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THERMOMETER STANDS AND SHADE TEMPERATURE.

OUR readers will recognize in the above a subject by no means novel to these pages, and upon which it is of vital moment that uniformity should prevail. The absurd position of many thermometers in the present day is but the perpetuation of the anarchy which Lawson vividly sketched in his scarce, privately printed, work on "The Arrangement of an Observatory for Practical Astronomy and Meteorology."

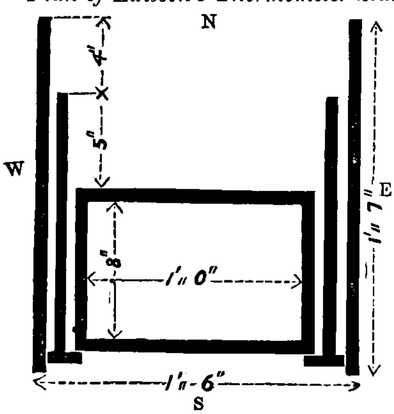
"I had often been led to doubt the accuracy of comparative observations between thermometers that were placed at a distance from each other, and particularly when the circumstances of their exact position as to height from the ground, or distance from the wall, or other localities were unknown. On conversing with my meteorological friends as to the indications of their thermometers, and the situations they respectively occupied with regard to shade, &c., I found that the variations or differences between my thermometers and theirs were often much greater than the circumstances of the day or weather seemed to warrant; I was, therefore, led to enquire whether the temperatures of the shady places, *or places so called,* on which the instruments had been fixed were at all in unison with each other, and I found that scarcely any observations had been made with thermometers placed under exactly similar circumstances, and without which unity no deductions can be drawn with any claim to accuracy. Some thermometers faced the north, some the north-east, some the north-west, &c., &c. Some were from three to five feet from the ground, some ten to twenty; some were embowered, some placed in a box, some sheltered by a high house or wall, some by a low wall, or by palings, some touching a wall, and others distant from it; some were in a angle of a high building (cool as a cellar), some exposed to the sun's rays either morning or evening."

In order to realize the fact that matters are *now*, in many cases, as bad as they were in 1843, it is only necessary for our readers to refer to our last number, or, better still, for them to follow Mr. Lawson's example, and converse with their meteorological friends as to the position of their thermometers. We shall be much surprised if the slightest examination does not convince *all*, how imperatively necessary it is that the subject should receive thorough and accurate examination.

We think a moment's reflection on the almost infinite variety of houses and grounds belonging to the numerous observers, in this and other countries, will demonstrate indisputably that a thermometer stand must be used; if, however, any persons are of a different opinion we shall be happy to record their views.

Assuming, in the interim, that *a* thermometer stand is accepted as indispensable, our difficulties have only commenced, for the varieties of stands are almost as numerous as the stands themselves, though they are mostly resolvable into modifications of Glaisher's, Lawson's, and Welsh's, and of their comparative advantages or frequency of adoption absolutely nothing is known. We have devoted considerable care to the investigation of the original designs and the successive modifications they have subsequently undergone, and believe that in this and subsequent articles we shall do greater justice to the various stands than their designers have done, *e.g.*, Mr. Lawson's stand has been lithographed once, in his own book, and engraved twice, viz., in the *Quarterly Journal of Meteorology* and in *Orr's Circle of the Sciences,* and all three represent it incorrectly, the last two reproducing the inconsistencies of the original lithograph.

Plan of Lawson's Thermometer Stand.



The stand, as designed about 1840, by Mr. Lawson, is accurately represented in the accompanying engraving and plan. The whole of the wood-work was to be ½-inch, deal painted white, the extreme height six feet three inches, the space between the double sides three-quarters of an inch; other dimensions can be taken from the drawings. The flat boards FF may be weighted or pegged to secure firmness, the legs LL are merely prolongations of the sides S *c* and *c*, the duplicate sides are kept apart by small blocks of wood, through which the screws pass, P is a sloping double roof to throw off the rain, No. 1 is the maximum thermometer, No. 2 the minimum, Nos. 3 and 4 the dry and wet bulb. It will readily be seen that the projection of the sides is such that it will be very rare for the sun's rays to reach the bulbs, even by reflection.

Reference was made last month to a series of experiments on various forms of thermometer stands which will shortly be commenced; it can hardly be necessary to state that their object is the determination of the best form of stand for general adoption, and the influence of the various patterns on the results recorded. Now, therefore, is the time for any suggestions on the subject to be brought forward; obviously we can neither undertake that every plan shall be described at length, nor engraved, nor constructed for trial against others, but we do guarantee careful and impartial consideration of all. Need we, in conclusion, point out to those who may favour us with designs, that accurate drawings or photographs are preferable to pages of descriptive matter, and that, if practicable, they should also state the cost.

METEOROLOGY AT NORWICH.

(Continued from page 124.)

Padre Secchi read the following interesting paper "On some Meteorological Results obtained in the Observatory at Rome" :—

Meteorology is a local as well as a general science, but some of its problems cannot be resolved until each single station has already thoroughly fixed what belongs to its own climate. Under this condition only shall we be able to institute a comparison between different places for discovering what is the relation which exists between the meteorological variations in different countries, and whether there are changes which are strictly periodical or not. When we compare in meteorology what is going on in different countries, we find a relation of two kinds, one of opposition, the other of similarity. The cases of opposition are not very rare, and in this year while summer was hot and dry in higher latitudes of Europe, it was wet and rainy in Rome, contrary to the ordinary rule. These opposite results are probably due to the same origin, that is to a different limit which has been reached by the aërial currents in this year in comparison with other years. But to establish this fact we have not yet sufficient grounds, and further researches are necessary. I thought, therefore, that the comparison would be easier in the department of similarity, and I proposed to myself the investigation as to whether certain storms which are said to be periodical at the same time of the year are really so. As these storms are generally accompanied by a great variation of temperature, I took this element as the basis of discussion. I had therefore reduced the temperature observations made at our observatory during the last forty years, in order to obtain the mean temperature of each day, free, if possible, from every accidental irregularity, and as these observations have been made with great care by diligent observers, I think the result will be perfectly trustworthy. The result has been calculated for the hour of noon from the year 1828 to 1867. Particular tables give the partial results for each five years. Simple inspection of the curve drawn after the figures of the table shews that even after so long a period of years, no regular curve is obtained, but only an irregular polygon. Now the question arises, is there any probability that by increasing the number of years we may arrive at a perfectly smooth and regular curve? Certainly if these variations are due only to chance they will disappear by increasing the number af years, because these changes being now in anticipation and now in *retard*, they will compensate one another, but if there are physical causes acting periodically, we shall never be able to eliminate them. Besides, if they are only local and accidental variations, they will be peculiar to one place only, but not to a large country. We have, therefore, a double means for discovering their real origin. The length of time is, unfortunately not at our disposal, since before the last forty years the observations were made with much less care than now, and they are not available for comparison with the present ones. But we can compensate for this want of long period of observations in another way. The best plan is that introduced by Mr. Bloxam, that is to combine the numbers so that each day would result from the mean of the five nearest days, so that the mean of 1, 2, 3, 4, 5, January, may be regarded as the result for the 3rd; 2, 3, 4, 5, 6, as the result for the 4th, and so on. By doing so we eliminate the accidental changes which proceed from irregular causes to the extent of five days, which may be admitted as a usual period during which meteorological causes may extend their action. Now the result is, that even after this operation no regular curve is obtained. Therefore we are induced to conclude that some of these most remarkable inflexions are not accidental, but connected with some periodical influence. To see how far this conclusion was supported by facts observed at other stations, a comparison was made between Rome and those meteorological stations of Europe, for which we have a similar calculation. Similar tables were formed for the following series of stations:—

Rome....	40	years	1828	...	1867
Bologna (Italy)	45	,,	1814	...	1858
Vienna (Austria)......	90	,,	1775	...	1864
Prague	40	,,	1800	...	1839
Paris	41	,,	1806	...	1848
Brussels	30	,,	1833	...	1862
Berlin	110	,,	——	..	——
Greenwich	45	,,	1814	...	1858

The series of curves is exhibited in a plate, and shows that even after centuries of observations no smooth and regular line can be obtained. Comparing together these curves, we find a full evidence that there are some periodical causes acting very strongly, because at certain periods of the year the inflexions of the curves are common almost to all the stations. One of the most remarkable of these inflexions is that of April 10th, when both in Rome and Bologna there is a *fall* of one degree in the mean temperature, but which in reality represents a fall of seven degrees. This variation can be traced up to Greenwich, with a little anticipation of a few days, which is of the same character as that which we usually find in the propagation of storms. Another very distinct fall is that of July 26th, which is very strong in Italy, and is visible with the same anticipation in the west of Europe. It is, however, to be observed that the midland stations of Vienna, Prague, and Berlin seem to be less affected. A very strong elevation of temperature is to be observed all through Europe on the 1st of May, while a great depression takes place after the 10th. This depression, however, although very strong in the northern parts of Europe, is scarcely sensible in Italy. The 10th of January, 30th of June, 28th of September, and 13th of December, are also remarkable periods for diminution of temperature, as July 15th, August 5th, and November 30th are days of sensible elevation. No doubt the real origin of these variations is the position of the sun and the distribution of its heat on the earth, considered not only according to the celestial declination of that luminary, but chiefly in relation to the portions of the earth's surface to which its rays are perpendicular. So, for instance, I have noticed that when the sun passes vertically from the broad ocean, over the continent of Africa, in the latitude of Guinea, we have always a strong change of temperature in Southern Europe. These strong variations of temperature take place always in consequence of great storms, and I have no doubt that the periods which are observed in these will be found to correspond with the positions of the sun vertically to certain portions of the earth's surface of a particular character. However, I think that we must also take into consideration the successive propagation of aërial waves, which introduces a considerable variation of the days in which this change becomes sensible in any particular place. And here I am naturally brought to say something about the propagation of the principal storms throughout Europe, especially between England and Italy. After the institution of the telegraphic international correspondence through Europe, I began to follow the track of the great storms which reach the Roman sea-coast. Attention paid to the telegraphic meteorological despatches, to the state of the barometer, and to magnetical instruments, persuaded me that we felt in Rome several of the greater storms which had appeared in England and Scotland, and that they reached us about two days after. A more accurate study of the track of the storms through France and Switzerland confirmed this induction. Now I arrived at the general rule that the barometer at Nairn in Scotland is the best indicator of future state of the weather in Rome for two days after, and I always keep that station as a most interesting landmark for a storm menacing Rome. The time employed by a storm to make this voyage is commonly two days, of which time a great part is traversing the Alps, this chain of mountains diminishing its speed, and often dividing a large storm into two or more partial storms. The late Professor Matteuci confirmed this result, and I am so sure of it that I suggested to that statesman to obtain a constant careful indication from Nairn or any station near it, in order to foresee the storms of the Mediterranean. I said that an advertisement of the approaching storm was also obtained through magnetical instruments. This is indeed a most important fact, and which, about ten years ago, gave me the key for understanding the very strange changes exhibited, especially by the horizontal force magnet. After much labour I finally came to the conclusion that a very great storm affected the magnetical instruments more or less, and that the magnetical disturbance anticipated in Rome, commonly by one day, the arrival of the storm. There had been a good deal of opposition in England against this conclusion, because no similar correspondence has been found to take place there. But 10 years constant observation, and a practical rule which has been already formed in our observatory for this purpose, persuade me that the fact is real, and if not general, we might look for an explanation, but must not deny it where it has been carefully observed. In France M. Marie Davy has verified my conclusion and accepted it. It is for us a constant fact that, when in Rome a fine, steady, and beautiful season is going on for several days the daily variations of the magnetical instruments are perfectly regular, but no sooner does a storm appear, or a storm is approaching, than a great irregularity takes place in the magnetical curves. This was supposed formerly to come from variations of temperature in the instruments, but this cause was excluded by the fact that the temperature of the observatory-room is kept almost perfectly constant. The origin, however, of these changes must not be sought very far. Everybody knows that electricity is powerfully developed in storms, and to such a degree that it affects common magnets readily in many cases. During some storms I have seen magnetical instruments become complete fools. These electrical currents have been found to circulate in telegraphic wires, and they propagate themselves to a great distance through the earth, and they must affect magnetical instruments even if they are far from the centre of electrical disturbance. This theory is so natural that I wonder it should have found any opposition. The anticipation of the storm by the currents is also very easy to be understood, since the velocity of earth currents is enormously greater than that of aerial currents. From the time of this anticipation it appears that the earth currents get in motion when the storm reaches the Continent from the Atlantic Ocean. It seems that electricity developed in the storm cannot be uniformly dispersed and distributed on the main continent as on the sea, so that we have in this manner definite currents determined in the earth according to the difference of electrical conductibility of the ground. This, perhaps, is the reason why this influence is not so evident in England which is surrounded by the sea, where the weather is so changeable, and the island is the very first landing-place of the storms. Whatever may be the reason of this difference (if it really exists), I cannot hesitate to admit a fact which I see so frequently reproduced in my observing-place. We must, however, remark, that when I say that the storm is accompanied by magnetical disturbance, it does not imply that every perturbation is invariably followed in course by a storm. The storm may pass at some distance and without having aerial rain or lightning, we may have only a cloudy appearance, which announces the not very distant storm, which is very often found from newspaper information to have taken place. There are also other perturbations which are not always connected with storms: notably some are due chiefly to the aurora borealis in distant northern countries. But these also, as far as I believe, will be easily connected with meteorological changes. I do not intend with this to state that all the magnetical variations in the globe have a meteorological origin; this would be too much. Certainly a particular solar action might be contemplated, although it may yet appear doubtful whether its influence is direct or only indirect. The members of this section are well aware, I think, that we prosecute the study of solar physics, especially in relation to magnetical purposes, and that to this effect a drawing is made in our observatory every fine day of the sun's image and spots. We have already ten years of these observations. From these it appeared that the minimum of

Meteorological Society of Mauritius had in 1853 adopted measures for tabulating the meteorological observations recorded in the log-books of the numerous vessels frequenting the harbour of Port Louis, and that a large mass of data had been chronologically arranged. The society, in short, during the last sixteen years, has been keeping a daily meteorological journal of the Indian Ocean; and it is from this journal, which contains the fullest possible details regarding the direction and force of the wind, the pressure and temperature of the air, the state of the weather with regard to cloud, fog, rain, lightning, &c., and the condition of the sea, that the materials for the charts are mainly derived. As the journal has been carried on without interruption since the 1st of January, 1853, and is being still continued, the character of the weather over the navigated parts of the Indian Ocean on any one day may be at once ascertained by turning up the date. Up to the present time above 215,000 days' observations, that is, observations of twenty-four hours each, have been tabulated in all, and a separate collection has been made of details relating to the gales and hurricanes which have taken place during the same period. Since 1858 the number of observations has considerably increased, and for several years there is a daily average of from seventy to eighty days' observations, or, in other words, of seventy to eighty vessels, on board of which observations were taken daily in different parts of the ocean. It is now fourteen years since, impressed with the importance of synoptic weather charts, as a means of investigating the conditions and laws under which meteorological changes are produced, I attempted to bring out a series of such charts in monthly parts. The observations for March, 1853, with several charts, were published in 1856, and daily charts for other months of the same year were prepared. For various reasons, of which paucity of data was one, the average daily number of observations being only thirty, the further prosecution of the work was abandoned. Subsequently, several hundreds of synoptic charts were constructed for periods for which the observations were more numerous, and it is now proposed to issue the charts for 1861. The average daily number of days' observations for that year, recorded in the Mauritius registers, is seventy, and as I have been favoured by the meteorological committee of the Royal Society with a portion of the observations collected for the same period, under the late Admiral FitzRoy, and been kindly promised the rest, the total daily average, including the observations taken at the Indian and other observatories, will fall little short of 100. In order to refer the observations to absolute time, the meridian of 60° E. is taken to represent noon, and the necessary corrections are applied to the local times at all stations, east or west, of that meridian. As the registers give the winds and weather at short intervals, and generally mention the times of change, the charts are easily made synchronous in these respects. When, however, vessels are at a considerable distance from the meridian of 60°, and are going at the rate of from seven to ten knots an hour, corrections have to be applied to their positions as given at noon. The direction of the wind, after correction for magnetic variation, is indicated on the charts by arrows flying with the wind, the vessels' position being at the arrow head. It being desirable that the charts should be as simple as possible, the Beaufort notation and scale for weather and force of wind have been adopted, and the currents and state of sea are denoted by symbols. In ordinary weather the barometer and thermometer are generally observed on board ships only at noon, and hence the isobaric and isothermal curves do not represent the pressure and temperature at the same moment of absolute time, but at local noon of each station. During times of great disturbance, when the barometer is falling rapidly, hourly or more frequent observations are taken at sea, and therefore the observations can be reduced to absolute time. But the area of disturbance, and consequently the differences in time being small, it is seldom that corrections are necessary. Great care is taken that the charts shall faithfully represent the facts, for the object is to ascertain truth at whatever sacrifice of preconceived notions. If, for example, nine vessels at moderate distances from each other should all have the wind from the same quarter, but a tenth vessel should have it from the opposite quarter, the latter is not rejected, but entered with the others, although there is a strong probability that an error has crept into her log-book. The observations are so numerous that occasional exceptions do not affect the general evidence. As specimens of the charts, I beg leave to lay before the section those for the 16th January and the 12th February, 1861. The former contains eighty-four arrows, representing an equal number of stations at which observations were taken on that day. The most prominent feature of this chart is a storm to the south-eastward of Cape Colony, consisting of two great currents of air, the one from the southward and the other from the northward, with a low barometer between them. It is one of those extra-tropical gales which point from westward to eastward, beyond the polar borders of the trade wind, and affect the barometer at Mauritius. The chart for the 12th February shows the winds, weather, &c., at ninety-six stations. It will be seen that between the north-west monsoon and the south-east trade wind two revolving storms are raging, accompanied by a low barometer, torrents of rain, and a very high sea. A glance at the storm farthest east shows the wind moving more or less round a central axis, for it happens that vessels are on all sides of it. The other, in which Mauritius is involved, is as rotatory as its companion, but the circuit is not completely seen from want of more vessels on its northern side. An inspection of the charts which precede and follow this one will show that these storms existed and travelled together for several days. Both charts show a strong tendency in the wind to move tangentially to the isobars, but it is only a tendency, the arrows being generally inclined to the isobars. Now, the Mauritius observations, together with those of the Meteorological Department of the Board of Trade, are alone sufficient for constructing daily charts (like those presented), for a period of ten years. I venture to think that a series of such charts would be of no small value in further elucidating various subjects of theoretical and practical importance—as the sources and development of atmospheric electricity, the relations of vapour and heat, the connection between the isobars and the direction of the wind, the origin, progress, and forms of storms, the limits, direction and force of the trades and monsoons with regard to season, and other subjects which will readily suggest themselves. As a method of investigating weather phenomena, and of discovering the laws which regulate atmospheric changes, there can, I think, be little doubt, that synoptic or synchronous charts, such as those exhibited, are much more important than mean or average charts, in which periodicities and various deviations and disturbances are entirely concealed. I would go further, and say that a series of synoptic charts for a particular ocean would be of more service to the practical navigator than average charts—that, for example, a synoptic wind-chart showing the actually observed directions and force of the wind at many stations on a single day, of average or normal weather, would be a better guide to the seaman than a chart showing the average directions of the wind for a period of three months. But however that may be, and without at all undervaluing the method of averages, I think it may be said, that it is to the system of mapping the daily weather over extensive areas that Meteorology is likely to owe its chief progress for some time to come. Who can doubt that, if we had charts, showing the directions of the wind, the isobars, &c., over the North Atlantic, the continent of Europe, and the British Islands, at a certain hour on each day, during the last twelve months, we should be in a position to solve partly or wholly questions of the utmost importance to science and navigation. I have no doubt that this will be done sooner or later—indeed it is being already done by France—and that valuable results will be obtained.

The learned Professor also read a paper on "Storm Warnings in the Mauritius." The author went into the subject in much detail, but the result of the investigations which he had set on foot, with a view to ascertain the relation which existed between the weather as observed at Port Louis in the Mauritius, and as it existed at the same moment of time all over the Indian Ocean, had established very satisfactorily the fact that no gale of any magnitude could occur at a distance of from 1500 to 2000 miles without it being known at the Mauritius.

A Member called attention to the advantages the southern position of Ceylon offers for issuing storm warnings to the Indian coast.

Dr. Mann read a paper "On the resemblance and contrasts of the climates of the Mauritius and Natal," and another entitled "Abstract of Meteorological Observations made at Pietermaritzburg, Natal."

Dr. J. H. Gladstone, F.R.S., read a paper by his brother, G. Gladstone, giving a brief account of the results of a few observations of the atmospheric lines of the solar spectrum in high latitudes.

SOLAR RADIATION TEMPERATURES.

To the Editor of the Meteorological Magazine.

SIR,—I have only just read Mr. Stow's letter in the August number of the *Meteorological Magazine* upon "Solar Radiation Temperatures," and referred to in the number just received. I cannot say, however, that it appears to me the great discrepancies existing between observers are as yet satisfactorily accounted for. Take, for instance, the extraordinary difference between the Ordnance Survey readings at Southampton and those of the Greenwich Observatory, given by Mr. R. Taylor. It is suggested, indeed, that the reason lies in the fact that the Southampton thermometer is placed 18 in. above the grass, and is not protected by a vacuum jacket, whilst the Greenwich instrument is placed upon the grass, and is in vacuo; but my own quite independent observations, within three miles of Southampton, and with the thermometer under similar conditions with Mr. Glaisher's, with the exception of its not being in vacuo, (which *on the grass* Mr. Stow tells us is not an important difference, the wind not perceptibly affecting it), would scarcely seem to bear out the theory.

The difference is still immense between readings on the grass here and readings on the grass at Greenwich, and it is still a mystery to me what can be the reason.

I append a comparative table of the Ordnance Survey, Mr. Glaisher's, and my own readings for June, and only add that the thermometer used by me is one of Negretti and Zambra's dull black spherical bulbs, the stem not blackened further than the bulb itself, and thoroughly exposed to the S.E., on a grass sloping bank always kept short mown.

Your readers will all no doubt look forward with interest to further communications on this subject, and if uniformity can be obtained in the method of making all meteorological observations, as well as for solar radiation temperatures, it will be a great thing gained.

	Greenwich.	Ordnance S.	Shirley Warren.
June 19	149·0	101·2	104·0
„ 20	165·3	101·4	103·0
„ 21	128·0	87·0	100·0
„ 22	110·0	87·1	90·0
„ 23	149·1	81·6	92·0
„ 24	135·0	83·4	100·0
„ 25	127·0	85·5	92·0
„ 26	145·0	90·1	115·0
„ 27	157·5	100·2	115·0

I am, Sir, yours truly,

R. C. HANKINSON.

Shirley Warren, Southampton, September 18th, 1868.

To the Editor of the Meteorological Magazine.

SIR,—Through the courteous kindness of Mr. Glaisher, I am able to answer the question put by myself in your journal of July last, viz., "What is the cause of a difference of so many as forty degrees of solar temperature between Holloway and the Greenwich Observatory?"

Mr. Glaisher having read my note, was so good as to offer to compare my thermometer with the instruments used at the Royal Observatory.

From the tenor of the correspondence on this subject that you have inserted subsequently, I was afraid that my thermometer was at fault. It was therefore with much satisfaction that I received a note from Mr. Glaisher, saying, "your thermometer is good; it reads very nearly identical with our thermometers when placed side by side." I had always, rightly it is thus shown, considered the name of Casella, as maker, a sufficient guarantee of accuracy. It was obvious, then, that the cause of the discrepancy must be some external local condition, and the result of my observations has been to confirm one of your conclusions, as stated in the August number of the Magazine, p. 114.

On the 11th inst., the day that I fetched away my thermometer from the Observatory at Greenwich, the sky was perfectly clear, and the sun had great power (the solar thermometer read 137°.) Looking down, however, from the high ground on which the Observatory is placed, one could see spread over the town, and away northward, a layer of smoke, dense enough to intercept a considerable portion of the sun's heat. Although this veil of smoke would become gradually thinner and lighter as it extended to my neighbourhood, there would doubtless still be enough of it to screen us from some of the sun's heat.

The Royal Observatory is 159 feet, and my garden 94 feet above mean sea level. The distance from my house to the densest part of the buildings between here and Greenwich, is three miles, from that point to the Royal Observatory is four and a half miles—sufficient conditions of elevation and distance to account for the greater clearness of the atmosphere over the Observatory, and consequently to give higher readings of solar radiation thermometers. Omitting then the minuter points of difference as to the construction of the instruments, I conclude that local influence of smoke is in this instance the main cause of the wide difference observed, while it shows also how thin a film suffices to make a screen. It is possible that the excess in the readings of the Greenwich thermometers over those of other stations, in the open country at high levels, may be accounted for by the proximity of wooden sheds, which I think would reflect some heat to the ground on which the thermometers are placed.

My conclusion is borne out by the result of your own experiments—your readings being a few degrees higher than mine, while they are also considerably below those at the Royal Observatory. Your garden in Camden Square has nearly the same relative bearings as my own, looking towards Greenwich, while it is about half a mile further from the centre of London.—I remain, Sir, yours, &c.,

W. B. KESTEVEN.

Holloway, September 16th, 1868.

To the Editor of the Meteorological Magazine.

SIR,—To prevent misapprehension, I must remind your readers that in my former letter I referred only to solar thermometers *in vacuo*, which read always 15° to 30° higher than the ordinary black bulb;

this results necessarily from their construction. The temperature indicated by a black bulb *in vacuo* consists of two parts—the temperature of the outer jacket, which is communicated to the bulb, plus the direct effect of the sun's rays on the bulb; the latter is rapidly received, because the sun's heat rays can pass through glass, but slowly parted with, because the heat so received cannot be radiated back through the glass. The temperature of the bulb, therefore, rises till it is so far above that of the glass jacket that the cooling effect of the latter equals the heating power of the sun's rays. The ordinary black bulb, on the contrary, loses heat, both by direct radiation and by contact with the surrounding air, and must therefore always indicate a lower temperature; such instruments are valuable for showing approximately the heat received by vegetation, but cannot be used for accurate *comparative* observations.

It will be easily seen from what I had said, that if the intensity of the sun's rays be the same, the indications of black bulbs *in vacuo* will vary according to the temperature of the outer jacket. Position, therefore, must make a considerable difference, and wind, by cooling the jacket, must, to a certain extent affect the instrument. Experiments show the effect of wind to be small on a solar *in vacuo* sheltered by being placed among grass, and (contrary to my previous belief) still smaller on one hung freely in the air at four feet, because the temperature of the glass jacket never, even in calm weather, rises much above that of the air; it is greatest when the instrument is placed on hot surfaces, such as black boards, which is a serious objection to their adoption, which I formerly was disposed to advocate.

We have three sources of discrepancy:—(1) difference in instruments; (2) difference in position; (3) difference in clearness of air. The first, though immense, between thermometers *in vacuo* and ordinary black bulbs, will seldom exceed 10° between well-made thermometers *in vacuo*. I have, indeed, in one instance found it 14°, but I think I was wrong in supposing this difference would be much greater in June than in March. As I have shown, this source of difference can be got rid of by extending the lamp-black to the stem. The second, causes extreme differences of 15° or 20° between thermometers *in vacuo* placed on grass and those hung in air, and of 8° or 10° between those placed on green grass and those which rest on a pretty thick bed of dry and withered grass. I hope next month to give an account of my investigations on the subject of position, which have been carried on this month. The third undoubtedly influences instruments in London and other large towns to a considerable extent; your observations at Camden Town, with instruments agreeing with mine, gave in the past summer readings often 10° lower, though Camden Town is very far from the heart of London, and how much more the sun is obscured in the city, I leave it to your readers to guess or discover.

I am, Sir, your obedient servant,

F. W. STOW.

Tunbridge Wells, Sept. 30, 1868.

SEPTEMBER, 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°.
			inches	inches.	in.							
I.	ENGLAND.	Camden Town	1·74	— ·52	·33	26	10	91·0	7	43·0	11	0
II.		Staplehurst (Linton Park)	2·70	+ ·48	·60	28	10	92·0	7	43·0	9	0
,,		Selborne (The Wakes)	4·49	+ 2·05	·98	19	11	81·5	7	36·5	11	0
III.		Hitchen	2·77	+ ·91	·71	30	10	79·0	7	43·0	10*	0
,,		Banbury	3·05	+ ·68	·83	25	10	81·0	7	36·5	24	0
IV.		Bury St. Edmunds (Culford)	1·74	+ ·13	·42	19	10	87·0	7	39·0	10	0
V.		Bridport	3·39	+ 1·07	·80	19	12	84·5	6	42·0	14†	...
,,		Barnstaple	3·71	— ·05	1·52	19	11	87·0	8	44·0	24	0
,,		Bodmin	6·44	+ 2·77	1·96	17	13	79·0	7	46·0	15	0
VI.		Cirencester	2·89	+ ·03	·75	30	8	...	...	..	...	...
,,		Shifnall (Haughton Hall)	2·62	+ ·67	1·15	25	10	76·0	7	40·0	24	0
,,		Tenbury (Orleton)	2·99	+ ·31	1·00	25	10	86·2	7	37·5	24	0
VII.		Leicester (Wigston)	2·61	+ ·40	·66	26	8	89·0	6, 7	38·0	24	..
,,		Boston	2·22	+ ·65	·80	19	9	87·5	7	43·5	25	0
,,		Gainsborough	...	..	...	...	.	...	...	...	...	...
,,		Derby	1·72	— ·62	·80	25	10	85·0	6, 7	44·0	17	0
VIII.		Manchester	...	...	...	...	...	...	...	...	...	...
IX.		York	3·24	+ ·91	1·05	25	15	83·0	6	41·5	9	0
,,		Skipton (Arncliffe)	4·28	— ·68	1·17	27	12	77·0	8	40·0	25	0
X.		North Shields	3·58	+ 1·88	·92	25	18	81·6	7	45·0	16	0
,,		Borrowdale (Seathwaite)	5·77	— 7·44	1·43	28	13	...	...	...	..	...
XI.	WALES.	Cardiff (Town Hall)	...	...	...	..	...	...	...	...	.	...
,,		Haverfordwest	4·04	+ ·33	1·00	19	9	78·8	6	41·0	13	0
,,		Rhayader (Cefnfaes)	3·86	+ ·02	·73	25	11	83·0	...	40·0	...	...
,,		Llandudno	1·77	— ·57	·79	25	7	87·5	6	43·5	13	0
XII.	SCOTLAND.	Dumfries	2·67	— ·06	·95	29	13	78·5	6	37·0	13	0
,,		Hawick (Silverbut Hall)	4·06	...	·68	25	14	...	...	...	...	..
XIV.		Ayr (Auchendrane House)	1·70	— 2·03	·48	29	13	78·0	6	30·0	13‡	2
XV.		Castle Toward	2·35	— 2·27	·80	30	13	73·0	6	33·0	14	0
XVI.		Leven (Nookton)	3·04	+ ·56	1·07	19	14	78·0	6	40·0	9	0
,,		Stirling (Deanston)	2·64	— ·51	·86	29	15	79·5	6	32·0	13	0
,,		Logierait	3·03	...	·75	29	13	...	...	...	...	..
XVII.		Ballater	6·30	...	2·20	19	17	79·0	6	31·5	14	1
,,		Aberdeen	3·87	...	1·07	19	15	78·2	6	40·7	13	0
XVIII.		Inverness (Culloden)	3·55	...	·97	29	12	75·0	6	39·8	13	0
,,		Fort William	2·11	...	·58	28	12	...	...	...	...	...
,,		Portree	4·44	— 6·33	1·23	29	14	73·0	6	34·2	15	...
,,		Loch Broom	2·07	...	1·10	29	14	...	...	...	...	...
XIX.		Helmsdale	3·27	...	1·20	29	12	...	...	...	...	...
,,		Sandwick	1·41	— 2·25	·33	27	13	67·5	6	41·4	12	0
XX.	IRELAND.	Cork	5·98	...	1·14	19	15	...	...	...	...	...
,,		Waterford	6·90	+ 3·77	1·70	29	17	73·0	5	48·0	28	0
,,		Killaloe	2·98	— 1·18	·62	25	18	78·5	5	39·0	28	0
XXI.		Portarlington	2·89	— ·39	·51	21	18	76·5	6	38·0	14	0
,,		Monkstown	3·16	+ 1·17	·93	25	11	...	...	...	...	0
XXII.		Galway	2·41	...	·43	10	13	74·0	8	34·0	30	0
,,		Bunninadden (Doo Castle)	2·85	...	1·00	29	9	66·0	2	32·0	..	0
XXIII.		Bawnboy (Owendoon)	2·23	...	·48	11	16	83·0	6	38·0	30	0
,,		Waringstown	1·68	...	·29	28	14	82·0	6	37·0	13	0
,,		Strabane (Leckpatrick)	1·64	...	·33	10	13	79·0	6	34·0	9, 25	0

* And 12th, 23rd & 24th. † And 24th. ‡ And 14th.

+ 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. fo Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hair S for Snow.

ENGLAND.

Linton Park.—The early part of the month exceedingly dry, only ·11 in. of R falling between the 22nd of August and 18th September; a little T on 18th and 27th; fog on 24th; the first seven days very hot; prevailing winds S., S.W., and N.E.

Selborne.—The storm on the 18th was accompanied by a kind of whirlwind, which occasioned much damage to the orchard house glass, and, at Worldham, tore up a tree of considerable size by the roots. Max. temp. 81°·5 on 7th, and only 64°·0 on 8th; T and L at 6 p.m. on 18th with heavy R and violent wind; T S from 3 to 5 a.m. on 27th, with H, heavy R, and violent wind from the S.W.; dense fogs on mornings of 20th, 21st, and 22nd.

Banbury.—L on 26th; T S on 30th.

Culford.—The rains which we have recently had are causing the pastures to assume their vernal hue which they have not previously done this summer. The late sown turnips are now growing vigorously, and promise to be very useful, and even early potatoes, planted after the R we had on the 6th of August, have now every appearance of producing a useful crop. T on 27th and 30th.

Bridport.—The first fortnight very fine, hot, and dry, the second fortnight wet and stormy. Gale sprung up on 25th from S.W., increasing to a very heavy gale on the 27th and continuing; till morning of 27th, a very heavy sea on. Heavy T S in the early morning of 26th, with vivid L and heavy R; L on 18th, 25th, 29th, and 30th.

Bodmin.—The rainfall since the 16th, 6·42 in. has been unprecedented.

Cirencester.—The latter rains, although so much less than in August, have produced greater effects on vegetation, doubtless occasioned by the lessened influence of the sun. T on 26th.

Haughton Hall, Shifnall.—The second growth of potatoe tubers larger than those first formed, and likely to be a good crop, frost permitting; barley stubble quite green, from the sprouting of the shed grain; damsons, an average crop; acorns, most abundant. Temp. very high at commencement of month, difference of 20° between it on 7th and 8th.

Orleton.—The first seven days were hotter than ever before registered in this month; on the 7th the ther. stood at 86·2 in the shade, but at 9 p.m. wind from N. suddenly set in with a cloudy sky, and by the next day the temp. had fallen 20°; no R till the 17th; remainder of month stormy, with heavy showers and rather cold; T on 19th and 29th, L on 29th and 30th. T S at 4 p.m. 29th.

Boston.—Very hot and sultry up to the 7th, temp. moderate during the rest of the month; T S S, with heavy rains, on 26th and 27th; gale from E. on 25th, and another from S.W. on 27th.

Derby.—September commenced with intense heat, and beautiful weather continued to the middle of the month, when copious showers began to fall continuing to do so to the end of the month. The temp. has been (here) 2°·5 above the mean of the past seven years, and, as a mark of the past season, Indian corn has ripened for the first time in upwards of 20 years during which I have grown it.

York.—T S at 4 p.m. 20th, and at the same hour on 30th.

Arncliffe.—An unusual amount of E. wind.

North Shields.—Auroræ on 15th and 18th, fog on 19th, L on 7th; T S on 20th and 26th.

WALES.

Haverfordwest.—The month commenced with fine warm weather, and up to the 11th summer heat continued, the wind then veered round to the E. with a great reduction in temperature; a very wet, and at times stormy, period from the 20th to the end of the month.

Rhayader, Cefnfaes.—A fine, warm, and genial month; harvest fine; acorns, haws, hips, and all berries very large and abundant.

SCOTLAND.

DUMFRIES.—The first half of the month fine, the latter half showery, but on the whole a remarkably fine month. Grass fields as green as in spring. Mean temp. exactly the same as September of last year.

SILVERBUT HALL.—Sharp frost on night of the 8th. A month of fine weather; pastures looking green and beautiful; cereals all secured in fine order; potatoes excellent in quality, and keeping almost clear of disease; Swedish turnips suffering from mildew, but a very fair average crop. T and L, accompanied by heavy R, on the 27th, 29th and 30th.

AUCHENDRANE.—The river and springs are still very low; the gale on the 12th was not severe here; 25th and 29th boisterous; the destructive gales of the 20th and 27th were not felt here.

CASTLE TOWARD.—A pleasant month; pasture abundant; turnips getting mildewed; vegetables plentiful; flower garden quite gay.

NOOKTON.—Heavy R on night of 19th; gale and heavy R on night of 20th.

DEANSTON.—Dry till the 20th; frost during the nights of 9th, 13th and 14th. T S with heavy R at 4.30 p.m. on 27th, and again at 11.30 a.m. on 29th.

BALLATER.—The latter part of the month very wet, and total rainfall much above the average for September. No frosts to speak of, and vegetation up to 7th of October uninjured and remarkably vigorous for the season.

ABERDEEN.—T and L on 7th, 28th and 29th. Auroræ on 5th, 6th, 11th, 12th, and 24th. Fog on 20th, 21st and 22nd. A month of dull, damp, gloomy weather; hours of R more in number than in any month since March, 1867. Rainfall, bar., and temp. all above the mean. Winds from N.W., N., N.E. and S.E., much above the average frequency.

ROSSE PARSONAGE.—Upon the whole a fine month; T and L on the night of the 5th. E. winds during the latter part of the month, but no great storm, though it was high on the 19th; S on the hills on the 25th.

PORTREE.—The finest September on record; the best harvest weather for 20 years; all the crops are chiefly in stack in good condition. The potatoes are very much diseased, fully two-thirds of the crop are quite rotten and unfit for use.

LOCH BROOM.—This has been a most beautiful month, equally beneficial to the farmer and the grazier.

SANDWICK.—Lunar rainbows on the 25th and 30th; auroræ on 9th, 15th, 19th (flashing high), 21st, 22nd, 25th and 26th. The month has been drier and colder than the mean. It has been fine harvest weather, and a good crop is all nearly secured, much earlier than usual.

IRELAND.

DOO CASTLE.—Delightful weather up to the last week, when there were some very wet and stormy days. The harvesting of all crops a complete success; fodder far more plentiful in the country than was at first anticipated, the prices of cattle in consequence "looking up." Potatoe digging just commenced in this locality; the crops excellent.

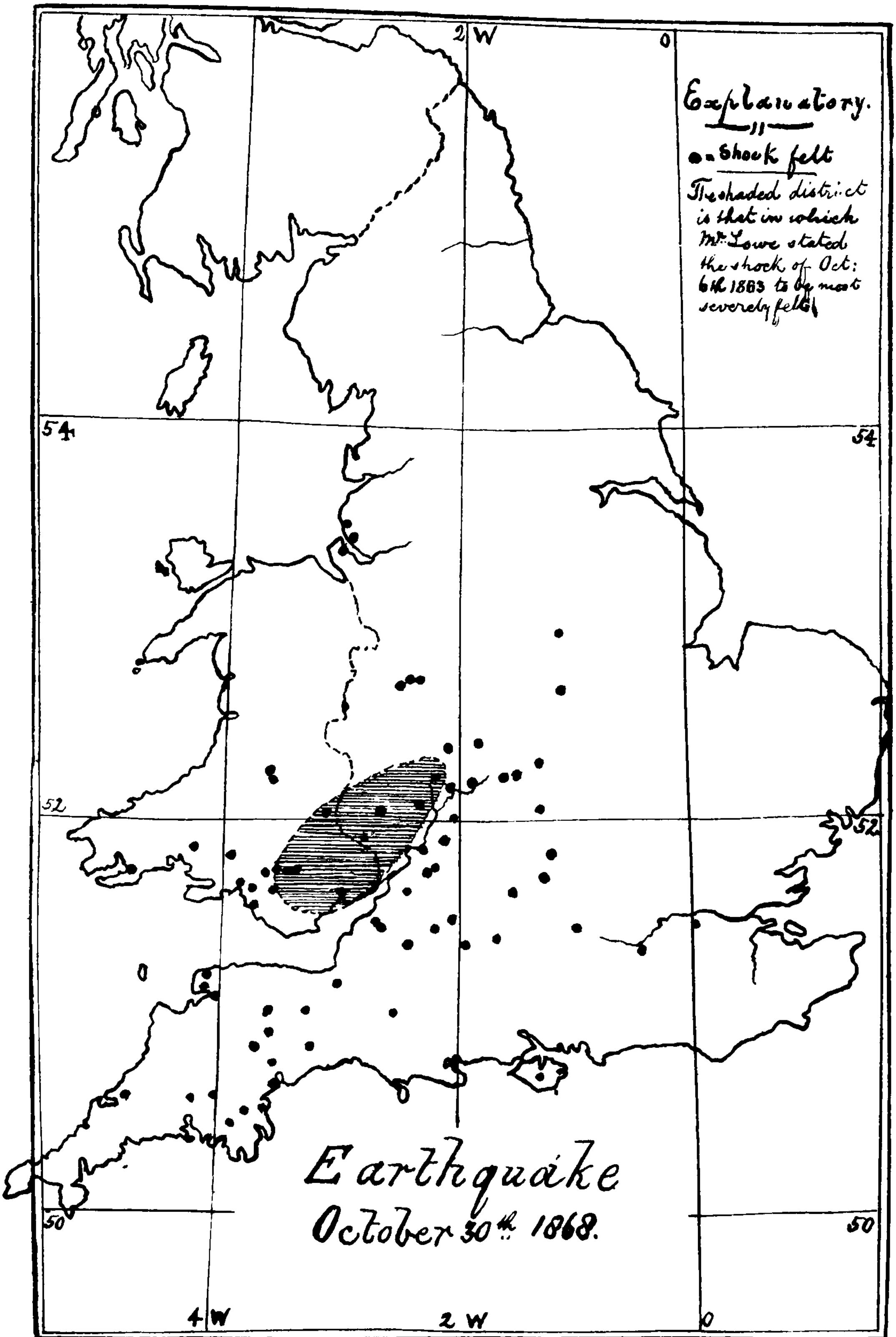
OWENDOON.—T on 30th.

WARINGSTOWN.—Fine, dry, and seasonable; first week very warm, after which cold N. and E. winds set in for a fortnight, another mild week at the close of the month.

LECKPATRICK.—A fine month; although the ther. in air 4 ft. above the ground never fell to 32°, there was frost on the grass on six nights, the minimum being 29°; so low a reading in this month is unprecedented.

TO OUR READERS AND CORRESPONDENTS.

Owing to the space occupied by the reports of the British Association Meeting, several very valuable communications are unavoidably postponed to our next.



G. J. Symons, Litho: