very valuable heifers belonging to Mr. Lucas were killed.

Coombe Abbey.—Struck, and slightly injured.

Harington.—Some trees splintered.

Hillmorton, Rugby.—Mr. Rathbone had two beasts killed, and on Mr. Rodgers' land a tree was struck.

Hill, Leamington Hastings, Southam.—Mr. Gilks lost a valuable sheep, and an elm tree was shivered.

Rugby.—Two trees struck, one in Dale Street and the other in Hillmorton Road,

Wolston, Coventry.—Eleven sheep belonging to Mrs. Parsons were killed under a tree; a cow belonging to Mr. Eales was struck dead in the open field, and an elm at the vicarage struck.

LEICESTERSHIRE.

Ashby Parva,—A cow belonging to the Rev. W. C. Ley was

stunned, but eventually recovered, and an elm tree near to the shed in which the cow was, was also stripped of some of its branches and bark. A large ash tree on the road from Ashby to Gilmorton was nearly destroyed.

Burton Lazars, Melton.—Mr. Benskin was on the top of a hay-rick, the storm becoming heavy he descended, and within three minutes a flash struck the rick, split a fork which had been left upon it, and also the ladder standing against it, and ignited the rick. [Another account comes from the same village, but gives the farmer's name as Sapcote; doubtless both refer to one event.—ED.]

Cold Overton, Melton.—Mr. Eaton had just alighted from his trap, taken out the horse, and left the trap, when it was struck, the iron of the splash-board and of the seat bent, and the trap sent away several yards.

East Norton, Leicester.—Several animals killed.

Long Whatton, Loughborough.—Mr. Wilkins had a very valuable horse killed.

Loughborough.--TS from 2.45 to 3.40 p.m. Black Horse Hotel struck, out-buildings damaged, and a clock stopped at 3.3 p.m. A boy named Arthur Orton was struck in The Pastures, but recovered consciousness within an hour. A chimney-stack was struck at Park-lane.

Lubenham, Market Harboro'.—A sheep killed, a chimney demolished, and an ash tree split from top to bottom.

Melton.—A chimney was struck in King-street; the owner of the house, Mr. Southgate, was sitting in the room conversing with a friend; the latter says that hearing a noise in the chimney he turned to see the cause, and saw a ball of fire in the grate. The ball immediately exploded, and the lightning passed between himself and Mr. Southgate on its course out of the room through the open window.

Scalford, Melton.—Mr. Kirk had a ewe and a lamb killed; and Mr. Wright lost a sheep.

Shangton, Leicester.—Some bullocks killed.

Sheepshead, Loughborough.—Mr. Cook's house struck, he temporarily stunned; the general damage was not serious, but "several tins were pierced as with a red hot iron."

Sileby, Leicester.—Mr. Dakin had a cow killed.

Somerby, Melton.—Mr. Gilford had five sheep killed, and a tree in the village was stripped of its bark, and the earth round its roots scattered.

Stonton Wyville, Market Harboro'.—Mrs. Garratt had a bullock killed.

Whitwick, Ashby-de-la-Zouch.—Mr. Green's house was struck in the evening, and two cows were killed.

Willoughby, Lutterworth.—A ball of fire was observed to strike a stack of clover, to divide it to the centre, and to set it on fire.

Wymeswold, Loughborough.—T. Hubbard and his uncles, J. and W. Tuckwood, were mowing rye grass, the storm being heavy, and there

being no trees they got close to a hedge, and covered themselves with some of the rye grass, while in this position they were all struck, and two out of the three killed instantly, the other recovered. There were no marks on the deceased, except that their faces were very blue.

RUTLAND.

Uppingham.—A gasometer was overthrown during the storm, but whether it was struck by lightning is unknown.

LANCASHIRE.

Barrowford, Burnley.—A horse was killed while grazing in a field, and two men who were near were struck, but not fatally.

Breeze Hill, Liverpool.—T.

Burrow, Hornby.—Mr. Capstick had two sheep killed.

Nelson, Burnley.—Two men seriously injured. [Probably another report of the Barrowford accident.—ED.]

Whittington, Hornby.—An ash tree split.

YORKSHIRE.

Crosshills.—A cartload of hay struck and ignited.

Ingleton.—Mr. J. Towers had six sheep killed.

Scarborough.—TS.

Skipton.—A tree shivered in the churchyard.

Slatenber, Ingleton.—A building belonging to Mr. Hezeltine was struck, and considerably damaged.

DURHAM.

Whorlton, Darlington.—Hot, with TS, and ·25 in. of R between 6 and 7 p.m.

NORTHUMBERLAND.

Unthank Hall, Haltwhistle.—A very severe TS with vivid and nearly continuous L; a cow killed under a tree near the hall. In four hours 2·01 in. of R fell here and on the hills; it must have been very heavy, for the burns were swelled beyond all experience, and came down in such volume and with such violence that bridges, watergates, large stone gateposts, &c., were carried away.

SCOTLAND.

DUMFRIESSHIRE.

Lockerbie.—The chimney of Miss Foster's house in Arthur's-place was demolished, and the roof damaged.

EDINBURGHSHIRE.

Leith.—The top flat of No. 24, Glover-street was entered by the lightning, the bell wires melted, and other damage done. A young man in bed, though much frightened at the ruin in his room, was quite unhurt.

FIFESHIRE.

Kirkcaldy.—Much damage was done in the town and suburbs. Miss Ramsay's house in Gallatown was struck, and the gas-pipes

exploded. At the Gallatown Maltings a ventilator was struck, and one of the beams shattered. At Sinclairtown Mr. Reid's house was struck, the woodwork set on fire, and various articles destroyed; a hay-rick was also struck and consumed.

PERTHSHIRE.

Avintully.—A thatched house was struck, set on fire, and partly burned; the inmates were rescued.

TSS were also reported from *Hawick, Roxburgh, Cassilis,* AYR, *Stronvar,* PERTH, *Cawdor* and *Glenfinnan,* INVERNESS, and *Miltown Malbay,* CLARE.

SATURDAY, JULY 5th.

KENT.

Goodnestone, Wingham.—The stables of Sir Brook Bridges were struck and ignited, and three valuable horses burned.

Sarr, Ramsgate.—The house occupied by Mr. Rogers was struck, and considerably damaged.

CAMBRIDGESHIRE.

Cambridge.—During the height of the storm a fire occurred about 3 a.m., at a shop in Sussex-street, which was believed to have been caused by lightning.

Kingston, Caxton.—A woman died suddenly during the storm, but it was probably due to fright.

ESSEX.

Colchester.—A house struck, and several persons slightly injured.

SUFFOLK.

Boxford.—Several trees struck, and insulators on telegraph poles broken.

Culford, Bury St. Edmunds.—T.

Rendlesham Hall, Woodbridge.—TSS.

NORFOLK.

Diss.—TS early.

Watton.—The telegraph instrument at the post office damaged.

DORSETSHIRE.

Stowell Rectory, Sherborne.—TSS.

LANCASHIRE.

Breeze Hill, Liverpool.—T L.

YORKSHIRE.

Spennymore.—A house was struck at night, the chimney being shattered, and J. Watson, who was within, was temporarily paralysed.

DURHAM.

Burnhope, Lanchester.—A house struck, and partly demolished, but the inmates escaped.

Consett.—During the storm in the afternoon, the house of a miner named T. Gill was struck and much damaged. Gill, who was nursing a child, was killed, but the child escaped.*

Lane Head, Weardale.—Two men were at work on the spire of the Wesleyan Chapel, when it was struck, and they were knocked down insensible, but they eventually recovered.

Whorlton, Darlington.—TS.

NORTHUMBERLAND.

Newcastle.—Several animals killed in this neighbourhood.

SCOTLAND.

INVERNESS.

Fort William.—L. McDonnell was killed while driving some cattle across a field; another young man had a narrow escape, as he saw the lightning strike the earth beside him.

Uig, Skye.—Two cows killed, and the telegraphic communication interrupted.

TS at *Hawick*, ROXBURGH; *Stronvar* and *Dalnaspidal*, PERTH; and *Kilkishen*, CLARE.

SUNDAY, JULY 6th.

MIDDLESEX.

Pinner.—TS.

SURREY.

Wallington.—Distant T at 4 p.m.

HEREFORDSHIRE.

Ross.—TSS from 4 to 5 a.m., and in E. from 2.15 to 4.15 p.m.

STAFFORDSHIRE.

Heath House, Cheadle.—T.

LEICESTERSHIRE.

Loughborough.—Slight TS in afternoon.

Woodhouse, Mount Sorrel.—Two calves, belonging to Mr. Holt, killed in a field.

LANCASHIRE.

Breeze Hill, Liverpool.—TS.

Everton, Liverpool.—During a storm in the morning, lightning passed through the roof of Holy Trinity Church, filling the building with a pale blue flame. The current passed between two boys, paralyzing the arm of one and scorching the boot of the other. A panic ensued; most of the congregation rushed out, and the service was abruptly closed. The bell was rendered useless, and coping-stones weighing several hundredweights were hurled some distance. A child lying ill in bed at Everton was struck by the lightning and killed.

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* Once reported as having happened on Sunday, 6th.

YORKSHIRE.

Northallerton.—Many cattle killed, and the railway works much damaged.

Rawcliffe, Goole.—Lightning struck one end of a clover stack, passed completely through it, and entered the ground; shortly afterwards smoke was seen to arise, and the stack was found to be on fire.

DURHAM.

Whorlton.—Heavy TS, and 2·01 in. of R between 0 and 1 p.m.

SCOTLAND.

DUMFRIESSHIRE.

Lockerbie.—Sixteen sheep were leaving a field in single file, when the foremost was struck, the lightning ran along the line and killed the whole of them.

ELGIN.

Forres.—Heavy TS.

INVERNESS.

Cawdor.—T.

TUESDAY, JULY 8th.

SUSSEX.

Littlehampton.—T.

HANTS.

Redlands, Emsworth.—TS at 2 a.m.

NORTHAMPTON.

Oundle.—T.

WILTS.

Pewsey.—T.

STAFFORD.

Heath House, Cheadle.—TS.

LANCASHIRE.

Breeze Hill, Liverpool.—T L.

YORKSHIRE.

Scarborough.—TS.

WESTMORELAND.

Shap.—TS at 9.30 p.m.

SCOTLAND.

ROXBURGH.

Hawick.—T.

FIFE.

Newton Bank, St. Andrew's.—TS and ·35 in. of R in 25 minutes.

ON THE FORMATION OF AIR BUBBLES IN WATER BY DROPS OF RAIN.

By CHARLES TOMLINSON, F.R.S.

BEING caught in a very heavy shower of rain, I sought refuge under an archway, and soon saw the roadway flooded, and a small torrent hurrying along the gutter. But what most arrested my attention was a number of large, well-formed bubbles of air bursting on the surface. I watched these with considerable curiosity, and called to mind some of the accounts given in books on physics as to the cause of the formation of similar bubbles. Thus, when a bullet is fired, or allowed to fall into water, the air is said to be dragged down by the bullet. Others affirm that it is the air adhering to the bullet that forms the bubble, or the adhesion of air to the solid.

I mentioned the phenomenom to one of my scientific colleagues at King's College, and he at once gave the adhesion theory, and remarked that a globule of mercury let fall into water did not form a bubble.

The earliest notice that I have met with of the phenomenon in question, is that by the celebrated Mariotte (who shares with Boyle the discovery of the law of gaseous elasticity) in his *Œuvres*, Leide, 1717, vol. ii., p. 353. He remarks that each drop of rain, in falling from the height of the cloud, drags down two or three times as much air as its own size, as may be shewn by letting a little ball of lead fall into a bucket of water; for as soon as it touches the bottom two or three bubbles of air rise, each as large as itself, which can only proceed from air which follows it to the bottom of the vessel. He compares it to the action of the *Trombe*, in which air is dragged down by falling water.*

It is a mistake to suppose that the air, thus liberated by a body projected into water is adhering air, or air driven in by the projectile, or that the effect is quite the same as the action of the *Trombe*.

In *Poggendorff's Annalen*, vol. xcv. (May, 1855), Professor Magnus refers incidentally to the phenomenon. He says that when a projectile penetrates water, it produces an excavation, of which it forms the bottom, and which closes at the surface before it is complete. The air thus enclosed rises later to the surface. But as the horizontal section of this excavation is always greater than that of the projectile, and increases with its *vis viva*, it follows that the volume of air thus imprisoned may be many times greater than that

* The *Trombe* is an ingenious arrangement for furnishing a wind blast in the Catalan method of smelting iron. A tree is hollowed out, and its lower end inserted into the top of a large wooden chest, while near its upper end a number of apertures, sloping downwards, are cut through the wood. The water of a mountain stream is so led as to pour into the top of the hollow tree, and the descending water exerting no lateral pressure, air rushes in by the slits, as into a vacuum, and accumulating under pressure in the chest, escapes by a blast pipe into the furnace, while an opening near the bottom of the chest, allows the superfluous water to run off.

of the projectile. It is further remarked that air cannot be introduced into water by a lateral projection of the solid.

In the *Comptes Rendus* for 1867, p. 564, M. Melsens adopts the view of Mariotte, that a leaden ball drags down air. He says that a bullet weighing nearly an ounce, let fall from a height of about forty inches, liberated a volume of air twenty times greater than that of the bullet. Half of the air escaped before the bullet got to the bottom; the other half ascended from the bottom. The length of the column of water is not given.

In the same volume of the *Comptes Rendus*, page 797, is an account of an experiment by M. Laroque, in which he allowed to fall into water a long cylinder of elder pith, to which a small sphere of lead was attached at the lower extremity. The cylinder penetrates the water a certain distance, is then arrested for a moment, and ascends. While falling into the water, a portion of the cylinder remains above its surface; but air-bubbles are formed below the sphere of lead, and are even propelled a little way below it, and ascend less quickly than the cylinder.

According to M. Laroque, the air is pushed forward by the projectile, and he concludes generally that when a projectile is darted into water, air penetrates (1) because it is pushed forward by compression (2) because it is dragged into the depression by the projectile, and the water closes over it; while (3) the volume of air thus imprisoned depends on the density and cohesion of the liquid, and the *vis viva* of the projectile at the moment when it strikes the water.

The phenomenon forms a good lecture-table experiment, if exhibited on a large scale. My mode of showing it is to fill with water a cylindrical glass vessel, 19 inches high, and $3\frac{1}{2}$ inches in diameter, and to suspend some feet above it a glass funnel, so arranged that the axis of the funnel shall be in the same vertical line as the axis of the cylinder. A small leaden or iron bullet, or large shot, put into the funnel, is thus neatly delivered to the water, and as soon as the shot strikes the bottom, several bubbles of air escape, and oscillate up to the surface. By catching the air thus liberated in a graduated inverted test tube, filled with water, the relation between the volume of the solid and that of the liberated air can easily be estimated.

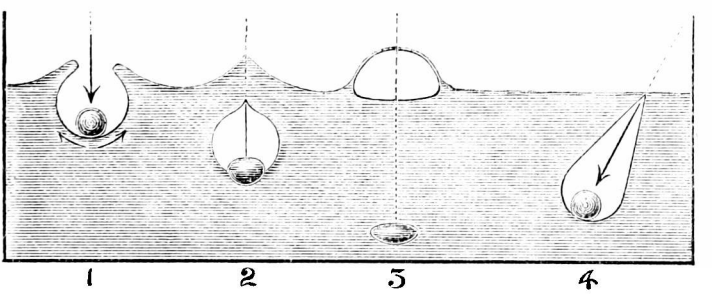
Small marbles may also be used, or inch lengths of thick wire with a similar result. The shot, &c., may be wet, or the lead amalgamated, but the result is the same, so that adhering air is not to be taken into account.

The experiment was also carefully and repeatedly tried with mercury, which formed no exception to the general result, as had been supposed. Indeed seeing how large a bubble can be formed by a drop of rain falling into water, it was not likely that a fluid upwards of thirteen times heavier than water should form an exception.

The experiment was also tried with other liquids, such as paraffin oil, spirits of wine, and ether, the volume of air liberated, depending on the height of the fall of the solid body, and the density of the liquid, the volume of air bearing an inverse relation to the density.

The result then, according to my view, may be thus stated :— When a heavy body, such as a bullet, falls upon water, it descends to a certain depth, and leaves above it a cylindrical space, into which air rushes more quickly than the water can fill it up. The shot continuing to fall, constantly clears a space, into which the air as constantly rushes ; until the shot being arrested by the bottom of the vessel, the air is detached by the concussion, and forms into bubbles, which ascend.

The dimensions of the vacuous space formed by the bullet depend of course upon its density and *vis viva* or velocity of descent, the greater the fall the larger the space and the larger the volume of air liberated. Thus when a bullet is fired into water from a gun, the *vis viva* is great, and the volume of air liberated is large in proproportion. Or when a drop of rain falls from a cloud, it has an enormous *vis viva*, and hence the magnitude of the bubble even in water as shallow as the gutter I was watching while taking shelter from the rain. The process of the formation of the bubble may be



thus graphically represented :—*Firstly.* The rain-drop preserving its integrity as a drop by means of its surface tension, penetrates the water, and leaves an empty space as in *Fig.* 1, into which air rushes before the water can close up the space. *Secondly.* The water closes in, and imprisons the air-bubble, which descends with the rain-drop, as in *Fig.* 2. *Thirdly.* The drop reaches the bottom of the puddle, and the air-bubble is detached, becomes convex by the resistance of the water during its ascent, and reaches the surface as a hemisphere, as in *Fig.* 3, and then bursts.

Fig. 4 shews the formation of a bubble when the direction of the rain is oblique.

Highgate, N., 18th July, 1884.

SUPPLEMENTARY TABLE OF RAINFALL, JULY, 1884.

[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	1·44	XI.	Carno, Tybrith	3·75
,,	Margate, Birchington...	1·68	,,	Corwen, Rhug	...
,,	Littlehampton	2·54	,,	Port Madoc	5·22
,,	Hailsham	1·90	,,	I. of Man, Douglas	4·36
,,	I. of W., St. Lawrence.	2·09	XII.	Stoneykirk, Ardwell Ho.	4·20
,,	Alton, Ashdell.....	2·37	,,	Melrose, Abbey Gate...	6·58
III.	Winslow, Addington ...	2·69	XIII.	N. Esk Res. [Penicuick]	5·65
,,	Oxford, Magdalen Col...	2·26	XIV.	Ayr, Cassillis House ...	4·65
,,	Northampton	3·75	,,	Glasgow, Queen's Park.	5·38
,,	Cambridge, Beech Ho...	2·44	XV.	Islay, Gruinart School..	2·56
IV.	Southend	1·96	XVI.	St. Andrews, Newton Bk	4·35
,,	Harlow, Sheering	2·04	,,	Balquhidder, Stronvar..	6·82
,,	Diss	1·26	,,	Dunkeld, Inver Braan..	5·64
,,	Swaffham	2·00	,,	Dalnaspidal H.R.S. ...	5·53
,,	Hindringham	...	XVII.	Keith H.R.S.	1·90
V.	Salisbury, Alderbury...	2·33	,,	Forres H.R.S.	1·45
,,	Warminster	3·51	XVIII.	Strome Ferry H.R.S....	5·57
,,	Calne, Compton Bassett	2·06	,,	Lochbroom	5·13
,,	Ashburton, Holne Vic..	4·93	,,	Tain, Springfield.....	1·93
,,	Holsworthy, Clawton...	3·62	,,	Loch Shiel, Glenaladale	6·37
,,	Lynmouth, Glenthorne.	2·36	,,	Invergarry	3·84
,,	Probus, Lamellyn	3·68	XIX.	Lairg H.R.S.	2·51
,,	Wincanton, Stowell Rec.	4·43	,,	Forsinard H.R.S.	1·91
,,	Taunton, Fullands	2·48	,,	Watten H.R.S.	2·01
VI.	Bristol, Clifton	3·67	XX.	Dunmanway, Coolkelure	6·01
,,	Ross	3·51	,,	Fermoy, Gas Works ...	1·50
,,	Wem, Sansaw Hall.....	2·68	,,	Tralee, Castlemorris ...	3·58
,,	Cheadle, The Heath Ho.	3·23	,,	Tipperary, Henry Street	4·36
,,	Worcester, Diglis Lock	3·72	,,	Newcastle West	3·36
,,	Coventry, Coundon	3·37	,,	Miltown Malbay.....	3·57
VII.	Melton, Coston	4·92	,,	Corofin	2·85
,,	Ketton Hall [Stamford]	3·52	XXI.	Carlow, Browne's Hill..	3·67
,,	Horncastle, Bucknall ...	3·50	,,	Navan, Balrath	3·20
,,	Mansfield, St. John's St.	3·83	,,	Mullingar, Belvedere ...	3·39
VIII.	Macclesfield, The Park.	3·83	,,	Athlone, Twyford	2·96
,,	Walton-on-the-Hill.....	4·86	XXII.	Galway, Queen's Col....	2·94
,,	Lancaster, South Road.	6·63	,,	Clifden, Kylemore	8·12
,,	Broughton-in-Furness ..	6·87	,,	Crossmolina, Enniscoe..	4·44
IX.	Wakefield, Stanley Vic.	3·11	,,	Carrick-on-Shannon ...	4·24
,,	Ripon, Mickley	3·75	XXIII.	Dowra	...
,,	Scarborough.....	2·29	,,	Rockcorry.....	2·79
,,	East Layton [Darlington]	5·18	,,	Warrenpoint	3·92
,,	Middleton, Mickleton ..	5·73	,,	Newtownards	4·22
X.	Haltwhistle, Unthank..	9·29	,,	Belfast, New Barnsley..	4·35
,,	Shap, Copy Hill	5·77	,,	Cushendun	4·03
XI,	Llanfrechfa Grange	3·83	,,	Bushmills	3·06
,,	Llandovery	4·22	,,	Stewartstown	3·12
,,	Lower Solva	3·06	,,	Donegal, Revelin Ho....	...
,,	Castle Malgwyn	3·90	,,	Buncrana	3·42
,,	Rhayader, Nantgwillt..	4·77	,,	Carndonagh	3·58

JULY, 1884.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Table to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Greatest Fall in 24 hours. Date.	Days on which ·01 or more fell.	TEMPERATURE. Max Deg.	Max Date	Min Deg	Min Date.	No. of Nights below 32° In shade	No. of Nights below 32° On grass
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	2·46	— ·01	·60	9	17	86·9	4	42·2	26	0	0
II.		Maidstone (Hunton Court)...	1·45	— ·59	·30	4	15	...	...	...	...	...	...
,,		Strathfield Turgiss	...	...	...	...	...	...	...	...	...	...	...
III.		Hitchin	3·89	+ 1·19	1·75	9	16	80·0	4	42·0	25	0	0
,,		Banbury	2·86	— ·12	·49	4	23	82·0	3,4	39·0	26	0	...
IV.		Bury St. Edmunds (Culford)	2·32	— ·65	·32	24*a*	18	87·0	3,8	42·0	25	0	...
,,		Norwich (Cossey)	2·17	— ·58	·63	21	14	85·5	3	44·0	20	0	0
V.		Weymouth(LangtonHerring)	2·41	...	·42	15	17	...	...	...	...	...	...
,,		Barnstaple.....	3·12	— ·43	·83	23	19	80·0	3	49·0	1,26	0	0
,,		Bodmin	4·29	+ ·85	·58	14	25	73·0	20	49·0	2*b*	0	...
VI.		Cirencester	...	...	...	...	...	..	...	...	...	...	...
,,		ChurchStretton(Woolstaston)	3·30	+ ·27	·51	11	22	75·0	8	46·0	26	0	0
,,		Tenbury (Orleton)	3·21	+ ·30	·51	13	18	76·8	8	40·2	26	0	0
VII.		Leicester	3·31	...	·44	23	22	86·0	3,4	42·2	26	0	0
,,		Boston	2·41	— ·12	·40	10	15	84·0	4	44·0	26	0	...
,,		Grimsby (Killingholme).....	2·36	— ·42	·52	10	20	76·0	13	44·0	26	0	...
,,		Hesley Hall [Tickhill].....	2·65	...	·83	10	19	87·0	3	41·0	20	0	...
VIII.		Manchester (Ardwick).....	4·23	+ ·42	·66	9	22	79·0	3,4	47·0	26	0	0
IX.		Wetherby (Ribston Hall) ..	4·05	+ 1·44	1·16	11	11	...	...	..	...	...	...
,,		Skipton (Arncliffe)	7·75	+ 2·80	1·25	10	27	72·0	31	39·0	24	0	...
X.		North Shields	2·72	+ ·17	·38	22	19	75·0	31	41·5	26	0	0
,,		Borrowdale (Seathwaite).....	10·01	+ 1·24	2·37	15	25	81·9	3	41·5	20	0	...
XI.	WALES.	Cardiff (Ely)..	5·12	+ 1·31	1·23	26	22	...	...	...	...	...	...
,,		Haverfordwest	4·97	+ 1·04	1·57	7	19	75·3	3	43·0	1	0	0
,,		Plinlimmon (Cwmsymlog) ...	5·04	...	·87	28	21	...	...	...	...	...	...
,,		Llandudno.....	4·48	+ 1·77	·91	5	20	72·0	5	42·8	21	0	...
XII.	SCOTLAND.	Cargen [Dumfries]	5·67	+ 2·54	·91	9	22	78·8	4	41·0	20*a*	0	0
,,		Hawick (Wilton Hill).....	5·49	...	1·21	5	20	...	...	...	.	...	...
XIV.		Douglas Castle (Newmains)	4·95	+ 1·66	1·58	10	17	...	...	...	..	..	...
XV.		Lochgilphead (Kilmory).....	5·26	+ ·72	1·73	10	23	...	...	...	...	...	...
,,		Oban (Craigvarren)	6·57	...	2·41	10	22	75·0	5	44·0	20	20	...
,,		Mull (Quinish).....	4·83	...	1·32	10	22	...	...	...	...	...	...
XVI.		Loch Leven Sluices	5·30	+ 2·25	1·10	11	13	...	...	...	...	...	...
,,		Arbroath	4·89	+ 2·25	1·20	11	22	68·0	17	43·0	20	0	...
XVII.		Braemar	4·93	+ 2·07	1·56	10	26	75·3	4	39·0	20	0	0
,,		Aberdeen	2·93	...	·65	15	18	70·0	13	39·0	26	0	...
XVIII		Skye (Sligachan)	...	...	...	...	...	...	...	..	...	...	...
,,		Culloden	3·86	+ 1·08	·81	7	15	75·0	9	41·0	20*c*	0	0
XIX.		Dunrobin	2·04	...	·45	23	16	69·5	8	38·5	20	0	...
,,		Orkney (Sandwick)..... ..	2·54	— ·12	·69	13	15	68 8	10	41·3	22	0	2
XX.	IRELAND.	Cork (Blackrock)	2·64	— ·20	·49	9	17	84·0	2	44·0	7	0	...
,,		Dromore Castle	6·28	...	·90	6,9	22	67·0	31	47·0	4	0	...
,,		Waterford (Brook Lodge) ...	2·19	...	·31	11	19	75·0	29	44·0	19	0	0
,,		Killaloe	4·33	...	·48	6	17	75·0	2	45·0	19	0	...
XXI.		Portarlington	2·51	— ·17	·48	22	23	75·0	2	45·0	18	0	0
,,		Dublin (FitzWilliam Square)	2 35	— ·07	·42	22	25	70·7	5, 30	47·1	17	0	0
XXII.		Ballinasloe	2·69	— ·19	·48	27	21	70·0	5	40·0	19	0	..
XXIII		Waringstown	3·19	— ·39	·57	28	22	80·0	4	44·0	19	0	0
,,		Londonderry (Creggan Res.).	2·84	...	·35	28	24	...	...	...	...	...	...
,,		Omagh (Edenfel)	3·46	+ ·21	·83	28	21	76·0	3	44·0	18	0	0

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

a And 28. *b* And 9, 26. *c* And 27, 29.

METEOROLOGICAL NOTES ON JULY.

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

[For details respecting the thunderstorms, see separate article.]

ENGLAND.

BANBURY.—The weather of the month was very unfavourable for getting hay, but was useful to grain crops, although they were considerably beaten down by the R. At the close of the month much hay was still out, some grass remained uncut, and the corn harvest had not commenced. T on 5 days.

CULFORD.—The ground at the beginning of the month was very dry, and although showers were general and frequent throughout, the quantity of moisture was not sufficient for dry soils. Harvest progressing favourably.

WOOLSTASTON.—A wet month; the hay harvest secured with much difficulty. Mean temp., 60°·0.

ORLETON.—The weather during the month was very showery, and there was rarely a day without a few spots of R; T was heard on 6 days, and L was seen on 2 days; on the 13th there was a great fall of R for a few minutes. The temp. was equable, and about 0°·5 below the average of 23 years; the bar. was generally steady. The crop of hay was very light, and much of the late secured was damaged by R.

LEICESTER.—The month was a very unsettled one, and T and L were frequent; on the 8th, between 4.15 p.m. and 4.45 p.m., the wind changed from E. to S.W., then to N.E., and then to S.W.

MANCHESTER.—June having been very dry, rain was much required at the beginning of this month, but on the 3rd day the dry weather ceased and welcome R began, and fell more or less for nearly 20 consecutive days, restoring vegetation, and replenishing to a large extent the supply of potable water, which had got dangerously low, besides flushing the sewers, and thereby improving the health of the town. The night temperatures were rather low; only two TSS occurred of any note.

KILLINGHOLME.—A real summer month; frequent T and L and many showers, but none heavy; more R wanted on heavy lands. Corn likely to be good in quality.

ARNCLIFFE.—During a violent TS on 3rd, ·65 in. of R fell in 45 minutes, a larger quantity than had fallen during the 48 days previous.

NORTH SHIELDS.—T on 6 days.

WALES.

HAVERFORDWEST.—The month was fine and warm, with high day and night temp. up to the 15th; after St. Swithin's Day (which was very wet and stormy) the weather continued broken and wet for several days, and did not recover its fine summer character until the 29th, from which date to the 31st the temp. steadily increased, and the air was very dry. The temp. rose to or above 70° on 12 days, and the R fell mostly at night. As a whole, it was certainly the finest July since 1880. Prevailing winds, Southerly, N. and N.W. On the 27th, at 11 p.m, a bright, but small meteor was seen in the S.E., at an angle of 45° above the horizon. Wheat and oats look very well, but barley is thin on most grounds; the frequent R during the greater part of the month did wonders for the green crops.

LLANDUDNO.—The temp. of the month, although equable, was slightly below the average, and the range, both diurnal and monthly, considerably less than usual. R fell on 20 days, the average being about 11 days, and the total fall was large; the pastures, gardens, and green crops, which had suffered much from the drought of the previous month, were of course much benefited by this excess of R, which falling mostly in showers, did not interfere materially with out-door exercise. Duration of bright sunshine, 137 hours.

SCOTLAND.

CARGEN.—A very unusual number of TSS occurred during the first half of

of the month ; mean temp. (59°·2) about the average ; duration of sunshine 40 hours below the average. T on 10 days.

HAWICK.—A fine growing month ; T on 6 days.

OBAN.—A glorious month, with sufficient R to encourage vegetation, which with ample sunlight has made excellent progress. In the latter half of the month the temp. fell considerably. T and L on 3rd, 4th, 9th and 10th. On 10th, 2·41 in. of R fell in 7 hours ; new rifts were opened in the hill sides, and a large amount of debris carried down.

ABERDEEN.—During the first week of the month foggy weather was experienced, and the prevailings winds during the first fortnight were south-easterly. Rainfall somewhat above the average.

CULLODEN.—The R of the month fell generally with TSS, chiefly between the 7th and 25th, and in consequence the hay crop was more or less damaged, but other crops benefited ; the weather during the last week was particularly fine and dry.

SANDWICK.—A pleasant month ; the rainfall was just about the average and the temp. was about the mean of the previous 57 years. The most remarkable feature of the month was the fog which prevailed more or less every day from 2nd to 9th, inclusive.

IRELAND.

CORK.—The weather about the beginning and in the middle of the month was dry, but frequent slight showers, generally in the evening or night, refreshed vegetation, so that the dryness of June proved less injurious than was expected.

DROMORE.—A bad month for harvesting ; potatoes suffering much from blight.

WATERFORD.—The weather of the month was very unsettled, although there were no heavy rains. Atmosphere remarkably clear on 25th.

KILLALOE.—A very beneficial month for all purposes ; a sufficiency of R, without excess to injure haymaking. Mean temp. 60°·4,

DUBLIN.—True to its traditional character, July was a very showery month, R falling on 25 days, compared with an average of 17·6 days ; nevertheless the total did not quite reach the average, the explanation being that the R fell chiefly in the form of showers, the 28th being the only thoroughly wet day. The mean temp. (59°·7) was almost identical with the average of 20 years, and owing to the prevalence of clouds and the frequency of showers by day, the extremes were not great. Distant T was heard on 2 days, but Dublin enjoyed a complete immunity from TSS, and there was no H. Mean humidity 78 ; mean amount of cloud 6·4 ; prevailing winds S.E. and W.

EDENFEL, OMAGH.—The weather up to the 12th was a continuance of the magnificent summer which marked the latter half of June, but from the 13th a copious rainfall, accompanied by a calm, humid atmosphere, forced into luxuriance crops and foliage of every kind.

METEOROLOGY AT THE INTERNATIONAL HEALTH EXHIBITION.

A CONFERENCE was held at the Health Exhibition on Thursday, July 17th, and Friday. July 18th, under the auspices of the Royal Meteorological Society. The chair was taken on the first day by J. Norman Lockyer, Esq., F.R.S., and on the second day by Dr. J. H. Gilbert, F.R.S. The following papers were read, and discussions ensued upon them :—

On some relations of Meteorological Phenomena to Health. By J. W. Tripe, M.D., F.R.Met.Soc.

In ages long past these relations excited much attention, but the knowledge concerning them was of the vaguest kind ; even now no

great advance has been made, because it is only quite recently that we have been able to compare an accurate record of deaths with observations taken at a number of reliable meteorological stations. My remarks will refer to the relations between (1) meteorological phenomena and the bodily functions of man, and (2) between varying meteorological conditions and death-rates from certain diseases.

Too much attention is paid to the barometer, for it really indicates only the variations in the weight of air pressing on our bodies, and these produce but little effect on health, for the advantages resulting from a residence at mountain stations are chiefly due to the generally altered climatic conditions, and the total change in the daily habits.

Man can bear greater variations of temperature than any other animal, for a temperature of —70° F. can be safely borne in the Arctic Regions, and 120° F. has been registered in Australia, so that he can live in fairly good health within a range of nearly 200° F. The effects of high temperature vary greatly according to the humidity, the effect of a moist air being to prevent evaporation, and the consequent cooling of the body; the effects of temperature also depend on the extremes, for when the days are hot and the nights cool, the system becomes partially restored; hot climates are not necessarily injurious to Europeans, but their children certainly degenerate, and after two or three generations die out.

The direct influence of rain on man is not marked except by its giving moisture to the air, and by altering the level of ground water; when ground water has a level less than 5 feet below the surface, the locality is unsuitable for habitation. Varying amounts of moisture in the air materially affect the health and comfort of man, as not only the evaporation from the skin, but also the amount of effete matter carried off from the lungs, depends upon it.

Variations of pressure and temperature affect the circulation of air in the soil, and as this "ground air" is frequently combined with dangerous gases, its effect on health is at times considerable.

There are certain known relations between meteorological phenomena and disease, but on the other hand there are many unknown relations; for instance, small-pox, while of an ordinary type, will sometimes assume an epidemic form under meteorological conditions with which it usually declines. A mean monthly temp. below 44°·6 is adverse to the spread of scarlet fever, and deaths from this disease are most numerous with a temp. between 45° and 57° Diseases of the lungs, excluding consumption, are fatal in proportion to the lowness of the temp. and excess of moisture. The relations between high summer temp. and diarrhœa have long been seen, but the cause is not clearly known, and the reason for its excess in certain districts has not been discovered. With regard to the relation between meteorological phenomena and many diseases, such as sunstroke, liver diseases, yellow fever, cholera, whooping cough, measles, &c., our knowledge is very limited.

(To be continued.)