

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

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THE STAMPEDE OF SHEEP ON NOV. 3RD.

In addition to the letter on the above subject, which we inserted in our last issue, a similar statement appeared in *Nature*, *The Times*, and many other journals. Having invited communications, procured copies of the local newspapers circulating in the district, and applied individually to those whose names were given in the public press as the authorities for the statements, we obtained a very considerable mass of materials, a selection from which follows.

It may be well, in the first place, to state what occurred, and secondly, to discuss the information and theories as to the cause.

On the night of Nov. 3rd, over an area about 25 miles long by from 6 to 8 miles wide, in the Valley of the Thames—stretching from Abingdon to Maidenhead—about four out of every five flocks of sheep broke down the hurdles in which they were penned, and ran about wildly, evidently in a state of intense alarm.

All accounts which state the direction in which the sheep fled give it as E.N.E. or S.E., which is quite as close an agreement as could be expected, and clearly proves that the general direction was easterly.

The time at which this stampede occurred is invariably stated at about 8 o'clock, or a quarter before; and, although we have seen no evidence in support of the statement, we have no reason for doubting it. It is stated also that it was intensely dark at this time, probably from high fog.

The suggested causes are:—

- 1st. A mad or wild dog.
- 2nd. A practical joke.
- 3rd. Lightning.
- 4th. An earthquake.

The first two theories are, we think, readily disposed of by the fact, that the area over which the stampede extended is much too large for one or even many men or dogs to have dealt with.

The third suggestion, Lightning, is unsatisfactory in many particulars. Although lightning is referred to as the cause in several accounts, there are definite statements that no lightning was seen at the time, though it was observed about 2 a.m., long after the occur-

rence. Again, if lightning were the cause, surely such stampedes would be of comparatively frequent occurrence, which certainly is not the case; and finally, if we grant an exceptionally vivid flash, surely the sheep would have fled from it in all directions, N., S., E. and W.

Unless further evidence is forthcoming, we are prepared to accept the earthquake theory as the true one, and chiefly on the following grounds

The fact that animals are undoubtedly remarkably sensitive to slight earth tremors.

The statement of the shepherd (made before the sheep were known to have broken out) that he felt a slight tremor at an earlier hour of the evening.

The fall of the portions of the wall at Frilford.

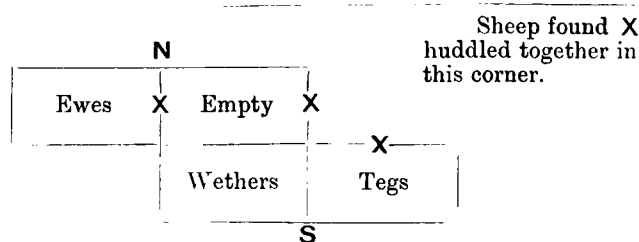
The terror exhibited by a dog at Wargrave without apparent cause.

The fact that all the flocks fled practically in one direction.

On reading all the accounts carefully, there are considerable indications of the cause of alarm being repeated once or twice at short intervals.

On Sunday morning the shepherds employed by various farmers in the parishes of Benson, Brightwell, Hagbourne, Moreton, Stoke, Sotwell, Warborough and other places in this neighbourhood, on visiting the flocks, found that in many cases the sheep had escaped from their folds during the night, and were discovered wandering about the adjoining fields. In many cases the hurdles were found lying flat on the ground, and in others the state of the hurdles showed that the sheep had used their utmost endeavours to escape, but had been unable to do so.

HALL PLACE, MAIDENHEAD.—The panic in the sheep folds on the night of Saturday, Nov. 3rd, extended over a larger tract of country than has been mentioned in the press. On that night I had 570 sheep penned in three folds on a field a good 5 miles nearer London than Twyford, and 3 nearer than Henley. The field is situated on the high land bordering the valley of the Thames, and to the S. of it. The sheep were penned thus :—



The ranks of hurdles marked with a cross were knocked flat down, and the ewes and tegs found mixed up together in a corner of the field. The wethers did not break out. The land at that time was comparatively dry, so it must have taken considerable force to knock down two ranks of hurdles as the ewes did. In the valley of the Thames, about 1 mile away, the sheep belonging to a tenant of mine broke down the hurdles the same night. The shepherd in

this case noticed the places where the sheep must have laid down directly afterwards, though they were not found there. The sheep belonging to a farmer, Mr. Weall, within a mile and a half of Maidenhead, also broke out. I have since heard that all the sheep broke out towards the N.E. on that night.—GILBERT A. CLAYTON EAST, Bart.

GOULD'S GROVE, BENSON, OXON.—On Saturday evening last, a little before eight o'clock, almost every flock of sheep for a distance of nearly twenty miles in length and seven or eight in width all along the valley of the Thames, viz., from five miles below Abingdon nearly to Goring, was driven out and the hurdles smashed and some of those in the meadows were driven over or through the hedges, and as far as I can ascertain almost all went towards the east or south-east. All who can fix the time agree that it happened a little before eight. The evening was very dark and still, and from no one can I hear of any lightning or any meteor (as of course there were many people about at the time) which could have frightened the animals; neither could they have been let out by any preconcerted action of any number of persons, as I do not believe a thousand men could have accomplished the work, added to which had such been the case the hurdles would have been opened and not smashed down.—WILLIAM NEWTON.

SOTWELL HILL, WALLINGFORD.—I cannot arrive at any satisfactory conclusions myself, the evidence is so conflicting, or rather the effect on different flocks of sheep in close proximity is so contrary. In my own case out of five flocks of sheep situated from half a mile to a mile apart four flocks were disturbed; the fifth was quiet. On making inquiries on Monday morning of the two shepherds who had charge of a neighbour's flock, they reported that their sheep were quite undisturbed that night, but one of the men said to me, "I noticed just as the Wallingford clock struck five (Saturday evening) the ground seemed to shake under my feet." The other shepherd said he did not notice anything unusual, but he remembered his mate remarking this to him at the time. This man had not at that time heard of any general or wide-spread disturbance of sheep. Curiously enough, this particular flock was quite quiet on the memorable night. One suggested explanation is that a pitch darkness came over this particular district at eight o'clock, so dark that men accustomed to dark evening walks could not see their hands before their faces. This can be authenticated. The dark cloud lifted after a few minutes; there was then nothing to be seen of lightning or meteor. It is supposed that the timid sheep were frightened by the black darkness, which made each sheep think he or she was separated and left alone. There was lightning seen about two o'clock in the morning of Sunday, but nothing unusual. On Jubilee night last year the firing of our signal rockets from Brightwell Hill so frightened my sheep, who were half a mile distant, that they rushed at the hurdles, and two so injured themselves that they had to be sent to the butcher's. On this night, November 3rd, those flocks which were frightened (about three out of four within a radius of five miles or more) had the appearance of having been hunted almost out of their lives. Flocks were found cut into two or three parts, hurdles broken down in various directions (perhaps less broken on the north side), troughs almost all turned over. The sheep, many of them, had been rolled in the mud, and one of mine had its leg broken.—ALFRED D. WELLS.

FRILFORD, ABINGDON.—In reply to your letter of the 10th inst., my ewes broke out of their fold in several places, and were found mostly near the

hurdles on the outside of the fold on the morning of Nov. 4th. From the footprints, it appeared that some of them ran several chains down the field south of the fold and back again; they probably ran backwards and forwards through the fold several times, as the hurdles were knocked about in all directions. I have several stone walls around my fields, one about half-a-mile long running from east to west, having the highway on the south, and an arable field on the north, about $4\frac{1}{2}$ feet high, partly mortared, the ground, on the north side being about six inches lower than that on the south, fell in three places some time between the 3rd and 4th Nov.; that is to say, about the top half of the wall fell towards the north in the first gap about 3 yards wide, in the second gap at about 8 yards distance from the first 3 yards wide, and the third gap 12 yards distant from the second 6 yards wide. It is not unusual for the walls to fall in a similar way in very wet weather, but there appeared to be little or no rain on the night in question, although it was very dark. There have been no gaps in the wall in question for several months previous to the 3rd Nov., nor have any fallen since. I hear of lightning having been seen on that night, and of a whirring sound having been heard in the air, but cannot hear of anyone who perceived an earthquake.—THOS. FLOYD.

1, CEDARS ROAD, BECKENHAM.—SIR,—As a practical farmer and sheep owner of many years' experience, the stampede of sheep you mention in your letter to the *Times* seems to me a simple matter. It was a densely dark night—what we call a ground darkness, which is, like a black fog, comparatively rare, and I have often known sheep break fold then. The least noise or an extra push, or, as in this case, a flash of lightning, startles them, and they make a rush, seeing nothing. If the hurdles give way, that frightens them still more, and there is no stopping them in their panic; and the sound of a flock rushing by in the mysterious darkness would infallibly startle another.—ARTHUR STONE.

GRASMERE, BUDHURST ROAD, CROYDON.—About ten or twelve years ago my flock and some of the neighbouring flocks broke out of their folds one night. My shepherd attributed it to ground lightning [An upstroke.—ED.]—M. A. SADLER.

7, LISBURN CRESCENT, TORQUAY.—It is possible that the panic amongst the sheep was caused in this instance by an earthquake. It does not appear invariably to alarm them, as I had myself a flock of sheep in North Devon at the time of a rather severe shock some years ago, accompanied by a loud rumble, and on that occasion neither my sheep nor those of any of the farmers in the neighbourhood, as far as I know took any notice of it.—J. J. PHILLIPS. (Late Capt. 6th Rifles, J.P.)

ATHENÆUM CLUB, PALL MALL.—SIR,—I see that you are asking for information about a panic and a rush of sheep in Berkshire and Oxfordshire. Of the facts in that case I know nothing, but I remember a similar catastrophe, which astonished flock owners in a part of Australia in which I was riding at the time, and of which I was, therefore, a casual witness. A storm of wind and rain was the occasion of the scattering of the sheep in the case in question, and the sheep literally fled before the wind like the light drift of clouds. They went absolutely in line with the wind. I have no doubt (in those days 1849 hurdles were commonly used to fold the sheep in at night) that some sheep-pens were blown down by the wind, and that the scattered sheep merely fled before the wind, but the belief among many of the neighbours was that the rush and pressure of the sheep in most cases carried away the side of the folds in the first instance.—G. W. RUSDEN.

ROYAL METEOROLOGICAL SOCIETY.

The first monthly meeting of this Society for the present session was held on Wednesday evening, the 21st instant, at the Institution of Civil Engineers, 25, Great George Street, Westminster, Dr. W. Marcet, F.R.S., president, in the chair.

Señor A. Arcimis, Mr. J. W. H. Gray, Dr. J. L. Green, Mr. R. T. Morgan, Mr. C. E. Mumford, Mr. E. L. Oxenham, F.R.G.S., Dr. A. M. Robertson, Dr. E. Seaton, Mr. J. N. Sidebotham, and Dr. T. C. Squance were elected Fellows of the Society.

The following papers were read :—

1. "Results of an Investigation of the Phenomena of English Thunderstorms during the years 1857—59," by Mr. G. J. Symons, F.R.S. This paper was written nearly 30 years ago; it has now been communicated to the Society at the request of the Thunderstorm Committee. The paper contains a summary, chiefly in statistical form, of some of the results of an investigation into English thunderstorms and the accidents produced by lightning during the years 1857—59. The author found that in sheet lightning the most prevalent colour is white, then yellow, blue, and red; in forked lightning the order is nearly reversed, blue being more than twice as frequent as any other colour, then red, white, and most rarely yellow. Sheet lightning was seen about twice as often as forked.

2. "Notes on the Meeting of the International Meteorological Committee at Zurich in September, 1888," by Mr. R. H. Scott, F.R.S. The Committee recommended certain rules for the publication of data by travellers, &c., so as to insure their being useful for the advancement of sound climatological knowledge. The proposals for an international cloud nomenclature, as recommended by Mr. Abercromby and Prof. Hildebrandsson, did not commend themselves to the Committee, who suggested that the subject should be further studied. At the conclusion of the meeting the Committee was dissolved.

3. "On a Method of Photographing Cirrus Clouds," by Dr. A. Riggenbach. The author exhibited some photographs of cirrus and other fine clouds, which had been obtained by using the surface of a lake as a polarising mirror.

Mr. A. C. Stratten exhibited some models of very large hailstones—of irregular shape, but about $2\frac{1}{2}$ inches in diameter—which fell at Montereau, about 40 miles south-east of Paris, on August 15th, 1888.

LIGHTNING AND ITS EFFECTS.

SIR,—The value of the paper on thunderstorms read at the late meeting of the Royal Meteorological Society, has not been in any way lessened by its being thirty years old, for there is now a slight revival of the study of static electricity, held in abeyance for more than this

time, by that of the more profitable dynamic system. This revival is partly attributable to the action of the "Lightning Rod" and now to that of the "Thunderstorms" Committees of the Society. Dr. Lodge has also given a valuable series of papers in *Nature* as well as in the *English Mechanic*, and other parties have sent communications to several scientific serials. There are, however, two points I should like to see more fully dealt with than has been the case, and which I think go a long way towards explaining results which are of so varied and mysterious a character—these points being (1) the upward current from the earth to the cloud; and (2) the great heat which accompanies the "lightning stroke."

In the first case, it is of course well known that in thunderstorms the earth, by induction from the cloud, is in an opposite state of electricity, and that an interchange of electric states (positive and negative) occurs between the clouds and the earth; therefore, there is as much cause for believing that a current proceeds as well in one direction as in another, yet in accounts of storms, the general inference is that the objects have been struck by the flash of lightning descending from the cloud, and hence the difficulty of explaining the results. If we take a few examples. In your September number, Mr. Tomlinson states that 120 sheep out of a flock of 140 were "struck by lightning" in Italy and killed. Is it not most probable that this flock with "its ascending column" of warm and damp air, formed the most convenient conductor at this place for the current from the earth, the catastrophe, of course, occurring with the lightning flash, or the commingling of the two electricities. We do not know how the boy with the kid was circumstanced, but probably sitting down with the kid in his lap, his clothes not of the cleanest, forming a better conductor than his body. The two horses also. Their iron shoes, accompanied by the column of moist air from their bodies, formed a better conductor, and from a larger space of ground than the man occupied. Again, when a tree is "struck," the roots, extending over a large area of ground, are the conductors for the electricity towards the trunk, and so the current passing through the branches to the extreme twigs and leaves forms attraction for the cloud to transmit its electricity to the earth, and thus a person standing beneath the tree forms a portion of the upward conductor, and so shares the result. I fancy, however, that if the person had gutta-percha soled boots, and stood on dry ground, the danger would be very much lessened, if not entirely removed. In many cases of buildings being struck, there is strong evidence of an upward current, and a gentleman told me recently that he was one evening watching a display of lightning among mountains on the coast of Africa, and saw many of the flashes ascending from the earth.

The other point on which I wish to remark is that of the heat, instantaneously developed by the current passing through bad or insufficient conductors, or, to speak in electrical language, "conduc

tors having considerable resistance." I conceive that we have very little idea of the intensity of this heat. We know that copper wires are not only fused, but deflagrated, and you cite cases of the effect on bodies of persons killed—one where it was burnt to a cinder, and two others nearly as bad. The disruptive effects must be in proportion to the amount of resistance to the current. Where this is great, the intense heat decomposes the constituent bodies, causing explosions of great force—*e.g.*, the sap in trees, the resin in pine-wood, carbon in the shape of soot, metals in various forms, the lime and moisture of mortar, and many other substances—so that the disruptions appear to me to be much more of a mechanical effect than of anything electrical, wrapped up, as it generally is, in so much mystery. Looking at some examples. The catastrophe at Crak Scar, Durham, as described by Sir W. W. Smyth (Quarterly Journal of the Royal Meteorological Society, July, 1888), is such as can be accounted for by this intense heat, causing the decomposition and explosion of the carbon (soot) and other substances in the chimney, as well as the mercury and tin on the mirror. The smoking chimney, well coated with carbon was a very tempting conductor for the exit of the upward current, as well as an attraction for the descending one; both of these must, in this case, have been of immense volume. In the case of an elm tree struck near Waterford in August, 1887, the bark was torn off from the root to the fork—20 ft. by 18 in. wide—and scattered about the field for over 50 yards. There were two deep pits blown up at the base, the whole evidently caused by the explosion of the sap. I could cite many other cases, but these are sufficient for my purpose. I think the cause of fulgurites is quite explicable by what I have herein stated.

In conclusion, I would ask, "What is a flash of lightning?" I take it that the flash, *per se*, is an *effect*, not a *cause*, and proceeds from the same cause as I have before stated, viz., the current, or currents, passing through our atmosphere, a medium of considerable electrical resistance, thereby developing heat sufficient to decompose on its path, the air and its contents, causing a vacuum, the collapse of which results in thunder.—Yours faithfully,

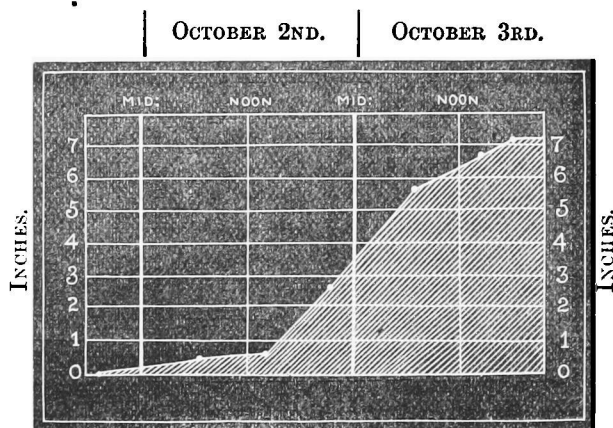
ROBT. J. LECKY.

3, Lorton-terrace, December 3, 1888.

GREAT RAIN AT GENEVA.

AN engraving will frequently convey to the mind a clearer conception of facts than can be obtained from numerical statements. The following little diagram is merely the graphic representation of the figures given on p. 146 of our last number, and yet we are sure that it will convey to all a more vivid idea of the persistent intensity of the rain than they previously had. It shows clearly that from the time (2 p.m. October 2nd) when the rain began in earnest, until the

same hour on the 3rd, soon after which it ceased, the fall must have been nearly uniform and at the rate of 1 inch in each four hours. This of course is far below the intensity usual in a severe English thunderstorm, when it sometimes rains ten or twenty times as heavily, but then it rarely lasts more than an hour or two. In the Geneva case it went on for 24 hours, and we should have great difficulty in finding a British record which would surpass it if duration and intensity are taken together.



THE BOLIDE OF NOVEMBER, 1887.

To the Editor of the Meteorological Magazine.

SIR,—Last January you were good enough to admit some observations, on the evidence then at hand of the phenomena attending the passage of this meteorite, which I submitted, with a view of shewing that the sound was due, not, necessarily at least, to explosion, but might be due to vibration only.

We have now had the advantage, thanks to Mr. Fordham's paper mentioned in this month's *Met. Mag.*, of seeing all the evidence that has since been so carefully collected and digested by him. He has undoubtedly made out a strong case in favour of the explosion theory—but I must say that, especially if we eliminate the cases where the sound is said to have been accompanied by distinct motion or earth tremor, the fact remains to which I adverted before, that the sound continued throughout a long line, but extended laterally over but a narrow belt; and that the area affected in the immediate neighbourhood of the supposed final explosion is really smaller than that 50 miles to the eastward—nor do I see any explanation suggested why if the final explosion took place, as Mr. Fordham thinks, in the Abingdon-Wantage district, the sound of it should have extended not more than ten miles westward, or why in that case the observer at Lambourn heard it in the N.W.

If any of your readers desire to pursue this subject, I would refer them to a valuable paper by M. Durand-Greville, in the *Revue Scientifique* of 21st April, of this year, on "Le bruit des projectiles à grande vitesse." The writer deals successively with the cases of a projectile whose speed is less than, equal to, and greater than, the speed of a sound-wave in the atmosphere—with the observer placed, first, approximately in the path of the projectile, and secondly at a distance therefrom. He demonstrates how in each case, though with variations proper to each, the simple result of the successive vibrations produced by the continuous whiz or rumbling of the projectile is, at any particular point, what he terms "une pseudo-explosion tout à fait violente et instantanée." He then discusses the case of a "bolide," which he assumes to have a speed greater than that of sound, and concludes that its sound whenever it reaches our ears does not produce on us the effect of a continuous noise, as it is in reality, but one "pseudo-explosion," apparently occurring at a point on the trajectory of the meteorite determinable and variable (according to rules which he explains) relatively to the distance of the observer from the trajectory and to the speed of the meteorite. "This does not mean," he goes on to explain, "that no bolide has ever exploded in our atmosphere; but observers have no doubt for the most part attributed to bolides an explosion which existed only in their imagination."

Mr. Fordham (p. 58) is inclined to minimise the evidence of tremor of the earth and of buildings, and to refer it to nervous excitement or imperfect observation. But I submit that the evidence on this point is too circumstantial to be thus rejected; and it seems to me that to admit it, does not at all displace his main conclusion. If it be true, as some have thought, that some seismic effects, when not attributable to volcanic causes, may be due to a temporary disturbance of magnetic equilibrium affecting the action of gravity upon the earth's crust, may it not be that the passage of a foreign body at a high speed, comparatively near the earth, and in a line almost exactly normal to the magnetic meridian should produce some such effect?

However this may be, the position of the places at which Mr. Fordham reports these effects to have been principally noticed is remarkable. These are Barrington, at the junction of the upper greensand with a chalk outlier; Ampthill (where doors are said to have jammed) on the lower greensand; Silsoe (two shocks) at the junction of the gault and lower greensand; Baldock, just on the edge of the chalk; Heyford, at the junction of the oolite and lias; Garsington (where clocks stopped), on the junction of the Kimmeridge and Oxford clays; and the far outlying Cubbington in Warwickshire, on the new red marl. On the contrary, places where it is expressly said that no tremor was felt were generally on the chalk, and at some distance from its escarpment. The sound heard so peculiarly at Welwyn Viaduct, may be due to the piers conducting the sound from the chalk beds deep below the surface.

These considerations will be appreciated by those who studied the "Report on the East Anglian Earthquake," in which the effect of geological structure on the transmission of a seismic wave is dealt with.

My view is that the phenomena of that morning were not limited to the passage of one meteorite, or even of two, of which also there is evidence.

One word more. Is it not possible that the incandescence of meteorites is to *some* extent referable to their sudden retardation by the earth's attraction when passing tangentially, the loss of motion being productive of heat?—Your obedient servant,

JAMES G. WOOD, M.A., F.G.S.

8, Lansdowne Crescent, W., Nov, 22, 1888.

Mr. W. White has kindly disinterred the following note from *British Rainfall*, 1868, where it has been buried for nearly 20 years. What with the meteor at Wantage, April 9th, 1628*, the under-mentioned one November 3rd, 1868, the one November 20th, 1887, reported upon by Mr. Fordham, and the sheep panic November 3rd, 1888, it really seems as if residents in that district in November have exceptional opportunities for meteorological research.—ED.

"November 3, 1868.—At 3.20 p.m., during bright sunshine, a meteor of considerable brilliancy was seen from London, Rugby, Birmingham, Chipping Norton, and Northampton. The following note from Col. Ward is of high interest in connection therewith:—"I was at Great Marlow that day. It was clear sunshine, with very heavy squalls of wind and rain at times. I was standing at a window of a friend's house, when I, with my friend and many others, heard a noise something between the report of a gun and the falling of some heavy substance on the roof. I said to my friend, 'Something has happened to the roof of your servants' apartments.' He went to see and came back shortly, saying that all was right. My carriage was at the door at the time, and both the coachman and footman looked up at the moment of the explosion and they remember the noise, but thought as I did, that something had fallen on the roof. The wind was apparently E.N.E. from where I stood, and it was exactly at 3.20 p.m. by my chronometer. Two days afterwards I was at a friend's near Gerrard's Cross, about ten miles N.E. of Marlow and not very far from Chalfont St. Giles, and he asked me if I had 'heard the earthquake' two days before. He said it was the general subject of conversation that day at the meet of the old Berkeley hounds close by, as everyone seemed to have heard it. I conclude this must have been the explosion of the meteor, visible in sunshine that day, and which was supposed to have burst over Banbury."—[From *British Rainfall*, 1868; pp. 65-6.]

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, MARCH, 1888.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	0.100	°	°	inches		0.10
England, London	55.4	10	24.7	2	45.0	33.7	33.9	84	92.8	17.7	3.34	20	8.5
Malta	81.6	27	42.1	1	64.4	50.4	48.5	77	132.3	36.5	.79	7	3.9
Cape of Good Hope. ...	97.2	13	51.9	...	79.4	59.2	...	...	...	...	.71	5	3.5
Mauritius.....	82.4	10	67.2	16	80.6	72.1	68.6	79	139.6	55.5	9.83	19	6.7
Calcutta.....	98.9	24	59.1	1	91.4	70.3	68.0	61	151.9	48.1	2.37	2	2.2
Bombay.....	95.6	21	71.8	8	86.8	75.0	71.5	74	145.0	60.2	.10	1	1.4
Ceylon, Colombo.....	92.2	23	72.6	3	89.5	74.6	71.4	73	145.0	65.7	1.65	13	3.1
Melbourne	94.0	28	42.0	22	69.2	51.7	50.4	71	139.8	33.1	2.16	11	6.5
Adelaide	96.8	28	46.5	19	77.9	57.5	48.9	50	146.7	36.1	.21	9	5.0
Wellington .....	...	...	...	...	...	...	...	...	...	...	...	...	...
Auckland	76.0	2	44.0	29	69.2	57.5	52.1	67	146.0	35.0	5.09	11	7.0
Falkland Isles.....	...	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston.....	89.8	10	61.1	6	86.7	66.5	67.4	70	...	...	0.28	...	...
Barbados	82.0	15	68.0	26	80.0	70.0	68.8	77	...	...	2.10	10	6.0
Toronto	48.3	20	— 1.2	5	29.5	15.1	19.6	88	...	—10.6	2.80	18	5.0
New Brunswick, Frederickton	48.8	22	2.0	2	35.4	19.7	23.5	71	...	...	2.60	18	6.9
Manitoba, Winnipeg ...	40.0	18	—25.9	22	17.8	— 6.5	5.5	88	...	...	1.09	15	5.0
British Columbia, Victoria	58.0	26	20.0	9	48.3	35.2	...	...	...	...	3.53	11	...

REMARKS, MARCH, 1888.

MALTA.—Mean temp. $56^{\circ}4$; mean hourly velocity of wind 10.3 miles. Sea temp. rose from $57^{\circ}5$ to $62^{\circ}5$. TS on 6th; H on 6th and 8th. Waterspout seen over the land on the 9th. J. SCOLES.

Mauritius.—Mean temp. of air $1^{\circ}9$ below, of dew point $1^{\circ}0$ below, and R 2.17 in. above, their respective averages. Mean hourly velocity of wind 10.3 miles, or 0.2 mile above average; extremes 25.5 miles on 14th and 30th, and 1.7 miles on 4th. Prevailing direction E.S.E. L on 8th and 9th. Signs of a cyclone having passed about 700 miles to E. on 27th. C. MELDRUM, F.R.S.

COLOMBO.—TSS occurred on 5 days, and L was seen on 9 other days.

J. C. H. CLARKE, Lt.-Col. R.A.

Melbourne.—Mean temp. of air $3^{\circ}7$, and of dew point $1^{\circ}7$ below average; humidity 3, amount of cloud 1.0, and R .05 in. above average. Prevailing winds W., S.W., and S., strong on 7 days. Heavy dews on 8 days. T and L on 4th. T on 15th. R. L. J. ELLERY, F.R.S.

Adelaide.—Weather unusually mild. Mean temp. $2^{\circ}8$ below the average of 31 years, only 4 days above 90° , and very few sudden changes. C. TODD.

Auckland.—Early part of month fine, middle and close wet and stormy, and unusually cold. Mean temp. nearly 3° below the average; R double the average. T. F. CHEESEMAN.

BARBADOS.—The mean temp. ($74^{\circ}3$), was the same as the average of 30 years. The wind averaged 10.2 miles per hour, being the same as the 15 years' average. The R was 10 per cent. above the 25 years' average. Nine days were more or less cloudy. R. BOWIE WALCOTT.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, APRIL, 1888.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	0-100	°	°	inches		0-10
England, London	64·8	30	27·7	6	52·4	37·1	37·0	78	111·1	20·1	2·37	13	7·0
Malta.....	82·9	7	49·9	15	70·0	55·7	51·7	71	131·4	42·1	·09	2	4·0
<i>Cape of Good Hope</i> ...	94·4	11	45·2	28	69·2	53·2	...	...	...	...	3·63	12	5·2
<i>Mauritius</i>	81·3	26	66·7	7	79·3	70·0	66·3	77	131·7	56·7	1·84	16	5·0
Calcutta.....	102·3	15	66·4	26	94·6	76·0	73·5	63	156·4	63·7	3·91	5	3·3
Bombay.....	91·4	13	75·0	1	88·9	78·2	74·0	74	145·2	64·8	·00	...	1·3
Ceylon, Colombo ...	91·6	1	72·0	23	88·5	75·8	73·6	79	147·5	69·6	28·78	21	5·5
<i>Melbourne</i>	88·9	6	34·8	24	70·1	47·4	46·3	66	136·5	28·4	·83	8	4·7
<i>Adelaide</i>	94·2	5	45·4	24	77·5	55·0	45·6	47	139·5	33·7	·09	5	2·3
<i>Wellington</i> .....	...	...	...	...	...	...	...	...	...	...	...	...	...
<i>Auckland</i>	73·0	13	43·0	26	65·3	52·2	50·3	74	130·0	36·0	·98	9	5·0
<i>Falkland Isles</i> .....	...	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston.....	93·0	5	62·6	7b	88·4	68·4	68·6	66	...	...	·86	...	...
Barbados	83·0	19a	69·0	1	81·0	72·0	71·9	79	...	...	6·46	15	7·0
Toronto	76·3	28	21·2	8	47·5	30·9	28·4	64	...	12·2	1·37	11	5·6
New Brunswick, Fredericton	71·8	28	9·7	8	46·2	26·1	24·8	59	...	...	·75	11	6·6
Manitoba, Winnipeg ..	73·0	25	— 0·7	6	43·4	21·6	25·8	72	...	...	1·30	10	5·6
British Columbia, Victoria	65·0	22	31·0	22	56·2	40·4	...	...	...	...	2·26	17	...

a And 20, 21. b And 8.

REMARKS, APRIL, 1888.

MALTA.—Mean temp. 61°·6; mean hourly velocity of wind 12·8 miles. Sea temp. ranged from 61°·3 to 63°·0. L on 15th. Temp. above 70°·0 on 14 days. J. SCOLES.

Mauritius.—Mean temp. of air 2°·0, of dew point 1°·6, and rainfall 2·88 in. below their respective averages. Mean hourly velocity of wind 11·8 miles, or 1·2 above average; extremes 24·8 on 11th and 1·9 on 30th; prevailing direction S.E. by E. to E.S.E. T on 19th. TL on 20th. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 0°·6, mean temp. of dew point 3°·2, humidity 7, mean amount of cloud 1·2, and R 1·44 in. below average; pressure 149 in. above average. Prevailing wind N. Heavy dew on 12 days. Fog on 6th. L on 8th and 9th. R. L. J. ELLERY, F.R.S.

Adelaide.—Mean pressure (30·256 in.) more than 100 in. above the average of 31 years, and the highest recorded. Mean daily range of temp. (22°·5) considerably in excess of the average, and the greatest since 1859. Mean amount of cloud and total R the lowest on record. Total R since Jan. 1, 734 in., far less than any previously recorded for the same period. C. TODD.

Auckland.—A fine and dry, but cool month. Mean temp. 3° below the average; R hardly more than a quarter of the average. T. F. CHEESEMAN.

BARBADOS.—Mean temp. 75°·8, same as 30 years' average; mean hourly velocity of wind 9·9 miles, same as 15 years' average; R 62 per cent. above the 25 years' average; 6 days more or less clouded. R. BOWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL,
 NOVEMBER, 1888.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
 see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain. in.	Div.	STATION.	Total Rain. in.
II.	Dorking, Abinger	4.74	XI.	Castle Malgwyn	8.27
„	Margate, Birchington... ..	3.55	„	Rhayader, Nantgwillt... ..	11.01
„	Littlehampton	4.14	„	Carno, Tybrith	7.46
„	Hailsham	4.27	„	Corwen, Rhug	5.17
„	Ryde, Thornbrough	5.01	„	Port Madoc	5.10
„	Alton, Ashdell	6.06	„	I. of Man, Douglas	6.11
III.	Oxford, Magdalen Col... ..	4.13	XII.	Stoneykirk, ArdwellHo.	3.67
„	Banbury, Bloxham	5.17	„	New Galloway, Glenlee	10.19
„	Northampton	3.20	„	Melrose, Abbey Gate	6.10
„	Cambridge, Beech Ho.	3.11	XIII.	N. Esk Res. [Penicuik]	8.60
„	Wisbech, Bank House.. ..	2.73	XIV.	Ballantrae, Glendrishaig	5.08
IV.	Southend	4.23	„	Glasgow, Queen's Park.	5.70
„	Harlow, Sheering	4.65	XV.	Islay, Gruinart School.. ..	4.37
„	Rendlesham Hall	3.65	XVI.	St. Andrews, PilmourCot	4.85
„	Diss	2.33	„	Balquhiddie, Stronvar... ..	13.88
„	Swaffham	2.75	„	Dunkeld, Inver Braan.. ..	8.30
V.	Salisbury, Alderbury	5.11	„	Dalnaspidal H.R.S.	10.12
„	Warminster	6.20	XVII.	Keith H.R.S.	3.43
„	Bishop's Cannings	5.16	„	Forres H.R.S.	2.85
„	Ashburton, Holne Vic... ..	14.74	XVIII.	Strome Ferry H.R.S.... ..	7.07
„	Hatherleigh, Winsford.	5.63	„	Fearn, Lower Pitkerrie.	2.64
„	Lynmouth, Glenthorne.	8.79	„	Loch Shiel, Glenaladale	12.78
„	Probus, Lamellyn	8.18	„	S. Uist, Ardkenneth ... ..	...
„	Launceston, S. Petherwin	7.00	„	Invergarry	9.37
„	Wincanton, Stowell Rec.	7.54	XIX.	Lairg H.R.S. ....	...
„	Taunton, Lydeard Ho... ..	7.22	„	Forsinard H.R.S. ....	...
„	Wells, Westbury	6.25	„	Watten H.R.S.	2.23
VI.	Bristol, Clifton	6.53	XX.	Dunmanway, Coolkelure	8.86
„	Ross	8.17	„	Fermoy, Gas Works	5.36
„	Wem, Clive Vicarage	4.29	„	Tipperary, Henry Street	5.60
„	Cheadle, The Heath Ho.	5.36	„	Limerick, Kilcornan	2.57
„	Worcester, Diglis Lock	5.64	„	Miltown Malbay..... ..	4.78
„	Coventry, Coundon	4.54	XXI.	Gorey, Courtown House	4.63
VII.	Melton, Coston	3.14	„	Navan, Balrath	4.83
„	Ketton Hall [Stamford]	3.24	„	Mullingar, Belvedere... ..	3.59
„	Horncastle, Bucknall	2.60	„	Athlone, Twyford	2.91
„	Mansfield, St. John's St.	4.29	„	Longford, Currygrane... ..	3.47
VIII.	Knutsford, Heathside	4.45	XXII.	Galway, Queen's Coll... ..	2.62
„	Walton-on-the-Hill... ..	4.57	„	Clifden, Kylemore	5.49
„	Lancaster, South Road.	4.97	„	Crossmolina, Enniscoe.. ..	4.64
„	Broughton-in-Furness	7.64	„	Collooney, Markree Obs.	3.32
IX.	Shipley, Esholt Vic. ....	...	XXIII.	Rockcorry..... ..	...
„	Ripon, Mickley	5.95	„	Warrenpoint	5.02
„	Scarborough, West Bank	3.53	„	Seaforde	5.96
„	East Layton [Darlington]	5.90	„	Belfast, New Barnsley	6.72
„	Middleton, Mickleton... ..	9.01	„	Cushendun	8.22
X.	Haltwhistle, Unthank... ..	6.10	„	Bushmills	5.41
„	Shap, Copy Hill	8.27	„	Stewartstown	3.33
XI.	Llanfrechfa Grange	8.75	„	Buncrana	3.70
„	Llandovery	8.02			

NOVEMBER, 1888.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which '01 or more fell.	TEMPERATURE				No. of Night below 32°.	
		Total Fall.	Differ- ence from average. 1870-9	Greatest Fall in 24 hours.		Max.		Min.					
				Dpth	Date.	Deg.		Date	Deg.	Date.			
											inches.	inches.	in.
I.	London (Camden Square) ...	4.38	+ 1.94	.91	2	20	59.9	16	34.6	28	0	3	
II.	Maidstone (Hunton Court)...	4.12	+ 1.22	.85	2	19	...	...	...	...	...	...
III.	Strathfield Turgiss	4.20	+ 1.45	.59	12	22	58.3	16	32.4	28	0	7	
III.	Hitchin	3.82	+ 1.21	.78	2	20	60.0	16	34.0	27	0	...	
IV.	Winslow (Addington)	4.79	+ 2.29	1.11	2	21	60.0	16	32.0	7, 28	2	5	
IV.	Bury St. Edmunds (Culford)	2.81	— .02	.48	26	14	...	...	...	...	...	...
V.	Norwich (Cossey)	2.50	— .81	.50	1	19	...	...	...	...	...	...
V.	Weymouth (Langton Herring)	7.99	...	1.88	12	25	58.0	16	34.0	7	0	...	
VI.	Barnstaple	5.63	+ 1.48	.93	29	20	59.0	16e	36.0	28	0	...	
VI.	Bodmin	9.21	+ 3.89	1.56	12	30	56.0	15	36.0	7	0	2	
VI.	Stroud (Upfield)	6.84	+ 3.90	1.35	12	23	58.0	15b	33.0	27	0	...	
VI.	Churchstretton (Woolstaston)	6.43	+ 2.99	1.18	12	27	57.0	15	30.5	7	3	5	
VII.	Tenbury (Orleton)	6.48	+ 3.62	1.35	12	24	60.2	16	29.0	28	1	4	
VII.	Leicester (Barkby)	3.28	+ .95	.42	2	23	61.0	16	29.0	27	1	5	
VII.	Boston	2.15	— .22	.52	1	16	60.0	16	30.0	28	1	...	
VII.	Hesley Hall [Tickhill]	3.67	...	.56	2	23	61.0	16	32.0	28	...	...
VIII.	Manchester (Ardwick)	4.73	+ 1.76	.68	23	23	56.0	15	35.0	8, 29	0	...	
IX.	Wetherby (Ribston Hall) ...	3.65	+ .89	.78	13	12	...	...	...	...	...	...
IX.	Skipton (Arneliffe)	11.05	+ 5.30	1.57	2	25	53.0	1	32.0	27	2	...	
X.	Hull (People's Park)	2.81	— .36	.52	27	21	...	...	...	...	...	...
X.	North Shields	3.01	— .44	.83	12	19	60.5	16	32.5	28	0	3	
XI.	Borrowdale (Seathwaite)	22.87	+ 11.65	3.57	23	24	...	...	...	...	...	...
XI.	Cardiff (Ely)	7.83	+ 3.63	1.14	12	27	...	...	...	...	...	...
XI.	Haverfordwest	9.53	+ 4.19	1.37	12	23	56.4	15	27.0	30	2	5	
XI.	Plinlimmon (Cwmsymlog) ...	6.13	...	.75	12	22	...	...	...	...	...	...
XI.	Llandudno	4.65	— .74	.66	2	25	62.0	16	35.0	28	0	...	
XII.	Cargen [Dumfries]	6.91	3.00	.86	12	18	55.0	15	27.6	29	4	...	
XII.	Jedburgh (Sunnyside)	4.26	+ 1.25	.73	27	21	57.0	14	28.0	28	6	...	
XIV.	Old Cumnock	7.27	+ 3.80	.95	23	20	55.0	15	25.0	28	5	...	
XV.	Lochgilphed (Kilmory)	7.84	+ 2.48	1.26	21	18	...	...	29.0	26	4	...
XV.	Oban (Craigvarren)	7.37	...	1.34	21	19	59.8	10	33.3	27	0	...	
XV.	Mull (Quinish)	5.33	...	.76	21	15	...	...	...	...	...	...
XVI.	Loch Leven Sluices	7.70	+ 4.15	1.20	24	21	...	...	...	...	...	...
XVI.	Dundee (Eastern Necropolis)	5.75	+ 2.62	1.00	12a	22	56.5	16	28.6	27	1	...	
XVII.	Braemar	6.45	+ 2.68	.86	21	25	53.0	16	20.8	27	5	14	
XVII.	Aberdeen .....	...	...	...	...	...	...	...	...	...	...	...
XVIII.	Lochbroom	7.64	...	2.09	21	14	...	...	...	...	...	...
XVIII.	Culloden	3.73	+ 1.03	.91	22	9	57.0	16	24.0	27	8	19	
XIX.	Dunrobin	4.41	...	.54	22	17	58.0	14	27.0	27	4	...
XIX.	Kirkwall (Swanbister) .....	...	...	...	...	...	...	...	...	...	...	...
XX.	Cork (Blackrock)	7.81	+ 3.20	1.15	29	23	58.0	13c	27.0	30	...	...
XX.	Dromore Castle	4.26	...	.90	9	17	55.0	4	33.0	26	0	...
XX.	Waterford (Brook Lodge) ...	5.32	...	.84	28	22	58.0	19	30.0	28	2	...
XX.	O'Briensbridge (Ross)	2.68	...	.43	10	20	56.0	11	31.0	30	...	...
XXI.	Carlow (Browne's Hill)	3.83	+ .91	.57	28	25	...	...	...	...	...	...
XXI.	Dublin (FitzWilliam Square)	6.55	+ 4.27	1.52	28	26	59.5	16	30.8	28	1	5	
XXII.	Ballinasloe	3.23	+ .23	.37	10	27	52.0	15d	24.0	28	6	...	
XXIII.	Waringstown	3.99	+ 1.28	.64	12	20	60.0	15	29.0	27	3	9	
XXIII.	Londonderry (Creggan Res.)	3.99	...	.68	23	22	...	...	...	...	...	...
XXIII.	Omagh (Edenfel)	3.75	+ .70	.85	10	26	55.0	23d	30.0	27	2	5	

a And 13. b And 16. c And 15, 20. d And 24. e And 17.

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

METEOROLOGICAL NOTES ON NOVEMBER, 1888.

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

ENGLAND.

STRATHFIELD TURGIS.—The month opened mild and rainy, with local fogs and with very welcome rain. In the middle the weather was very changeable, with low temperature and strong gales. At the close it was unseasonably mild with very considerable rainfall, so that low lands and the valley of the Loddon were in full flood. Primroses, daisies, and furze in flower and buttercups abundant.

HITCHEN.—The highest mean temp ever recorded in November ($46^{\circ}3$), and the first November in our record without a frost. Averaged temp. of November for 40 years, $37^{\circ}5$.

ADDINGTON.—The month was mild, wet, and windy, and very free from fogs. More rain fell, and there was less frost than in any November during the preceding 18 years. The temp. in shade did not fall below $32^{\circ}0$, and frosts on grass occurred only five times.

LANGTON HERRING.—The wettest month since November, 1877, when the rainfall was 8.02 in. The mean temp. was $48^{\circ}0$, or $4^{\circ}1$ above the average of November for 16 years, and excepting 1881, when it was $49^{\circ}7$, was the highest for 17 years. A heavy TS occurred about 5 p.m. on the 26th.

BODMIN.—A most genial month and the mildest November recorded. Mean temp. $47^{\circ}7$.

WOOLSTASTON.—A wild, wet, and stormy month, only three days on which no rain fell. Dense fogs with E. wind prevailed from 6th to 13th, and on the latter day the darkness at mid-day was intense. The latter part of the month was marked by a succession of gales and high winds. S fell on the 20th. Mean temp. $43^{\circ}7$.

ORLETON.—A very cloudy, warm, and rainy month, with a few bright days. R only once exceeded in November during 57 years, viz. in 1852, and mean temp. 5° higher than the average of 27 years. On the evening of the 12th R set in and continued about 27 hours, when 1.81 in. had fallen, producing great floods on the rivers Teme and Severn. After this the temp. was high for several days, the min. on 16th being $54^{\circ}5$, which was only equalled on five nights in July last. The wind was very rough at intervals and the weather very unsettled with a low bar. At 3 p.m. on the 23rd there was a well defined rainbow against a clear sky, with the exception of a few cirrus clouds.

BARKBY.—A mild month on the whole, with strong winds almost every day. Peas, violets, primroses, wallflowers, &c. in flower at end of the month. Mean temp. $45^{\circ}0$.

MANCHESTER.—A wet month; from 18th to 25th stormy and rough. On the 20th there was a severe TS and in the evening hail, wind and vivid lightning. Temp. unusually high; a little frost on ground on the 7th, 8th, 28th and 29th.

HULL.—The weather during the month was generally wet and mild, with a great amount of cloud and frequent strong winds.

SEATHWAITE.—Eleven days with more than an inch of R, and in the six days ending 24th 12.11 in.

WALES.

HAVERFORDWEST.—A stormy, very mild, and very wet month; the wettest November since 1852, when 10.36 in. of R was registered; only 7 days on which no R fell; only two frosty nights; the rest of the month remarkable for its high temperature. A sudden change of temp. occurred on 30th, when the thermometer in shade fell to 27° .

SCOTLAND.

CARGEN.—An unusually stormy month. An almost continuous succession of gales of wind, accompanied by heavy R, prevailed from 12th to 27th, the fall in that period being 6·50 in. Mean temp. $43^{\circ}\cdot4$, $2^{\circ}\cdot1$ above the average. Only 35 hours of sunshine occurred against 87, the mean for the month.

JEDBURGH.—The early part of the month was still and the corn and potatoe crops, though late, were well secured. There were many windy days, and the storm on the 16th was considered little less severe than the Tay Bridge storm; not much damage occurred, except upsetting of stacks and breaking of trees.

OBAN.—One-third of the month at the commencement was very fine, the remainder was remarkable for violent gales and heavy rain, that of the 20th being quite a hurricane. The temp. was high throughout.

LOCHBROOM.—There was no rain until the 13th, then for 14 days it rained incessantly, with high winds at times of hurricane force. The R of the 21st produced one of the highest floods remembered.

IRELAND.

CORK.—With the exception of a few fine days, it was very wet, damp, and raw, with two stormy nights.

DROMORE.—The month was rather wild and stormy, but not at all cold.

DUBLIN.—This was the wettest and most stormy November for 25 years. There was scarcely any frost and severe TS occurred on two occasions. Anti-cyclonic weather prevailed until 15th, but strong S.E. and S.W. winds and gales occurred in the latter half. Mean temp. 3° above the average.

EDENFEL.—A month of almost continuous gales and rains, with high mean temp.

AN IMPROVEMENT IN ANEMOMETERS.

To the Editor of the Meteorological Magazine.

SIR,—We have just read the letter upon the above subject in your last number. Mr. Russell's improvement appears to consist in multiplying the contacts so as to diminish the time between each, and in employing an astronomical chronograph to record the rapid succession thus established.

We have already constructed some anemometers on this principle, in which the contacts were so placed that a contact was made for each metre of wind that passed, and even some with one contact for each half metre. These are so combined with a system which divides the number of contacts by the time in which they are recorded, that the trace on the paper shows *the true speed of the wind during each second*.

The motive power is not obtained from Robinson's cups, but from a windmill fan made of aluminium, so as to have the minimum of momentum and friction, and it will turn with 0·20 metre per second (less than half a mile an hour), which Robinson's cups cannot do. But Robinson's cups could easily be attached in place of our fans if it is desired, to determine the correction requiring to be applied to them on account of their inertia.—Your obedient servants,

RICHARD FRÈRES.

Impasse Fessard, 8, Paris, November 20th.