

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

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COMPARATIVE OBSERVATIONS OF SOLAR RADIATION.

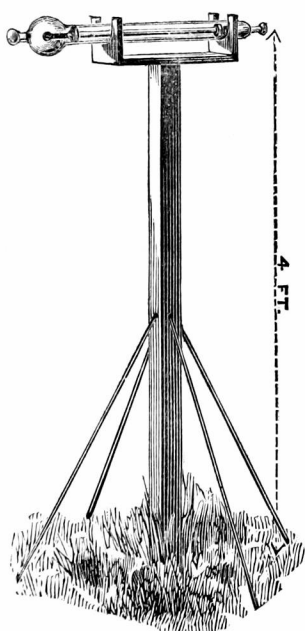


Fig. 1.

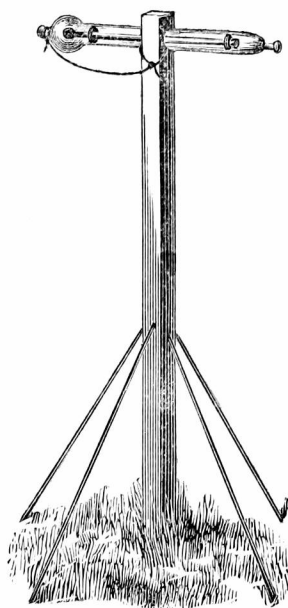


Fig. 2.

MR. STOW has become so thoroughly identified with accurate determination of the amount of solar radiation ; and absolute uniformity in constructing, mounting, and using all instruments is so desirable that we cordially welcome the following memorandum :—

SUGGESTIONS FOR OBSERVERS.

1.—Use a sensitive maximum thermometer *in vacuo*, which has the bulb and about one inch of the *stem* blackened with lamp black.

2.—A thermometer blackened only on the bulb will give readings dependent in some measure on the size of its bulb, and should,

therefore, be compared in full sunshine with one in which the lamp black is extended to the stem, and the difference of reading noted. If this difference be large, it will vary to an appreciable extent with the amount of radiation, and it will be difficult to apply any certain correction to the readings of the instrument, but if the difference be small (say less than 5°) it may be applied as a correction to the observed readings, which will then be fairly comparable with observations elsewhere.

3.—Place the instrument 4 feet above the ground, in an open space, with its bulb directed towards the S.E. It is necessary that the globular part of the external glass should not be placed in contact with, or very near to, any substance, but that the air should circulate round it freely.

4.—One of the most convenient ways of fixing the instrument will be to allow its stem to fit into, and rest upon, two little wooden collars fastened across the ends of a narrow slip of board, which is nailed in its centre upon a post steadied by lateral supports.

5.—The maximum temperature of the air in shade should be taken by a thermometer placed on a stand in an open situation. Any stand, which thoroughly screens it from the sun, and exposes it to a free circulation of air, will do for the purpose.

6.—The difference between the maxima in sun and shade thus taken is the amount of solar radiation.

7.—Those who wish to take observations on this plan are requested to communicate with the Rev. F. W. Stow, M.A., Hawsker, near Whitby, and to send him, from time to time, a copy of their observations on a printed form which he will supply.

As a sketch is generally more instructive than a verbal description, we annex one of the mounting proposed by Mr. Stow, and another of a plan which has been adopted by several observers; it has the apparent advantage of leaving the bulb less encumbered by wood, and the loop of string prevents the possibility of its being tipped over or carried away by a gale of wind. The thermometer in this case rests freely in a hole drilled through the upper part of a stout post; to set the instrument, draw the bulb towards the post, that enables the loop to be lifted off the terminal boss, and the instrument is free. We do not believe there would be the slightest difference of reading between the two plans; it is rather a question of safety and convenience; and we are sure all will bow to Mr. Stow's decision whether fig. 1 or fig. 2 is to be the standard pattern.

We are glad to find that the observers at Holloway, Camden Square, Worthing, Strathfield Turgiss, Wisbeach, Bristol, Malvern, Derby, Huddersfield, Ripon, Whitby, and Tipperary have already commenced observations such as are described in the above suggestions. We hope others will follow their example, not only in this country but abroad.

TYNESIDE NATURALISTS' REPORT.

To the Editor of the Meteorological Magazine.

SIR,—I beg to thank you for your able and careful review of the "Meteorological Report of the Tyneside Naturalist Field Club," in your number for July, 1869.

I am really glad that you have not been able to discover more errors than those which you have pointed out. The report was drawn up amidst the incessant pressure of very onerous duties, and, for the most part, in moments snatched as best they could be from my more regular work.

The arithmetical errors, enumerated in the first four lines of page 92, were made by a person who has the reputation of being an able arithmetician, and whose help I obtained simply to work out the line of average. I now wish I had done the work myself. Unfortunately I did not consider it necessary to go over the work after my helper had finished.

As regards the difference between the amounts of rainfall as published in Mr. Symons's annual volume and those given in the local report, I may remark that, as regards South End Darlington, the error is clearly mine, and arose from copying 1·83 as the amount of rainfall for February, instead of 1·33. Greta Bridge and Otterburn: the differences in these cases I am not accountable for. As regards Sedgfield and Seaham Hall, the quantities are correctly printed according to the figures given to me.

I should have been very glad if there had not been any blunders, but a very considerable experience in dealing with printed matter has taught me how vain it is to indulge in such a hope.—Faithfully yours,

R. F. WHEELER.

[All the differences except four are now cleared up; the observers concerned have been applied to, and in our next the correct values shall be given.—ED.]

Abstracts of Old Works.

UNDERGROUND TEMPERATURE.

Quelques Observations de Physique Terrestre. Par MM. AUGUST DE LA RIVE et F. MARCET. [Memoires de la Société de Physique et d'Histoire Naturelle de Genève, 1834.] Quarto, 26 pages, one plate.

THIS paper opens by relating the considerable attention given, at the commencement of the present century, to artesian wells in Switzerland, and relates how one M. Giroud had, after great difficulty, sunk one at Pregny, about two miles from Geneva, and at an altitude of 319 feet above the lake of that name, where he bored down 583 feet, or 264 feet below the level of the lake, without obtaining the water he sought. Having expended more than he originally intended to devote to the search, he abandoned it; but before removing the tools and

plant he offered, through his engineer, M. Bertrand, permission to use the same and continue the search, if the interests of science required its prosecution. M. de la Rive, after certain preliminary trials at his own cost, opened a subscription list for thorough and systematic prosecution thereof, and meeting a cordial response, both from government and the public, commenced operations early in 1833, and was enabled to continue them during 8 months, and to a total depth of 727 feet.

The diameter of the tube was only 4·9 inches, and it was lined with wrought iron pipes for 180 feet, which protected (so far) the bore from stoppage by the falling in of fragments of softer soil, which was especially troublesome at a depth of about 320 feet, where it was very friable. The water never rose to the surface, but it showed itself slightly when the boring had been pushed down to 19 feet; its level varied considerably, as is shown by the following table :—

Table showing the height of the water in the bore tube corresponding to different seasons of the year and to different depths of the bore.

Date of Observation.	Depth of Bore.	Depth of Water below surface		Rain in 30 days preceding each observation.	REMARKS.
		ft.	in.		
1831. June 16	55	14	11	0·54	The rainfall in 1831 was above the average.
1832. Feb. 9	147	13	10	1·78	
Mar. 9	293	14	11	0·62	Sudden lowering of water in tube. The summer of 1832 was very dry.
Oct. 19	533	23	9	1·34	
Dec. 19	577	24	3	1·49	
1833. Jan. 25	582	37	8	0·66	
April 1	599	35	7	0·85	
„ 8	606	34	3	2·45	
„ 11	608	33	9	2·36	
„ 13	608	33	0	3·87	
„ 15	612	32	0	4·17	
„ 16	613	30	9	4·44	
„ 18	616	30	1	4·53	
„ 23	620	27	8	4·64	
„ 27	623	27	0	4·82	
May 3	628	26	5	3·53	
„ 11	635	26	1	2·97	
July 15	673	27	0	4·31	
„ 29	683	27	8	2·89	
Aug. 3	687	28	10	1·87	The summer and autumn of 1833 have been very dry.
Sept. 23	718	38	0	3·64	
Oct. 12	727	38	0	1·96	

It seems, from this table, that the greater the depth of the bore the more does the water level sink. Thus :—after being stationary for a long time at about 15 feet below the surface of the ground, it all at once fell to 24 feet when the bore was carried down to 530 feet; then it fell to 32 feet in the spring of 1833, and after having risen again to 26 feet at the beginning of the summer, in spite of the increasing depth of the bore, it fell during the autumn to 38 feet

below the soil. M. de la Rive then remarks that we must not neglect, in considering these results, the influence of the relative humidity and rainfall previous to the dates of observation, and that the failure of the attempt to obtain a supply, even at a depth of 700 feet, must be held to demonstrate the improbability of artesian wells being available for agricultural purposes in the canton. "If it is true, as some *savans* suppose, that the supplies of artesian wells are derived from the rainfall on high lands, which follow the strata of the chalk and take their level, until, by a bore tube, we pierce the beds and allow the water to resume its previous level, then the very considerable inclination of these beds in the Jura range will explain why we have not reached them, even by piercing 400 feet below the level of the lake." The strata traversed by the bore may be very briefly described. Below the superficial beds of vegetable mould, sand, gravel, and conglomerate, a blue and gravelly clay intermixed with molassé* is reached. Below 128 ft. commences a succession of beds of marl and molassé, more or less indurated and variously coloured, which continue without interruption to the bottom of the bore. At 234 ft. we remark a bed of coarse molassé, 2 ft. in thickness, mixed with rounded pebbles, a fact sufficiently remarkable considering the depth. We ought also to mention a fetid and strongly sulphurous odour, which was observed in the yellow marl mixed with the molassé lying at the depth of 298 ft., *i.e.*, nearly level with the bed of the lake, and the presence of a grain of salt in the molassé situated at the same depth. This sulphurous odour is again evident at the depth of about 639 ft., without the presence of any sulphur compound which would account for its origin.†

The main portion of the work is devoted to the rate of increase of temperature at various depths, and so many of the remarks are of importance that we shall almost have to reproduce the whole essay. M. de la Rive commences by remarking that, during many years, isolated cases were on record, showing that there was a gradual rise of temperature at increasing depths, but that to M. Cordier the credit is due of collecting together these isolated cases, adding, moreover, many of his own, and showing, in a remarkable work published in 1827, that all tend to establish as a general fact, and consequently as a law of nature, that the temperature of the crust of

* Soft arenaceous beds, which constitute the middle tertiaries of Switzerland, generally composed of incoherent greenish sandstone.

† This is in such remarkable accord with recent reports from Crossness, that we add the paragraph in the original :—

"Nous devons mentionner encore une odeur fétide et fortement sulfureuse, qui fut observée dans la couche de marne jaune mêlée de molasse située à la profondeur de 280 pieds (298 feet), c'est-à-dire à peu-près au niveau du lac ; et la présence d'un grain du sel dans de la molasse située à la même profondeur. Cette odeur sulfureuse s'est de nouveau manifestée à la profondeur d'environ 600 pieds (639 ft.), sans que la présence d'aucun composé sulfureux ait pu servir à nous expliquer son origine."

the earth rises the deeper we penetrate towards its centre. Since its publication (*i.e.*, between 1827 and 1834) it has been further confirmed by other observations. Although, however, we have found as a universal fact a rise of temperature with depth, we are far from finding a uniform increase. M. de la Rive, therefore, enters into details as to the class of observations upon which M. Cordier had had to rely, namely, observations of the temperature of springs and rivers where they sprung suddenly from the earth at various depths, and of the air in mines and caves in the earth. He then points out the many circumstances necessarily masking true results by either method—such as the mixture of rain and surface water with subterranean streamlets and the uncertainty that their temperature at the outlet is identical with that at their source. In support whereof he quotes three instances where the rise is 1° in 37 feet, 1° in 64 feet, and 1° in 22 feet; the discordance of these results is sufficient evidence of the uncertainty of observations of that class; the other type of experiments are not less subject to error, among the principal of which are the circulation of beds of air of differing temperatures and the heat developed in mines by the labourers and by the necessary illumination. M. Cordier himself drew attention to the errors necessarily caused by air currents in the main shaft and also those produced by the ventilation of the mines; he endeavoured to avoid them in the observations he himself made, by making most of them in coal mines, because the coal is so rapidly extracted that the face of the rock has not time to lose its true temperature, moreover, he was able in a few minutes to bore a hole 20 or 30 inches deep and place his thermometer therein, yet it is not certain but that the friction of the bore, and the inevitable introduction of the air of the workings into the hole, may have vitiated these results. M. de la Rive then proceeds to show how vastly superior are the results obtainable from the boring under notice, that none of the previously mentioned sources of error can exist, that as the bore is so nearly full of water no air currents can exist, the bore is so small in diameter that the water it contains must be identical in temperature with the surrounding strata, and lastly, that the absence of an artesian supply frees the results from the complexities introduced by a current of water from an unknown depth. In short, this bore is simply a hole, just large enough to allow a thermometer to be lowered for the determination of the temperature at various depths. Perhaps some may think that currents of water would prevail in the bore and vitiate the results, but though it is not improbable this may be the case for 100 or 150 feet, it certainly is not at greater depths, for the water becomes so muddy currents could not exist, in fact, towards the bottom it is more properly very wet earth than water. We may, therefore, consider each observation as strictly representing the temperature of the strata at the respective depths; besides our mode of observation must have placed considerable difficulty in the way of any such currents as we have referred to. The thermometer was placed in a close cylinder of such a diameter that its exterior surface

was in immediate contact with the soil surrounding the bore, and must, therefore, at the end of a certain time, have been in thermometrical equilibrium with it. A further proof of the accuracy of the results is afforded by the fact that identical readings were obtained at similar depths, whatever the total depth of the bore might be, and whether its bottom was 100, 200, or 300 feet below the thermometer.

Having thus insisted on the special advantages of the class of observation under consideration, we must describe the details of our experiments.

We first tried a thermometer whose bulb was coated with various non-conducting materials, so that by lowering the thermometer to a certain depth, leaving it there for a considerable time and then withdrawing it rapidly, we might bring up the exact temperature; this plan answers very well for depths not exceeding 300 feet, but beyond that the diameter of the bore precludes our using a sufficient thickness of non conducting material to effect our purpose, and the thermometer changes before it can be brought to the surface. We were, therefore, compelled to have recourse to maximum thermometers, but as it was impossible to avoid jolting we could not use ordinary index thermometers; we endeavoured to substitute that of M. Bellani, in which the index is of steel pushed through a column of alcohol by one of mercury and retained by a hair which acts as a spring. Eventually M. Artaria constructed for us some large mercurial thermometers, with steel indices so arranged that they could be pushed up into the empty part of the tube by the mercury and yet would remain there in spite of considerable shaking. We also tried, towards the end of our experiments, a maximum thermometer of M. Bellani, constructed on an entirely different principle, and on which shaking could have no possible effect. A small ball of mercury placed in the middle of a column of alcohol indicated by its position the quantity of alcohol which had left the column, and, therefore, the maximum temperature.

The perfect agreement between all these instruments, whether employed simultaneously or successively, leaves no room for doubt as to the accuracy of the results we have arrived at; we have rejected all those where there was any lack of coincidence or suspicion of error, as in our first attempts when the indices occasionally became deranged.

In order to protect the thermometers in their passage we at first enclosed them in a tin case, but the pressure of the water broke both the case and the thermometers; we then had a strong copper one made and it was further protected by a case nearly three feet long, of which we have already said the diameter was nearly equal to that of the bore tube, and being intended to bring to the surface the fragments of soil detached in its descent and also to penetrate through the mud to the very bottom of the bore, was terminated by a borer, and also provided, near its lower extremity, with a valve opening upwards to retain the dislodged fragments. This case was screwed on to the boring rods, for the bore being only lined for a portion of its length, it would have been impossible to make it sink by its own weight or to raise it merely by a cord,

The first observations which we made with this apparatus were at those slight depths which we had previously examined by the insulated thermometer already described; they were utterly discordant, and eventually we were led to the detection of the error, by noticing that when drawn up the large cylinder was never quite full either of water or earth but that there was always air in it. From this it appeared evident that this was air, which, at the instant the cylinder entered the water could not escape, developed under continually increasing pressure an increase of temperature which raised the thermometer. In order to test the accuracy of this explanation we sent the cylinder down as quickly as possible, and found a proportionate increase of temperature. Once detected, the error was immediately removed by piercing the top of the cylinder with holes.

It is, therefore, to be understood that for depths of less than 200 feet we have the insulated thermometer agreeing with the two forms of maximum when the latter are in the pierced cylinder (the two latter agreeing at all depths) and on different occasions. The following tables give an abstract of the results :—

TABLE I.

TABLE II.

Depth.	Abstract of observations made with the thermometer in the pierced cylinder.		Erroneous observations made by placing the thermometer in the closed cylinder
	1st series.	2nd series.	
feet.	deg.	deg.	deg.
32	50·9	...	...
64	51·1	...	...
107	51·8	51·6	53·2
151	...	52·4	...
160	52·7	...	55·0
203	...	...	55·4
213	53·4	53·2	...
245	...	...	56·6
266	54·5	54·7	...
288	...	...	57·5
320	55·6	55·5	...
330	...	...	59·0
352	...	55·9	...
373	56·5	56·5	...
394	...	56·8	...
416	...	...	61·0
426	57·6	57·3	...
458	...	57·9	62·3
480	58·4	58·3	...
512	...	...	64·2
533	59·5	59·6	...
544	...	...	66·2
554	...	...	67·2
586	60·4	60·5	70·3
639	...	61·5	...
640	61·4	...	71·7
693	62·4	62·6	...
725	63·0	...	...

Before proceeding to consider these results we must premise (1) that the thermometers were left at each depth such a time as experience had convinced us was necessary for them to take up the true temperature of the strata, (2) that we ascertained by various trials that no perceptible rise of temperature was produced by friction in raising and lowering the instruments.

The results indicated by Table I are, briefly, that starting from a depth of 107 feet below the surface, at which the temperature is $51^{\circ}7$, the increase of temperature down to 725 feet follows a uniform and perfectly regular progression, and that it amounts to 1° for every 54.4 ft. The distinguishing feature of the results is their wonderful uniformity throughout the whole depth, instead of the sudden and irregular rises we have seen in other cases. Is not this result due to the mode of observation, which enables us to avoid the ordinary sources of error, and does it not, therefore, prove that the progression which follows the increase of temperature as we penetrate deeper into the earth is really subject to a regular law and independent of locality?

It will probably be noticed that the lowest temperature is at the surface of the water 32 feet below the ground, viz., $50^{\circ}9$, we have never had it so low as $49^{\circ}6$, which is the mean temperature of our locality and which we ought to have found at a depth of about 50 feet, if we had been in the solid earth. This result is probably produced by currents in the upper, limpid, parts of the water, but no such currents can exist in other parts of the water column, because the water ceases to be clear and changes into a mud in which they cannot exist, so that their influence ceases at about 100 feet. In concluding this notice we may be permitted to remark that they are the first of the kind ever made on a comprehensive scale in our country.

M. de la Rive next devotes one or two pages to magnetic observations, in which he explains that while two sets of identical needles were prepared and placed for equal times under similar circumstances, depth only excepted, those sunk to the bottom of the tube were, on withdrawal, always found more powerfully magnetised than those left at the top. We may add here a remark concerning the boring rods, which in 16 feet lengths screwed one into another formed virtually a solid bar 727 feet long, and which, from their long continued vertical position, had acquired a powerful magnetism, but this was so distributed that each length presented an opposite pole at each extremity, and what is most singular, each two rods though screwed one into another, preserved their own polarity as if entirely separate, so that one passed (at their junction) suddenly from one pole to the other. The free ends underwent no change when the rods were separated. We think those rods which penetrated deepest were most powerfully magnetised, and that those in the middle were less so even than the uppermost ones. M. de la Rive concludes his able paper by expressing his regret that the small diameter of the bore prevented his further prosecuting this branch of investigation.

REVIEWS.

Meteorological Tables for Smyrna. Lat. 38° 26' 10" N., Lon. 27° 10' 15" E. By E. PURSER, M.A., M.I.C.E. 1864-1867. Quarto sheets, privately printed.

THESE interesting tables have been long waiting that notice to which their importance entitles them. In the first place, we may remark that the observations are taken at the Smyrna station of the Smyrna and Aidin railway, at the head of the Gulf of Smyrna, and about 300 yards from the sea-shore. The ground is nearly level therewith. The barometer is a mercurial standard. The readings are taken at noon, and are printed uncorrected either for height (25 ft.) above sea, for temperature, or index error. We give them as in the originals, and approximately corrected for temperature and altitude. The rain gauge appears to be on the station roof, as it is "without lateral shelter, 38 ft. above the ground, and 45 ft. above the sea."

BAROMETER AT NOON.								RAIN			
Months.	1864.		1865.		1866.		Mean.	1864.	1865	1866	1867
	Uncor- rected.	Reducd. to 32deg and sea level	Uncor- rected.	Reducd. to 32deg and sea level.	Uncor- rected.	Reducd. to 32deg and sea level.	Reducd. to 32deg and sea level.				
Jan. ...	30·220	30·205	29·964	29·912	30·136	30·105	30·074	3·29	6·47	1·30	2·43
Feb. ...	30·101	30·049	29·787	29·747	30·066	30·014	29·937	1·43	8·26	1·68	2·94
March...	29·942	29·863	29·892	29·823	29·986	29·914	29·868	·54	4·03	1·69	1·06
April..	29·856	29·792	30·102	30·031	30·037	29·952	29·925	3·45	1·32	·20	·37
May...	29·942	29·850	30·020	29·925	29·977	29·878	29·884	1·49	·23	·95	1·27
June...	29·906	29·783	29·886	29·772	29·911	29·795	29·783	·74	·34	·63	·67
July...	29·885	29·758	29·910	29·784	29·843	29·706	29·749	2·40	·10	·13	0·00
Aug....	29·921	29·798	29·898	29·768	29·852	29·722	29·763	·50	0·00	·06	0·00
Sept..	30·001	29·889	30·065	29·959	29·960	29·840	29·896	3·00	0·00	·39	0·00
Oct. ...	30·002	29·912	30·036	29·928	30·100	30·015	29·952	3·21	1·17	·08	1·44
Nov...	30·000	29·933	30·098	30·034	30·053	29·994	29·987	6·20	2·47	3·54	5·26
Dec....	30·068	30·027	30·174	30·141	30·079	30·040	30·069	1·39	·10	3·61	6·48
Total..	29·987	29·905	29·986	29·902	30·000	29·914	29·907	27·64	24·49	14·26	21·92

It is interesting to compare Buchan's Isobars for the locality of Smyrna with the above observations :—

	Buchan's in.	Observed. in.	Difference. in.
January.....	30·13	30·07	—0·06
July	29·85	29·75	—0·10
Year	29·97	29·91	—0·06
„ (according to Schow)..	30·04	29·91	—0·13

The accordance of the above shows the advancing accuracy of meteorology, and leaves it quite a question whether the computed or

* In printed table 29·688 ; the minimum being 29·812, the reading has been conjecturally altered as above.

observed values are the more correct. In addition to the particulars given above, the following remarks are worth notice :—

“1864 was remarkable for the great amount of summer rain, 11·58 in. for the six months, April—September. An unusually heavy storm of hail and rain on July 1st gave 2·40 in.

“1865: the rainfall 3·15 less than 1864, but the rainfall of the six winter months—October, 1864—March, 1865, was 29·56, considered unprecedented, exceeding that of the corresponding period of 1863-64 by 20·95, and that of 1865-66 by 21·76 in.

“1866: rainfall 10·23 less than in 1865.

“1867: the summer rain, April—September, was below the average, and the rain of the last two months was in excess. On the night of January 22nd, 2·24 in. fell.”

The thermometric observations appear to have been made with considerable care. The instruments are said to be exposed to “free circulation of air, but shaded from sun and wind and lateral radiation;” the solar radiation thermometer was in a vacuum jacket; the depth of water in the well was 7 ft., and the sea observations were taken at a depth of 22 ft. The following are the principal results :—

TEMPERATURE IN SHADE.												IN SUN.	
Year.	Mean max.	Mean min.	Mean.	Absolute max.		Absolute min.		NOON.				Mean max.	Absolute max.
								Mean dry.	Mean wet.	Temp. of well.	Temp. of sea.		
	Deg.	Deg.	Deg.	Date.	Deg.	Date.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.
1864	73·6	52·8	63·2	July 14	100·5	Jan. 16	25·0	69·6	59·7	...	...	109·3	137·0
1865	74·7	53·0	63·8	July 26	100·5	Dec. 31	27·5	70·5	61·1	64·5	65·2	109·9	134·5
1866	75·8	51·2	63·5	July 26	102·5	Jan. 9	24·0	71·0	62·4	...	...	111·9	138·0
1867	..	...	...	..	...	Jan. 9	25·0	...	..	...	...	...	...

LUNAR AND SOLAR INFLUENCE ON THE WEATHER.

To the Editor of the Meteorological Magazine.

SIR,—The average rainfall at Greenwich for the period between the 28th of May and the 28th of July is about 4·50 in. The quantity registered there during the corresponding period of the present year was 1·29 in, which is more than 70 per cent. below the average of 54 years.

From the latter part of May to the middle of July the rainfall was least in Ireland and greatest in the Eastern Counties. Now, supposing the law I gave to apply to England and Ireland generally, this is precisely what should have occurred; for in the latter part of May the moon was 13 degrees west of the meridian of Greenwich when she reached perigee. In the present month the moon will be about 9 deg. east of our meridian when she reaches perigee; it will, therefore, be interesting to observe if there is a corresponding reversal of the rainfall distribution.

Perhaps I ought to have stated in my letter of May, that lunar perigee occurred near our meridian on the 5th of March, 1868. This was a little earlier than the limit given in the rule, but probably the

occurrence inclined the weather to drought. I ought also to have mentioned that there are other causes of great drought. Your correspondent, Mr. Stow, would not then have misunderstood me. Great heat has a tendency to produce drought, though drought does not always produce heat. The principle of uniformity with regard to the moon's positions near the equator (in December, January, April, or May) appears to cause a high summer temperature, and in that way to influence the rainfall. For instance, on the 20th April, 1868, the moon at midnight was $0^{\circ} 45'$ north of the equator, and on the 3rd of May, she was $0^{\circ} 46'$ south of the equator at the same time (midnight). The period of great heat and drought which set in about the end of April appears to have been caused, at least in part, by this uniformity. The instances that have occurred since 1766 are rare, but in every case great heat and drought accompanied the lunar phenomena. 1788, 1800, 1807-8, 1813, 1826, 1842, 1859, and 1868 were the *only* years in which this particular lunar uniformity occurred, and each year gave us a summer of great heat and drought. In 1846, 1857, 1859, and 1868 another kind of lunar uniformity occurred, and those years also gave us intense heat and much dry weather.—I am, &c.,

G. D. BRUMHAM.

To the Editor of the Meteorological Magazine.

SIR,—Referring to Mr. Brumham's letter, p. 56 of the *Meteorological Magazine*—May was very wet, especially last half; in June, 0.70 in. of rain fell in ten days; in July, 0.61 in. fell in ten days. Does this sustain the law alluded to in Mr. Brumham's letter?—Yours, &c.,

H. B. C.

Fartown, Huddersfield, Aug. 1st, 1869.

SIR,—I am sorry that my letter on Mr. Brumham's Lunar and Solar Theories of the Weather should have seemed to you to "trench upon the personal;" but I must admit, on re-perusing it in print, that the tone of the last paragraph but one does, to a certain extent, lay me open to your strictures, though I cannot think that it is quite fair to describe it as *personal*. My letter was written amidst the pressure of other engagements, or I should have probably expunged or modified the offending paragraph before sending it.

At the same time, I see no reason to recede from the main position of my letter, viz., that meteorological science has not yet reached that stage when predictions can be safely ventured on for periods of more than a few days beforehand, and that theories of weather prediction founded on a calculation of the positions of the heavenly bodies, though no doubt possessing a certain fascination of their own, are more likely to divert attention from more fruitful lines of investigation than to lead to any valuable results. I should be the last person in the world to wish to stifle free discussion of any kind, but when a theory can be shown on the very face of it to be *self-contradictory*, like this of Mr. Brumham's, *the same combination of the heavenly bodies frequently coinciding with opposite kinds of weather on the same*

meridian and at the same time, I cannot think any useful result can be gained by discussing it. I will only add, that the allusion to Zadkiel was simply suggested by the similarity of his methods of weather prediction to the theories put forward by Mr. Brumham, and was not intended to be taken as a personal reflection on that gentleman or on yourself, though I did think it a pity that your pages should be devoted to investigations which seemed to me so illusory.

I cannot expect you to find room for this letter, having already occupied too much of your space of late, but you are at liberty to make any use of it you like. I should be sorry that an incautious expression of mine should be the means of importing anything of an acrimonious nature into the discussions in your columns, which have been, hitherto, so free from anything of the kind.—Yours truly,

Nuthall, June 23rd.

GEORGE T. RYVES.

[The immense benefit which even an approximate knowledge of future weather would confer, induces us to welcome Mr. Brumham's communications. At the same time, there must be a limit to everything; we think that by the insertion of the preceding letters we have balanced the discussion, and that for the present the subject must drop. In reply to the letter of H. B. C., we may state that Mr. Brumham said (p. 59) that "a long period (that is, nearly a month or more) of deficient rainfall should commence, if it has not already commenced, in the latter part of May." At Camden Town the fall from May 28th to July 26th (59 days) was 1.22 in., being considerably less than half the average. We think that is very like accurate fulfilment. Mr. Brumham further said: "Fine weather for harvest must set in (if it has not already set in) a few days after the 9th of August, and for a long period the weather should be chiefly dry in these parts." *Nous verrons.*—Ed.]

ERRONEOUS MINIMUM TEMPERATURE.

To the Editor of the Meteorological Magazine.

SIR,—In the table of temperatures at p. 93 of your Magazine for June, the min. temp. at Bury St. Edmund's appears as 24°, on the 16th of June. Can that be correct? The min. at Greenwich on the same day was 43°·6, and here 45°.—Your obedient servant,

D. A. FREEMAN.

Upper Tooting, S.W., 17th July, 1869.

[We must plead guilty to carelessness in passing the figures quoted by Mr. Freeman. The reading is obviously incorrect; it arose from the usual cause—the evaporation of the spirit, and its condensation in the upper part of the tube. Its detection when there, and its dislodgement (*i. e.*, the restoration of the thermometer by merely swinging it sharply, bulb downwards) have been referred to over and over again, but the present is another proof that the commonest rules of thermometer management cannot be too often repeated. We regret having been led into printing an erroneous return, but if the detection and notification of the error induces observers to watch their spirit thermometers closely, the good may outweigh the evil we regret.—Ed.]

JULY, 1869.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which "1 or more fell.	TEMPERATURE.				No. of nights below 32° on grass
		Total Fall.	Difference from average 1860-5	Greatest Fall in 24 hours.				Max.		Min.		
				Dpth.	Date.	Deg.		Date.	Deg.	Date.		
		inches	inches.	in.								
I.	Camden Town	·62	— 1·17	·38	28	5	91·0	22	47·5	29	0	
II.	Staplehurst (Linton Park) ...	·32	— 1·66	·15	13	3	89·0	12*	46·0	14	0	
	Selborne (The Wakes).....	·97	— 1·23	·41	28	4	83·5	17	42·5	11||	0	
III.	Hitchen	·60	— 1·30	·53	28	3	85·0	22	46·0	28	0	
"	Banbury	·34	— 1·72	·12	31	6	86·0	18+	41·0	29	0	
IV.	Bury St. Edmunds (Culford)...	·46	— 1·53	·25	28	2	86·0	18	...	...	0
V.	Bridport	·41	— 1·70	·13	28	7	81·0	18	42·0	10¶	0	
"	Barnstaple.....	·90	— 1·96	·36	31	8	...	...	...	...	0
"	Bodmin	·96	— 2·15	·33	25	10	79·0	17	48·0	3	0	
VI.	Cirencester .....	...	...	...	...	...	...	...	...	...	...
"	Shifnall (Haughton Hall) ...	·72	— 1·45	·33	26	8	84·0	18	44·0	3	0	
"	Tenbury (Orleton)	1·00	— 1·38	·38	31	10	89·4	18	38·3	1	0	
VII.	Leicester (Wigston)	1·13	— ·97	·43	27	6	93·0	17	42·0	13	0	
"	Boston	·76	— 1·54	·33	28	6	90·7	22	47·0	29	0	
"	Grimsby (Killingholme)	·49	...	·20	5	7	82·0	22	45·0	1	0	
"	Derby.....	·65	— 1·54	·29	27	6	85·0	22	44·0	1	0	
VIII.	Manchester	1·13	— 1·56	·35	26	8	89·5	17	45·0	28||	0	
IX.	York	1·35	— ·59	·68	6	10	83·0	16	44·0	1**	0	
"	Skipton (Arnccliffe) ...	1·59	— 1·64	·68	27	7	81·0	19	35·0	1	...	
X.	North Shields	·77	— 1·04	·27	26	6	78·8	16	45·2	1	0	
"	Borrowdale (Seathwaite).....	8·30	+ ·16	3·53	31	15	...	...	...	...	...
XI.	Cardiff (Town Hall).....	·89	...	·36	25	7	...	...	...	...	...
"	Haverfordwest	2·38	— ·92	1·07	29	8	84·2	17	41·0	27	...	
"	Rhayader (Cefnfaes).....	·82	— 2·03	·50	26	6	81·0	18†	40·0	...	...
"	Llandudno.....	·50	— 1·79	·32	28	6	82·8	17	41·6	13	...	
XII.	Dumfries	1·20	— 1·25	·43	29	9	85·0	17	44·5	29	0	
"	Hawick (Silverbut Hall)	·58	...	·18	5	6	...	...	...	...	...
XIV.	Ayr (Auchendrane House) ...	2·39	+ ·23	·42	28	14	78·0	17	42·0	1	0	
XV.	Castle Toward	4·01	+ ·87	1·04	29	15	79·0	17	39·0	28	0	
XVI.	Leven (Nookton)	1·31	— ·96	·40	29	11	78·0	21	43·0	29	0	
"	Stirling (Deanston)	2·19	— 1·21	·52	29	10	77·8	17	37·5	28	0	
"	Logierait	1·48	...	·47	29	10	...	...	...	...	...
XVII.	Ballater	·59	...	·15	29	13	79·0	20	34·0	29	0	
"	Aberdeen	·94	...	·37	31	11	80·2	21	45·3	1	0	
XVIII.	Inverness (Culloden)	·44	...	·18	27	12	74·6	21	48·9	20	0	
"	Fort William .....	...	...	...	...	...	...	...	...	...	...
"	Portree .....	...	...	...	...	...	...	...	...	...	...
"	Loch Broom	2·46	...	·50	14	19	...	...	...	...	...
XIX.	Helmsdale	1·09	...	·19	13	16	...	...	...	...	...
"	Sandwick	3·20	+ 1·31	·60	24	19	69·0	8	48·0	19	...	
XX.	Cork	2·07	...	·55	25	13	...	...	...	...	...
"	Waterford	1·22	— 2·09	·37	25	8	82·0	19	50·0	13	...	
"	Killaloe	2·80	— ·39	·52	25	15	84·5	20	33·0	11	0	
XXI.	Portarlington	1·57	— 1·97	·39	25	14	81·0	16	47·0	12	...	
"	Monkstown .....	...	...	...	...	...	...	...	...	...	...
XXII.	Galway	3·87	...	·64	31	15	80·0	2	51·0	5dys	...	
"	Bunninadden (Doo Castle) ...	2·23	...	·38	24	17	77·0	3	38·0	27	0	
XXIII.	Bawnboy (Owendoon)	2·27	...	·42	29	14	89·0	16	44·0	27**	0	
"	Waringstown	1·56	...	·34	28	11	87·0	16	45·0	19	0	
"	Strabane (Leckpatrick)	3·09	...	·48	3	19	81·5	17§	38·0	1	0	

* And 16th. † And 22nd. ‡ And 19th. § And 20th. || And 29th. ¶ And 11th. ** And 28th
 + Shows that the fall was above the average; — that it was below it.

METEOROLOGICAL NOTES ON THE MONTH.

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

ENGLAND.

LINTON PARK.—A very dry month, the middle of it often hot; the first and last weeks not so much so; no T; wind mostly S. Bar. high and generally steady; small fall of R, only fell on 18th, 23rd and 29th; the ground very dry and cracking. Harvest not early, everything being so late at the beginning of the month.

SELBORNE, (THE WAKES).—The summer remarkable for the absence of T in this neighbourhood. Had my rain gauge been a few hundred yards to the E. on the 13th June, I should have recorded less than 2·00 in. in the two months; on that day a violent storm of R reached The Wakes, but extended no further eastward; T at 5 p.m. on the 12th July. Rye cut on 22nd, and oats on 23rd.

CULFORD.—See note as to erroneous thermometer, p. 109.

BRIDPORT.—Very fine, dry, and warm month. Harvest just begun at the end of the month.

BODMIN.—The drought has been severely felt here, and the rivers are even lower than they were last year.

SHIFFNAL.—The wind, so long in N. and N.E, changed on the 4th to S.W., when a decided improvement took place in vegetation, but the crops want R after the small supply of last month; a welcome R on 26th, but not enough to reach the roots of the plants; honey dew abundant on trees on 5th; mulberry blossoms, which were abundant, all dropped off on 7th; scarcely a white butterfly seen, and only one wasps' nest found up to the 21st; suddenly cold on 26th.

ORLETON.—Generally cloudy and cool, but dry till the 9th, then very fine, hot and dry to the 25th, when the pastures were very brown and the root crops languishing; after that date light showers every day; the total rainfall only one inch, of which more than one-third fell on the 31st; T heard on 23rd and 26th; temp. about 2°·5 above the average of the month.

WIGSTON.—Temp. above the mean, rainfall below it.

KILLINGHOLME.—Bar. high and steady throughout the month. Abundant crops of excellent hay secured in prime condition; R much needed; the crops of wheat and beans very promising; the pastures having had a good start in spring, have withstood the drought better than might have been expected; wheat generally in flower on the 10th; a little T on 18th; TS at 9 p.m. on 26th, lightning vivid but not near.

DERBY.—Temp. of July about 2° above the mean for July of the past 7 years, and 5° below that of July, 1868; the highest reading in the shade was 85°, against 92° last July; solar radiation 122°, against 135°. The amount of rainfall of June and July together amounted only to 2·06 in., 5·36 in. being the mean of 21 years. Hay all carried, and the most abundant crop ever known.

MANCHESTER.—T and L on 26th.

ARNcliffe.—The early part of the month unusually dry, and of high temp. Up to the 26th little more than half an inch of R.

NORTH SHIELDS.—TS on 26th, T on 25th, and T and L on 28th.

W A L E S.

HAVERFORDWEST.—A very fine, warm month; temp. above the average; drought very much felt; great scarcity of water, and vegetation entirely burnt up, many parts of the country looking like bare red or yellow rock; R, long wished for, came on the 25th, too late, I fear, to save the turnip crop; every prospect of an early harvest; oats cut on 24th.

CEFNFAES.—A dry, hot month, with much wind, generally S.E.; hay crops light, and fruit and vegetables very scarce.

LIANDUDNO.—Dense fog over the sea on 1st, from 11 a.m. to 12.30, and again at 7.30 p.m.; frequently hazy during the first half of month.

S C O T L A N D.

DUMFRIES.—This month very droughty during first week; some R in the

second week, then hot and dry till the 25th, and the rest of the month showery ; pastures burnt up, oats very short of straw ; harvest commenced with oats on 25th ; turnips looking well. Rainfall 1.41 in. below the average ; the drought this year has been more severe in this district than it was last, the rainfall in the spring having been less ; the rainfall in the first seven months of last year was 21.02 in., while in the same period this year it was only 15.65 in., being a decrease of 5.37 in.

HAWICK.—A most remarkably dry and warm month ; pastures nearly burnt up ; the hay crop bulks heavily, and has been got in in splendid condition ; turnips threaten to turn out a failure ; potatoes are small, but as yet clear of disease. Gardener and husbandman are alike crying out for R ; there were one or two claps of T on the 28th, the only T heard here during June and July. Fruit trees, &c., suffered much from the severe storm of wind on the 7th.

AUCHENDRANE.—River very low ; crops suffered from the drought up to the 22nd ; the rains at the end of the month saved our turnip crop ; T and L, but not heavy, on the 5th, 23rd, and 31st.

CASTLE TOWARD.—This month has been mild, with showers and sunshine, so that crops of all kinds are now all that could be desired. A plant of the yucca gloriosa, 7 ft. high, has at present several hundreds of full-blown flowers, and there is also in the same border a strong plant of lillian giganthemum, with 10 large flowers ; both plants are rare to be seen in flower. Mushrooms very abundant.

NOOKTON.—Fine to the 5th, then rather cloudy to 16th, again fine to 23rd, and thence showery to the close.

DEANSTON.—Very dry and parched from the beginning of the month to the 7th, when some R fell ; from 10th to 24th very hot and dry ; distant T and L on evening of 22nd.

LOGIERAIT.—Great heat with much drought ; hay well secured, but not heavy ; corn crops have a fair appearance, and potatoes and turnips look well.

BALLATER.—A dry, warm month throughout, although the max. temp. was not high ; rainfall much below the average, and vegetation consequently suffering.

ABERDEEN.—A very warm, dry, quiet month ; crops looking well on the whole ; bar. 29.49 on 6th, and 30.32 on 11th ; fog on 17th, 18th, and 21st, the latter being the hottest day this year. Strange TS at noon on 31st, T and L distant, for 15 minutes heavy R and ground white with H, for remaining 10 minutes still heavy R but sun shining brightly through it ; during the R the wind veered from S.W. to N.W., N., N.E., E., and round to S.W., blowing fiercely for a few minutes ; R very partial, not any falling 3 miles S. or 12 miles N.

LOCHBROOM.—This has been a beautiful month here, just plenty of both sunshine, and R, and warmth sufficient to make the crops in this district to be considered the best in the north.

SANDWICK.—July has been wet and warm, the R being much above the average ; there were gales of 40 miles per hour on the 6th and 12th, but the copious R and warmth had done much to correct the drought and cold of the previous months, and vegetation has been luxuriant.

I R E L A N D.

DOO CASTLE.—From 1st to 23rd close and oppressive ; cattle suffering from excessive heat and want of water ; crops, except in favoured situations, not progressing ; caterpillars have commenced their ravages on the cabbage tribe ; latter part of month showery.

OWENDOON.—The cattle, the green crops, and the grass are beginning to suffer from the great drought which prevailed till the 21st ; even last year this country did not seem so much burnt up.

WARINGSTOWN.—Fine, bright, and warm ; small rainfall ; T and L on 22nd and 28th.

LECKPATRICK.—Fine month ; plenty of R during the last ten days ; great growth of turnip crop ; harvest will be at least three weeks later than last year.

NOTE.

The concluding portions of "The Indications of the Sky," and of the "Review of the Report of the Tyneside Naturalists' Club," are unavoidably postponed.