

# SYMONS'S

## MONTHLY

# METEOROLOGICAL MAGAZINE.

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AUGUST, 1870.

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### NEW SERIES OF INSTRUMENTS AT THE ROYAL BOTANIC SOCIETY'S GARDENS.

THE accompanying illustrations, and brief notice of the instruments recently presented to the Royal Botanic Society by Mr. S. W. Silver, are reprinted from the annual report of the Society, read at the last general meeting :—

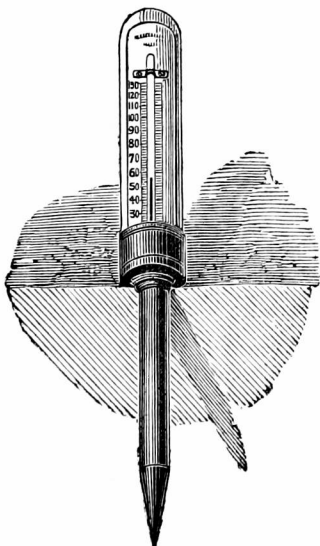
Every botanist is so familiar with the mutual interdependence of plants on climate, and climate on plants, that meteorological instruments are recognized as something more than a necessary adjunct of botanical gardens. Hence some forty-five years ago a set of the best construction then known were provided for the gardens at Chiswick, and started under the auspices of Prof. Daniell, F.R.S.; and similar observations have been conducted with more or less completeness at all the principal gardens, not only in the United Kingdom, but on the Continent. And though last mentioned, not by any means least effectively, by the Royal Botanic Society of London, who commenced, and with more or less completeness have continued, a register for nearly a quarter of a century. The Fellows of this Society are so well aware of the rapid progress of invention and improvement during this period, that they will not be surprised to learn that their old instruments and journal have fallen far behind the requirements of the present day. Hence they will understand how readily the Council accepted an offer of a set of instruments of the most improved construction, and how cheerfully I rendered such assistance as was necessary to secure their proper erection, and scientific registration. Cordially assisted by the Garden Committee and by Mr. William Sowerby, I have had the pleasure of seeing them placed in positions having few, if any, equals in this country.

The barometer is on the construction technically known as the Kew pattern, the special advantage of which is great accuracy combined with the avoidance of the delicate cistern adjustment required with Fortin's construction; consequently the instrument is as easy to read as an ordinary hall barometer, while it is almost infinitely more correct. It is placed on the inside N.W. wall of the museum in N. Lat.  $51^{\circ} 31' 34''$  and W. Lon.  $0^{\circ} 9' 15''$ , the cistern being 125 feet above the mean level of the sea. It, as well as the other instruments, is read thrice daily, viz., at 9 a.m., 3 p.m., and 9 p.m.,

The thermometers for determining the temperature of the air are placed in the centre of the herbaceous garden, where a circular grassed bed, fig. 1 (the paths of which mark true N., E., S., W., and also the secondary points N.E., S.E., &c.,) has been appropriated to them. The instruments for determining the temperature of the air in shade, and the humidity of the atmosphere, are placed upon a stand constructed exactly in accordance with the dimensions of the Greenwich stand communicated by Mr. Glaisher in *Symons's Meteorological Magazine*, Vol. III., p. 155. As this stand requires to be turned thrice daily, so as to keep its sloping face towards

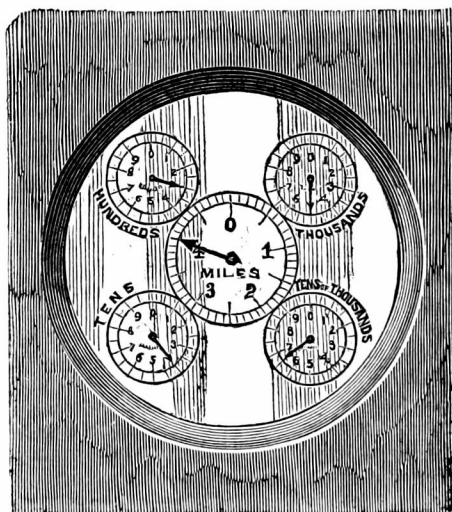
the sun, an arrangement has been adopted which renders forgetfulness of this duty on the part of the observer almost impossible. This stand carries four thermometers, viz., a dry and wet bulb (*fg*), which *jointly* give the humidity of the air, while the dry bulb (*f*) is further available as giving the actual temperature at any time; there are also a Rutherford's spirit thermometer (*e*) for showing the lowest temperature, and a maximum (*h*) on Negretti's construction for showing the greatest heat during the day. At the S. W. corner of the grass plot a very delicate thermometer (*d*) is placed on the grass to show the lowest temperature experienced by vegetation; and at the S. E. corner there is a 4 ft. post (*b*) carrying a maximum thermometer of which the bulb and one inch of the stem are blackened, while the whole is enclosed in a glass shield partially exhausted of air. This instrument shows the greatest heat in full sun. At the N. E. corner are buried five thermometers, the bulbs of which are respectively 3 inches, 6 inches, 1 foot, 2 feet, and 4 feet below the surface of the grass, and which therefore show the temperature of roots at those depths. There are several novelties in these instruments, but one very simple one is worth mention for its obvious simplicity and advantage. To read a thermometer correctly it is necessary that the observer "look square" at it, otherwise in consequence of parallax he will read it too high or too low. Earth thermometers have hitherto always been placed vertically, and consequently observers have had either to put their heads on the grass or read the thermometers incorrectly. This is obviated by the simple expedient of slanting the thermometers at  $45^\circ$ , as shown in fig. 2, where the section through the earth is represented as vertical. In rain gauges, as in most other things, the simplest arrangement proves the best, hence the pattern adopted for this series of instruments, and placed at the N. W. of the grass plot (*e*), is merely an 8 in. copper cylinder with vertical rim, funnel, and straight pipe, whence the rain passes into a receiver, from which, when a measurement has to be made, it is poured into a graduated glass.

Fig. 2.



Underground Thermometer, 6 in. deep.

Fig. 4.



Anemometer Dial (enlarged view.)

In gardens so beautifully wooded as those of the Society, it was not easy to find a suitably exposed position for an anemometer; it was however finally decided that a rough rustic ruin (fig. 3 and *a*, fig. 1) should be erected on the larger mound, in order to diminish as far as possible the almost inevitable unsightliness of a tall narrow column; if from an æsthetic point of view Mr. Sowerby (to whom we are indebted for the design), has not succeeded perfectly, I can only say that he has

met *all* the scientific requirements, and that nothing equal to it has yet been suggested. The instrument mounted upon this tower, and specially constructed for it, is an improved modification of Dr. Robinson's anemometer (*d*), the reading being made from a series of dials, shown on an enlarged scale in fig. 4, and showing the actual velocity of the wind, *i.e.*, the number of miles per hour at which it is moving, at any time, or the total motion since any previous time. Arrangements are also made for applying an electric communication whereby its indications will be recorded in the Museum, thus rendering it unnecessary for the observer to remain on the base of the tower during any violent storm, and also enabling him to observe simultaneously the velocity of the wind, and the fluctuations of the barometer.

In conclusion, I must not omit to express our thanks to Dr. Balfour Stewart, F.R.S. and the Committee of the Kew Observatory, for having in recognition of the importance of the observations, gratuitously tested the whole of the instruments, whence, I am glad to find that they have been constructed by Messrs. Pastorelli and Co. with their usual precision.

It is of no use having good instruments well placed unless proper arrangements are made for their punctual and correct registration; everything that is possible has therefore been done to secure this, both by providing blank registers of the most simple kind, and by personal instruction of the observers. It is yet too soon to express a very positive opinion on the subject, but thus far I have every reason to believe that the observers will prove worthy of the instruments, and that both are creditable to this Society, and an example for others to copy.

62, Camden Square, N.W.

G. J. SYMONS, F.M.S.

July 20th, 1870.

### THE DROUGHT OF 1870.

So much attention has been drawn to the recent deficiency of rainfall, that the following tables will probably be generally interesting. They show the leading features of the distribution of rain over the British Isles during the present year, and compare the same with the average of the six years, 1860 to 1865. Remarking upon them in the sequence of the months, we find that in JANUARY, the fall at all stations except those in Yorkshire and Lancashire, was *below* the average. In FEBRUARY the fall was rather irregularly distributed, but generally *above* the average, the exceptions being London, Maidstone, Bury St. Edmunds, Lancashire, and the north-west of Scotland. The fall in MARCH only reached the average at London and in Hampshire, at most stations it was *below* it, in some cases, especially in S.W. Scotland it was less than half the average. A similar *deficiency* occurred in APRIL, except in the N. and N.W. of Scotland where the fall was considerably in excess. Scarcely any English station had even one inch during the month. The fall in MAY was very similar to that in April but the *deficiency* in the S.W. counties was not so marked as in that month, neither was the *excess* in the N.W. of Scotland so considerable as in the previous month. In JUNE the drought became very severe over the whole of the British Isles, its intensity being greatest south of the 53° of N. latitude where at nearly all stations it was less than one quarter of the average fall. In JULY there were excessive local rains, but they were very limited in their extent, and did not reach any of our regular stations, which therefore uniformly show a deficiency.

Secondly, to run briefly over the several stations, we find that at *Camden Town* there has been only one month in which the fall reached the average; at *Maidstone*, there was not even one month in

which it reached it; at *Selborne* and *Banbury* there were moderate rains in February, but in other months the deficiency was similar to that at most other stations; all other English, and many of the southern and central Scottish stations present conditions identical with one or other of these types of distribution, but in the extreme N.W. of Scotland (as is very frequently the case) a partial reversal of the conditions is shown to have existed. February, instead of being *above* the average, is considerably *below* it, and *vice versa*. April is 50 per cent. *above* the average, instead of 70 per cent. *below* it.

We are not now prepared to express a decided opinion as to the relative severity of this and the many previous droughts from which we have of late years suffered, but there are several discordances on which perhaps some of our correspondents can throw light:—

(1) Why is it that the most torrential rivers have suffered most? The Wye was recently in places almost invisible, and easily crossed on foot, and yet the rainfall on the Welsh hills has not been inconsiderable—*e. g.*, at the Welsh station No. 55, at the head of the river Clwydog, the rainfall from January 1st to July 1st has been nearly 30 inches.

(2) Why have lawns suffered more in 1870 than in 1869, and yet the fires produced by sparks from locomotives been less numerous?

CAMDEN TOWN.		MAIDSTONE.		SELBORNE.		BANBURY.	
Total.	Diff. from average.	Total.	Diff. from average.	Total.	Diff. from average.	Total.	Diff. from average.
Jan ..... 1·38	— ·57	1·66	— ·40	2·00	—1·27	1·33	— ·76
Feb. ... 1·21	— ·01	1·14	— ·37	3·95	+2·24	2·44	+1·01
March... 2·31	+ ·23	1·64	— ·85	2·67	+ ·07	1·49	— ·71
April ... ·47	— ·66	·43	— ·79	·35	—1·15	·66	— ·50
May ... ·70	—1·80	1·14	—1·10	1·95	— ·53	1·17	—1·05
June ... ·83	—2·22	·32	—2·42	·51	—2·72	·75	—2·53
July ... 1·22	— ·57	1·95	— ·03	·49	—1·71	1·09	— ·97
Total ... 8·12	—5·60	8·28	—5·96	11·92	—5·07	8·93	—5·51

BURY ST. EDMUNDS.		BRIDPORT.		BODMIN.		ORLETON.	
Total.	Diff. from average.	Total.	Diff. from average.	Total.	Diff. from average.	Total.	Diff. from average.
Jan ..... ·89	— ·98	1·74	—1·45	4·35	— ·84	2·33	— ·20
Feb. ... ·78	— ·64	2·23	+ ·17	5·58	+2·79	2·50	+ ·93
March... 1·87	— ·33	1·93	— ·94	2·91	— ·84	1·86	— ·56
April ... ·78	+ ·03	·53	— ·95	·31	—1·39	·79	— ·75
May ... ·36	—1·80	1·44	— ·59	2·85	+ ·39	1·40	—1·48
June ... ·98	—1·60	·76	—2·48	·91	—3·13	·61	—2·91
July ... 2·00	+ ·01	·66	—1·45	2·18	— ·93	1·68	— ·70
Total ... 7·66	—5·31	9·29	—7·69	19·09	—3·95	11·17	—5·67



markable example of such a rainfall took place in the upper part of the Dale of Dent, on Saturday, 9th July. The phenomena which accompanied the thunderstorm at Stone House (five miles from the village of Dent), have been carefully recorded in a letter I have received from my friend, Mr. F. Nixon, who, for some years, has kept a rain gauge, and is a good and very careful observer. I can implicitly rely upon his facts, and I will extract his description of them almost word for word—suppressing or slightly modifying one or two sentences which could hardly be understood without a local plan or a personal knowledge of the features of the Valley. I think the following extracts well deserving of publication, and in this belief, and with Mr. Nixon's permission, I send them for insertion in your journal.

I remain, Sir, respectfully and faithfully yours,

A. SEDGWICK.

*"An account of the thunderstorm of the 9th of this month (July, 1870), in the upper part of the Dale of Dent:—*

"It commenced between two and three p.m., and lasted an hour and a half, and it seems at first to have burst, as a water-spout, near Stot Scales or Dale Head. For the rain had hardly commenced ere the new railway tunnel was flooded, and William Greenbank's house threatened with destruction. The water, like a mighty, irresistible power, swept before it all the materials of the new railway (wheelbarrows, tools, planks, and trees), and rushing down the valley, carried away all the bridges which cross the Dee, between Dale Head and the Church Bridge, a distance of about six miles, with the exception of Stone House Bridge, which is but slightly injured. The scene between Lea Yett and Dale Head is one of great desolation. In many places the walls and roads are gone, and the whole surface resembles the Beck bottom. It was an awful sight to see the water rushing past Stone House Mill, and high, muddy, angry, waves dashing over the bridge. The floods were accompanied by the loudest thunder—the claps and the flash close together; and singularly, all this happened without a breath of wind—during a dead calm. We hear of no damage from lightning, but a workman was caught in the tunnel at Dale Head and drowned, and a young boy while crossing a runner, near Moukey Beck, was swept away into the river and crushed and mutilated among the descending rocks and rubbish.

"All the rain fell in about an hour, and at the Stone House it was 2.53 inches by gauge! Had the rainfall been gauged at Dale Head it would have given a much larger number. It seemed to come down in sheets of water rather than in separate drops." Such are the extracts.

NOTE.—In a pamphlet circulated in 1868, I described (from an original document), an enormous snowfall at the head of the Dale of Dent, in 1756\*, which snow, a few days afterwards, in consequence of a rapid thaw, descended from the mountains in a succession of *avalanches*, one of which swept away a house at Dale Head and killed seven of its inhabitants.

Had Mr. Greenbank's house given way to the flood above-mentioned, the rainfall of 1870 might have been a match for the *avalanche* of 1752.\*

Dale Head is about a mile from Stone House, and the whole distance from Dale Head to the Church Bridge is about six miles.

Stone House Bridge has a single arch which spans the river from rock to rock, high above any ordinary line of the water.

A. S.

## THE FLOODS IN EAST LANCASHIRE.

*To the Editor of the Times.*

Sir,—It is yet too soon to pronounce as to the precise cause, intensity, or effect of the disaster which befell the district between Burnley (Lancashire) on the N.W., Sowerby-bridge (Yorkshire) on the E., and Rochdale on the S. At least lines joining these three towns and forming a roughly equilateral triangle, whose sides are 12 miles each in length, include nearly all the disasters reported, and also, singularly enough, include the place where observations of rainfall in England were first made—viz., Townley, where a register was begun in 1677. Unfortu-

\* Evidently one of these dates is incorrectly printed; we cannot at the present moment say which.

nately the register there has long been given up, or it would have been very useful in the examination of the present storm.

The rain there, however, seems to have been far less than it was about four miles S.E. of Townley, on a tract of rather high ground, known as Heald Moor, on the eastern edge of Lancashire, and a mile or two S.S.W. of Black Hambleton. This moor runs about W.N.W. to E.S.E., the water on the northern side passing down Ratten Clough into the Calder, and thence through Todmorden and Sowerby-bridge, while on the southern side it forms the source of the Irwell, which, about three miles further on, receives other tributary streams, the town of Bacup being built at this point of intersection, and at the bottom of the valley.

So much for the locality ; as to the exact nature of the phenomena it is too early to speak decidedly, but the following report from Bacup is corroborated by many others, and probably correct :—

“On Saturday (9th), in the forenoon, the weather was fine but sultry, and as the day advanced the heat increased, while dark clouds appeared to be gathering in the north. About 2 o'clock the storm broke over the town with a rapidity and force known only to tropical climates. Vivid flashes of lightning seemed to be accompanied rather than followed by loud crashes of thunder. Then came the rain, not in drops, or even streams, but positively in sheets. In an incredibly short space of time the two branches of the river (Irwell) completely filled their narrow channels, and overflowed their banks.”

The reporter then proceeds to recapitulate disasters amounting in supposed aggregate to 80,000*l.* or 100,000*l.*, but I will merely select two or three typical of the rapidity of rise of the water and of its force :—

“At the Waterloo Hotel, which is built over the river Irwell, and divides North from South Lancashire, the water forced up the floor with such rapidity that the boards above the bar had to be torn up in order to release the landlord and landlady, who had to be hoisted to the upper rooms with ropes. At Albion Mill, which belongs to Mr. G. Stewart, and is built over the river, the arch burst and filled the place, piling loom upon loom, and breaking the iron pillars as if they were matchwood.”

Thus much for the southern slope of the moor, now for the northern. And here I may mention another point worthy of note—viz., that while so much of the water as fell on the southern slope found its way through the Irwell to the Irish Sea, that which fell on the north of the same hill found its route through the Calder to Hull and the German ocean.

But to return to details. A Todmorden correspondent says :—

“At noon on Saturday the whole sky was covered by a dark cloud, which rendered the lighting up of the houses necessary. Vivid flashes of lightning and awful peals of thunder continued for about an hour, but to the surprise of the inhabitants very little rain fell in the town, the shower not lasting more than a quarter of an hour. Immediately, however, and without any warning, the water rushed in great volume down the river, washing away walls, battlements of bridges, and flooding all the tenements of Cobden Shade, &c., to a depth varying from two yards downwards.”

The writer then narrates the increasing devastation as he traced the course of the river up to Portsmouth station, and Ratten Clough. As, however, it is simply an iteration of levelled walls and houses, damaged bridges, &c., it is unnecessary here to reproduce it. Unfortunately, at least three lives were lost.

Now, as to the actual nature of the phenomena, as far as at present known. There appears to have been a violent thunderstorm, with an inch or so of rain, over East Lancashire, but not reaching into Yorkshire. But this did not produce the disasters. They seem due to the dark cloud which compelled the use of lights at Todmorden, and which, after hanging over the valley between Heald Moor and Black Hambleton, suddenly discharged its contents on the former. This inference is inevitable, if the statements already quoted are (as I believe them to be) correct, and it is confirmed by two other writers, one of whom says, “It was caused by the descent of a cloud of water on Flower Scar,” (the S.E. end of Heald Moor). The

other writes:—"On the hill opposite to where the water fell we hear that a waterspout was seen by persons at several points."

Of the amount of rain there is, I believe, no record at all, the moor being, like many others of equal or greater importance, without a gauge; and perhaps if there had been one it would have shared the fate of that at Scarborough, when the waterspout burst over it, on the 6th of August, 1857, and the rain gauge, which held nine inches, was filled, and found to be running over.

But although every additional gauge adds to my work, and there are now nearly 2,000 in operation, against about 500 when I undertook the collection of the returns in 1860, I feel it a sort of censure on the completeness of my work, when a storm like this drops in between the stations, and escapes measurement altogether.

I am, Sir, your obedient servant,

62, Camden Square, N.W., July 13th.

G. J. SYMONS.

## REVIEWS.

*Report of the Meteorological Committee of the Royal Society for the Year ending 31st December, 1869.* 8vo. Eyre and Spottiswoode. 58 pages and 2 plates.

*Quarterly Weather Report of the Meteorological Office; with Pressure and Temperature Tables for the Year 1869.* Published by the authority of the Meteorological Committee. Part I., January—March, 1869. Stanford. 4to, 73 pages, 37 plates.

THE preface to the report is so terse and informing, that we transfer it to our pages, affording as it does a clear insight into the mutual relations of the various bodies who are jointly concerned in the organization of the system of observation, the first result of which is the second publication at the head of this article.

### "PREFACE.

"The Meteorological Committee consists of gentlemen who were nominated in 1866 by the Royal Society, at the request of the Board of Trade, for the purpose of superintending the Meteorological duties formerly undertaken by a Government Department, under the charge of Admiral FitzRoy.

"The Committee are credited with a sum of £10,000, voted annually in the Estimates, for the administration of which they are wholly responsible, and over which they are given the entire control.

"The Committee hold a meeting of some hours' duration at least once a fortnight, when every subject on which action has to be taken by their executive officers receives their careful consideration. The duties of the Committee are onerous, and *entirely gratuitous*; they were accepted, and are very willingly performed by the members, on account of the earnest desire they severally feel for the improvement of Meteorological Science.

"The Committee consists of the following members:—

"GENERAL SIR E. SABINE, K.C.B., President of the Royal Society, *Chairman.*

MR. FRANCIS GALTON.

MR. GASSIOT.

THE HYDROGRAPHER OF THE ADMIRALTY.

DR. W. A. MILLER.

MR. DE LA RUE.

MR. W. SPOTTISWOODE.

Colonel W. J. SMYTHE, R.A."

There is an old adage that "one should never look a gift horse in the mouth;" and when eight such eminent scientific men as those above



named give such considerable gratuitous services, it seems almost ungracious to criticize them, but they state that the duties, &c., "are very willingly performed on account of the earnest desire they severally feel for the improvement of meteorological science." This being the case, they can surely hardly object to their work being fairly criticised by those whose feelings are identical with their own. But that they or their officials do so, or that they consider themselves superior to any hints from outsiders, seems almost evident from the fact that not one suggestion ever made in these pages has yet been adopted.

We are glad to find that the Committee are aware of the great loss which they have sustained through the resignation of Dr. Stewart; our earnest hope is, that although the connection between Dr. Stewart and the Committee is severed, his interest in, and consequent aid to, the progress of meteorology will not be lessened. We know nothing of the cause of his resignation, but we know no greater loss which the committee could have sustained.

After adverting to the resignation of Dr. Stewart, the report proceeds to the subject of Ocean Meteorology, which is under the special control of Captain Toynbee, who appears to exercise praiseworthy rigour in rejecting registers of observations the quality of which is at all doubtful. No decision as to the mode of publishing the results has yet been arrived at. Presentations of charts, &c., have been made to various captains whose "logs" were kept in the best manner. The report sketches the history of the anemometers constructed in accordance with the resolution of the British Association in 1857, and of the discussion of the observations made therewith, which, although carried out in conformity with the opinion of no less an authority than the late Lord Wrottesley, F.R.S., is apparently not highly esteemed by the Committee, as they propose to begin *de novo*. Passing reference is made to the improvements recently effected in thermometers for observations on the temperature of the sea at great depths, and to the collection and supervision of the instruments belonging to the office.

#### TELEGRAPHY AND WEATHER WARNINGS.

This is the second head of the report, in the very first paragraph of which we find statements respecting alterations in the stations which seem to us suggestive of further improvement, *e. g.*—

"Their (*i.e.* stations) number is now 20 (including Loodon where the reports are made by the clerks in the Meteorological Office)."

Repeated inquiries on this subject have been made to us, and we confess the vagueness of "London" and the difficulty of obtaining a good site for observations in the metropolis are difficulties which will be appreciated by all. But even if the Committee are unable or unwilling to obtain observations from Greenwich Observatory, to which there is telegraphic communication, they might surely obtain it from their own establishment at Kew, or failing that, they might indicate,

even if only by the postal district, to what part of the vast metropolis their observations refer.

"The substitution of St. Ann's Head, at the entrance of Milford Haven, for Weymouth, has been a most useful change. The development of Telegraphic communication &c."

Do we not here see indication of the desirability of further changes? Weymouth being given up, the south-coast stations now are Penzance, Plymouth, Portsmouth, Dover; would it not be desirable to substitute some point in the Isle of Wight for a sheltered spot like Portsmouth; and if the Scilly Isles telegraph be found to work well, a station in those islands would surely be desirable, free as they are from elevations which would distort the true direction of the wind.

We are glad to notice that the committee no longer repudiate storm warnings, but actually quote evidence in favour of their accuracy; and that the issue of barometers to small fishing villages is continued.

#### LAND METEOROLOGY OF THE BRITISH ISLES.

This is the third subject noticed in the report, but as it mainly refers to the second work on our list, we need not dwell upon it twice over.

This very interesting and on the whole satisfactory report closes with eleven appendices, one of which is a very lucid paper on the principle of the Pantagraph designed by Mr. Galton, F.R.S., a member of the Committee.

#### QUARTERLY WEATHER REPORT, NO. I.

The second work under notice is most welcome and satisfactory. It is not perfect (where is perfection to be found?), but we know of no publication the first number of which promised so well, or which we could more cordially commend to the notice of our readers; and having done so, our notes will partake somewhat of the character of a running commentary.

Before proceeding to analyse this Quarterly Report from a meteorological point of view, we cannot help expressing our astonishment that several offences against *Lindley Murray* have escaped notice; we do not quote them, since their presence must be accidental.

The introduction states the dates at which observations commenced at the various observatories, and that after overtaking the arrears the publication will be quarterly, it then proceeds to point out that facsimile reproduction (on reduced scale of the curves produced by the instruments), was the only mode of doing justice to the observations, and it briefly refers to the invention by Mr. Galton of an instrument which will effect this.

The introduction then describes the various curves given in the plates at the end of the volume, and it tells us that—

"The reading for any epoch can be obtained by the use of a rule or of a glass plate with a straight line engraved on it. This line may very advantageously bear the time scale, which, if thought requisite, may be even divided to show hours."

We regret that it did not occur to the committee to instruct some

scale maker to prepare a number of such time scales upon horn (like those in Piddington's and other works on the wind), and supply one in a pocket with each copy; a large number being required, their accuracy would have been as much greater, as their cost would have been less, than that which each separate student of the curves is now compelled to incur.

One paragraph in the introduction we commend to the notice of engineers, architects, contractors, and those meteorologists who have been sceptical regarding the high pressures recorded at Greenwich and Bidston (Liverpool) Observatory:—

“This table is obviously insufficient, at least in the case of storms, for whereas the highest pressure which is given is 36 lbs. and the corresponding velocity is 85 miles an hour, velocities and pressures respectively exceeding these values have been not unfrequently registered at our own observatories, and also by Mr. Hartnup at the Bidston Observatory.”

(*To be continued.*)

## A GUIDE TO SUMMER TEMPERATURE.

*To the Editor of the Meteorological Magazine.*

SIR,—If the correspondent in your June number had continued his investigations during the years 1865—69, he would have found that warm summers are not always preceded by a warm and dry January or February. I do not say that this contradicts the law which he announces, though it shows that the converse of the rules from which the law is deduced does not hold good.

The following table is compiled from Mr. Glaisher's remarks on the meteorology of England, published quarterly:—

Years.	Rain in January.	Temp. in January. (Mean of 99 years, 36·2)	Rain in February.	Temp. in February. (Mean of 99 years, 38·4)	Mean Temp. April to August inclusive.	Diff. of Mean Temp. April to Aug., from 55·7 mean of 99 yrs.
	in.	deg.	in.	deg.	deg.	deg.
1865 ...	3·3	36·3	1·9	36·6	58·5	+2·8
1866 ...	3·7	42·6	4·0	40·5	55·8	+0·1
1867 ...	2·8	34·2	1·2	44·7	56·4	+0·7
1868 ...	4·2	37·2	1·3	43·0	59·7	+4·0
1869 ...	2·9	41·1	2·3	45·3	56·3	+0·6

In each of these years the temperature of the five months, April to August, was above the mean of 99 years, and not in any January or February was the rainfall below an inch; and whilst January, 1866 (the warmest January during the five years), was followed by a summer 0°·1 only above the mean; the coldest January, that of 1867, was followed by a summer 0°·7 above the mean, and the January of 1868, which was only 1° above the average, with 4·2 in. of rain, was followed by the warmest of the five summers—one warmer than any of those indicated by your correspondent.—Your obedient servant,

D. A. FREEMAN.

*Upper Tooting, S. W., 17th June, 1870.*

## JULY, 1870.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which ·01 or more fell.	TEMPERATURE.				No. o Nights below 32°
		Total Fall.	Differ- ence from average 1860-5	Greatest Fall in 24 hours.		Max.		Min.				
				Dpth	Date.				Deg.	Date.		
											Inches.	
inches	in.	Deg.	Date.	Deg.	Date.	In shade below 32°	On grass					
I.	Camden Town .....	1·22	— ·57	·31	25	11	90·8	22	44·6	2	0	0
II.	Maidstone (Linton Park) .....	1·95	— ·03	·42	31	11	91·0	22*	43·0	2	0	0
	Selborne (The Wakes) .....	·49	— 1·71	·10	13	7	83·7	8, 25	42·5	8, 29	0	0
III.	Hitchin .....	1·20	— ·70	·52	9	10	80·0	21·	45·0	1	0	0
	Banbury .....	1·09	— ·97	·53	5	9	83·8	22	43·0	2	0	0
IV.	Bury St. Edmunds (Culford) .....	2·00	+ ·01	·80	15	8	83·0	24	41·0	1	0	0
V.	Bridport .....	·66	— 1·45	·47	31	6	87·0	24	43·0	2	0	0
	Barnstaple .....	1·17	— 1·69	·60	5	8	93·5	24	47·0	2	0	0
	Bodmin .....	2·18	— ·93	·53	8	15	83·0	24	51·0	1	0	0
VI.	Cirencester .....	1·81	— ·63	·42	13	8	...	...	...	...	...	...
	Shiffnal (Haughton Hall) .....	1·04	— 1·13	·44	5	7	83·0	23	45·0	2	0	0
	Tenbury (Orleton) .....	1·68	— ·70	·62	8	11	87·8	22	41·0	2	0	0
VII.	Leicester (Wigston) .....	1·00	— 1·10	·49	6	7	92·0	22	44·0	1	...	...
	Boston .....	·96	— 1·34	·41	5	7	87·0	20	46·4	2	0	0
	Grimsby (Killingholme) .....	·94	...	·54	11	8	80·0	20	48·0	1, 2	0	0
	Derby .....	·79	— 1·40	·31	5	9	85·0	23	48·0	1	0	0
VIII.	Manchester .....	...	...	...	...	...	...	...	...	...	...	...
IX.	York .....	·48	— 1·46	·33	3	4	82·0	23	48·0	2	0	0
	Skipton (Arncliffe) .....	·59	— 2·64	·40	3	3	91·0	23	39·0	2	0	...
X.	North Shields .....	·55	— 1·26	·16	3	10	76·2	23	47·2	1	0	0
	Borrowdale (Seathwaite) .....	1·50	— 6·64	...	...	...	...	...	...	...	...	...
XI.	Cardiff (Town Hall) .....	...	...	...	...	...	...	...	...	...	...	...
	Haverfordwest .....	2·21	— 1·09	·86	9	8	88·5	24	45·5	2	0	0
	Rhayader (Cefnfaes) .....	1·98	— ·87	1·12	31	7	...	...	...	...	...	...
	Llandudno .....	·54	— 1·75	·14	1	6	93·8	23	49·0	29	0	0
XII.	Dumfries .....	1·27	— ·98	·52	3	10	90·0	24	47·0	2	0	0
	Hawick (Silverbut Hall) .....	2·04	...	·57	10	12	...	...	...	...	...	...
XIV.	Ayr (Auchendrane House) .....	2·02	— ·14	·70	7	9	82·0	23	41·0	3	0	0
XV.	Castle Toward .....	2·68	— ·46	·74	3	18	83·0	24	41·0	3	0	0
XVI.	Leven (Nookton) .....	·97	— 1·30	·28	7	12	82·0	24	41·0	29‡	0	1
	Stirling (Deanston) .....	2·05	— 1·35	·39	20	13	84·2	24	38·7	29	0	0
	Logierait .....	·86	...	·24	10	8	...	...	...	...	...	...
XVII.	Ballater .....	1·55	...	·63	11	7	85·0	24	36·0	29	0	...
	Aberdeen .....	3·45	...	1·92	11	9	76·0	23	47·2	3	0	0
XVIII.	Inverness (Culloden) .....	1·33	...	·70	11	7	76·9	23	48·3	3	0	0
	Portree .....	4·17	— 1·90	·90	20	16	...	...	...	...	...	...
	Loch Broom .....	3·62	...	1·04	5	15	...	...	...	...	...	...
XIX.	Helmsdale .....	·72	...	·19	15	12	...	...	...	...	...	...
	Sandwick .....	1·33	— ·56	·24	14	14	66·7	25	43·0	29	0	0
XX.	Cork .....	1·01	...	·48	17	7	...	...	...	...	...	...
	Waterford .....	·47	— 2·84	·27	16	4	80·0	31	52·0	2, 3	...	...
	Killaloe .....	1·30	— 1·89	·38	14	14	89·5	24	41·0	6	0	0
XXI.	Portarlinton .....	1·17	— 2·37	·67	16	10	84·5	24	45·0	26	0	0
	Monkstown .....	...	...	...	...	...	...	...	...	...	...	...
XXII.	Galway .....	3·43	...	1·02	7	10	84·0	28	45·0	7	0	0
	Bunninadden (Doo Castle) ...	1·66	...	·36	31	14	82·0	24	36·0	27	0	0
XXIII.	Bawnboy (Owendoon) .....	...	...	...	...	...	...	...	...	...	...	...
	Waringstown .....	1·87	...	·40	7	10	84·0	23*	45·0	6	0	0
	Strabane (Leckpatrick) .....	1·76	..	·42	7	15	82·0	23‡	40·0	27	0	0

\* And 25. † And 24. ‡ And 30.

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

# METEOROLOGICAL NOTES ON JULY.

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.

CAMDEN TOWN.—Stormy all day on the 11th, TS at 7.4 p.m.; TS on 26th, commencing at 5 a.m., and continuing till 8.45 a.m.; H at 4.15 p.m. on 1st.

LINTON PARK.—T on 9th, 11th, 16th, 26th, and 31st, but mostly in the distance. A dry, hot month, as the little rains we had were followed by dry, scorching weather. Winds variable, but mostly S.W. and N.E. Bar. steady and generally high. Grass and other green crops suffering much, but other things good; harvest early; the greatest rainfall in one day was .42 in. on the 31st, being also the greatest fall on one day since December, 1869.

SELBORNE.—It is remarkable that the highest and lowest temp. of the month were recorded on the same day (the 8th), the highest being quite exceptional. There has been much more rain in all directions within a few miles than at Selborne. T at 11 a.m. on 9th, at 3 p.m. on 16th, at night on 24th, at 8 a.m. on 25th, and repeatedly in the course of the 26th, with heavy rain at Tisted, three miles distant, but not any at Selborne. Cloudy towards the end of the month, with fogs, very oppressive.

BANBURY.—T on 2nd, 9th, and 25th; L on 8th; T and L with R about 6 a.m. on the 1st of August.

CULFORD.—T on 1st, 15th, 25th, and 31st. Mean temp. of month, 64°.

BRIDPORT.—TS on 31st, with sheet L; R fell to the amount of 0.47. Wheat cut on the 20th, and pretty general at the end of the month. Eclipse of the moon seen very well here on the 12th. Max. temp. in shade, 87° on the 24th, the highest registered here during the last 12 years; lowest temp. at night, read on 25th, was 65° 0.

BODMIN.—Mean temp. of month, 63° 8. The unexampled drought of nearly four months' duration, has reduced our rivers to mere burns, and dried up most of our wells; the difference between the wet and dry bulbs on the 24th was 16°, the greatest I ever registered. The greatest heat (83° 0) ever registered except once.

CIRENCESTER.—Remarkable for the absence of T, and for keeping up the general character of the dryness of the year and the tendency of the wind to the N. and E. The rain of the 13th was local, without any wind, clouds appearing to be generated on the spot, wasted in steady rain. Seven months rain, 5.42 in. under the average of 20 years.

SHIFFNAL.—Another dry month; although more than an inch of rain fell, all dried up directly by the sun or winds, which latter were chiefly from the N.W. and S.W.; nights comparatively cool, only three, 8th, 30th, and 31st, reaching 60°. Pastures burnt up; swedes almost a failure, mangold wurzel doing well, hay on the uplands hardly worth gathering, wheat good on good land, poor on light. TS in the distance on the 25th at 3 p.m., but only slight R; a sudden change of temp. on the 29th, when max. was 65° and min. 48°. Few aphides and no American blight, thanks to the lady-birds of last year and this spring, none here now. A few humming-bird sphinxs, but very few wasps as yet.

ORLETON.—Another dry and hot month. The pastures very bare and brown. Much wheat cut, and barley carried in the last week. The air generally very dry, and the temp. about 2½ above the average of July. T heard on 1st, 9th, 25th, 26th, and 31st, and L seen on the 8th, 25th and 31st.

WIGSTON.—The mean temp. of the month 1¼° above that of last year, and 1½° below that of 1868. The shortness of grass for cattle is so great that many graziers are keeping their cattle on straw. Corn harvest very general at the end of the month.

BOSTON.—Very hot and dry during the month. Pastures completely burnt up by fierce heat, and lack of moisture. Oats cut here on the 21st, and wheat on the 28th; wheat crops are abundant, and in many places yield 7 quarters to the acre; oats, beans, and late sown barley are light crops. TS on 1st and 25th; no damage from L or R.

GRIMSBY.—The month dry, and rain wanted for the pastures, but this district has fared better than many. Roses bloomed in great perfection; fruit plentiful, and the corn crops good; T at 5.30 p.m. on 11th.

DERBY.—The temp. of the month about  $3^{\circ}$  above the mean, but still  $4^{\circ}$  below the memorable July of 1868. Rainfall only about one third of mean, but rather more than double July 1868; several TS occurred in the neighbourhood without reaching Derby, in Spondon, 3 miles distant no less than 1.37 in. of R fell in about half-an-hour. Wheat is described as looking beautiful, and many other crops most flourishing, notwithstanding the long drought.

SKIPTON.—Unusually dry and hot; I never registered so little rainfall (it is only about one fifth of the average).

#### W A L E S.

HAVERFORDWEST.—A very fine warm month, considerable R during the first nine days; more than the average number of days above  $70^{\circ}$ ; great heat from the 21st to 25th, preceded by dense sea fogs, so dense as to seriously interfere with the arrival and departure of the Irish and Bristol steamboats. Air extraordinarily dry during the great heat of the 22nd, 23rd, and 24th, the difference of wet and dry bulb being respectively: dry,  $80^{\circ}$ , wet  $68^{\circ}$ ;  $83^{\circ}$ ,  $70^{\circ}$ ; and  $86^{\circ}$ ,  $68^{\circ}$ ; the heat of the 24th ( $88^{\circ}.5$ ) was greater than any day for 20 years past; the nearest approach to it was on the 4th of August, 1856, when it was  $87^{\circ}.2$ , and the night temp.  $56^{\circ}.2$ , showing the mean of day and night to have been the greatest on the 24th of this month, the night temp. being  $56^{\circ}.5$ . T and L on the morning of the 25th with scarcely any rain; sheet L and distant T on the night of the 31st, heat most oppressive. Scarletina still lingering and still fatal. I find, on reference to back registers, that the mean heat of 11th July, 1859, exceeded that of the 24th of July, 1870, by  $0^{\circ}.4$ , the day being  $86^{\circ}.4$  and the night  $59^{\circ}$ , against  $88^{\circ}.5$  and  $56^{\circ}.5$ .

RHAYADER.—A remarkably dry, hot month; wind generally N.E. or N.W.; water very scarce. On 31st a TS, with heavy rain.

#### S C O T L A N D.

DUMFRIES.—On the night of 3rd there was a heavy fall of rain, and showers were frequent up to the 10th; from thence to 15th, fair and fine; rain on 15th and 16th; the latter half of the month warm and droughty; rainfall considerably below the average. At the beginning of the month the country looked fresh and green, at the close the pastures were brown and the soil parched. Harvest commenced by cutting oats on 28th, and will be general round Dumfries by the 8th of August; T on 9th and 16th.

SILVERBUT HALL.—TS on the 10th and 16th; that of the 10th was confined to two thunderclaps only, but one of them, which occurred at half-past 4 p.m., was perhaps the loudest and most startling peal ever heard; it was followed by .57 in. of rain in about two hours; the storm of the 16th was comparatively mild, only .44 in. rain fell; no rain has fallen since; a copious supply would be gladly welcomed, as the turnips and pastures are suffering severely.

AUCHENDRANE.—The bar., ther., elastic force of vapour, dew-point, and evaporation, are all in different degrees above our July mean, but the bar. range, rain, humidity, wind, and cloud, are all below the mean, the evaporation more than double the rainfall; the rivers are now much below the standard gauge; the weather has been very fine for all purposes, and no thunderstorms.

CASTLE TOWARD.—The weather on the whole has been very favourable for vegetation and every kind of farm and garden work; very warm since the 22nd, too warm for vegetable gardens, but the flower gardens and ribbon borders enjoy it, and are now very gay; grain crops good, and promise an abundant and early harvest; a heavy crop of hay is secured in fine condition.

DEANSTON.—Showery during the first week, dry afterwards for about a week, then fine rains from the 15th to 20th, afterwards very dry and hot to the end of the month, with cooling easterly wind at night. On 29th, ther. on grass  $33^{\circ}.5$  at night; pastures very good, hay abundant, and all crops fair and very early; some barley nearly ready for cutting.

LOGIERAIT.—The rainfall this month has been very small, at the same time the

heat has been excessive, and the consequence is that crops of all kinds, especially cereals and pasture lands, are much burnt up.

BAILATER.—Excessively hot and dry from the middle of the month to the end, and the crops suffering considerably. TS on 11th, and between 1 and 2 a.m. on 16th. Streams lower than almost ever known before.

ABERDEEN.—A warm, quiet month and dry, in spite of the heavy torrents of rain; after the rain of the 11th (1.92 in., but at Rubislaw two miles to W.S.W., it was only .97), the soil was quite dry 4 inches below the surface. 11th, 1.30, T almost uninterruptedly till 3.30 p.m., with vivid L and heavy rain; T never more than one mile distant. At 9 p.m. the rain since 9 a.m. measured .95; on Saturday, the 16th, TS from 1.30 a.m. to 2.30 a.m. T very frequent, L almost incessant and very vivid, some of the flashes seemed double.

PORTREE.—From the 1st to 7th, and from 13th to 20th wet and generally stormy; from the 22nd to the end extremely hot and dry, not a shower for the last 10 days, a very unusual state of matters in Skye; on the afternoon of the 31st, the sun had appearance of swimming in dark red blood.

LOCHBROOM.—A most beautiful month. Haymaking and ripening are progressing most satisfactorily. On Sunday the 3rd, between 2 and 4, a beautiful and perfect halo was seen around the sun; two days after we had a terrific storm and flood, in certain spots the R was a damaging deluge; on the night of the 24th and morning of 25th we had T and L the most vivid I had ever seen, it continued from 11 p.m. till full daylight, the flashes, bolts, and play of light were terribly grand in the N.W. and N.

#### I R E L A N D.

KILLALOE.—The smallest rainfall in July (except that in 1847 when the fall was only 1.01) for 25 years; remarkable want of sun.

DOO CASTLE.—Dry month, latter end sultry. Cattle have suffered from want of water. Caterpillars one month later this year than last.

WARINGTOWN.—First half of month showery and cool, last days very hot and fine. All crops looking splendid; hay all saved, and a very heavy crop.

LECKPATRICK.—Dry warm month; many Julys with less R than this; but the total of the first five months of this year is 2 in. less than the average, and the total of the first seven months is about  $4\frac{1}{2}$  in. less than the average; ther. was above 80° on two days; the moderate supply of R has been very favourable to the turnip crop, which promises to be a good one; great destruction by crows, just as thinning commenced, in a 4 acre field, at least 1 acre was left bare, the same occurred in the drought in 1868.

#### WEATHER REPORT, SELLACK VICARAGE, HEREFORD, JULY, 1870.

*To the Editor of the Meteorological Magazine.*

SIR,—Rain fell on eleven days, to the total amount of 2.58 in. The heaviest fall was 1.34 in. on the 30th.

The drought, though not quite so unbroken as in the preceding months, continued extremely severe, and being accompanied by unusual heat and by frequent dry scorching winds, had now become very disastrous. With the exception of the rain of the 30th—31st, the showers have been very light, short and partial.

Extreme heat prevailed in the third and fourth weeks. The highest temperature (88°) was attained on the 24th, but the thermometer on many days rose above 80° in the shade.

Much distant thunder occurred on the 9th, but there was no storm on that day here. Distant thunder and lightning were noticed in the morning on the 24th. On the 25th thunderstorms passed over from S.S.E. to N.N.W., with a rapid upper-current, the under-current being

E. During that day, the upper-current went slowly round to E., and the under-current to N. At 5 p.m. a very heavy thunderstorm passed five miles to the south, travelling towards W. At 7 p.m. another storm broke overhead, with only a few drops of rain, but with violent thunder and lightning. The latter was near and of a dangerous character. Nearly all the flashes I observed were in the lower regions of the atmosphere, and struck the earth's surface, but no casualties occurred in this immediate neighbourhood. This last storm travelled from N.N.E. Thunder and lightning continued till 9 p.m., with scarcely any rain.

A distant thunderstorm again passed in the S.E. at 7 p.m., on the 26th, apparently of the same dry character; its motion was from N.N.E.

At 6 a.m. of the 31st a thunderstorm of terrific violence arose in the S.E., and passed slowly over this place, being immediately overhead at 7 a.m. 1·34 in. fell in 35 minutes, this being the most violent storm which has occurred here since August 13th, 1857, (with the exception of the storm of September 3rd, 1867, when 2·44 in. fell in 45 minutes.) The thunder and lightning were extremely heavy. During the half-hour of the storm there were several periods of some minutes during which no rain fell. Some idea may therefore be formed of the extraordinary down-pour which occurred in the intervals. The storm travelled with a S.E. by E. upper-current, a gusty N.N.E. wind prevailing on the earth's surface. The last rumblings were heard in the N. about 8 a.m.

At 7 p.m. on the same day, there fell, as hail, ·10 in. in about a minute and a half. Through the evening and till midnight there was distant thunder and vivid lightning in the S.S.W. and S.W.

On the afternoon of the following day we had a remarkable wind-squall. Incessant distant thunder had occurred from 3 to 4 p.m. in N.E., the clouds slowly travelling from E., with a light southerly breeze on the earth's surface. Between 5 and 6 p.m. an extremely black cumulus formed in the S.S.E., when from a dead calm a violent wind arose in a few minutes from E. It lasted here about a quarter of an hour. During this time, the clouds in the S., about four miles distant, were traversed by frequent forked lightning, but the thunder was inaudible, or nearly so, through the roaring of the wind. The gust extended itself to the low cloud fragments, which moved with extraordinary rapidity. In Ross churchyard a large elm was blown down, destroying some of the grave-stones. Soon after 6 p.m. the lightning ceased, and in a few minutes this violent wind was again succeeded by a dead calm. The barometer rose about 4-100ths during the squall.

Of the extent of this curious storm I have not yet been able to obtain information, but the wind seems to have blown with greatest force a little to the S. and S.E. of this place, while some miles to the N. and at a greater distance from the cloud, it was much less felt.

My gauge is a Casella 5 inch, tested.

W. CLEMENT LEY.