SYMONS'S

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TEMPERATURE OF THE EARTH AT GREAT DEPTHS.

IN our last we gave the geological details of the Kentish Town Well, and its history up to the date of the issue of the fiat of abandonment by the Hampstead Waterworks Company. The next stage was the annihilation of the company, and the cession of their property to the New River Company, who, we believe, left matters *in statu quo* for many years, and eventually, about a year or so since, sold the building and plant for old materials. The builder who purchased the old bricks pulled the building down with more regard to economy than to the integrity of the lining of the well, which was broken through in two or three places to a depth of seven or eight feet, and covered only by a series of loose planks.

This was the state of affairs when Mr. Symons applied to Mr. Muir, the engineer of the New River Company, for permission to conduct a series of thermometric experiments at the abandoned site. Full and unrestricted leave having been granted in the most liberal manner, Mr. Symons made a careful examination of the condition of the well, and in addition to the details above-mentioned, ascertained that the bore tube was safely plugged and locked, *and* 10 *ft. below the level of the ground.* It was therefore inaccessible except by being lowered by ropes, and the plug was then found to be immoveable by any force which could be applied to it; besides the danger of this procedure, and the difficulty of guiding the thermometers down the tube, the desirability of shutting out as far as practicable the effects of atmospheric variations, the necessity for some protection to the instruments and to the observer, combined to render it evident that a roof and a floor must be provided.

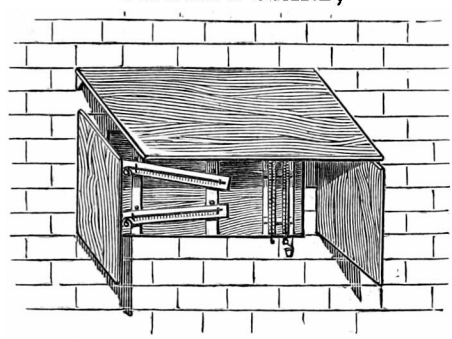
The frontispiece to this number gives a general idea of the arrangements which have been made—except that it does not show what is

beneath the floor from which the artist took his sketch, and what, as regards safety, is the keystone of the whole, namely, a set of extra-strong joists. The first process was to swing a stage 15 ft. down the well by ropes, then to cut notches in the brick lining for the joists, and lay down the floor (A), of course removing the temporary stage when done with; the broken walls were also repaired, and a wooden cabin built over the whole. After the framework of the cabin had been erected, it was found that what appeared to be solid earth, was in reality only consolidated rubbish, resting on the brick ledge (B), and when (B) was cleared out, a large opening remained; a sloping roof was therefore put over it, as Mr. Symons deems it very important to exclude external air as much as possible. The floor was fitted closely round the bore tube (C), and the wood has swelled so much with the damp that it is almost air-tight. Steps (D) lead to the door of the cabin (E). A small portion of the flooring (G) is removable as a trap-door, and affords access to the well. Crossing the cabin from one side to the other, is a stout beam (H), which carries pulleys leading the lowering cords (Q) over the trap and tube respectively. On (B) is the windlass, represented also on a larger scale, where (I) is the handle, (J) a fly-wheel, (K) iron drums, (wood was first used, but the string swelling by the moisture broke them), one carrying 600 ft. and the other 1300 ft. of stout string—by a very simple arrangement either of these drums can be disconnected and used independently; (L) is a registering apparatus showing, irrespective of any variation in the length of the cord consequent upon damp or continued strain, the exact depth at which the thermometers are; the design is very simple, merely a wheel whose circumference is 3 ft., round part of whose periphery the string passes with such tension as to ensure its revolution; the number of revolutions, *i.e.*, of yards, is by means of an endless screw and cog wheels, recorded on the two dials marked (M). The stand (N) which carries this apparatus is firmly fixed to the brickwork (B); (O) is a board carrying registering thermometers for the temperature of the observing room. A small arrangement is now in progress for measuring the variations in the depth of water in the well, but there *seem* to be some loose timbers floating in it which are much in the way; as the water is several hundred feet below the floor, it will not be very easy to remove them. About 90 ft. west of the well a rain gauge has been placed, and is observed in connexion with the water percolating the sides of the well and with the depth of water in it; (Q) are the strings for lowering the thermometers; (R) represents two ready for lowering, but concerning them more in our next.

THERMOMETER STANDS.

OWING to unforeseen difficulties in the engraving department, we are not able to describe so many of the stands this month as we had intended, but as even one is better than none, we annex a description of

MORRIS'S STAND,



which we have so termed because the best description of it that we have ever seen is given in his little manual*, in the following words :—

"*The best position for the Thermometers.*—The shaded maximum and minimum thermometers, for finding the daily mean temperature, and the wet and dry bulbs, (hygrometer) should occupy the same spot, about four or five feet above the ground, and facing due north. The north side of a high strong wall, running east and west, will be a good position. First of all a broad wooden board should be firmly secured to the stone or brick wall as a kind of lining to the wall, and having small projecting screws, on which to hang the instruments. Next, to keep off rain, a kind of roof should be placed a foot or more above the intstruments slanting outwards and downwards from the wall. Then again projecting sides of wood should be placed east and west to keep off the rising and setting summer's sun, and they should be bored with a dozen holes or more, of half an inch diameter, for the passage of air. The whole of this wooden enclosure should be very firm, so as to prevent vibration in stormy weather, and at the same time so contrived that there may be *free ventilation*. It will preserve the wood, and be less unsightly, if the whole is painted white. A small button of wood is also desirable to press the lower part of each instrument to the wooden frame at its back; this will prevent any shifting of the maximum and minimum in windy weather."

The engraving represents the sides without the holes, but fixed a little way from the board and roof, thus ensuring ample ventilation.

To the Editor of the Meteorological Magazine.

SIR,—I am glad to see the remarks of your correspondent, Mr. B. W. Smith on the high maxima recorded at Greenwich. On comparing them with the maxima I have observed here, it has occurred to me, as a possible solution on some occasions, that they may be due to an accidental omission on the part of the assistants to adjust the stand according to the position of the sun. *E. g.*, taking the month of July, on the 3rd the Greenwich maximum was 84°·3, here it was 78°, and at Kew it was 77°·3; and the mean of all the maxima for July at Greenwich was 82°, while here it was 79°·5.

* A Treatise on Meteorology, by A. J. T. Morris. Edinburgh, 1866.

The following is a comparison of the maxima for July, August, and September, at Greenwich, here, and at Kew :—

	Greenwich.	Upper Tooting.	Kew.
July.....	96·6	93·0	90·2
August	90·5	87·5	85·4
September ...	92·1	91·0	86·4

My instruments are placed in a double-louvred box, constructed after Mr. Thomas Stevenson's design, on a lawn. In comparing observations with those at Kew, it must be remembered that the large box, in which the instruments are placed there, is on the northern side of the observatory, and is to some extent sheltered by it from the direct rays of the sun.

It is, I think, a question whether the max. so ascertained represents quite fairly and impartially the true max. temperature of the air. Perhaps you will favour your readers with your opinion?—Yours,

D. A. FREEMAN.

Upper Tooting, S. W., Dec. 19th, 1868.

[We have not at present made any comments on the various forms of stand, thinking it best not to do so until all had been described, and we retain that opinion. We are obliged by the various letters with which our correspondents have favoured us, and we hope to have many more. We hope that the arrangement of the experiments undertaken by Rev. C. H. Griffith will be sharply criticized when at length we have described all the stands and given a *resumé* of the whole. We take, however, this opportunity of stating that we cannot think the assistants who are constantly passing and in view of the Greenwich stand could ever omit to turn it.—ED.]

A POPULAR VIEW OF METEOROLOGY.

THERE is one thing that clamours for attention, and will be listened to : it is the weather. The procession of cloud and storm from the Atlantic for the last week has been so long, and the pace so terrible, that one wonders where it all comes from, and where the tail of the column is. Overhead, the whole sky is in perceptible motion, even to the distant horizon, where the motion must be much to show. Underfoot, where the soil is absorbent it is saturated ; where not it is deluged. You walk either on a sponge or in a pool. Our towns, indeed, can never be too much washed, and this is a time to test and to scour all our costly novelties in draining. But even the metropolis now seems drenched almost to excess. The only people who must feel a sort of moody satisfaction in this sort of weather are they who have seen too many Christmas Days, and have lost all relish for them. To many, of course, the season must be one for sorrowful recollections. The familiar faces of former days may not even be replaced by familiar faces of a newer date. These people are, however, generally kind enough not to interfere with the attempts of their juniors, or their more fortunate contemporaries, to get a little gleam of happiness out

of the occasion. There are some otherwise and most exceptionally disposed. They confess to having found the season an illusion and an imposture. It is to them an effort and an affectation. They would like to see it stamped out, washed away, and forgotten. Could wind and rain blow Christmas to the North Pole, or drown it in the German Ocean, they would have no objection to this sort of weather till next June. Already they have the comfort of seeing some of our traditionary notions found at fault. Christmas has forgotten his throne of frost and robe of snow, his beard of icicles, and his crown of bright and wintry stars. Even his holly has lost much of its charm, when the fields are as green and the birds are as vocal as in May.

Winter, however, is the season for winds; and winds, we know, cannot come long from one quarter without giving way to a counter current from another. Our meteorologists, we apprehend, would have no great difficulty in making out. by such records as they possess, that the present fashion of winter is not so new as might seem. We must have set up a tradition somewhat at variance with historical fact, or, what comes to the same result, we must have constructed an idea of mid-winter by a select and partial induction, taking only into account winters of exceptional severity. Last winter, for example, was a very severe one, so far as regards the degree and the continuance of the cold, and already it has put almost out of remembrance the very different character of the winter before. But what is science about that it cannot form any system, or establish a single principle, or give us the slightest trustworthy prognostication as to weather? Beyond a safe belief in cycles, a dependence on averages, and certain utterly unverified ideas of lunar influence, there has been no addition made to the science of weather, and it is as far from being a science at all as in the days of our painted predecessors in this island. We can discover all about planets thousands of millions of miles off, and utterly beyond our unassisted vision, but we cannot even guess the history and movements of the blast which makes sport of us, our houses, and our property. It is fair to admit that great efforts are made, and materials are collected that may, or may not, be turned to good purpose by future meteorologists. But even the path of tropical cyclones and the course of the rotating storms that have devastated our temperate clime have not been laid down with any certainty, or in such a way as to yield any warnings of their recurrence. It frequently happens that a good and well-appointed ship leaves a port with a valuable cargo, many passengers, a first-rate captain, and a picked crew, only to be driven back, within twenty-four hours, with much damage, loss, and delay, unless, indeed, it come to worse disaster; whereas it is evident that this need not be the case if we knew anything about the weather in a scientific way.

Well, there is one consolation in this. It gives us something to be found out. This is no mere corner of physical creation; it is no collection of microscopic facts, with an interest only to the curious, or to the purely scientific, or to the philosophers bent on discovering

some new law of life and being. Here is one of the grandest, most important, most present, and most urgent of subjects waiting, not analysis, but some slight impression on its huge bulk. If the light of science could but illumine a fringe of this great cloud, that would at least prove wind and rain to be amenable to scientific investigation. Can it be said that we know anything whatever of the elements upon whose apparent caprice depend our harvests, our commerce, our communications with our distant neighbours, and our comfort day by day? The importance of such a knowledge is so great that a man possessing it would be able to levy a tax on the whole human race, for there is not a people that is not deeply interested in knowing what weather to expect, and that would not be ready to pay high for the knowledge. For example, in our country, in the year now drawing to its close (1868), many agriculturists accumulated, at great cost, live stock, which the drought compelled them to sell for just what they could get; and many had to sow their fields three or four times over before the descending rain would assist the seed to germinate. A forecast of weather is everything to a farmer, and in this respect he finds his case the same as that of the sailor and the merchant. They are all in the same boat and under the same sky, and whoever shall be able to assist one will do the same for the other. We don't seem to be even approaching the first stage of a science that shall produce this all-important knowledge, and he will be a great discoverer and an earth's benefactor who plants his foot on its very threshold.—*The Times, December*, 1868.

MONTHLY CHRONICLE—DECEMBER.

On 6th and 7th violent gales.

8th.—Shock of earthquake at Gibraltar.

10th.—At Prospect Hill Park, Reading, the nest of a bottle-tit was found with six freshly-laid eggs in it. At Nettlebed, Oxfordshire, a luxuriant crop of field beans might be seen, about 18 inches high, and with many plants in flower; they had shelled out plentifully during the gathering of the previous crop in August. In South Wales, the fields and woods were adorned with daisies and other wild flowers in full bloom.

12th.—A very remarkable phenomenon was experienced in the neighbourhood of Neath. During the whole of the day there was an incessant fall of drizzling rain, which terminated between 9 and 10 o'clock, and the night seemed inclined to be fair, but about 10·30 all of a sudden a tremendous gale sprung up, with torrents of rain coming from the south-west, threatening with destruction all buildings facing it, and alarming many of the inhabitants to a great degree. The most remarkable fact is, that during the whole of the storm, which lasted from ten to fifteen minutes, it was accompanied by a peculiar *continuous* roaring and rumbling sound as of distant thunder. Two or three flashes of lightning of a vivid redness were also observed during the gale. The storm in the above time, abated as suddenly as it commenced, and immediately afterwards all appeared a perfect calm.

13th and 14th—Heavy gale on the Devon and Cornish coasts.

16th.—Continuous heavy rain produced serious floods in Cornwall.

"TERRIBLE DEATH FROM LIGHTNING.—The whole of South Wales was visited on the afternoon of the 16th by a thunderstorm of great severity, and among the hilly districts, especially Merthyr, was its force most heavily felt. The lightning was extremely vivid, and one flash followed another from about two until four, with but brief intervals. At Cefn-coed-y-cymmer, a village near Merthyr, a woman and two donkeys were killed by the electric fluid. The deceased woman, whose name was Elizabeth Harris, went on to the mountain to pick up sandstones, taking with her the donkeys to bring them back. She was on the mountain during the whole of the terrific storm, and not returning in proper time her neighbours became alarmed and went in search of her. Her body was found about eight o'clock, and a short distance off were those of the two animals, all dead. The bodies presented a shocking appearance, and were completely blackened."—*Standard.*

Serious floods in many parts of Ireland.

"TERRIFIC STORM.—On Saturday morning, 19th December, the town of Towyn, on the Welsh coast, was visited by a tremendous storm of hail, accompanied by vivid flashes of lightning and heavy peals of thunder—a very unusual thing at this time of year. It commenced about half-past 11 and lasted ten minutes. About two miles from the town, on a farm called Braichyrhiw, seven sheep were killed by the electric fluid, and a woman who was crossing the same field was blind for a considerable time. The hailstones were as large as marbles. Had it not been calm at the time a quantity of glass must have been broken."—*Times.*

21st.—Severe storm at Wick, seriously injuring the harbour works. Short but violent thunderstorms at Stockton-on-Tees in the afternoon.

23rd.—Large tracts of land in the Thames valley flooded, especially round Oxford and Eton.

24th.—Barometer in London at 2.30 p.m. down to 28·699 in., reduced to sea level. In 1859, on 26th of December, it fell to 28·629 in., at 6 a.m., and on the 11th of February, 1866, at 4.30 p.m., to 28·606 in.; these are the only other readings below 28·7 in. during at least 10 years. At Nottingham it fell to 28·609 in. at 2 p.m.

26th.—Slight thunderstorm in Liverpool at 4·15 p.m. Storm, with sleet and vivid lightning at Nottingham at 6 p.m. Gale at night.

"SERIOUS LIGHTNING ACCIDENT.—A shocking accident is reported to have occurred at a farmhouse at Up-hill, near Weston-super-Mare, on Wednesday, during the prevalence of a very severe storm. A young lady named Harse was standing in front of a looking-glass, when a vivid flash of lightning first played upon the glass and then struck the unfortunate lady. The effect of the stroke was to blacken and completely paralyse one half of Miss Harse's body. Dr. Martin, of Weston, was sent for, and under his treatment the sufferer is said to be progressing towards recovery. After striking Miss Harse, the flash appears to have travelled through the house, smashing glass and doing other damage in a most extraordinary manner."

27th.—Violent gale, especially in Lancashire.

"A CLERGYMAN IN A TYPHOON.—The Rev. W. Barclay, a Church of England clergyman, chaplain to the Cheddar Valley and Yatton Railway labourers, narrates in a Bristol paper an extraordinary storm which he encountered last Sunday in the Mendip Hills. The rev. gentleman prefaces his story with the remark that if he had heard it a week ago of anybody else he would not have believed it. Here is the tale, just as Mr. Barclay tells it:—'I halted a moment to draw my plaid more tightly round my shoulders, and then went forwards, after

casting a glance towards Shut Shelf and its clump of pines. Flying across them in my direction (due south) came a ribbony cloud, seemingly about 200 feet long, and the same height above the trees. It was coming, javelin-fashion, full at my back, yet gyrating like a misty corkscrew. I took no particular notice of it, as the flying mists play strange pranks in these hills, and plodded on towards Axbridge, thinking over my sermon. Suddenly a rush and roar of wind arose from behind me. I was struck in the back with a sensation as if two or three stout cudgels had been simultaneously laid across me; was shot forward at the top of my speed like a stone from a catapult; ran, or rather flew, in this fashion for about 100 yards, during the last twenty of which my feet scarcely touched the ground; and was finally hurled to the earth with great violence, and rolled over half-a-dozen times by the same overmastering typhoon! In a second or two it had passed, and I sat up in terrified bewilderment. I found myself on some newly-laid stones, stunned, bruised, and bleeding, my coat sleeves torn to shreds, and myself be-plastered from top to toe with mud. My hat was fast disappearing in the remote distance. One of a pair of gloves which I was carrying in my left hand had flown no one knows where; the other I had stuck to, but it was mangled out of all decency by the stones over which I had been rolled. I staggered on to my legs, dazed, giddy, and deadly sick, as the first heavy fall had been flat on to my stomach. I felt my right elbow, which I feared was out, but there was no displacement. Then the fingers of my left hand, about which I was by no means so sure; then picked up my scattered senses, and went on to Axbridge, picking up also my hat about half a mile from the scene of the catastrophe, bedaubed with mud inside and out. I went into a good Samaritan's, hard by the mission room, where they helped me off with my damaged coat, pared the mud from the rest of my garments, washed my bruises, and lent me another coat, in which to officiate. I just managed to get through the service, and played the harmonium with the blood oozing from my knuckles; then 'went to surgery,' and was properly looked after; sent a message to Cheddar to stop my distant evening service; and after some food, and lying down for an hour, got home before dusk in considerable pain and soreness, but very thankful that I had had no limbs broken.'"

28th.—Thunderstorm at Sydenham at 3.30 p.m. Large dish of mushrooms gathered from fields at Otford, in Sussex.

MAGNETIC VARIATION.

To the Editor of the Meteorological Magazine.

SIR,—Your notices of suitable thermometer stands are most useful. Mine have hitherto hung at the end of a wall (on a board nailed to the wall, but kept off from it 1½ inches by blocks) facing north, the wall being 16 ft. long, and at right angles to the wall of the house; but I fear in summer at 9 a.m. my indications are too high, and the minimum too high as well. I mean to adopt a stand, but I write this chiefly to ask you to give in your next paper the deviation of the compass in three or four different parts of England, to enable parties to set their instruments right. Some years ago the magnetic north was 22½ degrees W. of true north for the south of England. I do not know now what it is, but you may be acquainted with some of the Greenwich Observatory people, who could tell you.—Yours, &c.,

F. J. MITCHELL.

Llanfrechfa Grange, Caerleon, Mon., 24th December, 1868.

[The above request is so reasonable, and one so often made, that we have been at some pains to satisfy it. We believe no data of the kind have been collected or published by the Greenwich authorities, whose

observations are exclusively made at the Royal Observatory, and the only recent tables known to us are in the *Report of the British Association*, 1861, and are reduced to January 1st, 1857. The twelve years which have since elapsed have caused such material changes, that we have roughly corrected the 1857 values to *approximate* ones for January 1, 1869. According to them the line of 20° now passes from Worthing to Cromer; that of 21° from Portland to Hull; that of 22 from Falmouth to Hartlepool, and that of 23° from Pembroke to Alnwick; but probably the most handy mode of giving the values is the tabular form below.

We by no means pledge ourselves to the accuracy of the following table, but believe it is in no case more than 1° in error, and rarely so much, and that that is sufficiently correct for all ordinary purposes.

Approximate Westerly Declination of the Magnetic Needle in 1869.

Latitude.	Longitude.								Latitude.
	5° W.	4° W.	3° W.	2° W.	1° W.	0	1° E.	2° E.	
55° N.	25°	24°	24°	23°	22°	..	...	...	55° N.
54	24	24	23	22	22	21°	...	...	54
53	24	23	22	22	21	21	20°	20°	53
52	23	23	22	21	21	20	20	...	52
51	23	22	21	21	21	20	20	...	51
50	22	22	21	21	20	20	19	...	50

The table gives the degrees of westerly declination at 40 places in and near England and Wales, the places being the intersections of the lines of each degree of latitude and longitude. The table, therefore, reads thus—in latitude 55° N. and longitude 5° W., the declination is now 25° W. The mode of using the table is very simple; suppose that at Birmingham, lat. 52°30 N. long. 2° W., a true meridian line has to be set out, inspection of the table immediately shows that in long. 2° W., and lat. 53°, the declination is 22°, and in lat. 52° it is 21°, and therefore in lat. 52° 30′ it is about 21½°, and the needle at Birmingham points between 21° and 22° W. of true north.—Ed.]

REVIEWS.

On the Meteorology of Port Louis in the Island of Mauritius, by Charles Meldrum, M.A. [From the Report of the British Association, 1867.] 8vo, 42 pages.

Professor Meldrum prefaces his paper with a very clear and appropriate description of the physical characteristics of Mauritius, an isle some 40 miles by 30, of volcanic origin, with a table land about 1000 feet high in the interior, and with chains of mountains running up to 3000 feet, with their lower slopes covered almost to the sea-shore with sugar plantations.

"For beauty and variety of scenery, for bold mountains, generally clothed half-way up their steep sides with evergreen trees and shrubs, and rearing their heads against skies of softest blue, for rugged precipices, fantastic knolls, peaks, and ridges, for tangled forests, deep ravines and caverns, picturesque waterfalls, shady groves and rich fertile plains and valleys, this little island is perhaps unsurpassed."

Professor Meldrum groups his notes on the observations 1860-66, under twelve heads, which we will rapidly notice. I. *Temperature.* The coldest hour of the day is 6 a.m., and its temperature 75° 6, the hottest hour 1 p.m., and its temperature 79°·4. The mean daily temperature is 77°·1 from the hourly observations, and 77°·8 from the self-registering thermometers, from which we also learn that the *daily* range averages only 6°·7 ; the monthly range is 9°·7, the hottest month (January) being 81°·7, and the coldest (July) 72°·0. The hottest *day* is about February 4th, and the coldest August 7th. The highest temperature in the seven years was 90°·0 on February 4th, 1865, and the lowest 62°·8 on the 29th of August, 1866. A vacuum black bulb thermometer, 40 feet above the ground, averaged 117°·6 in January, and 101°·2 in July, being probably *below* what it would read in this country. II. *Elastic force of vapour.* Harmonizes exactly with temperature curve. III. *Humidity.* The air is driest (63·6) at 1 p.m. and most humid about 3 a.m. (69·9.) During seven years the air was never saturated, the nearest approach being on August 21st, 1860, when it was 96·7, and driest on June 10th, 1861, when it was 46·3. IV. *Atmospheric Pressure.* Barometer reaches its first daily max. at 9 a.m. of 30·090, falls to 30·017 by 3 p.m., rises to 30·086 by 10 p.m., and again falls to 30·037 by 4 a.m. The mean reading of the barometer reduced to sea level is 30·089 in., and its range 1·391 in. V. *Pressure of Dry Air.*

"The phenomenon of the double maximum and minimum exhibited by the diurnal march of the total atmospheric pressure has received from M. Dové, and after him, from General Sabine, Sir John Herschell, and others, an explanation founded on the supposed effect of one of the constituents of the total pressure, namely, the aqueous pressure. Assuming that observations of the wet and dry thermometers enable us to determine the whole pressure of vapour in the atmosphere, and finding in many instances that when the vapour pressure thus obtained is deducted from the total pressure, the march of the residual dry pressure presents a single progression, having one maximum and one minimum corresponding with the hottest and coldest hours. It has been inferred that the double maximum and minimum of the total pressure is owing to the march of the vapour pressure being contrary to that of the gaseous pressure, an increase of temperature causing an increase of vapour pressure but a decrease of dry pressure, and vice versa."

Professor Meldrum examines his observations when cleared of the Elastic Force, and continues—

"We are thus led to conclude that if the observations of the dry and wet bulb thermometers afford the means of determining the vapour pressure, the gaseous pressure at Mauritius has a progression in every respect similar to that of the total atmospheric pressure, and, therefore, that the phenomenon in question cannot be accounted for by the direct action of the vapour pressure.

"A similar progression of the dry pressure at Bombay has been referred to the relations which arise from the juxtaposition of land and sea causing land and sea breezes. At Mauritius, surrounded on all sides by the Indian Ocean, the double progression of the dry pressure occurs in all kinds of weather, and from whatever quarter the wind may come, and is most marked on those days when the trade wind blows steadily, and hence it is presumable that it occurs at sea, away from the influence of land."

VI. *Direction of Wind.*—Situated in the south-east trades, it is almost superfluous to note that more than two-thirds of the observa-

tions are between E. and S.E. The wind almost always veers (or, as we should say in this northern hemisphere, retrogrades) with the sun from S.E., through E. to N., N.W., &c. It rarely veers in the other direction, except when a hurricane is passing on the E. of the island.

VII. *Force of Wind.*—The observations indicate that the greatest force occurs at the warmest hours, and that the pressure varies as the temperature. The greatest pressure observed was 40lbs. on February 15th, 1861.

VIII. *Cloud.*—The nights and mornings are comparatively cloudless; towards 10 a.m. the clouds gather; by 2 p.m. it is often wholly overcast, and in the evening clears again. The mean amount is 4·7, *i.e.*, rather less cloud than in this country.

IX. *Rainfall.*—The rainfall in Mauritius appears to be tropically irregular, although rarely tropical in amount. The gauge at Port Louis is unfortunately 40 ft. above the ground, and therefore no guide to the true fall at that station. When will observatories learn to observe the rainfall as well and as carefully as private individuals? Professor Meldrum has organized a corps of observers all over the island, about 30 in number, and half their returns are more trustworthy than their chief's; we sincerely hope that when the Professor returns to his island home he will take care that none of his subsidiary observers shall be better provided with apparatus than himself; but he really must start a gauge somewhat less than 20 in. by 10 in., and not quite 40 ft. above the ground. We said the rainfall was tropical in its irregularity—the mean fall by this 40 ft. gauge at Port Louis was 37·87 in.; the maximum 68·76 in. in 1861, and the minimum 20·56 in. in 1866, that is to say, the mean being 100, the max. is 182, and the min. 54, a variation about 10 per cent. greater than in this country. It is, however, in the monthly falls that the peculiarities become evident. In one month, February, 1861, 46·57 in. was registered at Port Louis, being more than the average yearly fall, and more than fell in the whole of the two years, 1864 and 1866. At another station, Vacoas, 13 miles S. of Port Louis, 99 inches fell in that month. Professor Meldrum discusses with much skill the returns from his numerous stations, but as no map is given in the report, we cannot reproduce it, and it is not easy to convey ideas of geographical distribution unless the positions of the stations are clearly impressed on the reader's mind. Suffice it therefore for the present to say that the effects of elevation, aspect and configuration of country, appear almost identical with those known to prevail in the British Isles, and the annual quantities also resemble those we have here, the highest being 192 inches, and the lowest 21 in.

X. *Thunder and Lightning.*—Thunderstorms are most prevalent in afternoons in January, February, March, and April.

XI. *Hurricanes.* — The "Mauritius" hurricanes have long been celebrated for their violence, and the details on this head are so ample as to be almost overwhelming, but one fact crops out and claims notice, namely, that the greatest pressure ever recorded is only 40 lbs., whereas

we have recently been told that a pressure of 80lbs. occurred near Liverpool on the 27th of December, 1868. We have therefore had twice the strength of a Mauritius hurricane on our own shores without knowing it.

XII. *Synopsis of results.*—A brief summary of the leading facts of this able paper, which terminates with a series of 42 tables of rainfall, temperature, pressure, &c.

Handy Book of Meteorology, by ALEXANDER BUCHAN, M.A., Secretary of the Scottish Meteorological Society. Second edition. W. Blackwood and Sons. Small 8vo, x-371 pages, 8 charts, and 58 woodcuts.

EIGHTEEN months ago we awarded almost unqualified praise to the first edition of Mr. Buchan's book. The public have apparently formed a similar estimate of its merits, since a second edition has for some months been waiting notice. Mr. Buchan has long been known as a hard worker, he is rapidly rising to a first rank among meteorologists, and therefore when he publishes a second edition of a work intended for popular use, and sure of a large circulation, we should neglect our duty if we did not note all its errors with unsparing severity. But Mr. Buchan has corrected the few slight ones we pointed out in the first edition, and left us hardly anything to complain of. We must enter a protest against the following paragraph concerning rain gauges :—

"There being often great difficulty or trouble experienced in replacing the glass measure when it chances to get broken, the late G. V. Jagga Rao, a wealthy zemindar of Vizagapatam, proposed a gauge in the form of a funnel having a diameter of 4·697 inches, or a receiving area of 17·33 square inches. Now, since a fluid ounce contains 1·733 cubic inches of water, it follows that for every fluid ounce collected by this gauge the tenth of an inch of rain has fallen. The measure can of course be graduated to any degree of nicety, and it can easily be reproduced if required. It is also the cheapest rain gauge, costing only 7s. 6d. when made of copper, and 4s. 6d. when made of tin."

Some years since Messrs. Knight, of Foster Lane, London, made a number of rain gauges 5·05 inches in diameter, because the area was then exactly 20 square inches; after the lapse of years the glasses got broken, and in several instances the observers asked for new ones "for a 5 inch gauge;" they obtained that for which they applied, and all their subsequent observations were 2 per cent in excess of the truth. The same error will arise with those above-mentioned, and the mischief will be greater though not so widespread; greater because the error will be 13 per cent. instead of 2 per cent., and not so widespread, because fewer persons will mistake 4·7 for 5, than 5·05 for 5. But why incur the risk at all? If ordinary medicine glasses were always correct, and decimally divided, there would be something to recommend Jagga Rao's gauge, but as they are not, and the makers of the gauge supply a divided glass closely resembling those sent with 5 inch gauges, it does not seem intended that medicine glasses should be used. We therefore think it a pity to mention it without reprobation. The idea *seems* good, but we have no doubt will lead to harm.

The parts of the book which seem to require most attention in the next edition are those on Thunderstorms and on Meteors and Shooting Stars.

In all other branches of meteorology Mr. Buchan's book not only retains its previously high position, but in several respects materially surpasses it. The chapter on, and charts of, barometric pressure all over the world are perhaps the most important contributions to the science since the publication of the kindred work by Dové "*On the Distribution of Heat, &c.*" and though not so likely to be popular, we shall not be surprised if Buchan's "Isobars" are not really more important than Dové's "Isotherms." It is impossible, without reproducing the beautiful maps, to convey an idea of the course of these lines, but we cannot refrain from pointing out the wide range in the mean annual pressure at the level of the sea, which varies from 30·2 inches near the Equator to 29·4 inches in the Arctic and Antarctic circles, thus corroborating Maury's views. High praise must also be accorded to the chapter on temperature in its relation to atmospheric pressure, wherein several recent hot and cold periods are demonstrated to be solely due to unusual air currents resulting from abnormal distributions of atmospheric pressure. There is one statement in a capital chapter on the temperature of the sea, which is so remarkable that we do not like to comment upon it, but would rather reproduce it, and enquire if similar results have been elsewhere or at any other time obtained?

"When Her Majesty's ship Nile was going from Halifax to Bermuda, in May, 1861, Admiral Sir Alexander Milne found the temperature 70° at the bow, while it was only 40° at the stern, as he entered the Gulf Stream, thus showing a difference of 30° of temperature within the short distance of a ship's length."

The following is a fair specimen of Mr. Buchan's style, and with it we must conclude our notice of his able, interesting, and instructive book:—

"In the schools of the United States of America, meteorological observations, and the keeping of meteorological registers, form a part of the common education of the people. Also in the higher schools of France, and some other European countries, systematic instruction is communicated on this subject. But in this country few even of the liberally educated classes are able to read from a vernier; they are ignorant of the use of the moveable cistern of a barometer; they have not the elementary knowledge to give an intelligible interpretation to the fluctuations of the barometer as indicative of coming changes of the weather; and when required to send their barometers to a distance for repair, so ignorant are they of their construction, that they forward them by rail as ordinary parcels, thus almost to a certainty securing their destruction. This state of things is the necessary consequence of the general neglect which meteorology receives in our educational system. There are, however, a few noteworthy exceptions. Meteorology has been taught for upwards of thirty years in the Dollar Institution, which has long been distinguished for the lead it has taken in incorporating science into its curriculum of study. This example has recently been followed by the Roman Catholic College at Stonyhurst, the Grammar School of Aberdeen, the High School of Inverness, Lerwick Educational Institute, Elgin Institution, Larchfield Academy, and other schools in the country. But the objects of meteorology can never hold that place in the public mind to which they are entitled, till the science becomes, as in America, a recognised branch of education."

DECEMBER, 1868.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	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° on grass
			inches	inches.	in.							
I.	ENGLAND.	Camden Town	5·12	+ 3·62	·53	31	27	58·2	6	31·5	30	1
II.		Staplehurst (Linton Park)	5·78	+ 3·95	·62	16	22	55·0	5	29·0	12	4
,,		Selborne (The Wakes)	8·54	+ 5·79	·74	15	27	64·5	6	28·0	20	3
III.		Hitchen	3·97	+ 2·66	·52	29	27	56·0	6	29·0	31	2
,,		Banbury	5·34	+ 3·67	·55	14	29	56·0	6	30·0	30	5
IV.		Bury St. Edmunds (Culford)	4·04	+ 2·55	·62	29	21	56·0	6	25·0	31	4
V.		Bridport	6·88	+ 3·51	·64	26	27	57·0	6	25·0	31	2
,,		Barnstaple	6·78	+ 3·66	·80	27	31	59·5	7	37·5	30	0
,,		Bodmin	9·56	+ 4·32	1·03	2	30	58·0	6	37·0	30†	0
VI.		Cirencester	6·70	+ 4·41	·75	21	27	...	...	...	...	...
,,		Shifnall (Haughton Hall)	5·52	+ 3·84	·58	28	29	54·0	6, 21	26·0	31	4
,,		Tenbury (Orleton)	6·65	+ 4·19	·67	6	31	57·5	6	29·5	12	4
VII.		Leicester (Wigston)	4·95	+ 3·43	·47	28	26	55·0	11	22·0	31	7
,,		Boston	5·59	+ 4·10	·58	28	28	56·4	6	31·1	30	1
,,		Gainsborough	...	..	...	...	...	...	...	...	...	...
,,		Derby	6·88	+ 5·33	·79	8, 28	27	56·0	22	32·0	30	0
VIII.		Manchester	8·12	+ 5·79	·73	7	29	55·3	4, 5	31·0	12	2
IX.		York	5·95	+ 4·15	·78	6	29	53·0	4, 11	25·0	30	4
,,		Skipton (Arncliffe)	12·24	+ 7·69	1·22	26	27	54·0	5	33·0	30	...
X.		North Shields	3·59	+ 1·39	·43	20	25	57·0	4	29·0	3	3
,,		Borrowdale (Seathwaite)	...	...	...	...	..	...	...	...	..	...
XI.	WALES.	Cardiff (Town Hall)	7·95	...	1·13	26	29	...	...	...	...	...
,,		Haverfordwest	10·48	+ 5·65	·96	26	26	56·0	10	26·5	31	3
,,		Rhayader (Cefnfaes)	7·77	+ 4·48	1·02	26	27	55·0	...	25·0	...	..
,,		Llandudno	8·22	+ 6·02	1·20	6	29	62·6	9	33·0	12	...
XII.	SCOTLAND.	Dumfries	7·05	+ 3·59	·70	21	27	54·0	10	29·0	12	...
,,		Hawick (Silverbut Hall)	5·68	...	·66	4*	25	...	...	...	...	...
XIV.		Ayr (Auchendrane House)	7·09	+ 2·91	·94	21	24	58·0	16	21·0	12	10
XV.		Castle Toward	7·47	+ 2·12	1·04	21	25	54·0	6	23·0	31	11
XVI.		Leven (Nookton)	4·71	+ 1·93	·85	10	19	53·0	4	24·0	30	4
,,		Stirling (Deanston)	6·81	+ 2·61	·89	21	27	55·5	10	21·0	12	14
,,		Logierait	6·27	...	·96	14	20	...	...	...	...	...
XVII.		Ballater	6·10	...	1·21	14	18	54·0	10	21·0	25	13
,,		Aberdeen	5·72	...	·95	13	25	56·1	10	27·2	12	17
XVIII		Inverness (Culloden)	2·15	...	1·02	11	12	54·9	10	27·4	31	4
,,		Fort William	11·39	...	1·99	10	22	...	...	...	...	...
,,		Portree	15·04	...	1·95	10	21	...	...	...	..	...
,,		Loch Broom	4·63	...	1·00	26	22	...	...	...	...	...
XIX.		Helmsdale	3·01	...	·43	10	22	...	...	...	...	...
,,		Sandwick	5·15	+ 1·18	1·15	9	21	55·4	11	28·9	31	3
XX.	IRELAND.	Cork	9·99	...	1·31	2	29	...	...	...	...	...
,,		Waterford	9·81	+ 5·39	1·12	20	29	58·0	3	34·0	31	...
,,		Killaloe	6·67	+ 3·18	·61	20	27	54·0	10	28·0	31	6
XXI.		Portarlington	5·10	+ 1·90	·69	21	31	56·0	4	30·5	30	2
,,		Monkstown	6·20	+ 3·58	·64	2	24	60·0	10	28·0	30	2
XXII.		Galway	6·49	...	·61	3	29	52·0	18	31·0	29†	2
,,		Bunninadden (Doo Castle)	7·81	...	1·00	17	21	54·0	10	16·0	28	6
XXIII		Bawnboy (Owendoon)	7·73	...	·75	21	27	56·0	10	28·0	18§	3
,,		Waringstown	4·55	...	·53	20	24	57·0	10	26·0	11‖	6
,,		Strabane (Leckpatrick)	4·77	..	·65	9	24	56·0	10	23·0	20	10

* And 14th & 21st. † And 31st. § And 29th & 31st. ‖ And 29th.

\+ 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; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STAPLEHURST—A mild, wet month; bar. very unsteady, fluctuating over an inch in 24 hours on 8th and 9th; frequent high winds; floods, but not high ones, in the river nearly the whole month; T on the 24th. Scarcely any frosts, and the fields as green and the birds singing as if it were April; many tender plants, as geraniums, &c., are still fresh in the garden; the mildness of the past month presenting a greater excess above the average than even last July.

SELBORNE.—The mildest December I have ever recorded, and the most tempestuous; prevailing winds S.W., with very little exception; T on 15th, 22nd, 24th and 28th; 16th, H at 9 a.m., ther. fell suddenly from 45° to 41°; thrush in full song on the 4th. L on 24th.

HITCHEN.—The lowest reading of the bar. I ever observed, on the 24th, and the greatest number of days on which R fell, I have ever recorded.

BANBURY.—Very wet month, with high winds and low bar.; draba verna in blossom on the last day; L on 9th, T S on 14th and 24th. Bar. 28·525 at sea level at 3 p.m. on 24th.

CULFORD.—A month of mild weather for the season, with much R; bar. extremely low nearly all the month, but rose rapidly during the last two days; average temp. more than two and a half degrees higher than the preceding month (November); on the 18th loud T and vivid L were heard and seen here, and was the more noticed from it being so late in the year. T on 24th.

BRIDPORT.—Very mild but stormy month, only four days on which R was not registered, and the greatest monthly fall registered here for 12 years except September, 1866, when 7·39 inches fell; heavy S.W. gales on 6th and 14th, and westerly gales on 27th and 28th; L on 14th, 16th, and 27th. Crocuses in flower in the garden.

BODMIN.—Singular oscillations of the bar., and the chart quite a curiosity.

CIRENCESTER.—The wettest December I have ever registered (24 years), 4·25 more than the average, it has brought up the annual fall to more than the average. The R of this month has been accompanied by T and L but not distinct storms, under the scud might often be seen electrical forms of cloud. The water in my deep well (100 ft.) in the upper oolite has, on the 31st, 44 ft. of water in depth, having risen from 6 ft. 7 in. in October.

HAUGHTON HALL.—Only two days without R, by far the wettest December ever experienced here, for 36 years at least, (my registering commencing in 1835,) the nearest approach was in 1860, when 3·69 fell; the temp. too has been high, no day the max. of which was below 40°. Much L on night of 14th, with heavy T S in the west of the county, the same with much R and sleet at 6 p m. on 26th; the old adage is fully confirmed this year—

"No one so surely pays his debt,
As wet to dry and dry to wet."

Gales on 4th, 6th, and 21st; severe storm on 27th from W., slight S with R on 28th from W.; throstle singing on the 20th; snowdrops up and whiten, 19th; peas and beans up for next year's crop on 15th.

ORLETON.—A very warm and rainy month; temp. about 5° higher than the average, and the fall of R greater than any December for 38 years, the nearest approach being 5·53 in December, 1860; R fell on every day except the 31st, when there was a heavy dew; distant T heard on 28th, and L seen at night on 7th 14th, and 26th; S on the Clee hills on the 28th, 29th, and 30th; River Teme very high all the month, frequently level full; great winds on the 4th, 5th, 10th, 14th, 16th, and 27th, greatest force from 1 to 4 p.m. on the 27th. Bar. 28·55 on 24th.

WIGSTON.—The rainfall this month has been more than double the average of the month, notwithstanding this and the large fall in August, the mean average

of the year is about three inches under that of the last 30 years. The temp. has been considerably higher than the average mean of the month, and vegetation has assumed more the aspect of April than December.

BOSTON.—A very wet and stormy month with high temp. ; bar. very unsteady, fluctuating very much, and falling to 28·300 on the afternoon of the 24th during a heavy gale. The fen districts of Lincolnshire have suffered severely from the sudden storms and heavy rainfall, thousands of acres were completely under water, and the Witham nearly overflowed its banks ; S on 28th, 29th, and 31st ; roses and pinks were in flower in the open air on the 15th, and strawberries were gathered in a garden at Louth.

ARNCLIFFE.—An unusually wet month ; it is remarkable that the ther. has never been below 32° during this month, and in fact has been nearly all the month wonderfully high ; a heavy fall of S on the 30th.

WALES.

HAVERFORDWEST.—A month of violent storms with constant and very heavy rains, the temp. high throughout ; polyanthuses in flower so late as the 22nd ; bar. very low all the month, but lowest on the morning of the 24th 28·625 (corrected) 50 ft. above sea level. General direction of wind, W., S.W., and N.W., five days it was E.S.E. T and L on 14th ; tremendous gales on 14th, 16th, 17th, 23rd to 25th, 27th, and 28th, accompanied by heavy H storms ; on the 30th the Precelly range covered with S ; the wettest December of the last 20 years, and the most stormy.

CEFNFAES.—A wet and stormy month, much R with a little S occasionally ; frequent H storms with T and L ; wind high and boisterous, chiefly N.W. and S.W.

LLANDUDNO.—The wettest month in my experience of Llandudno, now more than 10 years ; S on 20th ; T, L, and H at 4.15 p.m., 26th.

SCOTLAND.

DUMFRIES.—Only four days during the month on which no R fell ; the wettest December since 1852 ; mean temp. 3°·33 higher than the corresponding month of last year ; bar. unusually low, being 28·14 on 27th. T on 14th ; S on 27th.

HAWICK.—The heaviest rainfall of any December since 1856 ; heavy gales on 23rd, 24th and 27th. The unseasonable mildness was very unfavorable to health ; cutaneous diseases very prevalent. The last three days frosty, with a little S.

AUCHENDRANE.—Bar. and temp. below the average ; winds chiefly equatorial, and in mean force much less than the December means ; gales have occurred on the 10th, 14th, and 21st, with heavy R 24th and 27th, but several of the severe storms were not felt in this locality ; the river has been in constant flood, and the monthly height of water on the gauges is 20, the standard being 9.

CASTLE TOWARD.—A mild, wet, month ; heavy gales on 10th and 16th ; 27th and 28th, slight fall of S and a heavy fall on the hills ; T and L on the 30th ; snowdrops beginning to flower.

DEANSTON.—Great part of the month very dark and wet, but very mild for the season ; gales on the nights of the 4th and 10th ; very little sunshine during the month ; no S till the 26th and then one shower only, but the hills very white ; half-an-inch of S on 27th ; bar. 28·20 on 27th.

LOGIERAIT.—A remarkably wet month ; keen frost after the 29th, and ground white with S.

BALLATER.—1·15 in. of rain in six hours on 21st ; very changeable, with large rainfall ; bar. remarkably low, 28·43 at sea level on 27th.

ABERDEEN.—Auroræ 10th, 16th, and 17th. Mild, but wet, tempestuous month, with very unsteady bar., which was above 30 in. only on one day ; the reading on the 27th (28·19 in.) was the lowest on record at Aberdeen ; L on 12th.

CULLODEN.—A little S on 11th ; fog on 16th and 19th ; strong gale on 14th.

FORT WILLIAM.—A very wet month ; nearly 2 in. fell on the 10th ; 1 in. had fallen on the previous day.

PORTREE.—Very stormy, cold, and wet month, with frequent T and L, snow, sleet, and heavy hail showers. Sheep stock keeping healthy and strong.

SANDWICK.—December has been wetter and colder than the mean, with a remarkably low bar., it having reached 30 in. only on the morning of the 9th, while it was below 29 in. on 8 mornings and 11 nights, but the weather was fine during most of that time, on the 4th at night it fell to 28·650, and on 27th at noon to 28·280 ; a gale of 50 miles an hour on the 21st, from noon till 9 p.m., and another of 40 to 45 miles an hour from 9 p.m. on 27th to 4 a.m. on 28th ; first S on 28th ; auroræ on 11th and 17th.

IRELAND.

KILLALOE.—Frequent violent storms ; much sheet L on different nights ; remarkable oscillation of the bar. ; seldom two fine days together.

GALWAY.—Storms prevalent during the month ; T on evening of 28th.

DOO CASTLE.—Wet month ; coughs and colds very prevalent ; no farming operations ; gales on the nights of 10th and 27th.

OWENDOON.—The floods in this neighbourhood have been very high.

WARINGSTOWN.—The whole month wet, stormy, and gloomy, with very little interruption.

LECKPATRICK.—Very stormy month ; temp. high ; shrubs showing early starting of buds ; wasps seen the day before Christmas day flying about in full activity. December two and a half degrees warmer than November, consequently there are grounds for expecting the winter to be mild. Bar. fell to 28·432 on 27th in the morning. The following are the lowest readings of the barometer for six years—

1863, Jan. 8th.....28·548.	1866, March 23rd.....28·572
1864, Nov. 14th ...28·469.	1867, Jan. 8th .....28·548
1865, Jan. 13th ...28·321.	1868, Dec. 27th ... ..28·432

EARTHQUAKE OF OCTOBER, 1868.

To the Editor of the Meteorological Magazine.

SIR,—I have just seen your earthquake map and notice of the October shock. Compared with the shake, lift, and crash of 1863, this last movement was a mere nothing. I was in the dark at the time, and consequently could not mark the exact moment of the shock, but that moment was certainly between 10·35 and 10·38 p.m.

Yours faithfully, EDWIN J. ISBELL.

3, *Richmond Place, Hereford, Nov.* 1868.

To the Editor of the Meteorological Magazine.

SIR,—I am not aware whether there has been an earthquake felt in other parts of England, but at any rate we have had a slight shock here. At 10.40 p.m., October 30th, my house was manifestly shaken, causing the floors of up-stairs rooms to vibrate as if persons had rushed hastily over them, and causing jugs, water-bottles, &c., to jingle ; this was the effect up-stairs. I remarked a dull, heavy noise down-stairs, as if a heavy weight had fallen on one of the up stairs floors, but not the one over-head. I hear that this slight shock was remarked by others, and that it was also observed at Instow and Barnstaple. The last time we had an earthquake it fell much more heavily on the Exmoor range, and on the other side of the estuary of our two rivers.

I. H. GOSSETT.

Northam Vicarage, Bideford, N. Devon, Nov. 2, 1868.

To the Editor of the Meteorological Magazine.

SIR,—You ask for particulars of the earthquake on 30th October,

I was sitting alone reading, night very still. I first heard a curious movement of the shutters, a sort of straining of the whole house, which passed off in a few seconds, with a rattling of some glass shades on a marble table. I was in an up-stairs room; walls of house very thick and strong; floors rather springy; I immediately conjectured the cause, and looked at the time, which was as near as possible 10.35 p.m. I had felt the earthquake of 1863, and this did not seem to be so violent.

I am certain of the time to within one or two minutes of Greenwich time.—I am, Sir, yours obediently,

WHITEHALL DOD.

Llanneroh, St. Asaph, January 5th, 1869.

POSITION FOR SOLAR RADIATION THERMOMETERS.

To the Editor of the Meteorological Magazine.

SIR,—I feel I ought to redeem the promise I made of sending you some account of my investigations on this subject. I obtained at the end of August from Mr. Casella half-a-dozen solar thermometers *in vacuo*, having the bulbs and one inch of the stems covered with lamp black. Having carefully compared their readings in steady sunshine, and obtained, by taking the mean of 40 observations, corrections by which I might reduce their readings to the same standard, I set to work on the 1st September, in the most favourable weather. To the external glass jacket of each of these solar thermometers I attached a small unblacked mercurial maximum thermometer, the bulb of which being scarcely, if at all, more absorptive of solar heat than transparent glass, might be expected to furnish a tolerably accurate indication of the temperature of the glass with which it was in contact. Five of the instruments were then placed thus :—(1) on cut lawn grass; (2) on the surface of a painted black board placed on the ground; (3) on a similar board, sheltered by being sunk four inches below the level of the grass; (4) on a similar board raised 3 ft. above the ground; (5) freely suspended in the air at 4 ft., near my shade thermometers.

The following are the means of 28 observations made between the 4th and 13th September, and of the daily maxima throughout the month, respectively :—

	(1)	(2)	(3)	(4)	(5)	(Air at 4 ft.)
4th to 13th	133·9	129·0	132·5	125·0	119·2	74·1
Month	127·2	122·7	125·5	—	116·8	68·8

It was found that, though in each position a different reading of the black bulb *in vacuo* was obtained, the difference between that reading and that of the attached unblacked thermometer was the same, viz., about 41° or 42° on an average, in all positions. Difference of position, therefore, does not affect the excess of the temperature of the black bulb over that of the outer jacket, an excess which is caused by the direct rays of the sun, and the amount of which is a test of their intensity. Were the temperature of the glass jacket the same as that

of the air, this excess would be the exact measure of solar radiation. But the rays of the sun are partially absorbed by the glass, which thus becomes heated above the temperature of the air to a small extent, even when the instrument is suspended in the air; and when the instrument is placed on the ground, the heat of which, as well as of the air next to it, is much greater, there is in addition a large and fluctuating quantity, which enters into the temperature registered. An example will best show my meaning. On the 7th September the black bulb *in vacuo* read on the grass 147°, and at 4 ft. 132°, the shade maximum being 87°. The 132° was made up somehow thus: 87° (shade temperature), + 5° (excess of glass above air temperature), + 40° (excess of black bulb over glass jacket.) In the 147° there was the same 87° + 40° + 5°, but in addition there was an excess of temperature on the ground above that at 4 ft., which raised the temperature of the glass jacket, and therefore also of the bulb inside, 15° more. Out of the 132° only 5° were liable to be affected by wind, &c., whereas of the 147° no less than 20° were fluctuating and uncertain, dependent on the heat and dryness of the ground, and the varying condition of vegetation. At all events, on the 29th, a bright and windy day after rain, although solar radiation was equally powerful, the 20° was diminished to 6°, while at 4 ft. the 5° were diminished only to 3°·2. It is fair, then, to conclude, that if we wish to make exact comparative observations of solar radiation alone, it is best to place the black bulb *in vacuo* at 4 ft., exposed to a free circulation of air; but for those who desire to find the heat received by vegetation, of course the grass is the place. Both are important objects, but the former is that which I particularly wish to investigate. Let everyone choose for themselves. I shall be very glad, if I can induce a few observers to join with me, in making daily observations at 4 ft. with comparable instruments. By these means we shall soon know a great deal more about the comparative power of the sun's rays at different places and times than is known at present.

I will only add, that I think it desirable to place the instruments so that the bulbs are directed, not towards the midday sun, but to the S.E. or S.W. Perhaps S. 50° E. is the best direction. Whether owing to the thickness of the external glass near the end of the instrument, or from some other cause, I have found that when the bulb was directed towards the sun, the temperature of the black bulb thermometer fell 2° or 3°; but when turned away from it through any angle not less than 20° or more than 100°, a uniform result was obtained.—I am, Sir, your obedient servant,

F. W. STOW.

Tunbridge Wells, December 24th, 1868.

[Uniformity is of such high moment that we shall gladly do all in our power to assist; we would suggest that those who are able and willing to fulfil the above conditions should communicate with the Rev. F. W. Stow forthwith, and we shall gladly insert the results.—ED.]

RAINFALL REGISTRATION.

WHAT IS TO BE DONE WITH 1000TH OF AN INCH OF RAIN?

To the Editor of the Meteorological Magazine.

SIR,—At the risk of appearing to be pertinacious, I would once more refer to the solution of the above question; first of all, however, premising that if you assure me that the majority of observers follow the plan recommended to Mr. Griffith in your November number, I will give up my private fancies, and most scrupulously return ·007 of dew to the gauge, to be evaporated and thus disappear from the register altogether, or as the case may be, to be increased by ·003 on the following night, and then enter it on my register as ·01, and add that day to my list of days on which ·01 of an inch of rain has fallen.

If, however, you think that observers differ in their practice (and I have reason to believe that they do), I would suggest, as a third method, one which is the basis of all observations in almost every other department of science—viz., that any amount below ·005 should be thrown away and not entered at all, and that ·005 and over should be entered as ·01. From the tenor of your concluding remarks, I infer that this system would be in considerable favour with yourself. Whichever plan is adopted, the variations in the totals will be very small, but for uniformity's sake, it were well if all observers would follow the same method.—Yours truly, J. M. DU PORT.

Mattishall, Norfolk, Dec. 26th, 1868.

SIR,—It appears to me that the correct way of measuring small quantities of rain is to register it as ·01 inch whenever it exceeds ·005; for as every one registers the rainfall to the *nearest* hundredth of an inch, unless it is under ·01, why should there be any exception in this case? When the fall is less than ·005, I would suggest that it be returned to the gauge, to increase the next measurement. The plan you recommend, and which is consequently adopted, causes the curious anomaly, that if ·009 falls one day and ·007 the next, the first is recorded as ·00, but the latter (there then being ·016 in the gauge) as ·02.

As to the question of *how many* days a measurable amount of rain falls on, it is quite an independent one.—Yours truly,

T. W. BACKHOUSE.

Sunderland, Dec. 26th, 1868.

SIR,—I am much amused at Mr. J. M. Du Port's anxiety about registering thousandths of an inch of rain. There can be no doubt that we are quite low enough in the 0·01, and that your present system cannot be improved on.—Yours, J. LIDDELL, Com. R.N.

[We shall be glad to know if any of our readers have any objection to Mr. Du Port's suggestion, if not we have none.—ED.]

END OF VOL. III.

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