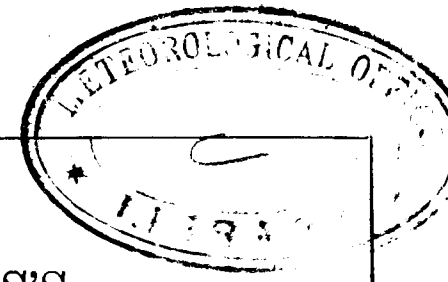

SYMONS'S

MONTHLY

METEOROLOGICAL

MAGAZINE.

VOLUME THE FIFTH.

1870.

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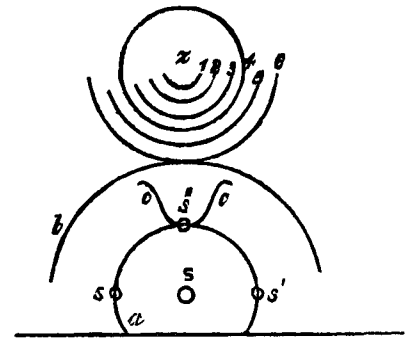
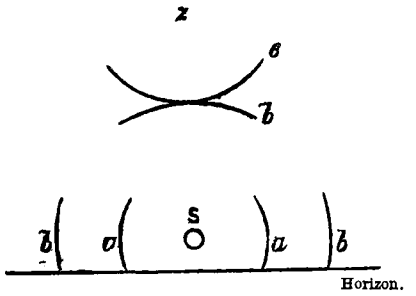


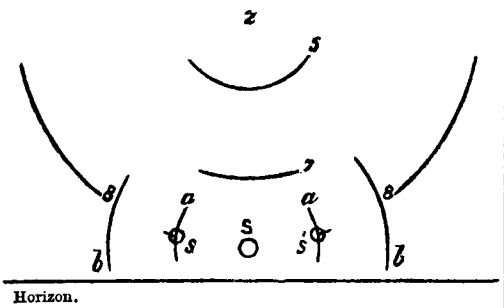
Aberdeen, 2 p.m.

Fig. 2.



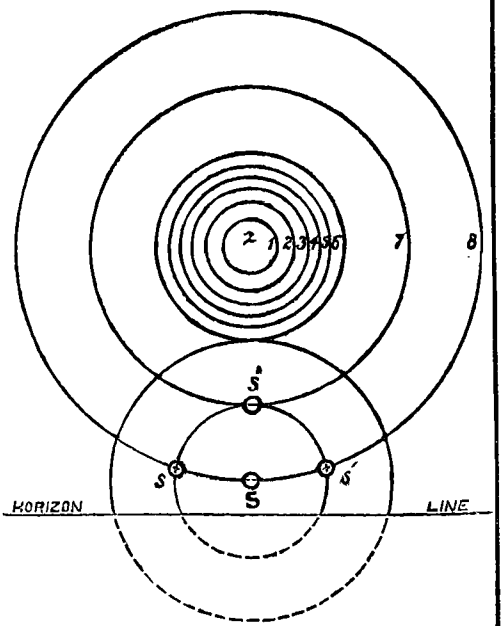
West Hill, Skene, 2 p.m.

Fig. 3.



North Kinmundy, New Machar, 2.30 p.m.

Fig. 4.



The System completed.

SOLAR HALOS SEEN IN ABERDEENSHIRE, JANUARY 23RD, 1870.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

XLIX.] FEBRUARY, 1870. [PRICE FOURPENCE or 5s. per ann. post free

SOLAR HALOS SEEN IN ABERDEENSHIRE.

SEVERAL of our Aberdeenshire correspondents have favoured us with accounts of the halos and parhelia witnessed by them on January 23rd, 1870.

The display as seen from Aberdeen, about 2 p.m., was singularly complete, and is but faintly indicated by fig. 1, wherein S is the sun (at about 11° above the horizon) s, s′, s″ are mock suns, produced by the contact of the primary solar halo A, fig. 1, with the zenithal halos (if the term is admissible as descriptive of circles having the zenith for their common centre), shown more clearly as 7 and 8 in fig. 4, where the rings are carried through the mock suns.

At no one station, or time, was the system seen complete as represented in fig. 4, but the fragments will readily be identified, the lettering being the same in all the figures, viz., Z being the zenith, 1, 2, 3, 4, 5, 6, 7, and 8 circles having the zenith for their centre, A and B two ordinary halos, having, of course, the sun S for their centre, and three mock suns s, s′, s″ at the intersection of the zenithal halos, 7 and 8 with the primary halo A.

The horn-like figure C, was only visible for a short time, as it rapidly changed into a segment of 7, as in fig. 3. It was not a mere fancy on the part of the observer, for it is similarly described by two observers. "It had at first the form of the horns usually put on the head of Moses, and then spread out into part of a circle." Another says—"From each side of the mock sun s″ there was a prismatic horn-like process proceeding outwards and upwards, and curving more outwards at the extremity. This may have been an optical deception, as one observer considered the appearance as a crescent or part of a small circle, concave upwards."

We think our readers will join us in thanking our northern correspondents, Rev. A. Beverly, Mr. Cruickshank, and others, for enabling us to place upon record so complete a representation of the phenomena.

NEW INSTRUMENTS.

Snell's Aneroid Hygrometer.—During a rain gauge examining tour in the West of England, we were more than once asked what we thought of Snell's Aneroid Hygrometer. Acknowledging profound ignorance of any such instruments, and finding from enquiry that they

were made by a private gentleman residing at Saltash, we made it a point when passing through to call upon him, and found that he had designed the rather ornamental instrument shown in figs. 1 and 2. Its construction is very simple—a piece of whipcord, dipped in some solution (probably salt and water), fastened at one end, is wound two or three times round the axle, on which the recording needle is fixed; it then passes upwards over a pulley, and has a leaden weight attached at the other end to keep the string tight. That it is a new invention so far as Mr. Snell is concerned, we have no doubt, nor do we recollect any of the old cord hygrometers so compact in form. The name certainly requires explanation; aneroid was puzzle enough, the present addition is almost incomprehensible. Not having time to test it ourselves, we submitted it to Mr. Kesteven, who reports as follows:—

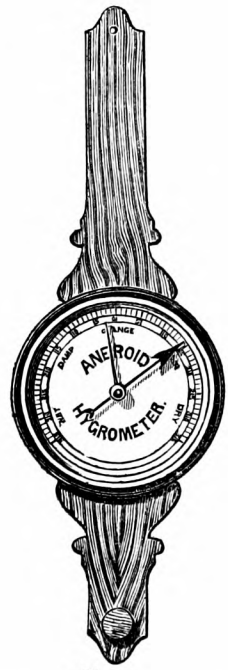


Fig. 1.

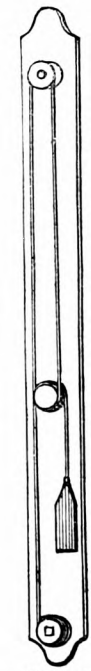


Fig. 2.

"SIR,—Herewith I return you the Snell's Hygrometer, upon which you asked me, some time since, to make observations as to the fulfilment of its professed object—viz., to point out impending changes of weather.

"I have kept it exposed to the air, outside of a window, protected from rain, and have carefully noted its movements.

"It is extremely sensitive to the slightest changes of atmospheric dryness or moisture, its rise or fall often anticipating changes of the barometer, and of the wet and dry bulb hygrometer. It is so far uniform in its susceptibility, that a pretty accurate scale could, I think,

be constructed, of its indications of the per-centage of moisture, corresponding with the humidity as calculated from the wet and dry bulb. Its inventor, I believe, does not claim for it the scientific precision of thermometric reading, he puts it forward merely as an instrument useful for gardeners. I believe it capable of being rendered more exact than it is. The scale of its index, to be comparable with the per-centage rendering of an ordinary hygrometer, requires re-adjustment. For instance, the mean moisture of the air for sixteen days in December last, afforded by Snell's hygrometer, was ·70, while that by the wet and dry bulb was ·86, but then the proportional difference was day by day nearly the same; therefore, by a more extensive series of observations, or greater delicacy of mechanism, it may be capable of much closer correspondence.

"The instrument, even as it is, will be found of great use to all those to whom the character of the coming weather is of importance.

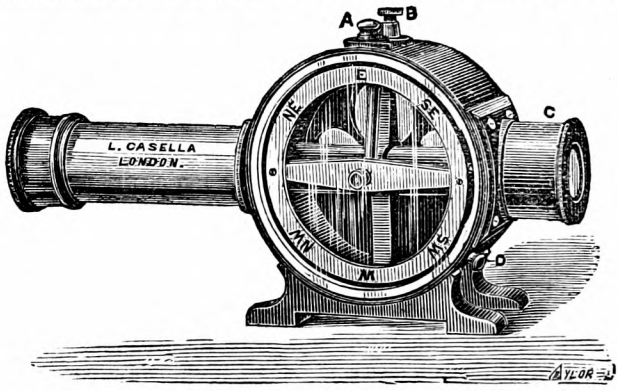
"It must be carefully adjusted in the first instance, and then requires no further interference, but speaks faithfully for itself to the ends it professes to serve.—W. B. KESTEVEN, F.R.C.S."

Browning's Guinea Aneroid.—The title of this instrument indicates its principal characteristic. When a maker, with a character to lose, brings out a new instrument at half the price usually charged second-hand, one feels inclined to think that there must be a mistake somewhere. There is none, however, in the fact, that Mr. Browning is prepared to supply for the sum named, an aneroid at least equal in quality to those sold a few years since at five times the price It is $3\frac{1}{2}$ ins. diameter, and $1\frac{1}{2}$ in. thick, is equally adapted for travelling, suspension, or standing on a table or mantel, and though, of course, not of the best quality, it is a good serviceable instrument, far superior to many sold at two or three times the price.

Pastorelli's Kew Standard Barometer.—We do not like quoting prices in such notices as the present, but just as we have been already once driven to it, so are we in this case. There is nothing very new in the form of instrument or its mounting, but there is decided novelty in the result of the formula $\frac{q}{p}$, if q represents quality and p price. Seriously, however, we believe that in drawing attention to this instrument, we are benefitting many observers quite as much as the maker, who now offers for three guineas a standard barometer, brass mounted, divided to show hundredths, and guaranteed not to be more than one-hundredth in error at any part of the scale. One chosen, haphazard, from the maker's stock, has been tested by us with most satisfactory results, but what is more, it has, by the courtesy of Dr. Stewart, been rigorously tested in the vacuum chamber at Kew, and is found to be perfectly correct for all ordinary pressures, and from 27 in. to 31 in., never to be more than 0·01 in. in error, thus confirming the maker's guarantee. While, therefore, it will not (is not intended to) compete with first-class standards, it places within the reach of most persons a degree of accuracy, quite sufficient for all ordinary purposes, and,

therefore, we believe its introduction is a decided help to the progress of meteorology.

The Casella-Galton Pocket Altazimuth.—The twin names prefixed to this instrument, lead one to expect (1) superior workmanship, (2) compactness and strength of design, coupled with great accuracy. If any one is competent to decide on the requirements of travellers, it surely is Francis Galton, F.R.S., the talented author of "*The Art of Travel*," and other delightful works. He, jointly with Mr. Casella, has long been striving to give in the smallest possible space, and with the least weight compatible with perfect solidity, the means of accurately measuring angles of altitude and azimuth; the result of their labours is the beautiful little instrument shown in the annexed figure, which



is half size. The dimensions being of some importance, we give the outside measurement of the case, 6 in. × $3\frac{1}{2}$ in. × $1\frac{3}{4}$ in., weight (including morroco case) 14 ozs. The fundamental parts of the instrument are a 3-draw telescope of about 10 in. focal length, having a micrometer wire at its focus near the eye end C. The eye piece has a large field, and through it the observer can not only see the object through the telescope, but also the micrometer wire, and the divided edge of the two discs. The disc for azimuth observations is merely a compass ring, divided on its edge as well as lettered on its face. It is two ins. diameter, and divided only to whole degrees, but owing to the power of the eye-piece, and the solidity of the instrument, we find it more accurate than a very fine $3\frac{1}{2}$ in. azimuth compass divided to half degrees. The compass is clamped by pushing forwards the slide A, and is also provided with a steadying pin at D. Angles of elevation are ascertained with equal accuracy by means of a disc heavily weighted in one quadrant, and divided on its edge the same as the compass ring. It is clamped by the pin B. The lower portions are formed as a foot, and the sides of plate glass, and thus this *multum in parvo* instrument forms a very delicate clinometer; but there is no end to the purposes for which it may be used. We do not see how it can be further improved, its accuracy, compactness, and strength are all that can be desired.

RAINFALL AT HOBART TOWN.*

Lat. 42° 53′ S. ; Lon. 147° 21′ W.

YEAR.....	1841	1842	1843	1844	1845	1846	1847	1848	1849
	in.	in.	in.	in.	in.	in.	in.	in	in.
January.....	·03	1·83	·55	2·01	·58	1·38	·73	1·04	·72
February	3·10	1·05	·11	·34	1·91	2·64	·07	·79	1·02
March	·33	·07	·02	3·22	1·55	2·15	2·67	1·18	2·37
April.....	1·11	·89	1·96	·92	·24	2·68	1·74	·51	1·46
May	·53	2·09	·10	2·24	·72	·65	1·49	4·38	3·59
June	1·23	4·41	1·91	2·74	4·27	2·29	·56	1·12	2·46
July	1·01	3·46	2·97	2·12	·72	2·20	1·73	2·43	5·99
August	1·32	·99	1·09	1·16	·63	1·53	·60	2·66	2·74
September ...	·82	1·08	·99	7·14	·73	·82	·39	1·84	1·91
October	2·41	1·78	1·47	2·57	1·19	1·61	1·74	1·27	1·41
November.....	1·75	5·84	1·70	1·56	3·75	2·87	2·21	4·04	8·94
December	·31	·11	·56	·23	·39	1·14	·53	2·36	·90
Totals	13·95	23·60	13·43	26·25	16·68	21·96	14·46	23·62	33·51

YEAR	1850	1851	1852	1853	1854	1855	1856	1857	1858	1859
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Jan. ...	1·20	2·33	1·46	1·43	·54	·48	·99	2·58	·43	4·61
Feb. ...	1·10	·58	·19	1·43	9·15	·18	·68	·43	4·42	1·70
March..	·29	·73	·31	·80	7·60	1·38	1·63	1·04	2·38	·26
April...	2·19	·18	4·99	1·18	2·72	1·17	5·01	·79	·44	1·43
May ...	·57	·74	1·46	1·28	1·22	3·31	2·42	·19	4·14	1·47
June ...	·70	2·35	·22	·35	·33	1·29	1·15	3·42	1·12	3·80
July ...	·30	1·17	3·14	·67	·33	1·42	1·89	1·00	1·75	2·09
Aug. ...	1·31	1·10	3·47	·87	·23	·69	1·70	1·02	10·16	1·70
Sept....	1·67	2·16	3·19	2·91	1·91	2·60	1·79	2·15	1·47	1·39
Oct. ...	·26	·79	1·77	2·59	1·74	1·51	2·22	2·20	·75	1 91
Nov....	4·31	4·19	1·41	·53	3·15	1·49	1·31	2·11	4·03	1·70
Dec. ...	·61	1·66	2·01	·48	1·62	2·73	1·94	·21	. 1·98	1·25
Totals	14·51	17·98	23·62	14·52	30·54	18·25	22·73	17·14	33·07	23·31

YEAR.....	1860	1861	1862	1863	1864	1865	MEANS, 1841—65. amount.	per cent.
	in.	in.	in.	in.	in.	in.	in.	
January.....	2·22	2·12	·93	2·39	·71	·63	1·36	6·0
February	·33	4·16	·22	2·40	1·43	2·94	1·69	7·5
March	1·68	·82	1·09	4·87	1·26	1·93	1·66	7·3
April	2·86	2·51	1·88	2·24	2·18	1·23	1·78	7·9
May	1·70	3·31	2·55	2·40	·84	1·88	1·81	8·0
June	1·30	1·58	1·23	·89	3·71	1·20	1·83	8·1
July	·48	1·84	1·11	5·62	4·44	1·60	2·06	9·1
August	1·11	·61	·97	3·29	3·68	1·23	1·83	8·1
September ...	1·25	2·02	6·26	1·63	1·25	2·55	2·08	9·2
October.....	3·09	5·04	1·72	3·11	2·63	2·42	1·97	8·7
November...	2·76	·89	2·03	4·23	2·06	2·03	2·84	12·5
December	2·27	3·29	1·73	7·60	3·92	3·43	1·73	7·6
Totals	21·05	28·19	21·72	40·67	28·11	23·07	22·64	100·0

* Result of Twenty-five Years' Meteorological Observations for Hobart Town, &c By Francis Abbott, F.R.A.S., Hobart Town, 1866.

[We regret our inability to render the above table complete by giving particulars as to the size and position of the instrument, but none are given in the work whence the table is quoted, the reader being referred to a previous publication, which we do not possess. Nor is any light thrown on the matter by reference to the account of the establishment of the observatory given in General Sir E. Sabine's volume of Meteorological and Magnetical Observations at Hobart Town.

We have added a column showing the mean monthly per-centage of the annual fall, which is principally noteworthy for its regularity.—ED.]

THE CHRISTMAS FROST OF 1869.

WE have to complete the article on the above subject in our last by a few additions, one correction, and the insertion of the following interesting letter. The additions are :—

Min. Temp. in Shade, December, 1869.

Temp. Fah.	Date.	County.	Station.	Observer.
13·0	29	Sussex ...	Uckfield	C. L. Prince, Esq.
14·4	29	Surrey ...	Cobham (Pyports).	G. Dines, Esq.
15·0	29	Durham ..	Gainford	A. Atkinson, Esq.
18·0	29	Essex.. ...	High Roding	Rev. E. Maxwell.
21·5	28	Devon ...	Sidmouth	Dr. Mackenzie.
22·0	28	Cheshire..	Pulford Hall	R. Massie, Esq.
23·3	28	Sussex ...	Worthing	W. J. Harris, Esq.
			Min. on Grass.	
7·6	29	Sussex ...	Uckfield	C. L. Prince, Esq.
17·2	29	,,	Worthing	W. J. Harris, Esq.

The correction is, that the min. at Kirkby Lonsdale was 4° above zero, which will be seen to agree very closely with adjacent stations.

To the Editor of the Meteorological Magazine.

SIR,—Had I known that the frost had been so severe in some parts of the country, I would have sent you the following additions to your table of minimum temperature :—

		Whitby.		
Dec.	Ripon	Hawsker	Lighthouses	Wind at time.
26th	25·5	24·3	26·0	N.W.
27th	16·0	28·5	25·0	E.N.E.
28th	15·5	24·0	24·5	W.
29th	14·5	23·0	24·0	S.
30th	36·0	24·0	28·5	S.W.

Hawsker is one mile from the sea, and 340 ft. above it; the lighthouses are on the cliff edge, and 200 ft. above the sea.

On this coast the snow was much more remarkable than the frost. From noon on Christmas Day till the evening of the next day, snow fell very thickly, driven by a furious wind, and on Monday morning, nearly all the roads were blocked with drifts 6 ft. deep, which at the end of a month have not yet disappeared. I got as near as I could to one drift, that rose 5 or 6 ft. *above my head.*

It will be seen that the N.E. wind was of a much higher temperature here than at stations inland, after it had parted with its moisture. At 10 p.m. on the 27th, the thermometer was still 35° here, while at Ripon it had fallen to 16°, and at Cockermouth to 9°.

It must be borne in mind that, as a general rule, the further a wind travels over land in winter in our latitudes, the colder it becomes. Hence the great cold which the N.E. wind brought to the south and west coasts, and the much higher temperature on the north-east coast, where the wind had just passed over the comparatively warm surface of the sea. Hence too, the high temperature at Llandudno, where the only land winds are S E. and S. Conversely, the S.W. wind is colder here in winter than at most places. This may be seen by the temperature given in the above table for the 30th ult. Another fact which throws light on sea coast temperatures is, that the influence of the sea, both in summer and winter, is comparatively little felt when the wind is not blowing from the sea. The sea coast in fact (unless sheltered on the land side) may be considered to have two distinct climates, according as the wind is from the land or sea.

I must not make this letter long, but will only add that great extremes of cold are necessarily local in their character. I have observed the thermometer not unfrequently 3° or 4° higher at the top of my father's garden at Ripon, than it was at the bottom, only 50 yards distant. When a clear sky and a perfectly still air after a dry Polar wind occur, in an inland valley or plain, the frost will be severe, especially if the heat from the earth is intercepted by snow, but seldom under other conditions. In any case, I believe a rise of 300 or 400 ft. into the air would inevitably reveal a much higher temperature.—I am, Sir, your obedient servant, F. W. STOW.

Hawsker, January 22nd.

P.S.—Since I wrote the above we have experienced a severe frost. On Thursday, the 27th, the lowest temperature of the air was 20°, and on four nights it was between 16° and 17° on the grass. The sky was cloudless from 10 a.m. on Tuesday till Sunday night, except a few hours on Saturday and Sunday mornings. The wind was S. and S.W. till Sunday, when it veered to S.E. at 0·40 a.m.

SEA SPRAY IN RAIN WATER.

To the Editor of the Meteorological Magazine.

SIR,— I observe in the last number of the *Meteorological Magazine* a letter from Mr. J. G. Wood, dated from Chepstow, respecting the amount of salt in rain water. I cannot help thinking there must be some error in the experiment he tried. Last year I evaporated the whole of the rain water collected in my gauge, which amounted to 932 cube inches down to about a cubic inch, and then sent it to Professor Voelcker to be analysed for salt, not having the means at command to do so myself. The quantity he found was 0·5 grain to a gallon—this gives 76lbs. 8oz. of salt to an acre. This year I have done the same, and early in January I purpose having it analysed in the same way. I have tested the rain for salt, and found it in rain from the west and

south-west, but none in that from the east. I am situated 18 miles west of Chepstow, and feel the south-westerly gales first. As regards the leaves being blighted with the salt, I am rather disposed to think that the violence of the wind twists the stem of each leaf, and thus causes the leaf to wither, as I have frequently observed one side of a tree or hedge to lose all its leaves, while the other side remains fresh and green, in very exposed situations.—Your obedient servant,

F. J. MITCHELL.

Llanfrechfa Grange, Caerleon, Mon., Dec. 18th, 1869.

SENSITIVE BAROMETERS.

To the Editor of the Meteorological Magazine.

SIR,—There are many passing variations of atmospherical pressure that are not, and cannot be, recorded by either the aneroid, mercurial, or water barometer. I allude to the slight variations constantly occurring, especially during stormy weather, and which would, I think, be exceedingly interesting to notice, if they could be rendered visible, and the waves mapped as they roll along. I was drawn to the consideration of this matter the other night by noticing the effect produced upon one of "Leon Clerc's Benzoline Lamps," or rather upon the flame proceeding from the lamp, during the opening and shutting of the door of my study. The door opens inwards, and if opened sharply the flame of the said lamp instantly shortens in height for a part of a second, and when the door is closed suddenly, the contrary effect transpires. This is not owing to any draught of air, for the flame will remain perpendicular whilst shortening and lengthening, but evidently takes place in and through altered pressure of air. Whilst I am writing, the night is boisterous, and the little lamp flame slightly elongates and shortens at times as the gale sweeps by, evidently indicating, in its quiet way, the variation of pressure. Seen through a good magnifying glass, the alterations are more perceptible. It is in fact a very sensitive barometer in its way. Can it be made still more sensitive? Perhaps some of your numerous readers may think the matter too trivial, but facts are not trifles. I remain, yours faithfully,

A. R. L.

Hengoed, Oswestry, December 13th, 1869.

TRUE TIME, AND HOW TO KEEP IT.

To the Editor of the Meteorological Magazine.

SIR,—One of your correspondents writes about the difficulty of getting a moderately cheap clock to keep good time.

I have had for some years a kind of clock I can recommend, made by Joyce, of Whitchurch, Shropshire. It is in a neat case with glass front, and strikes the hours. It has a wooden pendulum, with a heavy brass bob, price £15; might be a little cheaper in a plainer case; if with compensating pendulum and mercurial weight, which would make it as good as most watchmaker's regulators, it would be £18.

I have also a turret clock by same maker, with Denison's escapement, that goes as well as any clock can be expected to do, and the two will go together for MONTHS, striking almost to the second together. The regulating is done by putting a small weight on the top of the pendulum bob; a small piece of lead as big as a sixpence will increase the rate a few seconds a week, and it can be regulated to a nicety that way.—Your obedient servant, WHITEHALL DOD.

Llanneroh, St. Asaph, January 22nd, 1870.

To the Editor of the Meteorological Magazine.

SIR,—Approximate time may be independently found and kept in the following simple manner:—

On a common drawing board draw a number of concentric circles, about an inch apart, the exterior one being as large as possible. In the centre erect a stiff straight wire, as nearly perpendicular as possible (which may be done with a common square). The length of the wire should be about one-half the radius of the largest circle. Level the board in full sunlight, two or three hours before noon, and as the end of the shadow of the wire in shortening exactly touches the circles, make a small mark at the point of contact. Do the same in the afternoon, without disturbing the board, and then on each of one, two, or three circles, there will be two points. Join these by a straight line which bisect. The straight line drawn through these points of bisection and the foot of the wire will be in the meridian.

The simplest way to take advantage of this meridian line for the determination of time, is to note with a common watch the times of marking the points on the circles, and the mean of such times is the time by the watch at apparent noon, or in astronomical language, 0h. 0m. 0s. apparent time.—I am, &c., G. L. TUPMAN.

Malta, 16th January, 1870.

SNOW AND DECIMALS.

To the Editor of the Meteorological Magazine.

SIR,—·17 inches being one-twelfth of two inches of snow, because, I suppose, it is nearer *that* than ·16 inches—the decimal being really a recurrer. In the case of four inches of snow, is the decimal ·33 or ·34 inches, a recurrer again making its appearance?

How did you arrive at this measurement?—Yours, &c., H.B.C.

Huddersfield.

[We do not think that the measurement of the depth of snow or its reduction to water equivalent is ever sufficiently accurate to give a second place of decimals, but the answer to the question becomes obvious by carrying on the recurrer. ·17 most closely represents ·16′6, and ·33 most nearly ·33′3′. We do not know what the writers on arithmetic from Cocker to Colenso say on this matter, but as many persons stumble when reducing the number of decimal places, we venture to "lay down the law," and to illustrate it by examples:—

I.—If the last figure is less than 5 it is thrown off, and the previous figure remains unchanged, *e.g.*, ·164=·16.

II.—If the last figure is more than 5 it is thrown off, and the previous figure raised by one, *e.g.*, ·168=·17.

III.—If the last figure is a 5 it is thrown off, and *generally* the previous figure is raised, *e.g.*, ·155=·16 ; if the column contains only fives and noughts, the figures preceding the fives must be alternately thrown up and down.

Case I.	Case II.	Case III.	Case IV.
1·672=1·67	1·696=1·70	1·832=1·83	9·555=9·56
1·858=1·86	1·749=1·75	1·751=1·75	1·368=1·37
1·988=1·99	1·858=1·86	2·943=2·94	1·756=1·75
2·143=2·14	1·750=1·75	3·664=3·66	1·925=1·93
2·207=2·21	1·987=1·99	3·880=3·88	1·878=1·88
9·868=9·87	9·040=9·05	14·070=14·06	16·482=16·50

In case I., the rules above given produce a correct result, the sum of the reduced values 9·87 agreeing with that of the unreduced ones. In case II. there is an unusual proportion of high values among the terminal figures, and we, therefore, find the sum of the reduced values too high; in such a case the lowest terminal must be thrown off, and the previous figure *not* raised, even though contrary to rule II., and to what appears common sense. In case II. 1·696 must be represented by 1·69.

Case III. is the reverse of case II.: there is an excess of low values, and the highest of them must be thrown up, so that 3·664 becomes 3·67.

Case IV. illustrates the frequent necessity for disregarding rule III., for the fives there being thrown up give 16·50 instead of 16·48.

H. B. C.'s last question is best answered by reference to *Meteorological Magazine*, vol. II., p. 27.—Ed.]

DIRECTION OF THE WIND AT LINTON PARK, MAIDSTONE, AS TAKEN AT NOON EACH DAY FOR THE LAST TWENTY YEARS.

The following table denotes the number of days the wind blew from the eight cardinal points, or what appeared to be the nearest approach to these points, together with the rainfall and number of rainy and frosty days during great part of that time, from which it will be seen that the past year has been a wet one, whether in consequence of the greater prevalence of south-westerly winds or not is difficult to say, but with the exception of 1861 this theory might be set up as a valid one. Traditionally, the S.W. wind is a moist one in this district, but I must leave the further deduction to be made by those who have studied such matters for a similar lapse of years. Certainly the direction of the wind has not received that attention amongst other meteorological matters which its importance deserves, however much nautical men may have studied it. That I hope the future numbers of your very useful *Meteorological Magazine* will report observations from other quarters, so as to place the matter in the same position you have

done with the rainfall—namely, to tell us in what districts of the kingdom there is a prevalence of certain winds and *vice versa*, and possibly some idea may be worked out, connecting the rainfall with the winds, and other matters bearing thereon.

The following table shows the number of days the wind was in the direction indicated at noon each day.

Year.	E.	S.E.	S.	S.W.	W.	N.W.	N.	N.E.	Not ascertained.	Total Rainfall.	No. of Rainy Days.	No. of Frosty Days.
1850 ...	17	36	21	60	76	38	40	74	3	in.		
1851 ...	14	28	29	53	47	55	59	76	4			
1852 ...	36	32	46	93	40	22	25	69	3			
1853 ...	34	27	25	76	59	36	36	68	4			
1854 ...	32	17	29	100	62	41	36	47	1			
1855 ..	21	32	23	63	36	48	25	115	2	20·84	160	114
1856 ...	14	44	34	99	29	42	28	72	4	27·79	169	89
1857 ...	14	47	37	81	37	38	21	86	4	24·33	137	
1858 ...	16	71	16	73	24	58	19	87	1	16·33	116	93
1859 ...	8	53	21	125	11	59	9	78	1	29·55	151	93
1860 ...	13	27	64	88	29	49	42	54	...	33·66	216	93
1861 ...	12	28	66	110	34	21	45	47	2	24·01	158	85
1862 ...	8	24	77	95	33	18	73	37	...	26·93	195	67
1863 ...	12	31	82	118	29	25	36	31	1	22·75	169	64
1864 ...	30	40	65	66	26	28	35	71	5	21·25	156	96
1865 ...	28	45	59	74	36	29	35	55	4	35·18	172	80
1866 ...	16	32	54	89	71	31	35	31	6	30·82	179	66
1867 ...	13	24	80	72	46	27	59	42	2	26·71	176	94
1868 ...	7	16	73	88	46	27	53	54	2	25·19	137	62
1869 ..	8	23	71	79	46	28	53	54	3	29·09	162	76
Average...	17	34	49	85	41	36	38	62	3	26·30	164	77

J. ROBSON.

REVIEWS.

First Annual Report of the Bournemouth Meteorological Society. Bournemouth : Sydenham's Library. 8vo, 41 pages.

WE do not know the present population of Bournemouth, but well recollect, a few years since, spending a weary time trying to find it on a county map, on which it was not even marked, and now it has become known through the length and breadth of the land, nay it even has a meteorological society to itself. We need hardly say that we rejoice at such a state of things, and we hope that the zeal of the founders and present members will meet with no check. Two papers read before the society are printed *in extenso*, and the titles of five others are given. We hope in future short abstracts of all will be given, and as many *in extenso* as the secretaries think expedient and the funds of the society will permit. The first paper is on the meteorology of 1868, by Dr. Compton; a clear and well-arranged article. One column, however, which would be of much interest if correct, seems to us self-evidently fallacious. The temperature of the sea is an element of high importance in meteorology, medico-climatology, and even as a matter of pleasure in bathing. A table gives the "mean temperature

of the sea" in each month and for the year, and from it we learn that in July the mean temperature of the sea was 70°·1, being 5° hotter than the air; in August 68°·5, being 7° hotter than the air, and so on, the sea being always hotter than the air, and the yearly mean temperature of the sea being 57°·2 or 5°·6 hotter than the air. It is most desirable that the temperature of the sea should be regularly and carefully recorded, but though to our knowledge no careful observations have been made in the Channel, we have no doubt that when they are made, these observations will be proved to be nearly 10° too hot in the summer. Not a word is said as to *how* the observations are taken, or of what the *mean* consists, but we have little doubt that the temperature has been taken too near the shore; it is, to those unused to the subject, surprising how very much the temperature of the sea is raised by running over sands exposed to a noon-day sun. If the values given are correct, we pity the summer residents of Bournemouth, for they can have no reviving sea-breeze to waft refreshment, and as for a "dip in the briny" at 70°·1, we decline it with thanks. The second article is an able one, "On the Climate of Bournemouth," by the Rev. P. H. Newnham, which commences by stating in detail the localities and conditions under which the observations upon which it is based were made, the corrections applied, and every successive step up to the final inferences drawn.

We congratulate the Society on the progress it has already made; we wish it every success, and if its members will set carefully to work at the sea temperature, and show that the values assigned are correct, or that our objections to them are valid, in either case, (no matter which) they will contribute to progress, because they will give well ascertained, and indisputable facts.

The Rainfall on the St. Mary Church Road, Torquay, during the five years ending December 31st, 1868. By W. PENGELLY, Esq., F.R.S. 8vo, 14 pages.

The Rainfall in Devonshire during 1868. By W. PENGELLY, Esq., F.R.S., F.G.S., &c. [Reprinted from the "Transactions of the Devonshire Association for the Advancement of Science, Literature, and Art, 1869." 8vo, 13 pages.]

Two of the capital little monographs in which Mr. Pengelly gives the condensed result of much honest and careful work. Any one who wishes to know how to discuss rain records should obtain the first of these two pamphlets, or still better both of them. We have room only for one extract from the former, but it is one in which we fully concur.

"The mild character of the winter 1868-9 was, of course, noted by everyone. As is common when anything unusual occurs in our meteorological phenomena, the Gulf Stream was supposed to be out of order, and the blame was laid on it. It may be doubted, however, whether, in order to explain the high temperature, it is necessary to do more than to recognize the direct and indirect thermal effects of the protracted heavy rainfall already alluded to.

"1st. Such a rainfall implies the prevalence of wet, that is south-westerly, that is hot winds,

"2nd. It implies an atmosphere super-saturated with aqueous vapour, which, it is well known, greatly retards the loss of radiant heat by the earth.

"3rd. The conversion of water from the vaporous to the liquid state is necessarily attended with the passage of heat from the so-called *latent* to the *sensible* condition. In other words, being no longer employed in doing the work of keeping water in the form of vapour, the heat performs that of raising the temperature of the air.

"4th. Between November 19, 1868, and January 31, 1869, there fell in the Torquay district no less than 1890 tons of rain on every acre of ground. Taking this as the average for the county, and supposing the mean height of the rain clouds to have been no more than 772 yards—estimates both probably below the truth—the caloric into which the motion of the rain of Devonshire would be converted on being destroyed as motion, during the period specified, would be sufficient to raise the temperature of 4·5 millions of tons of water from the freezing to the boiling point.

"5th. But for the condition of the atmosphere, which renders such a rainfall possible, the surface of the earth, in all probability, would have been frozen, and the heat of the sun would have been largely expended in thawing; not having this work to perform, it helped to raise the temperature of the atmosphere beyond that which is usual at that period of the year. With a machinery so multiform and efficient at hand, it does not seem needful to be for ever supposing that the Gulf Stream is guilty of some irregularity of conduct."

Similar in its excellent aim and completeness to the papers by the same author, which we have had the pleasure of describing on previous occasions, it will be sufficient to note the appearance of the second pamphlet mentioned above, and to make one extract. Mr. Pengelly bases his papers exclusively on the returns published in *British Rainfall*, but works them up in a way peculiarly his own—*e. g.*, in order to compare the rainfall of Devon with other counties, he averages every element in the general tables of the publication above referred to, and among the results is the "mean acreage per gauge for each county"—on which column he makes the following remarks:—

"The average number of acres in each county represented by every gauge in 1868 is shown in the fourth column, and was obtained, of course, by dividing the total average [acreage?] of the county by the number of gauges it contains. It appears that this number is least in the case of Middlesex, where there is one gauge for every 7,466 acres; that it is greatest in that of Radnorshire, where every gauge represents 153,993 acres, or upwards of twenty times the Middlesex mean; that in the entire kingdom as a whole, there is one gauge for every 37,029 acres; that in 32 counties this acreage is exceeded; that the counties of Cumberland, Westmoreland, Carnarvon, are amongst the 20 in which this average area is not reached; and that 21 counties surpass Devonshire in the relative number of its rain gauges.

"That Middlesex should be thickly studded with stations at which the rainfall is observed is by no means surprising, but it is eminently creditable to the meteorologists of the three mountainous and thinly peopled districts that have just been named, that for every fourteen gauges in the kingdom generally, there should, on an equal area, be 21 in Carnarvonshire, 24 in Cumberland, and upwards of 28 in Westmoreland.

"It should be remarked too, that in Cumberland there are 11 gauges upwards of 1,000 feet above the sea, three above 2,000 feet, and one as much as 3,200 feet; that in Westmoreland there are five at an elevation exceeding 1,000 feet; and that though only one of the Carnarvonshire series attains this altitude, the returns made from every gauge in the county are, in every respect, complete; they contain full information as to height above the sea level and above the ground, the total rainfall, and the number of wet days. It may also be remarked that of the 14 gauges in this model county, 11 are superintended by Major Mathew, who also has gauges in Merionethshire and in Anglesea."

JANUARY, 1870.

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°. In shade	No. of Nights below 32°. On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	1·38	— ·57	·24	13	17	51·7	8	21·2	28	13	18
II.		Maidstone (Linton Park)	1·66	— ·40	·30	8	21	50·0	15	21·0	27	...	...
,,		Selborne (The Wakes)	2·00	— 1·27	·32	7	14	49·0	3, 16	14·0	28	15	17
III.		Hitchen	1·17	— ·97	·18	13	19	54·0	7	19·0	27	14	..
,,		Banbury	1·33	— ·76	·17	8, 13	18	49·0	4, 17	15·0	28	18	...
IV.		Bury St. Edmunds (Culford)	·89	— ·98	·14	5	12	50·0	7	17·0	27	11	18
V.		Bridport	1·74	— 1·45	·36	11	12	54·0	16	19·0	28	13	...
,,		Barnstaple	3·19	— ·33	·53	7	19	52·0	2	24·0	29	...	...
,,		Bodmin	4·35	— ·84	1·03	30	18	55·0	16	25·0	23	7	15
VI.		Cirencester	2·45	— ·55	·73	8	13	...	...	...	...	...	...
,,		Shifnall (Haughton Hall)	1·50	— ·40	·21	13	17	48·0	7, 16	18·0	26†	19	..
,,		Tenbury (Orleton)	2·33	— ·20	·30	13	19	51·3	77	17·5	28	16	21
VII.		Leicester (Wigston)	1·63	— ·35	·41	14	12	50·0	‡	20·0	25	16	...
,,		Boston	1·25	— ·56	·21	3, 6	19	48·7	1	23·2	28	8	24
,,		Grimsby (Killingholme)	1·26	..	·23	14	19	48·0	4, 8	24·0	27	7	...
,,		Derby	1·43	— ·36	·26	8, 13	21	51·0	7	21 0	27‡	11	...
VIII.		Manchester	3·13	+ ·61	·55	14	18	51·8	2	22·0	26§	12	21
IX.		York	1·68	+ ·10	·30	6	19	50·0	2	19·0	27	9	...
,,		Skipton (Arncliffe)	6·24	+ ·60	1·09	6	15	...	...	...	...	...	...
X.		North Shields	1·60	— ·51	·29	7	18	48·8	4	22·7	27	12	...
,,		Borrowdale (Seathwaite)	...	...	...	..	...	...	...	...	...	...	...
XI.	WALES.	Cardiff (Town Hall)	3·18	...	·62	8	17	...	...	...	...	...	...
,,		Haverfordwest	4·28	— ·77	·88	30	12	52·5	16	23·0	25	12	19
,,		Rhayader (Cefnfaes)	4·49	— ·03	1·00	7	13	49·0	...	19·0	...	10	...
,,		Llandudno	2·80	+ ·26	·42	18	15	52·3	16	28·0	26	8	...
XII.	SCOTLAND.	Dumfries	3·28	— 1·32	·58	13	17	47·0	4, 7	19·0	27	16	..
,,		Hawick (Silverbut Hall)	2·58	...	·49	6	17	...	...	...	...	...	..
XIV.		Ayr (Auchendrane House)	3·54	— ·98	1·05	13	16	53·0	31	21·0	24‖	12	19
XV.		Castle Toward	3·99	— 2·30	·67	7	17	49·0	17	23·0	25	19	24
XVI.		Leven (Nookton)	2·21	— ·66	·61	13	11	45·0	7	19·0	27	16	31
,,		Stirling (Deanston)	3·94	— ·78	·69	7	19	44·8	4, 30	18·3	27	23	...
,,		Logierait	2·40	...	·54	13	11	...	...	...	...	..	...
XVII.		Ballater	1·35	...	·25	3	11	42·5	7	13·0	24	20	..
,,		Aberdeen	1·51	...	·37	13	18	43·8	4, 7	22·9	27	18	29
XVIII		Inverness (Culloden)	...	...	..	.	...	..	...	...	...	...	...
,,		Portree	4·94	— 8·15	·85	30	20	...	...	...	...	...	...
,,		Loch Broom	4·42	...	1·96	12	17	...	...	...	...	...	...
XIX.		Helmsdale	2·96	...	·98	12	13	...	...	...	...	...	...
,,		Sandwick	2·31	— ·98	·75	11	18	45·0	17	30·8	11	3	19
XX.	IRELAND.	Cork	4·76	...	1·19	30	17	...	...	...	...	...	...
,,		Waterford	4·75	— ·11	·91	30	21	41·0	17*	25·0	10	12	...
,,		Killaloe	5·76	+ ·90	1·07	7	18	52·0	16	26·0	25	8	...
XXI.		Portarlington	2·83	— 1·18	·46	30	21	51·0	16	24·0	24	7	...
,,		Monkstown	2·53	— ·86	1·10	30	16	...	...	...	...	...	...
XXII.		Galway	4·11	...	·63	6, 13	17	50·0	17*	24·0	24	7	...
,,		Bunninadden (Doo Castle)	3·31	...	·76	30	19	52·0	16	21·0	25	11	..
XXIII		Bawnboy (Owendoon)	4·43	...	·97	13	17	52·0	16	23·0	25	15	18
,,		Waringstown	3·15	...	·79	30	17	51·0	16	23·0	24	13	21
,,		Strabane (Leckpatrick)	3·66	..	·78	30	15	52·0	17	17·0	25	21	27

* And 18. † And 27, 28. ‡ And 28, 29. § And 27. ‖ And 25.
+ Shows that the fall was above the average ; —that it was below it.

METEOROLOGICAL NOTES ON JANUARY.

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

ENGLAND.

LINTON PARK.—High wind on 8th, and steady frost from 24th to 30th inclusive, otherwise the month a mild and dry one for January. Bar. mostly high after the 15th. Winds various, and, contrary to usual custom, were S. and S.E. the greater part of the last week, when it was frosty; scarcely any S during the month; only 10 days on which the wind blew from the N. or compounds of N.

SELBORNE.—T with violent wind on 7th; high wind with H at 3 a.m. on 8th; T S at 5 a.m. on 12th; white frosts with fog 26th to 30th inclusive.

BANBURY.—High wind on 6th and 7th; slight S on 11th, 18th, 19th, 20th, 21st, 24th, and 25th.

CULFORD.—High wind on 7th and 8th; wind S. and S.W. up to 15th; the remainder of the month S. and S.E. No S has fallen here during the month.

BRIDPORT.—Very heavy S.W. gale on 7th and 8th. L on the 12th; gale on the night of 30th. Frost not severe enough for skating, as the thaw came in early morning of 28th.

BODMIN.—A very heavy gale on 7th from S. to W.N.W. Average temp. for the month 40°·8; average bar. 29·98; max. diff. between wet and dry bulbs 9° on the 24th.

CIRENCESTER.—A violent gale from S.W. on 8th; a moderate winter month, without S, wind or hard frost during the prevalence of the N. and E. winds, which lasted a fortnight; a great amount of uniform cloud throughout, so that only four or five days were bright, the moon at full not dissipating the clouds; no exciting causes have disturbed the general sleep of winter in plants.

SHIFFNAL.—A most variable month; R daily, with one exception, till the 16th. From the 19th frosts with occasional sleet, the last week quite severe. Ther. down to 18° on 26th, 27th, and 28th, and the ice 3½ inches thick. Bronchial attacks most prevalent; much illness, especially among the poor. T S with H and R from the N. about 2 p.m. on 4th; R with stormy wind on 6th, 7th and 8th; fog with high bar. on 16th, 17th, 18th. Woodcocks partially distributed, in some few places very plentiful, in others scarce.

WIGSTON.—There have been about the average of frosty nights for this month.

KILLINGHOLME.—Bar. low, 28·700 at 1 p.m. on 8th, but high and steady from the 17th to 26th. Frost from 25th to the 30th; splendid aurora on 3rd, and aurora like rays of cirri in N. at 11 a.m. on 13th. A queen wasp killed on the 2nd. Small birds singing feebly on 3rd; aconites began to flower on 22nd. A cold but seasonable month; the steady frosts of the latter part have kept vegetation backward without injuring it.

DERBY.—Aurora visible from 8 p.m. to 9 p.m. on 3rd.

MANCHESTER.— Auroræ on 2nd and 8th.

NORTH SHIELDS.—Fine aurora on 8th; L on 20th.

WALES.

HAVERFORDWEST.—The first fortnight constant R; very stormy at times; tremendous gale from the S.W. to N.W. on 7th and 8th. Lowest reading of bar. (corrected) 8 a.m. on 8th, 28·760; from the 18th to the end fine and frosty, except the last two days, which were very cold and wet, and accompanied by a tremendous gale from the S.E.

CEFNFAES.—The month generally fine; the last two weeks more or less of frost. Wind during this time N. and N.E. The violence of the wind between 2 and 5 o'clock on the morning of the 8th was terrific. Only slight covering of S on the low grounds, drifts on the hills, where it remains. Bar. above 29° from 14th to 29th.

LLANDUDNO.—Heavy H between 11 and 12 a.m. on 10th; H again on following day; from 9 to 10 a.m. nearly dark, although neither haze nor thunder cloud. The common violet has been gathered during December and January; in several gardens here, the gèant des batailles rose flowered through the winter. In spite of frost, H, and a little S, the yellow calceolarias are as bright and green in the open ground as those in any conservatory, though in an exposed bed. Honey suckle in leaf on the 1st. S on the distant hills from the 10th to the end of the month.

SCOTLAND.

DUMFRIES.—For the first 8 days the weather was showery, and occasionally stormy; no R fell on the 9th or 10th; from that time to the 18th the weather very variable, two or three changes every 24 hours; from 19th to 30th frosty; thaw on the 31st.

SILVERBUT HALL.—The weather has been very changeable throughout the month, but there were no boisterous winds. Broccoli and cabbage plants have suffered a good deal.

AUCHENDRANE.—Bar., bar. range, amount of cloud, and humidity, have all been more or less above the mean for January, while the ther., force of wind, rainfall and evaporation have all been below the mean. The temp. being low, a high humidity failed to produce a heavy rainfall. Previous to the 16th bar. low and ther. high, afterwards bar. high and ther. low. No gales from the N.E, but several from the S.W., particularly on 30th and 31st, with great rise of temp., and slight fall of R; weather seasonable; river still full.

CASTLE TOWARD.—Wet and very changeable, with several frosty nights up to the 17th. Dry with white frost and fog to the 29th; fine and breezy to the 31st, clearing away the fog. Mail boat two hours behind from Greenock to Dunoon on 24th, when there was a close fog. Seventeen wet days, with little more than half the usual fall; 14 dry days, and only 34 hours sunshine. The month has been remarkable for low temperature, white frosts, fog, and a damp atmosphere.

DEANSTON.—This month began wet and foggy, but mild; on the 11th some S and wind; more S on 12th, 13th, and 14th, and to the depth of 4 inches. From 17th to 28th exceedingly calm; some fogs and frosty; thaw without R on 28th; nights frosty.

LOGIERAIT.—A month of very severe weather; have had little intermission of frost since the close of October; heavy fall of S on 13th, which has mostly disappeared; but February opens with the appearance of continued frost, notwithstanding that the last day of January had a rainfall of ·16.

BALLATER.—Severe cold weather throughout; remarkably little S, but a continuance of hard frosts, preventing all out-door work; both rainfall and temp. below the mean of January.

ABERDEEN.—Bar. above the average of last 13 years; rainfall, temp., and pressure of wind all below the average. The month was comparatively dry, with frequent, though seldom severe, frosts. Hoar frost very frequent, especially towards the end of the month; very little S. Auroræ on 7 nights; solar halos and mock suns on 23rd; splendid auroral arch on 29th.

PORTREE.—The finest and driest month of January on record in these islands; the oldest inhabitant has not seen the like of it.

LOCHBROOM.—This month began beautifully, and continued fine until the 9th, 10th, and 11th, which were stormy; but the 12th was a terrific day, not to be forgotten here for a long time; from that date to the end, January has continued the finest month we could desire. Field operations are far in advance, and the soil is in excellent condition.

SANDWICK.—January has been much drier, and half a degree colder than the mean of last 43 years. The latter half of the month was particularly fine and dry, only ·09 in. of R having fallen during the last 14 days; auroræ on 7 nights. Snowdrops in flower on the 28th.

IRELAND.

DOO CASTLE.—Some severe frosts during the month.

OWENDOON.—First half of the month wet, with only one fine day; second half fine, with only two wet days, that is, the 30th and 31st.

WARINGSTOWN.—First fortnight wet and cold, but the end of the month frosty and very dry up to the 30th; ground drier than usual at this season, and consequently very favourable to farming operations.

LECKPATRICK.—Cold month, the greater portion of the R fell in the first fortnight, only ·03 having fallen between the 15th and 30th. The number of night frosts is remarkable; since 1st of October last, out of 123 nights, there has been frost on the grass on 83 nights.

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L.] MARCH, 1870. [PRICE FOURPENCE, or5s. per ann. post free.

UNDERGROUND TEMPERATURE.

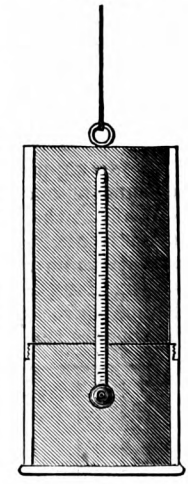
UNDER the title of "Temperature of the Earth at Great Depths," we gave in previous numbers* of this Magazine a detailed account, with engravings, of the arrangements adopted for observing the temperature at various depths down to 1100 feet below the surface, in the bore of the late Hampstead Waterworks Company, at Kentish Town. One slight addition to the arrangements has been made, and only one—viz., the addition of a large plug of felt, which is rammed into the top of the tube, to exclude still further the access of external air. We now give a statement of the results of the first six months' work, as detailed in an account of the observations supplied by Mr. Symons to the Underground Temperature Committee of the British Association, as printed by them in their recently published report.

"It was supposed that several trustworthy observations could be obtained in the course of one day, but the following Table shows that this was not the case, and confirms the expediency, where practicable, of allowing considerable time for the instruments, &c., to come to thermal equilibrium. At Kentish Town the observations on which reliance is placed have been made at intervals of not less than six days, and generally of seven. On two or three occasions, however, attempts have been made to obtain observations at short intervals, and the following are the results:—

Depth, in feet	Time allowed.	Date.	Temperature indicated.	True Temperature.	Error.
			°	°	°
100	1 hour.	March 5.	50·1	51·0	—0·9
200	,,	,,	51·8	53·6	—1·8
300	,,	,,	56·1	56·1	0·0
400	,,	,,	55·0	58·1	—3·1
500	,,	,,	58·1	60·2	—2·1
,,	,,	,,	60·0		—0·2
,,	,,	,,	60·2		0·0
550	,,	Feb. 12.	61·0	61·0	0·0
600	,,	March 5.	58·0	61·2	—3·2
,,	,,	,,	58·2		—3·0
700	,,	,,	62·5	62·8	—0·3
,,	,,	,,	62·6		—0·2
710	Half-hour.	,,	62·8	62·9	—0·1
,,	,,	,,	62·9		0·0
750	20 minutes.	Feb. 19.	63·0	63·4	—0·4

* *Meteorological Magazine*, Vol. III. pp. 174 and 185, Vol. IV. p. 7. See also Vol. IV. p. 99, for account of observations at Geneva.

"It is well known that in the solid crust of the earth the influence of seasons penetrates but a slight depth, say 60 feet; but it occurred to me that this might not hold good in the case of such an opening as the Kentish Town well. I therefore decided on commencing my observations at mid-winter, continuing them regularly to midsummer, and then repeating every observation; those at each depth will, therefore, have been taken twice, at exactly opposite seasons, and at intervals of six months. The necessity for this extreme care did not appear obvious at first, and it seemed as if the various precautions against the ingress of atmospheric temperatures had rendered it superfluous; but during recent hot periods its desirability has become abundantly manifest. The temperature at a depth of 50 feet was 49°·2 in January and 54°·1 in July; that at 100 feet was 51° in January and 54°·3 in July; at 150 feet 52°·1 in January and 54°·7 in July. It is, therefore, evident that under the circumstances existing at Kentish Town, it is more easy to determine accurately the temperature at great depths than at the lesser ones. It is certain that but for the precautions taken, and the unusual mildness of the winter, the temperature at 50 feet would have been much below 49°·2. Whence it further appears that though a single observation at depths below 200 feet, will probably give accurately the true temperature at any selected depth, yet in shafts and bores similarly circumstanced to that now under notice, very discordant results may be obtained at lesser depths; moreover, it is obviously impossible by any but long-continued observations to determine accurately the surface-temperature of the ground, or the equivalent of a depth of 0 feet; it may, therefore, be expedient, for the purpose of completing the series, to assume that the mean temperature of the surface of the soil at Kentish Town, 187 feet above mean sea-level, is identical with that of the air at Greenwich (49°) at 159 feet above the sea, and it is satisfactory to find that the observations hitherto made agree perfectly with this hypothesis. Although, as we have already stated, the experiments are by no means concluded, it may be convenient to tabulate the results hitherto obtained. Being impressed with the high importance of accurate knowledge of the rate and amount of seasonal change in the shaft, Mr. Symons designed, and Mr. Casella (aided in part by Messrs. Silver & Co.) constructed a very delicate thermometer, which was cased 5 inches thick in felt and non-conducting materials, and enclosed in an ebonite box, as in the annexed section; the non-conducting powers of this instrument were such that on one occasion it was raised into the observing-room showing a temperature of 51°·14, and after being in a temperature of 60° for thirty-five minutes it had only risen 0°·02. By this means it was, therefore, possible to bring up the exact temperature of any required depth, uninfluenced by the warmer or colder strata through which it might have to pass. It was regularly observed for some time during the present spring, and the following readings obtained —



"*Temperature by Insulated Thermometer* 100 *feet below Surface.*

"1869, April	3	51°·21		
,, ,,	12	51 ·40		+0 ·021
,, ,,	17	51 ·44		0 ·008
,, ,,	24	51 ·52		0 ·011
,, ,,	30	51 ·54		0 ·003
,, May	7	51 ·58		0 ·006
,, ,,	14	51 ·85		0 ·024
,, ,,	21	52 ·00		0 ·021
,, ,,	28	51 ·92		0 ·011
,, June	4	51 ·94		—0 ·003
,, ,,	11	52°·10		+0°·025

Increase, April 3 to June 11, 0·89 or 0°·013 per diem.

(To be continued in our next.)

COMPARABLE SOLAR RADIATION.

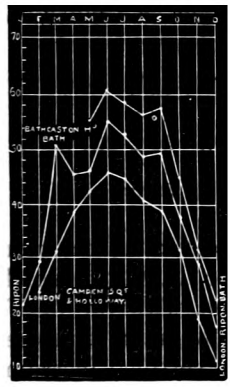
To the Editor of the Meteorological Magazine.

SIR,—I beg to submit to you a few results of the comparative observations of solar radiation begun last year. They must all be considered open to correction from more extended observation, for it is too soon to speak of any conclusions with confidence. I take this opportunity of thanking those who have kindly sent me their observations, and I trust that their number will increase. Observers are particularly wanted in Scotland and Ireland.

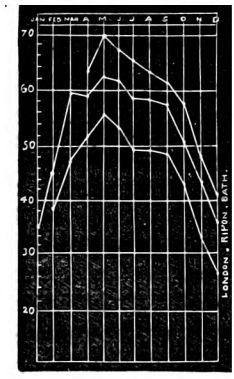
I have compared the amount of solar radiation (*i. e.*, the difference between the maxima in sun and in air at 4 ft.) in two ways, taking (1) the monthly means, (2) the mean of the ten greatest amounts in each month—*i. e.*, the sun's power on sunny days.

The following diagrams will exhibit at a glance the variations in these amounts :—

Mean Monthly Amounts.



Means of 10 *greatest amounts in each month.*



Batheaston House, near Bath, may be taken to represent the pure atmosphere of south-west England. Great as the amount of radiation appears to be, the observations seem fully borne out by others more recently commenced at Over Court, near Bristol.

London, as represented by the observations at Camden Square and at Holloway, which are generally in close agreement, shows the least radiation of any station, especially in winter. Wisbech seems, however, very little better off.

A large number of stations agree pretty closely with Ripon in amount of radiation on sunny days. Thus take the last half-year :—

	July.	August.	Sept.	October.	Nov.	Dec.
Worthing	56·8	57·1	55·4	49·5	...	...
Strathfield Turgiss	...	57·1	56·1	48·1	42·2	35·0
Malvern	56·0	56·8	53·8	49·7	41·6	31·3
Ripon	57·9	57·9	56·2	50·2	44·8	35·1
Hawsker	56·4	53·8	...	44·5	39·0	36·9
Lurgan, Ireland ...	...	...	...	47·9	42·8	38·8

Huddersfield comes below these stations, but above London.

It is worth while to notice the great power of the sun during the prevalence of polar winds. At Ripon the three greatest monthly

amounts of radiation *on sunny days* (59·5, 62·2, 62·1) occurred in March, May, and June respectively, and that although neither March nor June were fine months, and May was unusually wet. On the contrary, an equatorial current seems generally to diminish solar radiation pretty nearly in proportion as the heat becomes more intense. Thus, compare Aug. 28th and Dec. 28th, the one the hottest, the other the coldest day in the year, and it appears that at some stations the amount of solar radiation on December 28th was actually greater than on August 28th. At Ripon, it was no less than 13° greater, although both days were cloudless.—I am, Sir, your obedient servant,

F. W. STOW.

Hawsker, Whitby, Feb. 9th, 1870.

THE FROST OF FEBRUARY, 1870.

To the Editor of the Meteorological Magazine.

Readings of the Maximum and Minimum Thermometers in the shade, 4 feet above the ground, at Worthing, from February 9th to the 19th, taken at 9 a.m.

Date.	Max.	Min.	Date.	Max.	Min.
Feb. 9...	32·1	30·5	Feb. 15...	36·9	30·3
,, 10...	32·2	23·9	,, 16...	35·3	28·5
,, 11...	29·9	22·6	,, 17...	36·2	30·7
,, 12 ..	28·7	21·2	,, 18...	31·7	28·8
,, 13...	31·1	21·8	,, 19...	39·0	29·0
,, 14...	33·5	25·3			

This frost set in very suddenly about 5 o'clock on the morning of the 9th, when the wind shifted from S.E. to N.E., in which latter quarter it constantly blew from the whole time, with varying force.

The minimum thermometer exposed on the grass registered 17°·1 on the morning of the 12th, but not being a certified instrument the general readings are not recorded above, as some of them are certainly not true. My certified terrestrial was unfortunately broken just before the frost set in. W. J. HARRIS, F.M.S.

Worthing, March 2nd, 1870.

AURORA OF FEBRUARY 11TH.

To the Editor of the Meteorological Magazine.

SIR,—On Friday, the 11th February, a magnificent aurora was seen here at 8 p.m. Bright coruscating streamers shot forth from a luminous cloud close to the horizon, to an elevation of from 30° to 45°, the space between them being filled by a rose-coloured expanse, like that often seen at sunset, and scarcely fainter in hue. This was bounded by a luminous arch, extending from W. to N.N.W. and reaching in its centre an elevation of about 25°. The ther. at the time was 21°, and it fell the same night to 13° in air and 5° on grass, an unusual temperature for the sea coast. A light breeze prevailed from the S.W., but the next few days it blew hard from E., with snow and bitter cold.

Yours, &c., F. W. STOW.

Hawsker, Whitby, February 23rd.

[See Notes on February, "Sandwick," p. 15.—ED.]

BEST TIME FOR READING THERMOMETERS.

To the Editor of the Meteorological Magazine.

SIR,—Could you kindly find space for the following?

Day.	Min.	Max.	Mean of 24 hours.	Range in 24 hours.
Feb. 27 ...	35·8	52·2	44·0	16·4
,, 28 ...	42·3	55·5	48·9	13·2
March 1	47·2	55·2	51·2	8·0
,, 2 ...	49·6	58·8	54·2	9·2
,, 3 ...	41·0	57·8	49·4	16·8
,, 4 ...	36 0	36·0	36·0	0·0
,, 5 ...	32·1	42·1	37·1	10·0

The above readings of the max. and min. thermometers, and the mean temperatures deduced from them, show the great changes of temperature we have lately experienced here. But I think the curious anomaly worthy of notice which took place on the 4th. I read the instruments once daily at 9 a.m., the min. for the day being set against the day on which it is taken, and the max. is of course set against the previous day. However, it will be seen that the min. and max. curiously both read 36° *exactly* on the 4th by this mode of entry.

The explanation of this remarkable result is, I imagine, that the temperature at 9 a.m. afforded the min. for the 4th, but in reality the temperature fell *after* 9 a.m., so that 36° was not the true min. for the 4th at all. The max. too was derived from the 9 a.m. temperature on the 4th, which did not increase as is usual as the day advanced. This is certainly not altogether a favourable result of reading self-registering thermometers *once* a day at 9 a.m., for had the readings on the 4th been taken twice in the twenty-four hours, the result would have been different. Apologizing for the length of this letter,

I remain, yours very truly, FRANCIS NUNES.

Heathfield Lodge, Chislehurst, Kent.

P.S.—On Feb. 11th, my min. in air was 17°·5, and on 22nd, on grass, 12°·6.

[See also Notes on the Month, "Selborne," p. 30.—ED.]

DRYNESS OF THE FEBRUARY AND MARCH FROSTS.

To the Editor of the Meteorological Magazine.

SIR,—Yesterday the difference between the wet and dry bulb thermometers was greater than I have recorded in the month of March, with so low a temperature, during the previous 12 years. At 3 p.m. dry bulb 39°·5, wet bulb 30°·5. This dryness came with a W.N.W. wind. At 12·30 a.m, (13th), snow began to fall, and by 9·30 a.m. the ground was covered to a depth of 5·50 inches.—Yours truly,

J. ARNOLD, F.M.S.

Meteorological Observatory, Aldershott Camp, 13th March, 1870.

To the Editor of the Meteorological Magazine.

SIR,—The present frost has been such a remarkably dry one here that a few details may not be uninteresting. The following are the mean per-centages of humidity for the several days as deduced from my usual 10 a.m., 2 p.m., and 10 p.m. observations, after correction by Glaisher's tables:—

Mean humidity of the day.

10th.....	49	13th... ..	61
11th.....	55	14th.....	74
12th.....	42	15th.. ...	64

The greatest dryness which I noticed occurred at 2 p.m. on 12th, when the dry bulb thermometer stood at 27·5 and the wet bulb at 23, indicating a humidity per-centage of 28!

There has been no approach to this here since June 27th, 1867, when my hygrometer indicated a humidity of 30.

On both occasions my instruments were Casella's, verified at Kew, and placed under a Glaisher stand.—Yours faithfully,

T. A. COMPTON, M.D., B.A., F.M.S.

Bournemouth, Feb. 16th, 1870.

THE TEMPERATURE OF THE HYGROMETER DRY BULB.

To the Editor of the Meteorological Magazine.

SIR,—In your number for December, which reached me a few days ago, is a letter from Mr. W. B. Kesteven, containing some observations made with a "Solar-Radiation" thermometer suspended by the side of his ordinary "Dry Bulb."

As his observations stand, there are 12 readings in wet or foggy weather, and 13 in fine. The *mean excess* of the former is 0°·67, of the latter 0°·61.

Some years ago the same subject attracted my attention, and I dare say I can find the observations I then made, the result of which was, that at such times when actual moisture is deposited on the bulbs of the dry thermometers, the air is all but saturated, and consequently their readings are not sensibly affected. So long as the bulbs are *dry*, the moisture present in the atmosphere does not affect the readings.

I presume that the observations given by Mr. Kesteven were made with instruments by the same maker, whose index errors, or rather, whose *actual* errors, were most carefully obtained beforehand, under exactly similar circumstances, and that these errors have been applied to the readings.

It is not sufficient for such a delicate enquiry to read to the nearest half-degree, it is not even sufficient to apply the corrections supplied with the instruments; they *must* be compared together with the most scrupulous accuracy immediately before and *during* the experiments. Even with all possible care there may be an error of 0°·2 Faht., in a differential measurement.

I have no hesitation in saying, in the present instance, that the excess of the "Solar" thermometer *in vacuo* over the ordinary dry bulb, was due to the additional power possessed by its blackened bulb,

of absorbing radiant heat from surrounding objects, as the earth, thermometer stand, &c.

But all the difference found, viz., 0°·67, might be due to errors of the instruments; in fact, it is not usual to supply a table of verification with solar radiation thermometers enclosed *in vacuo*, and such an instrument is not suited for those observations. An ordinary thermometer, after being accurately compared, should be enclosed in the vacuum tube, and again compared before use. But I do not think such observations would lead to any practical results.—I am, &c.,

G. L. TUPMAN.

Malta, 16th January, 1870.

SEA SPRAY IN RAIN WATER.

To the Editor of the Meteorological Magazine.

SIR,—Permit a few words by way of rejoinder to Mr. Mitchell's reply to my former letter on this subject.

Mr. Mitchell draws a comparison between the average amount of salt per gallon found in the whole bulk of rain collected by him in 1868 with that alleged by me to have existed in the deposit of one remarkable shower during the equinoctial storms of September, 1869, and thence infers an error in my analysis. Can anything be more illogical?

If Mr. Mitchell is a chemist, he will, I think, be convinced when I tell him, that even *without any evaporation* the presence of common salt was so strongly marked that the addition of a single drop of a highly-diluted solution of nitrate of silver rendered the rain water in the test-tube not only cloudy but turbid, and after exposure in the sun there was a black precipitate.

Mr. Mitchell says he feels the south-westerly gales before I do. I begs leave to join issue on that point. He, sheltered in that direction from the Bristol Channel by the high range that separates the Ebbw and Usk valleys, and on a plateau sloping towards the east, though in longitude further west than Chepstow, cannot be so exposed as I am, facing the Channel, with no interposed heights, and on the east side of the Wye valley, which absorbs half the draught of the Channel, and is proportionably affected by its rainy influences. On a comparison of the returns published by you, it appears from the average of 1865—68, I had 11 per cent. more wet days than Mr. Mitchell, and on not one in six of such days would the wind be otherwise than in the western semicircle. Considering, then, Mr. Mitchell's greater altitude (360 feet against that of my gauge) and the geological position of the two stations, I think Mr. Mitchell will see that marine influences are more strongly at work here, and whilst in no way impugning the analysis he mentions, I beg firmly to assert the accuracy of mine.

Your obedient servant, JAMES G. WOOD.

Chepstow, March 2, 1870.

P.S.—Had Mr. M. ever seen such an effect on vegetation as I referred to, I doubt if he would have offered such an explanation on that point as he has; he would at once have seen its insufficiency.

TRUE TIME.

To the Editor of the Meteorological Magazine.

SIR,—I am much pleased with Mr. Du Port's plan for making a meridian dial, as described in your magazine for January, page 190.

Either, however, I do not quite understand his description, or there is some trifling error in it.

When the apparatus is fixed, he says "the shorter part of the zinc will be about parallel to the slate," whereas, as appears by the drawing annexed, the shorter part of the zinc (according to my understanding of Mr. Du Port's description), will be far from parallel to the slate.

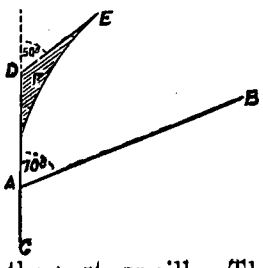
It would also be desirable if Mr. Du Port could kindly describe what he has found to be the best method of fixing the slate, &c.

I must apologise for troubling you, but as I intend to construct a dial on Mr. Du Port's plan, I am anxious to be sure that I understand it.—I am, &c., A SUBSCRIBER.

[As stated in the following letter, we forwarded a copy of that of "A Subscriber" to Mr. Du Port, and as he has favoured us with detailed description and correct diagram, we have (to avoid confusion) omitted that sent by "A Subscriber."—ED.]

To the Editor of the Meteorological Magazine.

SIR,—I thank you for sending me "A Subscriber's" letter privately, so that, the reply appearing with the query, as little time as possible is lost. I must apologise, too, to you and to your readers for the imperfections in my letter which appeared in the January number. I sent that letter to you so late, that I feared, if it were encumbered with a diagram, it might not appear. I regret that I described two lines inclined to each other at an angle of 10° or of 30°, as the case might be, as "*about* parallel;" these inclinations are not of the essence of the case, and I hoped some day to have the opportunity of making my description more precise. A B is the slate, which may be fixed



with screws and blocks of wood, to the inner sill of a window, or to the upper face of an oak post, driven firmly into the ground; the horizontal section of the post should not be much less than a square foot. The top of the post should be made as level as possible, and one of its vertical faces must be nearly perpendicular to the meridian; the slate may be tilted by wedges, or a block of wood fastened firmly to the post or sill. The slate must be at least 12 inches long, or else the image of the sun will fall beyond the edge of the slate at the winter solotice. C A D E is the piece of zinc: E D, 5 inches; D A, 6; and A C, 3 inches. A C is fastened with four screws to the south face of the post, or to a block of wood which has been screwed to the window sill, and against which the south end of the slate rests. F is the hole through which the sun shines; the zinc must be thinned away in its immediate neighbourhood, so as to secure a well defined

image. D F may be about an inch; the longer it is the longer the slate must be. The angle which D E makes with the vertical should be about equal to the latitude of the place, so that D E is as often as possible perpendicular to the sun's rays. A B should be about 20° or 25° inclined to horizon, the steeper it is the shorter may A B be, but if it is too steep it is difficult to draw the circles by which the meridian line is found, and also difficult to see the image of the sun. Wings of zinc, represented by the faint lines, serve the double purpose of strengthening the instrument and shading the slate, so that the sun's image seems the brighter. In determining the meridian line, as described on page 190, it would be well to mark it at first only in pencil, and then to repeat the process on several days; the mean of all these observations may then be marked with a fine pointed knife.

Yours truly, J. M. DU PORT.

Mattishall, February 28th.

RAINFALL AT ÖJE, FLEKKEFJORD, NORWAY, 1869.

Diameter of Funnel, 12½ in.; Height above Ground, 8 ft.; above sea level, 18 ft.

Month.	Total Depth.	Greatest Fall in 24 hours.		Days on which ·01 or more fell.	Days of Snow.
	English ins.	Depth.	Date.		
January ...	5·551	1·618	4	15	5
February...	6·408	·993	14	20	3
March	·748	·409	19	5	2
April	2·345	·515	4	11	...
May	1·369	·611	19	10	...
June..... ..	1·680	·634	5	9	...
July.....	1·886	·942	7	10	...
August ...	1·955	·800	7	11	...
September.	6·164	1·938	19	21	...
October ...	3·055	·881	26	10	2
November.	5·409	·990	3	18	4
December..	5·900	1·052	31	14	4
Total	42·470	...	...	154	20

March 3. Thunder and lightning in frosty weather, and nearly clear sky.
May 5. Snowed a little.
July 6. ·370 in. fell in less than 3 hours.
July 7. Excessively heavy rain.
September 11. 1·00 in. in 12 hours.
Amount of melted snow in the year, 2·133 in.

Extract (translated) from Ex-Consul Jens Beer's Letter, dated Jan. 29th, 1870.

"The fall of snow has been as extremely small as in 1868. One inch of snow (melted) is equal to about from 17 to 20 inches of snow (fallen).

"Although the temperature on the whole was mild, yet the summer was not so warm as usual; the nights especially were cold; we had

during nearly the whole year an unusual fog, particularly in the latter part of the year, when many ships were wrecked.

"I have seen in the newspaper that there were heavy masses of ice between Iceland and Greenland, which last year drifted southward. This circumstance would seem to account for the frosty nights here in the last few days of August, and the early part of September, which destroyed the corn and the potatoes entirely in the best parts of the country, near Trondhjem; and in the interior of the country to the north of Christiania, there are large tracts of land where they have reaped *neither corn nor potatoes.*

In general, for 1869, the corn harvest is estimated at below the average. But in these parts of the country it has been a tolerably good year, although upon the whole the year has not been favourable for Norway." (Signed,)

C. O. F. CATOR, FOR EX-CONSUL JENS BEER.

REVIEW.

The Mean Pressure of the Atmosphere and the Prevailing Winds over the Globe for the Months and for the Year. Part II. By A. BUCHAN, ESQ., M.A., Secretary of the Scottish Meteorological Society.

THIS paper is contained in the *Transactions of the Royal Society of Edinburgh*, Vol. XXV., Part I. having been printed in Vol. VI. of the *Proceedings* of the same Society; and it is with no small pleasure we turn from the numerous unnecessary and often valueless "Papers" with which meteorology is burdened, to examine one which being unadorned with theories founded on insufficient data, is adorned the most. Though, perhaps, we can hardly go so far as Mr. Buchan in saying that "Charts, showing by Isobaric lines the mean pressure of the atmosphere over the globe during the months of the year, may be justly regarded as furnishing the key to *all* questions of meteorological enquiry," yet their importance is so vast, that no one, we presume, will deny they stand second to none of the similar representations of temperature or humidity with which the world has been hitherto presented. Nor is this all; for as we have stated above, there are at present to be found in abundance, papers on different branches of meteorology of which, though the conclusions they contain may be carefully drawn and founded on reliable information, we give a full estimate of their value when we call them "interesting." Of those founded on insufficient or unreliable data we take no notice—they are worse than useless.

The present paper, however, is extremely valuable, since if the relative distribution of pressure is at all such as is shown in the charts appended to it (and there is abundant proof given that it is so), the whole question of the origin of wind-currents is opened up afresh, and the terms "polar" and "equatorial" when used in connection with the winds need serious consideration. It must have been evident to anyone who has thought much on the subject, that the theory of a

heated zone extending all round the earth in the neighbourhood of the equator, in which there is a constantly ascending current, is one which with the present distribution of land and water cannot possibly exist. Similarly the existence of a *band* or *zone* (in about lat. 25° each side of the equator), in which the current of air in its journey *to* the equatorial belt before mentioned, and that in its return journey thence towards the poles "crossed," the one taking the position of surface current in the temperate zone, and the other in the torrid—we say that the existence of any such belt or *zone round the earth* is also impossible. With a perfectly homogeneous globe, heated in the immediate neighbourhood of its equator, such a state of things *might* be possible; more than this we dare not say at present, but with the preponderance of land in the northern hemisphere, and its irregular distribution, it could *not* be.

Mr. Buchan, then, has collected a vast number of barometrical observations in all parts of the world, and all the observations having been reduced for temperature to 32° F., and corrected for height above mean sea level, they are rendered strictly intercomparable; then taking a separate chart for each month, he has laid down on them for the different stations the mean pressure for the months. A similar chart has been constructed for the year by plotting the *annual* instead of the monthly averages. Isobaric lines have then been drawn by the data so plotted, and the result is certainly very remarkable. Of course it *might* be pointed out that for many of the stations given by the author, observations are very scanty; and so they are: all the more reason, then, why the man who has laboured so hard to collect what he has, should be encouraged to *complete* by a yet larger collection the work he has had in hand. But the majority are fairly represented, many abundantly so, and it would be unfair to ignore this, and by pointing out an *inevitable* defect in so new and extensive a compilation, to insinuate that the whole work partakes of the same character.

But we must glance at the features which are displayed by these charts in order to give our readers *some* idea of their general drift. For more than this they must examine the original. A brief description of them may be conveyed in these words—great condensation of air is shown over the continents in their winter months, and relative rarefaction over the oceans; and *vice versâ*, great rarefaction over land in the summer months, and comparative condensation over the oceans. The consequence of this is that in the northern hemisphere we find in the winter and summer months the isobarics run more or less parallel to the general coast line of the great continents. In the winter these lines thus enclose the area of high pressure over the land and low over the sea, while in summer the opposite occurs, and the *range* of pressure is in many parts immense, for averages.

Thus, in February we find the average barometrical reading over Central Asia is about 30·4 ins., while in the North Atlantic, near Iceland, it is at the same time only 29·4.; but taking July the whole has changed; and while the mean value for Central Asia (rather to

the S.W. of the position of the winter max.) has decreased to 29·5 in., that over the Atlantic (not indeed near Iceland, but in about lat. 30° to 35° N.), it is as high as 30·2 in. In pointing out these values we have not been guided by chance in the selection of their positions, but have named the region of absolute max. and min. in these two neighbourhoods which the charts themselves show. We have then at these two periods of the year a change of no less than 1·7 in. in the relative distribution of pressure over the Atlantic Ocean and Central Asia. Of what consequence this is we will not say now—time must reveal it fully; but how old *theories* are upset, and the currents of thought on low equatorial and high polar pressure changed, it is serious to contemplate.

It is impossible to say much in the present number on the direction of wind-currents with respect to these areas of high and low pressure, but we shall hope to do so on a future occasion. The work of merely reviewing the Paper is one which, in fact, cannot be properly done in any ordinary article, and we can only advise all those who take an interest in meteorology to *study* the charts for themselves. We use the word "study" advisedly; for the condition of meteorology at present is one which requires years of hard and laborious study from patient and clear-headed men. Every fact connected with it which has hitherto been elucidated, has been theorized on and worked on—twisted and twirled by every wind of fancy—till for want of further material the science is in a puny state. It is only surprising to us that so much is gathered from it as there is, and it only proves what a mine of wealth remains unwrought in its interior. Years of hard labour at dull figures are necessary—years of careful observation—and an unsparing cutting down and destroying of unreliable matter and hastily-formed fancies. 'Tis to this we must look for good and substantial progress. The constant utilitarian cry for immediate "results" must in this science, at all events, be urged at great loss to the world in general, and can be only indicative of a want of information on the part of the criers as to the difficulties to be encountered. The Paper under notice is the result of years of judicious labour, and will in consequence stand the test of years to come. It is not everyone who has the power to obtain information from all parts of the world, and and it is perhaps well that it is so. But let everyone who undertakes to investigate meteorological phenomena even *locally* be sure of the accuracy of his data, scrupulous in his fidelity to what peculiarities it shows, and slow to construct theories by extending the laws of what happens in one neighbourhood, too hastily to other parts of the world. It is true that those who at present reason by induction on the laws of the weather, often, in fact almost constantly, fail; and the result would be depressing but for another fact, which is, that the tendency of all *widely* extended investigation is to show how reasonably we might have expected to find the peculiarities indicated had our minds comprehended on a sufficiently grand scale the area which is affected say by the rise or fall of one inch in the mercury, or a change of a few degrees in temperature. Mr. Buchan's paper is a great work.

FEBRUARY, 1870.

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°. In shade	No. of Nights below 32°. On grass.
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	1·21	— ·01	·35	6	14	54·9	28	20·1	11	14	16
II.		Maidstone (Linton Park)	1·14	— ·37	·25	7	19	51·0	28	21·0	11†	16	...
,,		Selborne (The Wakes)	3·95	+ 2·24	1·51	6	11	50·5	28	17·4	11‡	15	18
III.		Hitchen	1·36	+ ·10	·61	6	17	52·0	28	19·0	9, 11	15	...
,,		Banbury	2·44	+ 1·01	·86	6	17	53·0	28	17·5	12	19	...
IV.		Bury St. Edmunds (Culford)	·78	— ·64	·35	6	9	57·0	28	17·0	10	17	21
V.		Bridport	2·23	+ ·17	1·16	6	12	53·0	3, 27	17·0	13	17	...
,,		Barnstaple	1·89	— ·19	·50	6	16	55·0	28	25·0	11	...	..
,,		Bodmin	5·58	+ 2·79	1·43	1	16	50·0	28	23·0	10§	10	17
VI.		Cirencester	1·80	+ ·19	·70	6	7	...	...	...	...	...	...
,,		Shifnall (Haughton Hall)	1·76	+ ·87	·39	8	12	54·0	28	18·0	11‡	16	...
,,		Tenbury (Orleton)	2·50	+ ·93	·51	6	18	56·7	28	18·4	11	15	21
VII.		Leicester (Wigston)	1·64	+ ·30	·86	8	6	57·0	28	18·0	9	16	...
,,		Boston	1·30	+ ·09	·54	6	16	56·0	28	22·2	11	14	24
,,		Grimsby (Killingholme)	1·71	..	·56	6	20	60·0	28	20·5	11	12	...
,,		Derby	1·09	— ·39	·28	6	14	56·0	28	21·0	10‖	12	...
VIII.		Manchester	·86	— 1·09	·21	25	14	53·2	28	19·0	12	13	21
IX.		York	1·88	— ·50	·30	7	19	50·0	27	15·0	11	11	...
,,		Skipton (Arncliffe)	5·10	+ 1·43	1·13	7	18	...	...	...	...	..	..
X.		North Shields	1·95	+ ·41	·35	7	24	48·8	2	24·0	25	13	..
,,		Borrowdale (Seathwaite)	...	...	..	..	...	...	...	...	...	...	...
XI.	WALES.	Cardiff (Town Hall)	...	...	...	...	...	...	...	...	...	...	..
,,		Haverfordwest	3·89	+ 1·03	1·37	6	9	48·9	4, 6	20·5	14	12	18
,,		Rhayader (Cefnfaes)	3·92	+ ·94	1·00	1	10	...	...	...	...	12	...
,,		Llandudno	1·53	+ ·18	·29	2, 6	14	57·7	28	25·4	12	8	...
XII.	SCOTLAND.	Dumfries	3·87	+ 1·32	1·33	6	11	51·0	28	19·0	25	13	...
,,		Hawick (Silverbut Hall)	2·38	...	·52	27	20	...	...	...	...	...	...
XIV.		Ayr (Auchendrane House)	2·45	— ·91	1·29	27	13	55·0	1	22·0	22¶	15	22
XV.		Castle Toward	5·53	+ 1·79	1·14	6	17	51·0	28	17·0	25	21	23
XVI.		Leven (Nookton)	2·00	+ ·30	·57	25	18	45·0	5*	13·0	25	19	26
,,		Stirling (Deanston)	4·23	+ 1·23	1·30	6	22	47·0	20	9·0	25	20	...
,,		Logierait	5·68	...	1·75	6	11	...	...	...	...	..	...
XVII.		Ballater	6·32	...	3·15	6	14	44·0	2	13·0	24	17	...
,,		Aberdeen	3·14	...	·71	27	21	47·2	28	20·4	24	14	20
XVIII		Inverness (Culloden)	·78	...	..	...	.	46·7	4	24·8	14	12	...
,,		Portree	6·01	— 4·22	1·64	6	14	...	...	...	...	...	...
,,		Loch Broom	1·16	...	·30	28	14	...	...	...	...	...	...
XIX.		Helmsdale	1·81	...	·49	20	15	...	...	...	...	...	...
,,		Sandwick	2·92	+ ·44	1·18	6	16	44·6	20	24·5	26	11	20
XX.	IRELAND.	Cork	4·39	...	1·07	5	12	...	...	...	...	...	...
,,		Waterford	3·26	+ 1·23	·68	5	15	42·0	6	23·0	12**	20	...
,,		Killaloe	3·01	+ ·11	·59	28	14	52·5	6	25·5	11	16	...
XXI.		Portarlington	1·75	— ·28	·19	9, 28	22	49·5	27	27·0	11	8	...
,,		Monkstown	3·05	+ 1·41	·52	6	12	...	...	...	...	...	...
XXII.		Galway	2·72	...	·68	28	17	52·0	5, 7	26·0	9††	6	...
,,		Bunninadden (Doo Castle)	4·12	...	·82	28	16	46·0	2, 3	24·0	11‡‡	10	...
XXIII		Bawnboy (Owendoon)	3·62	...	·70	1	17	53·0	6	26·0	12	11	12
,,		Waringstown	2·15	..	·43	27	17	51·0	4	25·0	9	15	23
,,		Strabane (Leckpatrick)	3·62	..	·73	1	18	50·0	6	19·0	11	23	27

* And 20, 28. † And 12, 22. ‡ And 12. § To 13, and 16. ‖ And 11, 13. ¶ And 25.
** And 13. †† And 10, 11. ‡‡ And 14.
+ Shows that the fall was above the average ; —that it was below it.

METEOROLOGICAL NOTES ON FEBRUARY.

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

ENGLAND.

CAMDEN TOWN.—T at 3.45 p.m. with H on 5th; S at 4 p.m. and after 10 p.m. on 21st.

LINTON PARK.—The beginning and end of month mild, the rest very wintry, the 11th, 12th, and 13th especially being very severe, a cutting N.E. wind with drifting S; the frost, however, was not so intense as it has been sometimes, neither was the S deep, and the month as a whole has been a dry one, with fewer high winds than usual for February; small portions of S still remaining where drifted to the end of the month.

SELBORNE.—An extremely cold bleak month, with occasional high winds, all garden operations either retarded or suspended; S on many days, but in small quantities, most on 14th; incessant R from 1 p.m. on 6th to 6 p.m. on 7th, the fall on 6th being 1·51 in.; max. and min. ther. the same on 9th, 29°! mean max. 38°·7, mean min. 30°·4.

HITCHEN.—Splendid aurora on the 11th.

BANBURY.—Frequent S; aurora on 11th.

CULFORD.—The month has been excessively cold throughout; S on six days, and the mean temp. of the month has been under that of January, being 35°·3 to 36°·4. A very beautiful auroral arch spanned the heavens from S.W. to N.E. on the night of the 1st, and was visible here from about 9 to 10 o'clock.

BRIDPORT.—Heavy S.E. gale on 6th and 7th, with continuous R for 36 hours, on the 6th measured amount of R for the 24 hours being 1·16 in.; heavy easterly gale on 12th and 13th, and gale from the S.S.W. on 28th. Good skating on eight days; hardly any S fell here.

BODMIN.—Mean temp. of the month 4°·1 below the usual average of February at Bodmin.

CIRENCESTER.—More of a winter month than January; no S, but persistent frost day and night for a fortnight; no hoar frost; ice six inches thick in a tub. Vegetation backward.

SHIFFNAL.—A very variable month; up to the 8th, inclusive, moderately mild, with R; from thence to the 19th, inclusive, cold, with easterly winds, especially from 12th to 15th, when most bitter; ice bore skaters for the fourth time this winter. A sudden change on 27th and 28th, when temp. in shade rose on the latter day to 54°, with high wind from S.W. at night. Aconite in flower on 3rd.

ORLETON.—Cloudy and generally warm till the 8th with much R, then change of wind in night to N.E with S, followed by severe frosts and frequent slight falls of S which were dried up by a very cold rough wind; the last two days warm again. Temp. of month about 4° below the average.

WIGSTON.—The mean max. of the month is 10° below that of February, 1869, the mean min. 6° below, and the mean of the month 7½° below it. No signs of vegetation stirring at the end of the month; last year apricots, peaches, &c., in full bloom, and gooseberry trees in full leaf the corresponding period.

BOSTON.—Very cold and stormy throughout the whole month; on the 1st, about 9 p.m., a broad luminous belt of auroral light stretched across the sky from N.W. to S.E. Severe frost lasted from 8th to 14th, and strong gales from the E. and N.E. blew on the 12th, 13th, and 14th; on the 13th the S was drifted many feet in depth on the roads and fields.

KILLINGHOLME.—The month was a complete contrast to the February of last year; we have not had such snow drifts since 1855; owing to the high wind, but little S remained in the funnel, and, therefore, the quantity measured does not represent the total fall. Frost kept vegetation fast locked-up till the last day of the month, to come forth, it may be hoped, in greater perfection in due season. Last year the weather changed from warm to cold on the 28th, this year it changed from cold to warm on the corresponding day.

MANCHESTER.—February this year has been unusually dry, not one half the average of R having fallen.

NORTH SHIELDS.—Aurora on 1st and 11th; S fell more or less on ten days.

WALES.

HAVERFORDWEST.—Exceedingly wet and stormy, especially on the night of the 1st, when it blew heavily, the R continuing to increase till the 8th; a severely cold period then set in, a gloomy sky accompanied by a terribly severe wind from the N.E., which, on the 12th and 13th, reached the force of a gale. In consequence of the recent heavy rains, large masses of water were frozen to an astonishing thickness, and in railway cuttings and other places where water oozed from the sides of steep embankments huge frozen masses collected, having the appearance of large stalactites; a cold bleak air continued to the end of the month.

CEFNFAES.—From the 8th the month has been cold, wind N.E., and ther. low till the 19th. Much sickness and many deaths among old people and children.

LLANDUDNO.—Primroses gathered in the hedges on the 3rd, but calceolarias blackened and killed by frost a few days later; very frequent S showers till the latter part of the month, when it became finer and milder.

SCOTLAND.

DUMFRIES.—This month has been the most severe February since 1865; on the 6th the weather was stormy, with excessive R; from the 7th to 15th frosty, with much S; a temporary thaw on 15th, after which frost to the 21st; close of month very variable, R, frost, and S all within 24 hours. The mean temp. was 7°·5 below that of February, 1869.

SILVERBUT HALL, HAWICK.—The most wintry February remembered here for many years; S fell on 11 days, which with the keen frost enabled curlers, skaters, and sledgers to enjoy their favourite exercises right merrily. The month ended with heavy gales blowing from the W.

AUCHENDRANE.—With bar. a little above the average of February, and bar. range a little below, there occurred a very low mean temp. with deficiency of rainfall and evaporation, and although the humidity was about the average the amount of cloud and force of wind were both below. The equatorial current prevailed in the early part of the month, light, warm, and vapour-laden gales; on the 8th, however, the polar current appeared, and continued till the 23rd with its numerous calms but enlivened by its gales of heavy, cold, and dry air on the 8th, 13th, 14th, and 21st; during the remainder of the month the two air currents again commenced over this district their contest, which terminated in favour of the equinoctial by the great S. and S.W. gales of the 27th and 28th, and the waste water of their R and melted S still keeps the rivers in flood.

CASTLE TOWARD.—Wet, with several frosty nights to the 8th, clear and frosty to the 22nd; about 12 in. of S fell from the 23rd to 26th, inclusive, with hard frosts; gale on the 6th. Wind N. and N.E. during the month, changed to S. and S.W. on the 28th.

DEANSTON.—This month commenced showery, mild, and rather foggy; on the 8th a gale of wind from E.N.E. with S, during the remainder of the month it was frosty, and, at times, stormy, with S showers; temp. during night of 24th fell to 14°, and on 25th to 9°; on 22nd, 23rd, 24th, and 25th S to the depth of 10 ins. without drifting; thaw on the evening of the 27th, and S nearly gone on the 28th.

LOGIERAIT.—The most stormy month for many years; heavy falls of S with intense frosts; frosts set in towards the end of October, and have never been wholly withdrawn since; a fine genial thaw set in on 28th. Farm work much behind, and day labourers suffering much.

BALLATER.—Stormy and cold, with strong gales and occasional falls of S; the rainfall 3½ in. over the mean of the last nine years; 3·15 fell on the 6th. The temp. lower than in the corresponding month during the last six years, and 4°·6 below the aggregate mean; bar. also below the average.

ABERDEEN.—A very changeable month, but on the whole cold, wet, and dark; frequent falls of S which never laid very deep, deepest 3½ or 4 in. at 9 a.m. on 27th; aurora on 14th. Max. in sun on 24th 91°, and min. on grass on same day 16°·8.

LOCHBROOM.—This month is a perfect contrast to the last, a more severe month with frost has not been experienced for years. The country was entirely blocked up against agricultural operations and field labour, which threatens late sowing

and much loss to the farmers, besides the turnips have all been destroyed with frost, the herbage was either burnt up or covered with S, which is detrimental to stall feeding and most injurious to stock either on turnips or pasture.

SANDWICK.—February has been 2°·9 colder and slightly drier than the mean; S. and S.E. winds continued till the 9th, but N. winds after that till the 28th, except on 13th; frost and S from 21st till the evening of the 27th, when thaw commenced. Gales of 40 m. an hour on 1st, 60 m. on 6th, 7th, and 20th, 52 m. an hour on the 21st, and 50 on the 27th; aurora corruscating to zenith and red on the 11th, and less marked on three other days.

IRELAND.

OWENDOON.—The middle of the month very dry and favourable for tillage; little or no growth as yet and a backward spring.

WARINGSTOWN.—Gale on 28th; the month cold and ungenial; rainfall about the average; northerly and easterly winds most prevalent.

LECKPATRICK.—Very cold month; frost on the grass every night but the last; mean temp. as deduced from max. and min. 34°·9, nearly 1° colder than mean of last January; the coldest February since observations have been made here—1862. R fell during the first and last; S on the 26th, followed by a gale on the following two days. Since the 1st of October last, out of 151 nights, there has been frost on grass on 110 nights.

SOLAR HALOS SEEN IN ABERDEENSHIRE.

To the Editor of the Meteorological Magazine.

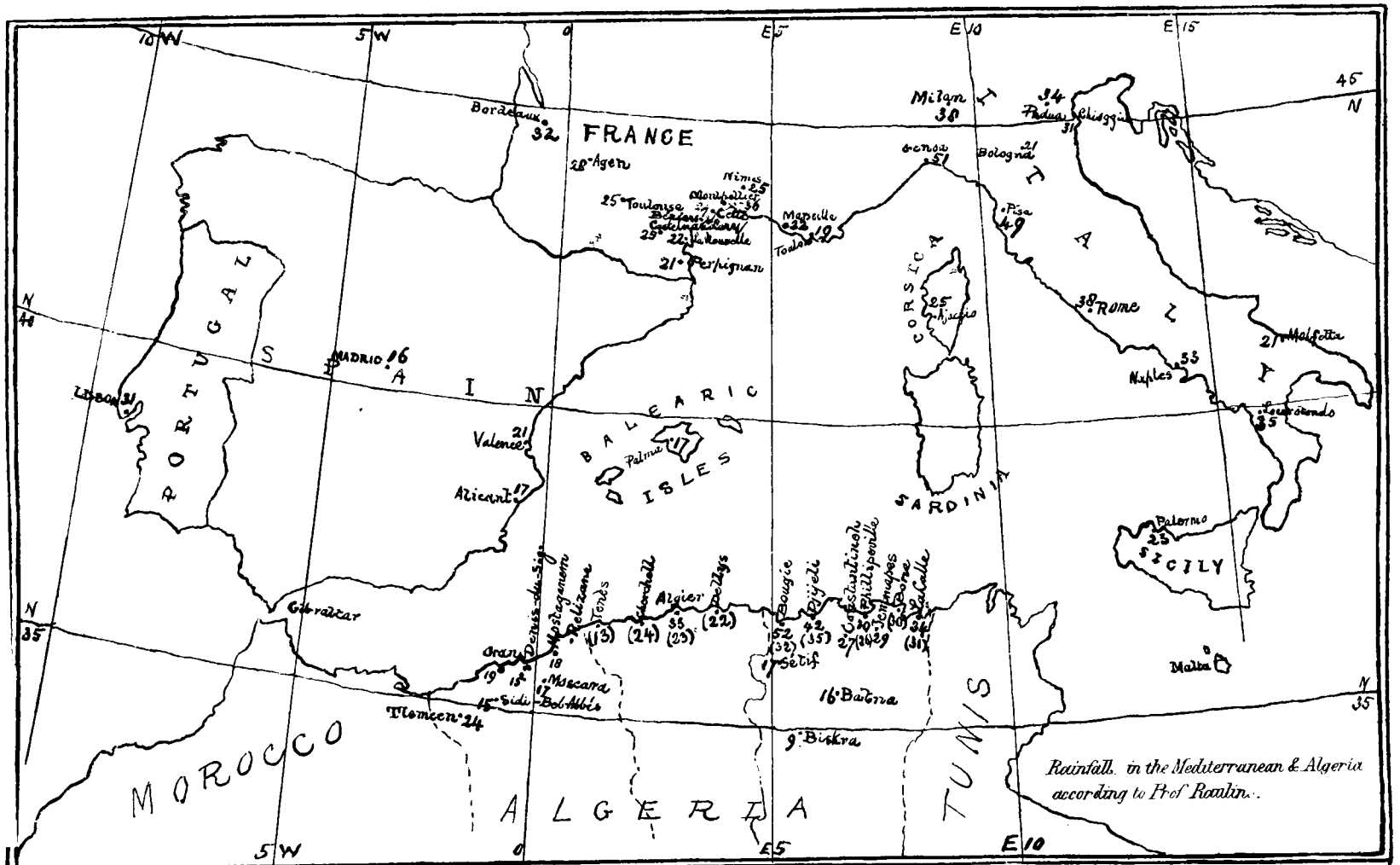
SIR,—The horn-like halos drawn in your February number are not uncommon, but they are generally more widely spread than in that illustration, except when the sun is very low. But the five concentric circles near the zenith seem to me to be the most remarkable part of the phenomenon, and a fuller description of them would be interesting. Can the halos marked 6 and 7 ever be seen as complete circles?

Yours truly, T. W. BACKHOUSE.

Sunderland, February 16th, 1870.

INFLUENCE OF RAILROADS UPON WEATHER.

The opinion seems to be gaining strength that the Pacific Railroad is working a great change in the climate of the Plains. Instead of continuous droughts all along the railroad rain now falls in refreshing abundance. This result has been remarked upon in other sections of the West. In Central Ohio, for example, it is said, the climate has been completely revolutionized since iron rails have formed a network all over that region. Instead of the destructive droughts formerly suffered there, for some four or five years there has been rain in abundance—even more than enough to satisfy all the wants of farmers. This change is thought to be the result of an equilibrium produced in the electrical currents, which has brought about a more uniform dispensation of the rain. It is a fact within the observation of all who remember ante-railroad times, that we have now few or no such thunderstorms as we formerly had in New England. The iron rails which touch and cross each other in every direction, serve as conductors and equalizers of the electric currents, and so prevent the terrible explosions which used to terrify us in former years. The telegraphic wires which accompany the iron rails everywhere, also act an important part in diffusing electricity equally through the atmosphere, thus preventing the occurrence of severe thunderstorms.—*Boston Traveller.*


10 W
5 W
0
E 5
E 10
E 15
46 N
35 N
FRANCE
Bordeaux 32
Agen 28
Toulouse 25
Nimes 25
Montpellier 36
Cette 27
Beziers 26
Carcassonne 25
La Nouvelle 22
Perpignan 21
Marseille 22
Toulon 19
Milan 38
Padua 34
Bologna 21
Genoa 51
Pisa 49
ITALY
Rome 38
Malfetta 27
Naples 33
Leghorn 35
CORSICA
Ajaccio 25
SARDINIA
Palermo 25
SICILY
Malta
PORTUGAL
MADRID 16
SPAIN
Lisbon 31
Valence 21
Alicant 17
BALEARIC ISLES
Palma 17
Gibraltar
Oran 19
Mostaganem 18
Arzew 15
Mascara 17
Sidi-Bel-Abbès 15
Tlemcen 24
Tenes (13)
Cherchell (24)
Algier 55 (23)
Delys (22)
Bougie (32)
Djijeli 42 (35)
Constantine 27
Philippeville (36)
Tebessa 29
Bone 60
Calle (31)
Setif 52
Batna 16
Biskra 9
MOROCCO
ALGERIA
TUNIS
Rainfall in the Mediterranean & Algeria according to Prof Rouliu.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

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ON THE RAINFALL OF SOUTH-WESTERN EUROPE AND ALGERIA.

THREE months since we inserted a translation of a portion of Professor Raulin's memoir, *Sur le Régime Pluvial du Bassin Occidental de la Méditerranée.* Almost simultaneously we received from our distinguished correspondent another memoir on the *Régime Pluvial de l'Algérie.* It was so evidently desirable that these memoirs should be jointly considered, that we deferred printing the second portion of the first paper until all the measures had been converted into English inches, and we were in a position to complete the consideration of the subject and place it clearly before our readers. In the present number we resume the translation of the first memoir, giving conversions of the most important tables, and a map showing the mean annual rainfall, in inches, at all the stations mentioned in *either* memoir.

"Lastly, the examination of the annual totals shows that very little rain falls at Madrid (16), and at Alicante (17), it increases at Valencia (21), and at Perpignan (21½), then gradually on the French coast at La Nouvelle (22), Sallèles-d'Aude (22), Béziers (24), Cette (29), increasing at Montpellier to 36, and then decreasing at Nîmes to 25, at Marseilles to 22, and at Toulon to 19. On the S.W. coast of Italy it is very considerable, at Genoa (51), then decreases at Pisa to 49, at Rome to 38, and at Naples to 33, and at Locorstondo to 35, and especially in Sicily, at Nicolosi to 28, and at Palermo to 23. In Africa, it is at Constantine (24), very little greater than at Palermo, less at Sétif (16), greater at Algiers (35), and less again at Oran (19). The quantities become greater at Gibraltar (29), and at Lisbon (31).

"In the interior of the Mediterranean the annual quantities decrease gradually from east to west, from Rome (38), by Ajaccio (25), to Palma (17), and Alicante (17). At Molfetta (21), on the Adriatic, there is not much more rain than on the south-east of Spain.

"Towards the north, in France, the well-marked Mediterranean rainfall district does not extend far inland. It is limited by La Montagne Noir, Les Cévennes, and Mont Pilat.

"This at least is the result indicated by the means for Castelnaudary, Saint-Ferriol, Albi, Rodez, Le Puy, and Lyons, which belong to different systems on the north-west of the mountain chains.

"In the west, the want of rainfall observations in northern Spain, prevents our ascertaining if the amount increases from Madrid up to the Pyrenees and the mountains of Asturia.

"Towards the east, we may be led to believe that a similar system extends even to the Alpine chain, which forms a lofty barrier between Italy and Germany. Nevertheless, the series of observations made in the plain of northern Italy, and which I have quoted for Milan, Padua, Chioggia, and Bologna, show that the basin of the Po possesses a distribution entirely different, and characterized like central and northern Europe by abundant summer rains. The line of demarcation between the two districts, wherein the seasonal distribution is thus wholly reversed, appears to be that of the Appenines from the Col de Tende, to Rimini on the Adriatic.

"Towards the south we know not yet how far the characteristics of the Mediterranean district extend into Algeria, for it is only since 1865 that meteorological observations have been made at the military hospitals in that country But in seven or eight years this want will be supplied, and we shall have ascertained facts, even on the great desert (Sahara) at Biskra and Laghouat, at from 100 to 200 miles inland.

Comparative Table of the Mean Monthly Rainfall in the Western Basin of the Mediterranean.

	Western Spain and Rousillon.				Southern Coasts of France.							
Station, Authority & Period.	A. Aguilar. 1859-67.	R. Chamorro. 1855-67.	J. Monserrat. 1857-67.	Béguin. 1856-67.	Ponts-et-Chausées. 1856-67.	Canal du Midi. 1856-67.	Crozals and Crouzat. 1856-67.	Doumet. 1864-67.	Martins. 1856-67.	Gasparin. 17 years before 1848.	Observatory. 1856-66.	Gasparin. 33 years before 1848.
	Madrid.	Alicante.	Valence.	Perpignan.	La Nouvelle.	Salleles d'Aude	Beziers.	Cette.	Montpellier.	Nimes.	Marseille.	Toulon.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in
Jan.	1·36	·80	1·14	1·42	1·22	1·86	1·52	2·38	2·87	1·75	2·20	2·14
Feb.	·78	1·36	1·09	1·59	2·27	1·94	3·20	2·72	3·63	1·95	1·30	1·07
Mar	1·65	2·08	1·07	2·44	2·24	2·49	2·03	2·32	3·58	1·85	1·70	1·33
Apl.	1·41	2·14	1·51	1·18	1 70	·96	1·41	1·33	1·31	1·97	1·69	1·60
May	2·27	1·19	2·14	2·86	2·45	2·17	2·25	2·76	3·31	2·23	2·05	1·60
June	1·67	·42	·83	1·51	1·27	1·43	1·49	1·41	1·48	1·12	·90	·71
July	·19	·59	·58	·78	·54	·56	·43	·59	·59	1·07	·26	·36
Aug.	·24	·57	·46	·98	·98	·74	·69	·97	1·71	1·32	·54	·68
Sep.	1·01	1·78	2·33	2·21	2·48	2·37	1·46	3·51	3·95	3·63	2·84	2·62
Oct.	2·09	2·26	3·84	2·88	3·20	3·66	4·60	6·16	7·23	2·54	4·16	2·83
Nov.	1·65	2·20	2·86	2·07	2·22	2·32	3·12	2·95	3·67	3·92	1·99	2·67
Dec.	1·66	1·30	2·65	1·57	1·81	1·42	1·58	1·82	2·73	1·93	2·46	1·15
Totl.	15·98	16·69	20·50	21·49	22·38	21·92	23·78	28·92	36·06	25·28	22·09	18·76

Station, Authority & Period	S.W. Coast of Central Italy.			Mediterranean Isles		Southern Italy and Sicily.					Southern Spain and Portugal.	
	N. Fasiani. 1833-67.	Gasparin. 12 years before 1848.	M. Cat. Scarpellini. 1857-67.	Ponts-et-Chaussées. 1856-65.	F. Barcels. 1857-67.	Observatory. 1842-53.	Gasparin. 13 years before 1848.	A. Campanella. 1856-67.	Gemellaro. 27 years before 1848.	Cacciatore. 1856-67.	Kelaart. 1812-36.	Observatory of Dom. Luiz. 1856-63.
	Genoa	Pisa	Rome	Ajaccio	Palma	Naples	Molfetta	Locorotondo	Nicolosi	Palermo	Gibraltar	Lisbon
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Jan.	4·35	4·33	4·54	2·78	1·32	3·61	1·93	3·38	4·57	2·29	6·00	3·60
Feb.	4·38	2·78	2·91	1·97	1·51	3·87	1·83	2·78	2·66	2·36	2·50	3·96
Mar.	3·64	2·50	3·95	2·25	1·44	2·96	1·68	4·08	4·89	2·65	2·00	4·20
Apl.	3·74	4·20	1·72	1·44	1·54	2·32	1·35	1·65	2·27	1·54	3·00	3·36
May	3·61	2·89	2·38	1·94	1·14	1·59	1·63	1·65	·69	1·04	1·50	2·15
June	2·14	2·31	1·16	·86	·88	1·19	1·15	2·15	·41	·71	·50	1·98
July	1·39	1·88	·41	·05	·44	·54	·82	·74	·02	·06	·00	·78
Aug.	2·82	1·85	1·70	·56	·61	2·20	1·75	1·84	·17	·49	·50	·08
Sep.	5·46	5·76	2·73	1·39	2·24	3·04	2·31	3·33	1·98	1·22	1·00	·52
Oct.	8·26	6·77	7·48	3·79	2·30	3·85	2·43	4·10	3·72	3·90	2·50	1·03
Nov.	6·73	10·31	5·49	4·44	2·19	3·75	2·20	5·27	2·74	3·25	5·00	3·74
Dec.	4·06	3·38	3·99	3·35	1·72	4·03	2·25	4·07	3·75	3·54	4·00	5·40
Totl.	50·58	48·96	38·46	24·82	17·33*	32·95	21·33	35·04	27·87	23·05	28·50	30·80

Station, Authority & Period	Algeria.				Plains of Northern Italy.				Plains of S.W. of France.			
	Vital. 1854-67.	Dumas and Rengarde. 1857-67.	Hardy. 1855-67.	Ancour. 1854-63.	Gasparin. 68 years before 1848.	Gasparin. 48 years before 1848.	Gasparin. 26 years before 1848.	Gasparin. 18 years before 1848.	Abria. 1842-60.	Bartayres and Magen. 1850-60.	Adm. du Canal. 1809-60.	Adm. du Canal. 1839-60.
	Constantine	Setif	Alger	Oran	Milan	Padua	Chioggia	Bologna	Bordeaux	Agen	Toulouse	Castelnaudary
	in.	in.	in.	in.	in.	in.	in	in.	in.	in.	in.	in.
Jan.	2·76	1·70	5·46	3·20	2·84	2·59	3·06	·84	2·86	2·37	1·63	1·98
Feb.	3·01	1·67	4·49	3·62	2·12	1·86	1·67	1·25	2·13	1·74	1·60	1·77
Mar.	3·28	2·50	4·33	2·44	2·25	2·14	1·78	1·46	2·16	1·67	1·67	1·66
Apl.	2·31	1·83	3·13	1·49	3·07	2·21	2·02	1·36	2·87	3·00	2·46	2·38
May	1·77	1·46	1·47	1·28	3·73	3·00	2·17	1·42	2·51	3·34	3·31	3·31
June	·93	1·07	·95	·20	3·17	3·60	2·71	3·30	2·34	2·59	2·45	2·48
July	·11	·13	·03	·06	2·94	2·72	2·83	1·28	1·88	1·75	1·87	1·61
Aug.	·34	·55	·22	·16	3·06	2·62	2·20	1·69	2·93	2·43	1·72	1·87
Sep	·90	1·16	·75	·58	3·27	3·00	3·07	2·20	2·98	2·41	2·29	1·99
Oct.	2·38	1·23	2·97	1·18	4·33	3·91	3·68	2·82	4·03	2·85	2·27	2·04
Nov.	2·32	1·44	4·50	2·76	4·13	3·63	3·43	1·68	3·16	2·13	1·78	2·19
Dec.	4·31	1·61	6·78	2·15	3·13	2·54	2·71	1·78	2·42	2·15	1·85	1·50
Totl.	24·42	16·35*	35·08	19·12	38·04	33·82	31·33	21·08	32·27	28·43	24·90	24·78

* The totals for Palma and Sétif are given as 452mm·8 (=17·80 in.) and 412mm·6 (= 16·25 in.), but the values in the tables are the sums of the monthly amounts, and probably correct.

"*Postscript.*—Since presenting this note at the meeting of the learned societies, at La Sorbonne, in April, 1868, I have become aware of the Etudes sur les mouvements généraux de l'atmosphère (Ann. de la Soc. met., t. xv., p. 8). M. Sourel has arrived (p. 62-63) at the following result, by the study of the circulation [of the atmosphere] on the surface of the Mediterranean basin during the meteorological year 1865. We see, in short, as general rules, decreasing condensation from north to south, and from west to east; the maximum of rain in autumn in the north, the centre, and the west of the Mediterranean, and in winter in the south. Autumn is the rainy season for the western basin of the Mediterranean, except for Algeria, where the maximum is in the winter."

REMARKS ON THE PRESENT STATE OF METEOROLOGICAL SCIENCE.

By John Ruskin, Esq., of Christ Church College, Oxford.

[*Reprinted from the "Transactions of the Meteorological Society," Vol. I., published in* 1839.]

The comparison and estimation of the relative advantages of separate departments of science, is a task which is always partially executed, because it is never entered upon with an unbiassed mind; for, since it is only the accurate knowledge of a science which can enable us to perceive its beauty, or estimate its utility, the branch of knowledge with which we are most familiar, will always appear the most important. The endeavour, therefore, to judge of the relative *beauty* or *interest* of the sciences, is utterly hopeless. Let the astronomer boast of the magnificence of his speculations—the mathematician of the immutability of his facts—the chemist of the infinity of his combinations, and we will admit that they all have equal ground for their enthusiasm. But the highest standard of estimation, is that of utility. The far greater proportion of mankind, the uninformed, who are unable to perceive the beauty of the sciences, whose benefits they experience, are the true, the just, the only judges of their relative importance. It is they who feel what impartial men of learning know, that the mass of general knowledge is a perfect and beautiful body, among whose members there should be no schism, and whose prosperity must always be greatest, when none are partially pursued, and none unjustly neglected. We do not, therefore, advance any proud and unjustifiable claims to the superiority of that branch of science for the furtherance of which this Society has been formed, over all others; but we zealously come forward to deprecate the apathy with which it has long been regarded, to dissipate the prejudices which that apathy alone could have engendered, and to vindicate its claims to an honourable and equal position among the proud thrones of its sister sciences. We do not bring meteorology forward as a pursuit adapted for the occupation of tedious leisure, or the amusement of a careless hour,

Such qualifications are no inducements to its pursuit by men of science and learning, and to these alone do we now address ourselves. Neither do we advance it on the ground of its interest or beauty, though it is a science possessing both in no ordinary degree. As to its beauty, it may be remarked that it is not calculated to harden the mind which it strengthens, and bind it down to the measurement of magnitudes, and estimation of quantities, destroying all higher feelings, all finer sensibilities; it is not to be learned among the gaseous exhalations of the deathful laboratory; it has no dwelling in the cold caves of the dark earth; it is not to be followed up among the charnel houses of creation. But it is a science of the pure air, and the bright heaven; its thoughts are amidst the loveliness of creation; it leads the mind, as well as the eye, to the morning mist, and the noon-day glory, and the twilight cloud—to the purple peace of the mountain heaven—to the cloudy repose of the green valley; now expatiating in the silence of stormless æther, now on the rushing of the wings of the wind. It is indeed a knowledge, which must be felt to be, in its very essence, full of the soul of the beautiful. For its interest, it is universal; unabated in every place, and in all time. He, whose kingdom is the heaven, can never meet with an uninteresting space—can never exhaust the phenomena of an hour; he is in a realm of perpetual change, of eternal motion, of infinite mystery. Light and darkness, and cold and heat, are to him as friends of familiar countenance, but of infinite variety of conversation; and while the geologist yearns for the mountain, the botanist for the field, and the mathematician for the study, the meteorologist, like a spirit of a higher order than any, rejoices in the kingdoms of the air.

But, as we before said, it is neither for its interest, nor for its beauty, that we recommend the study of meteorology. It involves questions of the highest practical importance, and the solution of which will be productive of most substantial benefit to those classes who can least comprehend the speculations from which these advantages are derived. Times and seasons, and climates, calms and tempests, clouds and winds, whose alternations appear to the inexperienced mind the confused consequences of irregular, indefinite, and accidental causes, arrange themselves before the meteorologist in beautiful succession of undisturbed order, in direct derivation from definite causes; it is for him to trace the path of the tempest round the globe—to point out the place whence it arose—to foretell the time of its decline—to follow the hours around the earth, as she "spins beneath her pyramids of night" —to feel the pulses of the ocean—to pursue the course of its currents and its changes—to measure the power, direction, and duration of mysterious and invisible influences, and to assign constant and regular periods to the seed-time and harvest, cold and heat, summer and winter, and day and night, which we know shall not cease, till the universe be no more. It may be thought we are exaggerating the effects of a science which is yet in its infancy. But, it must be remembered, that we are not speaking of its attained, but of its attainable

power; it is the young Hercules, for the fostering of whose strength the Meteorological Society has been formed.

There is one point, it must now be observed, in which the science of meteorology differs from all others. A Galileo, or a Newton, by the unassisted workings of his solitary mind, may discover the secrets of the heavens, and form a new system of astronomy. A Davy in his lonely meditations on the crags of Cornwall, or, in his solitary laboratory, might discover the most sublime mysteries of nature, and trace out the most intricate combinations of her elements. But the meteorologist is impotent if alone; his observations are useless, for they are made upon a point, while the speculations to be derived from them must be on space. It is of no avail that he changes his position, ignorant of what is passing behind him and before; he desires to estimate the movements of space, and can only observe the dancing of atoms; he would calculate the currents of the atmosphere of the world, while he only knows the direction of a breeze. It is perhaps for this reason that the cause of meteorology has hitherto been so slightly supported; no progress can be made by the enthusiasm of an individual; no effect can be produced by the most gigantic efforts of a solitary intellect, and the co-operation demanded was difficult to obtain, because it was necessary that the individuals should think, observe, and act simultaneously, though separated from each other, by distances, on the greatness of which depended the utility of the observations.

The Meteorological Society, therefore, has been formed, not for a city, nor for a kingdom, but for the world. It wishes to be the central point, the moving power, of a vast machine, and it feels that unless it can be this, it must be powerless; if it cannot do all it can do nothing. It desires to have at its command, at stated periods, perfect systems of methodical, and simultaneous observations; it wishes its influence and its power to be omnipresent over the globe, so that it may be able to know, at any given instant, the state of the atmosphere at every point on its surface. Let it not be supposed that this is a chimerical imagination—the vain dream of a few philosophical enthusiasts. It is co-operation which we now come forward to request, in full confidence, that if our efforts are met with a zeal worthy of the cause, our associates will be astonished, *individually*, by the result of their labours in a body. Let none be discouraged, because they are alone, or far distant from their associates. What was formerly weakness, will now have become strength. Let the pastor of the Alps observe the variations of his mountain winds; let the voyager send us notes of their changes on the surface of the sea; let the solitary dweller in the American Prairie observe the passages of the storms, and the variations of the climate; and each, who alone would have been powerless, will find himself a part of one mighty Mind—a ray of light entering into one vast Eye—a member of a multitudinous Power, contributing to the knowledge, and aiding the efforts, which will be capable of solving the most deeply hidden problems of Nature, penetrating into the most occult causes, and reducing to principle and order, the vast multitude

of beautiful and wonderful phenomena, by which the wisdom and benevolence of the Supreme Deity regulates the course of the times and the seasons, robes the globe with verdure and fruitfulness, and adapts it to minister to the wants, and contribute to the felicity, of the innumerable tribes of animated existence.

Oxford University.

REVIEWS.

On the Mean Pressure of the Atmosphere, and the Prevailing Winds over the Globe for the Months and for the Year. By A. BUCHAN, Esq., M.A., F.R.S.E., &c. [Second notice.]

IN our last number we placed before our readers a short notice of this paper, and sketched briefly the principal features in the distribution of pressure shown, and some of the extreme changes in it which occur in the different parts of the year. This latter description was purposely curtailed, as it would be better in going more minutely into the subject, to refer also to the *prevailing* winds, as shown on Mr. Buchan's charts, and for this we had not sufficient space.

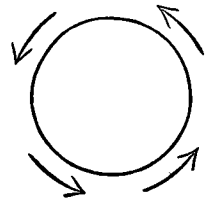
We now propose to do this, but in the absence of copies of the isobaric charts, must necessarily be a little verbose, to make the account clear to our readers.

Taking the chart for *January*, we find a vast area of mean pressure of 30 in. and upwards, embracing the whole of Central North America, where the northern border, running more southward, passes as a broad belt (between lat. 5° and 45° N.) across the Atlantic Ocean to the Old World. The southern border is then temporarily curved northward in crossing Northern Africa, but the two isobarics of 30 in. subsequently diverge, including in their bounds all but Northern Europe and the whole of Asia. At the eastern coasts of Asia a marked change takes place, for the northern boundary turns suddenly to the south and even south-westward, following closely the coast line of the seas of Okhotsk and Japan, and the Yellow Sea; it then turns eastward again, and with the southern boundary crosses the Pacific as a belt, between lat. 5° and 20° N., till near the American coast, when the northern line takes a more northern direction, and the area embraced (as before mentioned) is the whole of Central North America. Now in this region of high pressure, three distinct maxima occur, one equalling 30·3 ins. (and slightly upwards) near the centre of the United States, a second (of 30·2 ins. and more) in the North Atlantic, between the meridians of about 10° and 50° W., and the third (of 30 4 ins. and more) in Central Asia. The change from these maxima to the isobar of 30·0 ins., is in each case gradual, and each of them is separated from the other by a considerable space of about 30 ins. of mean pressure.

Thus far, then, for this one vast region of high readings in the northern hemisphere. Now, to the northward of its northern boundary, the barometer reads lower on an average, and in the neighbourhood of Iceland, there exists a minimum of about 29·4 ins. (and slightly less),

while a second depression (of about 29·6 ins.) is found in the North Pacific, near the peninsula of Aliaska. Here we have briefly explained what we stated in our last—that great condensation over the continents, and rarification over the oceans, is the feature of the winter months.

Now with regard to the winds in the northern hemisphere, we find that to the N.W. of the depression near Iceland, the prevailing direction is north easterly, to the S.W. of it north-westerly, to the S.E. of it south westerly, and to the E. of it southerly. Thus :—



And (so far as there are observations given) the same rule holds good in the case of the Pacific minimum. This circulation is precisely that found to hold from day to day, round the various areas of low barometrical pressure which exist in one place or another, and has recently been known by the term "Buys Ballott's Law." Around the high pressures we find a decided *tendency* to circulate in the opposite direction, but for reasons on which we will touch at some future time, these do not seem so *completely* shown. In this manner the south-westerly and westerly winds of northern and north-western Europe are accounted for, together with the more westerly breezes of the Atlantic and the northerly winds of northern America. The monsoons of the China seas are also shown to be dependent on conditions not nearly so local as have been imagined by some, and the theory of Dove as to their cause is abundantly confirmed. But we must just venture to remark, that there is some doubt as to the scientific correctness of comparing *average* pressures with *prevailing* winds, instead of *average* winds; and striking as the present result is, we cannot doubt it would be doubly so, could the *prevailing* winds be compared with the average pressure during their continuance. This of course is merely mentioned as a suggestion, and in no way as complaining that absolute perfection has not been attained. Again, the present charts might be greatly improved were they supplemented by the results of marine observations on wind, published by Maury, the Board of Trade, or the Dutch or French authorities; for it is well known that for wind the marine observations are by far the most accurate—at least, so far as *estimation* is concerned.

In the southern hemisphere the distribution of pressure differs very materially from the values being nearly uniform in all parts. There is a region of slight maximum in the South Atlantic and another lying in a belt from E. to W. in the South Pacific, about the parallel of 30° S.,

but readings in these are only between 30·0 and 30·1 inches, while the two minima noted are one in Central Africa (of 29·8 in. and slightly less), and one in Australia of 29·9 in. It is true there is represented a rapid decrease in pressure from about 30 in. in lat. 40° S. to about 29·2 in. in lat. 60° to 65° S., founded principally on one of the "Numbers of Meteorological Papers" published by the Board of Trade, but its existence uniformly *all round* the northern borders of the Antarctic regions, as given in the charts, is rather a disputed point among meteorologists, although the extraordinarily low readings in the neighbourhood of Cape Horn cannot be doubted. With regard to the winds observed south of the Line, very little information is given, but a tendency is observable to circulate round the respective depressions and regions of maximum pressure in directions exactly opposite to those noticed north of the equator—as, in fact, may be expected.

Thus, then, we have noticed the conditions observed in our mid-winter month, January, and with this we will briefly compare the results shown on the July chart. The band of max. pressures noticed in the northern hemisphere is now in the southern, but is connected with a distinct area of high readings, which exists over the North Atlantic, while a second condensation of air is noticed in the North Pacific. The high readings over Asia have given way to a minimum of 29·5 in., (while a second depression of 29·7 in. is found in North Africa,) and those in the United States to an area of 29·7 in. The winds still circulate round the districts of these depressions and elevations as before, though those in Asia are less clearly marked than we should have anticipated. The winds in the different districts are thus in most cases from points exactly opposite to those in January, the change being most marked in the monsoons of India and China. Our own British Islands, being under the influence of comparatively low readings to the N. and N.W. of them, are still influenced chiefly by the south-westerly winds, but European Russia now feels its northerly wind, and Eastern Asia experiences its southerly monsoons. Similarly, British Columbia has now northerly winds instead of southerly, and the eastern parts of the United States enjoy the contrary change. There appears to be (if we may judge by the winds charted) something defective in the isobarics which run from W. to E. across the South Atlantic and the southern part of Africa, but those in the northern hemisphere are from the better observations.

We feel that in giving this sketch of the features shown in the charts for these two months, we have done so inadequately; but the object has been not to supersede in any way the charts, but by drawing attention to their *principal* features to induce a desire in the minds of our readers to study the subject carefully for themselves. There is little doubt that a more extensive series of observations will will alter the precise courses of the isobarics; but the main features are too distinctly marked to admit of much doubt as to their accuracy. *Good* isothermal charts (if such exist) would be of immense value for comparison with the isobarics on the present scale.

Stonyhurst College Observatory.—Results of Meteorological and Magnetical Observations, 1869. JAMES ROBINSON, Preston: small 8vo, 32 pages.

THIS pamphlet consists mainly of a series of monthly abstracts of results for 1869, a comparison between them and the average of 22 previous years, and a short abstract of the magnetic observations. Our notice must, therefore, mainly consist of a few data selected as of more special interest. The barometer is a standard by Barrow, and the observations are given, corrected for temperature, but *not* for altitude. The height of the barometer above sea is 381 ft., *the mean annual temperature*, 22 years, 46°·8, the mean annual pressure for the same period, corrected for temp. and index error is 29·482, the correction for elevation is therefore 0·420, and hence we get the *mean pressure at sea level as* 29·902 *inches*.

The correction for the extremes of pressure cannot be accurately determined in the absence of information as to the temperatures at the time, but we shall certainly not err more than 0·03 in., and, possibly, not at all, if we apply the same correction to them; then we have—

Greatest pressure (on Feb. 11, 1849, and on March 4, 1854)	30·872 in.	at sea level.
Least ,, (on Jan. 14th, 1865)	28·359 ,,	,,
Range	2·513 in.	
Highest temperature of air in shade, July 15th, 1868.....	88·1	
Lowest ,, ,, ,, Dec. 24th,* 1860 ...	6·7	
Mean ,, ,, ,, ...	46·8	

The total horizontal motion of the air was, in 1869, 98,291 miles, or an average of 11·2 miles per hour.

The mean magnetic declination for 1869 was 21° 40′ 54″ W., but this appears to be simply the mean of one observation per month, and not the result of the photographic records. The high quality of the Stonyhurst observations has long been known, and we trust the able director will have such assistance as will enable him to place the results even more fully before the world than in the present abstract.

Devonshire Hospital and Buxton Bath Charity. Annual Report for the year 1869 Published at the Hospital, 8vo. 48 pages.

WITH this report, as that of an economically administered and excellent charity, we in these pages have nothing to do; our concern is with the Meteorological Report, drawn up by Mr. E. J. Sykes, F.M.S., and printed on pages 23 and 24.

We regard the inauguration of a series of accurate observations at Buxton as of considerable importance, not only on account of its geographical and geological situation, but also because of its altitude, 1,040 ft., and we should think that Dr. Robertson, the chairman of the board of trustees of the charity (especially if he is identical with the gentleman of the same name who in 1854 published a *Handbook*

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* Surely this should be Dec. 25th; we thought the lowest temperature occurred between 11 p.m. on 24th and 6 a.m., on 25th, if so, clearly the minimum should be that of 25th. The matter should be examined.

to the Peak), must be as glad as we are that the step has been taken. We wish the various health resorts would do likewise, and thus provide materials for accurate comparisons of their respective climates. We wish to see a fuller report next year, but in the interim, have hardly anything but praise for this first instalment. We know that the printing of meteorological tables is expensive, and we are glad to see that the treasurer of the charity seems to hold the purse-strings commendably tight. We see that the report may be purchased for a few pence, and therefore we do not quote a single result or a single word, and hope by so doing, we shall induce many of our readers to send some stray stamps, obtain the report for themselves, encourage the observer, and, perchance, induce the treasurer to look upon meteorological tables as a good investment.

HEIGHT OF RAIN GAUGES.

To the Editor of the Meteorological Magazine.

SIR,—As you court criticisms on your excellent rain gauge regulations, I venture to suggest a doubt as to one of them, that which limits the height of the gauge to one foot above the ground. It appears to me, that gauges so placed act as *traps* for the rain rather than fair measures of the average fall, that they retain all chance accessions, while they allow nothing once caught to escape them. The valuable experiments made at Rotherham, by Mr. Chrimes, tend to confirm this impression. They prove that on calm days a gauge on the surface of the ground receives no more rain than one placed 20 ft. above it; that on windy days the excess registered by the ground gauge varies with, and, we may fairly infer, is mainly caused by, the wind. The question is, does the wind increase the quantity of rain received by the ground gauge *above* the fair average; does it diminish the rain received by the high gauge *below* the fair average? or does it act in both ways, so that the true mean is to be found in some intermediate position?

Any one standing on the sea shore in a storm, will see the air filled to a great height with the spray, which is carried, as is proved by the salt it deposits, many miles inland. Now what is this spray but fine particles of water swept up, as it were, from the surface of the sea by the wind? And what is to hinder this same wind from carrying away a proportionate tribute from every field, every tree, every hedge-row it passes in its course, when field, tree, and hedge-row are all drenched and dripping with rain? Have we not here at least a partial explanation of the rapid decrease in the quantity of rain registered, with every foot of the first 10 above the surface, of the variation in the rate of decrease as determined by different observers, and of the discordant quantities received by similar ground gauges, even in the same locality.

On the other hand, the last issue of the *British Rainfall* records a remarkable experiment at Aldershot, in which two gauges, tilted at 45°, received the same quantity of rain every month in the year, though one was placed at 6, the other at 30 ft. above the ground. This result, if confirmed, would seem to show that a horizontal stratum

of wind contains as much rain at 30 as it does at 6 ft. above the ground, if we only know how to extract it, and we have, seemingly, no resource but the theory that wind when moving at a high velocity (at 30 ft. above the ground) carries a certain amount of rain with it, across the mouth of a *horizontal* gauge, which it allows to drop when its speed is checked by friction against the surface.

Being thus distrustful of both high and low gauges, I should advocate as a safer mean one (at least) 6 ft. above the ground, and I believe, if such gauges were generally adopted, the results would be more trustworthy, as well as more accordant. I may be allowed to doubt whether if the lower tilted gauge at Aldershot had been on the ground, instead of 6 ft. above it, the agreement with the upper would have been so perfect. Perhaps an experiment of this kind would be a fair test of the question.—Your obedient servant, R.

[We shall be glad to receive any remarks which our readers may desire to offer upon this subject (Rule IV. of *British Rainfall*, 1869,) provided they are sent in before April 30th.—Ed.]

MOVEMENT OF AIR.

To the Editor of the Meteorological Magazine.

Sir,—Can any of your readers tell me whether any work on meteorology tells you how long it takes air to move from one latitude to another. A volume of air starts, we suppose, from the parallel of 30°, and proceeds towards the North Pole. How long, that is, what time would it occupy in its transmission from 30° to, say 68°? I know there is a general translation of air in an easterly direction, with earth's rotation, of about five to eight miles per hour, but this is not the motion I am desirous of knowing. I am making some observations with regard to the alternation of tropical and polar currents, and am anxious to ascertain the average time required for the transmission of air from one parallel to another.

I am, Sir, your obedient servant, W. L. B.

Alpha House, Hatcham, March 26th, 1870.

ENTRY OF MAXIMUM AND MINIMUM TEMPERATURES.

To the Editor of the Meteorological Magazine.

Sir,—It may be presumed that meteorologists desire to record the highest and lowest temperature that occurs between midnight and midnight, otherwise there would seem to be no sufficient reason for the usual practice of entering the maximum as that of the day previous to the morning on which it is read.

On this supposition there are two possible cases in which error may occur (when thermometers are read and set at 9 a.m.), in addition to that mentioned by Mr. Nunes in your last number.

For the sake of clearness and brevity, I will suppose a case, extreme certainly, but by no means impossible, in which both these errors are combined in a very palpable form.

At 9 a.m. on a Monday in January, with a bleak east wind, the thermometers stand at 30°, and are set accordingly. In the course of the day the temperature rises to 32°; at midnight the wind changes to S.W., and the temperature rises (as I have seen it do repeatedly in such cases) to 48°. On Tuesday morning, with bright sunshine, the thermometers stand at 50°. The maximum entered for Monday will then be 50°, whereas the true maximum was 32°; the minimum entered for Tuesday will be 30°, whereas the true minimum was 48°.

These sources of error are so obvious, and of such common occurrence, I must suppose that meteorologists have not overlooked, but ignored them under the impression that general conformity was of more consequence than occasional error, influenced, perhaps, also, by the difficulty of suggesting a satisfactory remedy. Theoretically, the registering thermometers ought to be set and read at midnight; as this would not be convenient in practice, I would suggest, as a compromise, that when the wind changes from a northerly to a southerly direction, after 9 a.m., the maximum should be read and the minimum set as late as possible in the evening.

Your obedient servant, R.

A TAX ON OBSERVERS.

To the Editor of the Meteorological Magazine.

SIR,—Allow me to call your attention to what is becoming quite a tax on observers. I refer to continual applications for the result of their observations. One gentleman lately sent me a form on which to take observations for him *hourly*. I supplied the results of my observations to another gentleman, who did me the politeness to send me a copy of the pamphlet for which he used them, when I found he stated, "they must be incorrect," as they did not agree with his theory. The climax was arrived at a week or ten days since, when I received a letter from a perfect stranger, asking me to send him ten years' observations. Being a medical man, in active practice, I was taking every opportunity of filling up this gentleman's form, in my very microscopical quantity of spare time, when I got another letter from my strange correspondent, expressing his astonishment at my not having sent the forms, &c.

Now, Sir, is there to be any limit to this? I am willing to do all in my power to advance scientific enquiries, but if one is expected to answer the letters and fill up the forms of any gentleman who wishes to publish on any particular theory, the more especially as my observations are already published in the Registrar-General's Reports, I for one must give up my observations altogether.

I am, truly yours, M. B.

April 2nd, 1870.

MARCH, 1870.

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	Date	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade	On grass.
		inches	inches.	in.								
I.	ENGLAND. Camden Town	2·31	+ ·23	·95	3	13	60·5	3	23·8	14	8	18
II.	Maidstone (Linton Park)	1·64	— ·85	·38	4	17	62·0	3	22·0	14	13	...
„	Selborne (The Wakes)	2·67	+ ·07	·89	1	10	57·0	2	12·8	14	17	20
III.	Hitchen	1·82	— ·35	·56	4	15	56·0	2	24·0	13§	14	...
„	Banbury	1·49	— ·71	·57	1	13	55·0	2*	22·5	14	17	...
IV.	Bury St. Edmunds (Culford)	1·87	— ·33	·58	4	16	60·0	2	20·0	13	14	18
V.	Bridport	1·93	— ·94	1·23	1	10	60·0	17	22·5	14	12	...
„	Barnstaple	1·74	— 1·41	·46	1	9	58·0	19	26·0	14	6	..
„	Bodmin	2·91	— ·84	·95	1	14	54·0	31	28·0	24‖	6	9
VI.	Cirencester	1·76	— ·84	·70	1	7	....	...	...	...	...	...
„	Shifnall (Haughton Hall)	1·54	— ·40	·50	1	12	55·0	17	18·0	14	15	...
„	Tenbury (Orleton)	1·86	— ·56	·73	1	8	60·2	17	17·7	14	14	18
VII.	Leicester (Wigston)	1·10	— 1·01	·43	1	6	60·0	31	22·0	13	16	...
„	Boston	1·10	— ·69	·30	1	15	56·2	17	21·6	14	12	22
„	Grimsby (Killingholme)	2·30	..	·55	1	16	54·0	1*	26·5	14	6	...
„	Derby	1·72	— ·53	·52	1	9	57·0	17	24·0	14	14	...
VIII.	Manchester	2·38	— ·31	·59	2	9	57·0	31	22·0	14	11	19
IX.	York	1·80	— ·19	·39	3	13	59·0	19	27·0	12	10	...
„	Skipton (Arncliffe)	3·06	— 1·75	1·40	16	8	...	...	...	...	..	..
X.	North Shields	1·21	— 1·14	·33	22	13	57·0	20	25·0	13	8	10
„	Borrowdale (Seathwaite)	...	...	...	..	...	...	...	...	...	...	...
XI.	WALES. Cardiff (Town Hall)	...	...	...	...	...	...	...	...	...	...	...
„	Haverfordwest	3·88	+ ·43	1·33	1	8	56·0	31	22·0	13	7	11
„	Rhayader (Cefnfaes)	2·79	— 1·05	1·00	2	10	58·0	...	18·0	...	8	...
„	Llandudno	1·88	— ·38	·67	3	8	58·4	31	26·5	14	5	...
XII.	SCOTLAND. Dumfries	·86	— 2·12	·29	15	8	56·0	3, 17	24·5	13	15	...
„	Hawick (Silverbut Hall)	1·03	...	·25	21	13	...	...	...	...	...	...
XIV.	Ayr (Auchendrane House)	1·43	— 2·30	·52	14	7	56·0	17†	22·0	13§	15	18
XV.	Castle Toward	1·33	— 3·26	·33	15	9	56·0	31	24·0	24	21	26
XVI.	Leven (Nookton)	·77	— 1·30	·21	25	8	53·0	28†	22·0	14	14	28
„	Stirling (Deanston)	·52	— 3·01	·19	15	9	52·0	8‡	18·0	13§	24	...
„	Logierait	·49	...	·21	15	9	...	...	...	...	..	..
XVII.	Ballater	·88	...	·24	25	7	55·5	31	18·0	12	15	...
„	Aberdeen	·89	...	·12	30	16	56·0	19	22·0	12	9	17
XVIII.	Inverness (Culloden)	·28	...	·09	30	6	54·1	29	23·8	12	11	20
„	Portree	1·38	— 7·66	·30	29	16	...	...	...	...	...	...
„	Loch Broom	1·10	...	·25	10	17	...	...	...	...	...	...
XIX.	Helmsdale	1·22	...	·34	15	16	...	..	...	...	...	...
„	Sandwick	1·25	— 2·08	·23	12	22	50·0	19	19·9	12	10	17
XX.	IRELAND. Cork	2·22	...	·55	15	11	...	...	...	...	...	...
„	Waterford	2·99	+ ·10	·70	15	17	48·0	16†	25·0	14¶	17	...
„	Killaloe	2·74	— 1·58	·57	24	14	62·5	31	24·0	14	7	...
XXI.	Portarlington	2·28	— 1·03	·67	25	18	58·5	18	28·0	26	8	...
„	Monkstown	2·08	— ·50	·90	3	13	...	...	...	...	...	...
XXII.	Galway	1·45	...	·36	15	16	55·0	20	30·0	5**	6	...
„	Bunninadden (Doo Castle)	2·23	...	·82	24	13	...	...	..	...	...	...
XXIII	Bawnboy (Owendoon)	2·01	...	·42	24	13	60·0	19†	23·0	13	7	14
„	Waringstown	1·27	...	·24	21	13	65·0	19	21·0	12	13	17
„	Strabane (Leckpatrick)	1·31	..	·18	21	15	61·0	18	18·0	13	18	19

* And 16, 17. † And 31. ‡ And 10, 20, 21. § And 14. ‖ And 27. ¶ And 26.
** And 6, 12.

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

METEOROLOGICAL NOTES ON MARCH.

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

ENGLAND.

STAPLEHURST.—A cold, but not wet, month; rather heavy falls of S on 13th and 26th; no high winds, and very little sunshine; frosts numerous, but not severe; no floods in the river, but the frequent driblets of R and S kept the roads very dirty the greater part of the month, but for tillage purposes the land works well.

SELBORNE.—On the whole, a cold dreary month; all vegetation retarded and the crops very unpromising; great destruction in the flower gardens. The ther. on the morning of the 14th lower than I have ever known it in March (12·8), at E. Tisted three miles W. of this place it was rather lower, and at Guildford also (as I am told). The variations in temp. have been very remarkable. S 6 in. deep on 13th, and temp. 12°·8 on 14th; min. 43° on 22nd and max. only 39° on the following day.

BANBURY.—High winds on 2nd and 3rd; ball S at 2.30 p.m. on 26th; fog on 31st.

CULFORD.—March has again been an exceedingly cold month, the mean temp. being slightly in advance upon February, 39·6 to 35·3, it is also higher than March of last year, which was only 36·2, but that was the coldest March on record in the eastern counties; vegetation very backward.

BRIDPORT.—Very fine but cold month; 22 days on which the wind was from N. or E.; no S fell for the month enough to register.

CIRENCESTER.—The month has been remarkable for dryness and cold, with the exception of two fits of warmth, one at the beginning, the other, 17th and 18th of the month; frosty nights have been so frequent that vegetation is universally backward and spring flowers rare.

SHIFNALL.—The month came in warm, with high wind and R from S.W., which changed on the 2nd to the N.E., where it continued till the 8th, inclusive, from which day till the 19th it returned to N.W. and S W., the temp. varying greatly. On the 13th, 2 in. of S, followed by a severe frost next day, ther. 18°; from thence to the end of the month varying from N.W. to N.E.; on 22nd a sudden fall in temp. in midday from 53° to 36°. Vegetation exceedingly backward, the hawthorn hedges scarcely in bud on 31st, wheat no higher than in November, and in many places, especially on light soils, greatly injured by the repeated frosts. On 31st, S.W. wind with a cloudless sky; catkins on hazel open on 1st, yellow crocus beginning to flower on the 6th, apricots beginning to blossom on 23rd, celandine in flower on 25th; rooks beginning to build on 10th; chaffinch and yellowhammer singing on 20th, and eggs laid by throstle before the 26th.

ORLETON.—Warm with much R on the first three days, then generally dry with a variable temp., occasionally very cold, and a cloudy sky with wind chiefly from the N. and N.E.; S 4 in. deep on the 13th. Min. on grass, 14° on 14th. The last week fine, with severe frosts each night; bar. generally high during the month; temp. about 1° below the average.

WIGSTON.—Both rainfall and temp. have been below the mean of many years for the same month; vegetation very backward.

KILLINGHOLME.—Vegetation backward; laurels much scorched by the cold easterly winds; ground in first-rate condition for sowing at the end of the month; wild violets in flower on 19th, apricots beginning to flower on 25th, pyrus japonica on 27th, and peach on 31st; rooks building on 6th, chaffinch singing on 9th, larks soaring and singing on 21st, frogs spawning on 10th; aurora on 13th, Noah's ark from N.W. to S.W. on 30th.

DERBY.—The month has ended with beautiful weather, but, except at the end and a few days about the 15th, it has been unusually raw and cold, with frosts of great severity, not doing, it is hoped, much harm in so backward a season. The atmospheric pressure has been above the mean, and, consequently, the rainfall considerably below. The weather is now all that the husbandman or gardener could desire, the soil never broke up in a more splendid condition; let us hope the results will be in harmony with the seed-time.

WALES.

HAVERFORDWEST.—The commencement very wet, but afterwards a fine month, good for field operations, excellent sowing time; temp. below the mean, yet not severe; no gales of any importance; some S fell on the 4th, and a considerable fall on the 25th; cold fine weather continued to the end of the month; wind principally from the N.E.

CEFNFAES.—Dry cold weather, with frosts; fall of S on the 20th; temp. low, wind generally from N.E.

LLANDUDNO.—S about 3 ins. deep on 13th. On the whole, a fine month, especially the last week of it; measurable R only on eight days.

SCOTLAND.

DUMFRIES.—With the exception of a few days in the middle of the month, the weather has been ungenial, frost by night and drought by day; S fell on 2nd, 3rd, 11th, 22nd, 25th, and 27th; vegetation behind previous season; mean temp. of month 41°·7.

SILVERBUT HALL, HAWICK.—The cold easterly gales, and the hard frosts, H, and S showers which we had on no less than 15 days, were most trying for young lambs, and the little bleaters had a very chilling welcome. We have frequently had more severe S storms and longer frosts, but for protracted duration not many winters can parallel that of 1869-1870.

AUCHENDRANE.—With reference to our local averages, the bar., mean temp., and amount of cloud are slightly above, while the bar. range, rainfall, evaporation, and mean force of wind are slightly below; the elastic force of vapour, dew-point, and humidity are close on the average, as is also the difference between temp., dew point and the mean temp. of the month; the polar and equatorial currents prevailed during an equal number of days each; calms also were very numerous; a small rainfall and an evaporation equalling it in quantity, reduced the rivers considerably, without bringing much of the welcome March dust.

CASTLE TOWARD.—A cold dry month; frost more or less to the 15th, and again from the 20th to the 26th, so that vegetation has made little progress; early cabbages and broccoli are much injured; very favourable seed time, the ground being dry and in good condition; mild and warm from the 27th to the end of the month.

DEANSTON.—Whole month very dry, but frequent strong cold east winds and much frost at night; some S on the hills on the 22nd.

LOGIERAIT.—Keen frost with high wind on 12th. General character of the month, favourable, vegetation advancing; saw lapwings on 17th.

ABERDEEN.—Bar. and temp. above the average; R less than in any year since 1856; most prevalent wind, N.W. A dull cold month; very little has yet been done in cropping the ground; agricultural operations have been kept terribly back.

PORTREE.—This month, on the whole, has been very favourable for out-of-door labour; much less R than usual, and more frost and S than is usual for the month of March. Solar halos on the 26th and 27th from noon to sunset.

LOCHBROOM.—This has been, on the whole, a fine month for the farmers and farm labour, and in a measure makes up for the backwardness of last month.

SANDWICK.—March has been 1°·85 colder than the mean of previous 43 years; a gale of 50 miles an hour on the 11th, and one of 60 miles an hour on the 12th; S on several days, drift on 22nd; aurora on six nights; large lunar halo on the 14th.

IRELAND.

OWENDOON.—This has been a splendid month for the farmers.

WARINGSTOWN.—Cold and parching during the first fortnight, then a few fine days, and again cold weather till the end of the month; rainfall much below the average.

LECKPATRICK.—Driest March ever registered; in 1863, the next driest, there fell 1·52 in. The average temp. of the quarter is about 2½° under the mean of quarter deduced from eight years observations; the average rainfall (for eight years) in March is 3.55, consequently the fall of this month (1·31) is not half the average. Very favourable seed time.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

LII.] MAY, 1870. [PRICE FOURPENCE, or5s. per ann post free.

ON THE RAINFALL OF SOUTH-WESTERN EUROPE AND ALGERIA.

(Continued from page 36.)

WE resume our notice of this subject by inserting the following *résumé* of Prof. Raulin's memoir on the rainfall of Algeria, which appeared in the "*Atlas Météorologiques de l'Observatoire Impérial*, 1868."

After a brief record of all the gauges hitherto used in Algeria, 37 in number, and many of them only recently started, Prof. Raulin proceeds to say—"My rainfall investigations in the south-west of France have caused me to recognise that the most important and the most characteristic feature in the fall of rain on the surface of a country is not the absolute quantity of water which falls upon the ground during the year, but the distribution between the seasons, and especially during the several months.

"In fact, even when the annual totals are alike, there is in respect of monthly distribution complete opposition between the Mediterranean district, and Central and Northern Europe, and also in Siberia from other parts of Asia.

"In the vast district which extends from the western coasts of France, of England, and of Scandinavia, even to Kamtchatka, the summer rains are more pronounced than they are further east, although in the Mediterranean district there is almost total absence of rain during that season.

"The physical configuration of the district, although all-important as affecting the total fall of rain, has very little influence over its seasonal distribution. Thus, the rainfall at Bordeaux, although very considerable (32 in.), is not much more than half that which falls at Bayonne (56 in.), and especially at the mouth of the Bidassoa (70 in.), but the seasonal distribution remains the same.

"So also on the coast of Algeria, the rainfall at Bougie (52 in.) is almost double that at Algiers (31 and 35 in.), and three times that at Oran (19 in.), but the seasonal distribution remains the same, and June, July, and August are always extremely dry."

Prof. Raulin then proceeds to point out that only the records from Algiers, Constantine, and Mostaganem are of sufficient length to afford reliable data of seasonal distribution. Then he gives the following table, the importance of which has induced us to convert all the values and print it *in extenso*:—

Comparison Table of the Rainfall in Algeria, 1838-1867.

STATIONS ON THE COAST.

	Oran.	Mostaganem.	Algiers P. et Chaus	Algiers Hardy.	Bougie.	Djedjeli.	Phillipeville.	La Calle.
Altitude.	164 ft.	262 ft.	131 ft.	16 ft	98 ft.	131 ft.	197 ft.	82 ft.
	in.	in.	in.	in.	in.	in.	in.	in.
1838	...	...	34·03	...	...	...	...	...
9	...	...	28·38	...	..	...	...	...
1840	...	...	31·68	...	...	...	...	...
1	14·49	...	35·28	..	...	...	...	...
2	23·04	..	35·46	...	...	...	...	...
3	10·87	..	30·13	...	...	...	...	...
4	20·77	...	41·23	...	...	..	...	...
5	24·37	...	41·22	...	...	...	...	...
6	15·75	...	41·23	...	...	...	...	...
7	18·38	...	51·42	..	...	...	...	...
8	23·07	...	40·51	...	...	...	...	...
9	12·56	11·81	21·97	...	..	...	...	...
1850	12·04	11·02	29·91	...	...	..	...	...
1	13·93	12·66	31·54	...	...	...	...	...
2	16·22	21·01	29·58	...	...	...	...	...
3	28·05	22·01	35·93	...	...	...	...	...
4	16·27	19·76	42·32	...	...	...	44·30	...
5	21·54	23·39	21·54	20·86	...	...	18·76	...
6	20·47	15·73	28·66	27·35	...	...	13·50	...
7	35·71	27·68	35·36	39·11	...	...	30·25	...
8	13·07	15·85	24·75	34·21	59·59	...	41·19	...
9	15·31	16·91	35·28	40·60	57·42	..	35·51	...
1860	18·40	17·21	26·49	40·35	65·72	33·52	31·62	...
1	13·90	14·47	21·44	32·21	29·98	29·83	20·55	...
2	16·58	22·91	24·32	47·16	38·51	71·11	21·12	30·60
3	21·97	13·66	24·37	40·85	35·63	37·14	29·44	39·99
4	29·80	27 84	27·50	43·50	32·44	40·59	24·54	44·10
5	26 10	21·31	38·47	42·75	66·13	62·42	37·70	39·17
6	17·20	13·48	17·01	24·02	74·22	24·52	17·22	20·72
7	12·79	9·84	20·83	...	...	...	37·24	38·51
Mean*	19·02	17·91	31·12	35·06	51·82	42·15	30·36	34·32
Max..	35·71	27·84	51·42	47·16	74·22	71·11	44·30	44·18
Min..	10·87	9·84	17·01	20·86	29·98	24·52	13·50	20·72

* These are conversions of the means given by Prof. Raulin; they differ slightly from the true means of the yearly values as given, owing, we presume, to misprints in the "Atlas."

STATIONS INLAND.

	Tlemcen.	Sidi-Bel-Abbès.	St. Denis du-Sig.	Mascara.	Jemmapes	Constantine.	Sétif.	Batna.
Altitude.	2690 ft.	1542 ft.	180 ft.	1903 ft.	295 ft.	2116 ft.	3533 ft.	3448 ft.
	in.	in.	in.	in.	in.	in.	in.	in
1838	...	...	...	...	...	36·57	...	...
9	...	...	..	...	...	29·07	...	...
1840	...	...	...	...	...	20·32	...	..
1	...	..	...	...	...	19·99	...	...
2	...	...	...	...	...	21·63	...	...
3	...	...	..	...	...	39·27	...	...
4	...	...	...	...	..	25·55	. .	..
5	...	..	...	...	...	26·83	...	...
6	...	...	...	...	...	31·00	...	...
7	...	...	...	...	...	39·97	...	...
8	...	...	...	...	...	...	...	...
9	...	...	...	...	...	...	...	...
1850	...	...	...	...	...	..	...	...
1	...	...	...	..	...	...	...	...
2	...	...	...	...	. .	..	...	...
3	19·80	...	...	...	...	...	...	...
4	16·28	...	...	...	...	42·53	...	...
5	31·61	..	...	...	...	16·13	20·28	...
6	25·10	...	..	...	...	15·37	...	...
7	29·81	...	24·47	...	...	24·65	25·67	...
8	21·93	...	10·87	...	..	25·81	17·31	...
9	16·81	26·10	12·60	8·76	31·37	31·50	15·67	..
1860	24·82	15·95	12·13	14·23	23·17	22·95	15·19	...
1	16·02	7·92	9·72	10·47	21·87	14·93	8·17	9·93
2	22·36	13·56	15·81	20·71	31·36	22·28	13·65	16·54
3	26·01	14·24	17·28	19·56	36·57	30·20	23·19	25·26
4	34·41	19·25	21·79	30·28	28·59	20·74	13·80	15·48
5	40·99	18·71	21·42	23·93	36·08	32·58	19·84	10·14
6	20·95	11·77	13·31	10·83	13·59	14·61	10·67	7·59
7	11·58	7·83	9·03	8·53	26·26	23·52	10·47	14·07
Mean	23·91	15·06	15·28	16 52	29·21	26·94	16·66	16·40
Max..	40·99	26·10	24·47	30·28	36·57	42·53	25·67	25·26
Min...	11·58	7·83	9·03	8·53	13·59	14·61	8·17	7·59

Before returning to the question of seasonal distribution, Prof. Raulin makes the following remarks on the above tables :—

"The comparison of these annual quantities shows that there is not entire agreement in the succession of dry and wet years at the various stations. But, as one might expect, there is more analogy between what occurs on the coast and in the interior of the same province, than between what occurs through the entire coast line of the three provinces.

"The last three lines of the table enable us to establish that the excesses of the maxima above the mean are greater than the defects of the minima below it, whence it results that the mean of the two extreme

years is above the true mean of the whole period, the only exceptions are Phillipeville and Jemmapes, stations nine miles apart."

The maxima are to the minima in the relation of $3\frac{1}{2}$ and $2\frac{1}{2}$ to 1.

Prof. Raulin's remarks on the seasonal distribution of rain in Northern Africa will be noticed in our next.

UNDERGROUND TEMPERATURE.

(Continued from page 18.)

THE following is a continuation of the Report of the Underground Temperature Committee of the British Association, read at their meeting last year at Exeter :—

"The main results of the experiments in the bore-tube are shown in the following table :—

"*Abstract of Results obtained at Kentish Town Well, Jan. 1 to June 30, 1869.*

Depth.	Date of observation	Observed temperature.	Difference for 50 feet.	Rate of increase, in degrees, per foot.	Temperature in observing-room. Max.	Temperature in observing-room. Min.	Depth of rain.	Depth to surface of water in tube.
ft.		° 49·2	° 1·8	·036	° 46·8	° 38·2	in. 1·06	ft. in.
50	Jan. 8							
100	,, 15	51·0	1·1	·022	49·2	39·5	·20	
150	,, 22	52·1	1·5	·030	46·8	36·0	·22	210 0
200	,, 29	53·6	2·4	·048	43·0	31·8	·64	
250	Feb. 5	56·0	0·1	·002	48·4	39·5	·83	208 6(*a*)
300	,, 12	56·1	0·0	·000	49·4	42·3	·89	210 6
350	,, 19	56·1	2 0	·040	48·2	39·2	·38	
400	,, 26	58·1	1·0	·020	46·5	36·8	·67	209 6
450	Mar. 5	59·1	1·1	·022	46·5	35·2	·59	210 0(*b*)
500	,, 12	60·2	0·8	·016	45·8	35·2	·10	
550	,, 19	61·0	0·2	·004	44·0	34·8	·15	
600	,, 23	61·2	0·2	·004	44·5	37·6	·95	
650	,, 27	61·4	1 4	·028	43·0	34·9	·05	? 219 0(*c*)
700	April 3	62·8	0·6	·012	43·6	36·0	·22	211 0
750	,, 12	63·4	0·8	·016	54·0	37·3	·19	
800	,, 17	64·2	0 8	·016	54·4	46·2	·38	209 0
850	,, 24	65·0	0·8	·016	52·4	40·8	·53	
900	,, 30	65·8	0·9	·018	56·2	40·6	·01	210 0
950	May 7	66·7	1·1	·022	53·8	43·5	1·00	
1000	,, 14	67·8	1·2	·024	54·2	45·4	·47	210 6
1050	,, 21	69·0	...	..	55·2	44·2	·47	210 6(*d*)
1070	,, 24	69·3	...	...				
1085*	,, 28	69·6	...	...	58·0	47·2	·75	210 6
1085*	June 4	69·8	0·7	·014	56·0	43·0	·58	
1100*	,, 11	69·7	1·0	·020	61·9	48·5	·01	210 6
1100*	,, 14	70·0	...	..				

"(*a*) First observation in the water.

"(*b*) Water becomes muddy.

"(*c*) This water-measurement seems erroneous.

"(*d*) On attempting to lower the thermometers to 1100 feet, found the mud supported them, and the cord became slack. The observations to which an asterisk is attached were obtained by leaving the cord so slack as to allow the

thermometers to bury themselves in the mud; but there is much risk in attempting to withdraw them."

"Assuming 49° as the surface-temperature, and adopting 70° as the temperature at 1100 feet, we find, for the mean rate of increase downwards, ·0191° per foot, or 1° for 52·4 feet.

"Comparing the first observation in the water (56°) with the temperature at the bottom (70°), the mean rate of increase comes out ·0165, or 1° for 60·6 feet.

"During the remainder of the present year the repetition of the observations will be continued, and it is hoped the influence of seasonal changes will be measured and eliminated. In conclusion, we have to acknowledge the liberality of the New River Company in allowing Mr. Symons unreserved access to their grounds, and permission to erect the necessary apparatus, which has been efficiently protected by their servants."

I desire to say, in reference to the foregoing Report, that the length of time which Mr. Symons found it necessary to interpose between his observations is a peculiar circumstance of which I can at present offer no sufficient explanation, and I cannot help thinking that it might be obviated by some modification of the arrangements. Mr. M'Farlane, in three different bores, has found 15 minutes amply sufficient to give the correct temperature. Can the difference be owing to the greater size and smoothness of the bore in this instance offering less resistance to vertical currents?

As regards the first 210 feet, being the portion occupied by air, it is not surprising that the influence of season should here be perceptible, seeing that the well is 8 feet in diameter. The temperature of the air in an opening of this size, *even for the average of the year*, cannot be taken to represent that of the solid earth at the same depth, but will doubtless be found to be intermediate between the latter and the mean temperature of the external air.

"*Observations on the Temperature of the Strata, taken during the sinking of the Rose Bridge Colliery, Wigan, Lancashire*, 1868-69. By EDWARD HULL, M.A., F.R.S., Director of the Geological Survey of Ireland.

"In an elaborate paper by Mr. W. Hopkins, F.R.S., entitled 'Experimental Researches on the Conductive Powers of various Substances,' published in the Philosophical Transactions for 1857, an account is given of a series of experiments made under the general supervision of Mr. Hopkins himself and Mr. W. Fairbairn, F.R.S., during the sinking of the Astley Pit of Dukenfield Colliery, in Cheshire.* At the time this paper was written, the depth attained was only a little more than 1400 feet, and the rate of increase between the depths of 700 feet and 1330 feet was found to be 1° F. for about 65 feet. These observations were subsequently continued until the pits had attained their full depth of 2151 feet from the surface. The last observation made was in the shale overlying the coal-seam known as the 'Black Mine,' which it was the object of the proprietor, Mr. Astley, to reach, and the temperature was found to be 75° F. Assuming the 'stratum of constant temperature,' or, as it is also called by Humboldt—'the invariable stratum,' to be that which was reached at 16·5 feet with a temperature of 51° F., the total increase of temperature would amount to 24° F., giving as the rate of increase 1° F. for every 83·925 feet. This is much below the average rate of increase.

"During a part of the period above referred to (from 1854–56) another coal-pit was being sunk at Wigan, which reached the depth of 1800 feet, down to the celebrated 'Cannel Mine.' At this pit similar observations on the temperature of the strata were made very carefully by the manager, Mr. Bryham, which were kindly communicated to myself for publication, and will be found in my work on the 'Coalfields of Great Britain.' The ultimate temperature attained in this pit, at the depth from the surface of 1800 feet, was found to be 72° F., and assuming

* The entire series of these interesting observations were kindly supplied to me by Mr. W. Fairbairn, and are published in 'The Coalfields of Great Britain,' 2nd edition, p. 226.

the invariable stratum to be the same as that at Dukenfield Colliery, the resulting rate of increase would be 1° F. for every 61·5 feet, which accords very closely with the result obtained by Professor Phillips, F.R.S., at the Monkwearmouth Colliery.

"Since the time above referred to, the proprietor of the Rose Bridge Colliery, Mr. J. Grant Morris, determined to carry down the shafts from the 'Cannel' seam to the 'Arley' seam of coal, which was known to lie more than 600 feet below it, and, consequently, in the spring of 1868, preparations were commenced for carrying out this project. In the incredibly short time of one year and two months the Arley coal was struck, and was found to be of good thickness and quality. The total depth reached was 2,424 feet, and the ultimate temperature in the coal itself was found to be 93½° F. The manager of the colliery, Mr. Bryham, sensible of the value of observations on the temperature of the strata at such unusual depths (this being probably the deepest colliery in the world, certainly in Britain), made a series of observations with as much care as the circumstances would admit, and has entrusted them to me for publication.

"The mode of taking the observations was as follows:—On a favourable stratum, such as shale, or even coal, having been reached, a hole was drilled with water in the solid strata to depth of one yard from the bottom of the pit. A thermometer was then inserted, the hole having been sealed and made air-tight with clay. At the expiration of half-an-hour the thermometer was taken up and the reading noted.

"It might possibly be objected that the time allowed (30 minutes) was insufficient for the imbedding of the thermometer, and that the readings are liable to error from this cause. I feel sure, however, that if any error has arisen it is inappreciable, and does not in the least invalidate the general result. In fact I am assured by Mr. Bryham that, from actual testing on several occasions, he found less than this time of 30 minutes sufficient for the purpose required.

"While the temperatures of the strata were being measured, observations were also carried on *pari passu* on those of the open pit during the descent; these are given in the table annexed. By a comparison of the results in the two columns, it will be observed that as the depth increased, the difference between the corresponding temperatures in the pit and the strata tended to augment; in other words, the temperature of the strata was found to augment more rapidly than that of the open pit.

"The effects of the high temperature and pressure on the strata at the depth of 2425 feet, are, as I am informed by Mr. Bryham, making themselves felt, and cause an increase in the expense both of labour and timber for props. This colliery, in fact, will be in a position to put to the test our views and speculations on the effects of high temperature and pressure on mining operations.

"In order to obtain the average rate of increase of heat, as shown by the experiments at Rose Bridge Colliery, we may assume (in the absence of direct observation) the position and temperature of the *invariable stratum* to be 50 feet from the surface and 50° F., which is probably nearly the mean temperature of the place. With these data the increase is 1° F. for every 54·57 feet, which approximates to that obtained by Professor Phillips at Monkwearmouth of 1° F. for about every 60 feet.

"If, on the other hand, for the purpose of comparison, we adopt the measurements for the *invariable stratum* as obtained at Dukenfield, we find the rate of increase to be 1° F. for every 47·2 feet as against 1° F. for every 83·2 feet in the case of Dukenfield itself. So great a discordance in the results is remarkable, and is not, in my opinion, attributable to inaccuracy of observation in making the experiments. On the other hand, I may venture to suggest that it is due, at least in some measure, to dissimilarity in the position and inclination of the strata in each case. These I now proceed to point out.

"*Position of the Strata at Rose Bridge and Dukenfield Collieries.*—Rose Bridge Colliery occupies a position in the centre of a gently sloping trough, where the beds are nearly horizontal; they are terminated both on the west and east by large parallel faults, which throw up the strata on either side. The colliery is placed in what is known as 'the deep belt.'

"Dukenfield Colliery, on the other hand, is planted upon strata which are

highly inclined. The beds of sandstone, shale, and coal, rise and crop out to the eastward at angles varying from 30° to 35°. Now, I think we may assume that strata consisting of sandstones, shales, clays, and coal, alternating with each other, are capable of conducting heat more rapidly along the planes of bedding than across them, different kinds of rocks having, as Mr. Hopkins's experiments show, different conducting powers. If this be so, we have an evident reason for the dissimilar results in the two cases before us. Assuming a constant supply of heat from the interior of the earth, it could only escape, in the case of Rose Bridge, *across* the planes of bedding, meeting in its progress upwards the resistance offered by strata of, in each case, varying conducting powers. On the other hand, in the case of Dukenfield the internal heat could travel along the steeply-inclined strata themselves, and ultimately escape along the outcrop of the beds.

"I merely offer this as a suggestion explanatory of the results before us, and may be allowed to add that the strata at Monkwearmouth Colliery, the thermometrical observations at which correspond so closely with those obtained at Rose Bridge, are also in a position not much removed from the horizontal, which is some evidence in corroboration of the views here offered."

Thermometrical Observations at Rose Bridge Colliery.

Date.	Depth in feet.	Strata.	Temperature in open pit.	Temperature in solid strata.
			° F.	° F.
July, 1854	483	Blue shale	...	64·5
August, 1854	564	Warrant earth	...	66
May, 1858	1650	Blue shale	...	78
July, 1858	1800	Warrant earth	...	80
May 18, 1868	1890	"Raven coal"	73	83
July 24, 1868	1995	Linn and wool	75	85
April 19, 1869	2019	"Yard Coal" mine	76	86
November 18, 1868	2100	Strong blue metal	76	87
February 22, 1869	2208	Do.	76	88½
March 12, 1869	2244	Shale	77	89
April 17, 1869	2286	Linn and wool, or strong shale	78	90·5
May 3, 1869	2322	Strong shale	80	91·5
May 19, 1869	2346	Blue metal	79	92
July 8, 1869	2403	Strong blue shale	79	93
July 16, 1869	2424	Coal (Arley mine)	79	93½

Remarks.

All holes vertical in solid at bottom of pit drilled with water 1 yard deep, and thermometer remained in hole thirty minutes, and made air-tight with clay.

CLIMATE OF NEW ZEALAND.

THE Government of this distant colony have taken a wise step in fostering meteorology, by supplying observers with good instruments, good places in which to observe them, placing them under an able chief, and not crippling him for a few pages of printing.

The folio publications noticed at the foot* are principally numerical

* *Appendix to the Statistics of New Zealand (Meteorology) for* 1866, 1867, *and* 1868, *Wellington*, Folio, 28 pages.

Monthly Tables, 1868 *and* 1869 (except September, 1869). Folio, 23 pages.

Meteorological Report for 1868, *together with Abstract of all Meteorological Returns for New Zealand prior to that date.* By JAMES HECTOR, M.D., F.R.S. Wellington: G. Didsbury, Government Printer, 1869. 8vo., 21 pages.

tables, but in the octavo pamphlet Dr. Hector has wisely inaugurated his superintendence of the whole of the stations by a review of "*all* meteorological returns for New Zealand prior to that date." The word which we have italicized is a strong one to use, but we believe it to be correct.

The pamphlet commences with a brief recital of previous publications upon the subject, and of the steps taken in order to secure perfect uniformity among the observers, brief (a trifle too brief for residents at the antipodes) notes of the positions of the observatories, of the instruments and of their positions, then abstracts of the monthly mean temperature at the various stations, the result of which is epitomized in the following table and remarks :—

TABLE I.—*Mean Temperature of the Air in shade, recorded at the Chief Towns in the North and Middle Islands of New Zealand, from the earliest Observations up to the end of* 1867.

Place.	Mean Annual Temp.	Mean Temp. for (SPRING) Sept., Oct., Nov.	Mean Temp. for (SUMMER) Dec., Jan., Feb.	Mean Temp. for (AUTUMN) Mar., Apl., May.	Mean Temp. for (WINTER) June, July, August.	Period of Observations.
NORTH ISLAND.	deg.	deg.	deg.	deg.	deg.	
Auckland	60·7	58·8	68·6	62·3	53·3	15 years.
Taranaki	56·8	55·9	64·2	57·4	49·5	12 ,,
Wellington	55·7	54·6	63·6	56·7	47·9	10 ,,
Means for North Island ..	57·7	56·4	65·4	58·8	50·2	
SOUTH ISLAND.						
Nelson	54·6	53·3	62·5	56·4	46·7	16 years.
Christchurch	55·1	55·5	64·7	55·9	44·5	11 ,,
Dunedin	50·7	50·0	57·4	51·6	43·6	15 ,,
Means for South Island...	53·4	52·9	61·5	54·6	44·9	
North Island	57·7	56·4	65·4	58·8	50·2	
South Island	53·4	52·9	61·5	54·6	44·9	
Means for North and South Islands	55·6	54·6	63·5	56·7	47·5	

"From the above Table it will be observed that in the North Island the mean annual temperature for Auckland is the highest (60°·7), and that for Taranki (56°·8) the next, while Wellington is the lowest (55°·7).

"In the South or Middle Island, Christchurch and Nelson show the highest annual mean temperature (55°·1 and 54°·6); Dunedin is very much lower, viz., 50°·7.

"January and February, corresponding to July and August in England, are the two warmest months in New Zealand; and July and August, corresponding to January and February in England, the two coldest (excepting in Nelson and Wellington, at which places the mean readings are lowest for June and July).

"The climate of London is 7°·2 colder than that of the North Island, and 3°·8 colder than the Middle Island of New Zealand, and the difference between the mean annual temperature of the whole of New Zealand and that of London is 5°·7, the former being 55°·7 and the latter 50°.

"The following are the means for the two warmest and two coldest months in the year in the several localities, with their differences :—

Auckland.	Taranaki.	Wellington.	Nelson.	Christchurch.	Dunedin.
69·6	64·7	64·6	63·6	65·2	58·0
53·1	49·3	47·8	45·9	44·3	43·2
16·5	15·4	16·8	17·7	20·9	14·8

"From which we find that the average difference between the mean temperature of the warmest and coldest months of the year in New Zealand is 17°·0; at Rome it is 27°, at Montpellier 33°, at Milan 38°, and at Jersey 22°.

"The observations from these six stations have been selected to form the above Table, as they extend over a tolerably long period, and give a fair comparison of the climate of the North and South Islands."

The extremes of temperature are not abstracted, but running cursorily over the folio returns and some others in our possession, we notice no shade temperature above 98°, or below 9°, the range is therefore less than in this country.

We regret that Dr. Hector has not given the rainfall in each year from the commencement of observations, but only the averages up to 1867. Arranging the stations from south to north, they are as follows:—

			Mean Annual Fall. in.	No. of years.
Middle Island.—	S.	Southland	43·63	9
	E.	Dunedin	32·74	15
	E.	Christchurch	31·64	11
	C.	Bealey	126·02	1
	W.	Hokitika	119·40	3
	E.	Blenheim	26·10	5
	N.	Nelson	53·30*	16
North Island.—	W.	Wellington	50·52	10
	E.	Napier	39·60	2
	W.	Taranaki	59·39	12
	E.	Auckland	44·68	15
	W.	Mongonui	57·70	3

In the absence of the yearly fall at the older stations, it is impossible for us to reduce the above to anything like true averages, and we need not in these pages point out how delusive are averages of only a few years. Mr. Martens, the observer at Southland, in a paper printed in 1866, gave the details for his own station up to that date; completing it from Dr. Hector's tables, we have the yearly fall at Southland as follows; side by side therewith we give the ratio of the fall in each year to the mean of the whole period (10 years) of observation.

	Total Depth. in.	Ratio.
1859	22·71	53
1860	29·32	68
1861	27·51	64
1862	47·27	110
1863	53·03	123
1864	51·16	119
1865	63·69	148
1866	47·24	110
1867	41·62	97
1868	46·35	108
Mean	42·990	100

* Rain gauge 27 feet above ground.

Mr. Martens is careful to state that his observations were taken near the surface of the ground, and hence the most obvious explanation of the small values in the first three years—viz, that until 1862 the gauge was on some building—is untenable. Are we then to consider that during the three years 1859, 1860, and 1861, the fall was less than two-thirds of the mean of ten years, including those years of drought? There is no evidence to disprove this view, and if we are to accept it, we must also acknowledge that if at Southland the fall had only been observed during 1859, 60, and 61, the mean would have been taken as 26·51 in., and if during 1863, 64, and 65, as 55·96 in., that is to say, in one case as rather more than twice as great as in the other. As, however, it will be noticed that the later years are more uniform than the earlier ones, we doubt if any of the means assigned to the various stations are more than 25 per cent. in error. This uncertainty might have been greatly lessened by the adoption of the mode of discussion pursued in *British Rainfall*, 1867, p. 19. We hope that in a future publication Dr. Hector will either adopt this method himself, or at any rate supply the yearly totals from the commencement of observations at each station, so that others may do so if they desire it.

A short note on barometric results is followed by a table of radiation temperatures 1865—67, indicating very similar values to those in this country.

The next table contrasts the climates of the E. and W. coasts (which we have roughly indicated on page 00, by prefixing letters indicating the positions of the rainfall stations), Christchurch and Hokitika being selected. If our readers will for Christchurch read Scarborough, and for Hokitika read Portree, in each case raising the mean temperature three degrees, they will at once understand the two climates.

We have no desire to disparage meteorological progress in our own country, but if our colonies continue as liberal to meteorology and the observers and directors as zealous as they now are, we shall soon have them setting us an example.

SNELL'S ANEROID HYGROMETER.

To the Editor of the Meteorological Magazine.

SIR,—In describing this instrument in your February number, have you not made a slight mistake? You say, "a piece of whipcord, fastened at one end, is wound two or three times round the axle, it then passes upwards over a pulley, and has a leaden weight attached at the other end to keep the string tight." Should it not be that the piece of whipcord being fastened at one end, passes upwards over a pulley, and on its return downwards is wound two or three times round the axle, and has a weight attached to the end?

According to your description, the needle would be affected only by the expansion and contraction of the cord between the place of fastening and the axle (a very small length), whereas, according to the

latter, the expansion and contraction of nearly the whole length of cord would be brought to bear.

A self-constituted instrument, of a similar kind, may be seen by anybody visiting the Charing Cross Hotel, on going up in the "lift," which is regulated by a thick rope passing up the whole length of the "lift." The porter in charge will tell you any day what the weather is going to be, by the slackness or tightness of the rope.

I am, yours truly,

Avon Lodge, near Rugby, 6th April, 1870. FREDERICK FULLER.

[Quite true; in our description the course of the cord was incorrectly stated.—ED.]

THUNDERSTORM IN YORKSHIRE.

To the Editor of the Meteorological Magazine.

SIR,—I beg to enclose you particulars relating to the damage done by the sharp but short thunderstorm which occurred near here at 4.30 p.m. Greenwich mean time, last Saturday.—Yours truly,

LOUIS J. CROSSLEY.

Willow Hall Observatory, April 11th, 1870.

"A heavy thunderstorm passed over Halifax and neighbourhood on Saturday afternoon (9th), its effects being particularly felt at Ovenden, where the residence of Mr. Johnson, cotton spinner, was struck. The lightning went down one of the chimneys, and, with two exceptions, entered every room in the building, smashing all the windows and destroying the principal staircase. The lightning passed through the back kitchen window, which was instantly demolished, and entered the yard, where it tore up the flags, after which it entered the wash kitchen, destroyed the pump, and tore up the flags. Considerable damage was done to the house internally. Mr. Johnson, his wife, and the servant were in the house, but fortunately none were at all injured. There was an immense fall of hailstones"

HEIGHT OF GAUGES.

To the Editor of the Meteorological Magazine.

SIR,—As you invite remarks upon Rule IV., I venture to say a word on the subject.

Your correspondent, "R.," argues, that the excess of rain at 1 foot above that registered at greater heights is caused by the wind gathering water from (1) the sea, (2) lakes and ponds, (3) trees and hedgerows.

With regard to (1), I find that the fall here, one mile inland, is nearly always greater in storms from the sea-ward than on the cliff edge, even when the gauge on the cliff is quite whitened outside with a deposit of salt. Probably, if the spray is light enough to be blown up the cliffs, it is light enough not to fall in any appreciable quantity into the gauge.

(2) The water of ponds and lakes is seldom enough agitated to be raised by the wind. I would venture to draw your correspondent's attention to the fact, that the gauge on Derwent Island catches no more, but rather less, than other gauges at Keswick.

(3) As far as I have observed, hedgerows and trees arrest the flying drops of rain, and allow it to fall directly to the ground in larger drops, so that a gauge on the lee side of them catches less and not more than the correct fall.

I am obliged, therefore, to conclude, that the reasons alleged against Rule IV. are insufficient. Besides, if the object of a rain gauge is to find how much rain falls to the ground, it should be put *as near the ground as possible, provided that insplashing be avoided.* The amount of condensation of vapour in the atmosphere above any place is a different thing from the rainfall.—I am, Sir, your obedient servant,

F. W. STOW.

Hawsker, Whitby, April 26th.

To the Editor of the Meteorological Magazine.

SIR,—With reference to a letter signed "R.," in your last number, upon Rule IV. of *British Rainfall*, 1869, in which he advocates 6 ft. above the ground as a better mean, I would beg to call his attention to Rule II., "Old-established gauges should not be removed," and on looking over the elaborate tabular exposition of last year, I find that there are only 12 gauges situated at an elevation of six feet above the ground, whilst there are upwards of 1300 below that height—a good reason for their retaining their present position, which many have occupied for years, others are not suited for mounting.

Some fourteen years ago, when I first began to need instructions on meteorological instruments, the books on this subject were not easily obtainable, I went into a stationer's shop and asked for a work on meteorological instruments and their use, or practical meteorology, and was told I might perhaps get what I wanted at the ironmonger's over the road. I fixed my solar radiation thermometer at 6 ft above the ground; after two years I was told that near the ground was the proper place, and was adopted by the generality of observers, and of course placed it so; now, after ten years, it is hoped I shall put it back from where it was removed; so that the present rules only stand good until the next magazine arrives.

As the remarkably close agreement of my inclined gauges at 6 feet and 30 feet has called forth a few remarks from your editorial pen, and also from "R.," I may add that I did not append any to my table, not having sufficient data, and nothing should be done in a hurry, except catching flies; I cannot say that a tilted gauge near the ground would yield the same results, but I think there would be a close approximation. I recollect, some years ago, before I knew anything about tilted gauges, placing pads of bibulous paper at an angle of 45° and others flat, from heights near the ground to 30 feet, on several wet days; and after a short exposure, on being re-weighed, the results were, that those which had been placed at an angle were of the same weight, whilst those laid flat differed in the same proportion as ordinary gauges do with elevation.

I should like to try a tilted gauge near the ground, but pecuniary circumstances will not admit of it at present. It would require to be worked by a vane at some distance.

I am, Sir, your obedient servant,

April 30th. J. ARNOLD, F.M.S.

APRIL, 1870.

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°. In shade	No. of Nights below 32°. On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	·47	— ·66	·12	9, 29	6	79·4	20	26·7	2	6	10
II.		Maidstone (Linton Park)	·43	— ·79	·16	9	4	80·0	20	28·0	1§	8	...
,,		Selborne (The Wakes)	·35	— 1·15	·22	9	4	73·0	20	20·8	2	10	14
III.		Hitchen	·43	— ·57	·18	29	8	72·0	20	25·0	1, 3	5	...
,,		Banbury	·66	— ·50	·22	9	7	74·5	20	28·0	5	7	...
IV.		Bury St. Edmunds (Culford)	·78	+ ·03	·21	10	8	74·0	20	23·0	5	6	11
V.		Bridport	·53	— ·95	·30	9	4	70·0	20	22·5	6	11	...
,,		Barnstaple	·58	— 1·43	·11	30	9	75·3	21	31·0	7	..	..
,,		Bodmin	·31	— 1·39	·14	29	7	65·0	13	31·0	6	3	...
VI.		Cirencester	·68	— ·61	·35	9	5	...	...	...	...	...	...
,,		Shifnall (Haughton Hall)	1·09	— ·06	·35	29	8	71·0	20	26·5	5	4	...
,,		Tenbury (Orleton)	·79	— ·75	·23	29	9	76·0	20	25·2	5	4	12
VII.		Leicester (Wigston)	·55	— ·75	·20	29	5	82·0	20	25·0	4	5	...
,,		Boston	·73	— ·24	·16	9	7	78·9	20	28·1	4	3	16
,,		Grimsby (Killingholme)	·64	..	·18	29	7	71·0	20	31·0	5	2	...
,,		Derby	·75	— ·68	·31	9	7	77·0	20	28 0	5	4	...
VIII.		Manchester	2·22	+ ·46	·76	29	10	76·3	20	31·0	3, 5	2	6
IX.		York	·66	— ·44	·32	9	6	79·0	20	32·0	6	0	...
,,		Skipton (Arncliffe)	2·46	— ·58	·40	8	10	...	...	...	...	..	..
X.		North Shields	·78	— ·53	·52	9	9	64·2	20	32·5	5, 6	0	...
,,		Borrowdale (Seathwaite)	...	...	...	.	...	...	...	...	...	...	...
XI.	WALES.	Cardiff (Town Hall)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	·71	— 1·15	·41	8	6	67·5	18	27·1	4	4	6
,,		Rhayader (Cefnfaes)	·89	— 1·00	·30	30	7	72·0	...	26·0	...	6	...
,,		Llandudno	2·08	+ ·58	·61	13	9	72·8	19	35·7	3	0	...
XII.	SCOTLAND.	Dumfries	·69	— ·98	·25	22	9	72·5	18	30·0	5	3	10
,,		Hawick (Silverbut Hall)	·96	...	·28	29	11	...	...	...	...	...	...
XIV.		Ayr (Auchendrane House)	2·11	— ·11	·47	12	18	73·0	21	28·0	3	2	9
XV.		Castle Toward	2·48	— ·02	·57	23	18	66·0	18	30·0	3	5	9
XVI.		Leven (Nookton)	·50	— ·75	·14	8	10	64·0	16*	31·0	5, 6	2	15
,,		Stirling (Deanston)	1·22	— ·53	·32	23	15	71·5	18	25·0	10	10	...
,,		Logierait	·79	...	·21	20	11	...	...	...	...	..	...
XVII.		Ballater	·77	...	·15	28	8	70·5	20	28·0	4	5	...
,,		Aberdeen	1·29	...	·46	9	13	66·5	25	33·3	4	...	...
XVIII		Inverness (Culloden)	·93	...	·20	14	12	69·1	20	36·0	9	0	10
,,		Portree	7·80	+ 2·53	1·14	23	22	...	...	...	...	...	...
,,		Loch Broom	6·44	...	·85	27	20	...	...	...	...	...	...
XIX.		Helmsdale	2·22	...	·44	30	18	...	...	...	...	...	...
,,		Sandwick	2·77	+ 1·03	·49	25	20	60·9	17	34·7	28	0	1
XX.	IRELAND.	Cork	1·14	...	·40	20	8	...	...	...	...	...	...
,,		Waterford	·82	— 1·41	·28	8	8	50·0	15†	30·0	...	4	...
,,		Killaloe	2·07	— ·06	·53	20	15	68·0	16‡	27·0	5	4	...
XXI.		Portarlington	·93	— 1·09	·24	22	16	66·0	19	34·0	4	0	0
,,		Monkstown	·61	— 1·03	·52	13	3	...	...	...	...	...	...
XXII.		Galway	2·61	...	·68	20	18	67·0	19	37·0	8	0	...
,,		Bunninadden (Doo Castle)	1·72	...	·57	20	12	59·0	25	25·0	5	2	...
XXIII		Bawnboy (Owendoon)	2·01	...	·49	20	17	70·0	19	33·0	8	0	3
,,		Waringstown	1·62	...	·58	8	15	69·0	17	30·0	1, 2	3	10
,,		Strabane (Leckpatrick)	2·32	..	·50	20	18	69·0	17‡	26·0	7	6	8

* And 17, 18. † And 16, 25. ‡ And 19. § And 2, 29.

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

METEOROLOGICAL NOTES ON APRIL.

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.—T and H at 2.10 p.m. on 10th; S in forenoon of the 28th.

LINTON PARK.—A dry, warm, and sunny month, with frosts only on six days and R on four days; winds changeable, but not high; bar. high and steady from the 11th to the 29th. Great progress in vegetation during the month, yet things are not, at the end of it, as forward as they were last year at the same time. Cuckoo heard on the 16th.

SELBORNE.—A most ungenial month; all vegetation retarded to an almost unprecedented degree; the drought and low temp. injurious to crops of almost every kind. Dense fog on the 5th, H at 2 p.m. 10th; min. temp. 20° higher on the 8th than on the 6th; bright aurora with coruscations on the 5th. Martin first seen on 12th; cuckoo heard on 17th.

HITCHIN.—The greatest heat (72° on 20th) recorded so early during 20 years' observations.

BANBURY.—H on 9th and 10th.

CULFORD.—T and H on 10th, and H on 27th; mean temp. of month 48°·1.

BRIDPORT.—Very fine calm month; ther. fell below 32° on the first seven nights, the frost of the 6th being very severe (22°5·), but doing no damage, whilst on the 29th, when the ther. registered 29°, the potatoes were cut severely; cherry in blossom on the 20th, horse chesnut in leaf on 21st; cuckoo made its appearance on the 20th, swallows on the 21st.

BODMIN.—Great evaporation on 19th and 23rd. The drought, which lasted 38 days, has been severely felt, ·37 in. only having fallen, and, during 21 years, I have never registered so small a quantity in that number of days.

CIRENCESTER.—A dry and cold month, with two short fits of S. and S.W. winds and warmth; a little R and H, but increasing warmth and much sunshine have moved the sap and burst the buds of early trees, and the moderate night frosts have not destroyed the blossoms.

SHIFNALL.—A seasonable month on the whole, rainfall about the average; vegetation, though very backward, made rapid progress towards the end of the month, when the temperature rose greatly (71° on 20th). Prevailing winds throughout were N. and N.W. Willow in blossom on 4th, celandine in flower on 5th, gooseberries in blossom on 10th, hawthorn in leaf on 18th, asparagus cut on 19th, blackthorn in blossom on 20th, wild cherry on 21st, and pear tree on 26th; white butterfly first seen on 5th; golden plovers in a flock on passage on 11th; swallow (H. rustica) first seen on 16th; cuckoo first heard on 19th.

ORLETON.—Thick fog at 9.30 a.m. on 16th; cuckoo frequently heard and seen on that day.

WIGSTON.—An unusually dry month; the range of ther. excessive; the reading (82°) on the 20th was higher than I have any record of in April for more than 40 years. The warmth of the weather between the 16th and 22nd stimulated vegetation very much.

BOSTON.—The month was, on the whole, dull and cold, and the changes in temp. very sudden and remarkable; lunar halos seen on 8th, 14th, and 15th; H fell on the 9th; T heard on 10th; horse chesnut in leaf on 18th, hawthorn on 23rd, field elm and lime on 24th.

GRIMSBY.—Grass very scarce till the close of the month; very few swallows (first seen on the 9th); much of the wheat has been destroyed by the wire-worm; very little R fell until the last two days of the month. On 23 days the wind was W. or compounds of W. A little H on 28th; large lunar halo on 14th; peewits inland on 1st; willow warbler heard on 14th, and cuckoo on 24th. Colts-foot flowered on 1st, ribes on 5th, pilewort on 7th, yew and wych elm on 8th.

DERBY.—April has passed, and, until the last day, without April showers; the weather has been fine, but generally cold; spring backward; N.E. wind only once recorded.

YORK.—Dew point for the month 39°·9.

NORTH SHIELDS.—Lunar halo on 13th; auroræ on 24th, 26th, and 28th; H

on 27th ; cherry in blossom on 17th, pear on 26th, violets on 1st, and, before the end, auriculas, hyacinths, primroses, anemones, early tulips, polyanthus, &c.

WALES.

HAVERFORDWEST.—A dry cold month; some warm weather about the middle ; very little frost. Vegetation backward, and water becoming rather scarce ; every indication of a dry summer. Scarlatina prevailing in a severe form, many deaths.

CEFNFAES.—A dry cold month ; frosty nights and sunny days; wind N.E. and N.W. ; vegetation backward.

LLANDUDNO.—Cuckoo first heard on 15th and swallows first seen on 16th ; dense fog from 1.30 to 7 p.m. on 16th ; a lilac in flower on the 23rd in a sheltered spot : gathered honeysuckle in full flower on the 25th.

SCOTLAND.

DUMFRIES.—This month has been very dry and cold, with frequent frosts; four days, from the 17th to the 20th, very hot : the ther. in shade at 72°·5 on 18th ; during the third week the temp. at night high, which, with the few days' heat, caused vegetation to make great progress for a few days, when checked by northerly winds; S on the 9th; swallows seen on the 19th; cuckoo heard on 21st.

HAWICK.—Rather a cold dry month, with slight frosts on 13 nights, on six nights the drinking troughs sheeted over with ice ; the rainfall of this and last month has amounted to 2 ins. only, and R is now very much wanted. Apricots are well set on the open walls, and, owing no doubt to the well-ripened wood of last season, there is a fine appearance of a bounteous crop of fruit ; swallows first seen on the 26th ; some H fell on the 30th.

AUCHENDRANE.—Bar. pressure, mean temp., elastic force of vapour, and dew point above the mean for April ; below the mean were the bar. range, rainfall, mean force of wind, cloud, evaporation, and the difference between the mean dew point and the mean temp.; the humidity agreed with the April mean, but fell once so low as 61° ; this dryness of the air and small amount of cloud caused a great range between the day and night temp., and was accompanied by most seasonable weather for sowing the seed and cleaning the arable land.

CASTLE TOWARD.—A month of good spring-like weather of showers and sunshine, with only a few slight frosty nights, so that although vegetation has only progressed slowly, it has met with no check ; very warm from the 16th to the 21st, which burst many of the deciduous trees into full leaf in a few days ; apricots well set with fruit ; other stove fruit and early pears have been in full flower since the 15th, and as there has not been any frost during that time we expect a full crop ; gale on the 22nd ; foggy on morning of 19th.

NOOKTON.—High wind on night of 19th.

DEANSTON.—Month generally cold and frosty ; high cold winds, especially during the last ten days ; some mild days ; only two days in succession (the 22nd and 23rd) with any R worth mentioning ; vegetation very backward, few trees having any green about them at the end of the month.

LOGIERAIT.—First part of the month dry, with a high temp.; on 23rd a change occurred—cold north winds, a measure of frost which continued to the end of the month ; swallows first seen on the 1st of May.

BALLATER.—One of the finest spring months known, and seed got put into the ground in excellent order. Rainfall below the mean ; temp. high for the season ; the last week experienced a marked decrease in temp., N.E. winds prevailing, with an unusual amount of cloud.

ABERDEEN.—Mean bar. and temp. above the mean of 13 years ; rainfall below the mean ; winds chiefly S.W., S., and N.W.; a fine dry month till the 26th, after which it was boisterous and cold ; H on the 10th, 26th, 27th, and 28th ; S on the 27th ; L at night on 6th and 8th ; dense fog all day on 18th, and till 8 p.m. on 19th. Auroræ on 6 nights.

SANDWICK —April was mild and dry till the latter part, but the last ten days were wet and the last five days boisterous, N.W. winds prevailing. Auroræ on 2nd, 16th, 17th, 18th, 19th, 21st and 28th, coruscating to the zenith on the 18th and 28th ; large lunar halos on 9th and 14th ; a gale of 43 miles an hour from 8 to 10 a.m. on 7th, of 54 miles from 3 to 4 a m. on 23rd, of 50 miles from 7 p.m. 26th, and continued till 8 a.m. on 27th, 55 miles from 12 till 2 a.m. Solar halos on 10th and 15th.

IRELAND.

DOO CASTLE.—Fine month for farming operations, spring work in a forward state in consequence; cold wind blowing strong from N. and N.W. the greater part of the month retarded vegetation and blanched braird; swallows seen in the middle of the month; cuckoo heard on the 30th.

WARINGSTOWN.—Fine and very favourable for labour, though not warm; spring, in some respects, backward, but crops looking well; the ground unusually dry and easily handled.

LECKPATRICK.—Fine month, latter half very cold; on 18th the wind veered round to S.E., followed by a gale and R; the last week very cold, constant northerly wind; swallows first seen on 22nd.

A TAX ON OBSERVERS.

To the Editor of the Meteorological Magazine.

SIR,—May I trouble you with a word or two relative to a letter ("A Tax on Observers") I have recently seen in the April number of your periodical? When observations are undertaken, and continued for many years with care and patience, it is scarcely to be supposed that the observer is willing to waste his meritorious labours by concealing their results from every eye but his own. There are certain localities (such as Devon, Cornwall, and the Isle of Wight), the meteorology of which will always be pre-eminently interesting; and observers who are fortunate (or unfortunate) enough to reside in them, must expect to be applied to occasionally. If the task set them be beyond their powers a courteous statement to that effect would, I am sure, satisfy the applicants. I have met with great kindness from meteorologists in general (one of whom, a "perfect stranger," has more than once sent me his registers, at the risk of loss or damage in transit), and I am slow to believe that any gentleman would discontinue observations in preference to following the course I have ventured to recommend. I am also slow to believe that the good feeling characteristic of meteorologists is on the decrease—an obtuseness engendered by the fact, that in four out of five cases I have received the information asked for, with kindly professions of friendship.—I remain, faithfully yours,

April 22nd, 1870. CIT.

AURORA BOREALIS.

To the Editor of the Meteorological Magazine.

SIR,—A most beautiful display of aurora borealis was observed here last night. About 7.30 p m. a bank of light of a deep red colour appeared in N.N.E., with waves passing across the sky to W.S.W. When first seen, the light was taken for the reflection of a large fire. At 8 p.m. it suddenly faded away At 8.10 p.m. a great number of pale white streamers rose from a dark line on the northern horizon, and as they neared the zenith became tinged with red; they continued very bright till 8.35, when they became much dimmer, and at 9 p.m. had almost disappeared. The idea of a storm following within three days of a display of aurora does not seem to hold good, as it was observed on several occasions last month without any change in the weather.—Yours truly, THOS. PAULIN.

Winchmore Hill, April 6th, 1870.

[Two valued communications on evaporation and several other notes unavoidably postponed.—ED.]

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

LIII.] JUNE, 1870. [PRICE FOURPENCE, or 5s. per ann. post free.

PECULIAR CLOUD FORMATION.

To the Editor of the Meteorological Magazine.

SIR,—On the afternoon of Sunday, May the 22nd, an unusual appearance of the sky was very generally observed throughout Ireland. Before describing the phenomenon at length, I may premise that on the preceding day, Saturday, the 21st, a wave of heat crossed Ireland from the S.W. In Dublin the thermometer rose to 73°·1 in the shade. During the ensuing night the wind veered to N.W., and the temperature fell rapidly, the reading at 9 a.m. on Sunday being only 54°·9. The sky was now almost covered by a stratum of low cumulo-stratus cloud, which was driven by a fresh breeze from the north-westward. At noon this cloud system showed signs of breaking up, and through the interstices which formed in it, a diffuse upper cloud, *resembling cirrus*, was seen to overspread the sky. Under the influence of this new formation, the disorganisation of the lower cumulo-stratus became rapidly complete, and the latter soon disappeared. The atmosphere near the ground was at this time remarkably clear, and at 1 p.m. the top of Snowdon was indistinctly visible from Howth, a native of which place remarked that this clearness was due to the presence of "sleet in the air." Through the canopy of cirro-stratus the sun now came into view, being at first of a pale white colour, but soon assuming a pinkish or carmine tint. A strange lurid light spread over the landscape, and it seemed as though a total eclipse was in progress. For some hours the sun was seen under these peculiar circumstances, and several spots were noticed scattered over its disc. At 5 p.m. it totally disappeared from view, as the cloud became denser, but at 7 p.m. it assumed the character of a ball of fire, and so continued until its setting. Shortly afterwards the cloud melted away, and the temperature fell quickly to 42° on the grass at 9 p.m., and finally to 36°.

The cloud which produced the appearance just described, no doubt was a vapour-fog suspended in mid-air, the motion of which was extremely slow. The extent of this cloud formation, again, was remarkable. It was noticed in Wicklow, Dublin, Meath, Cavan, Connemara, Louth, and Antrim.—I am, Sir, yours &c.,

J. W. MOORE, M.B.

Dublin, June 2nd, 1870.

THE WEATHER.—Great heat suddenly came along the coast on Saturday, the thermometer rising nearly 15°, the open sunshine being almost unbearable, this being a strong contrast to the chilliness of the past week. Dense fogs are reported as prevailing in the Irish Channel about Holyhead. On Sunday the temperature again fell considerably, the glass being about 60° in the shade. A hot summer is anticipated. On Sunday afternoon the singularly pink colour of the sun, as seen through a thin film of mist for some hours, attracted general observation.

A Connemara correspondent writes :—"On Sunday last it was remarked that the sun had a strange bright copper colour, and, when looked at through an ordinary opera glass, eight spots were distinctly visible on lower half of disc. The atmosphere was thick, and indeed the sun seemed as if shining through smoke."

SOLAR PHENOMENON—BAILIEBOROUGH, MAY 26, 1870.—On Sunday, the 22nd inst., this town and neighbourhood presented a very extraordinary appearance. From a very early period of the day until late in the evening, groups of people might be seen gazing heavenward, some of them betraying by their looks evident apprehension of danger, and all of them more or less emotions of interest or astonishment, while they continually inquired from one and the other, "What is the matter with the sun?" Young and old, rich and poor, were attracted by the strange and varied attire with which "mighty Sol" decorated himself, ever and anon exhibiting, with almost lightning rapidity, dresses of every tint and colour, simple and compound, in somewhat like the following order :—Light pink, blood red, purple, green, blue, yellow, and then bright like silver. At times the whole of the disc was covered with one or other of the above hues, at other times with combinations of them, but in every aspect considerably minified in apparent size, and so modified in brilliancy that the weakest eye could behold the great orb of day performing his grand masquerade without being in the least degree incommoded! As nothing of the like kind has ever been heard of or recollected here before, I, in common with several others, have been on the look-out for some notices of the event in your columns, but failing to observe any, I think it my duty to furnish you with this communication, and hope that it may elicit some statements explanatory of the causes of such a remarkable phenomenon. I have also to add that the moon on the following night presented a partial duplicate of the sun's drapery on the day before. It would be satisfactory to know had they one wardrobe in common, or were they each private property?—*Correspondent.*

SOLAR PHENOMENON.—*To the Editor of the Daily Express.* SIR,—The strange and unique solar phenomenon about which inquiry was made in your paper of the 27th inst., was caused by a haze of a pink colour, which assumed various depths of intensity of that colour as the passing haze happened to be in greater or lesser volume. The colour here was a true carmine, as I had many tints of colouring made and held up, so as to take in the sun and the tint at the same glance. Carmine alone gave the tint, and only differed as all earthly colours must in the transparent brilliancy of the sun-light. Could we have tinted on burnished gold an exact representation might have been given. The obscuration of the pink veil lasted until five o'clock p.m. During its prevalence all terrestrial objects presented a strange lurid appearance, like as exhibited during a solar eclipse. There were very many spots on the face of the sun, some of them large enough to be seen by the naked eye, which required no defence of darkened glass even in the focus of a three-inch object glass telescope. The thermometer fell to 53, the barometer stood at 30·45. The haze was very evenly spread over the visible heavens, except in the south-east, where very large wool-pack, rainy-looking clouds, were carried S.E. by apparently a strong wind. The wind was light here. Distant thunder was heard towards S.E. I have never seen or heard of a similar phenomenon, but there is no doubt that it was occasioned, as stated, by a pink haze, as the deep tone of the carmine colour became paler as the haze thinned off towards the close. The great variety of colour mentioned by your Bailieborough correspondent was not observed here, the only changes being in the intensity of the pink, with sometimes a tendency to an orange shade round the circumference; neither did anyone of the observers seem alarmed. The phenomenon was very

beautiful and not alarming, although I overheard someone remark that, as the sun had the colour of blood, there would soon be much bloodshed. Any person who had the instrument for spectrum analysis could have easily discovered what was the substance which tinted the haze.—Faithfully yours, GEORGE H. READE.
Inniskeen Rectory, Dundalk, Co. Louth, May 27th.

"On the afternoon of the 22nd a very curious appearance was noticed by many The sky was hazy, and the sun was seen through the haze of a pink colour, inclining to purple. I see by a newspaper that the same was noticed at Dublin. A red or orange sun is common, but I never before saw its colour on the purple side of red.—JOSEPH JOHN MURPHY, Old Forge, Dunmurry, Co. Antrim, May 24th." —*From "Nature," May 26th.*

"In reference to Mr. Murphy's communication in our last number, respecting the purplish pink colour of the sunlight, we learn from correspondents that it was noticed also at Tynemouth at 5 p.m. on Sunday, the 22nd ult.; at Cambridge at 10 a.m. on 23rd, and in Gloucestershire on both these days. In all these cases the sky is described as being hazy at the time."—*From "Nature," June 2nd.*

[We think that the above collection of extracts, (for most of which we are indebted to Dr. Moore), supplemented by the remarks of some of our regular correspondents, (p. 78—80), will render unnecessary many of our own. We think that there is no doubt that Dr. Moore's explanation is correct, supported as it is by the time assigned to the appearance by several observers, *e.g.*:—

Doo Castle	Sligo	From 9 a.m. to 3 p.m. on 22nd.	
Ballieborough	Cavan	Very early in morn. to late in even., 22nd.	
Dunmurry	Antrim	From 1 to 5 p.m., 22nd.	
Inniskeen	Dundalk	To 5 p.m.	,,
Dublin	Dublin	From 1 to 5 p.m.	,,
,,	,,	In the afternoon	,,
Tynemouth	Northumberland	At 5 p.m.	,,
Cambridge	Cambridge	At 10 a.m. on 23rd.	

These times would agree tolerably with a passage from N.W. to S.E., at an average rate of eight or ten miles an hour, which we believe also agrees with several anemometrical records for that day. *Why* this cloud should have produced such an unusual appearance, we have yet to learn.—ED.]

TERRIBLE STORM.

THE *Industriel Alsacien* says—"Germany has been visited by a dreadful storm. The disasters are immense, houses have been carried away, and a large number of persons have perished. At Grosbun (Siebenburgen) the rain was so heavy that houses and their inhabitants were carried away by the current of water produced. After the subsiding of the flood hundreds of cattle, interspersed with human corpses and the ruins of houses, were discovered in the slime; more than forty dead bodies have been recovered up to the present time; of the sixty families composing the commune, scarcely ten remain alive. At Nazy-Kun eighty houses were carried off by the waters; sixty persons were destroyed by this catastrophe, to say nothing of the loss of property, which is exceedingly great. At Erfurt the lightning struck several objects, notably the steeple of All Saints' Church, consuming the spire."—*Daily News, June 4th.*

ON THE RAINFALL OF SOUTH-WESTERN EUROPE AND ALGERIA.

(Continued from page 52.)

PROFESSOR RAULIN'S remarks on the seasonal distribution of rain are as follows:—

The most superficial examination of the monthly quantities renders evident the Mediterranean characteristics of the seasonal distribution, that is to say, an almost total absence of rain during the three months of June, July and August, at all stations, especially at those nearest the coast.

Closer examination will show that on the shore there is a predominance in the January fall at Oran and at Mostaganem, in that of December at Algiers, Bougie and Djidjeli, and in that of December and March at Jemmapes and La Calle. In the interior the wettest months are, with one exception, January, and March or April. The exception is Batna (on the edge of the desert of Sahara), where the wettest months are March and April.

But the examination of the fall in three-monthly or seasonal groups shows a difference in these two categories.

On the shore of Algeria, as on the whole southern shore of the Western Mediterranean, from the Straits of Gibraltar to Palermo, through 15° of longitude and between 36th and 38th degrees of latitude, the seasonal distribution remains the same: great excess in the winter rains, less excess of autumn rains over those of spring, or even the reverse sometimes even in stations very close together. These last form a mean between the summer and winter rains, whatever the total annual fall may be, whether 19 inches as at Oran, or 52 inches as at Bougie.

But as soon as we pass to the interior an altered distribution becomes evident. The spring rains sometimes exceed those of winter, and always markedly surpass those of autumn. In the west, in the province of Oran, the spring rains exceed the mean at St. Denis du Sig at 13 miles from the coast, at Mascara 21 miles, at Sidi Bel Abbès at 26 miles; they equal those of winter at Tlemcen at 19 miles. In the east (Province of Constantine), the fact of an excess of spring rains, already sensible at Jemmapes at 7 miles from the shore, is very striking at Constantine at 27 miles. These rains exceed those of winter at Sétif at 21 miles, and still more at Batna at 57 miles.

What occurs still further south and on Sahara? We know not yet; the numerous breaks in the observations made at the military hospitals at Biskra and Laghouat prevent this being yet ascertained.

There are great differences in the mean annual fall at the various stations especially between those on the shore where the altitudes of the stations, are most similar.

From Oran (19 in.) and Mostaganem (18 in.,) where the fall is small, it becomes almost double at Algiers (31 in. and 35 in.,) and triple at

Bougie (52 in.,) then gradually decreases at Djidjeli (42), Phillipeville (30 in.,) and Jemmapes (29 in.); a fresh increase occurs at La Calle (34 in.) Bougie thus possesses a more considerable maximum than Genoa on the opposite coast, and starting from which the quantities decrease, towards the east as far as La Calle and even Palermo, and towards the west as far as the frontiers of Morocco; just the same as starting from Genoa, the quantities go on decreasing towards the south-east as at Naples and Palermo, and towards the west and south-west to Marseilles, Perpignan, and along the coast of Spain.

On the table lands the fall is everywhere less than on the shore. The decrease in the quantity of rain from the coast towards the interior ought to be examined in the two-fold relation of distance from the sea and altitude of the localities. It results from this examination (as may be seen from the following table)—

(1) That in the provinces of Oran (with the exception of Tlemcen) and of Constantine, the rainfall decreases according to the distance from the coast.

(2) That in the same provinces (with the exception of Tlemcen) the rainfall decreases as the altitude above sea-level increases.

Distance from Sea.

57 miles.	27–19 miles.	13–7 miles.	On the Coast.
	Tlemcen.....24 in. 19 miles.		
	Mascara .....17 in. 21 miles.	St. Denis-du-Sig, 15in. 13 miles.	Oran ... .19 in.
	Sidi-Bel-Abbes, 15in. 26 miles.		Mostaganem, 18in.
			31 in.
.....	.....	.....	Algiers ... 35 in.
Batna, 16 in. 57 miles.	Sétif .....17 in. 21 miles.	Jemmapes.. .....29 in. 7 miles.	Bougie .....52 in.
	Constantine, 27 in. 27 miles.		Djidjeli .....42 in.
			Phillipeville, 30 in.
			La Calle.....34 in.

Altitudes.

	Interior.		Coast.
2,500 ft. and above.	1,500 to 2,500 ft.	Under 1,500 ft.	0 to 300 ft.
Tlemcen, 24 in. 2,690 ft.	Sidi-Bel-Abbs, 15 in. 1,542 ft.	St. Denis-du-Sig, 15in. 180 ft.	Oran .....19in. 164 ft.
	Mascara .... 17 in. 1,903 ft.		Mostaga 18 in. 262 ft.
			Algiers, 31 in. 131 ft.
....			Algiers, 35 in. 16 ft.
Sétif .....17 in. 3,533 ft.	Constantine.....27 in. 2,116 ft.	Jemmapes ...29 in. 295 ft.	Bougie ..52 in. 98 ft.
Batna ...16 in. 3,448 ft.			Djidjeli, 42 in. 131 ft.
			Phillippe. 30 in. 197 ft.
			La Calle, 34 in. 82 ft.

It is impossible to avoid noticing in the last place that the relative

amount of rain along the northern coast of Algeria corresponds with the breadth of the eastern basin of the Mediterranean measured along the meridians, that is to say, the extent of water surface supplying by evaporation the vapours, the condensation of which furnishes the rain. In fact, if, as is probable, it is the northerly winds which bring clouds and rain to Algeria, it is not surprising that the winds which come from Marseilles, in crossing the Mediterranean at its greatest breadth, are more charged with vapour than those which come on the west from Spain, crossing only the straits which separate its southern coast from those of Morocco and Oran, and on the east in passing from Germany over Italy and Sardinia, crossing only the comparatively narrow Tyrrhenian Sea before arriving at La Calle, and especially at Palermo.

EVAPORATION.

To the Editor of the Meteorological Magazine.

SIR,—As the month of April, unlike its predecessors, has been favourable for observing the amount of evaporation, having had but five rainy days, with a total rainfall of 0·4 inch, I send you a description of my gauges, all placed within a few feet of each other, and the amount of evaporation from each.

No. 1, although not sufficiently large, is my best gauge, 18 inches diameter; full particulars of its construction are given on page 167 of your *British Rainfall* for 1869. The mode of measurement as there described, after some months' trial, has proved satisfactory, and its indications may be depended upon to the $\frac{1}{500}$th part of an inch. As this one gauge was taken every morning with other instruments, I send you the amount for each day, noted down at the time of observation.

	in.		in.		in.
April 1.....	·012	April 11.....	·041	April 21.....	·211
,, 2.....	·078	,, 12.....	·087	,, 22.....	·205
,, 3.....	·042	,, 13.....	·140	,, 23	·251
,, 4.....	·091	,, 14.....	·148	,, 24.....	·208
,, 5.....	·090	,, 15.....	·093	,, 25.....	·149
,, 6.....	·094	,, 16.....	·109	,, 26.....	·168
,, 7.....	·120	,, 17.....	·128	,, 27.....	·213
,, 8.....	·117	,, 18.....	·165	,, 28.....	·120
,, 9.....	·153	,, 19	·146	,, 29.....	·064
,, 10.....	·132	,, 20.....	·173	,, 30.....	·068

The temperature of the water in this gauge varied during the month from 32° to 77°, that of the water in the river Mole from 39° to 60°·3.

No. 2 is 8 inches in diameter, 6 inches deep, and (bottom excepted exposed to the air. The measurements in this gauge are taken by a vertical float, with a vernier attached.

No. 3 is 5 inches in diameter, 2½ inches deep, and (bottom excepted) exposed to the air; the mode of measurement similar to No. 1.

No. 4 is 4 inches in diameter, 2 inches deep, fixed at the top of the thermometer stand; in order to keep the temperature of the water

more even, the outside is covered with felt, but not so as to interfere with the rainfall. The measurements are now taken by the glass of rain gauge, a graduated glass tube below having been destroyed by the frost.

No. 5 is a 5-inch Casella rain gauge, with stand-pipe fixed in centre any overflow passing into the bottle below.

The evaporation from the several gauges during the month was as follows:—

No. 1	3·816	inches.
,, 2	5·66	,,
,, 3	6·71	,,
,, 4	6·37	,,
,, 5	4·65	,,

Nos. 2 and 3 gauges were placed by the side of the 18-inch gauge, about 4 feet from the ground. No. 5 stands by the side of other rain gauges one foot above ground.

There being so little danger from rain during the month, the water in Nos. 1, 2, 3, and 4 was generally kept about half-an-inch below the edge of the vessels; No. 5 was rather lower—about an inch. After the gauges were once filled, the quantity of water put into them was carefully measured, the errors therefore from any deficit in the different modes of measurement cannot amount to much; any rainfall was of course allowed for.

It will be seen that the evaporation from gauge No. 3 was 76 per cent. greater than that from No. 1. I shall not enter at present into the reason for this difference; had the evaporation during the day time only been given, the difference would have been far greater, as whenever the opportunity of observing the gauges twice during the 24 hours has occurred, the evaporation from the smaller gauges during the night has been much less than from the larger ones.

On page 156 (*British Rainfall*, 1869) the following sentence occurs:—"We have already pointed out that we consider the accuracy of an evaporator is largely dependent on its capabilities of retaining the temperature of the contained water at as nearly as possible that of large volumes of water, such as reservoirs, rivers, and ponds." What you have there said I fully endorse. There are other points yet to be determined, but unless this one is attended to, evaporating gauges are only a "delusion and a snare." They may answer for the purposes of comparison, but are of no use whatever in determining the true amount of evaporation. The result of one simple experiment, (only one of many,) made at the same time and place, with an accurate balance, must be my justification for writing thus strongly.

From water, the temperature of which varied from 90°·7 to 85°, the evaporation was at the rate of ·015 inches per hour; from water at 62°, the temperature of the room, the evaporation was at the rate of ·0031 inches per hour.

As some of your readers may have both the time and opportunity for investigating this subject, allow me to suggest a plan for doing so.

Between the levels of the upper and lower water of a canal lock, or a mill-pond, fix a moderate-sized cistern, with a small pipe attached leading from the higher water, and an overflow into the lower. In this cistern place the vessel containing the water exposed to evaporation. In determining the height which the edge of the evaporating vessel should be above the water, we have only a choice of evils; if the water is too low the evaporation will be less, if too high the in and out splash of the rain would affect the results; but as one splash would probably be compensated by the other, I should prefer the water being kept within about an inch of the edge of the vessel, supposing the evaporation taken daily. I need scarcely add, that a rain gauge must be fixed close by, and water occasionally measured into and out of the evaporating vessel. G. DINES.

Cobham, Surrey, May 2nd, 1870.

Postcript.—During the last month the evaporation from the same gauges was as follows:—

No.	1	4·927 in.
,,	2	5·621 in.
,,	3	6·542 in.
,,	4	8·111 in.
,,	5	5·340 in.

The positions of Nos. 1, 4. 5, have not been altered, but Nos. 2 and 3 have been placed, for experiment, sometimes in earth and sometimes in water nearly to the level of the upper rim.*

June 1st, 1870. G. D.

To the Editor of the Meteorological Magazine.

SIR,—In your *British Rainfall*, 1869, you gave some observations on evaporation, by Mr. H. H. Watson, at Bolton-le-Moors. I would suggest that if you are in possession of Mr. Watson's previous observations, it would be interesting to publish them. Mr. Watson's observations appear to me noteworthy, not only from his having been a pupil of Dr. Dalton, and using the form of gauge recommended by him, but also from their remarkable agreement with Mr. Greaves's observations at the East London Water Works (*British Rainfall*, p. 161), which, as far as our present knowledge goes, probably more nearly represent the actual evaporation from a natural water surface than the majority of observations do.

I am, Sir, yours truly,

ROGERS FIELD.

6, *Cannon Row, Westminster, May 5*, 1870.

[We have much pleasure in supplying the information requested, and for the sake of completeness have reprinted the values for 1856-69, and taken the decennial means.—ED.]

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* The temperature of the water in gauge No. 1 varied from 33° to 84°, that of the water in the river Mole from 46° to 66°·8.

Evaporation at Bolton during 39 years.

Year.	Amount.	Year.	Amount.	Year.	Amount.	Year.	Amount.
	in.		in.		in.		in.
1830	...	1840	23·79	1850	29·23	1860	21·94
1831	22·07	1841	24·51	1851	26·40	1861	19·45
1832	22·35	1842	24·69	1852	35·93	1862	17·80
1833	24·23	1843	24·02	1853	23 85	1863	19·04
1834	24·18	1844	22·60	1854	21·17	1864	20·31
1835	23·78	1845	23·39	1855	17·86	1865	20·24
1836	24·36	1846	24·16	1856	20·03	1866	19·03
1837	17·12	1847	22·76	1857	22·52	1867	18·88
1838	20·16	1848	22·02	1858	22 21	1868	23·41
1839	24·71	1849	26·21	1859	18·99	1869	19·24
Mean...	22·551		23·815		23·819		19·934

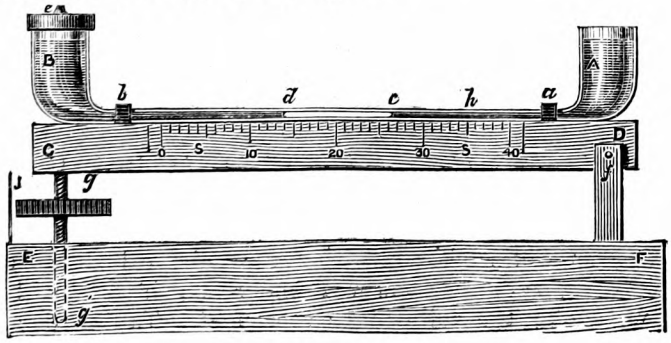
LAMONT'S VAPORIMETER.

To the Editor of the Meteorological Magazine.

SIR,—In *British Rainfall*, 1869, you gave as an appendix a valuable paper on evaporation, wherein will be found a description of the various instruments proposed for the measurement of evaporation. However, I find you have not mentioned Lamont's Vaporimeter, which appears to be worthy of consideration. Accordingly I submit the following sketch of the instrument, together with the description, which has been translated by my friend Mr. J. S. Harding, F.M.S. I will only add, that to render the dimensions of the instrument apparent to the general reader, it may be stated that, with vase B one inch in diameter, and the tube *b* one-tenth of an inch in bore, the scale between *a* and *b* should be 25 inches long, which divided into 25 equal parts, each division would represent ·01 of an inch of the water evaporated. On account of the length of the bubble it would be advisable to make the scale extend to 30 inches at least.—Yours faithfully,

R. STRACHAN.

11, *Offord-road, Barnsbury, N., 6th May*, 1870.



Description from the Bulletin of the Munich Observatory.—"The arrangement is extremely simple, and consists, as shown by the accom-

panying figure, of two glass vessels, A and B, connected by a tube *a b*. The vase A is open, and B is closed by a metal cover, in which there is the smallest possible opening at *e*. If the instrument be filled with water so that an air bubble *c d* is left in the communicating tube, the evaporation goes on uninterruptedly in the open vase A, whilst from the vase B only an infinitessimal amount of water will evaporate; and, as the water must remain level in both vases, the air bubble *c d* will advance towards *a* as the water in the vase A diminishes. This is the whole theory of the principle of the vaporimeter, but the manner of setting it up must be more fully explained. The glass tube is fastened by two clamps *a* and *b*, to the wooden support C D; this support is itself fixed to a box E F, serving as a base, and has a vertical movement round the horizontal axis *f*, just under the centre of the vase A. To produce the vertical movement, that is, to change the incline towards the horizon, the headed screw *g g'*, furnished in the usual manner with an index J and divided on the rim is used. The screw works in the box E F, and is brought to bear exactly under the centre of B. If, by turning the screw the vase B be raised one inch, the water in A will rise half-an-inch (*h*), and the air bubble will advance towards *a* on the scale *s s*, to be read off in amount of *p* scale divisions to which this change of level of half-an-inch corresponds. To convert the readings of the scale into amount of evaporation, they have only to be multiplied by the factor $\frac{h}{p}$. The screw *g g'* also serves to bring the air bubble into the communicating tube; for this purpose the vase B is lowered about half-an-inch below the horizontal position, and water is poured into A until the surface reaches the point *a*, then turn the screw again until the surface reaches *h*, and then pour in water and a bubble of the length *a h* is obtained. While completing the filling the support C D must be gradually raised to the horizontal by means of the screw, so that the bubble comes within the scale and near the commencement of it. On reading off the scale, both ends of the bubble must be noted, and the mean of their sum must be taken as the state of the bubble. There is only one obstacle in the way of obtaining an accurate observation, that an air bubble in a glass tube only moves perfectly easily when the interior surface is moist, and this obstacle may be easily removed by causing the bubble to pass to and fro before reading off by means of the screw."

REVIEWS.

Table to facilitate Finding the Humidity of the Air. By H. C. Russell, B.A., Government Observatory, Sydney, N.S.W. London: W. D. Thomson, Upper Street, Islington. Single sheet, card, folio.

This is a diagram, not a table, but whatever it be called, it is a very useful publication, as our readers will understand if they will follow us while we make the following experiment. Taking our 9 a.m. readings this day, dry bulb 62·8, wet bulb 58·6, the curve gives by simple inspection 75·5. Let us now obtain the same from Glaisher's tables in the usual way.

	Humidity.
Dry Bulb 62, and Wet Bulb 58	77·0
Diff. for increase of 1° in dry = —5 ∴ for 0°·8 =	—4·0
	73·0
Diff for increase of 1° in wet +5 ∴ for 0°·6 ..... =	+3·0
Humidity corresponding to 62·8 and 58·6 ..... =	76·0 by calculation.
,, ,, ,, ,, ... =	75·5 by diagram.

Careful examination of the curves shows that they are generally as near in their agreement with Mr. Glaisher's Hygrometrical Tables (4th Edition) as in the above case, and we therefore consider them a boon to all persons who require to reduce their observations according to that edition of those tables. We make this distinct reference to the fourth edition, because when first examining Mr. Russell's diagram we were perfectly staggered at the utter inconsistency of his diagram and Guyot's tables. We do not for a moment presume to decide between Messrs Guyot and Glaisher, but as an incentive to the examination of the subject by those competent so to do, we annex a copy of the table we first drew up in order to test Mr. Russell's diagram :—

Dry Bulb.	Wet Bulb.	Humidity. (Saturation, 100·0.)			
		Guyot.	Glaisher's Tables.		Russell's Diagram.
			1st edition.	4th edition.	
°	°				
56·0	45·0	34·6	52·7	44·0	44·0
61·0	50·0	40·2	53·0	47·0	46·4
66·0	55·0	45·0	55·3	48·0	48·4
71·0	60·0	49·0	57·9	50·0	50·1
76·0	65·0	52·4	58·2	52·0	51·8
81·0	70·0	55·4	58·7	53·0	53·1
86·0	75·0	57·9	59·0	55·0	54·5

From the above it will be seen that (leaving out of the question the values in the early edition), the difference between Mr. Russell's diagram and Mr. Glaisher's fourth edition, averages only about 2 in 1000, while the difference between Messrs. Glaisher and Guyot is seldom less than ten times as great. We need not dwell upon the necessity for ascertaining which values are correct. Reverting for a moment to Mr. Russell's diagram, we must express our astonishment that any observer, especially one attached to Sydney Observatory, should publish a scale of humidity not extending through a greater range than 100 to 40; 100 to 25 would have rendered the diagram even more generally useful than it is in its present form.

Fourth Annual Report on the Sanitary Condition of Merthyr Tydfil, being for the year 1868. By T. J. Dyke, F.R.C.S. Merthyr: White and Sons. 8vo, 26 pages.

Having on previous occasions noticed Mr. Dyke's Reports, lengthy remarks are now needless, especially as the present one differs little

from its predecessors. We regret that Mr. Dyke dismisses the quantity and quality of the water supplied to the town with so brief a notice as the following:—"The purity of the water supplied from your works has been maintained at its usual high standard of excellence."

Merthyr being at some little distance from any of the stations whence we are in the habit of printing detailed returns, it may not be inexpedient to transfer Mr. Dyke's meteorological report to our pages. It must be remembered it is for 1868, not for 1869.

"*The Weather in* 1868.—1st Quarter. The mean temperature in the first week in January was 5° below the freezing point of Fahrenheit. East winds prevailed until the 12th, when a gale came on from the west and continued until the 20th. The direction of the wind was from the same quarter until the end of the month; the temperature of the air increased and much rain fell. The mean heat was 35°. The rainfall on 17 days amounted to 6·75 inches. A great gale of wind from the N.W. set in on the last night in January, and continued until noon on the 1st of February. Very stormy weather occurred also on the 5th, 19th, and 22nd of this month. The mean temperature was 41°. Rain fell on 11 days to the depth of 4·36 inches. Stormy winds from the north blew from the 2nd to the 5th of March, and again on the 10th and 24th. The mean temperature of the month was 43°; and 4·47 inches of rain fell on 17 days. The rainfall during the quarter was 15·58 inches on 44 days, the mean temperature 39°·5.

"2nd Quarter. During the first week in April, east winds prevailed; the temperature at night was but slightly above freezing, while in the day it rose to 60° in the shade and to 90° in the sun. On the 13th the night temperature was but 26°; in the day, in shade, 60°. On the 19th the wind veered round to the west, much rain and a more genial warmth followed. On 13 days 3·92 inches of rain fell, the mean temperature of the month being 45°·5. South and south-westerly winds ushered in May showers. Rain was collected on 12 days to the amount of 3·62 inches. Thunderstorms occurred on the 19th and 29th. The mean temperature was 47°·5. June was almost a dry month; it rained on six days only, on each of three of these days but the $\frac{1}{100}$th of an inch fell—the whole rainfall being half-an-inch. The mean temperature was 58°·5. On the 27th the heat in the sun was 116°, and, on the 30th, 118°. The mean temperature of the quarter was 47°, and it rained on 31 days to a depth of 8·05 inches.

"3rd Quarter. The month of July was nearly cloudless and rainless. Rain fell only on the 29th and 30th, and then but to the extent of $\frac{47}{100}$ths of an inch. The mean temperature was 63°·5. On the 21st and 22nd the heat in the sun was 118°. It continued fine until the 6th of August, when the wind went round to the west, and from that date until the end of the month rain fell on 18 days, to the depth of 9·32 inches. The mean temperature was 58°·8. Up to the 18th September fine clear weather prevailed, after that day until the end of the month, rain, which fell on 11 days, was collected amounting to 5·23 inches. The temperature was 53°·7. During the quarter the rainfall amounted to 15·02 inches on 31 days. The mean temperature was 58°·5.

"4th Quarter. In October the wind blew chiefly from the north, and bright days were frequent. The mean temperature fell to 42°·5, and, though it rained on 17 days, the quantity of water collected was but 3·64 inches. On the 30th October, at 10.40 p.m., a shock of earthquake was felt, which lasted about three seconds. In November fine clear days predominated. It rained on 12 days, the gauge recorded 5·61 inches. The mean temperature was reduced to 39°·7. In December, stormy winds from the west brought with them a more elevated temperature and much rain. The fall on 24 days amounted to 13·69 inches; the mean temperature was 44°. A heavy thunderstorm broke over the town on the 28th. The rainfall of the quarter on 53 days was 22·94 inches. The mean temperature being 48°·9.

"*Rainfall of the Year.*—The rainfall during the year 1868, on 159 days, amounted to 61·59 in. In 1867, the rain collected was 51·78 in. on 164 days; 1866, 58·39 inches on 204 days. The mean rainfall of the three years would be 57¼ inches, on 176 out of 365 days."

MAY, 1870.

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°. In shade	No. of Nights below 32°. On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	·70	— 1·80	·32	11	6	85·1	21	30·8	4	2	5
II.		Maidstone (Linton Park)	1·14	— 1·10	·39	12	7	87·0	21	27·0	3	6	...
„		Selborne (The Wakes)	1·95	— ·53	·87	11	7	76·5	21	26·0	4	7	10
III.		Hitchen	·85	— 1·08	·31	11	8	75·0	21	30·0	8	2	...
„		Banbury	1·17	— 1·05	·52	11	8	77·0	21	29·0	4	2	...
IV.		Bury St. Edmunds (Culford)	·36	— 1·80	·21	11	4	84·0	21	30·0	2‖	6	10
V.		Bridport	1·44	— ·59	·80	11	9	72·0	28	27·0	3	5	...
„		Barnstaple	1·63	— ·81	·52	11	10	74·5	20*	36·0	3	0	..
„		Bodmin	2·85	+ ·39	·92	11	12	73·0	21	31·0	3	1	1
VI.		Cirencester	1·80	— ·48	·85	10	6	...	...	...	...	...	...
„		Shifnall (Haughton Hall)	·76	— 1·50	·40	11	9	79·0	21	33·0	3	0	...
„		Tenbury (Orleton)	1·40	— 1·48	·61	11	10	78·8	21	29·8	5	3	5
VII.		Leicester (Wigston)	·71	— 1·41	·46	11	7	82·0	21	32·0	2¶	...	...
„		Boston	·58	— 1·36	·27	11	7	82·6	21	31·4	4	1	11
„		Grimsby (Killingholme)	·74	..	·31	11	8	74·0	20*	35·0	3	0	...
„		Derby	·72	— 1·44	·34	11	7	78·0	21	33 0	3	0	...
VIII.		Manchester	·75	+ 1·91	·41	11	9	77·0	29	30·8	4	1	1
IX.		York	1·08	— ·87	·43	11	8	76·0	21	34·0	3	0	...
„		Skipton (Arncliffe)	2·48	— ·87	·85	12	10	74·0	22	27·0	3	3	..
X.		North Shields	1·40	— 1·24	·42	11	12	70·4	20	33·5	3	0	1
„		Borrowdale (Seathwaite)	15·00	...	...	..	...	...	...	...	...	...	...
XI.	WALES.	Cardiff (Town Hall)	...	...	...	...	...	...	...	...	...	...	...
„		Haverfordwest	3·26	+ ·54	2·60	11	6	75·0	27	32·6	2	0	3
„		Rhayader (Cefnfaes)	2·73	— ·12	·93	10	9	70·0	...	30·0	...	...	...
„		Llandudno	·73	— 1·65	·22	11	9	74·0	21	39·7	2	0	...
XII.	SCOTLAND.	Dumfries	2·49	+ ·10	·73	11	14	76·5	27	31·5	4	1	...
„		Hawick (Silverbut Hall)	1·93	...	·53	12	16	...	...	...	...	...	...
XIV.		Ayr (Auchendrane House)	4·15	+ 1·04	1·04	31	16	67·0	27	27·0	4	1	3
XV.		Castle Toward	3·98	+ ·59	·58	14	15	73·0	27	29·0	4	3	5
XVI.		Leven (Nookton)	1·72	— ·29	·64	11	15	69·0	25†	31·0	2	1	6
„		Stirling (Deanston)	2·96	+ ·31	·37	19	18	74·8	27	27·8	4	2	7
„		Logierait	1·90	...	·48	12	9	...	...	...	...	...	...
XVII.		Ballater	1·72	...	·50	1	8	70·5	27‡	33·0	3	0	...
„		Aberdeen	1·49	...	·34	21	13	63·8	27	34·9	3	0	6
XVIII		Inverness (Culloden)	·74	...	·24	23	8	63·9	29	36·4	2	0	3
„		Portree	5·48	+ ·15	·91	18	19	...	...	...	...	...	...
„		Loch Broom	1·58	...	·42	21	19	...	...	...	...	...	...
XIX.		Helmsdale	1·20	...	·43	21	5	...	...	...	...	...	...
„		Sandwick	1·67	— ·59	·32	21	21	58·1	13	34·7	3	0	2
XX.	IRELAND.	Cork	2·38	...	·51	10	15	...	...	...	...	...	...
„		Waterford	3·50	+ 1·25	·70	11	18	57·0	24	31·0	2	1	...
„		Killaloe	3·94	+ ·76	·55	10	19	73·0	26§	30·0	3	1	...
XXI.		Portarlington	2·15	— 1·04	·40	10	18	71·0	26	35·5	1	0	...
„		Monkstown	1·37	— ·54	·42	9	11	...	...	...	...	...	...
XXII		Galway	4·36	...	·72	9	19	72·0	29	40·0	12	0	...
„		Bunninadden (Doo Castle)	3·30	...	·59	11	20	70·0	26§	34·0	3	0	...
XXIII		Bawnboy (Owendoon)	...	...	..	...	...	...	...	...	..	...	...
„		Waringstown	2·18	...	·45	13	16	78·0	26	36·0	8	0	1
„		Strabane (Leckpatrick)	2·51	..	·37	12	19	73·0	27	31·0	8	1	2

* And 21. † And 26. ‡ And 28. § And 27. ‖ And 3, 8, 9. ¶ And 4, 9.
+ Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON MAY.

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

ENGLAND.

Camden Town.—21st, frequent L in S.E. after 11.50 p.m. ; fifteen flashes per minute at 0·15 a.m. 22nd, and in S.S.W., passing to S.S.E. from 0.17 to 0.32 a.m. T at 0.22 a.m.

Linton Park.—A dry month, sharp frosts on the 3rd and 4th, and more slight on 6th, 9th, 10th, and 11th. Very hot from 15th to 22nd. T on 1st and 22nd ; R much wanted for vegetation, and fears are entertained for the water supply for general use, as only 6 inches of R has fallen this year.

Selborne.—Hail at 2.3, and hailstorm at 5 p.m. on 1st ; R at 9 a.m. on 11th, continuing for 12 hours = ·87 in. 22nd, min. ther. 50°, the warmest night this year. Fog in early morning of 28th ; prevailing winds—first week, N. and E.; from 11th to 21st, S.W.; last week variable. Vegetation very backward until the rain of the 11th, since which the gardens and fields have progressed rapidly.

Banbury.—H on 1st, and very slight S. on 2nd.

Culford.—A month of excessive drought; great appearance of rain during the last three days, but without its realization at this station, where it is much required, though I believe it has fallen to some amount during that time at places only a few miles distant.

Bodmin.—This month has been one of great drought, and the streams have never been so low in May. Remarkable evaporation on the 25th and 26th, with a fresh N.E. wind, the wet and dry bulbs differing 12°.

Cirencester.—Dryness and sunshine the rule of the month, with one happy exception, succeeded by cloudless skies ; the rain on the 10th from the S.E. was unintermitting for 13 hours, and being succeeded by showery weather, incalculable benefit accrued to the spring corn, but not being followed by mild weather, grass crops are very backward.

Shifnall.—An unusually dry May, none approaching it in 20 years but those of 1853 and 1861, when ·79 and ·75 in. only were registered. We had but one day's R of any amount, viz., ·40 on the 11th, the other 8 being only slight showers. Vegetation very backward, especially the grass. The early part of the month cold, with N.W. winds ; S.E. from the 8th to 12th, after that varying from S.W. to N.W. Temp. from 19th to 29th inclusive unusually high, reaching on 21st 79° in the shade. Turtle doves arrived on 3rd, numbers of white butterflies on 5th, orange-tipped ditto first seen on 6th ; apple in blossom on 10th, lilac on 12th, oak in leaf on 16th, and hawthorn in flower on 22nd.

Orleton.—Another dry month, with a large proportion of sunshine, the earth becoming parched and the grass crops scanty ; nearly all the R fell between the 10th and 16th ; several sharp frosts in the night of the first week ; no T heard, or L seen. On 22nd, fine at sunrise, cloudy from 7 a.m. till noon, then fine. Lofty veil of clouds after 5 p.m. from N.W. and cold.

Wigston.—A very dry month ; the rainfall during the 5 months ending May 31st is the smallest I have registered, being only 5·63 in.; during the same period last year we had 14·06. The years nearest this are 1863, 6·18, and 1868, 7·71. No grass in the pastures ; on good ground the corn looks well ; the bloom on the fruit trees has been very abundant.

Grimsby.—Very dry month ; pastures, meadows, and spring corn suffering greatly. A person killed by L at Coningsby on the 1st. Apple began to blossom on 7th ; hawthorn in flower on 20th.

Derby.—Again we have to record a deficiency of rainfall ; a relief of the drought was indicated on the 29th, but it passed off, and the bar. again rose; the weather, however, has been most enjoyable. Temp. slightly above the mean, and no N.E. wind or frost ; country looking beautiful.

Manchester.—An excessively dry month, not over one-third of the average R.

York.—T S on 1st.

North Shields.—H on 1st, aurora on 2nd, T on 28th and 29th; strawberry in blossom on the 18th.

WALES.

HAVERFORDWEST.—The great drought broke up on the 17th, when one of the heaviest rainfalls occurred; 2·60 in. in 19 hours. The weather continued foggy and cold till the last week, when a few warm days were noted; on the whole an ungenial month. Scarlatina still prevailing.

CEFNFAES.—A dry cold month; vegetation backward; herbage for cattle and sheep scarce upon the hills; wind generally N. and N.E.

SCOTLAND.

DUMFRIES.—H on 1st, T on 30th; the first 10 days cold and droughty; on the 11th much R, and weather showery till the 23rd; end of month very fine, except the last two days, which were showery. Rainfall below, and temp. above the average of the last five years. Hawthorn in blossom on the 20th, eleven days later than last year. The crops at the end of the month very promising, and grass abundant. On Sabbath, 22nd, the sun had a singular appearance; the day was fine, but with a thick vapoury sky, and the great luminary had a strong resemblance to the moon, but was not so bright, having a silvery-grey look; his disc was visible in that state for several hours, but his rays never pierced the vapoury atmosphere.

HAWICK.—1st, cold and stormy day, ice on dog troughs at night. Squally westerly winds from the 11th to the 15th; R every day from the 11th to the 23rd, but except on the 12th, ·53 in. only, in small quantities. There has been no frost except on the first three nights, and there is every prospect of an abundant fruit harvest. The hay crop looks promising; the laburnams and hawthorns are laden with blossom, and the whole country is looking most beautiful.

AUCHENDRANE.—This May, with a mean temp. above that of the month, has been seasonable and fertilizing, with sufficient R to supply all the demands of both vegetation and rivers.

CASTLE TOWARD.—The first part of the month dry, with some frosty nights, but in the middle showery and mild, and towards the close, 26th and 27th, very warm, bar. falling from 30·46 to 29·42 in last six days. About a mile of natural terrace is very gay with native plants. Chesnuts and whitethorn in flower on 18th, all about 10 days later than last year; several pyramid hollies, thickly studded with fruit, forming a striking contrast with the whitethorns, which are about the same size. I have not seen hollyberries hang on so late in the season before, and they appear as if they would continue for some weeks to come.

DEANSTON.—Gale and wind on 1st from N.E., very cold; dry till the 11th, with some frost at night, but bright sun during the day, and hot from 6th to 11th, when R fell, and some T and L on 13th; fine mild growing weather on to the end of the month, crops looking very well. On the evening of the 30th, T and L, with heavy R. Hay crop apparently will be heavy and good, as indeed pasture in general.

LOGIERAIT.—A very favourable month, and vegetation making rapid progress.

BALLATER.—A dry and rather cold month; vegetation made but little progress till the last week, when, with an increase of temp. and seasonable showers, a marked improvement took place. A very violent gale from the northward began at 6 p.m. on 19th; cuckoo first heard on the 7th, swift seen on the 27th.

ABERDEEN.—H on 2nd and 16th, T on 13th and 16th; fog on 5th, 27th and 29th; a warm, dry, but rather rough month; crops advancing wonderfully; winds from N. and S.W. above the average, none from N.E. Estimated pressure rather above the average.

INVERNESS.—The great deficiency in the rainfall still continues, and has now extended over four months. The scarcity of water is being felt in several districts.

LOCHBROOM.—A very fine month, suitable to the farmer, and propitious to the agriculturist; it has been such a contrast to the last, that it is hoped it may make some amends for the bad effects of it, except in the deaths among the sheep, particularly the lambs, which hence are very scarce and dear in the hill country.

IRELAND.

DOO CASTLE.—Wet and rough two-thirds of the month, which greatly retarded the second covering of potatoes and other farming operations; showers of H on the 1st, 13th and 16th. Curious appearance of sun from 9 a.m. to 3 p.m. on

22nd, changing from red to pale violet; there was a dense and peculiar cloud passing high up from the earth; horizon clear.

WARINGSTOWN.—Very fine and genial; crops very promising; spring, though late, very rapid when it set in.

LECKPATRICK.—Fine month; two great depressions of bar. in second and last week, accompanied by south-easterly gale and R. Rainfall since the beginning of the year deficient by about two inches of the average for that period; weather most favourable for all growing crops.

A GUIDE TO SUMMER TEMPERATURE.

To the Editor of the Meteorological Magazine.

SIR,—The following law is, I think, sufficiently interesting to merit attention.

When the rainfall of January or February is below an inch, and the mean temperature of the month in which the dry weather occurs is above the average (say above 36° if the month is January, and above 38°·7 if February is the dry month), the warmth of the period from April to August inclusive is *always* equal to, or above, the Greenwich average of 99 years, which is 55°·7 The following table contains *all* the instances that have occurred relative to this law since 1796.

The rainfall amounts for 1806 and 1807 are taken from Luke Howard's tables, the remaining rainfall amounts, as well as the monthly mean temperature values, are from Mr. Glaisher's tables.

Years.	Rainfall in January.	Mean temperature of January at Greenwich.	Mean temperature of April to August.	Difference of mean temp of April to August from mean of 99 years, which is 55°·7
	inches.	deg.	deg.	deg.
1859.....	0·8	40·4	58·5	+ 2·8
1822.....	0·6	39·8	57·8	+ 2·1
1835.....	0·7	38·0	57·4	+ 1·7
1858.....	0·8	37·5	57·1	+ 1·4
1807.....	0·7	36·7	57·0	+ 1·3
1864	0·9	36·5	56·1	+ 0·4
	February.	February.		
1806.....	0·7	41·5	56·1	+ 0·4
1834.....	0·4	40·2	57·9	+ 2·2
1852	0·9	40·8	56·4	+ 0·7
1857...	0·2	39·2	58·3	+ 2·6
1859.....	0·9	43·1	58·5	+ 2·8
1862... ...	0·5	41·1	55·7	0·0
1863.....	0·5	42·1	56·4	+ 0·7

In the above list of summers ruled by the month of January, the following very remarkable fact will be perceived. The warmth of each summer is almost exactly proportionate to the warmth of the preceding January. For instance, January, 1859, was the warmest of all, and was followed by the warmest summer. The year 1822 had the next warmest January and the next warmest summer, and so on to 1864, at the end of the list, when the mean of January was only a little in excess of the average, and the mean of the following summer was above the average to a correspondingly slight extent.—I am, &c.,

Barnsbury, June 4th, 1870. GEORGE D. BRUNHAM.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

LIV.] JULY, 1870. [PRICE FOURPENCE, or5s. per ann. post free.

THE THUNDERSTORMS OF JUNE 16TH-17TH.

VERY few words of introduction or explanation are required to preface the following accounts with which we have been favoured by several correspondents, and which are followed by a series of extracts from various papers, printed, as is our custom with quotations, in small type. These reports, coupled with those of our regular contributors (on pages 98-100) render the following deductions tolerably certain :—

I. The storm was felt earliest in Devon, Dorset and Somerset.
II. In those counties alone was the hail seriously destructive.
III. The storm was felt gradually later towards the Yorkshire coast.
IV. The lightning was most destructive in the Midland Counties, but considering its frequency was very harmless.
V. Very little rain fell except in the Eastern and North-Eastern counties, in several of which it was very heavy, *e.g.*, Granchester Mill, Cambridge, 1·40 ; Killingholme, 2·25 ; York, 1·17 ; Malton, 1·35 ; and Whitby, 2·00.

To the Editor of the Meteorological Magazine.

SIR,—On the 16th and 17th of June we had a succession of thunderstorms here. The 16th was a very oppressive sultry day, the shade maximum being 80°·4, and the solar 132° About 5 p.m. dense clouds formed in S.W., and at 5.50 lightning was seen, the flashes occurring about one per minute, followed at 6 by heavy rain. A lull then occurred till 6·45, when the second storm commenced, coming up from S.W. At 7 there was a very heavy fall of hail, with rain, lasting 7 or 8 minutes, the lightning frequent and vivid. The storm passed off to N.E., and the evening was fair till 10 o'clock. The third storm commenced at this hour, and lasted about 20 minutes, the lightning being very bright, accompanied with torrents of hail. The fourth storm commenced at 2 a.m. on 17th, and lasted till 2.40, but although of longer duration, was much less violent than the preceding ones. All the storms came up from S.W., but the wind gradually shifted to W. by daylight of 17th.

A sheep was killed in a field close to the city, by the lightning, and at Shockerwick (4 miles E.) a large quantity of glass in greenhouses was

destroyed by the hail. The bar. fell two-tenths of an inch between 9 p.m. 15th and 9 a.m. 16th.—Yours faithfully,

C. S. BARTER, M.B.

27, *Paragon, Bath, June 20th*, 1870.

BATH.—Thunderstorm on 16th; rain = ·69.—C. P. RUSSELL.

To the Editor of the Meteorological Magazine.

SIR,—You will probably like to have some particulars of the remarkable local hailstorm of the 16th instant.

Unfortunately I was from home, and can only give you information as gathered by putting together the accounts of a good many different people.

The storm commenced at Maiden Newton about 4.45 p.m., and lasted 10 minutes or more. The hailstones were of two sizes: the smaller ones precisely of the shape and size of confectioner's "acid drops;" the larger ones more or less oblong, slightly ragged, and at least an inch in one diameter. The weight of these ranged from an ounce to an ounce and a half. The smashing of glass was universal, probably one pane in every three exposed to the storm was broken. No rain fell, and only very distant thunder was heard. There was more or less of this distant thunder for about 12 hours from 3 p.m., and about 9.30 p.m. was a considerable storm close at hand, but I know of no accident. The total rainfall was 0·57, but I expect that the hailballs rebounded out of the gauge funnel.

The storm passed over Abbotsbury, Maiden Newton, Evershot, and Sherborne, but only a little rain fell at Dorchester. The hail was least at the former place, and greatest at the latter, so far as I can learn.

Faithfully yours,

P. H. NEWNHAM.

Frome Vauchurch, Maiden Newton, Dorchester, June 30th, 1870.

STRATHFIELD TURGISS.—Thunderstorm on 16th at 5 and 7.15 p.m., rain = ·42.—C. H. GRIFFITH.

To the Editor of the Meteorological Magazine.

SIR,—I send you a few particulars as to the thunderstorm of last night. A large but not very black cloud had been forming and rising in the south from 4 to 7 p.m. At 7.15 the sky was overspread suddenly, and 0·01 of rain fell; no thunder was heard. At 7.45 a short spurt of rain came down, = 0·08. Thunder (not very loud) and distant lightning accompanied it. After this an odd-looking arc—the Cupid's bow of the artists (though I never saw a bow of that shape), appeared in the clouds about 20° S.W. of the zenith. This was formed of some very dark vapour, with a deep grey cloud below it (to which it was the margin) and light stuff above and outside it. I could not perceive that it moved, although of course it was doing so. The lightning began to play along it as the sky grew darker, and rain began to fall heavily. Suddenly one great spread of lightning entirely broke up this

bow; before the flash it was quite distinct; after the flash it was nowhere. Then some pelting rain came down, but no hail, so far as I know. This was at 8.30 p.m. The cloud split into two (as nearly all thunder clouds do with us), and the bulk of it went N.W., and the side slip travelled eastwards. Plenty of lightning appeared, of most beautiful ramifications. I saw one flash like a series of streamers, all tending upward. The reflection was of a pale blue tint, not deep blue, as sometimes. After this storm had divided itself, and while we got its reflex from the north, a deep grey cloud began to rise from due S., and the wind (which had worked from S.W. to N.W.) backed to the S. quite suddenly. This last storm came up at a moderate pace; the lightning was very beautiful, and the rain still more so. We had 0·49 in all, and most of it fell before midnight. Take it altogether, I never knew so nice a storm. There was no violence about it; all the lightning went upward, and a lady might have watched the whole with nothing to make her nervous. The cloud-movements were very slow, and the thunder never cracked at all. In short, the clouds were higher (I think) than in dangerous thunder-storms, and the interchange of electricity seemed to be among them alone.

Yours truly,

R. D. BLACKMORE.

Teddington, June 17th, 1870.

CAMDEN TOWN.—Rain began at 7.35 p.m.; thunder first heard at 7.37 p.m.; lightning first seen in S.W. at 8·2, distant 3½ miles, and came no nearer; the storm kept off and on all the evening, with sharp showers at 10.22 and 11.24 p.m. The lightning was most brilliant (pink) about 1 a.m. on 17th. Total rain, = 0·49 in.—G. J. SYMONS.

To the Editor of the Meteorological Magazine.

SIR,—At 9 a.m., bar. (cor. and red.) read 30·037 falling, thermometer in shade 72°, and wind S.E., but at 1 p.m. it changed to the S., where it remained for the rest of the day. The weather was most oppressively hot, thermometer in shade reached 87°·3 and 140° in sun. At 7.30 p.m. distant thunder first heard, and showers with occasional lightning, principally sheet, during the evening.

The storm really began about 11.30 p.m., accompanied with very vivid forked and sheet lightning, and very heavy but not continuous rain, lasting on and off till about 2 a.m., after which the storm gradually subsided. The atmosphere seemed at times suffocatingly hot. The storm clouds appeared to come up from the W., the wind being S., and moved in a N.E. direction. Only 0·20 inch of rain fell here during the whole time. The barometer at 10 at night was 29·885 inches, having fallen 0·182 in. during the day.

Yours truly,

FRANCIS NUNES, M.A., F.M.S.

Heathfield Lodge, Chislehurst, Kent.

To the Editor of the Meteorological Magazine.

SIR,—The great heat of yesterday was last night followed by a very violent and protracted thunderstorm, lasting with little intermission for 7 hours. Distant thunder was first heard in S. about 6 p.m. 7.30 p.m., thunderstorm. Lightning vivid, but not frequent; slight rain at 7.45. 9 p.m., vivid lightning in S. and S.W., with distant thunder. 10.15, violent thunderstorm, lightning incessant and intensely vivid; storm right overhead from 10.25 to 10.40. At 10.30, a tree was struck by lightning at Forty Hill, Enfield. Heavy rain at 10.30. Storm ceased at 11 p.m. 12, midnight, storm again approaching from S.S.W.

17th, 1 a.m., heavy thunderstorm, storm continued till 2 a.m., and vivid lightning and distant thunder in S.E. till 3 a.m.

Barometer at 9 p.m. 29·84, having fallen from 30·02 at 9 a.m. Max. temp. in shade, 88·5; amount of rain gauged, ·41.

Yours truly,

THOS. PAULIN.

Winchmore Hill, 17th June, 1870.

HARROW.—Thunderstorm on 16th, rain = ·56 in.

To the Editor of the Meteorological Magazine.

SIR,—You may like to have a few notes as to the thunderstorm on June 16th and 17th. We had not much of it here, but it seemed to be severe to the west of this, and to be moving northwards. I left Chelmsford for this place on the 16th at 7.45 p.m., and saw the first flash of lightning about half an hour after in the direction of W. by S., and met the rain about 8.50. The lightning was very frequent, but the thunder not loud enough for me to hear above the noise of my conveyance. The storm approached this between 2 and 3 a.m. on the 17th, with some heavy rain for a short time, but I only marked 0·12 in. after all in the morning. I was told that a heavy shower fell at Dunmow on the afternoon of the 17th. The total rainfall for the last six months has been only 5·06 in., which has fallen on 63 days. The total rainfall has been—

1866	28·03 in.
1867	24·50 ,,
1868	21·59 ,,
1869	25·50 ,,
Total in 4 years	99·62 in.
Average	24·9 in.

So the rainfall of the last six months has been a little more than a fifth of the four whole years' average. The hay crop here is next to nothing. The wheat looks very good.—Yours truly,

EDWARD MAXWELL.

High Roding Rectory, Dunmow, Essex, 1st July, 1870.

To the Editor of the Meteorological Magazine.

Sir,—We have had a continuance of thunderstorms with slight

intermissions, from 9 p.m. on the 16th to 3 p.m. to-day, principally from S.W.; at Granchester Mill the fall was 1·40 in., 1·06 in. of which fell in an hour and a half, from 11.30 to 1 p.m. to day; the thermometer fell 10 degrees, from 70° to 60°, from 11.30 a.m. to 1 p.m.; at Beech House (only two miles distant) we have had only 0·78 in. during the same time, viz., on 16th and 17th.—Yours truly,

JAMES NUTTER.

Beech House, Cambridge, June 17th, 1870.

To the Editor of the Meteorological Magazine.

SIR,—A lightning-storm of the grandest description visited our district last night between the hours of 9 p.m. and 2 a.m. The day had been very sultry; max. temp. in shade 82°; in sun, by vacuum thermometer, 128°; wind S.; the sky a good deal overcast with the higher formations of cloud. About 8.30 p.m., lightning was seen and distant thunder heard in S. or S.E., and from that time the storm continued to approach, till it reached a climax at 10 p.m., with some very vivid lightning, and one crashing peal of thunder, followed by a downpour of rain. From 10 to 11 p.m. there was a partial lull in the storm, though lightning continued to flash rapidly in N.E., accompanied by distant thunder. Soon after 11 lightning began to appear again in S., and from 11.30 p.m. till 2 a.m. of the 17th, there was an almost incessant display of lightning of the most magnificent kind, with a nearly continuous roll of thunder. The frequency and intensity of the electric discharges during this time, especially from about midnight up to 2 a.m., were something astonishing, scarcely, if at all, inferior to the great storm which visited the midland districts on the night of the 29th of last September, of which I sent you a description at the time. A house about a quarter of a mile from the Vicarage was struck by the lightning and the roof injured, but beyond this I have not yet heard of any casualty in our neighbourhood from last night's storm. The amount of rain measured this morning was 0·92 in., a most welcome supply after the long drought. The weather this morning has been overcast, with occasional light showers, and distant thunder at intervals, the wind veering in turn to every point of the compass.

I am, Sir, yours, &c.,

GEORGE T. RYVES.

Sutterton Vicarage, 10 miles N.E. of Spalding, June 17th, 1870.

MONKMOOR, SHREWSBURY.—Thunderstorm, rain = 0·15 in.

LANNERCH PARK, ST. ASAPH.—Thunder on 16th; rain, = ·50 in.—WHITEHALL DOD.

To the Editor of the Meteorological Magazine.

SIR,—We had a heavy fall of rain in this district on Thursday and Friday, the 16th and 17th of June, 2 inches falling within 24 hours. The following amounts caught in the experimental gauges show that when there is heavy downpour, with excessive humidity of the air

and little wind, neither size of gauge nor height above ground make much difference.

Magnitude Series.—24 in., 1·93; 12 in., 1·98; 8 in., 1·98; 6 in., 2·00; 5 in., 1·98; 4 in., 2·00; 3 in., 1·99; 2 in., 1·99; 1 in., 2·04.

Elevation Series.—Isolated level, 2·03; at 6 inches, 2·00; at 1 ft., 1·99; at 5 ft., 1·97; at 10 ft., 1·95.

Form and Material Series.—8 in. with flange (zinc funnel), 2·01; 5 in. with flange (copper funnel), 1·98; 5 in. upright rim (zinc), 2·03; ditto (copper), 1·98; 5 in. ordinary rim (copper), 1·98; ditto (zinc), 1·96; ditto, japanned tin, 1·96; ditto glass, 1·96; Crallan's disc gauge, 1·64.

The small quantity caught in the 24 in. gauge is probably occasioned by the flatness of the funnel. For about half an hour it rained at the rate of more than an inch per hour, and at 11·45 a.m. on Friday I noted 0·03 in. in half a minute —3·6 in. per hour. This very heavy splashing rain coming at an angle of about 70°, doubtless caused some out-splashing from gauges with flat or shallow funnels.

I am, Sir, your obedient servant,

F. W. STOW.

Hawsker, Whitby, June 25th.

P.S.—The fall registered at Ling Hill was: top of hill, 1·60; north slope, 1·59; lighthouse garden, 1·74. At Grosmont, 6 miles inland, the fall was 1·70.

BRISTOL.—The storm burst over Bristol about 6 o'clock in the evening, and for upwards of three hours the rain descended on the parched earth, accompanied by vivid lightning and some loud peals of thunder.

WINCANTON.—In Somersetshire the tempest was accompanied by a hailstorm. At Wincanton in that county thousands of panes of glass were broken by the hail. Masses of ice fell which measured 5½ inches in circumference.

DORSETSHIRE.—On Thursday a heavy storm occurred in the neighbourhood of Stalbridge. The hailstones, some of which are described as being as large as pigeons' eggs, were partly globular and partly elongated. They continued to fall for about five minutes, and were followed by drenching rain. During the hail-storm, birds were killed, and the windows of greenhouses, in many instances, destroyed.

WEYMOUTH.—On the 16th there were several thunderstorms coming up from S.S.W., the lower current being from E.S.E., but after 6 p.m. from S.W. and W. Slight rain fell from 2.40 p.m. to 2.45, then heavier from 3.17 to 3.20. Thunder was first heard at 3.30 p.m., and zigzaz lightning seen in S. at 3.40, both of which continued till 4.30, with occasional heavy rain. The lightning was only half a mile distant at 4 p.m. This storm gradually died away in the N.E. Another storm came up in the W. at 5 p.m., gradually passing off to N. after 6. I saw forked lightning in the N.W., about 10 miles off, at 6.26. There was distant thunder and lightning in the W. almost incessantly from about 6.20 to 9. The storm came nearer from 8 to 8.45, during which time there were a few showers. Another storm came up at 9 and lasted till 9.37, the lightning being very vivid and of a pink colour, and the thunder occasionally very loud, though the lightning was not less than about 3 miles off, towards the west. This storm was accompanied by heavy rain from 9.30 to 9.36, and 9.40 to 9.45. Distant lightning was seen in the eastern horizon at 10.30 p.m., and occasionally through a fog which had come on, from 11 to 11.15.—E. E. GLYDE.

PORTSMOUTH.—A smart, although brief, thunderstorm has burst over here, passing from a south-easterly to a north-easterly direction, with vivid flashes of

sheet lightning, and rain for a short period fell heavily. The whole was over between 6.30 and 7 p.m.

NEWBERY.—The lightning was very vivid, and the peals of thunder very loud. The rain fell heavily for some time.

LONDON.—Slowly and surely, as all men who are sensitive to the influences of the atmosphere may have known days and days before, the tempest of Thursday night burst with appalling grandeur over London; that tempest had been collecting its forces for the attack. A heat no greater in degree, perhaps, than the normal heat of an English midsummer, and certainly less than the least heat of the tropics, but very much severer in its kind, had been experienced all over the country, but to a most unsupportable extent by dwellers in the pent-up neighbourhood of cities and large manufacturing towns. At all the meteorological stations, during Thursday, the barometer fell; but, the change being very uniform, the relative distribution of pressure was unaltered. Temperature had fallen a few degrees on our western coasts, but it remained still very high in the east and south of England. Rain and fog were reported from the west, and everywhere the sky was cloudy, the sea being very calm, and smooth as oil. Showers fell in Yorkshire, and revived the hopes of the farmers that the young clover seed sown among the corn may now soon appear. It was late in the evening when rain began to fall, and fall heavily, round London; many persons returning by road from Ascot were caught in the earliest showers, but the full force of the storm was not felt till somewhat later. The vividness of the lightning in London was remarkable. Often it lingered so long as to give the effect of an intensely bright moonlight, and, on its subsiding, the darkness was left blacker than before. We learn, from all parts of the country, that the storm was very general; rain having, in many places, commenced in the daytime, as, for instance, at Liverpool. The disturbed electrical condition of the atmosphere on Thursday night interrupted the working of the telegraphs so much as to cause serious inconvenience to the newspapers, whose intelligence from London was much delayed. A fire, which is supposed to have been caused by lightning, broke out about 10 o'clock on Thursday night, at Stoat's Nest Farm, Coulsden, Surrey, in the occupation of Mr. G. Smith. A stack of hay of about 50 loads, and three straw stacks of 20 loads each were destroyed; a cow-shed, two stables, a cart-shed, and a granary were burnt, and had fallen down; the store-shed and contents were slightly damaged by fire and water. A house of three rooms, occupied by Mr. J. Kent, was burnt, and another house seriously damaged. The storm seems to have passed over nearly the whole of England, and was everywhere accompanied by heavy rains, which will prove of the utmost value to the crops. About a quarter to 1 in the morning, the lightning broke a large window in a shed of the London Gaslight and Coke Company, in Battersea.

COULSDEN.—The storm of last night was very severe at the village of Coulsden, near Croydon. It was reported that a man named Joshua Martin was killed by lightning, and that a girl had shared his fate.

CAMBRIDGE.—The storm continued here for several hours; the lightning was unusually vivid, and several fires were occasioned by it in the neighbourhood. An old malting, situated about nine miles from the town, was burnt down. Several fires were caused by the electric fluid at Swavesley and other places in the locality.

LEICESTERSHIRE.—The storm here was one of the most severe witnessed for some years. The drought has been severely felt in this county, and the unfortunate results of a short supply of rain are made evident by the unusually slight crop of hay, which has been mown within the past week to prevent the scorching rays of the sun from burning up even the small crop there was to gather in. At about 10 o'clock on Thursday night the storm was at its height, and the rain poured down in sheets of water, which in a few minutes literally flooded the fields which a few hours before were dry and parched.

LINCOLNSHIRE.—The storm raged here with great intensity. Widespread alarm was felt in the district, and not without reason, as was proved by at least one event. Several accidents are reported, though no definite particulars have been obtained regarding them. A curious incident occurred in the neighbourhood of Long Sutton. The lightning struck a horse, singed the hair over one of the

animal's eyes, cut a piece out of its back, and slightly injured it in one of the hind legs.

THRAPSTONE. — At Thrapstone, Northamptonshire, a man was struck by lightning, and is not expected to recover.

HEMSWELL.—About 5 o'clock on Thursday night, during the thunderstorm which then prevailed, a woman, named Mrs. Atkinson, was struck dead by a flash of lightning at Hemswell, near Gainsborough. She sat at tea in her own house at the time. A man who was sitting at the table had his arm greatly scorched.

STAINWELL.—In the north of Yorkshire about a third of an inch of rain fell on Thursday night. Shortly before noon on Friday another thunderstorm set in, accompanied by exceedingly heavy rains. At Stainwell a few sheep were killed by the lightning, but no other accident is reported from Yorkshire.

MALTON.—The heaviest rainfall ever registered at Malton occurred between 10 a.m. and 2 p.m. on Friday, when 1·35 in. of rain fell, equivalent to 135 tons of water to the acre. At 2 p.m. rain ceased, and up to Saturday night no further fall occurred. On Saturday the farmers reported that the rains will afford a capital turnip season, but that they are too late for the corn and hay crops, especially on sandy lands. Old hay has risen £1 per ton. Clovers to mow and graze after sell from £8 to £12 per acre, and bad crops.

SCARBOROUGH.—The long wished for rain began to fall at Scarborough and in the neighbourhood on Thursday evening, several smart showers coming down freely up to nine o'clock, accompanied with thunder and lightning. About two o'clock yesterday morning, rain, with thunder, again occurred. The morning after that time was not so unfavourable as to prevent an excursion train to the York Gala from being well freighted; but from 10 o'clock until three it rained heavily and incessantly. Considerable damage was done in several gardens, the heavy rain washing and scouring the earth away. Shortly before noon, thunder and lightning prevailed, one particular flash being of remarkable intensity, while the thunder was so loud as to cause sensible vibration. The lightning struck the roof of the house, No. 7, Albemarle-terrace, partially stripping it of slates and breaking the spars. Several people were momentarily stunned, but nothing more serious has been reported.

Heavy thunderstorms were again experienced in the eastern counties on Friday, and torrents of rain fell throughout the day.

THE HEAT IN JUNE, AND THE DROUGHT.

WE have been favoured with many notes upon the above subjects, several of which we append.

With respect to the heat, allowance must be made for differences of stand and of position; subject to this, the following abstract will be interesting:—

ENGLAND.

Six Highest Returns.		*Six Lowest Returns.*	
Middlesex, Winchmore Hill. .	92°·0	Devon, Ashburton	75°·0
London, Camden Square	91 ·2	Northumberland, N. Shields..	75 ·8
Kent, Beckenham	90 ·8	Cornwall, Bodmin	76 ·0
,, Greenwich Observatory.	90 ·2	,, Penzance	77 ·0
Middlesex, Harrow	90 ·0	Devon, Dartmoor	77 ·0
Leicester, Wigston.....	90 ·0	,, Sidmouth	77 ·5

Concerning the drought, we leave our correspondents' letters and the usual monthly table and remarks to speak for themselves—supplementing them only by drawing attention to the large hay crop in parts of Scotland and Ireland. In London we have had about seven inches rain in six months, instead of twelve inches, or very little more than half our average; and in the last three months two inches instead of six and a half.

To the Editor of the Meteorological Magazine.

SIR,—In comparing the thermometer readings in the *Meteorological Magazine* with my observations here, I find that the maximum in London in May was 85°·1 ; Maidstone, 87°, &c., &c. Here it only reached 68°·6. Our minimum was 34°·0 I also observe the highest temp. in the shade at Greenwich on the 22nd of June was 90°·2 ; at Sidmouth it was 77°·5. The thermometers have been verified at Kew. The rainfall in June was 0·65, falling on 4 days. It may be gratifying to some people to know where the temperature is lowest at this time of year.—I am, truly yours,

J. I. MACKENZIE, M.B., F.M.S.

Sidmouth, June 4th, 1870.

To the Editor of the Meteorological Magazine.

SIR,—On 21st inst. my maximum thermometer in Stevenson's stand read 83°·5 ; on 22nd, 86°·7. Highest solar reading, 21st, 142°·5 ; 22nd, 141° ; solar thermometer *in vacuo*, bulb and one inch of stem blackened, placed on grass. To-day the minimum temperature (3 a.m.) 49°.—Yours faithfully,

C. S. BARTER, M.B.

27, *The Paragon, Bath, June 24th*, 1870.

To the Editor of the Meteorological Magazine.

SIR,—I think you would like to know the account of rainfall here for six months, to compare with others :—

	Inches.	No. of Days.	Greatest fall.	
January	1·98	16	0·33	on 7th.
February	2·27	9	0·83	on 6th.
March (up to 12th).	1·01	4	0·49	on 2nd.
March (13th to 31st)	·08	2	...	...
April	0·45	5	0·26	on 29th.
May	1·16	6	0·51	on 11th.
June	0·65	3	0·55	on 16th.
Total in six months	7·60	45		
Total from March 13 to June 30, incl..	2·34			

I am, yours faithfully,

JOHN DRUMMOND.

The Boyce Court, Gloucester, 1st July, 1870.

To the Editor of the Meteorological Magazine.

SIR,—As you will probably be giving statistics of the drought in the next number of your *Meteorological Magazine*, I forward particulars for this district. I am inclined to think the western half of Berkshire has suffered more than any other in England, for rains have been reported from all parts, while here not the tenth of an inch fell between May 15 and July 1. The thunderstorm of June 16 gave us only 0·03, and the showery weather of the 24th and 25th, which in London sent the funds up and wheat down, was represented here by 0·05.

Rainfall at Wantage.

January	1·43
February	1·85
March	1·42
April	0·56
May	1·15
June	0·09
	6·50

Max. temp., 86°, June 22nd; highest barometer, 30·56, June 6th.

Yours faithfully,

E. C. DAVEY.

Wantage, July 1st, 1870.

To the Editor of the Meteorological Magazine.

SIR,—In your next number of the *Meteorological Magazine* I shall look for some statistics of this long, and, so far as my experience reaches, quite unprecedented drought. In this part of the country we have had no rain to speak of since the snow storm of March 13. The effect on our sandy soil may be "better imagined than described."

I add a few figures for the sake of comparison.

Rainfall on 6 days of April, 0·3200 in., =1·2109 below mean of 15 years.
,, 7 ,, May 0·7500 ,, =1·1934 ,, ,,
,, 4 ,, June 0·5900 ,, =1·5723 ,, ,,
Total half-year's rainfall on 55 days to June 30, 7·2925 in., =3·7688 in. below mean of 15 years.

Total rainfall from March 13, 1870, exclusive, to July 3, inclusive, (4 lunar months) ..... 2·15 in.
Ditto during thunderstorm in the night of July 11 and morning of July 12, 1868 ..... 2·36 ,,

Difference in favour of Jupiter Tonans ..... 0·21 in.

I am, Sir, yours very truly,

WM. FREDK. HARRISON.

Bartropps, Weybridge Heath, 7th July, 1870.

To the Editor of the Meteorological Magazine.

SIR,—You may like to have my 6 months' rainfall for comparison with others.

	Rainfall.		Days, 010.	
January	1·656		15	
February	1·120	4·821	12	40
March	2·045		13	
April	0·366		5	
May	0·723	1·471	6	14
June	0·382		3	
	6·292		54	

The rain seems to avoid us here, and on 1st inst., when there was a fair fall at many places, I only had 0·040.

On 22nd June my thermometer on Glaisher stand reached 90·8; my next highest records of the year so far being—

May 21	84·5	June 16.....	86·5
,, 22.....	81·4	,, 19.....	82·1
June 13.....	80·9	,, 20.....	81·7
,, 14...	82·4	,, 21..... ..	84·7
,, 15...	81·7		

My highest minima were—

June 3	56·0
,, 17	59·0
,, 23	60·6

My lowest (also in June)—

37·9 on June 6th.

I am, dear Sir, yours truly,

PERCY BICKNELL.

Foxgrove, Beckenham, Kent, 4th July, 1870.

To the Editor of the Meteorological Magazine.

SIR,—The rainfall of the past half year being of an extraordinary small amount, I thought you would be interested to have the account of it, which I accordingly enclose, and also a statement shewing the average here for the first half of the year from 1860.

Rainfall in 1870.

January	1·29	
February	1·685	
March	1·92—1st quarter,	4·895
April	·52	
May	·99	
June	·265—2nd quarter,	1·775
Half year		6·67
Average, 1860-69		12·46
Deficiency		5·79

Rainfall in first half-year from 1860 *to* 1869.

1860	16·51	1865	11·935
1861	9·5	1866	17·735
1862	13·66	1867	12·4
1863	10·38	1868	10·15
1864	8·95	1869	13·395
			124·615
Average for 10 years			12·46

Yours truly,

JAMES WESTON.

Tanfield Lodge, Croydon, 2nd July, 1870.

To the Editor of the Meteorological Magazine.

SIR,—The drought and unusual heat we have had is, I think, worthy of notice. The following is our rainfall since January ;—

January	1·44 in.
February	1·01 ,,
March	2·24 ,,
April	0·41 ,,
May	0·79 ,,
June	0·39 ,,
Total	6·28 in.

The deficiency of rain cannot be far short of 5 inches in this locality, and is, I believe, unparalleled up to the present time.

	Max. in shade.		Max. in shade.
June 13	82°·4	June 18	74°·0
,, 14	80°·7	,, 19	82°·3
,, 15	83°·0	,, 20	78°·2
,, 16	87°·3	,, 21	82°·0
,, 17	73°·1	,, 22	89°·8

The heat in this high situation on the 22nd was very remarkable, and I cannot at all remember feeling anything like it before. The dryness of the air was very great at times during this period of heat.

Yours truly,

FRANCIS NUNES, M.A., F.M.S.

Heathfield Lodge, Chislehurst, Kent, July 1st, 1870.

To the Editor of the Meteorological Magazine.

SIR,—The deficiency of rain the last three months at this place is shown on the accompanying table, which represents the rainfall of the first six months of the driest seasons we have had the last 16 years.

	1855.		1858.		1870.	
	Rainfall.	No. of days.	Rainfall.	No. of days.	Rainfall.	No. of days
January	·47	15	·79	6	1·66	21
February	1·24	14	·77	6	1·14	19
March	1·69	17	·80	9	1·64	17
April	·26	5	1·93	11	·43	4
May	2·32	12	2·16	13	1·14	7
June	1·21	11	·67	3	·32	5
Total	7·19	74	7·12	48	6·33	73

By the above it will be seen the rainfall of the past three months, April, May, and June, has been under two inches, being less than any three spring months the past 16 years. The total rainfall of the six months contrasts also strongly with that of last year, when upwards of 15 inches fell, while in 1866 nearly 17 in., and in 1860 nearly 18 inches of rain fell in the same time; fortunately the ample fall of last year maintains our wells and springs, otherwise the supply for domestic use would be much less than it now is, but it may be low enough yet before the end of summer.

J. ROBSON.

Linton Park, Maidstone, July 1st, 1870.

THE RECENT DROUGHT.

From the "Daily News."

"At a season of the year when rain is seldom wanting; in March, when 'a peck of dust' is worth 'a king's ransom,' in changeful April, and in May, which

is usually but a second April, there has prevailed this year a most unusual drought. The fields have been parched to brownness, cattle have not only been deprived of their usual spring pasturage, but the roots which would have served for their winter food have been injured or destroyed. The hay crop has been a miserable one, and even cereals have been endangered; in fact, all the food supplies of the people have either directly or indirectly been seriously threatened. Yet the moisture which would have refreshed our fields has been all the while close at hand. Even when our skies have been clear during the past few months, the upper regions of air have been abundantly supplied with the water for which our fields have been languishing. The moist south-westers have blown over the country, yet without bringing the needed rain. The skies have even been for the most part cloud-laden, yet the winds have drifted onwards those vehicles of the precious moisture, which needed only a slight change of course to have brought fatness to the land. We have, in fact, been once again reminded how slight the causes are, which may make all the difference to us between abundant rain supplies and droughts such as those of the past three months and the summer of 1868. The moisture-laden air current which comes from over the Atlantic may flow so low that the western hills rob it of its wealth of water, and suffer dry air alone to pass over the rest of the country; or, on the other hand, the south-westers may range so high as to carry the moisture-laden clouds past our isles, not to discharge their stores of water until they near the upper slopes of the Scandinavian Alps; or, lastly, the south-westers, may be beaten back through all the summer months by the dry winds from the east, and so a real dryness of the air prevail, as during the exceptional weather of May, 1866. Yet it is comparatively seldom that we owe our droughts to such a real dryness of the upper regions of the atmosphere. The proof of this is found in the fact that our summer nights are seldom cold. In countries where the soil by day 'is as fire, and the wind as flame,' the cold at night is intense; but the moisture in our English skies protects us from these vicissitudes. Yet it is not without a sense of disquietude that the meteorologist regards our skies when drought afflicts the land, for though he knows that abundant supplies of moisture are there suspended, he also knows that those supplies may pass away to nourish other lands than ours, unless the steady flow of the upper air currents be fortunately interfered with.

"It is in seasons of drought that we are led to consider somewhat more thoughtfully than usual what it is that rain really does for our land. There is little in the progress of a shower of rain to indicate the action of nature's giant forces, yet we see really in the shower the unloosening of a mighty spring which has been wound up by the sun's action elsewhere. There is nothing more amazing in the lessons taught by modern science than what we have learned respecting the real significance of the apparently most commonplace phenomena of nature. 'I have seen,' says Tyndall, 'the wild stone avalanches of the Alps which smoke and thunder down the declivities with a vehemence almost sufficient to stun the observer. I have also seen snowflakes descending so softly as not to hurt the fragile spangles of which they were composed; yet, to produce from aqueous vapour a quantity which a child could carry of that tender material demands an exertion of energy competent to gather up the shattered blocks of the largest stone avalanche I have ever seen, and pitch them to twice the height from which they fell.'

"Even as wonderful is the 'force-equivalent' of the rain-showers which nourish our fields. We can well understand that the country should languish when rain is denied to it, if we consider that a day's steady rainfall over a region no larger than Middlesex has been shown to correspond to the action of a force capable of raising more than 3,000 millions of tons to the height of a mile. All the coal which men could dig from the earth in many centuries would not give out, a modern writer tells, 'enough heat to produce by the evaporation of water the earth's rain-supply for a single year.'

"Placed as the British Isles are in the direct course of the Gulf Stream, it may be regarded as on the whole an unlikely thing that for many months together they should be left without rain. Yet it does happen, from time to time, that even when the south-westers are carrying across our land the moisture-laden air

from the Atlantic, we suffer from protracted droughts. Nay, in our summer months we have commonly more to hope from easterly and north-easterly winds —dry though these winds are—than from the moist south-westers. The steady rains of winter, doubtless, come from the west; but in summer the contrary is often observed, the easterly winds, though dry themselves, forcing the south-west winds which they encounter to part with their supplies of moisture.

"But there are few subjects on which meteorology throws less light than on the causes which influence the dryness or wetness of our summers. At times it would almost seem as though the weather of tropical and sub-tropical regions were brought to us with the northing of the summer sun; and then we have a species of *monsoon* in the rains commencing about St. Swithin's Day. But during other summers an irregular variation prevails, corresponding more closely with the position of our country within the temperate zone.

"The attempts to discover any traces of periodicity in the recurrence of dry and moist summers has not hitherto been rewarded with success. If Professor Piazzi Smyth, the Astronomer Royal for Scotland, should succeed in establishing his strange theory that there are what he calls supra-annual changes of temperature —that is, variations taking place in a period not associated with the common year—it may be just possible that some trace of connection between these changes and the occurrence of moist and dry seasons may be detected. It would be surprising indeed if, as Professor Smyth suggests, some of our weather changes should be found in any way associated with the red flames around the sun; but, undoubtedly, the evidence yet adduced on this point is far too narrow to establish a theory upon.

"Nor again does there seem to be any evidence in favour of the view that our climate is undergoing a gradual change whether as respects temperature or humidity. Two such seasons of drought following so closely as those we have experienced during the past months and in 1868, might lead us to fear some such change, especially since it is a well-known fact that in some countries the rainfall has notably diminished in the course of so short a period as twenty or thirty years, remaining thenceforth permanently less than of yore. But it needs only a moderate acquaintance with the records of past seasons to enable one to record instances of droughts even more remarkable than that of 1868, when the sparks from passing locomotives fired the grass on railway cuttings and embankments. Hear, for instance, how Gilbert White, of Selborne, describes the heat which prevailed during the summer of 1783. 'The heat was so intense,' he says, 'that butcher's meat could hardly be eaten the day after it was killed, and the flies swarmed so in the lanes and hedges that they rendered the horses half frantic and riding irksome. The country people began to look with a superstitious awe at the red lowering aspect of the sun. Milton's noble simile in his first book of *Paradise Lost* frequently occurred to my mind, and it is indeed particularly applicable, because, towards the end, it alludes to a superstitious kind of dread with which the minds of men are always impressed by such strange and unusual phenomena:—

> "'As when the sun new risen
> Looks through the horizontal, misty air,
> Shorn of his beams; or, from behind the moon,
> In dim eclipse, disastrous twilight sheds
> On half the nations, and with fear of change
> Perplexes monarchs.'"

ON THE RAINFALL OF SOUTH-WESTERN EUROPE AND ALGERIA.

(Concluded from page 70.)

The clouds which thus arrive from the Mediterranean, are condensed in winter principally on the shore, the first cold surface, although low, which they meet. In spring, when the soil is warmer, the vapour-bearing clouds pass it, and are condensed on the high lands— cold, by

virtue of their altitude. In summer the high temperature of the air and of the soil is almost entirely opposed to condensation, especially on the shore, except during storms, and the clouds pass even the loftiest plateaux and lose themselves in the dry aerial ocean of Sahara and the whole interior of Africa. Lastly, in autumn, when the soil cools, the rain on the coast is relatively greater than that on the high lands.

An appendix gives a short note on the rainfall observed during the last few years at the military hospitals, and at Biskra.

[We are sure our readers will agree with us in thinking that the considerable space we have devoted to a partial re-production of Professor Raulin's memoirs has not been greater than their importance merits. The detail in which we have given them renders it unnecessary for us to add many remarks, but there are a few points which claim attention, and if these notes indicate hesitation on our part to accept all the data, we wish it distinctly understood that it is with some of the observations, and not with Professor Raulin, that we are dissatisfied.

In Professor Raulin's previous memoirs, he has generally given the height of the rain gauges above the ground, as well as their altitude above sea level. That he has not done so in this case, materially lessens the value of the returns, and can only, we presume, be due to a lack of information.

Our main objection, however, is to the general tables converted on pages 50 and 51 of this magazine. Of these we will quote a few instances; and, first, the returns from Djedjeli. The fall in 1862, 71·11 in., is 29 inches *above* the average; at the nearest stations, Constantine, it was 4½ inches *below* the average; at Sétif 3 inches below, and at Bougie 14 inches below. At most stations it was about 5 inches below, therefore, Djedjeli reports 34 inches more than seems probable, *i.e.*, 71 instead of 37. Possibly Professor Raulin has the *monthly* values, if so, he may be able to throw some further light on this.

Another puzzling return is Bougie, in 1866, 74 inches, or 22 inches *above* the average, while *every* other station was more or less below it.

Lastly, it is of the very highest importance that the record kept by the officers of the department of Ponts-et-chaussées (usually such good observers) should be closely examined. Thirty years' observations are given, the decennial means being—

Algiers.		Constantine.	
1838–47	= 37·01	1838–47	= 29·020
1848–57	= 31·73		
1858–67	= 26·05	1868–67	= 23·912

Hence we find reported a decrease of 30 per cent. in 20 years, and this decrease is confirmed by the returns from Constantine, but flatly contradicted by the observations made by M. Hardy at a second station in Algiers, which for a few years agree with those of the department, but latterly, when the officers of the Ponts-et-chaussées were reporting about 25 inches, M. Hardy was stating the fall to be 40 or 50 inches. The Oran register, which alone is available in considering this point, shows little variation, and, if anything, a slight increase.

Hence, we are not only left in uncertainty as to the actual fall at Algiers, but also as to its being increasing, stationary, or decreasing.

Professor Raulin has, however, done good work, and it would be completed by the gauges being carefully examined, and their construction and position described by himself or some competent deputy.—ED.]

FINE MIRAGE IN THE CHANNEL.

To the Editor of the Meteorological Magazine.

SIR,—The party on board my yacht "Hadassah," on her passage from Alderney to Guernsey on Saturday, 21st May, witnessed a phenomenon so striking, and in these latitudes so rare, that I am tempted to send you a short account of it. The wind was light from E.N.E., the sky cloudless, the sun very hot, and the barometer steady at 30·21. There had been some signs of fog in the morning, but they had disappeared. At about half-past three in the afternoon we observed over the small island of Herm a peculiar hazy reflection, which became more and more defined until it presented an exact inverted image of the land beneath. A similar effect was soon visible round the whole horizon. The islands Alderney, Guernsey, Jersey, Sark, and Herm, seemed raised to more than twice their natural height; sharp pointed outlying rocks were capped with inverted images of themselves, apparently balanced upon them point to point like enormous rocking stones. The Ortach rocks, of which we had previously lost sight, were now to be seen with startling clearness in the air. The Casquets, with its three lighthouses, presented a most curious appearance: the lighthouses were drawn out into colossal pillars, on whose summits rested a huge mass of rock, clearer in outline than the real island beneath. Ships were seen sailing keel upwards through the air, every sail and spar distinct, and in some cases the images were re-duplicated. Several of the vessels thus reflected were below the horizon and invisible to us. The northern end of Guernsey, where the land runs low, was twice reflected in the air, so distinctly that even those who were familiar with the island found it hard to recognize it. We seemed to be looking at some half submerged country, where countless still lagoons were divided from each other by narrow strips of land. As we neared Guernsey the picture became less distinct, but meanwhile the mirage was becoming more wonderful still over Alderney. Here the deeply marked cliffs were magnified to an apparent height of many hundred feet, and no scene painter devising a grand transformation scene ever dreamed of more fantastic groups of basaltic columns, grottos, and rock arches, with the tide flowing beneath, than was exhibited by the island and the isolated stacks around it. Having remained visible for more than three hours, the panorama of wonders gradually faded away, and by seven o'clock the horizon was clear save where a dark narrow line of cloud or mist hung low in the N.E. I may add, for the information of weather prophets, that this unusual state of atmosphere was not the forerunner of high wind or any change in the weather.

THOS. WARING.

Schooner "Hadassah," Queenstown, June 15th.

JUNE, 1870.

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	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32° In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	·83	— 2·22	·49	16	3	91·2	22	43·5	6	0	0
II.		Maidstone (Linton Park)	·32	— 2·42	·16	1	5	88·0	22	43·0	6, 10	0	0
,,		Selborne (The Wakes)	·51	— 2·72	·24	16	3	82·8	22	39·0	24	0	0
III.		Hitchen	·79	— 1·85	·57	16	5	81·0	22	44·0	6	0	0
,,		Banbury	·75	— 2·53	·32	24	8	85·0	22	41·0	6	0	0
IV.		Bury St. Edmunds (Culford)	·98	— 1·60	·55	24	6	85·0	16‡	40·0	5,6,9	0	0
V.		Bridport	·76	— 2·48	·50	16	2	79·0	22	41·0	14	0	0
,,		Barnstaple	·92	— 3·20	·78	1	4	80·0	22	46·0	24	0	0
,,		Bodmin	·91	— 3·13	·54	16	11	76·0	21‡	47·0	24	0	0
VI.		Cirencester	·75	— 2·63	·65	16	2	...	...	...	...	...	...
,,		Shiffnal (Haughton Hall)	·54	— 2·57	·16	24	9	81·0	21	43·0	6	0	0
,,		Tenbury (Orleton)	·61	— 2·91	·38	16	7	85·2	22	38·0	6	0	0
VII.		Leicester (Wigston)	·60	— 2·16	·18	12	6	90·0	16	35·0	5	...	...
,,		Boston	1·60	— ·59	·73	16	9	85·0	19	42·6	6	0	0
,,		Grimsby (Killingholme)	3·86	..	2·25	16	14	77·5	22	41·0	6	0	0
,,		Derby	1·23	— 1·66	·58	16	13	82·0	22	43·0	27	0	0
VIII.		Manchester	1·79	— 1·55	·30	16	16	82·0	19	43·0	2,6 7	0	0
IX.		York	2·81	+ ·71	1·17	16	13	78·0	23	44·0	6, 28	0	0
,,		Skipton (Arncliffe)	3·52	— ·58	1·30	1	16	80·0	9	39·0	28	0	...
X.		North Shields	2·44	— ·30	·73	26	15	75·8	21	43·0	10	0	0
,,		Borrowdale (Seathwaite)	4·25	...	...	..	...	...	...	...	...	...	...
XI.	WALES.	Cardiff (Town Hall)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	1·18	— 2·47	·54	16	3	76·5	21	43·5	23	0	0
,,		Rhayader (Cefnfaes)	·90	— 3·08	·42	16	10	78·0	...	42·0	...	..	...
,,		Llandudno	1·06	— 1·23	·39	11	6	79·2	6	47·5	1	0	0
XII.	SCOTLAND.	Dumfries	1·51	— 1·39	·24	15*	15	81·5	6	43·0	23	0	0
,,		Hawick (Silverbut Hall)	1·86	...	·43	24	13	...	...	...	...	...	...
XIV.		Ayr (Auchendrane House)	2·40	— ·95	·30	12	17	73·0	6	44·0	2§	0	0
XV.		Castle Toward	2·32	— 1·17	·52	12	16	77·0	6	43·0	11	0	0
XVI.		Leven (Nookton)	1·91	— ·33	·44	30	16	74·0	6	41·0	18‖	0	1
,,		Stirling (Deanston)	1·72	— 1·20	·25	26	16	78·2	6	38·0	10	0	0
,,		Logierait	·75	...	·20	3	12	...	...	...	...	...	...
XVII.		Ballater	1·20	...	·18	24	11	78·5	21	36·0	13	0	...
,,		Aberdeen	·92	...	·29	11	11	80·5	21	40·7	12	0	5
XVIII.		Inverness (Culloden)	1·69	...	·55	1	14	70·2	6	42·8	12	0	0
,,		Portree	3·66	— 1·12	·45	25	24	...	...	...	...	...	...
,,		Loch Broom	2·36	...	·42	24	17	...	...	...	...	...	...
XIX.		Helmsdale	1·00	...	·11	10†	16	...	...	...	...	...	...
,,		Sandwick	1·70	+ ·16	·29	24	22	65·2	21	40·0	10	0	1
XX.	IRELAND.	Cork	·64	...	·26	15	5	...	...	...	...	...	...
,,		Waterford	...	...	...	..	...	..	...	...	...	...	...
,,		Killaloe	·71	— 2·91	·36	11	10	81·5	5	39·0	17*	0	0
XXI.		Portarlington	·86	— 2·39	·29	17	16	77·5	6	45·0	1	0	0
,,		Monkstown	...	...	...	...	..	...	...	...	...	...	...
XXII		Galway	1·45	...	·72	11	12	78·0	5, 7	45·0	25	0	0
,,		Bunninadden (Doo Castle)	1·53	...	·57	11	15	77·0	6	37·0	17	0	0
XXIII		Bawnboy (Owendoon)	...	...	..	...	...	...	...	...	..	..	...
,,		Waringstown	·95	...	·34	11	14	83·0	5	44·0	11	0	0
,,		Strabane (Leckpatrick)	1·75	..	·26	11	21	78·0	5	40·0	1¶	0	0

* And 23. † And 19. ‡ And 22. § And 5, 18. ‖ And 28. ¶ And 11, 22.
+ Shows that the fall was above the average ; —that it was below it.

METEOROLOGICAL NOTES ON JUNE.

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

ENGLAND.

CAMDEN TOWN.—T S from 7.37 p.m. on 16th, to 3 a.m. on 17th; L very vivid.

LINTON PARK.—A very dry but not particularly hot month. T on 4th, 17th, and 23rd; bar. mostly high, excepting on 1st, 9th, 10th, and 11th; winds changeable, but mostly S.W. and W.; vegetation suffering from want of R, there being scarcely any hay; wheat in ear on 11th, being two or three days sooner than the average.

SELBORNE.—The drought during this month has been most injurious to the hay and root crops as well as to gardens; in the last three months less than 3·00 in. of R has fallen. On the 16th, about 6 p.m., during a short T S, a remarkable appearance was observed N.W. of Selborne—a ball of fire falling and leaving a line of light. It is reported that about two miles distance from Selborne the ground was struck and the soil scattered. S.W. wind prevailed from the 9th to the 23rd, afterwards variable; on the 1st the max. temp. was only 56°·5, the lowest for that day that I have known for several years.

HITCHEN.—T on 16th.

BANBURY.—T S on 16th and 17th; solar halo at 11 a.m. on 9th.

CULFORD.—T on 16th and 17th. Another month of extreme drought, and accompanied with high temp. from the 8th to the 24th, when a considerable decrease took place; severe T S on the night of the 16th, with (no?) R falling, and only a slight fall on the 17th amounting to 0·08 in.; T again on 24th, with ·55 in.

BRIDPORT.—Very fine month; hay crops very short; heavy T and L on 16th, commencing at 4 p.m. and lasting till 10 p.m., with heavy R. In the neighbourhood there were heavy hailstorms, large flat hailstones fell two inches across and as large as walnuts, breaking a great quantity of glass; R much wanted.

BODMIN.—This month has been remarkable for the continued drought, the springs never having been so low in June within the memory of the oldest person. Average temp. of the month, 61°·6; max. difference of wet and dry bulb, on the 23rd, 8°; average difference, 4°·7.

CIRENCESTER.—A dry and hot month, greatly lessening the hay crops and the growth of straw in the corn crops; but for the R in the middle of May, and the T S on the 16th of June, the spring corn would have been a total failure.

SHIFFNAL.—Exceedingly dry still; temp. up to the 16th, generally exceeding 70°, min., with one exception, not above 55°. The little R that fell dried up directly by the bright sun; pastures burning up; barley coming into ear, only a foot high; prevailing winds N.W. and W.; T in distance on 11th, and again on 16th, only ·10 in. of R fell on each day; excessively hot on the 21st and 22nd, when 81° and 78° in shade; next day a sudden fall in temp., which lasted, with N.W. winds, to the end, with little variation. Ash in leaf on 1st; seringa in blossom on 3rd; pear trees infested by grubs, nine-tenths of it destroyed; scarcely a flower on the hollies, which last year were loaded with berries.

WIGSTON.—This locality had not the benefit of the fine R which many parts of the country enjoyed in the middle of the month; corn is generally looking well, particularly wheat, though very short in the stem; no grass; cattle suffering from the continued drought. The last seven days have been very cold and ungenial, with strong breezes. The total fall of R in the last *six* months has only been 1·50 in. more than fell in *May* of 1869.

BOSTON.—The first half of the month was remarkable for the dryness and heat of the atmosphere. On the 6th, when the temp. was comparatively cooler and the sky overcast, the dry bulb at 1 o'clock stood at 69°·5 and the wet at 56°; a T S of unusual violence occurred about 10 p.m. on the 16th, and reached its maximum of intensity about 2 a.m. on 17th; the L was more vivid than I ever remember to have witnessed, and the display of the flashes, which continued for many hours without intermission, was grand beyond all powers of description. The hottest day was the 16th, the mean temp. being 70°·1; the black bulb in vacuo in the

full rays of the sun, close to the ground, stood as high as 145°·2 on 15th; the hay crops in this district are exceedingly light, and pastures are scanty and brown with the fierce heat; the root crops have also suffered much from the drought; wheat crops, which always agree with dry summers, promise to be abundant, and look exceedingly well; the wheat was in ear on the 20th.

GRIMSBY.—The beginning of the month very dry; no R of any consequence fell before the 16th and 17th, when we had a T S, and 3·00 in. of R fell in about 20 hours; H fell in the form of crystals. The change produced both on corn and grass land was marvellous; wheat began to shoot into ear on 9th, and was in full flower at the end of the month; wild roses began to flower on 13th. During the T S of 16th and 17th a boy was killed at Limber, and the shed which he was in was burnt. The cuckoo sang without its usual stammering note almost to the end of the month.

DERBY.—Another droughty month to be added to the preceding ones, each one of the past half year being below the mean; total, 6·94, against 11·68, the mean of 21 years; to the paucity of R must be added the immense evaporating power of the dry air, which has prevailed so long, still the foliage (excepting the oak) is beautiful; temp. about 2° above the mean, but 2° below that of June, 1868.

NORTH SHIELDS.—T S on 16th; grass cut on the 23rd; strawberries ripe on 22nd, and an abundance of flowers of all kinds.

WALES.

HAVERFORDWEST.—A cool, dry June; temp. only reached 70°, or upwards, on seven days; general appearance of the crops, very good; hay quite the average of 20 years. Had it not been for the heavy rainfall, 2·50. which fell on the 11th of May, the drought would have been severely felt here; that R saved us, and accounts for our presenting a better appearance than other parts of the country. Scarlatina abating; it has been the most general and fatal epidemic during 25 years. The peculiar state of the atmosphere and singular appearance of the sun last month, was noticed here on 21st, 22nd, and 23rd of May.

RHAYADER.—Very dry month, with wind chiefly N.E.; complaints of great want of food for the cattle and sheep; no herbage on the hills; all crops light, with the exception of wheat.

LLANDUDNO.—Sea fogs on 4th, from 5 30 to 8.45 p.m., on 8th in morning, on 22nd from 10 to half-past in morning, and on 29th, from 8.15 to 9 a.m.; T in afternoon of 16th; eglantine and woodbine in flower in the hedges on 7th; wheat in full ear and barley shooting on 20th; oats in ear on 27th; commenced cutting hay on the 13th.

SCOTLAND.

DUMFRIES.—The weather, on the whole, has been very favourable for vegetation; during the first five days refreshing showers, to the 11th finer, after which, showery to 19th; close of month fine, with occasional showers; the grain crop looking remarkably fine, rarely been seen so good in this district; grass abundant, and hay a good crop, although the crop suffered from drought in April; the country looks very fresh and beautiful. Temp. of day and night 1°·34 higher than June, 1869.

HAWICK.—The copious rains at the latter end of the month came just in time to save the turnip crop, which was suffering much from drought and the fly; there were some large H drops mingled with the T showers of the 24th and 25th; the hay harvest is just commencing, and the crop will bulk largely this season.

AUCHENDRANE.—Bar. slightly above our local mean for June, as were also the bar. range and, more particularly, the mean temp. and the rainfall; but moderate winds, and clouds in excess enfeebled the evaporation, although it exceeded in amount the large rainfall; the weather of this month has been of great fertilizing power, and even the rivers have not suffered from want of water; no T S; never were the woods in finer foliage.

CASTLE TOWARD.—This has been a beautiful month; crops of all kinds, both in the garden and in the field, are abundant and good; the usual supply of stock are unable to keep the grass down; pulled the first strawberries and peas on the 25th.

DEANSTON.—Starlings not numerous, and swallows very scarce this season; about half-an-inch of R in the first three days, then very dry till the 10th, then drizzly and windy; latter part of the month cool and breezy with occasional showers.

LOGIERAIT.—This, upon the whole, has been the finest June for many years; with frequent showers vegetation has made great progress, and, at present, there is the prospect of both an early and abundant harvest; for some days back, however, cold winds have prevailed, and moisture is needed.

BALLATER.—Temp. high during first week, and mean above average for June; rainfall about the average, although the middle of the month was dry, and complaints of injury to crops from this cause were general; northerly winds prevailed, and retarded vegetation.

ABERDEEN.—A warm, dry month, but with very considerable variations of temp.; the crops are looking remarkably well. Max. in sun 148°·2 on 21st; min. on grass 28·5 on 12th; fog on 5th, 6th, and 7th; T on 9th, 10th, 15th, 16th, and 17th; L on 10th; H on 10th and 30th; mean bar. and mean temp. above the average, rainfall and wind pressure below it; northerly winds more than usual.

PORTREE.—On the whole, this month has been very cold and stormy, but July has come in very fine.

LOCHBROOM.—This has been a particularly fine month both for the farmer and grazier: the rain is under the average, but the heat has not been great, though the warmth was general, hence the earth retained the moisture, which renders grass and crops quite luxuriant. Never was there a better or earlier crop in this part of the country; turnips have succeeded well, and hay seems plentiful.

IRELAND.

KILLALOE.—A remarkable absence of sun, moon, and stars. The smallest rainfall in the month of June for 25 years, the next smallest being June, 1849=·73 in.

DOO CASTLE.—The finest season within the memory of the oldest inhabitant, and this month of June put the climax on the seasonableness. Agricultural prospects high, and everything most blooming. There has been one slight drawback—the prevalence of N. and N.W. winds.

WARINGSTOWN.—Fine, bright, and seasonable; rather cool. All crops looking most promising; hay cutting commenced, and yield in general very large.

REVIEWS.

Report of the Sanitary Committee of the Borough of Nottingham for the year ending December 31st, 1869. Allen and Sons, Nottingham. 8vo, 20 pages.

WE are very glad to find that the Committee have recognised the advantage of making their sanitary year identical with the civil year, and with those of most other towns. It is also issued with commendable promptitude. The meteorological returns are given in praiseworthy detail, and we gladly make a few extracts.

Barometer Highest, December 6th, 9 a.m.....	30·629	in.
,, Lowest, ,, 16th, 9.15 p.m..	28·761	in.
Temp. in Shade, Highest, August 29th.....	91·2	deg.
,, ,, Lowest, December 28th.....	11·8	,,
,, in Sun, Highest, July 19th.....	132·9	,,
,, on Grass, Lowest, December 29th	8·7	,,
Total Rainfall (on 192 days)	27·75	in.

It would be an improvement if the averages of the various elements for the year, and for previous years, were given at the foot of each column.

NOTE.—Although we have supplemented our usual space by four pages, several articles—"New Instruments at the Gardens of the Royal Botanic Society," Sequel to papers on "Uunderground Temperature," &c., have to wait for our next.

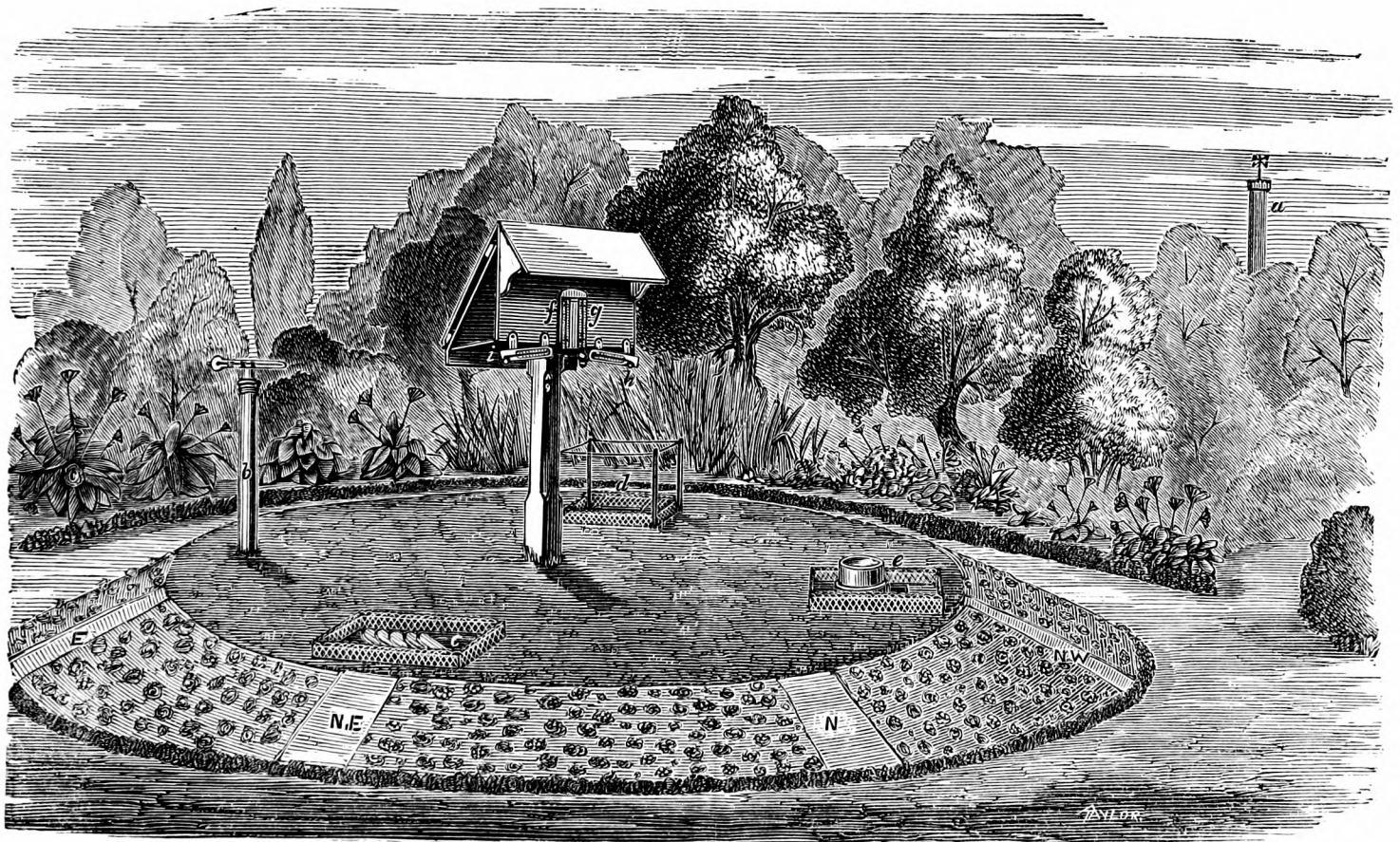


Fig. 1.—Thermometric Ground, Royal Botanic Gardens, Regent's Park, London.

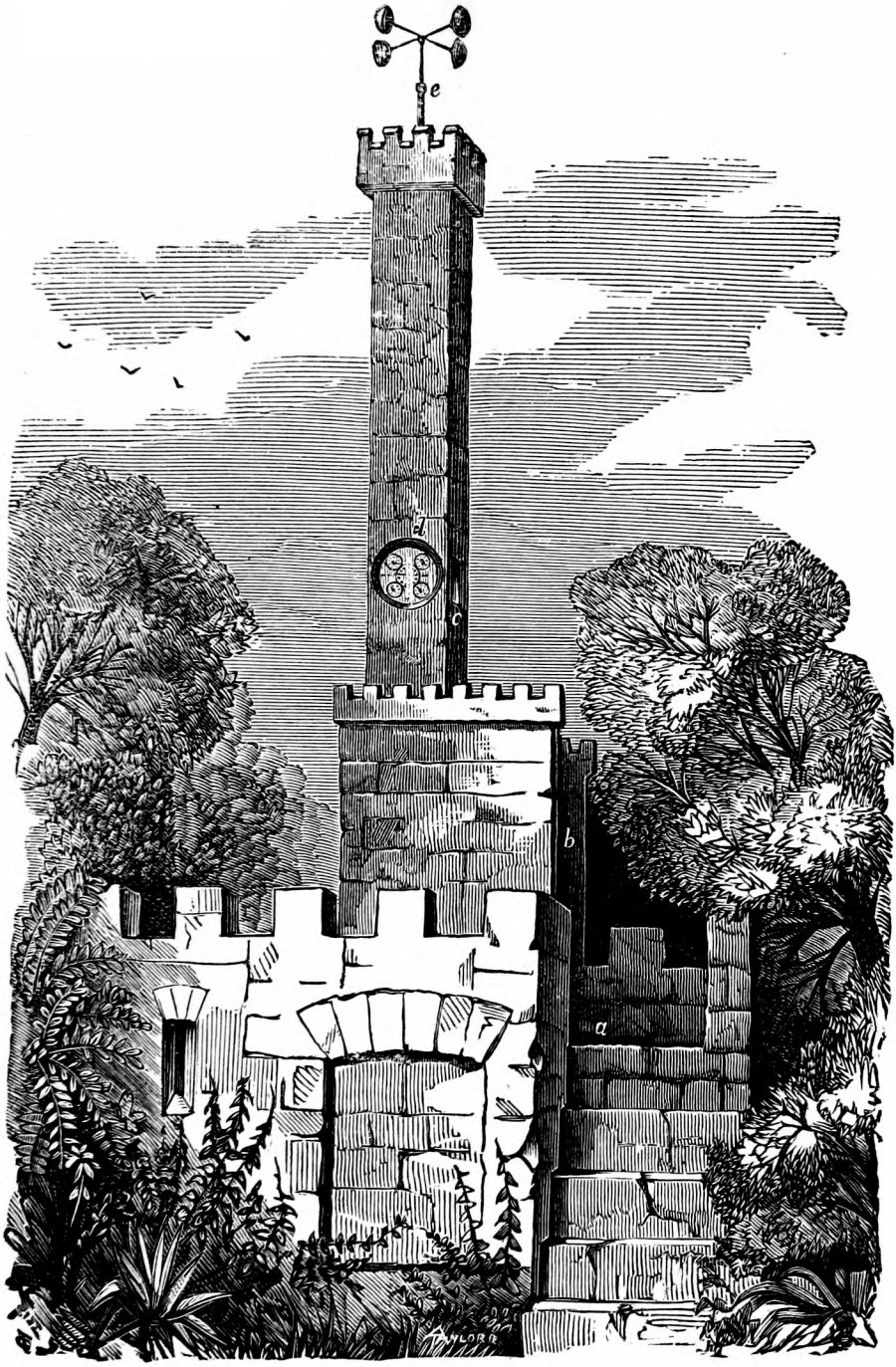


Fig. 3.—Anemometer Tower, Royal Botanic Gardens, London.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

LV.] AUGUST, 1870. [PRICE FOURPENCE, or5s. per ann. post free.

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 :—

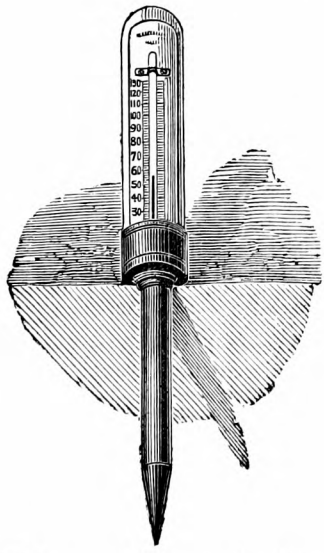
Every botanist is so familiar with the mutual interdependence of plants on climate, and climate on plants, that meteorological instruments are recognized as something more than a necessary adjunct of botanical gardens. Hence some forty-five years ago a set of the best construction then known were provided 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° 31′ 34″ and W. Lon. 0° 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

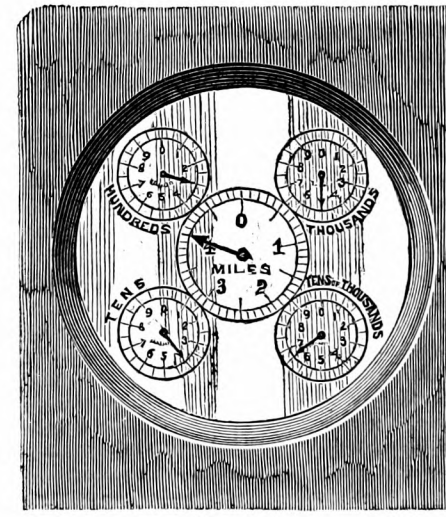
the sun, an arrangement has been adopted which renders forgetfulness of this duty on the part of the observer almost impossible. This stand carries four thermometers, viz., a dry and wet bulb (*fg*), which *jointly* give the humidity of the air, while the dry bulb (*f*) is further available as giving the actual temperature at any time; there are also a Rutherford's spirit thermometer (*i*) 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°, 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, is 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 Clwyedog, 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

	Leicester.		Boston.		Manchester.		York.	
	Total.	Diff. from average.	Total.	Diff. from average.	Total.	Diff. from average.	Total.	Diff. from average.
Jan.....	1·63	— ·35	1·25	— ·46*	3·13	+ ·61	1·68	+ ·10
Feb. ...	1·64	+ ·30	1·30	+ ·09	·86	—1·09	1·88	+ ·50†
March...	1·10	—1·01	1·10	— ·69	2·38	— ·31	1·80	— ·19
April ...	·55	— ·75	·73	— ·24	2·22	+ ·46	·66	— ·44
May ...	·71	—1·41	·58	—1·36	·75	—1·91	1·08	— ·87
June ...	·60	—2·16	1·60	— ·59	1·79	—1·55	2·81	+ ·71
July ...	1·00	—1·10	·96	—1·34			·48	—1·46
Total ...	7·23	—6·48	7·52	—4·59			10·39	—1·65

	Rhayader.		Ayr.		Stirling.		Aberdeen.	
	Total.	Diff. from average.	Total.	Diff. from average.	Total.	Diff. from average.	Total.	Diff. from average.
Jan.....	4·49	— ·03	3·54	— ·98	3·94	— ·78	1·51	.....
Feb.....	3·92	+ ·94	2·45	— ·91	4·23	+1·23	3·14	.....
March..	2·79	—1·05	1·43	—2·30	·52	—3·01	·89	.....
April ..	·89	—1·00	2·11	— ·11	1·22	— ·53	1·29	.....
May .	2·73	— ·12	4·15	+1·04	2·96	+ ·31	1·49	.....
June ...	·90	—3·08	2·40	— ·95	1·72	—1·20	·92	.....
July ...	1·98	— ·87	2·02	— ·14	2·05	—1·35	3·45	.....
Total ...	17·70	—5·21	18·10	—4·35	16·64	—5·33	12·69	.....

	Skye.		Orkney.		Waterford.		Dublin.	
	Total.	Diff. from average.	Total.	Diff. from average.	Total.	Diff. from average.	Total.	Diff. from average.
Jan.....	4·94	—8·15	2·31	— ·98	4·75	— ·11	2·53	— ·86
Feb.....	6·01	—4·22	2·92	+ ·44	3·26	+1·23	3·05	+1·41
March...	1·38	—7·66	1·25	—2·08	2·99	+ ·10	2·08	— ·50
April ...	7·80	+2·53	2·77	+1·03	·82	—1·41	·61	—1·03
May ...	5·48	— ·15	1·67	— ·59	3·50	+1·25	1·37	— ·54
June ...	3·66	—1·12	1·70	+ ·16	1·29	—1·69		
July ...	4·17	—1·90	1·33	— ·56	·47	—2·84		
Total ...	33·44	—20·67	13·95	—2·58	17·08	—3·47		

PROF. SEDGWICK ON AN EXTRAORDINARY THUNDER-STORM.

[Extracted from the *Cambridge Independent Press*, July 23rd, 1870.]

Sir,—Our provincial papers have for some weeks past given us notices of thunderstorms, accompanied by great and often destructive falls of rain. A re-

* Not —·56 as printed in *Meteorological Magazine* for February.
† „ —·50 „ „ „ March.

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 Monkey 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 Hambledon. 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 Hambledon, 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. 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° In shade	No. of Nights below 32° On grass
			inches	inches.	in.								
I.	ENGLAND.	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.		Hitchen	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.	WALES.	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.	SCOTLAND.	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.	IRELAND.	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.		Portarlington	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; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

CAMDEN TOWN.—Stormy all day on the 11th, T S at 7.4 p.m.; T S 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.—T S 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. T S 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. T S 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° above the mean, but still 4° below the memorable July of 1868. Rainfall only about one third of mean, but rather more than double July 1868; several T S 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).

WALES.

HAVERFORDWEST.—A very fine warm month, considerable R during the first nine days; more than the average number of days above 70°; 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°, wet 68°; 83°, 70°; and 86°, 68°; the heat of the 24th (88°·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°·2, and the night temp. 56°·2, showing the mean of day and night to have been the greatest on the 24th of this month, the night temp. being 56°·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. Scarlatina 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°·4, the day being 86°·4 and the night 59°, against 88°·5 and 56°·5.

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

SCOTLAND.

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.—T S 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 wiud at night. On 29th, ther. on grass 33°·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.

BALLATER.—Excessively hot and dry from the middle of the month to the end, and the crops suffering considerably. T S 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, T S 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.

IRELAND.

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. Catterpillars one month later this year than last.

WARINGSTOWN.—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 4½ 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.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

LVI.] SEPTEMBER, 1870. [PRICE FOURPENCE, or5s. per ann. post free.

A SOLAR RADIATION ENIGMA.

To the Editor of the Meteorological Magazine.

SIR,—I have often been much surprised by the large amounts of "solar radiation" obtained, even by the comparison of the black bulb thermometer "*in vacuo*" at 4ft. with the ordinary shade temperature at the same height, it being not at all uncommon to have so much as 70° of so-called "solar radiation." I have myself had the same result with Casella's thermometers. I have accordingly for some time been thinking that if we wish to ascertain the true amount of radiation, we are scarcely right in comparing, in a direct manner, the "vacuum thermometer" in the sun with the ordinary shade instrument. The former is most sensitive and peculiar in its action, not under at all the same conditions as the latter, being besides protected from rain, moisture, wind, &c., to some extent, and also having a thick coating of lamp-black over its bulb and part of the stem, and appears to be remarkably affected by diffused or radiated light.

Why not compare the black bulb "*in vacuo*," in the sun, with the black bulb thermometer "*in vacuo*" in the shade? We should then have to start with two thermometers more under the same conditions, and at any rate reduce the amount of "radiation" by this method, as will be seen from the following experiments, which I have just begun. The thermometers used are first-class instruments by Pastorelli. The vacuum instruments are both blackened on the bulbs and one inch of the stems, and have been compared together in shade and sun. They are placed with the bulbs facing the S.E., mounted on posts as shown in *Meteorological Magazine*, Vol. IV., p. 97, fig. 2. Both the solar and shade thermometers are fixed at 4 ft. above the ground, in a clear open space, and in close proximity to one another. The stand used has the double sloping back, in the same manner as the "Glaisher" stand, but does not rotate, and is constructed with sides or "wings."

It is certainly very surprising to note the wonderful excess of the readings of Casella's thermometer in sun over Pastorelli's. The difference in the amounts of "solar radiation" given by the two thermometers "*in vacuo*" (A + D), as compared with the ordinary method (A + C), is very considerable. I have also given the wind, force and direction,

as bearing on the question. To take an example of the high readings:—On the 12th August Pastorelli's thermometer was 123°·8, and on the same day Casella's was 140°·7! Now, as the sun temperature consists of the shade temperature + the amount of solar radiation, the 123°·8 is made up thus: 85°·2 vacuum temperature, + 38°·6 solar radiation = 123°·8. But comparing the ordinary shade temperature with the vacuum shade, it will be seen that from the nature of the thermometer used, the vacuum temperature is too high by 9 degrees. Therefore, 85°·2 + 38°·6 − 9° = 114°·8 appears to be the sun temperature, and which is certainly rather a different result to 140°·7, as obtained by Casella's thermometer in the ordinary mode.

Yours very truly, FRANCIS NUNES, M.A., F.M.S.

Heathfield Lodge, Chislehurst, Kent, Sept. 1st, 1870.

P.S.—This may be further illustrated by the mean values, which give the following results, viz.:—Pastorelli 109°·4, Casella, 124°·8; the 109°·4 is 77°·7 + 31°·7, but the vacuum is too high by 8°·5; therefore 77°·7 + 31°·7 − 8°·5 = 100°·9, against 124°·8.

All thermometers 4 ft. above ground.

	Max. in sun.		Max. in shade		Wind during day.		
	Blackened Bulb *in vacuo.*		Pastorelli's.				
Reference Letters...	Pastorelli. A	Casella. B	Ordinary max. ther. C	Blk. Bulb *in vacuo.* D	Direction.	Force 0—12	Rain.
1870.	deg.	deg.	deg	deg.			in.
Aug. 7 ...	87·2	92·5	66·8	74·5	S.	—	0·26
,, 8 ...	110·4	127·0	72·6	83·5	E.N.E.	6	0·02
,, 9 ...	122·8	140·0	76·5	85·7	N.E.	2	0·03
,, 10 ..	114·8	130·0	72·0	78·5	N., N.N.E.	4	0·09
,, 11 ...	116·2	133·0	73·2	82·5	N., N.E.	5	
,, 12 ..	123·8	140·7	76·2	85·2	N., E.N.E.	4	
,, 13 ...	115·2	132·5	73·6	82·5	N.E.	4	
,, 14 ..	116·2	135·0	68·2	76·5	N.E.	3	
,, 15 ...	107·0	120·3	69·8	77·7	N.E.	3	
,, 16 ...	108·0	119·0	68·7	76·7	N.E.	3	
,, 17 ...	113·8	129·0	69·3	77·1	E., N.E.	3	
,, 18 ...	115·1	130 2	77·0	85·2	S.W., N.W.	3	0·01
,, 19 ...	108·5	123·5	64·8	73·8	N.N.E., N.	3	
,, 20 ...	107·0	123·5	67·0	75·3	N.N.W.	3	
,, 21 ..	103·8	119·0	64·2	72·2	N.E., N.W.	3	
,, 22 ...	106·2	120·0	67·8	77·7	S.W.	5	0·71
,, 23 ...	102·5	117·0	65·2	74·5	N.W.	3	0·02
,, 24 ...	112·0	130·0	69·2	79·8	W.N.W.	4	
,, 25 ...	104·8	120·0	66·7	75·0	N.W.	4	
,, 26 ..	102·0	117·0	63·0	70·5	N.W.	5	
,, 27 ...	109·0	123·0	70·7	79·4	W.N.W.	2	0·51
,, 28 ...	111·8	127·2	71·0	78·5	S.W., W.	6	0·17
,, 29 ...	105·7	123·8	64·5	72·5	N.N.W.	5	
,, 30 ...	104·2	120·5	64·0	71·8	N.N.W.	4	
,, 31 .	108·4	126·0	68·8	77·2	S., W.	3	
Mean.....	109·4	124·8	69·2	77·7	...	..	

Reference Letters	Solar Radiation. A + C	Solar Radiation. A + D	Solar Radiation. B + C	Differences. In Sun. B + A	Differences. In Shade. D + C
1870.	deg.	deg.	deg.	deg.	deg.
August 7... ..	20·4	12·7	25·7	5·3	7·7
,, 8.....	37·8	26·9	54·4	16·6	10·9
,, 9	46·3	37·1	63·5	17·2	9·2
,, 10.....	42·8	36·3	58·0	15·2	6·5
,, 11.....	43·0	33·7	59·8	16·8	9·3
,, 12... ..	47·6	38·6	64·5	16·9	9·0
,, 13.....	41·6	32·7	58·9	17·0	8·9
,, 14.....	48·0	39·7	66·8	18·8	8·3
,, 15	37·2	29·3	50·5	13·3	7·9
,, 16.....	39·3	31·3	50·3	11·0	8·0
,, 17.....	44·5	36·7	59·7	15·2	7·8
,, 18.....	38·1	29·9	53·2	15·1	8·2
,, 19.....	43·7	34·7	58·7	15·0	9·0
,, 20.....	40·0	31·7	56·5	16·5	8·3
,, 21... ..	39·6	31·6	54·8	15·2	8·0
,, 22.....	38·4	28·5	52·2	13·8	9·9
,, 23.....	37·3	28·0	51·8	14·5	9·3
,, 24	42·8	32·2	60·8	18·0	10·6
,, 25.....	38·1	29·8	53·3	15·2	8·3
,, 26.....	39·0	31·5	54·0	15·0	7·5
,, 27.....	38·3	29·6	52·3	14·0	8·7
,, 28.....	40·8	33·3	56·2	15·4	7·5
,, 29.....	41·2	33·2	59·3	18·1	8·0
,, 30... ..	40·2	32·4	56·5	16·3	7·8
,, 31.....	39·6	31·2	57·2	17·6	8·4
Mean	40·2	31·7	55·6	15·4	8·5

[Solar radiation temperatures have long been a source of trouble to meteorologists, and we had only just soothed ourselves with the idea that Mr. Stow had solved all difficulties, and that for the future comparable results were readily obtainable, when we received the above letter from Mr. Nunes. Rude as has been the shock to our mental complacency, we rejoice that it has come thus early in the history of "Comparable Solar Radiation," and we are all indebted to Mr. Nunes for pointing out the remarkable discordances. The letter naturally resolves itself into two parts: (1) The true temperature in the sun; (2) The true shade temperature wherewith to compare it.

Startling as it is to find ourselves again adrift, when we had considered that we were sailing safely under Mr. Stow's pilotage, the only thing now to be done is thoroughly to examine all possible causes of the discordances. First, as to the cause of the enormous mean difference of 15°·4 between the thermometers A and B, both of which are by good makers, which agree when placed in the shade, both of which are dull blackened on the bulb and up the stem. We can only see one point in which they can differ, and it is one on which we are not aware that any experiments have been published—*they may be exhausted to a different extent.* To test this point, we have prevailed on

Mr. Nunes to add to his present staff of thermometers three others, containing different quantities of air—one, of which the exhaustion is as perfect as possible, one, which is partially exhausted, and one, which is not exhausted at all, but in which the air is chemically dried. We regret the necessity for even this precaution, but fear that otherwise the interior of the jacket would frequently be dimmed by condensed vapour. There is evidently a very serious error somewhere, and we trust that it may soon be discovered. Mr. Nunes is evidently suspicious of temperatures in sun above 130°, and yet he lives far from London smoke and nearly 300 ft. above the sea. What will Mr. Stow say to that? We know that Negretti's and Casella's thermometers agree, and now it seems that Pastorelli's are 15° below them; truly this wants looking into.

With the second part of Mr. Nunes' letter we do not quite concur. We consider that the excess of (D + C) the vacuum thermometer in shade over the ordinary thermometer alongside of it, simply proves that the ordinary thermometer stand does not produce perfect shade, and therefore that it virtually resolves itself into a test (and a very good one) of the efficacy of thermometer stands, with which object we shall endeavour to apply it to the experimental ones at Strathfield Turgiss.—ED.]

THERMOMETER STANDS.

To the Editor of the Meteorological Magazine.

SIR,—In your monthly number for April, 1869, you led your readers to expect information of a high value from the arrangements reported as made for an impartial trial at Strathfield Turgiss, of the various forms of thermometer stands in ordinary use. May I ask you when the observations are likely to come under discussion? If the result should lead to a gradual adoption of an uniform stand, a great service will have been rendered by Mr. Griffith, for observations at different places will then be strictly comparable, which they are not now.

The form of stand I have had in use, abroad and here, for the last six years, is Stevenson's. The comparison of the readings in that stand with those taken in a Glaisher stand at the Royal Observatory, and published in Mr. Glaisher's Quarterly Reports, shows this curious result: that, in the winter months, the mean of the maxima in Stevenson's stand are fractionally *above* those in Glaisher's stand, the mean monthly variation being 0°·5 to 1°, whilst in the summer months, the mean of the readings in Stevenson's *below* Glaisher's is from 2° to 2°·5, and the absolute maximum registered at Greenwich in the months of June and July usually exceeds that in my stand by from 3° to 4°.

I think it highly probable that the readings at both places would far more nearly approximate if the observations were taken under similar conditions.—Your obedient servant,

D. A. FREEMAN.

Upper Tooting, S. W., 22nd August, 1870.

[We are obliged to Mr. Freeman for recalling attention to this very

important subject. A series of observations, accurate and extensive beyond precedent, were made by Mr. Griffith during part of 1868, the whole of 1869, and part of 1870. They were then discontinued, and the observations (about 50,000) are now being discussed by Mr. Gaster. A "Glaisher" and a "Stevenson" stand were at work within 20 ft. of each other, and from a cursory remembrance of the records we think the differences were very similar to those quoted by Mr. Freeman as subsisting between his and the Greenwich records. But we must wait for Mr. Gaster's analysis before deciding *which* of the two stands, or whether either of them, is correct. As Mr. Gaster has only limited time available for the purpose, we cannot unduly press him, but we can assure our readers that the results shall be laid before them at the earliest possible date.—ED.]

SEA TEMPERATURES AT BOURNEMOUTH.

To the Editor of the Meteorological Magazine.

SIR,—As no resident member of the Bournemouth Meteorological Society has hitherto replied to your criticisms in the February number of the *Meteorological Magazine*, wherein you ask for explanations as to the "Mean" Sea Temperatures, as published by that Society in its Report for 1868, perhaps you will allow me to say that the "mean" for the month was deduced from one daily observation, made between noon and 1 p.m. The observation was taken by letting down a thermometer from the end of the pier, which extends about 150 yards or thereabouts, beyond ordinary low-water mark. The depth of the water at this hour of the day is probably never less than twelve feet, and the thermometer was let down about 8 or 9 feet below the surface. There can be no doubt that the observations fairly represent the temperature of the "briny" in which the bathers had to "dip."

Although the mean temperature of noon for July, 1868, reached the enormous height of 70°·1, it is only what was to be expected from the law which is exhibited in the other months. The excess of the sea temperature over the air temperature in the first six months of the year was 5°·2, 3°·2, 4°·5, 4°·7, 4°·5, and 4°·1 respectively. In the famous hot July of 1868, the difference was 4°·3.

That this difference is not solely due to solar heat, is proved by the enormous divergence of 10°·1 in October and November; and I think that this phenomenon is worthy of more than passing notice, partly as indicating one of the causes of the prolonged high mean temperature of November and December along the south coast district; partly also in this particular instance, as being a precursor of the unprecedented mildness of December, 1868, to February, 1869.—Yours, &c.,

P. H. NEWNHAM.

[We gladly insert the above note on our criticism; having no object but the ascertainment of truth, we gladly hail any contribution to it. At the same time we retain our personal repugnance to "a dip in the briny at 70°·1," and should certainly prefer some locality where the temperature is lower. In February we urged the desirability of further observations; Mr. Newnham's letter seems to us to demonstrate it.—ED.]

THREE WATERSPOUTS.

To the Editor of the Meteorological Magazine.

SIR,—A gentleman sent me the following description of a curious waterspout which appeared about this locality on the 7th. I beg to forward it to you, to give it a place in your magazine, if you think it sufficiently important.—Yours obediently,

D. O'DOWD.

Doo Castle, co. Sligo, 16th August, 1870.

[Although quaintly written, it is so evidently a faithful account of what the writer saw, and it seems so certain that he did not know enough of the subject to manufacture his description, that we think it worthy of insertion *literatim et verbatim*.—ED.]

"On Sunday evening, the 7th inst., about 7 p.m., in a very still and warm atmosphere; the upper currents excitably attracted towards the north (say, seaside of Knockmarea Mountain, co. Sligo), where two ordinary-looking waterspouts appeared fully engaged with rain thereabouts; a third and to my mind a very unusual sort of spout appeared here the eastern part of Doo Castle, co. of Mayo, about fifteen miles from the others. Its base was in a murky brown, angry-looking cloud, and immediately as it appeared it tossed about like the trunk of a huge elephant, even to the lip and nostril; it then let down a few feet of a small inner tube, which rapidly increased in circumference, when the whole spout began to twist and coil in oblique circles. The whirling of the air in the small tube appeared distinctly and disported itself on the northern side in a chaos of roll, when it again elongated itself by several feet in the same way. As this was four times repeated, each extension being longer, and the cloud not much over 100 feet from the earth, I expected to see some more wonderful phenomenon, but the upper currents moved more rapidly towards the north, where the other two spouts were, and induced our very gorgeous visitor to return in nubibus, after enjoying its freaks, which it did with imposing majesty, and increased tossing in the same order, it descended, and all the smaller coils played or retreated entirely on the opposite or east side of the trunk. There was no water in the locality of this air-borne wonder, its like never having been noticed in this region before. Some stray showers of rain fell very unevenly about an hour after."

OZONE PAPERS.

To the Editor of the Meteorological Magazine.

SIR,—I take the liberty of troubling you with my experience of ozone test papers. At the end of May last I purchased a box of the papers from Messrs. Negretti and Zambra, and began to test for ozone for the first time. I placed the papers on a hook under my thermometer stand, and read three times daily. I send herewith my results for July. The figures in the "day" column are derived from papers exposed from 9 a.m. to 9 p.m. The "night" column is derived from papers exposed from 9 p.m. to 9 a.m., and the "24 h." column from papers exposed from 9 a.m. to 9 a.m. of the following day. On refer-

ence to the table it will be seen that the mean of the readings for the 24 hours is *less* than that of the "day" hours. This result I was not prepared for, and am totally at a loss to explain. On several occasions, as a glance at the table will show, the paper which was coloured to the extent of say No. 5 of the scale, as on July 10 in the evening, *lost* its colour during the night, and was as colourless at the end of the 24 hours as when first placed on the hook. My experience, short as it is, has convinced me that papers exposed longer than 12 hours are not to be depended upon, and I now read twice daily only.

Your obedient servant,

JOHN THRUSTANS, F.M.S.

Wolverhampton, August, 1870.

1870.	Day.	Night.	24 hours.	Wind.
July 1.....	9	9	10	N.W.
,, 2.....	7	7	8	,,
,, 3.....	6	0	0	,,
,, 4.....	3	6	7	S.W.
,, 5.....	0	6	8	,,
,, 6.....	4	2	3	W.
,, 7.....	4	1	1	S.W.
,, 8	3	0	0	,,
,, 9.....	3	5	6	Calm.
,, 10.....	5	0	0	W.
,, 11.....	6	5	6	N.E.
,, 12.. ...	6	0	1	N.W.
,, 13.....	4	5	7	,,
,, 14.....	6	0	3	S.W.
,, 15.....	4	4	4	,,
,, 16.....	6	7	10	W.
,, 17.....	5	1	2	,,
,, 18.....	0	0	0	S.
,, 19.....	3	1	3	S.W.
,, 20. ...	4	0	0	W.
,, 21.....	3	2	2	N.W.
,, 22.....	4	0	0	Easterly.
,, 23.....	2	0	0	
,, 24.....	2	0	0	
,, 25	1	7	9	
,, 26.....	3	0	0	
,, 27...	4	8	8	
,, 28.....	8	1	3	
,, 29.....	4	7	7	
,, 30.....	4	9	9	
,, 31.....	5	8	7	
Total.....	128	101	124	...
Mean.....	4·13	=3·26	=4·00	...

HERTFORDSHIRE RAINFALL IN JUNE AND JULY, 1870.

To the Editor of the Meteorological Magazine.

SIR,—During the months of June and July last the few storms which visited this part of England were of so partial a nature as to

make them quite remarkable. Black clouds would gather, distant thunder roll around, but no rain would fall on the thirsty ground, and the common remark was, "A storm somewhere but not here."

In order to find out where in this neighbourhood these storms fell, I wrote to different persons in and near this county, and with the information they so kindly gave me, I have drawn up the following table:—

Date.	Hoddesdon.	Hertford.	Great Hadham.	Buntingford.	Stevenage.	Hemelhempstead.	Gt. Berkhamstead	St. Albans.	Dunstable.	Hitchin.	Potters' Bar.	Dunmow.	Enfield.
June 1	·05	·09	...	...	...	·15	·17	·26	...	...	...	..	·22
,, 2	...	...	...	...	...	...	...	...	·02	...	...	...	...
,, 4	...	...	...	...	..	...	·01	...	...	...	...	...	...
,, 11	...	...	·07	·05	·05	...	...	...	...	·03	...	·09	...
,, 12	...	...	...	...	...	·01	·03	...	...	...	...	...	...
,, 16	·30	·66	·42	·98	·48	·40	·47	·62	·12	·57	·53	·16	·33
,, 17	...	...	...	·38	·17	·02	...	...	...	·17	...	·11	...
,, 18	...	...	...	...	...	...	·02	...	..	...	..	...	...
,, 23	...	...	·03	..	...	. .	...	...	·20	...	·13	...	...
,, 24	·05	...	...	·05	·02	·22	·16	·27	...	·01	...	·10	...
,, 27	...	..	...	·02	...	...	·03	...	...	·01	...	...	...
,, 30	...	...	...	...	...	..	...	...	...	...	...	·03	...
Total	·40	·75	·52	1·48	·72	·80	·89	1·15	·34	·79	·66	·49	·55
July 1	·10	·04	·02	...	·09	·05	·06	·02	·14	·12	...	..	...
,, 3	·20	·17	·25	·37	·18	·04	...	·06	·11	·15	·12	·40	·07
,, 4	...	...	·01	...	...	·03	·10	...	...	·02	·05	...	...
,, 5	·10	·11	·24	·26	·25	·18	·24	·25	...	·26	·11	·17	·17
,, 6	...	...	...	..	·01	...	...	...	·29	...	...	...	...
,, 8	...	...	...	...	·01	..	·02	...	·02	...	...	...	...
,, 9	...	...	·05	...	·43	·07	·09	·21	·26	·52	·09	...	·02
,, 10	...	..	...	·13	..	...	...	...	...	...	·01	...	...
,, 11	·30	...	·52	1·18	·03	...	...	·09	...	·01	...	...	·07
,, 12	...	...	...	...	...	..	·01	...	...	...	...	...	...
,, 15	·10	..	·16	...	...	...	...	...	...	...	...	·25	*·12
,, 17	·02	·04	·01	...	·04	·02	·01	·04	...	·02	...	...	·03
,, 26	·08	...	...	...	...	...	·30	...	·45	...	·03	·02	*·21
,, 28	...	...	...	...	...	...	·03	...	·05	·02	...	...	...
,, 29	...	...	·03	·02	·02	...	·02	·03	·03	·03	...	·01	...
,, 30	..	...	...	...	..	...	...	·26	·02	...	...	...	..
,, 31	...	...	·20	...	·01	·87	·75	·46	·23	·05	·71	·10	·14
Total	·90	·36	1·49	1·96	1·07	1·26	1·63	1·42	1·60	1·20	1·12	·95	·83
,, in 2 months	1·30	1·11	2·01	3·44	1·79	2·06	2·52	2·57	1·94	1·99	1·78	1·44	1·38

* Two days' rainfall unavoidably placed in one; not by the observer, but by me.

N.B. All observations taken at 9 a.m., and entered against *preceding* day. Thousandths of an inch not noticed.

On looking over this table, the following remarks suggest themselves.

In June there was no rain in any quantity (except a shower on the 1st, which was confined mostly to the west of the county), till the thunderstorm on the evening of the 16th, which was very general and heavy; very severe at Buntingford, which place was again visited by a heavy but very partial storm on the 17th; partial thunderstorms visited the W. and N.W. of this county on the 24th. It will be seen that the rainfall at Buntingford is greatly in excess of that at any other station.

July.—Showers very general from 1st to 5th; on the 6th a very local shower appears to have fallen in the Dunstable district only.* On the 9th heavy thunderstorms passed over, but were confined to the N. and W. of the county. On the 11th a violent but limited thunderstorm broke over the E. of the county. The fall of rain at Buntingford was 1·18 in. in this storm. Very partial thunderstorms occurred only in the W. of this county on the 26th and 30th, and again (very heavy) on the 31st. Can these storms have all gone into Bedfordshire? The least rain fell at Hertford, 1·11 in.; the greatest amount at Buntingford, 3·44 in.—an extraordinary difference in two places only 11 miles apart in a direct line.—I am, Sir, yours truly,

W. CLINTON BAKER.

Bayfordbury, Hertford, Aug. 30.

THE DROUGHT OF 1870.

To the Editor of the Meteorological Magazine.

SIR,—In your August number, p. 104, you ask, "Why have lawns suffered more in 1870 than in 1869, and yet the fires produced by sparks from locomotives been less numerous?"

In answer to the first part of the question, I would suggest one reason—viz., that although the months of June and July were dry in both years, yet in May, 1869, upwards of 3 in. fell, which was very beneficial in producing good hay crops, and also in strengthening the growth of lawns, whereas this year the drought has continued from middle of March.

The total monthly amounts for each year to the end of July were as follows:—

	1869.		1870.
January	2·800	.....	1·483
February	2·523	.....	1·083
March.....	1·714	.....	2·169
April	1·223	.....	·409
May	3·369	.....	·702
June	1·321	.....	·419
July	·667	.....	2·062
	13·617		8·327

The second part of your question is not so easily soluble, but I would venture the following as possible: on account of the exceptional

* May not the explanation be that the entry on the 6th really belongs to the 5th, on which *none* is reported from Dunstable, although from 0·10 to 0·26 fell at every other station?—ED.

calmness of the season, the sparks have not been blown away so much from the locomotives.—I am, Sir, yours truly,

C. O. F. CATOR.

Beckenham, Kent, August 22nd, 1870.

To the Editor of the Meteorological Magazine.

SIR,—The vale district of Gloucestershire appears to have suffered so severely by the drought of 1870, that I am induced to send you a statement of the rainfall here up to the end of July, for the purpose of comparison. On comparing it with the returns from the twenty stations given by you in your number for August, it appears we have had less rain than any, with the exception of Leicester.

Rainfall at Berkeley during the first Seven Months of 1870.

Month.	Depth of Rain. inches.	No. of days. on which not less than 0·01 fell.	Remarks.
January ..	1·83	14	
February ..	0·98	8	
March	1·41	7	
April	·44	4	
May	1·41	6	1·10 fell on 11th
June.....	·56	2	0·55 ,, 16th
July	·79	5	0·48 ,, 6th
Total.....	7·42	46	.....

During the same period of 1869 we had 14·67 in. of rain, which fell on 85 days.

To-day rain has fallen almost without intermission from 1.30 to 8 p.m., accompanied by a thunderstorm during the last hour, and 2·85 in. of rain has fallen in six hours.—Yours faithfully,

J. H. COOKE.

Berkeley, August 22nd, 1870.

To the Editor of the Meteorological Magazine.

SIR,—Possibly you may be able to find a corner in your very valuable magazine for the following statement as to the rainfall at this place during this very remarkable year. The gauge has been tested by Mr. Symons, and is kept in an open situation, about 700 or 800 yards from the sea-shore. Showers have frequently been reported a few miles away, while not a drop has fallen here.

	Average, 1864-70, inclusive.	1870.	Difference from Average.
January	1·96	1·47	—0·49
February.....	1·74	2·07	+0·33
March	1·85	1·16	—0·69
April	1·85	0·74	—1·11
May.....	2·17	1·18	—0·99
June.....	1·52	2·66	+1·14
July.....	1·68	0·30	—1·38

Deficiency from the average in 1870, January to July inclusive,

3·17 in. In 1868 the defect from the average (1864—70) as above, was 2·48 in. In other words, the rainfall in 1870 is less than in the dry year of 1868 by 0·69 in.

Up to to-day (Aug. 27) the quantity measured for the present month only amounts to 0·48 in. The excess in June is more than accounted for by two heavy thunder-showers. On June 9th, 0 83 in. fell, and on 26th 0·74 in. February was a wet month; rain fell on 18 days, and on the 6th 0·57 in. was measured. Every other month than February and June shows a deficiency in the fall.—Yours, &c.,

R. F. WHEELER.

The Vicarage, Whitley, North Shields, Aug. 27.

RAINFALL AT WORTHING.

To the Editor of the Meteorological Magazine.

SIR,—I beg to forward you the following extract from my journal, relative to the heavy rainfall we had here on August 9th :—"The day broke fine, and a hot wind prevailed from the N. and N E. throughout the forenoon. After 1 p.m., heavy banks of clouds began to form in the N. and N.E., and about 4 p.m. a heavy shower passed over the immediate neighbourhood, accompanied with lightning, but no thunder was heard. Throughout the afternoon it continued squally and threatening to rain, but little fell in the town till about 6.40 p m., when two very heavy and dark masses of cloud, one from the N.E. and the other from the N.W., met, with a discharge of electricity in the shape of lightning and thunder, accompanied with a most precipitate downpour of rain, coming down more like a sheet of water for some *sixteen minutes* at the outside. The sea was very much disturbed, and blown about in all directions, and the whole phenomenon partook more of the character of a whirlwind and waterspout together. The total fall of rain gauged in this short space of time was 0·39 inch." Our rainfall for the past eight months has been only 11·05 inches, as you will perceive by the annexed mem.

January.....	2·15	inches	during	17 days.
February ...	1·78	,,	,,	12 ,,
March	2·30	,,	,,	10 ,,
April.....	0·18	,,	,,	3 ,,
May	0·85	,,	,,	6 ,,
June	0·22	,,	,,	2 ,,
July	1·11	,,	,,	9 ,,
August	2·46	,,	,,	11 ,,

Yours obediently,

W. J. HARRIS, M.R.C.S.E., F.M.S.

Worthing, Sept. 3rd, 1870.

A GUIDE TO SUMMER TEMPERATURE.

To the Editor of the Meteorological Magazine.

SIR,—In the rule referred to by Mr. Freeman in your last number, as in many other rules of the same kind, the converse does not hold good, and your correspondent very properly acknowledges that I did not say that it did.—Yours, &c., GEO. D. BRUMHAM.

Barnsbury, Sept. 1st, 1870.

THE ANEMOMETER AT THE ROYAL BOTANIC GARDENS.

To the Editor of the Meteorological Magazine.

SIR,—In your last (p. 103) you refer to the "improved modification of Dr. Robinson's anemometer," but you do not explain wherein the improvement consists. The dial is clearer and more handsome than any I have yet seen, and it works at a considerable distance below the cups, but is there anything else novel about it?—Yours truly,

Q.

[Yes, and a full description was given by Mr. Pastorelli, at the last meeting of the Meteorological Society, where the anemometer was exhibited. The following is an abstract of the description given.—ED.]

"This anemometer is based on the measurement of the velocity of the wind by Robinson's rotatory cups. The velocity is registered on separate dials, indicating on the one dial single miles and fractions, and upon the others are shown 10 : 100 : 1000 : and 10,000 miles, so that a velocity of miles from the time of observation to the next can be read off with the greatest ease and distinctness. In the construction of this apparatus great care has been taken to diminish the friction. The method by which this has been effected will be seen from the following description :—

"The rotatory cups are supported by a vertical axis, resting with its pointed end on a hard steel face, enclosed in a socket. This axis passes through a cylindrical tube, with an upper fitting to keep the axis vertical and steady. Fixed on the lower end of the axis is an endless screw, which drives a wheel with 20 teeth, which has a long axis, and upon the same is another endless screw, which acts upon a wheel of 100 teeth. One revolution of this wheel represents 5 miles. The motion of this wheel is seen by the index in the centre of the dial, which allows the reading off of single miles and fractions. Fixed on the side of the 100-teeth wheel is a pin, which during each revolution comes in contact with a lever having a click attached, with a steel back spring. The click drives a ratchet wheel of 20 teeth. The ratchet wheel has an index on the dial, and registers the miles from 0 to 100 (it is figured tens of miles.) Upon the axis of this ratchet wheel are two arms, opposite to each other. Each of these acts during one revolution of the axis upon a lever. This lever is provided with a similar click as already described, and sets another ratchet wheel of 20 teeth in motion, moving the index on the dial engraved 100ds of miles. By a corresponding arrangement two other dials are set in motion, registering 1000 and 10,000 of miles.

"I consider the chief improvement in the construction of this anemometer to consist in the diminution of friction by the introduction of the levers and ratchet wheel motion, instead of the constant friction caused by the uninterrupted action of the toothed wheels. The arrangement enables an observer to divide his dial in such a way that fractions of miles, as well as 10,000 of miles, are shown most clearly. Another advantage consists in the ease with which each index can be set to 0 ; the rate of the wind can then be read off with greater facility at any moment. The total velocity of wind registered during 24 hours can be seen at first sight, as the extensive range of this instrument would even register the velocity of the greatest hurricane if blowing for 24 hours.

"The instrument has an electrical arrangement, by means of which the velocity of the wind can be recorded in miles in the office or library at any distance ; this will prove a great advantage during a brisk gale or hurricane. It may also be an advantage to apply the same means to several anemometers in different situations to observe the differences in their registration. This might serve as a medium of testing anemometers."

AUGUST, 1870.

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	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32° In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	2·69	+ ·05	·85	1	8	82·5	12	40·5	31	0	0
II.		Maidstone (Linton Park)	2·06	— ·65	·62	28	7	81·0	6	38·0	30	0	0
,,		Selborne (The Wakes)	1·66	— 1·52	·61	22	10	76·0	1, 18	33·7	31	0	1
III.		Hitchen	1·23	— 1·12	·49	28	7	74·0	4, 6	40·0	30	0	0
,,		Banbury	1·73	— ·40	·58	27	9	80·0	1	35·0	31	0	0
IV.		Bury St. Edmunds (Culford)	1·77	— ·67	·72	27	8	80·0	1, 6	34·0	30	0	0
V.		Bridport	·82	— 1·77	·29	6	5	79·0	12	41·0	30†	0	0
,,		Barnstaple	1·35	— 2·84	·54	27	9	83·5	13	42·0	31	0	0
,,		Bodmin	4·23	+ ·37	1·28	22	9	75·0	12	44·0	31	0	0
VI.		Cirencester	2·74	— ·10	1·75	22	6	...	...	...	...	...	...
,,		Shiffnal (Haughton Hall)	2·92	+ ·05	·98	22	9	77·0	1, 11	40·0	31	0	0
,,		Tenbury (Orleton)	2·09	— ·79	·90	22	7	81·7	11	36·3	31	0	0
VII.		Leicester (Wigston)	1·89	— ·30	·69	23	7	85·0	1,5 6	39·0	20	...	...
,,		Boston	1·45	— ·84	·67	27	8	82·0	5	42·7	27	0	0
,,		Grimsby (Killingholme)	1·53	..	·63	27	12	77·0	5	43·0	31	0	0
,,		Derby	1·15	— 1·45	·59	25	4	80·0	1, 12	43·0	30†	0	0
VIII.		Manchester	1·65	— 1·85	1·00	27	8	...	...	...	...	..	...
IX.		York	1·58	— 1·13	·68	27	8	79·0	11	43·5	27	0	0
,,		Skipton (Arncliffe)	2·24	— 3·70	1·46	28	4	85·0	3*	32·0	27	0	...
X.		North Shields	2·12	— ·73	·83	27	10	70·7	6	43·0	30	0	0
,,		Borrowdale (Seathwaite)	1·50	—12·58	...		...	...	...	...	...	...	...
XI.	WALES.	Cardiff (Town Hall)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	2·70	— 2·18	1·26	21	5	78·2	2	36·9	19	0	...
,,		Rhayader (Cefnfaes)	2·00	— 2·66	1·00	27	8	79·0	...	36·0	...	..	...
,,		Llandudno	1·44	— 2·38	·75	27	7	84·2	3	45·5	31	0	0
XII.	SCOTLAND.	Dumfries	1·72	— 2·16	·70	27	12	88·5	12	39·5	30	0	0
,,		Hawick (Silverbut Hall)	1·54	...	·40	28	8	...	...	...	...	...	...
XIV.		Ayr (Auchendrane House)	2·06	— 1·91	1·10	4	10	77·0	1, 2	33·0	29	0	1
XV.		Castle Toward	2·03	— 4·27	·73	4	11	80·0	10	38·0	29	0	0
XVI.		Leven (Nookton)	·95	— 2·04	·33	27	11	79·0	11‖	40·0	19¶	0	...
,,		Stirling (Deanston)	·95	— 3·67	·25	18	11	79·0	10	35·0	29‡	0	2
,,		Logierait	2·12	...	·77	2	17	...	...	...	...	...	...
XVII.		Ballater	1·88	...	·42	28	11	82·0	9	40·5	9	0	..
,,		Aberdeen	·84	...	·34	28	11	72·8	9, 11	44·2	16	0	4
XVIII		Inverness (Culloden)	...	...	...	...	...	...	...	...	...	...	...
,,		Portree	2·12	— 5·33	1·00	21	11	...	...	..	...	...	...
,,		Loch Broom	2·21	...	·40	25	12	...	...	...	...	...	...
XIX.		Helmsdale	1·27	...	·23	25	13	...	..	...	...	...	...
,,		Sandwick	1·11	— 2·60	·31	21	13	69·2	6, 8	43·8	28	0	0
XX.	IRELAND.	Cork	1·60	...	·85	6	8	...	...	...	...	...	...
,,		Waterford	2·17	— 1·78	1·21	6	11	82·0	11	49·0	21§	..	...
,,		Killaloe	2·49	— 2 44	·78	21	12	85·0	2	30·0	13	1	0
XXI.		Portarlington	1·61	— 2·89	·56	28	13	79·5	2	39·5	20	0	...
,,		Monkstown	...	...	...	...	..	...	...	...	...	...	...
XXII.		Galway	3·29	...	·68	27	11	87·0	13	43·0	31	0	0
,,		Bunninadden (Doo Castle)	·86	...	...	...	...	...	...	...	...	...	...
XXIII		Bawnboy (Owendoon)	...	...	..	...	...	...	...	...	..	..	...
,,		Waringstown	1·45	...	·79	27	9	90·0	10	38·0	30	0	1
,,		Strabane (Leckpatrick)	2·42	..	·94	28	14	80·0	10	31·0	21	1	8

* And 12, 14. † And 31. ‡ And 30. § And 29, 30, 31. ‖ And 12. ¶ And 29.
+ Shows that the fall was above the average ; —that it was below it.

METEOROLOGICAL NOTES ON AUGUST.

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

ENGLAND.

CAMDEN TOWN.—T S on 1st; L on 18th and 20th; gale on 27th at night.

LINTON PARK.—A dry fine month, with R only on seven days, on each occasion followed by bright weather, so that its effects soon disappeared; very little T, and no high winds. Bar. generally high; winds mostly from N., N.E., and N.W.; rather heavy fogs on 2nd, 3rd, and 4th; and mornings of the 21st, 30th, and 31st, cool, and in some places approaching a frost.

SELBORNE.—Prevailing winds S.W. till the 7th, then N.E. and N.W. to 21st, then more or less W. T on 8th, 18th at 4 p.m., (when a farm-house near Winchester was struck and burnt down), and on 20th. Fog on 1st, 2nd, 3rd and 8th. Heavy R on the 7th within 2 miles, but none here.

BANBURY.—T and L on 1st and 20th.

CULFORD.—T and L on 1st and 18th. First half of month exceedingly dry. Slight indication of frost on morning of 31st, but the grass thermometer did not quite reach freezing point.

BODMIN.—Average temp. of the month 62°·8; max. diff. of wet and dry 9° on the 6th, average diff. 4°·8. On the 22nd 1·28 in. of R fell in one hour, and no less than ·69 fell in 15 minutes.

CIRENCESTER.—N. and N.E. wind all the month, excepting on three occasions, when there was R. It has been all the year since January the tendency of the wind to cling to the north, which has caused the extreme dryness of the weather and the cold nights, with a great amount of sunshine. The great R of the 22nd, 1·75, commenced about noon, soon becoming steady and exceedingly heavy; at 7 p.m. T came on. One of the finest harvests ever known, was nearly completed before the R came.

SHIFFNAL.—A most acceptable T S from S.W., with ·46 in. of R on the 1st, and repeated on the 7th, with ·47 in. of R; these, with the plentiful falls on the 22nd and 27th, quite saved our turnips, though with little benefit to the pastures, which are as hard as the road. Fog on the mornings of the 3rd, 4th and 5th. The nights cool throughout, owing to the prevalence of the N. and N.W. winds. Red admiral butterfly first seen on the 17th; few wasps seen till the 22nd, and no earwigs; 26th, peacock butterflies appear, with more red admirals; 28th, hornets from a nest in the roof of a house near, feed on the sap exuding from a large oak, and afterwards on the apricots and plums, with the wasps; sulphur butterfly on 31st.

ORLETON.—The drought, which has been of unexampled duration, continued till the 22nd, when a steady and at intervals very very R set in soon after noon, and continued till 7 p.m., without T or L. Before this the weather was very fine and warm, but afterwards it became much cooler. Much T and L in N.E., with gentle R from 4 to 6 p.m. on the 1st. T and R again on the 7th, and L seen on the 19th. The crops light, but harvested in fine condition. Great wind on the 28th. Temp. rather above the average for the month. Damp fog in morning of 4th.

WIGSTON.—The corn harvest was nearly completed before the 20th, in the more forward districts ten days sooner. The fine R which fell on and after the 20th improved the appearance of the grass land.

GRIMSBY.—Wheat harvest began on the 2nd; grass scarce, and all kind of root crops suffering from the drought. Harvest plentiful and well got in. Very abundant crops of apples, pears and wall fruit. Pleasant weather for harvesting, nearly all finished at the end of the month. Some very welcome R on the 27th. Northerly winds prevailing.

DERBY.—The deficient rainfall of summer has extended over August, the fall less than half the mean; this added to the N.E. winds which prevailed the greater part of the month, has had its effects on the pastures; the fall of R recorded on the 25th has wonderfully changed the aspect; fruit abundant.

MANCHESTER.—Very heavy R on the 27th.

NORTH SHIELDS.—Fog on the 1st and 2nd; T on 6th, 17th, and 29th; clematis, hollyhock, and china-asters in bloom in the first week.

WALES.

HAVERFORDWEST.—Splendid summer weather during the first 17 days, temp. each above 70°; a rather sudden change took place on the 19th, temp. falling at night to 36°·9; after which the weather became much cooler; heavy R on the 21st, with considerable fall of temp.; rest of the month fine, air quite autumnal; magnificent harvest weather throughout the month; all the crops good and splendidly harvested; oats heavy.

CEFNFAES.—Nights generally cold during the month, often slight frosts. Days hot, with bright sun. Harvest early, and well got in; wheat good on the average, other grain light and short in straw. Great distress for water and herbage. Prevailing winds N.E. and N.W.

LLANDUDNO.—Barley was cut on the 29th of last month, wheat on the 1st of this, and oats on the 3rd; peas cut and led on the 18th. Very hazy on the 2nd and 3rd, on the former day even the near hills could not be defined, a few T drops at 5.30 p.m.; T on the 4th and 5th at a distance; very heavy shower between 8 and 9 p.m. on 28th.

SCOTLAND.

DUMFRIES.—The first half of month very dry, except on 4th and 7th. T on 4th; latter part of the month showery; H on 19th; weather on the whole very favourable for harvest, which was nearly completed at the end of the month. The R of incalculable benefit to pastures and turnips. Wheat a good crop; barley excellent, potatoes very good; turnips good, where not attacked with mildew; oats above the average. Mean temp. 61°·3.

SILVERBUT HALL.—A very dry and warm month, and yet there have been very few wasps or caterpillers, but many of the humblest weeds have been attacked by red spiders. Garden peas terribly mildewed, and will soon be over; harvest operations are well forwarded, and potatoes so far have kept clear of disease. T on 2nd and 4th.

AUCHENDRANE.—Bar., evaporation, and diff. between mean temp. and mean dew point above the average for August; bar. range, rainfall, mean temp., elastic force of vapour, dew point, humidity, force of wind, and amount of cloud, were below the mean. With these plus and minus signs of the instruments, the weather was splendid throughout. What was a gain to the harvest was a loss to the rivers, now almost dried up; only one severe T S, on the 4th, when there fell in a few hours more than half the total rainfall of the month. Aurora streamers and meteor seen on the 15th, 21st, and 24th.

CASTLE TOWARD.—A fine harvest month; T and L on the 3rd and 4th; exceedingly bright and warm from the 8th to the 17th; during these 10 days the average max. temp. was 78°, min. 56°, mean 67°. Grain crop above the average, all cut, and much of it secured in fine condition. Foggy on 2nd on the Clyde.

DEANSTON.—The whole month bright, hot, and dry; grain being cut on the 13th; all cut by the end of the month, and some secured in the stackyard.

LOGIERAIT.—Intense heat in the early part of the month; T S on the 2nd; sudden change of temp. on the 18th; that and the four following days cold, with east wind; after which, the cold winds moderated, but we no longer complain of the heat. Crops are being well secured, the bulk is not very great.

ABERDEEN.—A warm, quiet, and unusually dry month; a remarkable continuance of fog in the beginning of the month, lasting till the 8th. Bar. and temp. above the average, rainfall and wind pressure below it.

PORTREE.—A very fine month. Harvest commenced on the 19th, the earliest harvest in this island since 1826; not one shower from the 21st of July to the 18th of August (a very unusual thing for Skye, never happened before in the memory of any one living), and the heat during this dry period was intense, more so than ever remembered for so long a period. Hay all secured; all other crops looking well, but the potatoe disease is appearing.

LOCHBROOM.—Dry and pleasant throughout. The crops are nearly all cut, and

some in the stackyard, events seldom occurring so early in the season in this far northern region. The dried up rills and shallow streams have had some running water for the last two days, but for the previous two months water seemed to have abandoned them.

SANDWICK.--August has been warmer and drier than the mean, indeed warmer than any August since 1858, and drier than any for the last 30 years, except that of 1852. The ther. stood above 100° in the sun on several days, and on the 11th at 106°·5.

IRELAND.

DOO CASTLE.—One of the driest months on record; ground parched, cattle suffering, and green crops poor.

WARINGSTOWN.—Fine, bright, and hot; great scarcity of water; harvest progressed very rapidily, but has ripened rather too fast. Crops in general very good, the best in this district for many years.

LECKPATRICK.—Day temp. of the month much above the average, nearly as warm as in July; night temp. much below, so that the mean is about the average. Rainfall still deficient; the amount for the year to the end of August is 19·35, about 5¼ in. below the expected average. Ther. in shade reached 80° on one day only. Rainfall on the 28th the heaviest of the year. Magnificent harvest weather, crops all good.

METEORIC PHENOMENON.

The following account of a meteoric phenomon is extracted from the *Belfast News Letter* of August 16th:—

SIR,—As it is unusual, if not altogether unprecedented, in meteoric displays to find a permanent trace of them, I think this phenomenon is worthy of notice.

On Monday evening, at about 20 minutes to nine o'clock, when the display of fireworks in the Botanic Gardens had just begun, a strange meteoric phenomenon appeared in the north-western heavens. It seemed, at first, like an ordinary "shooting-star," except that it was considerably larger and more of a silver brightness. At the end of its course, which was some fifteen degrees above the horizon, it exploded. The peculiarity of its appearance, however, consisted in the permanent bright trace which it left in the sky. There was a sombre bank of haze hanging over the mountains, and extending about ten degrees above them. The sky beyond this was clear and bright, as is usual in these summer evenings.

It was in this bright sky that the meteor appeared. Its course was from a position somewhat to the south of the tail of Ursa Major in the direction of the head of Leo Minor, extending in all over some 12°. The track left was, at first, of this length, and in the direction of the course of the meteor. The haze, it may be added, seemed to be striated in the same direction. After an interval of about five minutes the straight luminous line became varied, then more curved, until about ten minutes after the occurrence it took the form of a somewhat irregular corona, breaking finally before its evanescence into the figure of a horse shoe. The phenomenon was altogether visible about thirty minutes.

There was little or no wind at the time, and no apparent cause for the curious changes in figure which the luminous line underwent. The northern horizon in the early part of the night had rather an electrical appearance.

EDMUND M'CLURE, Clk.

Belfast, August 16th, 1870.

ERRATUM.

In *Monthly Meteorological Magazine, August*, 1870, p. 115, line 10, *for* "T never *more* than," *read* "T never *less* than," &c.

AURORA BOREALIS, AS SEEN NEAR WHITBY, ON SEPTEMBER 24TH, AT 9.30 P.M. (*See page* 139.)

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

LVII.] OCTOBER, 1870. [PRICE FOURPENCE, or5s. *per ann. post free.*

THE BRITISH ASSOCIATION AT LIVERPOOL.

FOLLOWING the precedent of previous years, we commence our report of the recent meeting with a list of those present most noteworthy for their direct and indirect contributions to the progress of meteorology in its various branches. Foremost amongst them was our distinguished Transatlantic *confrère*, Professor Henry, of the Smithsonian Institution, whose "Contributions to Knowledge" so thoroughly merit their sensible title, to whom also we are indebted for "Tables Meteorological and Physical, by A. Guyot," of which we have so often had occasion to speak in the highest terms.

Ansted, Prof., D.T. ..... London.
Bateman, J. F., F.R.S... ,,
Belcher, Admiral Sir E. ,,
Bewick, T. J., C.E. .....Allenheads.
Birt, W. R., F.R.A.S....Walthamstow.
Brooke, C., F.R.S. .....London.
Buchan, A., F.R.S.E. ...Edinburgh.
Chambers, C., F.R.S.....Bombay.
Chevallier, Rev. Pro., F.R.S. Durham.
Curley, T., C.E.....Hereford.
Denny, H., F.L.S.....Leeds.
Denton, J. Bailey, C.E...London.
Dowson, E. T. .....Beccles.
Elliott, Sir W. ....Wolfelee, N.B.
Ellis, W. H. .....Exeter.
Evans, J., F.R.S.....Hemelhempstead.
Everett, Prof., D.C.L. ...Belfast.
Field, R., C.E. .....London.
Galton, F., F.R.S..... ,,
Gassiot, J. P., F.R.S..... ,,
Gilchrist, J., M.D.....Dumfries.
Glaisher, J., F.R.S. .....Blackheath.
Hailstone, E.... .....Bradford.
Hall, J. J. .....Richmond.
Hartnup, J., F.R.A.S....Bidston Obs.
Hartnup, J., Jun..... ,, ,,
Hawksley, T., C.E.....London.
Howlett, Rev. F. .....Alton.
Lawton, W... .....Hull.
Lewis, Capt. .....Hastings.
Lloyd, Rev. A. R.....Hengoed.
Lowe, E. J., F.R.S. .....Nottingham.
Lund, C..... Bradford.
Main, Rev. R., F.R.S. ...Oxford.
Moffatt, T., M.D. .....Hawarden.
Osler, A. F., F.R.S. .....Birmingham.
Parnell, J... .....Upper Clapton.
Peckover, A. .....Wisbeach.
Pengelly, W., F.R.S.....Torquay.
Perry, Rev. S. J.....Stonyhurst.
Phillips, Prof. J., F.R.S..Oxford.
Scott, R. H., F.R.S. .....London.
Smelt, Rev., M.A., F.R.A.S. Cheltenham.
Smith, D., F.R.A.S.....Birmingham.
Smyth, J., C.E.....Banbridge.
Snow, Rev. H. .....Eton College.
Stewart, Prof. B., F.R.S. Manchester.
Symons, G. J. ....London.
Talmage, C. G. .....Leyton.
Tomlinson, C., F.R.S. ...Highgate.
Waterhouse, J., F.R.S....Halifax.
Wilson, C. .....Garstang.

It is not generally known that the gross income of the British Association is about £2000 per annum; of this perhaps £800 goes for printing, salaries, &c., leaving £1200 or thereabouts available for

scientific purposes. Kew Observatory originally drew little more than £200 per annum, but with its increased utility for magnetic and other work, its expenditure rose, until for several years past it has drawn £600, or half of the entire sum available for scientific investigations. It is felt that a central physical observatory is an absolute necessity for this country, and it is also felt that the cost of such an establishment should not fall on the limited and fluctuating funds of the British Association. A large proportion of the time of the staff is now absorbed by the work of the Meteorological Committee and paid for by them; this already tends somewhat to make Kew rather a Government establishment than one belonging to the British Association. Moreover, though not *expressed*, we believe it has been *felt* by some of the naturalists belonging to the British Association, that the limited branches of physical science represented at Kew had somewhat of a lion's share of the income of the Association. Lastly, there is, if not the probability, at least the hope, that the Royal Commission on Science now sitting, may recommend the establishment of Kew as a National Observatory and Laboratory for the Physical Sciences.

Under these circumstances, the General Committee confirmed a resolution of the Council to the effect that they will continue the present grant to Kew for two years, and that thenceforth the connexion between the Association and Kew will cease.

Having thus concisely, but we believe accurately, explained the present prospects of Kew Observatory, we proceed with extracts from the report of the Kew Committee, so far as they touch upon Meteorology:—

Meteorological work.—The meteorological work of the Observatory continues in the charge of Mr. Baker.

Since the Exeter Meeting, 150 barometers have been verified, and 30 have been rejected; 1160 thermometers and 103 hydrometers have likewise been verified. 19 standard thermometers have been constructed for Professor Tait, and 2 for the Meteorological Office.

The self-recording meteorological instruments now in work at Kew will be again mentioned in the second division of this Report. These are in the charge of Mr. Baker, the photography being superintended by Mr. Page.

(B) Work done at Kew as the Central Observatory of the Meteorological Committee.

"It is stated in the Report for 1867 that the Meteorological Committee had appointed Mr. Balfour Stewart as their Secretary, on the understanding that he should, with the concurrence of the Kew Committee, retain his office of Superintendent of the Kew Observatory.

"On the 8th October, 1869, Mr. Stewart resigned his appointment as Secretary to the Meteorological Committee, and Director of their Central Observatory—a step which took effect on 31st March, 1870, and which was followed by a modification of the relation between the two Committees.

"The Meteorological Committee, at their meeting on 12th November, 1869, resolved that they were prepared to make the following proposals to the Council of the British Association:—

"I. That Kew be continued as one of the ordinary self-recording observatories, in which case the Committee would be prepared to allot to it annually £250; or,

"II. In addition to the foregoing work, that Kew be maintained as the central observatory for examination of records and tabulations from all the other observa-

tories, in which case the Committee will be prepared to allot a further annual sum of £400.

"The Kew Committee having been furnished with this resolution of the Meteorological Committee, resolved that it be recommended to the Council of the British Association that Kew be continued for the next two years as one of the ordinary self-recording observatories of the Meteorological Committee, that body allowing it annually £250 ; and that, in addition, it be maintained as the central observatory for the examination of the records and tabulations from all the other observatories, for the further sum of £490 per annum. This arrangement was approved by the Council ; and it was thereupon resolved by the Kew Committee, that out of the £650 received from the Meteorological Committee, £200 be given to Mr. Stewart for superintending the meteorological work of the Observatory. This resolution to take effect after 31st March, 1870.

"1. *Work done at Kew as one of the Observatories of the Meteorological Committee.*—The barograph, thermograph, and anemograph furnished by the Meteorological Committee are kept in constant operation. Mr. Baker is in charge of these instruments. From the first two instruments traces in duplicate are obtained, one set being sent to the Meteorological Office and one retained at Kew; as regards the anemograph, the original records are sent, while a copy by hand of these on tracing-paper is retained. The tabulations from the curves of the Kew instrument are made by Messrs. Baker, Page, and Foster.

"2 *Verification of Records.*—The system of checks devised by the Kew Committee for testing the accuracy of the observations made at the different observatories continues to be followed, the only alteration being that the Kew staff, at the suggestion of the Meteorological Office, have undertaken to rule on the barograms and thermograms a set of zero lines, which are of great use in pantagraphic operations.

"Mr. Rigby continues to perform the main part of this work ; Mr. Baker, Meteorological Assistant, having the general superintendence of the department.

"3. *Occasional Assistance.*—The Meteorological Committee have availed themselves of the permission to have the occasional services of Mr. Beckley, Mechanical Assistant at Kew ; and he has lately been visiting the various observatories of the Meteorological Committee.

"The self-recording rain gauge mentioned in last Report as having been devised by Mr. Beckley, has been adopted by the Meteorological Committee, and instruments of this kind are at present being constructed for their various observatories.

"The Staff at Kew continue to make occasional absolute hygrometrical observations by means of Regnault's instrument, with the view of testing the accuracy of the method of deducing the dew-point from the observations with the dry and wet bulb thermometers.

"Two erections have been made in the grounds adjoining the Observatory ; and on one of these a large Robinson's anemometer is placed, while a small instrument of the same kind is placed on the other.

"By this means the indications of the large and those of the small-sized instrument may be compared with each other. The cost of this experiment has been defrayed by the Meteorological Committee.

"J. P. GASSIOT, *Chairman.*

"*Kew Observatory, 9th Sept.*, 1870."

REPORT ON LUMINOUS METEORS.

This was read by Mr. Glaisher, who, before proceeding to the immediate business deputed to him, bore testimony to the efficient services rendered to the committee by the late Professor Brayley, of London, who had contributed most important information bearing upon meteoric and astronomical science. Mr. Glaisher explained the contents of a voluminous catalogue which he laid before the meeting, embodying the proceedings of the committee upon this branch of their labours during the past year. He also acknowledged the receipt of a

long correspondence forwarded by Professor Charles Augustus Kesselmeyer, of Manchester, respecting a fireball which was seen on the Lake of Geneva, in the month of September, 1869, and was observed by other watchers in various parts of Europe, who also discovered several other grear meteors. Mr. Glaisher then read the following extracts from the appendix :—

"The appendix which follows the observations of luminous meteors, includes, as in previous years, those descriptions of large meteors which have come to the knowledge of the committee, with the exception of a large number of foreign observations of the great fireball seen in the south-west parts of Europe on the 8th of September, 1869, of which it is expected that a condensed account will be published before the preparation of another report, embodying all the principal features of its course, to which a brief allusion, with references to the original observations, is made in the present catalogue. A large number of observations of shooting stars during the August period in 1870, are also omitted from the catalogue, while the general appearances of the shower are described at length in the appendix ; and for the most part bright meteors only, and those which were found to have been doubly observed at distant places, are entered for future discussion in the catalogue. It will be seen that whereas only six fireballs were so well observed in England and Scotland during the past year as to enable their heights to be determined—on the 1st and 11th of October, 6th and 14th of November, and 12th of December, 1869, and on the 20th of August, 1870—the heights of 16 shooting stars were obtained during the meteoric showers of the 5th and 11th of August, 1870 ; and 20 shooting stars recorded at Greenwich during the same meteoric shower were so distinctly seen at other places that their real heights are at present undergoing calculation.

"During the meteoric shower of the 14th of November, 1869, the sky at places in the south of England was generally overcast; but at the Royal Observatory, Greenwich, at Stonyhurst, and at Edinburgh, Glasgow, and Culloden, in Scotland, a clear view of the sky was obtained during a portion of the time in which the shower appeared to be at its height ; and a considerable fireball was doubly recorded by the observers at the last two stations, of which the observations and the calculated heights are contained in the catalogue and its appendix. The advantage of maintaining a watch for the phenomenon at such widely distant stations as Culloden, Glasgow, Stonyhurst, and Greenwich was the more apparent at the last return of the November star shower, since in America, on the morning of the 14th November, 1869, the sky was, throughout the United States, so completely overcast with a heavy fall of snow that no other announcement of the meteoric shower having been seen west of the European continent, with the exception of the brilliant phenomena observed in Florida and California, has hitherto been received by the committee. The observations of the same shower in Italy, at Port Said in Egypt, and at the Mauritius are described in the last appendix of the Report. Although the state of the sky was quite favourable for its observation in Italy, and partially so at the other stations, it does not appear that a distinct maximum of the shower was observed at any of those points of view ; but the number of shooting stars observed during the progress of the shower rose and fell, sometimes very rapidly, through a great range of activity and of the apparent rate of frequency of the meteors. It may be inferred from these results that the phenomenon of the November star showers is now rapidly declining in it its intensity, and that the stream of the Leonids, if it should be crossed by the earth on the morning of the 14th of November in the present year, will be found to have grown diffuse, and to have scattered itself into groups of pretty frequent falling stars with intervening lulls or barren intervals, in which observers will be rewarded by the sight of very few meteors, or in which it may happen that for the space of many minutes no shooting stars will be observed.

"Following the example set by Professor Schiaparelli, of Milan, and by the Italian astronomers at Turin, Urbino, Rome, Palermo, and at other observatories in Italy, whose separate catalogues of shooting stars reported from the surrounding

stations now number many hundreds of observations, to record observations of shooting stars, as far as possible on stated nights, at such widely separated stations as to increase the visibility of any meteoric shower which might be traced, the committee have decided, with a view to ultimately co-operating in the same well-devised scheme of observations, to confine their immediate attention for the present to those nights of the year on which long-known and well-established meteoric showers are annually expected to occur; and for this purpose they have provided star charts, suitable forms of registry, and directions to observers of the meteors which annually make their appearance with more or less regularity on the 1st and 2nd of January, the 19th to the 21st of April, the 5th to the 12th (especially the 10th) of August, the 18th to the 21st of October, the 12th to the 15th of November, and the 11th to the 13th of December, on each of which meteoric dates in the coming year (as their endeavours during the August shower of this year were rewarded with very valuable results) the committee desire to renew their appeal to observers in distant parts of England to use the same ability in mapping and counting the numbers of the meteors seen on the predicted nights which continues to render these reports a valuable chronicle of observation and a work of reference for meteoric science."

The thanks of the section were cordially given to Mr. Glaisher for his interesting paper, upon which there was no discussion.

A paper containing observations on shooting stars was sent by the Rev. R. Main, but in the absence of that gentleman the paper was presented, but was not read.

THE REPORT OF THE RAINFALL COMMITTEE

was read by Mr. G. J. Symons, the secretary. It commenced by referring to the steps taken last year to secure uniformity in the registration of rain by the observers throughout the country, to the acceptance by the General Committee of the recommendation of the Rainfall Committee that additional observers should be obtained in parts of the country where at present such observers are far from one another. Dartmoor was last year quoted as an illustration; thither after last meeting Mr. Symons proceeded, and the result is that the number of stations in that district has been doubled. There are, however, still two parts of the moor where no one lives, and no one has yet been found willing to superintend a gauge. Reference is next made to other steps taken by the Committee to secure returns from various other districts, and to the success of these efforts. The Committee close this portion of their report by pointing out that to keep up an amateur staff adequate to the requirements of the subject, say from 1,500 to 2,000 observers, it is indispensable that a number of new ones be enlisted each year to supply vacancies caused by deaths and removals, and they therefore intimate their desire to receive through their secretary, (G. J. Symons, Esq., 62, Camden-square, London,) offers of assistance from parties willing to provide themselves with the inexpensive and simple gauge now generally in use.

The Report mentions that the secretary has during the past year visited and examined the gauges in use at upwards of one hundred stations. By this personal intercourse, greatly improved accuracy and uniformity of procedure is secured.

The Committee regret that through want of funds they have been

unable to make any progress with the collection of old returns during the past year.

The report then proceeds to describe certain experiments carried out at Calne, in Wiltshire, by Col. Ward, with a view to determining the difference in the amount of rain collected at various heights above the ground, not so much with a view to determining the cause of this variation as its amount, and therefrom the possibility or otherwise of redhcing observations made with gauges at different heights above the ground to what they would have been at some uniform datum. This portion of the report commences by a brief notice of the experiments made by Prof. Phillips at York in the years 1832-35, then pass on to illustrate the necessity for the determination of these corrections; thence to a description of the instruments employed, and their position; and then follow a heavy batch of tables of the calculations and results which it is impossible to abbreviate. Part of the conclusions were exhibited in the form of diagrams representing the total rainfall on the surface of the ground, and its decrease at various altitudes above it, one diagram giving the mean annual decrease, and a series of twelve others the monthly curves; from these it was perfectly obvious that the difference between a gauge on the ground and one 20 ft. high is in winter nearly three times as great as in summer, and hence it becomes evident that the mean annual correction is applicable to the total fall in one or more years only, and not to individual months, for each of which separate corrections are given.

The report considers in the next place the most suitable height for the orifice of gauges to be above ground, and gives various reasons *pro* and *con*, finally concluding that 1 ft., as hitherto adopted, be still recommended.

The next subjects referred to are the tables in an appendix giving the monthly fall of rain at about 300 stations during the years 1868-9, and various calculations in different states of progress.

The report concludes by pointing out the great work being done by the voluntary and entirely gratuitous services of nearly 2000 observers, and suggests that it would be alike a graceful and an economical act on the part of the Government were they to offer to relieve the observers from the cost of reducing and publishing the observations which are now by their accuracy and completeness accepted as a type by foreign countries and our own colonies, and which are found yearly more and more useful in relation to our manufacturing and commercial interests. The Committee conclude with the following words:—"A few hundreds annually would probably suffice to hold together a body of trained observers which has no equal in the world, and which, once broken up, could not be replaced, since irrespective of the difficulty of training new observers, the continuity of the old observations would be destroyed."

Mr. R. Scott, F.R.S., called attention to the valuable results obtained by Dr. Angus Smith, F.R.S., who has analysed samples of rain-water collected in various parts of England. The rain as it falls dissolves

and brings with it many of the impurities contained in the air of the district, and therefore the analysis detects the foreign substances present in the air.

The President of the section (Mr. J. Clerk Maxwell, F.R.S.) pointed out that unless considerable care was taken in the collection of the samples, delusive results would be obtained.

Mr. Scott was understood to explain that Dr. Angus Smith provided the collecting glasses, &c., so as to obviate error from that source.

Several other gentlemen addressed the section.

Mr. Symons, in the course of his reply to the various speakers, mentioned the fact that, even by the coarsest tests, sea-spray might be detected mingled with the rain twenty, thirty, or even forty miles from the coast. He expressed his conviction that the rainfall observers throughout the country would cheerfully assist Dr. Angus Smith, with whom he would himself communicate on the subject.

(To be continued.)

AURORA BOREALIS.

To the Editor of the Meteorological Magazine.

SIR,—I forward you a sketch of the aurora borealis as I saw it, about 9.30 p.m., on the 24th September. The northern horizon was fringed with non-luminous cloud; above this was an irregular luminous band, out of which streamers extended upwards, and patches of luminous matter shot rapidly up to the zenith, and even to within some 60° of the southern horizon, resembling fragments of white mist driven by a northerly gale. The wind, however, was southerly. I could see the time by my watch by the light of the aurora. I am told that the display was even more splendid at 12.45 a.m., after which it suddenly disappeared. It was, however, very bright again for a short time the next evening.—Yours, &c., FENWICK W. STOW.

Hawsker, Whitby.

SOLAR RADIATION.

To the Editor of the Meteorological Magazine.

SIR,—I think we all owe a debt to Mr. Nunes for having discovered the possibility of two solar thermometers in vacuo by different makers differing by so large an amount in their readings, although both have an inch of the stem blackened. At the same time, I see no reason for supposing that such a difference is at all common, though the fact of its existence shows, that to obtain strictly comparable results we ought to compare the instruments previously in the sun's rays. I have recently compared one of Negretti's with mine, which is by Casella, and found the difference to be 1°·5, a difference which might easily result from Negretti's thermometer having a considerably larger bulb, which would, necessarily, expose a smaller surface in proportion to its bulk than a smaller bulb; moreover, a large bulb is less sensitive than a small one. Again, Messrs. Burrow, of Malvern, send me observations taken with a solar thermometer, which on comparison I find reads 2°·6 lower than mine. Thus, we have three good makers within 3°. And to shew how closely instruments by the same maker agree, permit me

to quote the following figures. (A, is my own instrument, B, that of a friend going out to India, E, excess of B over A) :—

	A	B	E
July 28	118·5	118·5	0·0
,, 29	118·5	118·5	0·0
,, 30	76·0	76·0	0·0
,, 31	117·0	117·0	0·0
Aug. 1	92·	92·	0·0
,, 2	118·0	118·2	0·2
,, 3	121·0	121·3	0·3
,, 4	96·5	96·2	—0·3
,, 5	123·0	123·2	+0·2
,, 6	123·8	124·0	0·2
,, 7	123·8	124·0	0·2
,, 8	121·3	122·0	0·7
,, 9	127·0	128·0	1·0
,, 10	126·0	126·5	0·5

The two thermometers were both placed at 4 feet above the ground, six inches or more apart.

I shall be glad to learn what is the effect of imperfect exhaustion of the jacket, and to what cause the extraordinary difference between Pastorelli and Casella is to be attributed.

With regard to the second point raised by Mr. Nunes, I cannot see what we should gain by using thermometers in vacuo to indicate the temperature in shade. Though very sensitive to the sun's rays, they are not very sensitive when used as ordinary thermometers, with which, however, they will agree in perfect shade. Last May I proposed to Mr. Griffith to test the experimental stands by suspending on each a thermometer with blackened bulb, which ought to agree with the unblackened instrument if not exposed to any reflected or radiated heat from the ground or the atmosphere. For this purpose it would not be necessary to use thermometers *in vacuo*: but, anyhow, I am glad it is to be tried. I have lately become convinced that the effect of reflected and radiated heat is more considerable than I supposed. I am obliged, in fact, to condemn my own thermometer stand in the form in which it has been tried at Strathfield Turgiss. Profiting by the suggestions of different friends, I have altered it as follows :—The "bottom board" is removed, except a strip six inches wide through which the post passes, and this strip is raised two inches. In front of this strip the thermometers are hung, with their bulbs only just, if at all, below the lowest part of the louvred front. At the back the louvre boards are carried a few inches lower than before. A board, eight inches wide, is screwed to the boards on which the maximum and minimum thermometers are hung, passing immediately beneath all the bulbs, and cutting off all reflection or radiation from the ground. An outer roof is added, which may be made of rustic work, a space of two inches being left between the two. A louvred door is added in front. I own I was surprised to find the maximum on the altered stand frequently 2° lower than on one of the original construction. Probably in its altered form it gives readings approaching more nearly those of the

Stevenson than the Glaisher stand. Its appearance is, in my opinion, improved, and its cost (about 15s.) probably very little increased. I suppose it will be allowed that reflected and radiated heat do not form a part of the true temperature of the air. This reminds me that people speak of the *true amount of solar radiation.* Will you permit me to remind your readers that *there is not and cannot be be any such thing?* All measurements of solar radiation are relative, depending on the relation of the rapidity of the reception of heat by radiation to the rapidity of its loss by conduction, convection, or radiation. You cannot have any test of it that is not arbitrary. The earth itself is only a large bulb surrounded by a peculiar envelope, which, happily for us, consists of air and not of a glass jacket containing a vacuum. The question is *not* "Is it the right amount of radiation?" but "Does the amount shewn increase or diminish with the intensity of the solar rays?" and "Will these instruments always and all of them shew the same amount for the same intensity?"

I am, Sir, your obedient servant,
FENWICK W. STOW.

P.S.—From what I hear from Mr. Nunes, the small size of the jacket, as well as the large size of the bulb, may have *something* to do with the comparatively low temperatures registered by Pastorelli's solar thermometers. It is evident we ought to have a standard pattern, and standard dimensions. A small jacket generally implies thick glass, and thick glass must absorb a greater proportion of the sun's rays than thin glass.

ALTITUDE ABOVE SEA LEVEL.

I HAVE purposely used the word "altitude" instead of "height," thinking that it will be a convenience if the term height could be reserved for the elevation of a gauge above the ground, and altitude for the elevation of the ground above the sea. Should the suggestion be good, it will eventually be adopted; if it is not good, it will doubtless be consigned to the oblivion it merits. This, however, by the way. The object of the present note is to ask all observers who are in any uncertainty as to the altitude of their stations, to notify the same to me, by postal card or otherwise, *before the end of October.* I am sure that many of the altitudes given in *British Rainfall* are incorrect, and I regret it. On the other hand, I know that many, the majority, are correct, and that if they *all* were, the altitudes of the 1500 stations quoted in that work would be of considerable utility in many enquiries. I am as willing to do what I can to increase the accuracy of the altitudes as to forward any other branch of the work, and the only stipulation is, that enquiries on the subject must be sent in at once.

G. J. SYMONS.

62, *Camden Square, London, N. W.*

REVIEWS.

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.

(Continued from page 111.*)*

We have already spoken in high praise of the above work; we add thereto the expression of our opinion that to all who wish to study the wind and weather changes of the north-west of Europe, it is indispensable.

It is impossible in the limits of a review to thoroughly discuss the mass of information it contains, for be it remembered that it gives *continuous* records of the barometer, thermometer (dry and wet), direction and velocity of the wind, at seven observatories for three months—the curves being reproduced in fac-simile and on a rather contracted scale, ten degrees Fahrenheit being represented by 0·375 in., one inch of the barometer by 0·75 in., and 24 hours by about $1\frac{1}{4}$ in. The lithographs are, however, so clearly printed that magnifying power may be employed if desired.

As a specimen of the accuracy of the work we have taken the Kew observations of the storm of Feb. 12th, 1869, which many of our readers may recollect, and which was noticed in these pages* and also elaborately by Mr. Glaisher.†

We interpret the records as showing that the barometer fell to 29·29 in. (= 29·33 at sea-level) at 4.10 p.m., that the temperature fell from 50°·2 at 4.20 p.m. to 38°·2 at 4.50 p.m., and the wind veered from S.W. to N.W. between 4.10 and 4.20 p.m. Reference to Mr. Glaisher's paper will show that the storm travelled from W. to E. at a mean rate of about 35 miles an hour. Kew Observatory is about 8 miles W. of Camden Square, therefore changes at Kew should have been about 13 minutes earlier than at Camden Square. Then we have—

From the *Meteorological Magazine*, Vol. IV., p. 23—

Min of. bar. at Camden Square ..... 29·318 at 4.15 p.m.

From the curves—

Min. of bar. at Kew... ..... 29·33 at 4.10 ,,

Observed difference ..... —·012 + 5 minutes.
Difference due to position ... +13 ,,

Wind reached N.E. at Camden Square ..... at 4.40 p.m.
,, ,, N.W. at Kew ..... at 4.20 ,,

Observed difference ..... +20 minutes.
Difference due to position ... +13 ,,

Again, Great George Street, Westminster, is about $7\frac{1}{2}$ miles E. of Kew; then we have—

Change of wind to N.N.W. at Westminster..... 4.35 p.m.
,, ,, N.W. at Kew ..... 4.20 ,,

Observed difference ..... +15 minutes.
Difference due to position ... +12 ,,

* Vol. IV., p. 21. † *Proc. Met. Soc.*, Vol. IV., p. 294.

Mr. Cator's anemometer at Beckenham is 12½ miles E. of Kew Observatory; from his account we have—

Wind reached N.W. at Beckenham at	4.55 p.m.
,, ,, N.W. at Kew	4.20 ,,
Observed difference	+35 minutes.
Difference due to position ...	+23 ,,

Lastly, Greenwich Observatory is 13 miles E. of Kew, and—

At Greenwich the fall of temp. began at	4.45 p.m.
At Kew ,, ,, ,, ...	4.20 ,,
Observed difference	+25 minutes.
Difference due to position ...	+24 ,,

The decrease of temperature was—

Harrow	48°	to 37°	=11°
Westminster	49°	to 37°	=12°
Camden Square.....	50°·2	to 37°·8	=12°·4
Greenwich	—	to —	=11°
Dunmow..... ...	47°·5	to 33°	=14°·5
Kew	50°·2	to 38°·2	=12°

We cannot conceive any necessity, as far as what may be called storm meteorology is concerned, for greater accuracy than is here shown by the concurrent testimony of instrumental records and ordinary observation, and we doubt if the Committee themselves are aware not only of the great precision attainable, and at Kew actually attained, but of the reliability of the reduced and printed results.

That portion of the report which gives a sort of chronicle of the weather is on the whole satisfactory, but it suggests an idea which may be worth mentioning. In order fully to understand the weather on any given date, the reader requires—*first*, the reduced barograms, thermograms, and anemograms given in this report; *secondly*, the notes on the weather and general distribution of pressure, &c., also given in this book; but *thirdly*, he requires the daily weather table issued by the office, and printed in the *Times* and some other papers. Nothing is more compact and legible than the report as printed in the *Times*, but we cannot say the same of the folio form lithographed by the Committee; if they had the tables set up in ordinary type, for immediate distribution, they could be stereotyped and, reprinted in the quarterly report, they would render it even more complete than at present.

It would of course be very unfair to complain that arrangements made in 1867 do not meet the *possible* requirements of 1870 or 1871, but the Committee promise to give in future issues of the *Quarterly Weather Report*, tables of periodic corrections, "and thereby to afford information as to daily range in various parts of the United Kingdom." We hope that before committing themselves to such a publication, they will carefully consider the influence of position on their thermometers, for we think they will find that the amplitude of the daily range at some of their stations is thereby diminished 5 or 10 per cent. Having previously suggested that engravings of the instruments *in situ*

would be very useful, and such engravings not having been given, we leave that point, and proceed to test the thermometric tables given in this report, and we will confine ourselves to the English observatories Falmouth, Stonyhurst, and Kew. The only elements given in the present publication are the mean temperature of each month, and the highest and lowest readings. As, however, the first of these is unaffected, or nearly so, by contracted daily range, and the only mode of exhibiting the remarkable character of the extreme readings recorded, is by comparison with proximate stations, and we cannot *prove* them to be correct, although we believe them so to be, we must content ourselves with a comparison of the twin records at Stonyhurst, where there can be no doubt of the quality of the observations.

Months.	Photographic.			Self-Registering.			Difference.		
	Max.	Min.	Range.	Max.	Min.	Range.	Max.	Min.	Range,
January	51·8	28·3	23·5	53·2	26·7	26·5	+1·4	+1·6	—3·0
February	56·3	30·8	25·5	57·5	31·8	25·7	—1·2	—1·0	— ·2
March	48·2	27·9	20·3	49·4	27·6	21·8	—1·2	+ ·3	—1·5
April.....	73·1	32·9	40·2	73·2	32·9	40·3	— ·1	·0	— ·1
May	60·3	36·2	24·1	63·0	34·4	28·6	—2·7	+1·8	—4·5
June	72·5	41·0	31·5	75·0	39·7	35·3	—2·5	+1·3	—3·8
July	80·5	43·8	36·7	83·3	43·7	39·6	—2·8	+ ·1	—2·9
August	83·2	36·8	46·4	86·0	36·0	50·0	—2·8	+ ·8	—3·6
September.....	68 8	44·3	24·5	70·4	42·9	27·5	—1·6	+1·4	—3·0
October.....	71·0	30·0	41·0	72·8	28·2	44·6	—1·8	+1·8	—3·6
November.. ..	53·0	27·4	25·6	53·5	26·0	27·5	— ·5	+1·4	—1·9
December.....	54·6	14·3*	40·3	55·0	13·4	41·6	— ·4	+ ·9	—1·3
			31·6			34·1	—1·6	+ ·9	—2·5

* Marked as doubtful, but evidently correct.

The above table shows that at Stonyhurst the mean monthly range is reduced from 34°·1 to 31°·6, and the annual range from 72°·6 to 68°·9, or seven and five per cent. respectively.

Falmouth compared with the proximate stations of Helston and Truro, gives far more startling contrasts, and even Kew and Greenwich often differ 4° or 5° ; for instance, in June, 1869 :—

	Max.		Min.		Range.
Kew.....	82°·0	.....	40°·6	.....	41°·4
Greenwich	87°·5	.....	35°·6	... ..	51°·9
Difference	+5°·5		—5°·0		10°·5

We do not presume even to think which is more probably correct, but we do consider it unsatisfactory for the two leading authorities in meteorological matters to differ so widely.

Remarks on Clinical Thermometers. By Cornelius B. Fox, M.A. [Reprinted from the *Medical Times and Gazette.*] Theakstone, Printer, Scarborough, 12mo, 12 pp. 1869.

Points out the necessity for sending clinical thermometers of every description, and by whomsoever made, to Kew Observatory for verification, in which recommendation we fully concur.

SEPTEMBER, 1870.

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	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32° In shade	Grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	2·00	— ·26	·41	7	9	74·0	28	37·6	15	0	0
II.		Maidstone (Linton Park)	2·08	— ·14	·83	7	7	77·0	26	38·0	15§	0	0
,,		Selborne (The Wakes)	2·39	— ·05	·94	5	8	...	...	31·9	25	1	4
III.		Hitchen	1·63	— ·23	·48	5	9	68·0	2	36·0	24	0	...
,,		Banbury	1·33	— 1·04	·37	13	11	70·0	2, 27	32·0	25	0	...
IV.		Bury St. Edmunds (Culford)	1·58	— ·03	·41	13	11	72·0	2	32·0	15	0	3
V.		Bridport	·99	— 1·33	·39	8	9	72·0	28*	37·0	1	0	0
,,		Barnstaple	2·04	— 1·72	·44	7	12	75·0	30	42·5	21	0	0
,,		Bodmin	2·17	— 1·50	·46	9	10	71·0	29	44·0	1, 21	0	0
VI.		Cirencester	1·22	— 1·64	·38	2	7	...	...	...	...	0	...
,,		Shiffnal (Haughton Hall)	·70	— 1·25	·16	13	13	67·0	2	35·0	15	0	...
,,		Tenbury (Orleton)	1·25	— 1·43	·29	13	11	72·8	26	33·5	15	0	2
VII.		Leicester (Wigston)	1·60	— ·61	·55	14	9	76·0	27	35·0	14‖	0	...
,,		Boston	·90	— ·67	·41	13	9	72·1	2	37·4	16	0	2
,,		Grimsby (Killingholme)	1·43	..	·40	13	20	68·0	9	39·0	15	0	...
,,		Derby	1·13	— 1·21	·30	5	11	71·0	27	37·0	25	0	...
VIII.		Manchester	2·66	— 1·03	·57	13	14	73·0	26	35·0	15	0	0
IX.		York	1·18	— 1·15	·31	13	14	71·0	2	32·5	15	0	0
,,		Skipton (Arncliffe)	2·90	— 2·06	·66	13	13	70·0	29	29·0	11	2	...
X.		North Shields	·99	— ·71	·30	2	12	67·2	20	38·0	15	0	0
,,		Borrowdale (Seathwaite)	12·00	— 1·21	...	..	...	...	...	...	...	...	...
XI.	WALES.	Cardiff (Town Hall)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	2·75	— ·96	·93	5	6	68·2	29	36·0	3, 29	0	...
,,		Rhayader (Cefnfaes)	3·11	— ·73	·54	13	12	69·0	...	37·0	...	...	...
,,		Llandudno	2·18	— ·16	·62	12	14	74·7	28	42·7	15	0	0
XII.	SCOTLAND.	Dumfries	2·89	+ ·16	·57	4	14	68·5	23	35·0	15	...	...
,,		Hawick (Silverbut Hall)	1·97	...	·57	4	12	...	...	...	...	...	...
XIV.		Ayr (Auchendrane House)	3·87	+ ·14	1·12	1	15	70·0	22	34·0	15	0	0
XV.		Castle Toward	3·80	— ·82	1·07	1	15	69·0	23	37·0	15	0	0
XVI.		Leven (Nookton)	2·47	— ·01	·83	9	14	66·0	5+	34·0	15	0	...
,,		Stirling (Deanston)	3·15	0·00	·36	13	15	67·2	17	31·0	15	1	3
,,		Logierait	3·54	...	1·13	1	13	...	...	...	...	...	...
XVII.		Ballater	2·36	...	1·00	9	9	69·5	23*	30·0	15	1	..
,,		Aberdeen	2·10	...	·59	13	13	67·0	29	39·7	9	0	7
XVIII		Inverness (Culloden)	2·10	...	·85	14	12	64·0	23	39·7	15	0	2
,,		Portree	6·25	— 4·52	1·65	4	19	...	...	..	...	...	...
,,		Loch Broom	4·68	...	·95	13	17	...	...	...	...	...	...
XIX.		Helmsdale	3·42	...	1·02	1	15	...	...	...	...	...	...
,,		Sandwick	3·30	— ·36	1·03	1	18	64·0	19	38·6	9	0	0
XX.	IRELAND.	Cork	...	...	...	...	...	...	...	...	...	...	...
,,		Waterford	2·36	— ·77	·72	4	19	69·0	16	47·0	11	..	...
,,		Killaloe	3·66	— ·50	·92	1	18	74·0	22	31·0	21	1	...
XXI.		Portarlington	2·95	— ·33	1·35	2	24	70·0	28	38·0	10	0	...
,,		Monkstown	...	...	...	...	..	...	...	...	...	...	...
XXII		Galway	3·51	...	·73	1	16	69·0	19	35·0	29	0	...
,,		Bunninadden (Doo Castle)	3·59	...	...	...	...	67·0	19	37·0	12	...	...
XXIII		Bawnboy (Owendoon)	...	...	..	...	...	...	...	...	..	..	..
,,		Waringstown	2·74	...	·62	1	17	74·0	21‡	40·0	10**	0	0
,,		Strabane (Leckpatrick)	3·78	..	·91	9	19	70·0	22	35·0	6¶	0	4

*And 29. †And 8, 21, 25, 30. §And 16. ‖And 24. ¶And 11, 27. ‡And 28, 29. **And 14, 29.
+ Shows that the fall was above the average ; —that it was below it.

METEOROLOGICAL NOTES ON SEPTEMBER.

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

ENGLAND.

CAMDEN TOWN.—Heavy dews and misty mornings and evenings, but brilliant sunshine and most enjoyable weather, from the 13th to the end; particularly warm during the last week. T and heavy R in evening of the 3rd; lunar halos on the 4th and 11th; ·05 of dew during the dry time; N.W. gale on 10th.

LINTON PARK.—R on 2nd, 3rd, 6th, 7th, 9th, 10th, and 13th, and high wind on 10th, but the last fortnight exceedingly fine, dry, and bright sunny days, with heavy dews at night. Wind chiefly E. and N.E.; bar. high and steady during that time; T and heavy R on 3rd; dense fog on 16th; fog on morning of 22nd.

SELBORNE.—Frequent R till the 13th, after which time, bar. varied very little; the range between the 18th and 25th did not exceed ·4 of an inch. Aurora on 3rd was extremely bright and beautiful, but was exceeded by that on the 24th, which was the most beautiful I ever saw; it extended from S.W. to N.E., but there were no corruscations. The light was sufficient to show objects for a considerable distance. There was a diffused aurora on the 25th, and again on the 26th; fog on every day of the last week, which, when condensed in gauge, measured not less than ·03 in.

HITCHEN.—Singularly dry month; very high bar.; heavy fogs every morning; frequent auroræ at night; wind N. in morning, E. in afternoon and evening.

CULFORD.—T on 3rd, and very high wind on the 10th and 11th, more particularly on the former day, which made sad havoc in the orchards and fruit gardens of the eastern counties, denuding many of the trees of their entire crop. No R has fallen since the 17th, and the latter half of the month has been remarkably warm and summer-like in its character, each morning being ushered in by a heavy fog, which gradually cleared off, and was succeeded by a day of the brightest sunshine, with wind from S.E. and bar. above 30 in.

BRIDPORT.—Rather stormy the first part of the month, with south-westerly gale on the 9th; no R fell after the 13th; brilliant aurora on the 24th at 10.45 p.m., and also at 9 p.m. on 25th; bar. very high at the end of the month.

BODMIN.—Average bar. for month, 30·10; average temp., 59°·6; the drought most severely felt.

CIRENCESTER.—September further realized the character that has marked the whole year since January—the prevalence of N. and E. winds, and extreme dryness, with summer heat in the days and cold nights, the sky being almost cloudless night and day. Water getting very short, and (4th October) no apparent change at hand.

SHIFFNAL.—The month opened with a good prospect of returning verdure from the R which fell so generally for the first fortnight; after that, the drought returned with parching E. wind, which dried us up again. Bar. remarkably steady from the 18th to the 27th, the variation being only ·05 during that interval; wind westerly from 1st to 15th—quite a gale on the 10th—then easterly to the end; mornings thick fogs or misty from the 18th, which somewhat relieved the drought, although followed each day by a cloudless sky; condensed fog at end of month, ·03; distant T in S.W. on 6th; the air alive with aphides, which come from the turnips (17th); by the 24th the swede turnips annihilated by them and mildew, as bad as in 1865; mangold wurzel the only root crop uninjured; mushrooms abundant on 8th; blackberries abundant on 10th; damsons and walnuts in great profusion on 18th.

ORLETON.—R fell in small quantities on 11 days out of the first 13, which partly restored the green of the pastures, but did not penetrate the land to any depth; the remainder of the month was dry, with a very high and steady bar.; fogs very frequent in the mornings, but the day generally very brilliant, and the air calm. At the end of the month the pastures again becoming brown, and the swedes drying up. T heard on 6th and 7th; aurora on 3rd and 24th; swarms of winged ants on the 18th, and the air filled with aphides for many days at the close of the month.

WIGSTON.—The last fortnight of the month has been remarkable for the brilliance of the days, the sky having been nearly uniformly cloudless, preceded by a thick fog at daybreak; the pastures at the end of the month nearly as short of grass as in January; extensive blight upon the turnips and cabbages; a splendid aurora on the night of 24th.

GRIMSBY.—Remarkably fine month; although small quantities of R fell on several days, more is greatly needed; much fog and gossamer; many webs of the garden spider, the usual accompaniment of settled fine weather at this season; at the latter part of the month the bar. was unusually high and steady; T, L. and R at 6 p.m. on 7th; T at 6.15 on 9th; high wind on 9th from S.S.W., and on 10th from W.S.W., W., and N.W.; lunar corona on 12th; max. fall of R on 13th; rime on 15th; aurora on 24th, and fine one at 8.20 on 25th.

DERBY.—The slight but refreshing rains which fell in the early part of the month wonderfully freshened the pastures, but no R has fallen since the 13th, and bar. is still high; the weather has been all that could have been desired had the previous months yielded the usual fall of R instead of less than half; as it is, the drought is more sustained than that of 1868, but the temp. rather lower than in that remarkable year.

ARNCLIFFE.—No R for the last 14 days of the month, which is very unusual. Bar. very high and steady during that time.

NORTH SHIELDS.—Fine from 14th to end; lunar halo on 12th; aurora on 4th, 24th and 25th.

WALES.

CEFNFAES.—No R for the last 13 days; nights frosty, with heavy fogs; bright, hot, sunny days; wind generally S.E. or N.E.

LLANDUDNO.—The latter part of the month, from the 18th, has been one continuation of brilliant summer weather; bar. never below 30·250, and on the 30th, 30·500.

SCOTLAND.

DUMFRIES.—The first half of the month showery, the latter half remarkably fine, resembling June; mean temp. 55°·2; days warmer and nights colder than average; on the evening of the 3rd a singularly beautiful display of the northern lights; harvest completed in the lower districts by the beginning of the month, and in the higher districts by the end of the month.

SILVERBUT HALL.—First half of the month wet and windy, second half most charming and summer-like weather. Sharp frost and thin sheeting of ice on the night of the 14th; fine aurora on the 24th; heavy gale on 9th.

AUCHENDRANE.—This month, as a whole, has been a period of unfavourable weather, although the fine weather after the 17th may be held to compensate for the bad before that date. Both 4th and 5th had been stormy from the S.W., and the aurora was seen early on the 4th, but the "Captain's" gale of the 7th did not reach here till the 9th, when, at 9 a.m., the bar. and ther. (which had previously been very unsteady) stood at 28·96 and 56°, and a violent gale from S.W. and N.W. with dreadful squalls prevailed throughout the day. The other great event of the month was the second aurora, which commenced at 9 p.m. on 25th, and continued with great brilliancy over the whole sky till 4.15 a.m. of 26th; rivers still very low, but the fogs by day and the dews by night are very persistent.

CASTLE TOWARD.—Wet and rather stormy to the 16th, then dry, mild, and foggy to the end of month; fogs frequent close to the Clyde, while it was bright 60 feet above it; gales on the 4th and 9th; aurora very bright from 9 to 12 p.m. on 24th. Turnips and pastures good; potatoes getting diseased; vegetables still plentiful, and flower gardens quite gay.

NOOKTON.—Within ·01 of average.

DEANSTON.—First half of month wet, and several days of high wind; latter half of month, very bright sunshine, very calm, but a good deal of fog, mornings and evenings.

LOGIERAIT.—Very wet and cold during the first half of the month, afterwards bright and warm throughout the day, with heavy mists and a tendency to frost during the nights.

BALLATER.—Much R during the first half of the month, after the 15th none fell, the latter half being very fine and dry, with a tendency to frost. A reliable person here reports that on Saturday morning, the 1st of October, about half-past 3 o'clock a.m., she was alarmed by her room being brilliantly lighted up, and upon looking out of the window to ascertain the cause, observed lying on the grounnd, a small round ball about the size of a large marble or crystal bowl, as she described it, apparently in a glow of heat, but which presently disappeared. She did not look for it at the time nor in the early morning, and later in the day she thought it would be of no use as it is in a public street. By the time she got out of bed and looked out, the light had faded. This looks a fabulous tale, but the person is confident of what she saw, and is a person of good sound sense. What could it have been?—J. P.

ABERDEEN.—A fine mild month; rather damp during the first half, and very dry during the last fortnight; auroræ on 13 nights; T on 6th and 7th; fog on 16th, 28th, 29th, and 30th.

PORTREE.—First fortnight wet and stormy, which retarded harvesting very much, but in general the crops are all secured in good condition; all kinds of crops are above the average in this island, in fact it is very seldom they are as good; in some places, however, two-thirds of the potatoe crops are diseased, and fit only for swine.

LOCHBROOM.—The R which commenced on the 28th of August (after an almost unprecedented drought of months) continued, without one day's cessation, until the 16th, since which date we have had the finest weather that could be desired; indeed, the heat this day (October 1st) is something almost unbearable, at times and in some spots it is like the air from a furnace. The harvest produce is securely housed and stacked, but it is much feared the potatoe disease is making sad havoc among the small crofters and on shallow soil.

SANDWICK.—This has been one of the driest Septembers I have ever seen; since the 18th, particularly, it has been warm and dry, with moderate wind, so that harvest has been concluded under very favourable circumstances, and now (October 1st) the bar. stands at 30·566, so we have hopes of the fine weather continuing. Strong winds on 3rd and 4th; auroræ on 3rd, 15th (very red), 17th, and 31st; sea roaring on 22nd, must have been a storm in the Atlantic, but not here; lunar rainbow on 10th.

IRELAND.

LECKPATRICK.—First half of month wet and stormy. Gale from S.W. all day on 9th; much damage done to ungathered crops, many trees blown down, roofs stripped, &c.; wind fell at sunset; bar. rose rapidly during the night. Last 10 days fine. Rainfall a little above average.

METEOR ON SEPTEMBER 28TH.

To the Editor of the Meteorological Magazine.

SIR,—About 7.30 p.m. on Wednesday, September 28th, I observed an exceedingly brilliant meteor in the western sky. I am not certain that I saw the whole of its course, as, when I caught sight of it, I had just passed a house standing on the west side of the road, but, assuming that I noticed its first appearance, it started from a point in the head of Bootes, and burst after taking an almost vertical path of 10° or 12° towards the horizon. Its colour was white, and its size about one-sixth of the moon's apparent diameter.—Yours faithfully,

T. B. ARMITSTEAD.

Hutton House, Burton, Westmoreland, Oct. 1st, 1870.

Several communications unavoidably postponed till next month.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

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THE SQUALL OF OCTOBER 19TH.

THIS squall (to which under the title of a Tornado, some space has recently been devoted in the *Times*,) evidently merits more attention than we can at present devote to it. Strongly recommending to the attention of our readers the details of its mechanical power given in the following pages, we refrain from dwelling upon that part of the subject.

Station.	County.	Longitude.	Time of Occurrence.		
			Reported.	Computed.	Difference.
Camborne	Cornwall	5°18' W.	9 to 10 a.m.	9.30 p.m.	
Neath	Glamorgan	3 48	10.15	10.45	+30 min
Kingsbridge	Devon	3 47	11?	10.46	—14 ,,
Chepstow	Monmouth	3 41	11.15	10.51	—24 ,,
Llanwrtydd	Brecon	3 39	10.45	10.53	+ 8 ,,
Crediton	Devon	3 39	11?	10.53	— 7 ,,
Paignton	,,	3 35	11?	10.56	— 4 ,,
Lindridge	,,	3 34	11.15	10.57	—18 ,,
Westbury	Somerset	2 43	11.30	11.39	+ 9 ,,
Stratford-on-Avon	Warwick	1 43	0.15 p.m.	0.29 p.m.	+14 ,,
Cowes	Hants	1 18	0.45	0.50	+ 5 ,,
Camden Square	Middlesex	0 8	1.45	1.48	+ 3 ,,
Wood Green	,,	0 7	1 to 2?	1.49	...
Hayward's Heath	Sussex	0 6	1.50	1.50	0

We do not know the general character of storms of the type indicated by the following narratives, and we shall gladly learn where (if at all) they have been described; and in the absence of such knowledge, we feel ourselves rather groping in the dark. A glimmer if not a positive ray of light has been afforded by charting the observations hereafter recorded; and as an indication of what we wish to do, we annex a short table, the headings of which are, with one exception, self-explanatory. The exception is the column headed "Computed time of occurrence;" which has been inserted as a rough guide to the progress of the squall. The calculation is very simple; it is *assumed* that the squall was over Camborne at 9.30 a.m., and that it travelled eastwards at the rate of 1° in 50 minutes (or about 50 miles an hour);

e. g., Neath is 1½° east of Camborne, therefore the squall should have reached there (1°·5 × 50m. = 75) 1h. 15m. later than Camborne, namely at 10.45, which is therefore the computed time of reaching Neath, and so of the others. Considering the loose way in which the times are reported, we think the agreement so very remarkable that we refrain from further comment until next month, and hope that in the interval our numerous correspondents will turn to their registers for October 19th, and send us copies of any notes they may find recorded.

CAMBORNE.—A very heavy thunderstorm passed over here yesterday between nine and ten. a.m. The lightning was exceedingly vivid, and the rain deluging. A blacksmith's shop belonging to Mr. Holman, in Chapel-street, was struck by the lightning, and the greater part of the roof carried away. Fortunately, no person was injured.

Redruth has been visited this week by unusually heavy showers, the wind blowing strongly from the south-west. Yesterday the rain was accompanied by vivid lightning, and loud peals of thunder. Very little damage has been done. and the heavy rainfall is heartily welcomed.

SIR,—The following account from a local paper is not colored. It was an extraordinary rotary storm, very limited, but destructive, in its effects. I witnessed it at Kingsbridge. Simultaneously, there was a tidal wave of 3 or 4 feet height, at Salcombe, which lifted a sunken barge out of its bed, where it had lain for some years, and carried it some feet further off; also lifted the passage boat, with people in it, on to the rocks, and left it high and dry. Very heavy rain at the time, but only for a short time.—Very truly yours, GEO. FOX.

KINGSBRIDGE.—A destructive whirlwind swept over Kingsbridge on Wednesday morning, doing immense damage to houses, &c., in its course. The morning had been stormy throughout, and squalls of wind, with heavy showers, were frequent. About eleven o'clock, a very violent squall, accompanied by rain, which poured down as if it were one sheet of water, passed over the town, but without doing any damage except at the lower end of it, where a whirlwind swept across from West Alvington-road to Hill-side. It passed in less than a minute, during which time the wind shifted suddenly from south to north; but during that brief space of time, from twelve to fifteen houses were partially unroofed, several trees were blown down in the Retreat-field and West Alvington-road, and slates and timber flew about in all directions.

After the wind had subsided, a melancholy picture of wreck presented itself. In the turnpike road trees were lying and blocking up the passage, and just below the turnpike gate other trees, opposite Hooper's Cottages, had fallen on to the telegraph wires, which, being new and strong, did not break; but as something was bound to give way, the new large telegraph pole erected at Gallants'-bridge was broken short off, and hung in mid-air, supported by the wires crossing Mill-street. These are attached to a large pole in Mr. Tucker's garden, which although pulled out of place, did not break, and so a general wreck of the Salcombe and Brest telegraph was averted. In Union-road a house was almost totally unroofed, and at the Seven Stars Inn, a tree in Quay House grounds fell on a shed in the inn court, which it completely crushed in, shattering in its fall a gig belonging to Mr. Helmer, which had been placed underneath out of the rain. Mr. Hingston's brew-house was nearly unroofed, but the Town Mills, which stand high, and might have been expected to suffer in conseequence of greater exposure, escaped with only a few slates being lifted. The houses and stores occupied by Messrs· Hannaford, Jarvis, Boon, Lane, Grant, and Beer & Trant, were all more or less damaged—the first four very seriously—and the greater portion of their roofs

must be renewed. The wind lifted a piece of zinc—the roof of a bow window at the Ship and Plough Inn—curling it completely up, and then passing round the house, quite stripped off the whole of the plaster from the wall at the back, and scattered it over the yard. Mr. Thomas' house suffered by the roof being damaged in two places, and a chimney of the adjoining house, belonging to Mr. Beer, was thrown down from the base, fortunately falling clear of everything, into Mr. Thomas' yard. In Ebrington-street, which one would have thought sheltered, the wind was very erratic. Mr. Hammett's house was partially unroofed, and a window blown in bodily; the adjoining house escaped with but slight damage, while a few doors beyond, a great portion of Mrs. Jarvis' roof was blown off. Between these houses stands Mr. Martin's: his roof escaped, but his front door was blown out into the street. Miss Webber's house at Hill-side suffered severely; they are so damaged that probably a new roof will be required: a great hole has been made, which extends two-thirds of the length of the entire building. The violent rain had driven indoors most people, but those who were standing where they could see the effects of the wind, say the slates were flying thick in the air as a flock of birds. Timber was carried high in air, large stones were whirled about, and vehicles upset. We have not at present heard of any serious damage in the country, although at Bearscome and Shindle Mills a little has been done, and some persons who were on the roads felt the violence of the wind. Mr. H. Crimp, of South Huish, who was sheltering under a hedge, says it seemed as though the whole hedge was being lifted, and even his horse was so frightened that it was some time before he could pacify the animal.

The destructive effect seems to have been confined to a strip of country about fifty yards wide, but how long we cannot as yet tell. It was a sight such as is rarely witnessed in any but foreign countries, and one which no person would wish to see repeated.

Another Account.—A terrific squall did considerable damage in Kingsbridge yesterday morning, although lasting for only two or three minutes. It occurred at about 11 o'clock, and was confined within a radius of a quarter-of-a-mile. The Ship and Plough Hotel suffered severely, being partially unroofed and having a quantity of glass broken. A tree fell on, and knocked down, the stable of the Seven Stars Hotel, completely crushing a carriage in it. All the houses in the neighbourhood, especially in Ebrington Street, were injured, and Hillside, the residence of Miss Webber, was entirely unroofed. The greatest alarm prevailed during the few minutes of destruction. Slates were flying in the air in all directions, waggons on the quay were overthrown, the telegraph poles supporting the Brest telegraph cable snapped asunder, and trees in the West Alvington Road rooted up and blown into the road, causing the temporary suspension of traffic. It is estimated that damage has been done in the south of Kingsbridge to the extent of several hundreds of pounds.

A violent storm of wind and rain visited the neighbourhood of Paignton yesterday morning at about eleven o'clock. The rain was heavier than has been seen for a long time. No casualties of moment occurred, except that the shop front of Mr. Marley, draper, Church-street, was blown in, and slates and thatch were removed from several houses,

To the Editor of the Meteorological Magazine.

SIR,—The tornado which reached Stratford-on-Avon at 12·15 on the 19th October (*Times*, 24th October), passed here at 11.15 exactly. After taking down some large elms at Hardwick, on the Monmouthshire side of the Wye, it disabled some exposed trees in the open, about half a mile to the S.E. of this; when crossing a narrow lane it was encountered by a close orchard of about 250 yards square. Within this orchard some 30 or 40 trees lie prostrate, all their roots and soil facing the south, as also the elms in the hedges surrounding it; one large tree at the north end resisting, has its trunk twisted and burst open from near

the ground upwards; two firs standing about 18 feet, like broken masts. The inhabitants of a house in the open, on each side of which it rushed, and near the disabled trees, are said to have felt the house itself as twisting. It is said to have come from Cardiff and Neath, and to have been there at 10.15.—Yours, RICHARD PEAKE.

Wirewoods' Green, Chepstow, October 25th, 1870.

LLANWRTYD.—*To the Editor of the Times.* SIR,—I have read Mr. Morford's letter with much interest, and am induced to send you an account of what I witnessed on the same day. On the morning of the day named, the 19th, I rode, in the midst of blinding wind and rain, to see some men that were working near a wood at Llanwrtyd, Breconshire. I found that the men had been driven to seek shelter from the rain, and I was induced by them to shelter also for a few minutes before entering the wood. While we were thus standing together, a sudden irresistible blast passed up the valley, and, almost simultaneously, 11 oak trees fell to the ground before us, uprooted. There was no swaying of the branches, but the trees fell just as bare poles would fall. The noise of the storm, hitherto raging, seemed hushed for the moment, and a low whistling sound was all that I heard. The time was, as nearly as possible, a quarter before 11, and the trees all fell within three seconds, and alike in the same direction, west to east. Llanwrtyd is about 80 or 90 miles due west of Stratford-on-Avon, and the storm thus described was probably that which reached Shakespeare's birthplace an hour later.—I am, Sir, your obedient servant, *John Lloyd. Jun.*, Huntington Court, Hereford, Oct. 25.

CREDITON.—Yesterday morning at about eleven o'clock, a whirlwind passed over the extreme western part of the town, causing considerable damage in the locality. About 40 feet of walling were blown down in the garden of the Grammar School, and nearly an equal amount of damage was done to Mr. Berry's garden. Elm and apple trees suffered much, and one of the western roads was rendered impassable by the branches of trees. Several chimney stacks were knocked down by the terrific force of the wind. Mr. John Long, who lives in a newly-built house at Threshers, being an invalid, had but just risen from his bed, when an immense mass of bricks from the chimney fell through the roof on the bed. The force of the storm, which lasted only a few minutes, was not by any means so great in other parts of the town. Very heavy rain fell before and after the whirlwind,

LINDRIDGE.—*To the Editor of the Times.* SIR,—It may interest some of your readers to know that a tornado similar to that described by Mr. Morford in your paper of the 23rd inst. passed over this neighbourhood on the same day (Wednesday, 19th), about 11.15 a.m., at which time it struck my house, situate about twelve miles S.W. of Exeter, and four miles from the coast, blowing in some glass of the windows with great violence. Its duration was about three minutes, and its course was marked by the devastation caused among the timber, one elm in particular, 14ft. in girth, having been snapped off at about 15 ft. from the base. The area of extreme force of wind did not appear to exceed 200 paces in width. I understand it visited the town of Kingsbridge, causing considerable damage. I remain, Sir, your obedient servant, *J. G. Templer*, Lindridge, Oct. 26.

WESTBURY.—*To the Editor of the Times.* SIR,—The tornado mentioned by a correspondent in the *Times* of to-day, passed over, or rather through, this village (Westbury, near Wells, Somerset) on Wednesday last, about half-past 11 a.m., doing considerable damage. Its force was confined to a space of about 100 yards wide, its direction was from the west. The air, for about a minute, was filled with earth, leaves, &c.; many trees were blown down, some stripped of leaves and branches; the roofs of several buildings destroyed, ricks half blown away; two galvanized iron sheep-troughs, 12 feet long, in a field in front of my house, were first turned upside down, and the wind then catching them up, one was deposited safely on my lawn, having cleared a sunk fence wall 4 feet high; the other, not so fortunate, caught an angle, and was doubled round it like a strip of linen or paper, where it stuck. The cast iron wheels were snapped off, one being found in the yard attached to the house, and to get there it must either have passed over a gate

which was not in its direct course, or over a wall 9 feet high, which was. The course of the wind was towards Chewton Mendip, where it is said to have done damage; but the chief injury in this neighbourhood was in this village, but only through a space of about the width mentioned.—I am, Sir, yours obediently,
Oct. 24. T. K. T.

STRATFORD-ON-AVON.—*To the Editor of the Times.* — SIR,— At the risk of troubling you with what may seem to many a matter of slight importance, I take the liberty of communicating to you an item of intelligence which seems not to have been forwarded to the press by any other observer.

Some mention has been made of the fact that a severe gale, of brief duration, swept over certain portions of the south of England about noon on Wednesday last, the 19th, supplementary to the heavy gales of less immediate violence, but longer duration, which had, during the previous week, prevailed on the Channel and at different points along the coast, doing extensive damage and causing considerable loss of life. It is within my knowledge, however, that at least at one point in midland England, not only was any violence of that gale, otherwise recorded, fully equalled, but that the rare spectacle, for the British Islands, of an actual tornado was witnessed in, perhaps, the most notable spot in all these islands.

At about a quarter-past 12 that day, I was within the vestry-room of the old Church of the Holy Trinity at Stratford-on-Avon, examining, with a party of friends, the birth and burial records of Shakespeare, whose remains are well known to lie under the chancel pavement of that church. A heavy dash of rain had been heard against the windows and on the roof, and the wind was observed to be blowing with a certain degree of violence. But suddenly the violence of the wind seemed to be increased a hundred-fold; its pressure against the great stained glass window of the vestry-room (filling the end of the cross immediately abutting on the Avon), cracked the glass and sent it flying in splinters into the vestry, with serious prospect that the whole window would be crushed in like so much pasteboard; the entire portion of the church seemed to rock and sway, leading to grave momentary doubt whether at least all that portion of the doubly-sacred old pile would not be overthrown, at the same time that the solemnity and terror of the moment were added to by the almost total absence of the light of day.

This extreme violence of the wind lasted, providentially, but for perhaps two or three minutes, though the gale did not waste itself for fully half-an-hour.

Examination made immediately afterwards showed that several of the great elms standing on the Avon bank had been wholly or partially destroyed—branches wrenched from trunks and trunks overthrown, and one magnificent tree, not less than 15 inches in diameter, snapped like a reed at some 10 ft. from the ground; while iron railings and their stone foundations had been wrenched from their places, monuments damaged, and a sad though limited scene of ruin presented to the few who were at once fortunate and unfortunate enough to be present.

That the violence of the wind, pressing against the window itself, broke the glass, and threatened so much worse consequences than actually ensued, and that the damage did not result (as some allege) from pieces of the broken trees being hurled against the panes, will be realized by those who know that this window, like that of the Shakespeare Birth-room, in Henley-street, is completely covered by close wire-netting, making such a blow from branches impossible.

After-observations, crossing Warwickshire towards Warwick and Leamington, showed trees somewhat damaged, but no traces of so much violence of the wind expended in any other spot than that around which clusters so much of the best reverence of Englishmen and the world.—I am, Sir, yours obediently, *H. Morford,* Langham Hotel, October 21.

COWES, I.W.—*To the Editor of the Times.* SIR,—It will doubtless interest many of your readers to know that on the 19th inst., the day mentioned in Mr. Morford's letter, in *The Times* of the 24th inst., a very violent gust of wind swept over the north point of the Isle of Wight. Mr. Morford states he observed the tornado at Stratford-on-Avon, at about a quarter-past 12, while here the intense gust passed at about a quarter to 1 p.m., or about half-an-hour later. The *maximum* force lasted but about five minutes, but in that time it did very

considerable damage to houses, chimney stacks, and trees that lay in its narrow path. An anemometer, nearly in the centre of its path, recorded the extraordinary pressure of 30lb. on the square foot.—I am, Sir, your obedient servant, J. R. M., Cowes, Isle of Wight, October 25th.

CAMDEN SQUARE.—Very sharp squall, with heavy rain, between 1.45 and 1.53 p.m.; 0·10 in. of rain fell in that time.

WOOD GREEN.— On Wednesday a severe hurricane passed over Wood Green, causing considerable damage. The pianoforte manufactory of Mr. Ivory, adjoining the railway, is a building of four stories in height, the roof of which was completely blown off, exposing the machinery and damaging seriously the ceiling and brickwork of the third storey. When this happened the proprietor and men were at dinner*, thus fortunately averting loss of life. A tree in front of Mr. Hollingsworth's house was limbed, one branch falling upon the carriage-house, upon which not a tile remained. An unfinished house opposite the pianoforte manufactory had all its back windows blown out, and all the sheds in the vicinity of this building lost some of their tiles or slates. In Lordship-lane considerable damage was also done to the trees. In a field opposite the "Nag's Head" stood a hay-stack, the thatching of which was all blown off, and the hurdles surrounding it blown in all directions. A magnificent willow which stood in front of Mr. Minnett's house in Lordship-lane, now presents an unsightly appearance; the greater part of its trunk has been broken off, and the upper part limbed. The field adjoining this house was strewed with small limbs of trees. At No. 1, Lindum-villas, the chimneys were broken off on a level with the roof, and blown down on the house. The hurricane seemed to have swept over in a straight line, beginning at the pianoforte manufactory, and ending its career in Lordship-lane. No damage seemed to have been done elsewhere but in the line indicated.†—*North Londoner*, October 22.

To the Editor of the Meteorological Magazine.

SIR,—The barometer here has been falling steadily since yesterday morning, with a special exception this afternoon. My readings for the day are—

7.50 a.m.	29·50
1.15 p.m.	29·38
1.30 p.m.	29·34
1.45 p.m.	29·32
2 p.m.	29·38
7 p.m.	29·33
8.30 p.m.	29·29

I was much struck with the rapid fall from 1.15 to 1.45 p.m. At 1.50 a violent squall with a very heavy rain passed over us, blowing down a wall, and by 2 p.m. it was gone, and the weather clearing.

The barometer is now falling again, the wind rising, and the weather looking threatening.

You may, perhaps, feel interested in this squall. The wind was south. My barometer has a wood scale; height above sea, 200 feet. Temperature, 55°.—Yours very faithfully,

THOMAS CRALLAN.

Hayward's Heath, Oct. 19th, 1870, 8.30 *p.m.*

[We shall be glad to receive further details of this storm, and should wish them to reach us by the 28th inst.—ED.]

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* Therefore it probably occurred between 1 and 2 p.m.

† This would be about from W. to E.

THE AURORÆ OF OCTOBER 24TH & 25TH.

In spite of ridiculous assumptions of the omniscience of the editorial *we*, there probably lives not an editor who does not feel that in spite of all his efforts he has not done full justice to many a subject which comes before him. We own to such a feeling with respect to the recent auroral displays. We have endeavoured to select from the mass of communications (with which we have been favoured) those which were most usefully descriptive, and we have doubled the size of our Magazine in order to insert them; but, after all, the delicate softness of many of the tints remain simply in memory's eye, for none can reproduce them, either verbally or by the brush; and the height and position of that glorious band are, as yet, undetermined. We hope that others more favourably situated than ourselves (in a Great Western express) have noted the positions of the streamers with sufficient accuracy to determine their height. Our only *exact* observations on the 24th, were:—At 8h. 18m. 50s., when between Twyford and Taplow, we noticed a white streamer shot vertically between Mizar and Alioth, Ursæ Majoris, and at 8h. 34m. 5s., between Langley and West Drayton, a red one, also nearly vertical, passed over the constellation Lacerta.

MALTA.—Last night (the 24th) there occurred a strong red light in the sky between 7 and 8 o'clock. Naval friends told me of this, and of their doubts as to whether it was an aurora borealis or an eruption of Etna, which would be visible from this place. This evening the light was far stronger, and I was able to observe it. It commenced very soon after dark, about 6.30, and at the time I am writing (9 p.m., 25th) there is but the faintest tinge of the light left. I obtained access, with some friends, to the top of the house, which is very lofty, and, from my view thence, I have little doubt it was an aurora borealis, as two rays were to be made out. The light was directly north as its centre, of a brick-dust red (it has been very hazy all day, and is so now). The people here are in much amazement; most believe in a great eruption of Etna; hence it is obviously very seldom that such a sight is seen here, and that it should occur two nights running surprises those who know the aurora borealis. If it be that, it has, no doubt, occurred with uncommon brilliancy in England, and it may be interesting to know that it has been seen here, so far south.—*R. H. Fawcett.*

NEWPORT, ISLE OF WIGHT.—This evening (October 24th), shortly after 8, I witnessed the grandest display of Northern Lights which has occurred here within the memory of persons of quite an advanced age, if not within that of the "oldest inhabitant." In the N.E. and W. the sky had the appearance of a distant conflagration, the usual tint being supplanted by a bright red. In the N. and near the horizon, its colour was pale green. At one time I remarked a band of primrose, or sulphur-hued, streamers in the vicinity of the pole star, flanked by others of a fiery red appearance. By 8.30, the heavens had regained much of their usual aspect. Barometer, 29·41 inch; temperature about 48°. The weather lately has been exceedingly stormy, and 4·35 inches of rain have fallen this month.—*E. G. Aldridge.*

CYNTHIA VILLA OBSERVATORY, WALTHAMSTOW.—A very fine aurora was visible here on the evening of October 24th (Monday), 1870, between 8 and 9 p.m. The peculiar magnetic or auroral light in the magnetic north was very vivid. I observed numerous auroral clouds (if the term may be permitted) deeply tinged with red, strikingly in contrast with the light in the north, in various parts of the heavens, particularly one a little south of the prime vertical, which covered the constellation Taurus, the light of the stars appearing as if impeded by a slight fog or mist.—*W. R. Birt.*

WINCHMORE HILL.—Most magnificent displays of aurora borealis were observed here last night and to-night. At 7 p.m. last night (24th), a bank of white light, extending from N. to W., rose to about 20°. At 8 p.m., an arch of brilliant red light stretched across the sky from N.N.E. to W.S.W., and pale waves of light rolled across the sky almost to the southern horizon, which continued till 8.30, when it faded away. At 11.15 p.m., it again became very bright. To-night the display was almost finer than that of last night. At 6.30 p.m., the whole sky was covered with a brilliant red light; streamers from all points of the horizon converging to a centre right overhead, presenting the appearance of a dome of fire. At 7.30, the sky unfortunately became cloudy in the west and north. Streamers were visible through the clouds, and the sky in the east and south continued tinged with deep red till 9 p m., when it became completely overcast. The light on both nights was almost as strong as that of the moon.—*Thos. Paulin.*

ORLETON.—The appearance of the aurora borealis on the 24th and 25th was very brilliant. The barometer, which had been very low the whole of the 23rd, began to rise very gradually on the 24th. After sunset there were a few dusky drifting clouds, with a brisk wind, but the sky was generally clear, and the north-western half was filled with a bright, diffused, auroral light, very red in the N.E. and W.S.W. Gradually deepening in these points and fading in the N.W. till about 8 p.m., when masses of rosy streamers shot up to the S.E. of the zenith, forming at times a bight corona, with one of the stars in Cassiopia nearly in the centre. This brilliant appearance continued, with rapid changes, for about 15 minutes, after which it gradually faded away, with much diffused light and occasional streamers till midnight. On the 25th, at a quarter before 6 p.m., the sky was again generally clear, with the same bright light in E.N.E. and S.S.W., and streamers to the zenith; but the arch formed by these was farther to the south-east than the one on the 24th, and the north-western part of the sky was more faintly illuminated. For 15 minutes the corona and streamers were very beautiful, but not so deep in colour as on the 24th, shooting up from the southern half more than from the northern half of the sky, and meeting to the S.E. of the zenith, at times like the ribs of a vast umbrella. After 6 p.m., the streamers began to fade into a steady diffused light, but they re-appeared occasionally from the N.W. till 10 p.m.—*Thos. Hy. Davis.*

SUTTERTON, SPALDING.—Fine aurora here last evening (25th). From six to seven p.m. the whole sky suffused with a lurid red tint. The appearance at this time very remarkable, owing to the mingling of what seemed to be cirro cumulus clouds with the auroral light. About 8 p.m., the phenomenon assumed the ordinary appearance of an irregular arc of light in N., resting on smoky-looking clouds below, and sending streamers from the upper edge, which reached up to, and beyond, the zenith. Gradually faded after 10 p.m. A remarkable feature was the continuance of great isolated masses of light in S. and S.W. after the main body of the aurora had become concentrated above the northern horizon.—*G. T. Ryves.*

WOLVERHAMPTON.—A few words about the aurora. The first day's display was, undoubtedly, the grandest, so far as the magnificent arch, which formed here about 8.10, and lasted, more or less perfect, for about 20 minutes; but, to my mind, the second evening's display was the most interesting. It began soon after sunset, and, from about 6 till nearly 10, was very beautiful. At no time was an arch completely formed, but in the zenith, or rather, about five degrees to the S.W. of the zenith, a most singular appearance was presented. It resembled the wing of a bird, the thick end being to the S.W. and streamers continually issuing from it in all directions except the S. and S.W. These streamers appeared to be met by other streamers issuing from banks of light cloud on the horizon. The incessant change of position and colour of the streamers was almost bewildering, and very beautiful to behold.—*John Thrustans.*

HAWSKER.—I shall not attempt to describe the indescribable aurora of the 25th, but there were some very unusual features about it which demand notice. In the first place, at 7 p.m. there was little to be seen in N., but an intense dark crimson in E. and S. At 9 p.m. there were white streamers (not corruscating) in N., but

the magnificent display was overhead. In the constellation of Andromeda there was a central point from which the rays, partly white and luminous, partly of the most beautiful and bright crimson, diverged to N. and E., partly to S., but principally to W. These appearances seemed to indicate that the aurora would be seen over a large area and very far to the south, which was actually the case.—*Fenwick W. Stow.*

SUNDERLAND.—The intense redness of the aurora of the 24th was most remarkable. I looked at its spectrum, and found that a red line, which is always visible in the spectrum of red auroræ, was unusually bright in the reddest parts, but in no part of the aurora, so far as I observed, did it exceed in brightness the yellowish-green line, which is characteristic of all auroræ. Besides these two lines, three fainter and more refrangible bands were visible. This magnificent aurora lasted throughout the night of the 24th, and the greater part of the next night.—*T. W. Backhouse.*

WREXHAM, NORTH WALES.—A most splendid aurora borealis was seen here last night, October 24th. Its greatest brilliancy was about 8 p.m., when the whole heaven, from N.E. through N. to W., was illuminated, the colours changing from a deep rose to orange and green, the last-named being especially noticeable towards the W. A perfect boreal crown appeared a little S.E. of the zenith, with pale streamers radiating to the brilliant arch of colour above mentioned. This is the finest aurora I have ever seen in this latitude. The wind at the time was N.W., fresh; barometer rising.—*Boscawen T. Griffith.*

MENAIFRON, CAERNARVON.—Soon after 8 p.m. on the night of October 24th, my attention was drawn to an extraordinary appearance of the sky, the greater part of which was of a blood-red colour. On closer examination, I found that streamers of a yellower hue shot across the red, radiating from a central point overhead, a little south of the zenith; these latter reaching, in places, down to the horizon, more especially towards east and west. The stars were visible through the reddest part, excepting where occasional heavy clouds, whose edges were, however, tinged with the prevailing tint, intervened. The wind was W.N.W. at the time, and blowing in heavy squalls. Barometer low (28·613), but rising; thermometer attached, 56°. The appearance continued about half-an-hour, when it gradually became fainter and finally disappeared. A similar sight was witnessed, but not by me, on the night of October 14th; and in a lesser degree on the nights of October 16th, 19th, and 21st. Three heavy gales and strong breezes occurred within that time.—*W. Wynn Williams.*

BLOOMSBURY, MOUNT ANVILLE, CO. DUBLIN. At about 7.40 p.m. (24th), the whole sky, from about S. by E. to S.E. by S. (northerly), was brilliantly illuminated, the brightest part being from E.S.E. to E.N.E., which appeared as a cloud of a fiery orange hue; also the same colour of a lighter shade to the S W., the southern edges of both clouds lightening into the usual colour of the sky; the interval towards the north being filled with streamers of white, culminating in a ragged cloud, slightly to the S. and E. of the zenith. During a portion of the time the aurora was visible (which was not more than ten minutes from the time I first saw it) there was a horizontal flickering of white light from about 70° to the zenith. At the time of the appearance the barometer stood at 29·22 (rising), thermometer 44°, wind W.N.W.—*J. Wensley Bond.* P.S.—I have since heard that the aurora was visible from 6 p.m., but I did not see it.—J. W. B.

THE BRITISH ASSOCIATION AT LIVERPOOL.

(*Concluded from p.* 139.)

Rainfall of the United States. By Professor HENRY.—Professor Henry gave an extremely interesting account of the steps which he has taken to collect and discuss the observations of rainfall made in the United States. As we hope on an early occasion to be able to refer to the matter more fully, we will merely state that he has for some time past had a staff of six or seven computers engaged in collecting and discussing all the observations hitherto made in the States, and

that charts showing the results thence deduced are nearly ready for publication. Professor Henry also explained the steps which he was taking (by the issue of identical instruments to be placed uniformly) to ensure improved accuracy in future observations.

On Barometric Predictions of Weather. By Mr. GALTON.—The barometer corresponds, not with the tumultuous changes of the weather, but with those of its average quality. Numerous trials showed the period of time for which the averages should be taken to be about twelve hours; and the correspondence of a curve drawn on that principle with the barogram was fairly satisfactory. The flexures of the two curves are, on the whole, simultaneous, since neither curve habitually anticipates the other, but seldom absolutely simultaneous. They correspond in extreme positions as closely as in near ones, proving that it is not the absolute height of the barometer, but the variation in its successive heights, which indicates change of weather. The superior influence of the wind upon the barometer over both temperature and damp was remarkably apparent by the help of these curves. Lastly, the influences of temperature and damp were shown to conform to the already described period of twelve-hour averages. A simple formula for the prediction of weather for the next six hours was constructed upon these data. It included (1) the difference between the first and second of two barometric readings taken six hours apart; (2) that between the average wind velocity during two periods (which we may call c and a) of six hours each, c succeeding the last barometric reading, and a preceding the first reading, the intermediate period b necessarily disappearing from the formula; (3) half the difference between the average temperatures during c and a; (4) the same as regards vapour tensions. Then, it was shown that (1) was equal to the term of the remainder when the barometer and vapour tension are reckoned in hundredths of an inch, the velocity in miles per hour, and the temperature in degrees Fahrenheit. A calculation was made with the above formula to determine the average velocity of the wind for a large number of six-hour periods, and the predictions were compared with the facts. It was found that the average error of the predictions was one-third larger than if the observer had simply guessed that the average wind velocity would continue unaltered for the next six hours. The reason why the errors are so large is, first, that correctness in the result depends on the correctness of all the elements of the formula, but the values of these are only true on the average, while in each particular and in each case there will be more or less deviation from that average; secondly, any error in the expectation of the twelve-hour average is, on the whole, doubled in the six-hour prediction, because the difference between what is expected of the whole and what was fulfilled in the first half of it, is heaped on to the second half, which has therefore to bear an additional error, equal to what rightly belongs to it. The fame of the barometer is due to its success in predicting a type of storm very rarely met with in the British Isles, but frequently in hurricane latitudes, when the fall of the mercury far outstrips the increasing severity of the weather. In ordinary gales, and much more in ordinary weather, the author considered the barometer to be useless as a guide, when consulted without a knowledge of what is occurring at adjacent stations; in short, without such information as is supplied by the "Daily Weather Report."

On Atmospheric Currents. By Mr. J. K. LAUGHTON.—In examining into the geographical distribution of winds, we must bear in mind that well-attested and careful observation is the only satisfactory basis, and that descriptions founded on theoretical opinions are of no value whatever. If we refer Hadley's Theory of the Trade Winds to this test, we find, in the first place, that the effect of heat in producing wind is not quite such as has been represented. Experimentally, heat does not produce a blast, unless the space between the heat and cold air be very confined, as is roughly shown by holding a newspaper before the fire. Geographically, heat does not cause a wind towards any of the principal areas of greatest temperature; either towards the Great African Desert, the Desert of Arabia, or of Australia, towards the Red Sea or the Persian Gulf, or even, when carefully traced, towards the Great Prairie of North America. In the second place, we

find that the effect attributed to the rotation of the earth is not consistent with numerous observed facts, such as the S.E. wind in the Gulf of Mexico, the N.W. wind on the coast of North Africa, the N.W. gales in the North Atlantic, the S.W. wind on the south coast of Australia, and very many others; and, indeed, the idea appears to have originated in a temporary forgetfulness of the power of friction, which in the case of air and all fluids is very intense.

Winds, which, in accordance with Hadley's theory, have been very generally divided into *polar* and *equatorial*, seem more naturally to divide themselves into *easterly* and *westerly*; and it is this division which has, from the days of Columbus, been adopted by really practical men, to whom the winds were matters of fact, not of mere theory; but the trade-winds—having attracted early notice by their very great steadiness and regularity—have always been considered as the direct manifestations of the first cause, whatever it might be, of the great atmospheric movements; the westerly winds, which were not discovered till much later, having been considered as secondary and comparatively of little importance. But, as our experience grows larger, we learn that the westerly winds have an extent and a strength and a rude vigour incompatible with the idea of their secondary nature. Whether in the northern or southern hemisphere, they are exceedingly violent and boisterous; and, without considering the Arctic and Antarctic regions, concerning which we have not sufficient evidence, they extend from 60° N. to 60° S., interrupted only by the trade-winds, which blow over an area large indeed, but small *in comparison* with that on which they intrude. The trade-winds are also of very limited height, whilst above them the westerly winds blow as strongly as they do in the temperate zones, where they reach into the upper strata of the atmosphere as far as we have any knowledge. We are thus led towards the conclusion that the westerly winds are really the primary winds, far extending and boisterous; whilst the quiet equable trade-winds—of very limited volume—are reflex streams of air caused by the impact of the great westerly winds on the continental barriers, whether against mountain ranges or the more sluggish air which lies over the land. The Atlantic Ocean affords us the most familiar illustrations of this; where we see the main westerly stream dividing on about the parallel of 45° N., and turning north, as a south-westerly wind on our coasts, and the coast of Norway; or south, as a north-west and northerly wind on the coast of Portugal, and a north-easterly on the coast of Africa; whilst the rest of it forces its way onward, a westerly wind over Northern Europe and Asia, or a northerly deflection in the several basins of the Mediterranean. On the other hand, on the extreme west, the westerly wind continually dragging away the air from the eastern side of the Rocky Mountains, causes such a tendency towards a vacuum, that the air from the south and north is induced towards it, and the wind over Western America rules from the south or north, according as the season throws the axial line of the temperate zone to the north or south of its mean position. Examining at great length into the various local winds and irregularities in the different parts of the world, we arrive at the conclusion that the whole atmosphere has a continued tendency to move from west to east, and does so more when it is not interrupted. The interruptions are of two kinds: one occasional and irregular, being caused by fluctuations in the hydrostatic condition of the air, the other permanent or seasonal and regular, caused by the pressure of lines of coast and mountain ranges.

It is impossible to say definitely why the atmosphere should have this prevailing motion; but if the cause is neither heat nor the influence of the earth's rotation, nor any agency which we can detect at work on the earth, we are driven almost insensibly to the belief that it must be the result of celestial attraction; and the fact that the barometer shows no trace of any noteworthy rise or fall, as of an atmospheric tide, suggests that the atmospheric currents, which must necessarily be formed by the action of such an intense disturbing force, do not in any way clash, but flow uninterruptedly onwards in one certain direction, either towards the east or towards the west. All observation shows us that there is not a permanent current towards the west, but that there is one towards the east; and although we are unable at present to master all the details of the manner of the motion, the evidence of geographical fact, combined with that of astronomical possibility,

justifies us in inclining towards the belief that the motive force for which we are seeking is really the disturbing force of the attraction of the heavenly bodies.

Third Report of Underground Temperature Committee. — This was read by Professor J. D. Everett, the Secretary of the Committee. — Mr. G. J. Symons, whose observations, extending to a depth of 1,100 feet in a well at Kentish Town, were reported at last meeting, has since repeated his observations at several depths.

The first 210 feet of the well (which is eight feet in diameter to the depth of 540 feet) are occupied by air, and in this portion of the well the second series of observations give temperatures exceeding those observed in the first series by from 2° to 5°, the excess diminishing as the depth increases. The second series were taken in July and August, whereas the first series were taken in January. It is evident that, in this portion of the well, in spite of the precautions taken to exclude atmospheric influences, by boarding over the well and erecting a hut over it, the temperature varies with the seasons, the variations being in the same direction as in the external air, but smaller, and diminishing as the depth increases, but still amounting to 2°·2 at the depth of 200 feet.

We can feel no certainty that even the mean annual temperature in this portion of the well represents the temperature in the solid ground. On the contrary, the mean temperature in the well at any depth is probably intermediate between the temperature of the solid ground at that depth and the mean temperature of the external air.

It is well that such observations should have been carefully made and recorded in this one instance, if only for the sake of warning; and they show that we cannot expect to attain the object for which the Committee has been appointed by observations in large shafts filled wth air.

Mr. Symons has also repeated the observations at 250 feet (which is 40 feet under water), and at the depths of 600 feet, 750 feet, and every fiftieth foot from this to 1,100 feet, which is the lowest point attainable on accounnt of the mud, which extends 300 feet lower. The differences from the results obtained last year are +·2, —·3, —·4, —·2, — ·2, 0, —·1, —·1, 0; which, upon the whole, strongly confirms the correctness of the observations.

The temperature at 1,100 feet is 69·8, which, if we assume the mean temperature of the surface of the ground to be $\left\{\begin{matrix}50°\\49°\end{matrix}\right\}$, gives a mean increase downwards of $\left\{\begin{matrix}\cdot0180\\\cdot0189\end{matrix}\right\}$ of a degree Fahrenheit per foot, or 1° for $\left\{\begin{matrix}55\cdot5\\52\cdot9\end{matrix}\right\}$ feet.

The curve in which temperature is the ordinate and depth the abscissa, exhibits considerable irregularities till we reach the depth of 650 feet, beyond which it is nearly a straight line, and represents an increase of ·0187 of a degree per foot.

The strata penetrated by the well to the depth to which our observations extend, consist of clay, sand, chalk, and marl, besides flints. (See tabular list appended.)*

Mr. Symons, in his report, calls attention to the anomalous position of a column of water, increasing in temperature and, consequently, diminishing in specific gravity downwards, and suggests the inquiry why the warmer and lighter portions do not ascend to the top? The proper reply seems to be that the diminution of specific gravity, amounting to less than one part in 50,000 per vertical foot, does not furnish sufficient force to overcome liquid adhesion, and the water is thus able to remain in unstable equilibrium.

Mr. Symons intends during the remainder of the present year, verifying those of his observations which have not yet been repeated, and concludes his report by remarking that it appears desirable to ascertain by observations from year to year, whether the temperature at a given depth (say 1,000 feet) remains constant or is subject to minute changes, periodical or otherwise—a suggestion which appears fully worthy of being carried out.

Mr. Wm. Bryham, manager of Rosebridge Colliery, Ince, near Wigan, has taken very valuable observations during the sinking of that colliery, which is now the deepest excavation in Great Britain. The principal results have already been

* This was given in *Met. Mag.*, Vol. III., p. 176.

given in a paper to the Royal Society by Mr. Edward Hull, director of the Geological Survey of Ireland, who had previously published some important contributions to our knowledge of underground temperature; and has now consented to become a member of this committee. Some of the depths have, however, been re-measured since Mr. Hull's paper was read, and we are now enabled, through the kindness of Mr. Bryham, to furnish a rather a rather more accurate report.

The temperatures observed, and the depths at which they were taken, are as follows :—

Depth in yards.	Temp. Fahr.	Depth in yards.	Temp. Fahr.
161	(64½)	734	88½
200	(66)	745	89
558	78	761	90½
605	80	775	91½
630	83	783	92
663	85	800	93
671	86	806	93½
679	87	815	94

All these temperatures, except the first two, were observed during the sinking of the shaft, by drilling a hole with water, to the depth of a yard, in the solid strata at the bottom. A thermometer was then inserted, the hole was tightly plugged with clay so as be air-tight, and was left undisturbed for half-an-hour, at the end of which time the thermometer was withdrawn and read—a mode of observation which appears well adapted to give reliable results. With respect to the temperatures at 161 and 200 yards (which are enclosed in brackets to indicate uncertainty), Mr. Bryham says that he has some doubt as to the correctness of the thermometer with which they were taken, and that they were not taken in the shaft at the time it was sunk, but in the seams at the depths named.

Assuming the surface temperature to be 49°, we have, on the whole depth of 815 yards, or 2,445 feet, an increase of 45°, which is at the rate of ·0184 of a degree per foot, or a degree for every 54·3 feet.

On plotting the temperature curve, including the two observations marked as doubtful, we find that it naturally divides itself into four portions, which are approximately straight lines.

The most remarkable of these portions is the second from the top, extending from the depth of 161 yards to that of 605 yards. It embraces 1,332 feet, and shows an increase of only 1° for every 86 feet.

The third portion, extending from the depth of 605 yards to that of 671 yards, covers only 198 feet, and shows an increase of 1° for every 33 feet.

The lowest portion extends from the depth of 671 yards to 815 yards. It covers 432 feet, and shows an increase of 1° in 54 feet.

The topmost portion will be affected by the assumption we make as to surface temperature. Assuming this as 49°, it shows an increase of 1° in 31 feet.

It is interesting to compare the Rosebridge observations with those previously made by Mr. Fairbairn at Astley Pit, Dukinfield, Cheshire, which have been described by Mr. Hull in "The Coalfields of Great Britain," and by Mr. Fairbairn himself in the B. A. Report for 1861. The results have been thus summed up by Mr. Hull :—

1. The first observation gives 51° as the invariable temperature throughout the year at the depth of 17 feet. Between 231 yards and 270 yards the temperature was nearly uniform at 58·0. And the increase from the surface would be at the rate of 1° F. for 88 feet.
2. Between 270 and 309 yards, the increase was at the rate of 1° for 62·4 feet.
3. ,, 309 and 419 ,, ,, ,, 1° for 60 ,,
4. ,, 419 and 613 ,, ,, ,, 1° for 86·91 ,,
5. ,, 613 and 685 ,, ,, ,, 1° for 65·6 ,,

The result of the whole series of observations gives an increase of 1° for every 83·2 feet.

Mr. Fairbairn's own summary is as follows:—"The amount of increase indicated in these experiments is from from 51° to 57¾°, as the depth increases from 5⅔ yards

to 231 yards, or an increase of 1° in 99 feet. But if we take the results which are more reliable, namely, those between the depths of 231 and 685 yards, we have an increase of temperature from 57¾° to 75½°, or 17¾° Fahrenheit. That is a mean increase of 1° in 76·8 feet."

Mr. Fairbairn here, by implication, throws doubt on the alleged invariable temperature of 51° at the depth of 17 feet, a determination which, in itself, appears highly improbable, seeing that at Greenwich the thermometer, whose bulb is buried at a depth of 25·6 feet, exhibits an annual range of 3°·2, while that at the depth of 12·8 feet exhibits a range of 9°. But even if we assume the mean surface temperature to be 49°, we have still upon the whole depth an increase at the rate of 1° in 80 feet, as against 1° in 54·3 feet at Rosebridge.

Mr. Fairbairn's paper gives also the results obtained at a second pit at Dukinfield, which agree with those in the first in showing an exceptionally slow rate of increase downwards. The temperatures at the depths of 167½ yards and 467 yards were respectively 58° and 66½°, showing a difference of 8½° in 299½ yards, which is at the rate of 1° in 106 feet. The increase from the surface down to 167½ yards, assuming the surface temperature as 49°, would be 9°, or 1° in 56 feet, and the mean rate of increase from the surface to the bottom would be 1° in 80 feet, the same as in the first pit.

A tabular list of the strata at Rosebridge is appended to this report. A full account of the strata at Dukinfield is given in Mr. Fairbairn's paper (B. A. Report, 1861).

With strata so nearly similar and in two neighbouring counties, we should scarcely have expected so much difference in the mean rates of increase downwards. In this respect, Rosebridge agrees well with the average of results obtained elsewhere. Dukinfield far surpasses all other deep mines or wells, so far as our present records extend, in slowness of increase.

This implies one of two things, either that the strata of Dukinfield afford unusual facilities for the transmission of heat, or that the isothermal surfaces at still greater depths dip down in the vicinity of Dukinfield.

Mr. Hull has called attention to a circumstance which favours the first of these explanations, the steepness of inclination of the Dukinfield strata. He argues, with much appearance of probability, that beds of very various character (sandstone, shales, clays, and coal), alternating with each other, must offer more resistance to the transmission of heat across than parallel to their planes of bedding, as Mr. Hopkins has shown that every sudden change of material is equivalent to an increase of resistance; and it is obvious that highly inclined strata furnish a path by which heat can travel obliquely upwards without being interrupted by these breaches of continuity.

To this suggestion of Mr. Hull's it may be added that inclined strata furnish great facilities for the convection of heat by the flow of water along the planes of junction. It appears likely that surface water, by soaking downwards in this direction, may exercise an important influence in assimilating the temperature at great depths to that which prevails near the surface. Mr. Hull's own statement of his views is given in the foot-note below.*

* "Rosebridge Colliery occupies a position in the centre of a gently-sloping trough, where the beds are nearly horizontal; they are terminated both on the west and east by large parallel faults, which throw up the strata on either side. The colliery is placed in what is known as the 'deep belt'

"Dukinfield Colliery, on the other hand, is planted upon strata which are highly inclined. The beds of sandstone, shale, and coal rise and crop out to the eastward at angles varying from 30 to 35 degrees. Now, I think we may assume that strata consisting of sandstones, shales, clays, and coal, alternating with each other, are capable of conducting heat more rapidly along the planes of bedding than across them, different kinds of rock having, as Mr. Hopkins's experiments show, different conducting powers. If this be so, we have an evident reason for the dissimilar results in the case before us. Assuming a constant supply of heat from the interior of the earth, it could only escape, in the case of Rosebridge, across the planes of bedding, meeting in its progress upwards the resistance offered by strata of, in each case, varying conducting powers. On the other hand, in the case of Dukinfield, the internal heat could travel along the steeply-inclined strata themselves, and ultimately escape along the outcrop of the beds.

"I merely offer this as a suggestion explanatory of the results before us, and may be allowed to add that the strata at Monkwearmouth Colliery, the thermometrical observations at which correspond so closely with those obtained at Rosebridge, are also in a position not much removed from the horizontal, which is some evidence in corroboration of the views here offered." —*Proc. Roy. Soc.* Jan 27th, 1870.

Mr. McFarlane has been prevented from continuing his observations near Glasgow during the past year by the press of business incident to the removal from the old to the new college.

Mr. F. Amery, Druid House, Ashburton, Devon, has taken some observations with one of the Committee's thermometers in the shaft of a mine which had been unused for a year, and was nearly full of water. The shaft is 12 feet × 7 feet, and descends vertically for 350 feet, after which it slopes to the south at an angle of 50°, continuing to the depth of 620 feet. The water stood at 50 feet from the surface. Mr. Amery observed the temperature at every 50th foot of depth in the vertical portion, and found it to be 53° at all depths, except at 250 feet and 200 feet, where it was 53°·4 and 53°·2 respectively. A copper lode crosses the shaft at the depth of 250 feet, and it appears to be generally the case in the Cornwall and Devonshire mines, that copper lodes exhibit a high temperature, a circumstance which Professor Phillips explains by the conformation of the strata, which is such as to cause water from greater depths to make its way obliquely upwards by following the course of the copper lodes.

The nearly constant temperature observed from the surface to the bottom of the the shaft seems to indicate a large amount of convective circulation. In this respect small bores have a decided advantage.

Mr. G. A. Lebour has taken observations with one of our thermometers in several shafts and bores near Ridsdale, Northumberland, made for working coal and ironstone. Mr. Lebour does not report the temperatures observed, which he characterises as discrepant and utterly valueless, owing, he believes, to the numerous water-bearing beds which they cut through, and the very varying temperature of these waters. Having now, however, found a dry bore, he hopes to make a useful series of observations next winter.

One of the Committee's thermometers has recently been sent to Mr. John Donaldson, C.E., Calcutta, who has expressed his desire to aid in scientific observation, and, being now engaged in examining for coal and iron under government, is likely to render us effective service.

Shortly after the last meeting of the Association, the Secretary of this Committee addressed a letter to Professor Henry, Secretary of the Smithsonian Institution, U.S., requesting his co-operation in furthering the object which the Committee have in view, at the same time forwarding one of our protected thermometers.

In June of the present year, an answer was received from Professor Baird, Assistant Secretary in charge, to the effect that Professor Henry's ill-health during the present season had prevented his communicating to us the results of his labours in response to request.

The letter addressed to Professor Henry made special reference to an artesian well of extraordinary depth which was understood to be in course of sinking at St. Louis, and, at the same time, a letter was addressed, and a special thermometer sent to Mr. C. W. Atkeson, the superintendent of the work of boring at St. Louis. No reply has been received from Mr. Atkeson, who appears to have left St. Louis before the letter arrived; but letters have been received through the Smithsonian Institution from Dr. Charles W. Stevens, superintendent of the County Insane Asylum at St. Louis, this being the institution for whose uses the well was sunk, together with a very interesting newspaper cutting, consisting of Mr. Atkeson's report on the works. The boring of the well was commenced (at the bottom of a dug well 71½ feet deep) on the 31st of March, 1866, and was continued till the 9th of August, 1869, when the work was stopped at the enormous depth of 3,843½ feet, exceeding by more than one-half the depth of Dukinfield Colliery. The strata penetrated consisted in the aggregate of 63 feet of clay, 6 feet of coal, 380 feet of shales, 2,725 feet of limestone, and 620 feet of sandstone.

A cast iron tube of 11½ inches bore was first put down, reaching from the top and secured in the limestone at the bottom. This tube was then lined inside with a wooden tube, reducing the bore to 4½ inches. A 4½-inch drill was put down through this tube on the above-mentioned date. The bore was afterwards enlarged to 6 inches, and subsequently to 11½ inches to a depth of 131½ feet. A sheet-iron tube was then put down, extending from the top to this depth, and the

bore below was enlarged first to 6 and afterwards to 10 inches diameter, to the depth of 953 feet. A sheet-iron tube, 79 feet long, was then put down, which rests on the offset at the bottom of the 10-inch bore. The 4½-inch bore was then enlarged to 6 inches to the depth of 1,022 feet, and a wrought iron tube of 5 inches bore, weighing more than six tons, was introduced, reaching from the top and resting on the offset at the bottom of the 6-inch bore, thus securing the work to this depth, and reducing the bore to convenient size to work in. The 4½-inch bore has been continued to the depth of 3,843 feet 6 inches without further tubing.

At the depth of 3,029 feet the first observation of temperature was taken, and the reading of the thermometer was 107° F. This first observation is stated by Dr. Stevens to be specially worthy of confidence, as having been confirmed by several repetitions, or rather, to use Dr. Stevens's own words, "this was the maximum of several trials." It was taken, as well as those that followed it, by means of a registering thermometer (kind not mentioned); but in answer to our inquiries, Dr. Stevens states, upon the authority of the carpenter who attached the thermometer to the pole by which it was lowered, "that no means were taken to defend the bulb from pressure." In the absence of further information (and Mr. Atkeson himself has not yet spoken), we can place no reliance upon the temperature recorded, as the thermometer had to bear a pressure of three-fifths of a mile of water.

The temperatures registered at lower depths, the deepest being 800 feet lower, were all, strange to say, somewhat lower than this, a circumstance which is all the more remarkable because the pressure (which tends to make the reading higher) must have increased with the depth. At the bottom, or rather at 3,837 feet, being 6½ feet from the bottom, the temperature indicated was 105°. Either of these results, taken apart from the other and compared with the surface temperature, would give a result not improbable in itself. The mean temperature of the air at St. Louis appears to be about 53°, but it seems desirable to avoid publishing calculations till the data are better established.

Unfortunately, the apparatus which was employed in boring has all been removed, after the insertion of two wooden plugs, with an iron screw at the upper end of each, one at the offset at a depth of 1,022 feet, and the other at the offset at the depth of 953 feet, for the purpose of separating the fresh from the salt waters. These plugs were driven in with great force, and can only be withdrawn with the aid of a series of poles and other appliances, such as were used in the boring, which will be rather costly. The poles alone are estimated to cost $1,152, or about £200. If the plugs were withdrawn—and, according to Dr. Stevens, there is nothing but the expense to prevent—the whole well would be available for observation. The Committee will make every effort to prevent so rare an opportunity from being lost.

The Secretary has also been in correspondence with Messrs. Mather and Platt, of Salford Iron Works, respecting a boring at Moscow, for which they have furnished machinery, and which is to be carried to the depth of 3,000 feet. They refer to General Helmerson, of the Mining College, St. Petersburgh, as the best authority to whom application can be made for particulars of the Moscow boring as to temperature, &c. The Secretary has, accordingly, written to General Helmerson, endeavouring to interest him in the objects of the Committee, and offering to forward thermometers. No reply has yet been received.

An element which it is necessary to know, with a view to the correct reduction of our observations, but which in many instances it is difficult to obtain by direct observation, is the mean annual temperature of the ground at, or near, the surface. Instances frequently occur in which the temperature at the depth of 200, 300, or it may be 500 feet is accurately known, while the temperature in the superincumbent strata can only be guessed at. This is the case at the Kentish Town well, and partially at Rosebridge and Dukinfield Collieries.

It is very desirable that in connection with temperatures at great depths there should in each locality be an accurate observation at the depth of from 50 to 100 feet. At such depths in the solid ground before it has been disturbed by mining operations, one observation suffices to give a good approximation to the mean temperature of many years. At depths of two or three feet it is necessary to observe,

once a week or so, throughout the year, in order to get the mean temperature at that depth for that year; and this may differ by a considerable amount from the mean of a series of years.

In the Report of the Scottish Meteorological Society for the quarter ending December, 1862, there is a comparison of the mean temperature of the air with that of the soil at the depths of 3, 12, and 22 inches, at four stations, from observations extending over 5 years; and in the Journal of the same society for the quarter ending December, 1865, there is a comparison of the temperature of drained and undrained land from one year's observations, undertaken for this purpose, at two stations, and including also a comparison with the temperature of the year. The mean temperature of the air for each day, is, in these comparisons, assumed to be the simple arithmetical mean of the maximum and minimum as indicated by self-registering thermometers 4 feet from the ground. From these observations, it appears that the mean annual temperature of the soil was, in every case, rather above that of the air, and that the excess was greater for sand than for undrained clay, and was greater for drained land than for the same land undrained.

The greatest excess occurred in the case of the 22 inch thermometer at Nookton (Vale of Leven), where both surface and subsoil are sandy and dry. The five yearly means at this station were :—

Air, 46°·1; soil at 3 inches, 46°·3; at 12 inches, 47°·3; at 22 inches, 48°·0; giving an excess of 1°·9 for the temperature at the depth of 22 inches as compared with air.

The smallest excess, in the case of the 22 inch thermometers, observed for five years, was at Linton (East Lothian), where it amounted to 0°·7; but the observations on the effect of drainage gave for the year of observation an excess of only 0°·2 at the depth of 30 inches in light sandy, but undrained, soil under a rye-grass crop, at Otter House, near Loch Fyne, the corresponding excess for drained land of the same kind and in the immediate vicinity being 0°·9.

The mean temperature at the depth of 3 feet at Professor Forbes' three stations at Edinburgh, from five years' observations, gave an excess of 0°·55 above the mean temperature of the air at Edinburgh as determined by Mr. Adie's observations.

Observations on soil temperature in England are much needed, but the Greenwich observations give an excess of soil above air temperature falling within the limits above quoted, the excess at 3 French feet being 1°·7, while at 24 French feet it is reduced to 1°. The soil of which the Observatory Hill is composed, and in which the thermometers are sunk, is dry gravel, and the unusual circumstance of decrease of temperature downward observed in the comparison of the 3 feet and 24 feet thermometers, seems to indicate that the surface of the hill is warmer than the surrounding land.

In the present state of our knowledge, then, it appears that when the temperature of the earth has been observed at a depth of some hundreds of feet in any locality in Great Britain, and has not been accurately determined at a less depth, some knowledge of the rate of increase downwards may be obtained by assuming provisionally that the mean temperature of the surface is about a degree higher than the mean temperature of the air, supposing the latter to be known.

It is to be wished that the Meteorological Society, would, from the ample materials in their possession, publish a map of annual isothermals for Great Britain; and the objects of this Committee would be greatly furthered by an extensive series of soil temperature observations at the depth of about 3 feet.

The Committee are anxious to carry into effect Mr. Hull's proposal (quoted in their last Report) to bore down from the bottom of a deep mine; and as Rosebridge Colliery appears to be an eminently suitable locality for such an operation, the Secretary has consulted Mr. Bryham respecting its practicability and probable cost. Mr. Bryham's reply is, that there would be no difficulty in carrying out the proposal at Rosebridge, that to make preparations and bore 300 feet would, on a rough estimate, cost £150, and that the second 300 feet would probably cost about the same sum.

The Committee would earnestly appeal to the liberality of the Association to enable them to put this design in execution, and they would remark that the sooner it is carried out the more valuable the results obtained will be, as the mine

has been but recently opened to its present depth, and the influence of atmospheric temperature will every year become more sensible in the strata below.

At the conclusion of the report, Professor Bolzani (of Kazan) and Mr. C. W. Siemens, F.R.S., suggested the employment of certain forms of electro-thermometers, and pointed out the advantages which they considered would result from their employment.

We may mention that subsequently the General Committee passed a grant of £150 for the purpose of carrying out Mr. Hull's suggestion at Rosebridge Colliery.

On the Great Movements of the Atmosphere. By A. BUCHAN, F.R.S.E.—Mr. BUCHAN gave a succinct resumé of the principal results contained in his paper of Barometric Pressure recently printed in the *Phil. Trans. of the Royal Society of Edinburgh*, which has already been fully noticed in these pages. Under these circumstances, lengthened report of his excellent Liverpool address seems unnecessary.

On the Temperature of the Air at 5 ft., 22 ft., and 50 ft. above the Ground. By Mr. J. GLAISHER.--In the Report to the British Association for 1866 (the last of the Balloon Reports), the author maintained that the law of decrease of temperature with increase of elevation was variable throughout the day, and variable in different seasons of the year ; that at about sunset the temperature was nearly the same up to 2,000 feet ; and that at night (from the only two night ascents) the temperature of the air increased from the earth upwards. It was therefore evident that, instead of a few ascents being necessary only, a larger number were required than it was possible for him to make. Fortunately, in the second year of the balloon experiments, he planted at the Royal Observatory, Greenwich, a dry and wet bulb thermometer, at the height of 22 feet above the soil ; and since then readings have been taken daily of these instruments at the hours of 9 a.m., noon, 3 p.m., and 9 p.m. Sometimes readings at the higher point were above those at 4 feet from the ground ; but no reductions were made until after the observations had been made by M. Giffard's captive balloon, which proved that the decrease of temperature with increase of elevation had a diurnal range, and was different at different hours of the day ; the changes being greatest at about mid-day, and least at or about sunset (see Report for 1869), whilst sensible changes occurred within 30 feet of the earth. In consequence, the observations made at the height of 22 feet were reduced by taking the difference between the readings of the two thermometers, and affixing the sign *plus* (+) to that difference when the temperature was higher at the higher elevation ; and the sign *minus* (—) when *vice versâ*. All the observations made in the years 1867-70 were treated in this way. On taking the monthly means of these differences, it was found that the *mean* temperature of the air at 22 feet high was higher than at 4 feet. At all hours of the day and night, during the months of January, February, November, and December ; in the early afternoon and during the night in the months of March, April, August, September, and October ; and in the evening hours (5th to 7th), and during the night in May, June and July ; and that the results in one year agreed very closely with those in the same months in the other years. By selecting the greatest number with a + sign, and the greatest number with a — sign in each month, it was found that in the winter months the temperature at 22 feet high ranged from 2 to 3 or 4 degrees above, and from 1 to 2 degrees below, that at 4 feet, and in the summer months from 4 to 5 degrees above, to 4 or 5 degrees below, that at 4 feet high. The ratio of minus readings to plus readings was in January and February 1 to 5 in all hours. In March, April, August and September during the day one of equality. In May, June and July during the day hours the ratio was 3 to 2 ; in October 1 to 4 ; in November 1 to 7, and in December 1 to 10. At the hour of 9 p.m. throughout the year it was 1 to 7. Thus the minus sign preponderates; indicating low temperature above during the day hours in the months of May, June and July ; the minus and plus are about equal in number in the months of March, April, August and September ; and the plus sign preponderates, indicating greater warmth above, during the day and night in January, February, October, November and December, and during the night throughout the year. A second thermometer, properly protected from radiation,

was placed in the middle of the year 1869 at the height of 50 feet, and since then its readings have been regularly taken. The mean monthly temperatures of the air at 50 feet high were found to differ from those at 4 feet, as follows :—

	At 9h. a.m.	At Noon.	At 3h. p.m.	At 9h. p.m.
1869, October	+0°·2	−0°·5	+0°·7	+1°·5
,, November	+0°·6	+0°·5	+0°·8	+1°·4
,, December	+0°·9	+0°·3	+0°·5	+0°·5
1870, January	+1°·1	+0°·3	+0°·7	+0°·9
,, February	+0°·1	−0°·3	+0°·3	+0°·5
,, March	−0°·3	−1°·8	−0°·7	+0°·7
,, April	−0°·9	−2°·2	−1°·7	+1°·4
,, May	−2°·4	−3°·6	−2°·8	+1°·1
,, June	−2°·4	−3°·8	−3°·1	+1°·1
,, July	−1°·8	−2°·9	−2°·8	+1°·1
,, August	−1°·7	−2°·7	−2°·0	+1°·7

Thus we have the unexpected result that the mean monthly temperature of the air at 22 feet and at 50 feet high is higher during the evening and night hours throughout the year than at the height of 4 feet, and also higher night and day during the winter months. By selecting those days with a sky covered by dense clouds, it was found that there was on such days no difference between the temperature at 4 feet, 22 feet, and 50 feet high. At the height of 50 feet, in the summer months, the temperature during the day was frequently 6 and 7 degrees lower than that at 4 feet, and at night 5 or 6 degrees higher.

In the discussion, Prof. Bolzani, of Kazan, said he considered the observations treated, and the conclusions drawn from them, important, and that they should be continued and extended in the way Mr. Glaisher indicated. He had himself been trying to make observations in balloons, having heard from Mr. Glaisher and other members that such observations made in the interior of the great continent would be of value. He obtained a grant from the Minister for Public Education, and had constructed instruments for observations of temperature and pressure of the atmosphere up to a height of 1,000 feet, with a captive balloon. The thermometer is on Mr. Siemens's principle, and is read on the ground by means of a galvanometer connected with the instrument, and attached to the balloon by a wire in the cable of the balloon. By using Wheatstone's balance, in a way also indicated by Mr. Siemens, he is able to get rid altogether of the influence of the intermediate strata. The instrument for pressure is new, and constructed on the same principle. As he was only able to perfect the arrangements before starting on his journey here, he had as yet no observations to lay before the Section, though he hoped to be able to produce some at the next meeting, when the construction of the instruments will be illustrated by diagrams. With regard to greater heights, he trusted also to be able to make some ascents at Kazan, as he hoped, with the help of some members of the British Association and with part of the money granted, to procure a balloon of larger size.

A Proposed Re-arrangement of the Registration Districts of England and Wales for the purpose of facilitating Scientific Enquiry. By ALFRED HAVILAND.—The author commenced his discourse by stating that the registration districts of England and Wales were formed for the general purposes of the Poor Law Administration, and therefore it could not be expected that they were planned with any view of assisting science ; they had, however, done so when in their present crude and artificial form, and it was generally believed among scientific men that if their boundaries were determined on a natural system, the advantages to meteorology, climatology, and other branches of science, would be incalculable, and the expense and confusion of constant alterations avoided. Messrs. Keith Johnston had lately been much engaged by him in the rectification and completion of the registration maps of England and Wales, for the purpose of insuring extreme accuracy in his basis map of the geographical distribution of disease in England and Wales. This had involved him in a considerable extra outlay, but through the recommendation of the Registrar-General, the Treasury, seeing the necessity of the

work, had expressed their approval of a grant being paid to Mr. Haviland for the extra expenses incurred. He urged that the artificial system adopted in defining the boundaries of the registration districts had been the cause of all this extra work and expense, and that it had nothing whatever to recommend its continuance; on the contrary, it was the fruitful source of repeated alterations, and would continue to be so whilst it was persevered in. On the other hand, the author showed that were a natural system substituted for the present one, and our country divided into districts regulated by its watershed and river system, we should then have in every district a focus of scientific enquiry, whether it be as to the rainfall, temperature, prevalence or strength of winds, agricultural statistics, the produce of our fields, our mines, or our rivers, or for the purpose of registering the occupations, the diseases or the deaths of the people. Moreover, such a system would form the best basis map for every future census, and being once established upon a well considered and natural plan, would do away with the necessity of those eternal alterations which are now year by year going on, to the utter confusion of the scientific student. In France the watershed system is adopted in defining and naming the departments, it is vastly superior to our own, and although its deficiencies are numerous, yet they will act as beacons to us. The author was well aware that such a revolution could not be accomplished under ten years, therefore he urged the necessity of commencing it at once. Should the natural system be adopted before 1881, it would be ready for the census of that year, by which time the Registrar-General will have completed two more decades of mortuary records under the present system, and these, with the one (1851-60) which Mr. Haviland had geographised, will form a most important foundation for all future enquiry. Mr. Haviland proposed that a committee should be formed to take the whole matter into consideration, and report thereon, first to the British Association, and then to Her Majesty's Government.

On a Scale for Computing Humidity, By Prof. J. D. EVERETT.—This was a description of the scale designed by Mr. Russell, of Sydney, and already noticed in these pages.

On Variation of Rainfall, with Elevation of the Gauge. By Mr. C. CHAMBERS.—It is well known that the quantities of rain received in gauges placed at different elevations above the ground diminish as the elevation of the gauge increases. Two distinct causes are suggested to explain this: (1) that damp air transferred by the agency of winds from a warm to a cold district finds the latter region colder, not in the upper strata of the atmosphere only, but also in the lower, and in cooling has its vapour condensed as well in the lower strata as in the higher. Consequently, a rain gauge placed at any given elevation will catch rain amounting to the sum of the condensations of the strata above it, and therefore the lower a gauge is placed the greater will be the quantity of rain it receives. The second cause suggested supposes the particles of vapour suspended in the air to be susceptible of electric induction, and, consequently, to be electrically polarized by induction from the ground, which is known by observation to differ in electrical tension at all times from the atmosphere above it. This polarization of the particles of vapour gives rise to mutual attractions between them, and to their successive coalescence forming rain drops, and the attractions being strongest near the ground, the coalescence will be there most rapid. Consequently, not only should more rain be caught by a gauge at a lower elevation than by one at a higher, but the rate of variation with height of the quantities received should be more rapid near the ground: and this is in accordance with observation. The second cause also serves to explain the greater fall of rain over forest-land than over similarly situated even ground; and also, in part, the greater fall in mountainous districts than over neighbouring plains.

On a new Electro-Magnetic Anemometer, and the Mode of Using it in Registering the Velocity and Pressure of the Wind. By Mr. J. J. HALL.—After describing the difficulties attending the use of the present forms of anemometrical apparatus, the author described the apparatus devised and exhibited by himself. The anemometer consists of two parts, viz., velocity apparatus and registering apparatus.

The first, a set of Robinson's hemispherical cups, communicate their motion downwards into a brass box, where it is reduced in angular velocity, and causes a contact disc or commutator, in which two platinum contact-pins are fixed equidistant from one another, to revolve in 1-10th of a mile. An insulated metallic lever, having a platinum working face, stands on either side of the disc, so that upon the completion of every 1-500th of a mile one or other of the contact-pins comes in contact with the two levers, thus uniting them and completing the circuit. The levers are raised a few degrees, and then fall back to their normal position ready to be taken up by the next pin, and so on. The recording apparatus consists of a train of wheels and pinions working in a frame or between two brass plates, the arbors of which project through a dial-plate whereon the circles and figures are engraved, and carry the hands. These wheels are driven by a weight attached to a line wound round a barrel, and a locking-pin disc—the pinion of which works in the first wheel—is released at every contact of the cup apparatus by an electro-magnet, which unlocks the pin-disc and allows the first hand to advance 1-500th of a mile on the graduated dial by a jump similar to the minute hand in remontoire clocks. By turning on a "strike-silent" stop, a hammer lever is brought into connexion with the escapement and strikes a bell at every contact. By this arrangement the observer has nothing to do but to notice the seconds hand of his watch or chronometer while he counts the number of times that the bell is struck, each of which corresponds to the 1-500th of a mile, and by a formula arranged and exhibited by Mr. Hall, who has also arranged a comprehensive series of tables for use with this instrument, the hourly velocity may be readily deduced. In noting velocities extending over long periods of time, the instrument is read in the same manner as the ordinary cup and dial anemometer, or as a gas-meter. By means of the formula before mentioned—although the unit of measurement by this instrument is 500ths—the observer may arrive at results as near the truth as if the instrument were capable of recording the 1,000th part of a mile, while the great advantage lies in the fact that the battery power is less called into action, from which we may infer its elemental duration will be considerably longer.

A paper by Mr. R. A. PEACOCK, on "*Changes of Climate.*" was next read. He expressed the opinion that these changes were due to rain and rivers, denudations, rising and sinkings of land, and the great range of temperature on the earth's surface. These would account for a future warm, and afterwards for a cold period, and for a glacial and cool period in the past. He contended that the future cold period would come on when the present land had been denuded to below high water, and will probably be aided by the natural sinkings of land, and especially by the upliftings of mountains, if such should recur. He added that the present gradual (or intermittent) rise of Northern Europe and Asia will assist to produce cold if it continues.

The Rev. R. B. BELCHER raised the question whether it is not possible to influence the weather by artificial means. He thought it was possible; and mentioned in support of his view the great hurricane or cyclone, and the immense wave which swept both the French and English coasts immediately after the explosion and petroleum fire in the Bordeaux harbour. He also stated that the explosion on the Mersey of the Lotty Sleigh was heard where he lived, a hundred miles from the scene of the explosion. It was followed by an immense black cloud and very heavy rain. Then, directly after the fighting commenced between the French and Prussians, the long drought which preceded it was broken up, and all wars were, for the most part carried on in rain and mud. He thought, therefore, rain could be produced by artificial means. The subject was not followed up by any other speakar.

SOLAR RADIATION.

To the Editor of the Meteorological Magazine.

SIR,—I send you the commencement of my observations with the three solar thermometers (F, G, H) with the air differently exhausted.

They are by Pastorelli, made with the greatest care, out of the same piece of glass, pointed together, and of one uniform size throughout. The bulbs are about five-sevenths of an inch in diameter, and, together with a small portion of the stem, are blackened by means of flame. I have to thank Mr. Pastorelli for his kindness and attention during their manufacture. The exhaustion of the air, as is always the case with these instruments, was conducted under the immediate superintendence of Mr. Pastorelli himself. They are constructed on the same principle as Negretti's patent now expired, and are very sensitive in their action. In the thermometer F, as given in the table, the vacuum is as perfect as can be accomplished with the air-pump. From G the air is only partly exhausted by heat. In H all the air is left, and I am glad to say that it has not been found necessary to chemically dry the air at all. They are placed on posts 4 feet high and the same distance apart, and with the bulbs all facing the E.S.E., in an open space.

Original Thermometers.			*Experimental Thermometers.*				
Date. 1870.	Pastorelli. A	Casella. B	Vacuum F	Air partly exhausted. G	Influence of partial exhaustion G—F	Not exhausted. H	Influence of non-exhaustion H—F
October 14 ...	...	...	82·0	80·8	— 1·2	79·0	— 3·0
,, ,, ...	..	...	86·5	82·5	— 4·0	81·8	— 4·7
,, ,, ...	..	..	89·0	84·0	— 5·0	83·3	— 5·7
,, ,, ...	...	...	90·0	84·4	— 5·6	84·0	— 6·0
,, ,, ..	..	.	95·0	86·5	— 8·5	86·5	— 8·5
,, ,, ...	...	...	100·0	92·5	— 7·5	91·5	— 8·5
,, ,, ...	...	...	110·0	100·0	—10·0	98·8	—11·2
,, ,, M	98·5	111·7	112·5	101·0	—11·5	99·7	—12·8
October 15 ...	...	..	87·0	79·4	— 7·6	86·2	— 0·8
,, ,, ..	...	...	93·0	84·7	— 8·3	87·5	— 5·5
,, ,, ...	...	...	104·0	95·0	— 9·0	93·5	—10·5
,, ,, ...	..	...	107·5	96·7	—10·8	95·3	—12·2
,, ,, M	97·2	111·0	108·3	98·2	—10·1	97·1	—11·2
October 17 ..	...	...	84·0	78·8	— 5·2	77·8	— 6·2
,, ,, ...	...	. .	96·5	89·0	— 7·5	87·8	— 8·7
,, ,, ...	...	...	99·5	90·8	— 8·7	89·5	—10·0
,, ,, M	94·2	107·7	104·6	95·3	— 9·3	94·0	—10·6
October 18 ...	...	.	93·8	85·0	— 8·8	83·0	—10·8
,, ,, ...	...	...	100·7	91·7	— 9·0	90·0	—10·7
,, ,, ...	...	...	104·0	93·7	—10·3	91·8	—12·2
,, ,, ...	.	...	105·5	95·0	—10·5	94·0	—11·5
,, ,, M	99·5	114·5	110·8	100·6	—10·2	99·5	—11·3
October 19 ...	...	...	82·4	79·3	— 3·1	78·4	— 4·0
,, ,, M	93·4	103·8	98·3	92·8	— 5·5	96·0	— 2·3
October 20 M	83·0	96·2	96·0	86·7	— 9·3	85·2	—10·8
,, 21 M	78·5	87·0	84·0	79·0	— 5·0	79·0	— 5·0
,, 22 M	77·2	82·8	81·0	78·0	— 3·0	77·5	— 3·5
,, 25 M	78·0	87·0	77·8	75·2	— 2·6	74·0	— 3·8

M indicates the maximum of the day.

It appears from the readings given in the table that the more perfect the exhaustion the higher the temperature attained; and that

imperfect exhaustion, as compared with all air, or no exhaustion, does not make a great deal of difference. I foresee a very important question must soon arise, viz., is the so-called vacuum thermometer the more correct test of "solar radiation," or the thermometer with all the air left in the jacket? I hope, however, as the experiments progress, light may be thrown on the whole matter.

Mr. Stow, in his letter to you, is much surprised at the large mean difference (15°·4) in August between Pastorelli's (A) and Casella's (B) thermometers; I am equally so, but to prove that the thermometer used was not a solitary exception, I will mention that for some time I have had another of Casella's instruments (C), which differs from (B) by not more than 3°.

The latter (C) has a remarkably good verification from Kew up to 92°, so I think we may reasonably infer that it is a good instrument throughout its scale.

I cannot help thinking that Mr. Stow labours under a delusion in supposing that large bulbs read lower, in all cases, than small ones. I have certainly not found it so; to give some instances:—

		Mean of October.
(A)	Thermometer blackened on bulb, half-inch diameter, and part of stem	90°·5
(E)	,, very slightly larger bulb, not blackened on stem	90°·8
(D)	,, still larger bulb ,, ,, ,,	92°·9
(F)	,, bulb $\frac{5}{7}$-inch, blackened on stem, averages 10° higher than thermometer (A).	

I find, also, that in the two Casella thermometers (B, C) before mentioned, that though both are blackened on the bulbs and stems, the one with the larger bulb (B) reads higher, though there is very little difference in the size. Mr. Stow also seems to lay considerable stress on the superior sensitiveness of small bulbs, but I should not imagine that would make much difference in the long run. Moreover, vacuum thermometers are so wonderfully sensitive to the slightest rays of sun or light. He further mentions that he cannot see what we should gain by using thermometers in vacuo to indicate the shade temperature for comparison with the sun, and also for a test of thermometer stands. Your space would certainly not permit, even if your inclination did, my entering into a long discussion on this matter, so suffice it to say for the present, that it looks as if we should have to compare the vacuum in shade with the vacuum in sun, or alter our thermometer stands so that they are unaffected by radiated light, *perhaps* then we might compare the ordinary maximum with the vacuum with more show of reason.

Mr. Stow further says, talking about thermometers in vacuo, "though very sensitive to the sun's rays, they are not very sensitive when used as ordinary thermometers." Permit me to say that I think if the same words had been applied to the ordinary maximum, there might have been a greater show of observation in them. To take an example. I have found the vacuum instrument so sensitive in my stand that merely moving it two inches lower caused a difference of

more than two degrees! So that in testing stands it is most important to have the vacuum thermometer *exactly* on a level with the ordinary maximum. Mr. Stow seems to lay a good deal of stress on testing stands with a black bulb thermometer *not* in vacuo, but I cannot think it could be nearly so effectively performed as by the other method—for instance, referring to some of my notes, I find that on the 20th September last, which will be a fair example I think, a bright and sunny day, the greatest difference in my stand between a blackened bulb not in vacuo and an ordinary thermometer was only 1°·5, but the difference between the vacuum thermometer in the stand and the other thermometer was 6°·5. It should be remembered, too, that the excess of my vacuum shade maximum over the ordinary shade (as given by me in your September number) amounted to nearly 11° on more than one occasion.—Your very truly, FRANCIS NUNES.

Heathfield Lodge, Chislehurst, Kent,
1st November, 1870.

P.S.—In accordance with your suggestion, I annex tabular particulars of my different thermometers.

Distinctive Letter.	Diameter of Bulb.	Blackening	Diam. of Jacket.	Maker.	Remarks.
	in.		in.		
A	0·5	On bulb & part of stem	2·0	Pastorelli.	
B	0·4	,, ,, ,,	2·5	Casella.	
C	0·35	,, ,, ,,	2·4	,,	
D	0·55	,, not on stem.	2·0	Pastorelli.	
E	0·53	,, ,, ,,	1·8	,,	
F	0·71	,, and on stem.	1·9	,,	Perfect vacuum.
G	0·71	,, ,, ,,	1·9	,,	Partial ,,
H	0·71	,, ,, ,,	1·9	,,	Not exhausted.
I	...	.....	...	...	.....
J	...	.....	..	..	.....

RAINFALL IN OCTOBER.

THE distribution of the fall of rain during the last month having been rather unusual, we supplement our usual table with a few other returns, some noticeable for their large amounts and others for the reverse. The station which heads the list is a new one, near Beddgelert, recently started by Major Mathew.

	in.		in.
XI. Snowdon, Pen-y-gwryd...	23·00	VIII. Bolton.....	11·54
X. Helvellyn, Birkside	22·50	IX. Willow Hall, Halifax ...	10·39
XI. Head of Clwyedog	22·00	V. Holne Vicarage, Dartmoor	10·34
X. Helvellyn, Wythburn ...	21·75		
XI. Llanwddyn	21·70	XVI. Dundee	3·29
X. Easedale	21·00	IV. Dunmow...	2·80
XI. Llanidloes	19·50	,, Diss.....	2·73
X. Mardale Green	19·00	XVII. Budgate, Nairn	2·02
IX. Malham Tarn	13·06	,, Auldearn ,, ...	1·70
,, Bucknall, Skipton	14·89		

DIFFERENCE BETWEEN READINGS OF MERCURIAL AND ANEROID BAROMETERS.

To the Editor of the Meteorological Magazine.

SIR,—During the atmospherical disturbances throughout the past month, I was particularly struck with the differences which existed between the readings of the mercurial and aneroid barometers; and on referring to the observations noted by me in the months of August and September, I observed the differences to be of a *reverse* notation and of equal range to those in October; it seemed to me, therefore, that these variations of the indication of pressures,(be it from any cause inherent in the instruments,) if they stood the test of future observations, might prove of some value in predicting coming changes, or the prolongation of either fine or stormy weather, and moreover would be of much utility to seamen.

With a view of attracting the notice of your readers to this subject, and possibly of inducing some of them to follow up the investigation, I send you an abstract from my register for the months of August, September, and October, 1870, taken daily at 9 a.m.

I will not occupy your valuable pages by pointing out each peculiarity of the differences of the simultaneous readings of both these instruments; it may suffice were I to notice prominently the high rate of the + differences in August, its gradual decrease to the 6th September, and the further fall preceding the stormy and rainy weather we experienced from and after that date. Again, from about the end of September the differences fluctuated, and decided — differences occurred from the 8th October, foretelling the advent of stormy weather and its prolongation.

There was another interesting coincidence: the greatest — differences occurred on the 24th and 25th October, the dates on which the brilliant aurora was visible; greater on the former date when its display was superior.

Before I close this communication, I consider it proper to say that my aneroid was set on the 12th June last to the corrected height (reduced to 32° F.) of my standard mercurial barometer, which was made by Negretti and Zambra.

My daily readings were according to this formula, only adding to them the quantities equivalent to the height of my instruments above sea level; no allowance was made for temperature to the observed reading of the aneroid.--Yours truly,

JOHN KNOTT.

Ilminster, November 3rd,

NOTE of explanation of abbreviations in the Abstract Registers :—

o	Overcast sky.	q	Squally.
f	Foggy.	qq	Stormy.
d	Drizzle.	Ci	Cirrus.
L	Lightning.	Cu	Cumulus.
g	Gloomy.	c	Clouds.
r	Rain.	b	Blue Sky.

Ilminster, Somerset, August, 1870

Date.	Reduced to 32° F., sea level		Diff. of Aneroid from Bar.	REMARKS ON WEATHER.
	Barom.	Aneroid		
1 ..	29·850	29·867	+·017	o, f, d ; Scotch mist all day ; L at 7 p.m.
2...	·919	·939	+·020	o, g, d ; do. do. ; r at 5 p.m.
3...	·880	·909	+·029	o, g, d ; g day with mild sunshine
4...	·781	·801	+·020	Very cloudy ; r at 2 p.m. ; d from 7 p.m. and during night.
5...	·734	·754	+·020	Do., d ; fine sunny day.
6...	·975	·995	+·020	Sunny day, light breeze ; q from 9 p.m. ; q r during night.
7...	·758	·791	+·033	Very cloudy ; mild sun during day.
8...	·924	·937	+·013	o morning ; wind S.W. ; from 9 a.m. wind S. ; hot day ; from 1 p.m. r.
9..	30·140	30·176	+·036	Warm sunny day ; wind veering from N.N.E. to N.N.W.
10...	·203	·229	+·026	o morning ; warm sunny day.
11...	·254	·287	+·033	o with very light cirrus ; very cloudy and sunny day ; wind veering W. to N.W.
12...	·284	·321	+·037	close warm morning ; hot day.
13...	·325	·365	+·040	o g morning ; very cloudy and hot day.
14...	·259	·297	+·038	Very cloudy and sunny all day.
15...	·118	·156	+·038	Do. do.
16...	·129	·160	+·031	Do. mild sunny day.
17...	·116	·140	+·024	Clear morning ; very cloudy and hot day.
18...	·032	·046	+·014	Very g morning ; hot day.
19..	29·940	29·944	+·004	Dark and light cumuli in morning ; b during day.
20...	30·129	30·138	+·009	cold clear morning ; light r at 10.30 a.m. ; strong wind in afternoon.
21...	·257	·269	+·012	Do., do., do. ; very cloudy and sunny day ; wind backing from N.W.
22...	·131	·170	+·039	Occasional light r during day, and heavy from 8 p.m., to midnight.
23...	29·917	29·919	+·002	Very cloudy all day ; wind unsteady from S.W. to W.N.W.
24...	·975	·987	+·012	Very cloudy ; light r at 11 a.m. ; cloudy and sunny afternoon.
25...	30·059	30·070	+·011	Fine sunny morning ; wind backed from N.N.W. to N.W.
26...	29·948	29·957	+·009	Very cloudy ; Ci intermingled with dark Cu ; sunny day.
27 ..	30·009	30·027	+·018	Mares' tails in morning ; very cloudy, and light r during day ; q r during night.
28...	29·587	29·600	+·013	Very cloudy day ; and light r during day with scud.
29...	·933	·937	+·004	Cloudy, sunshine, and high wind during day.
30 ..	30·229	30·234	+·005	Cloudy, with light wind during day.
31...	·331	·341	+·010	Gloomy, sunshine during day.
Mean..	30·036	30·057	+·021	

September, 1870.

Date.	Reduced to 32° F., sea level.		Diff. of Aneroid from Bar.	REMARKS ON WEATHER.
	Barom.	Aneroid		
1...	30·011	30·022	+·011	Very cloudy ; q all day and at night, with r.
2...	29·514	29·525	+·011	Do. ; mild sunshine during day ; r from 7 p.m. and at night.
3...	·606	·610	+·004	Sunny day, with high wind and very cloudy.
4...	30·030	30·045	+·015	Very cloudy and sunshine during day, and strong S.W. wind.
5...	29·696	29·706	+·010	0, r, and q ; from 5.45 to 9 a.m., scud ; again from 5 to 6 p.m. ; r at night.
6...	·520	·535	+·015	0 ; light r in morning ; hail storm at 2.50 p.m., followed by smart r.
7...	·365	·369	+·004	0 morning, with smart r ; b sky all day, with occasional showers.
8...	·813	·801	—·012	Mares' tails in morning ; very cloudy and fine during day ; r during night.
9...	·453	·444	—·009	Very cloudy ; sunshine and passing showers during day.
10...	·775	·766	—·009	Cloudy and b sky ; d, q ; high wind all day.
11...	30·200	30·210	+·010	Misty b sky, and cloudy during day ; heavy black C in afternoon.
12...	·201	·216	+·015	Very cloudy day : light r at 5.30 p.m.
13...	·107	·116	+·009	Do. and g all day, with occasional d.
14...	29·961	29·977	+·016	Do., do. during day ; do., do. ; sunny afternoon.
15...	30·299	30·309	+·010	r early morning ; 0, g, d, all day.
16...	·522	·550	+·028	0, g, all day.
17...	·508	·538	+·030	0, g, all day.
18...	·369	·404	+·035	0, f, morning ; very cloudy and occasional sun during day.
19...	·342	·377	+·035	0, f, morning ; cloudy and occasional sunshine during day.
20...	·348	·356	+·008	f ; cold ; ice in garden ; g, b during day ; sunny afternoon.
21...	·371	·378	+·007	b ; cold ; cloudy ; sunny during day ; warm.
22...	·351	·364	+·013	0, f ; g sunshine during day ; heavy dew at 6 p.m.
23...	·326	·334	+·008	g, b morning ; sunny all day.
24...	·305	·317	+·012	Heavy f ; sunny and hot during day.
25...	·377	·397	+·020	Do. f ; very cloudy, and sunshine during day.
26...	·224	·244	+·020	Fine sunny day, with lengthy Ci streaks N. to S.
27...	·266	·267	+·001	b and sunny all day.
28...	·343	·357	+·014	Do., do. in morning ; very cloudy and sunny day.
29...	·419	·432	+·013	Dense f in morning ; clear during day, and cloudy afternoon.
30...	·480	·498	+·018	0, g ; very damp morning ; very cloudy and damp forenoon, and sunny afternoon.
Mean..	30·103	30·115	+·012	

October, 1870.

Date.	Reduced to 32° F., sea level.		Diff. of Aneroid from Bar.	REMARKS ON WEATHER.
	Barom.	Aneroid		
1...	30·559	30·572	+·013	o, g morning ; b all day.
2...	·516	·538	+·022	f morning ; streaky Ci ; higher Ci moving fast E. to W. ; b all day.
3...	·510	·520	+·010	f morning ; b and sunshine during day.
4...	·548	·565	+·017	Dense f, street wet; dim sunshine latter part of day.
5 ..	·406	·420	+·014	Dense f, streets less wet ; do., do.
6...	·190	·200	+·010	g morn.; very cloudy Cu; mild sunshine during day.
7...	29·821	29·831	+·010	g ; heavy dew in morning ; high wind ; sun ; r from 1.25 p.m. ; q night.
8 ..	·245	·243	—·002	Sunny morning: sunshine in day ; passing showers in afternoon.
9...	·059	·042	—·017	Very cloudy ; passing showers during day, and little b sky.
10 ..	·481	·444	—·037	b ; frosty morning ; sunshine during day ; dark Cu in evening.
11...	·934	·892	—·042	b ; frosty morning ; very cloudy day ; after midnight q, r.
12...	·333	·316	—·017	o, q, r, morning ; q all day ; qq, r, at night.
13...	·545	·515	—·030	q ; sun morning ; very cloudy, q all day ; r from 3.30 to 4.30 p.m.
14...	30·047	30·032	—·015	r early morning ; very cloudy all day and cold.
15...	·008	29·992	—·016	fine, cold morning ; g sunshine all day ; o q night.
16...	29·410	·396	—·014	o, g, q, r, morning ; q ; much light r all day.
17...	·599	·573	—·026	Sunny morning, much b sky ; o, q ; light r all day.
18...	·907	·892	—·015	o morning ; q, r, forenoon; qq, r, scud in afternoon.
19...	·516	·505	—·011	Very cloudy morning ; temp. at 9 a.m. 56·1, at noon 45·0 ; hail storm.
20...	·595	·565	—·030	q, r, all day ; q, d, at night.
21...	·990	·975	—·015	Very cloudy, mild sunshine, and l during day.
22...	·886	·879	—·007	Very cloudy, and light r all day, with high wind.
23...	·017	28·990	—·027	Sunny morning ; sun ; very cloudy and light r during day.
24...	·098	29·052	—·046	qq, r, since midnight, and so nearly all day, with sun ; aurora at 7.30 p.m.
25...	·510	·467	—·043	o, r, morning ; very cloudy day, with d and sun; aurora N.E. at 8 p.m.
26...	·535	·507	—·028	o, g, d, morning ; very cloudy, occasional sun, and r during day ; r at night.
27 ..	·705	·671	—·034	o, d, morning; heavy r drops ; fine day ; q at night.
28...	·923	·897	—·026	q and fine morning ; sunny during day ; very cloudy evening.
29...	30·053	30·053	...	o, g, morning ; light r all day.
30...	·007	·002	—·005	Sunny morning ; sunny during midday ; from 6 p.m. r ; q, r at night.
31...	29·661	29·650	—·011	o, q, r, morning; q to 1 p.m.; sunny 1 to 3 p.m.; o afternoon.
Mean..	29·794	29·780	—·014	

OCTOBER, 1870.

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°. In shade	No. of Nights below 32°. On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	3·68	+ 1·09	·46	30	23	69·7	2	31·0	11	1	4
II.		Maidstone (Linton Park)	3·89	+ ·79	·98	23	20	70·0	2, 3	30·0	11	3	...
,,		Selborne (The Wakes)	4·85	+ ·64	·67	16	16	66·2	2	25·8	11	3	4
III.		Hitchen	3·47	+ ·92	·64	30	18	63·0	8	33·0	9§	0	...
,,		Banbury	3·83	+ 1·40	·67	30	18	67·0	2	30·0	11	1	...
IV.		Bury St. Edmunds (Culford)	3·03	+ ·32	·43	20	19	65·0	3	29·0	10	1	5
V.		Bridport	3·52	— ·51	·57	22	19	68·0	2	29·0	11	1	...
,,		Barnstaple	8·50	+ 4·38	·78	19	23	69·0	5	36·0	11	0	...
,,		Bodmin	7·60	+ 2·28	·96	19	21	69·0	2	38·0	31	0	...
VI.		Cirencester	4·54	+ 1·05	·98	16	14	...	...	...	...	...	...
,,		Shiffnal (Haughton Hall)	4·47	+ 2·23	·91	7	21	61·0	1, 2*	30·0	11	1	...
,,		Tenbury (Orleton)	4·87	+ 1·64	·92	7	21	68·7	1	28·3	11	2	6
VII.		Leicester (Wigston)	3·48	+ ·78	·56	31	17	71·0	1, 2	30·0	10	1	...
,,		Boston	3·30	+ 1·18	·62	7	21	65·0	1	33·9	11	0	2
,,		Grimsby (Killingholme)	6·60	..	1·70	7	23	60·0	1, 4	32·0	26	0	...
,,		Derby	4·91	+ 2·07	1·14	7	23	68·0	2	31 0	11	1	...
VIII.		Manchester	8·36	+ 4·55	1·12	8	25	69·0	1	31·0	11	2	2
IX.		York	6·10	+ 3·58	1·25	8	21	63·0	1	31·5	11	1	...
,,		Skipton (Arncliffe)	13·38	+ 6·72	1·85	12	21	67·0	5	25·0	11	6	...
X.		North Shields	66·	— 1[illegible]	08·	2	21	2·67	02	0·88	21	0	0
,,		Borrowdale (Seathwaite)	23·00	+ 6·68	...	..	...	...	...	...	...	...	...
XI.	WALES.	Cardiff (Town Hall)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	8·52	+ 3·33	1·99	16	13	66·0	1	26·5	10	1	...
,,		Rhayader (Cefnfaes)	12·23	+ 6·63	1·20	12	22	63·0	...	27·0	...	3	...
,,		Llandudno	7·04	+ 3·08	·97	12	23	69·6	1, 2	41·2	11	..	...
XII.	SCOTLAND.	Dumfries	5·72	+ ·80	1·07	12	17	...	...	..	...	..	...
,,		Hawick (Silverbut Hall)	3·35	...	·59	12	20	...	...	...	...	...	...
XIV.		Ayr (Auchendrane House)	4·99	+ ·04	·83	7	20	68·0	2	30·0	10	1	9
XV.		Castle Toward	6·21	+ ·46	·89	18	18	67·0	2	31·0	10	1	3
XVI.		Leven (Nookton)	3·24	— ·51	1·11	12	13	60·0	1†	30·0	15	1	19
,,		Stirling (Deanston)	5·31	+ ·40	.87	18	19	60·0	1	27·5	11	5	13
,,		Logierait	4·08	...	·81	23	12	...	...	...	...	...	...
XVII.		Ballater	4·75	...	1·12	18	15	70·0	2	26·0	16	7	..
,,		Aberdeen	3·09	...	·66	18	16	58·0	1	33·2	15	0	18
XVIII		Inverness (Culloden)	2·32	...	·62	17	15	62·2	1	35·7	14	0	19
,,		Portree	7·37	— 3·41	1·01	16	22	...	...	..	...	...	...
,,		Loch Broom	5·20	...	·80	17	20	...	...	...	...	...	...
XIX.		Helmsdale	2·98	...	...	...	...	...	...	...	...	...	...
,,		Sandwick	3·17	— 1·75	·59	17	21	62·3	1	35·4	27	0	16
XX.	IRELAND.	Cork	6·70	...	1·15	11	14	...	...	...	...	...	...
,,		Waterford	5·74	+ 1·34	1·20	15	23	63·0	4	32·0	11	..	...
,,		Killaloe	9·91	+ 4·89	2·12	15	22	69·0	2	27·0	11	2	...
XXI.		Portarlington	6·54	+ 1·41	·91	16	30	65·0	1	30·5	10	...	...
,,		Monkstown	6·53	+ 2·61	1·52	8	17	...	...	...	...	...	...
XXII.		Galway	9·69	...	1·22	30	22	70·0	1	32·0	9, 31	...	...
,,		Bunninadden (Doo Castle)	9·92	...	1·75	11	22	59·0	6	24·0	11	2	...
XXIII		Bawnboy (Owendoon)	...	...	..	...	...	...	...	...	..	..	..
,,		Waringstown	6·81	...	·94	7	19	69·0	4	30·0	9	3	9
,,		Strabane (Leckpatrick)	9·74	..	1·24	12	23	65·0	2, 3	24·0	6	5	20

*And 8. †And 2, 3. §And 10, 11.

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

METEOROLOGICAL NOTES ON OCTOBER.

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

[NOTE.—All remarks on the Auroræ of the 24th and 25th have been omitted in these pages; most of those in which special and probably useful details were given, have been printed on pages 155-157.]

ENGLAND.

CAMDEN TOWN.—Gale on 12th and 13th; solar halo at 4 p.m. on 18th.

LINTON PARK.—First week dry and fine, the remainder changeable, with frequent R. T on the 8th and 9th; bar. very changeable at that time. No very high winds or severe frosts during the month, and less fog than usual in October.

SELBORNE.—The bar. was higher on the 1st than it has been for four months, and on the 24th it was lower than it has been since December, 1868; the wind excessively high during a considerable part of the month, and principally from the S.W.; frequent fog during the first week.

HITCHEN.—1st, the highest bar., and 9th, the lowest bar. I ever saw; heavy T S on 26th to the N.W.

BANBURY.—High winds on 12th, 19th, and 22nd.

CULFORD.—Frequent fogs during the first week; high winds on the 12th, 13th, 15th, and 16th; T and hailstorm on 27th; mean temp., 49°·0.

BRIDPORT.—The first week fine, but wet and rough weather during the remainder of the month; heavy gales on 16th and 19th; some swallows seen on the 30th. L on 23rd.

SHIFFNAL.—Fog or mist each morning for the first week, when a most acceptable soaking R (·91) came, on the 7th, which was repeated, with only four exceptions, daily throughout the month, but 8 in. still due to make up the average for the year; too late to benefit the after-marth, but swedes, apparently dead, sprout again; mangolds a fine crop, also potatoes. Common B fly appears, after some years' interval; 8th, aphides cleared off by the fine R of yesterday; 11th, tender plants partially killed; 17th, black Hamburgh grapes and also figs ripen fully on the open wall; 27th, Spanish chesnuts ripen their fruit; 31st, dahlias and other half hardy plants still exist, slightly cut.

ORLETON.—Very cloudy and misty mornings and bright afternoons till the 7th, when the long drought broke up with a heavy fall of R (·92), and the remainder of the month was stormy and wet; bar. very high on the 1st, and afterwards very low, especially on the 23rd; violent winds on 12th, 13th, 17th, 18th, and 24th; temp. of the month about 1° below the average.

DERBY.—The drought which prevailed the whole year up to this month has ended, and we record an excess of rainfall for October (nearly double the mean). On Thursday, the 27th, this neighbourhood was visited by a fierce T S accompanied by an amount of H, which remained till the next day.

MANCHESTER.—H on 9th and 17th; we have had an enormous rainfall this month, more than double the average.

ARNCLIFFE.—11th, a very large halo round the moon, followed on the 12th by storms of wind and R. The heaviest fall of R in the last three weeks of the month I have ever registered (13·38 in.).

WALES.

HAVERFORDWEST.—The fine weather broke up on the 5th; heavy fogs, ending in R, fearful storms of wind and R all through the month, especially on the 11th, 16th, and 21st. General character of the month, stormy, wet, and mild. Nearly all the R fell during the night, consequently this month did not fall short of its usual number of fine days.

CEFNFAES.—The month has been rather remarkable. First week dry, and fine pleasant weather; afterwards, continuance of R and often violent gales of wind (chiefly N.W.); on the night of the 12th the wind was very strong, and much damage ensued in this district.

LLANDUDNO.—H showers and L on 9th; H on 17th and 26th; heavy T on 27th.

SCOTLAND.

DUMFRIES.—The first week very fine, during the rest of the month much R; S on the hills on 9th.

SILVERBUT HALL.—Dense fog on the first seven mornings, with prodigious numbers of winged ants darkening the atmosphere in the twilight; slight frost on the night of the 10th; the heavy rains have kept the Teviot running full to the brim, and great numbers of salmon are now ascending to spawn.

AUCHENDRANE.—With a bar. pressure below the October mean, there has been a low mean temp., and small amount of cloud and evaporation; but the bar. range, much above the October mean, was attended by heavy R and by winds, principally equatorial, of a force also above the mean. There were gales on the 8th and 12th from N. points, and on 18th from S.; in the early part of the month there were fogs and calm heavy dews, and in the latter part of the month, auroræ, heavy rains, swollen rivers, and boisterous weather.

CASTLE TOWARD.—The fine weather of last month continued until the 11th of this; it has since been stormy and cold, with much R. Bar. very unsteady; it stood at 29·66 at 9 a.m. on 22nd, and at 28·64 at 9 a.m. on 23rd; gales on the 8th and 18th.

DEANSTON.—Till the 15th, only ·88 of R fell of the 5·31 in. that fell in the month, but it was generally dull and foggy, with some night frosts; storm of wind on the 13th; very wet after the 15th.

LOGIERAIT.—Severe easterly gales from the 12th to the 19th; the month closed fine.

BALLATER.—A good deal of R fell up to the 24th, after which the weather continued dry to the end of the month; sharp frosts have occurred on several nights, but the mean temp. has been comparatively mild throughout.

ABERDEEN.—The month was notable chiefly for unsteady bar. and the great bar. range, which, since 1856, has been exceeded only in February, 1860, and December, 1869; Deeside hills covered with S on 11th.

PORTREE.—From the 8th, the weather was cold, and very squally, the high ground generally covered with S; bar. fell 1·25 during the night of 22nd.

LOCHBROOM.—The fine weather which commenced at the middle of last month continued till the 8th, since which we have had a continuance of rough broken weather, but, on the whole, it has been one of the earliest and best harvests of this century.

SANDWICK.—October has given us a continuance of the fine weather of this remarkably fine season. It has been drier than the mean, and the wind less, but rather colder; heavy gales on 16th, 17th, and 18th.

IRELAND.

KILLALOE.—This (9·91) was the greatest fall at Killaloe in any month during the last 25 years, the next to it was in 1848 (9·80), but of that, 4·04 fell in one day; the fall (2·12) of the 15th began at 3 p.m.

MONKSTOWN.—The fall (1·52) of the 8th was the greatest in 24 hours since 5th of January, 1867, =1·64.

DOO CASTLE. Continually wet since the 6th; great floods in this locality; potatoe digging delayed fully three weeks.

LECKPATRICK.—First week fine, thence constant R and storm; gale of 12th nearly as destructive as that of the 9th of September; rainfall about double the average, the total fall being the largest since the gauge was started; number of frosty nights (20) unprecedented.

THE COMING WINTER.

To the Editor of the Meteorological Magazine.

SIR,—According to a law which, since 1771 (the year when reliable thermometrical observations were commenced), has *always* proved

correct, the coming winter must be remarkably severe, that is, the mean temperature must be very considerably below the average.

Whenever we have had meteorological phenomena similar to those to which the above-mentioned law refers, the mean temperature of a period of three consecutive months of the four comprising the succeeding winter (reckoning from December to March inclusive), has *always* been more than two degrees below the average of 99 years, and *eleven* times in twelve the mean has been more than three degrees below that average.

I do not wish to encroach unnecessarily on your valuable space, but if any of your readers would like to see the law and the proofs of its accuracy, I shall be most happy to furnish them in another letter. A law which (as applied to the last hundred years) has *never* failed, may perhaps be acceptable to some of them.—I am, &c.,

GEORGE D. BRUMHAM.

Barnsbury, November 8th, 1870.

METEOR OF SEPTEMBER 7TH.

To the Editor of the Meteorological Magazine.

SIR,—I had often wished to have the pleasure of seeing a meteor, and last night at 8.17 my wish was gratified. At the time mentioned above, a very dense cloud concealed the moon; in the west were some beautifully-shaped clouds, from which I observed two or three flashes of lightning. It was from these clouds that a brilliant meteor *plunged*. I know of no better expression to convey the idea of its motion; slowly at first, like a ball from a Roman candle, increasing in rapidity and in size, brilliancy and splendour, falling at an angle of about 45°; it was lost behind some clouds in the horizon immediately below the planet Saturn. It seemed to make its first appearance in the meridian line parallel with Saturn, and disappear as I have just said, under that planet.—Yours truly,

C. MALDEN.

St. Lawrence Rectory, Ventnor, I.W., Sept. 8th, 1870.

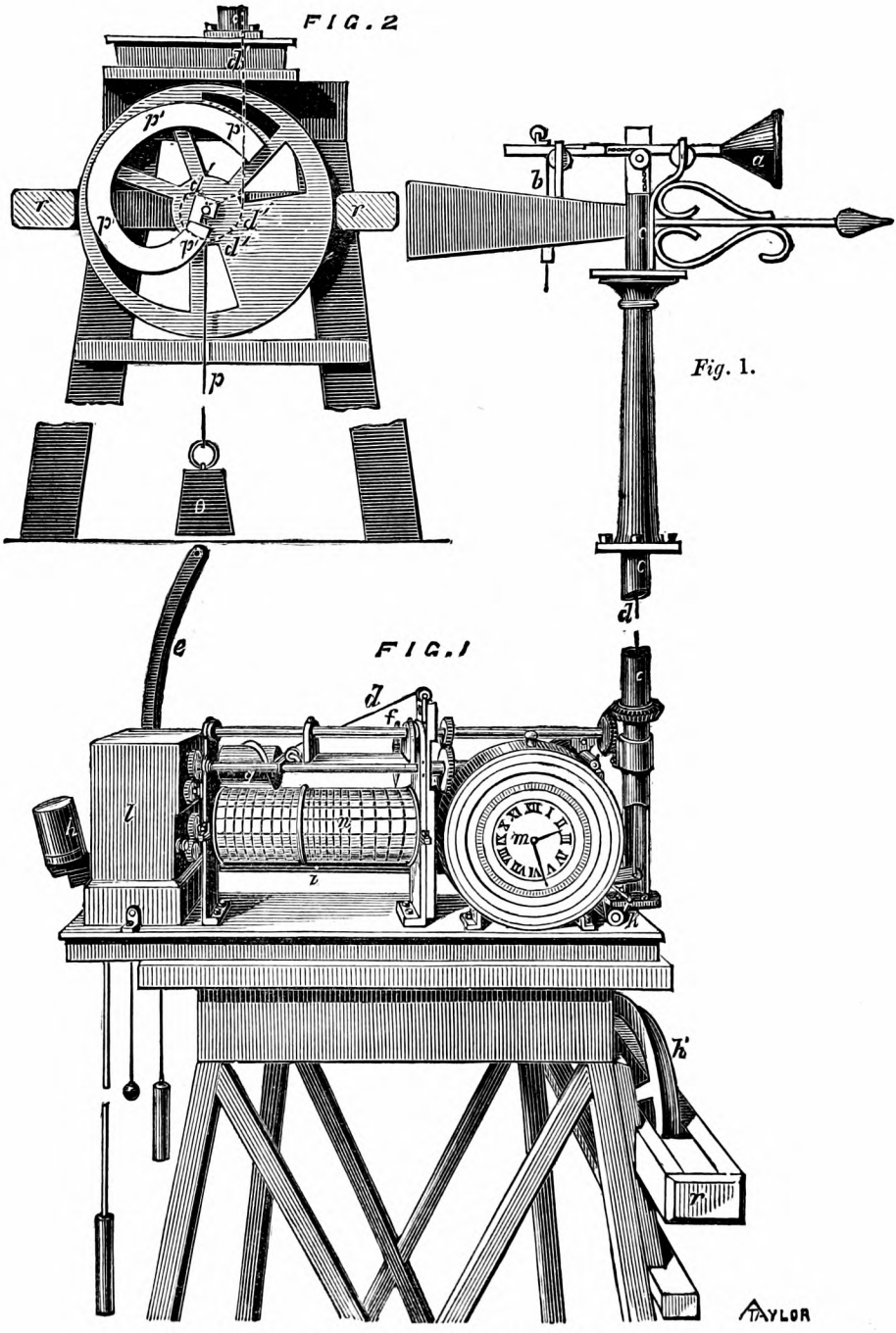
[We regret that the above was unavoidably omitted last month.—ED.]

SEA FOG.

To the Editor of the Meteorological Magazine.

SIR,—On Wednesday, September 28th, I witnessed a phenomenon which I think is not common. A sea fog prevailed all day, and in the afternoon the sun shining on the fog produced a bow similar to a rainbow, but almost if not quite colourless; it continued for about an hour. The air was not when I first saw it quite saturated here (dry 55°, wet 54°·5 at 3 p.m.), but on the higher grounds moisture was thickly deposited on the hair and clothes. The air is generally saturated most of the day during a sea fog here, whatever Dr. Allnatt may assert to the contrary.—I am, Sir, your obedient servant,

F. W. STOW.



CATOR'S ANEMOMETER, WITH SPIRAL ARRANGEMENT.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

LIX.] DECEMBER, 1870. [PRICE FOURPENCE, or5s. per ann. post free.

CATOR'S IMPROVED ANEMOMETER.

A description of Mr. Cator's anemometer, as fitted up with the double-curved levers, was given in a previous number (XXIII. Dec. 1867); we have pleasure in now supplementing it by the following note.—ED.

"Another plan for measuring the strength of the wind having about that time suggested itself to me, I applied it to the instrument, and had it fitted up,—not intended as an improvement upon the levers, which may or may not be the case, and remains to be seen, but as it seemed to be worth a trial, it being so easy to apply it to the instrument by disconnecting the levers and connecting it instead, or *vice versâ*, and this ready application of either principle must be considered a great advantage. This new application is a system of double spirals, of which the following is a description:—

The other parts of the instrument being explained at length in the number above referred to, this notice is limited to the spirals. Figure 1 is the same figure reproduced here with the addition of the spiral apparatus (*h*), and the support (*r*) to which it is fixed. Figure 2 shews the spiral apparatus in detail. The spirals or snails are concentric and rigidly connected together with each other and with a horizontal rod passing through their centres, and revolve, with such rod as their common axis, in vertical planes side by side, the horizontal rod resting on strong supports (*r*) at each end of it. The two spirals are of different sizes; the perimeter (*d*) of the smaller one is equal to the length of the scale of pounds on the recording-sheet (*n*), and also to the total space through which the pressure-plate (*a*) is moved, viz. about 5 inches; and round this is wound a chain (*d*), one end of which is rigidly fastened to the rod at its centre, and the other to the steel wire (*d*) which comes down from the bar connected with the pressure-plate; and it is so adjusted that when it is calm (fig. 2 shewing their position in a state of calm), the chain is wound wholly round this spiral, and leaves it as a tangent at the point furthest from its centre. viz. about 2 inches: and as the pressure-plate is moved forward by the wind, the steel wire (*d*) is lifted up, and so unwinds the chain (*d*) from the spiral, and causes it to leave the spiral as a tangent, accordingly, at

a point nearer to its centre. The other spiral (*p*) is of much larger size; and round its perimeter is wound a string (*p*) to one end of which is fastened the horizontal rod which passes through its centre, and to the other a weight (*o*), which is adapted to the size of this spiral: it is so arranged that, when it is calm, no part of the string is wrapped round this spiral, but it merely hangs direct from, or is a tangent to the curve at its centre; and as the pressure-plate is moved forward by the wind, this spiral (being rigidly connected with the other one) is made to revolve, and the string (*p*) to be wrapped round it, leaving it as a tangent, accordingly, at a distance from its centre.

From the above it will be readily seen that the two spirals are moved through equal angles, and act reversely (or with opposite intensity), the small one being unwound while the large one is being wound, the tangential chain (*d*) of the small one nearing the centre as the tangential string (*p*) of the large one becomes at the same time further from it; and so the effect is doubled. The apparatus may be considered as a continual series of levers, the actual and relative lengths of the two arms from the fulcrum being gradually altered as it is made to revolve: in the first instance, a very small force applied at the pressure-plate, or, which is the same thing, at the end of the chain, will cause the apparatus to revolve, and will lift the fixed weight (*o*) hanging from the centre or fulcrum; and power will always be gained, or, in other words, the pressure of wind will always be less than the fixed weight, till it has revolved through such an angle that the chain (*d*) and string (*p*) are at the same length of arm from the centre; and as it revolves further round, the pressure of the wind, so causing the chain to act at a shorter and shorter arm or nearer and nearer to the centre, will be always proportionately greater than the fixed weight, which will act at a longer and longer arm, or further and further from the centre. The string which carries the recording-pencil (*f*) to and fro is fastened to the steel wire (*d*) at a short distance above the chain belonging to the small spiral.

Beckenham. C. O. F. CATOR, M.A.

ELECTRICAL ANEMOMETERS.

To the Editor of the Meteorological Magazine.

SIR—I notice, through the pages of your interesting magazine, that the attention of meteorologists is being drawn to electrical anemometers, it having been stated that arrangements are to be made for the indications of the anemometer lately erected at the Botanical Gardens by means of electricity.

As I have for some years past taken great interest in this particular branch of meteorological science, and have devised and used electrical anemometers of several descriptions in situations where it would have been impracticable to have placed the ordinary arrangement, I venture through the medium of your publication to describe, for the perusal of your readers, my latest contrivance, which is, I think, the simplest yet arranged; as it obviates the use of a battery, I think it all the more

likely to meet with the approval of meteorologists who may not have had much experience in electrical batteries.

On the spindle which supports the cups, and near the foot of it, is placed a worm, which is geared into a large toothed wheel, with a definite number of teeth cut in it, according to the scale upon which the instrument showing the velocity is graduated, that is to say, if it is desired to show the velocity at more frequent intervals, this wheel must have fewer teeth in it, in order that it may revolve faster.

The axle on which this wheel is fixed carries a "camb," such as is used in the "cutting off" arrangement in the Kew barograph and thermograph instruments.

Working on this camb is a long bell-cranked lever, to which is attached at the end remote from the camb an electro-magnet, the poles of which are in proximity to those of a powerful permanent magnet.

As soon as the end of the lever falls into the camb, the coils of the electro magnet are suddenly withdrawn from the permanent magnet, the result being that a current of electricity is induced, which is connected by the wire leading from the anemometer to the recording apparatus, which may be placed at any distance from the cups.

The counter or indicator may be an ordinary "Compteur Electrique" on Brequet's principle, or it may be made to register on paper the varying velocity of the wind by an apparatus specially devised, three of which I have made.

I have been induced to use magneto-electricity in these apparatus for two reasons—first, to avoid the trouble of a battery, and in the second place, in the peculiar arrangement just described, the necessity of a contact maker for transmitting voltaic currents is dispensed with, which in practice is found to be a very difficult thing to arrange, to suit light winds and strong gales equally well.—I am, yours truly,

LOUIS J. CROSSLEY.

Willow Hall Observatory.

SOLAR RADIATION.

To the Editor of the Meteorological Magazine.

SIR,—Although I feel considerable diffidence in writing on a subject which is, to a great extent, new to me, I will venture a few remarks on solar radiation thermometers, leaving it to you to judge if they are worthy of insertion.

It is obvious that the temperature of a thermometer exposed to the sun depends on two things.

1st, the rate of heating by the sun's rays;

2nd, the rate of cooling, by radiation into space, and by the convection of the air.

That the temperature may be stationary, these two effects must be equal. If the first be in excess, the temperature will rise, if the second, it will fall, and as the rate of cooling depends on temperature, it will, in either case, soon reach a position of equilibrium.

By surrounding the bulb with an exhausted envelope of glass, we

largely prevent the cooling action of the air, but we also interfere with the radiation into space.

If the thermometer radiated the same kind of heat which it absorbed, the character of its coating would be of no consequence, for it would affect both radiation and absorption in the same proportion. But while much of the heat which it absorbs is luminous heat, the whole of its radiation is obscure. While the glass is very transparent to the luminous rays of the sun, it is almost opaque to the obscure radiation of the thermometer. The result is a veritable heat trap; the heat gets in and can't get out, and with suitable envelopes almost any temperature might be obtained.

Thus the indications of the thermometer must be affected by the thickness and quality of the glass envelope, and if a cloud came over the sky, without obscuring the sun, the thermometer would rise, from lessened radiation into space.

In fact it seems to me that the determination of solar radiation from the indications of *any* thermometer is a problem involving two unknown quantities, both subject to perpetual variation; and I should fear that mere thermometric observations can never give results of real value.

The only absolute method of measuring solar radiation with which I am acquainted, is by adopting the principle of Pouillet's Pyrheliometer, in which the increase of temperature of a mass of water or mercury, in a given exposure to the sun's rays is noted, and compared with its loss by radiation when shielded from them.—Yours truly,

HENRY R. PROCTER.

North Shields, Sept. 26th, 1870.

To the Editor of the Meteorological Magazine.

SIR,—Can you find space for the following extract?—"Sir H. Davy ignited the charcoal points connected with a battery in a vacuum, taking care to place the charcoal points at the top of the jar, and a concave mirror with a delicate thermometer in its focus, at the bottom of the vessel placed upon the air-pump plate. The effect of radiation was ascertained, first when the receiver was full of air, and next when it was exhausted to $\frac{1}{120}$th. In the latter case, the effect of radiation was found to be three times as great as in an atmosphere of the common density."

It would be easy to try a similar experiment with sun instead of charcoal points, and without the mirror, but the above is enough to render it at least probable that the low readings mentioned by Mr. Nunes', result as you suggested, from imperfect exhaustion.

I remain, Sir, your obedient servant,

F. W. STOW.

Hawsker, October 30th.

To the Editor of the Meteorological Magazine.

SIR,—I have just seen Mr. Nunes' letter. His experiments confirm the conclusion which I thought might be drawn from an experiment made by the late Sir H. Davy, of which I sent you an account too late for

publication in your November number. The results he has obtained are very satisfactory to me, because they prove that Casella's thermometers in vacuo are as carefully and correctly constructed as I believed them to be. The same no doubt is true of Negretti and others. Permit me to analyse the figures given. I will take those days only on which, from the number of observations taken, we may presume there was some steady sunshine.

Oct.	Casella. B	Pastorelli's new vacuum. F	Diff. B—F	Pastorelli's original vacuum. A	Pastorelli's new vacuum. F	Diff. A—F	Pastorelli's original vacuum. A	Pastorelli's new non-vacuum. H	Diff. due to exhaustion in A A—H
14...	111·7	112·5	—0·8	98·5	112·5	—14·0	98·5	99·7	—1·2
15...	111·0	108·3	+2·7	97·2	108·3	—11·1	97·5	97·1	+0·1
17...	107·7	104·6	+3·1	94·2	104·6	—10·4	94·2	94·0	+0·2
18...	114·5	110·8	+3·7	99·5	110·8	—11·3	99·5	99·5	+0·0
Means.	111·2	109·0	+2·2	97·35	109·05	—11·7	97·35	97·57	—0·2

Thus we find that (1) there is a pretty close agreement between Casella's thermometer and the new and carefully constructed one of Pastorelli's. The difference, however, is in favour of Casella, showing that Casella's has either a slightly better vacuum, or (as I think) reads higher from the other causes which I mentioned—viz., smaller size of bulb and larger size of jacket. (2) The difference between Pastorelli's original instrument and his new one (both professing to be in vacuo) is enormous. (3) There is a suspiciously close agreement between Pastorelli's original thermometer *in vacuo*, and his new one *not in vacuo*. The only conclusion that I can draw is, that by some unfortunate accident, the air gained admission into the former in course of manufacture, there being no other difference in the construction of A and F, which could account for a tithe of the difference in their readings. I think all observers owe thanks to Mr. Nunes for having thus laid the ghost which he had conjured up.

It is possible that thermometers in unexhausted jackets may give good results, but they can hardly agree with one another more closely than the present vacuum thermometers do when properly constructed. As they read lower, they give a smaller "amount of radiation," and cannot therefore give so delicate a test of the sun's power. I think all your readers will agree with me, that unless they should be proved to be very superior to those used at present, it would be a great mistake to introduce any new mode of registering the sun's heat. The present instruments are very good. Mr. Casella informs me that he guarantees all those which he makes to be within $\frac{3}{4}$ per cent of an absolute vacuum.

From the returns which Mr. Nunes is so kind as to send me, I find that the difference between sun and shade, or 'amount of solar radiation,' was reduced in H compared with F by 23, 21, 21, and 21 *per cent* on the 14th, 15th, 17th, and 18th October respectively.

Mr. Nunes is a little hard on me in reference to some minor points.

I did not say that large bulbs read lower *in all cases* than small ones. On the contrary, when the stem is not blackened, or insufficiently blackened, the large bulbs always read higher, because their greater bulk is less affected by the colder stem. What I meant to say is this, that *ceteris paribus* the large bulb reads somewhat lower : and in this I do not "labour under a delusion," unless Mr. Nunes can disprove the law that the surface of a sphere varies as the square of the diameter, but the mass or bulk as the cube.

I certainly do lay stress also on the superior sensitiveness of small bulbs. It may not "make much difference *in the long run*," but on days when there are only gleams of sun, it makes a good deal of difference. How else is the great excess of B over F on the 25th, to be accounted for?"

Mr. Nunes does not understand what I mean by the sensitiveness of thermometers in vacuo, "when used as ordinary thermometers." I mean that if both stand say at 50°, and are put in a dark room where the temperature is 60°, the ordinary thermometer will reach 60° first; and if the experiment be reversed, the ordinary thermometer will fall to 50° first. Of course the experiment should be tried with thermometers having equal-sized bulbs. But I dare say vacuum thermometers are sensitive enough, and do not attach much importance to this point.

I laid no *stress* whatever on testing thermometer stands by a black bulb *not* in vacuo; all I said was, "It would not be *necessary* to use thermometers in vacuo for this purpose."

The shade thermometer which we compare with the sun thermometer ought if possible to be unaffected by reflected heat: and as on Mr. Nunes' stand the ordinary thermometer was on one occasion affected by this cause 11° *less* than the thermometer in vacuo, I would use the former as being *nearer* to the true shade temperature, though I certainly prefer his second alternative, that we ought to "alter our thermometer stands so that they are unaffected by radiated light," or more correctly, radiated or reflected *heat*. Whatever the result of the millions of figures magnificently elaborated at Strathfield Turgiss, we shall hardly be asked to adopt any stand which does not satisfy this condition.—I am, Sir, your obedient servant,

Hawsker, Nov. 20. FENWICK W. STOW.

THE SQUALL OF OCTOBER 19TH.

To the Editor of the Meteorological Magazine.

SIR,—The only fact of importance omitted in my letter to the *Times* was, that we heard two short sharp growls of thunder immediately before the squall.

The apparent hushing of noise at the time was occasioned probably by the branches being blown stiff by the force of the wind; they appeared to be fully extended and rigid.

I understated the number of trees blown down; probably there were fifteen oak, and two ash, the latter broken off in the middle. A farmer near had the thatch blown off his ricks.

It had been blowing a gale of wind all the morning, accompanied by driving rain, and the weather previously had been unsettled. On the Monday previous the ground was slightly covered with snow.

I am quite sure as to the time of day being 10.45, when the squall passed us. Yours obediently,

JOHN LLOYD, JUNR.

Huntington Court, Hereford, November 30th, 1870.

To the Editor of the Meteorological Magazine.

SIR,—Negative evidence may be as good as positive in tracing the course of this squall. On the 19th I registered heavy rain, hail, and high gusty wind. 20th, ditto, without the hail. The force on both days 8 (1 to 12 estimated). Barometer 29·49 and 29·56 respectively, corrected and reduced. The 23rd, barometer the lowest reading of the month, 28·93, and I concluded there were heavy gales somewhere; but my estimate again did not exceed 8 as the maximum force. There was nothing remarkable about the wind here on either of those occasions. Gales of greater violence raged in this locality on the 12th and 13th. The direction of the wind on 19th and 20th was W.N.W. From your table it would appear that the storm was probably cyclonic. showing great force to the N. in Breconshire, and to the S. in Somersetshire. This neighbourhood, therefore, was near the centre, and consequently in comparative calm. Your table does not give the direction of the wind at the different stations. Faithfully yours,

FRANKLEN G. EVANS, M.R.C.S., F.M.S, &c.

Tynant Radyr, Pentyrch, near Cardiff, November 25th, 1870.

P.S. Be kind enough to publish Mr. Geo. D. Brumham's meteorological law, for general information.

To the Editor of the Meteorological Magazine.

EXTRACT FROM METEOROLOGICAL REGISTER, OCT. 19TH, 1870.

Barometer.

9 a.m. ... 29·514 f. 9 p.m. .. 29·390 s.

Thermometers. *Means of day.*

min.	max.	solar.	dry bulb.	wet bulb.	dew point.	deg. of hum.
49°·5	60°	94°	52°	50°·5	49°	89°

	Elastic force of vapour.	Mean in cubic foot of air.	Short of complete saturation.	Mean weight of cubic ft. of air.
9 a.m.	0·374 in.	4·2 gr.	0·4 gr.	532·3 gr.

The tornado was not noticed here.

Rainfall in 24 hours, 0·650 in.; ozone (0-10), 8; Wind (Robinson's Anemometer), 915 miles in day; cloud (0-10), 8.

Gale with heavy rain and lightning from S.W.

On October 23rd, 1·355 in. of rain with hail fell in 24 hours.

C. S. BARTER.

27, *Paragon, Bath.*

To the Editor of the Meteorological Magazine.

SIR,—The peculiar character of the squall of October 19th, was clearly marked here. At 10 a.m. the wind was S. dry bulb. 56°·2:

rain just commencing, with a rising gale. At 11.30, strong southerly rain squalls sweeping by. At 11.42, as near as I can correct the time, the wind instantaneously changed to N.N.W., with a tremendous "splash" of rain; and the dead leaves which strewed the lawn in front of my windows whirled round and round, in a circle of about 40 to 50 yards diameter, the gyratory motion carrying them gradually upwards. This "whirlwind" continued at least one minute, and the great downpour of rain did not last much longer.

As I am writing, I may mention that in the splendid aurora of October 25th, as seen from this place, two streamers distinctly shot up to the zenith from the centre of a southern arch, at 7.10 p.m. These were not prolongations of northern streamers, for there were none such at that particular time. I beg to call attention to the fact that this aurora of October 24-26 is strictly periodical.

At Bridport and at this place, about 10.40 p.m., on the 22nd instant, a loud earthquake rumbling was plainly heard. I was at Bournemouth on that night, and did not notice this phenomenon; but at 0.45 on the morning of the 23rd, in the midst of the sharpest thunder and lightning squall that I ever saw in the winter, two distinct earthquake waves passed by, from nearly W. to E. The movement was more upwards and downwards than oscillatory; my bed appearing to be bodily elevated and then let down again. Faithfully yours.

P. H. NEWNHAM.

Frome Vanchurch, Maiden Newton, Dorchester, November 26th, 1870.

To the Editor of the Meteorological Magazine.

SIR,—In your monthly number of the *Meteorological Magazine* for November, you ask for further particulars of the squall or tornado, that swept over the west and south of England on the 19th ult. In addition to the few facts noted in my letter which you have inserted from the *Times*, I would add, that the path of the severe gust was traceable here for at least a mile, and was about fifty yards wide; the wind coming from W.S.W. Several chimneys and small trees, six to nine inches in diameter of stem, were broken and thrown down, and many branches of large trees wrenched off, one house was unroofed, and another partly so, and windows of other houses were blown in. The anemometer which was in its path recorded the great pressure of 30 lbs. on the square foot. Very curiously, trees which had a large branch broken off, were in almost all cases otherwise uninjured; the damage being done only in spots, very weak limbs and twigs only three or four feet away from those wrenched into splinters, suffering no injury whatever.

Not being able to reconcile the facts given from different places in the south of England with one another, I had laid down the wind currents as given, of the preceding and following days; and as therefrom I think the cause of such destruction is clearly to be traced, I offer you the sketches I made at the time, and the conclusion I came to.

On the morning of the 18th, the wind in this part of Europe, was an equatorial one; and blowing in the southern part of the British

Isles from south, and with the force of a gale on the south coast of Ireland. Early in the morning of the 19th, this current became influenced by a polar wind, coming across the North Atlantic from the N.W.; which gradually diverted and turned the equatorial current from south; and on the forenoon of the 19th, although the equatorial current retained the force of a storm, it was so far forced aside by the stronger or larger polar current; and by the morning of the 20th, the polar current, still with the force of a storm, was, although changed in direction, supreme over Britain and its environs.

Now the tract across the west and south of England, marked with such extraordinary devastation, was where these two winds struggled with their full force upon one another for the mastery. Impinging and breaking in upon one another, the tract of their fierce collision entered the south-west of England, about ten a.m., passing over the south, and leaving the south-east coast at about three p.m.

Their battle track was doubtless also well marked, as it advanced across the Irish Sea and Ireland, and possibly the loss of the steam ship *Cambria* can be traced to it.

Their furious combat did not probably proceed further than the east coast of England, as the equatorial current, although itself deflected in doing so, had curled the polar current northwards over the German Ocean on the morning of the 20th. This storm is the more interesting, as it resulted from the collision of two winds in our land, instead of, as is usual with us in our great storms, from a cyclone passing over us, which had been generated in the tropics.

I enclose you six rough tracings, shewing the winds' course, the equatorial wind being coloured red, and the polar blue.

The Weather Book by the late Admiral Fitzroy p. 235, and diagram VII., I see describes such a storm.

The tidal wave noticed at Salcombe was doubtless caused by the polar current driving southward, the water of St. George's Channel, while the equatorial current as abnormally raised that from the Atlantic.—Yours faithfully,

J. R. MANN.

East Cowes, Isle of Wight, 24th Nov. 1870.

To the Editor of the Meteorological Magazine.

SIR,—The storm of October 19th reached us at 0.30. The wind in the town did not attract much attention, but the violent rain with hail which followed, was especially noted. There was no thunder nor lightning here. The rain measured next morning was 0·37 inch. I think most of it fell during the storm. No mischief was done in the town, so far as I know; but at Milcomb, 4 miles S.W. of Banbury, trees were blown down. At Wardington, 4 or 5 miles N.N.E. of Banbury, many trees were blown down or broken, and the ridge of a house was taken off. My informant particularly mentions the way in which the trees were twisted. The wind came in two "puffs" from the S.W.; and the course seemed, from the damage done, to be a quarter of a mile wide. In Edgcote Park, just beyond Wardington, many trees blown down or

damaged. At Radway, just below Edgehill, 7 miles N.W. of Banbury, the vicar, the Rev. G. Miller, says: "I did not see the havoc among the trees till some few days after. The width of the damage done was about 300 yards, and the length about one mile. Beyond this distance there are no particular traces of the storm" At Burton Danete, two or three miles N.E. of Radway, the roof of a barn was taken off, and a wall blown down. The wall fell towards the apparent course of the wind.

It is probable that further inquiry would discover many more traces of the storm. If the gale had been more noticeable at Banbury I should have been led to make more investigation at the time.

I cannot hear of any change in the direction of the wind during the storm. Truly yours, T. BEESLEY.

Laboratory of Analytical Chemistry, 5, High Street, Banbury, November 27th, 1870.

To the Editor of the Metcorological Magazine.

SIR,—Having read the reports of your various correspondents respecting the storm of the 19th of October, I beg to offer a few remarks on the subject. A similar if not more severe storm occurred at this place on the same day. During the morning nothing in particular happened to indicate its approach, the wind was S.W., with a little rain; about 12·40 a most terrific gale sprang up, due west, it swept everything before it, one elm in particular, of very large size, containing more than 300 feet of timber, without reckoning the limbs and the top, was blown up; others were broken in two at different distances from the ground; one of these was two feet in diameter. In fact, the wind destroyed everything with which it came in contact; perhaps the most remarkable circumstance connected with the hurricane is, that it should have spent all its force in a valley, whilst the surrounding hills were not in the least affected; it lasted not more than two or three minutes, and during that time the rain came down in sheets of water, accompanied by occasional pieces of ice, the whole atmosphere being darkened by the branches and leaves of trees, &c., moving with the wind. The length of the district affected must have been about 1,000 yards; and the width about 300, just through the middle of the valley, and direct from west to east; it would be very easy to draw a line on each side of the course taken by the wind from the effect it produced. J. DANIELS.

Swyncombe Gardens, Henley-on-Thames.

To the Editor of the Metcorological Magazine.

SIR,—The gale which had been raging all the previous evening continued throughout the night and early morning, but moderated towards 8 a.m.; in the course of the forenoon it however recommenced. About 1 p.m., or shortly after, a very heavy and severe squall suddenly sprang up from W. and S.W.; the afternoon and evening were very stormy, and the wind was high and gusty.

W. J. HARRIS, F.M.S.

Worthing.

To the Editor of the Meteorological Magazine.

SIR,—Seeing by your Magazine that you wish for more information respecting the squall of October 19th, I send you an account of what was witnessed of it here.

The day in question was very windy, with a little rain. Barometer falling 29·576 at 9 a.m., 29·316 at 9 p.m., (corrected to sea level and 32°.) I saw the storm coming up from the S.W., a few minutes before two p.m. The height of it here was two or three minutes after two. I cannot tell exactly the minute, but I am sure it was past two, but not five minutes past. The first damage it did was, after crossing the river Granta, partly moving a very fine plane tree close to the river, then taking a north-easterly course for about fifty yards, it blew completely up by the root three very large elm trees, twisting off numerous branches in its course, and tops off other elm trees across the park for about a quarter of a mile, damaging the trees by twisting off the branches not like an ordinary wind, showing that it was a whirlwind. I saw the leaves and small branches from near where the elms were blown down, taken high up in the air, and many of them fell some fifty or sixty yards N.W.

What seems to me most curious is, that it was only in the valley that any damage was done to the trees, for it passed trees on an elevated spot, just before getting to the river, and the last marks it left were near the top of a hill on the other side of the park, its course being nearly E.N.E. The rainfall during the storm, which I should think lasted from one to two minutes, was 0·12—temperature about 67°.—I remain, Sir, your obedient servant,

J. BRYAN.

Audley End Gardens, Saffron Walden, Nov. 23rd, 1870.

ERIDGE, TUNBRIDGE WELLS.—Rain began at 11 a.m.; at 1.55 p.m. a sudden squall with rain and hail. The wind was violent, and the darkness considerable. The wind at the time shifted from S.S.W. to W.N.W.

To the Editor of the Meteorological Magazine.

SIR,—I have read with great interest the accounts of the severe squalls which visited several parts of the west of England, on the 19th of October, 1870. These accounts are sadly deficient in giving the direction of the wind, otherwise we should be able to ascertain with some degree of precision whether these squalls conformed at all to the ordinary type of revolving gales. You give the rate of lateral progress at about 50 miles an hour. It, however, appears unlikely that they all were one and the same squall, which visited the stations in succession. If it were the same squall that visited Kingsbridge and Chepstow it would partake of the nature of a zone of very violent force, in a larger revolving storm, the centre of which was to the west of the two stations. At Llanwrtydd, upon this hypothesis, the centre was to the north. Extracts from registers kept in different parts of the west of England, other than those visited by the squalls, would supply a great

deficiency and go far to elucidate a question, suggested by a Committee of the Royal Society in 1840, which I believe has not received the attention it demands, viz.—the nature of the wind-flaws between ascending columns and sheets of air, capricious in their direction, and often amounting to sharp squalls in their intensity.

I am, Sir, yours very truly, W. R. BIRT.

Observatory, Cynthia Villa, Walthamstow.

P.S.—My article on Atmospheric Waves, contains an allusion to the 'wind-flaws" (on p. 11), such as I conceive the "squalls" of the 19th 'October to have been.—W. R. B.

[As we have not yet received so many of the "copies of any notes which our numerous correspondents may find in their books" as we consider requisite for a full discussion of this remarkable storm, we again defer it, and trust that, reinforced by Mr. Birt's request, ample materials will soon be forwarded. Dr. Barter's return from Bath is a capital type of what is required.—ED.]

THUNDERSTORM ON NOVEMBER 22ND.

To the Editor of the Meteorological Magazine.

SIR,—On the 22nd of November, at 9.3 p.m., there was here a dazzling flash of lightning, accompanied by deafening thunder (together), and instantly a fall of large hailstones and torrents of rain, which ran over the shoots from the house like a waterfall. Query, did the lightning cause the condensation of a cloud—the coldness causing the drops to freeze?—Yours, F. S. AMERY.

Druid Ashburton, Devon.

To the Editor of the Meteorological Magazine.

SIR,—Throughout the evening and night of Nov. 22nd, we had an almost incessant storm of lightning and thunder, with frequent showers of rain and hail. No damage was done in this parish, but at Hartfield, about eight miles to the northward, the spire of the parish church was shattered. The electric fluid struck the ball at the top of the vane, split the top of the spire, ripped out the shingles and some of the timbers on the south side and some of the stones on the top of the tower. In fact the whole of the spire is so severely shaken, that much of it will have to be removed before it can be repaired. The pieces of shingle were scattered all over the churchyard and in the adjoining fields, both north and south. A large piece of timber and shingle fell across a wooden rail placed over a grave near the belfry door, smashing it to atoms. The spire is supposed to be one of five in England, that are clearly of the third pointed date—broach spires, A.D. 1377.

A storm of such severity and duration is of rare occurrence at this season of the year.—Yours obediently,

C. L. PRINCE.

Uckfield, Dec. 4, 1870.

[Reference to the November Notes on p. 199 will show that this storm was felt more or less throughout the south of England.—ED.]

DIFFERENCE BETWEEN READINGS OF MERCURIAL AND ANEROID BAROMETERS.

To the Editor of the Meteorogical Magazine.

SIR,—In your last number, Mr. Knott gives an interesting table showing the difference between the readings of the mercurial and aneroid barometers, during August and the two following months. This variation is, I think, explained by the last paragraph in his letter. "No allowance was made for temperature to the observed reading of the aneroid."

I am not aware whether any compensating principle has been successfully applied to aneroids to correct the errors caused by changes of temperature on metals, and on the elasticity of metal springs. All aneroids that I have compared, show a sensible variation with the rise and fall of the thermometer. Supposing the mercurial barometer to give the correct reading, we should expect the error of the aneroid, which was a plus quantity at the beginning of August, to vanish by degrees, and become a minus quantity, as the season progressed and became colder. This rule seems to have been followed by Mr. Knott's aneroid. Further, I observe that the plus error was greatest during the hot weather, about August 10th. Again in October, it was highest on the 2nd, which according to your monthly table was in most places the hottest day of the month. Again the minus error was great on the 11th, which your table shows to have been generally the coldest day of the month. All this seems to bear out the presumption, that these variations are due to the influence of temperature.

Yours, &c, P. P. PENNANT.

Brynbella, St. Asaph, Nov. 21*st*, 1870.

MAGNIFICENT DETONATING METEOR.

To the Editor of the Meteorological Magazine.

SIR,—The remarkable meteor of Saturday last (19th), reported in the public papers, I observed here, while out inspecting the meteorological instruments at nine o'clock p.m., the night then being very dark and the sky overcast with thick fog, no stars visible. I can describe it thus: "While walking in a northern direction I was instantly arrested by a gleam of intensely brilliant white light, which burst forth with a blinding sensation, such as I had scarcely ever witnessed, producing a brilliant white misty spectrum before the eyes, and illuminating all around. I instinctively turned sharply round towards the point from which the light seemed to emanate, south or south-west, and had a momentary glance of a large circular fiery body or flash, similar to the gleam of a discharge from a piece of heavy ordnance, but more vivid; giving off frizzled fervid like beams or sparks, directed towards the margin, and apparently of the diameter of eight or ten feet. Almost instantly it vanished in several quick repeated flashes like lightning, and of various colours: red, blue, and green predominating. The meteor remained visible only a few seconds and gave then no noise; but in about twenty seconds afterwards a receding roll of rapid discharges was heard in the south or south-west, having a noise like a

distant cannonade, and accompanied with a most peculiar booming sound, similar to the reverberatory sound caused by an earthquake."

It would be about fifty degrees above the southern horizon at the moment of its disappearance. Also I may remark that the large size of the meteor, as apparent to me, must have been produced by the state of the atmosphere diffusing the light emitted. Altogether it was a most imposing object. I have seen several very fine meteors, but nothing equal to this last. DAVID HENDERSON.

Deanston Gardens, Stirling, 22nd November, 1870.

EXTRAORDINARY METEOR.—A correspondent from Carnwath, Lanarkshire, writes: At 9 o'clock on Saturday evening a most extraordinary meteor was observed here. At the time indicated a blazing meteor, of a reddish blue or bright mauve colour, with a brilliant tail or streak behind, suddenly appeared in the northern sky, about 55 or 56 degrees above the horizon, and shooting towards the west through a point a degree or two nearer the zenith than the Pole Star, lighted up the whole heavens with a brilliancy so intense as almost to dazzle the eye. The meteor was observed for about two or three seconds, during which time it seemed to pass through a space of 15 degrees, when, appearing to sweep or bend towards the earth, it burst seemingly without report, into a number of pieces, the blaze at the same time being extinguished, leaving a streak of a dark greenish colour, which was visible for a few seconds, and which appeared to be about 10 degrees in length and half a degree in breadth. The Pole Star was observed to be near the centre of the streak when it faded. In from 80 to 90 seconds after the disappearance of the meteor, a most alarming sound was heard, apparently proceeding from the point where the meteor burst. It resembled thunder at a distance of about 5 miles, and was also like the noise produced by a train when heard passing rapidly over a bridge on a calm frosty night, at the distance of half a mile or so. The sound had also a peculiar "whirr" or "boom," resembling the noise made by an engine having a heavy pressure of steam. Indeed, so dreadful was the noise that every one who heard it afterwards declared they never had felt the same indescribable feeling of awe and fear come over them. The sound which was heard for about 50 seconds altogether, gradually increased in loudness up till about 40 seconds, when it seemed very like the noise produced by the passage of a heavy body through the air close at hand; and at 50 seconds from the time it was first heard the sound suddenly ceased. Was the noise caused by the meteor itself before it burst, or was it produced by the portions into which the meteor was divided, after bursting, falling towards the earth? Supposing the latter to have been the case, according to the rule by which distance is calculated from sound, the distance of the meteor when it burst would be about 18 miles from this place. It may be stated that the weather was calm and the sky cloudless when the phenomenon took place; and that a faint aurora borealis was observed in the northern horizon, which from 9.5 till 10 p.m., overspread the sky from west to east by north, and was of almost all colours—from white to deep red. At 11 p.m. the sky became overcast and rain began to fall.

Another Account.—AIRDRIE, LANARKSHIRE.—About 9 o'clock on 19th, a strange meteoric phenomenon appeared in the heavens. The whole sky was illuminated by a bright light, resembling the lime or magnesium light. All eyes were turned in a north-easterly direction, where a large meteor was seen travelling to the south-west, and apparently nearing the earth in an oblique direction. At first it appeared as a large ball of fire, with a tail resembling a comet. When apparently near the earth, the ball burst, and the light disappearing, left the sky as dark as it was before the meteor was seen, except that there was a small white cloud visible in the direction whence the whole had come. So vivid was the light that an alarm of fire was raised in the neighbourhood of South Street, and several parties were seen running in the direction of the Gas Works, where it was supposed the fire had originated. People who were in quiet neighbourhoods heard, following the appearance of the meteor, a low sound as of distant rolling thunder.

THE WINTER.

To the Editor of the Meteorological Magazine.

SIR,—In compliance with the request of a great many of your correspondents, I have much pleasure in stating the law referred to in my last letter. It is as follows :—

When the rainfall of the first seven months of the year is below 10 inches, (near London or at Lyndon in Rutland), or there have been in the first eight months of the year, three or more months in each of which the rainfall has been below an inch, the succeeding winter is *always* remarkably severe, if the Greenwich mean temperature of August to October inclusive has been not more than 56°·1 in the former case, or in the latter more than 53°·4. The following are *all* the instances relative to this law since 1770. It will be seen that in all these instances the mean temperature of the winter was more than 2° below the average of 99 years, and eleven times in twelve the mean was more than 3° below that long average.

The rainfall amounts of the first seven months in the period from 1771 to 1791, are taken from the tables of Mr. Barker, of Lyndon ; those for the period from 1792 to 1796, from the journal of Mr. Adams, of Edmonton; those for the period from 1797 to 1814, from Luke Howard's tables, and the remaining rainfall amounts, as well as the mean temperature values, are from Mr. Glaisher's tables.

The Greenwich rainfall observations only being available from 1815, I was obliged to have recourse to the above-mentioned registers.

TABLE I.

Year.	Rainfall of January to July inclusive.	No. of months below 1 inch from Jan. to Aug. inclusive.	Mean temp. of August to October inclusive.	Period of Winter.	Difference of Mean temperature of winter from the average of 99 years.
	inches.		deg.		deg.
1771...	7·5	...	52·5	Jan. 1771 to Mar. 1771	—3·6
1785...	7·8	...	53·7	Jan. 1786 to Mar. 1786	—3·1
1788...	9·2	...	55·0	Dec. 1788 to Feb. 1789	—3·8
1794...	7·8	...	53·8	Dec. 1794 to Feb. 1795	—6·3
1796...	8·0	...	55·2	Dec. 1796 to Feb. 1797	—4·1
1798...	9·7	...	55·9	Dec. 1798 to Feb. 1799	—3·4
1813...	...	3	53·4	Jan. 1814 to Mar. 1814	—6·5
1829...	...	3	52·8	Dec. 1829 to Feb. 1830	—4·6
1837...	9·6	...	55·4	Jan. 1838 to Mar. 1838	—4·1
1840...	9·3	...	54·3	Dec. 1840 to Feb. 1841	—3·8
1854...	9·7	...	56·1	Jan. 1855 to Mar. 1855	—4·4
1864...	8·2	...	55·7	Jan. 1865 to Mar. 1865	—2·04
1870...	7·1	...	55·5	... ..	...

It appears from the foregoing, as also from the following law, that drought in the first seven, eight, or nine months of the year should be placed among the elements of the problem of the weather for a given winter.

In the following law uniformity of monthly mean temperatures in the spring and summer, instead of a low or moderate temperature from August to October, is connected with deficient rainfall.

When the Greenwich rainfall of January to September inclusive is below the average to the extent of 0·7 inch, or more, and the mean temperatures of April and May are within 2°. of uniformity, or the mean temperatures of any two consecutive months, from the 15th of May to the 14th of August, (reckoning the month from the beginning of one calendar month to the end of the same, or from the middle of one month to the middle of the next), are so nearly uniform that there is a range of not more than 0°·1; the succeeding winter is invariably very severe.

The following table contains all the instances that have occurred relative to this law since 1814. It will be seen that in each instance, the mean temperature of a period of four months, was more than 1°· below the average of 99 years.

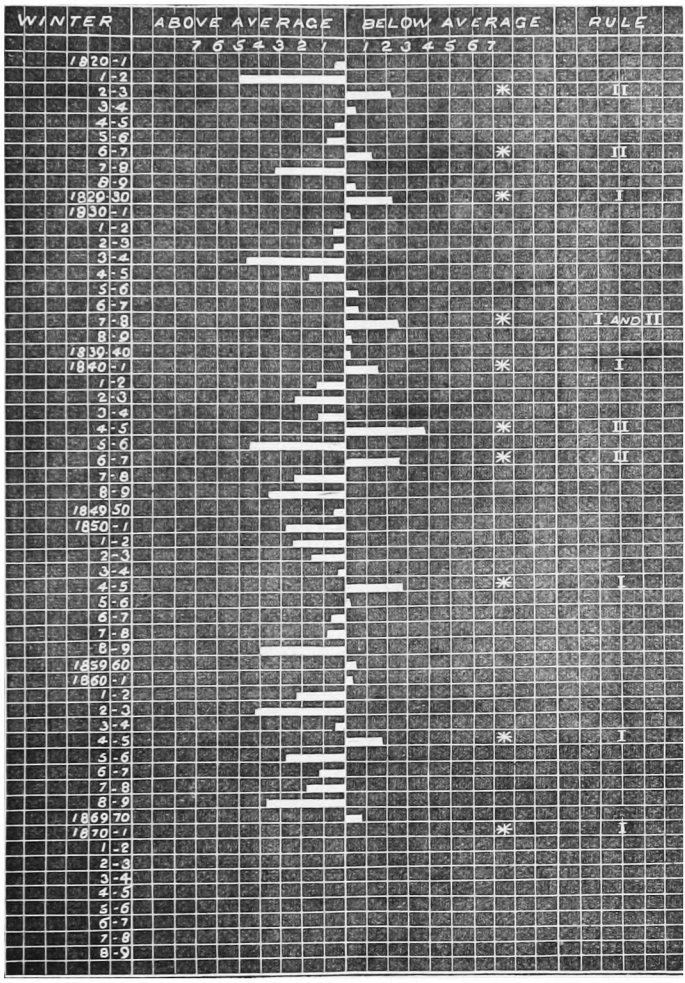
TABLE II.

Year.	Diff. of Greenwich rainfall from average of 55 years.	MEAN TEMPERATURE OF							Difference of mean temp. of Dec. to Mar. inclusive, from average of 99 years.	Year of Winter.
		April	May.	June.	July.	May 14 to June 14	June 15 to July 14	July 15 to Aug. 14		
	inches.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	
1822	—1·2	..	...	62·6	62·5	61·9	61·9	...	—2·2	1822–3
1826	—1·4	49·0	50·0	...	...	...	...	...	—1·2	1826–7
1837	—2·9	...	...	...	..	...	63·5	63·4	—2·6	1837–8
1844	—2·1	51·7	52·9	...	...	...	...	...	—3·9	1844–5
1846	—0·7	..	...	...	...	...	64·6	64·7	—2·6	1846–7

From 1771 to 1820 there were eleven winters when the mean temperature of December to March inclusive was below the average by more than 2°, viz.—the first seven years given in Table 1, and the winters of 1777-8, 1783-4, 1784-5 and 1799-1800. In 1777, 1783, and 1784 the falls of rain in England, were respectively (according to Mr. Symons) 11, 7, and 4 per cent. below the annual average. In each of these seasons, too, there was a very remarkable uniformity in the monthly mean temperatures or in their differences. In 1799, the uniformly low temperature from January to October inclusive, was particularly striking; *every month being below the mean.* It was doubtless this remarkable uniformity that indicated the very severe winter which followed.

The accompanying diagram shows the departure from the average of 99 years, of all the winters in the last half century.

In the diagram the stars are placed against those winters that are mentioned in tables 1 and 2. On comparing the minus departures from the mean with the asterisks, it will be seen that in every past year there is no minus of more than 1° without a star, and no star without a minus of more than 1°. It will also be seen that in the last 50 years there were nine winters, in which the mean temperature was more than 1° below the average, and nine years in which the phenomena mentioned in laws 1 and 2 occurred. The nine years in both cases exactly correspond.



It thus appears that during the last half-century, unusually severe winters have *always* occurred after the phenomena mentioned in the foregoing laws, but have *never* occurred without those phenomena having previously prevailed.

There is one additional fact which it may be worth while to state. It is this—the coldest months in the last hundred years occurred in the winters given in the foregoing tables. December was coldest in 1788, and the next coldest was in 1796. The coldest January was in 1795, and the next coldest was January 1814. February was coldest in 1855; and the coldest March on record (except that of 1785) occurred in 1786. All these intensely cold months occurred in the winters mentioned in Tables 1 and 2.

I think the foregoing statements, diagram, and tables, sufficiently prove the accuracy of the laws to which they have reference.

GEORGE D. BRUMHAM.

Barnsbury,

NOVEMBER, 1870.

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	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32° In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	1·76	— ·65	·75	22	13	56·4	24	27·3	19	8	15
II.		Maidstone (Linton Park)	1·70	— 1·49	·34	20	12	56·0	26	26·0	13	8	...
,,		Selborne (The Wakes)	2·77	— ·77	·72	22	10	52·0	1, 26	22·5	19	17	19
III.		Hitchen	1·29	— ·85	·32	24	14	53·0	24	26·0	16	9	...
,,		Banbury	1·90	— ·30	·34	22	14	52·7	1	23·0	17	14	...
IV.		Bury St. Edmunds (Culford)	·89	— 1·50	·25	12	10	55·0	24	26·0	17	9	19
V.		Bridport	1·86	— 1·30	·48	24	10	57·0	3	22·0	18	13	...
,,		Barnstaple	3·36	— ·78	·55	22	18	58·0	1, 25	33·0	13†	...	...
,,		Bodmin	4·50	— ·48	·86	23	18	54·0	22*	32·0	18	0	7
VI.		Cirencester	2·26	— ·53	·65	22	9	...	...	...	...	...	...
,,		Shiffnal (Haughton Hall)	2·75	+ 1·18	·82	22	18	53·0	24	25·0	17	15	...
,,		Tenbury (Orleton)	2·78	+ ·31	·48	22	15	57·2	24	25·0	17	13	15
VII.		Leicester (Wigston)	1·38	— ·78	·32	23	12	55·0	24	28·0	11	8	...
,,		Boston	1·37	— ·77	·30	24	14	55·5	24	27·5	17	8	15
,,		Grimsby (Killingholme)	1·65	..	·47	23	14	54·0	24	28·0	9§	7	...
,,		Derby	1·99	+ ·36	·57	22	12	57·0	23	28·0	12§	7	...
VIII.		Manchester	2·42	— ·34	...	...	12	..	...	...	...	...	...
IX.		York	1·93	— ·05	·57	23	19	52·5	24	24·0	17	12	...
,,		Skipton (Arncliffe)	3·94	— 2·51	·91	24	9	53·0	25	18·0	17	16	...
X.		North Shields	3·50	+ ·80	·88	9	16	56·0	3	30·0	10‡	8	15
,,		Borrowdale (Seathwaite)	8·00	— 8·67	...	..	...	...	...	...	...	...	...
XI.	WALES.	Cardiff (Town Hall)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	3·98	— 1·69	·75	14	12	54·0	1	27·5	19	14	...
,,		Rhayader (Cefnfaes)	3·85	— ·73	1·00	23	10	52·0	...	21·0	...	5	...
,,		Llandudno	2·94	— ·22	·67	20	15	55·4	2	29·6	15	1	...
XII.	SCOTLAND.	Dumfries	2·07	— 1·15	·61	21	13	60·0	3	25·0	10	12	...
,,		Hawick (Silverbut Hall)	1·71	...	·43	12	13	...	...	...	...	...	...
XIV.		Ayr (Auchendrane House)	2·15	— 1·92	·40	19	16	54·0	1, 3	22·0	9, 10	13	21
XV.		Castle Toward	2·52	— 2·12	·64	13	13	56·0	4	26·0	10	12	17
XVI.		Leven (Nookton)	1·55	— 1·49	·43	13	10	58·0	3	25·0	27	15	27
,,		Stirling (Deanston)	1·32	— 2·19	·45	21	12	54·8	3	21·0	8, 9	20	25
,,		Logierait	1·82	...	·46	21	11	...	...	...	...	...	...
XVII.		Ballater	2·94	...	1·00	21	10	52·0	1	22·0	27	21	...
,,		Aberdeen	2·47	...	·37	11	20	50·0	3	29·7	14‖	5	29
XVIII		Inverness (Culloden)	...	...	...	...	...	...	...	...	...	...	..
,,		Portree	10·07	— ·41	1·11	16	21	...	...	..	...	...	...
,,		Loch Broom	4·17	...	·50	12	22	...	...	...	...	...	...
XIX.		Helmsdale	4·74	...	·72	15	25	...	...	...	...	...	...
,,		Sandwick	3·67	— ·33	·41	21	20	53·1	3	31·6	24	1	17
XX.	IRELAND.	Cork	3·33	...	·84	18	13	...	...	...	...	...	...
,,		Waterford	3·78	— ·17	1·17	18	17	54·0	1,3,4	30·0	17	1	...
,,		Killaloe	2·21	— 2·68	·51	18	16	59·0	24	28·0	18	10	...
XXI.		Portarlington	1·04	— 2·88	·27	19	21	53·0	1	27·0	16	9	...
,,		Monkstown	1·41	— 1·48	·40	19	12	...	...	...	...	...	...
XXII.		Galway	4·57	...	1·40	22	16	60·0	2	30·0	17*	5	...
,,		Bunninadden (Doo Castle)	2·56	...	·30	14	20	50·0	7	20·0	26	14	...
XXIII		Bawnboy (Owendoon)	...	...	..	...	...	...	...	...	..	..	..
,,		Waringstown	1·77	...	·28	12	13	57·0	1	23·0	8	12	22
,,		Strabane (Leckpatrick)	2·30	..	·35	15	18	52·0	1, 2	21·0	9	22	29

*And 25. †And 17, 18, 20. §And 17, 18. ‡And 11, 12, 15. ‖And 23.

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

METEOROLOGICAL NOTES ON NOVEMBER.

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

ENGLAND.

CAMDEN TOWN.—Dense fog at noon on 9th; a few flakes of S on the 10th, at 7 a.m.; S also 13th and 15th; T S at 7.45 p.m. on 22nd; gale on 23rd and 24th.

LINTON PARK.—The middle of the month wet and sometimes wintery, but the first 12 days and last five days quite dry; distant T on the 23rd, but few fogs; and perhaps the most remarkable event for November was the dust blowing on the 10th. On the whole it has been a favourable month. Highest reading of bar. 30·21 on the 3rd, lowest 28·75 on the 15th and 22nd.

SELBORNE.—Only one day with R before the 19th; R on every day but three from 19th to the end of month; a few flakes of S at 8 a.m. on 10th; dense fog all day on 9th, and again on 17th and 26th; fogs on 2nd, 3rd, 4th, 11th, 27th, 28th, and 29th; aurora on 21st; T S with H and R on evening of 22nd, and again at 1 a.m. on 23rd, followed by violent wind and R at noon; gale with heavy R on 24th; bar. remarkably low from the 9th to the 25th, then a sudden rise; S on 15th in early morning, which disappeared by noon on 18th.

BANBURY.—Slight S on 13th; fog on 2nd, 3rd, 4th, 9th, 26th and 27th; T and L with high wind on 22nd, and high wind on 23rd also.

CULFORD.—Fog 2nd, 3rd, 5th, the three following days and 26th, and two following days; slight fall of S on 10th, and again on 12th.

BRIDPORT.—T and L on 22nd, nearly all the R fell in eight following days from 19th to 26th inclusive; heavy south-westerly gale on 24th.

BODMIN.—Highest bar. 30·51 on 3rd, lowest 29·08 on 20th; mean temperature of November 42°·9.

SHIFFNAL.—This month has kept up its character throughout, fog or R varied with frost. The prevailing winds up to the 25th were westerly, from which date they came from the E. The temp., with one exception (53° on the 24th), seldom exceeded 45°, while on 15 days it sank below 32°; the bar. high during the first week, from which date it sank considerably, but rose again, terminating the month unusually high, viz., 30·22. Redwings arrived on 6th, fieldfares, in flocks, on 10th; woodcocks unusually scarce up to the end of the month.

[ERRATUM.—In last month's Notes, "Comma Butterfly" was misprinted "Common Butterfly."—ED.]

ORLETON.—The weather very cold till the 21st, with frequent fog, and frost almost every morning, but with very little R; then very warm and rainy till the 26th; cloudy and dry after. Bar. highest at the beginning and end of the month, but very low in the middle; T heard on 16th, 17th, and 23rd, and L seen on 21st and 23rd; aurora at 9 p.m. on 19th; mean temp. nearly 2° below the average.

BOSTON.—R and S on the 10th, 14th, 15th, and 16th.

KILLINGHOLME.—Much fog; temp. colder than usual; many days of calm. Wheat comes slowly out of the ground. Winter began on 10th; S falling again on the 11th, and on the 12th the ground was covered with S. A spot on the sun visible to the naked eye through the fog on the 17th.

ARNCLIFFE.—A fortnight of severe cold weather from the 5th to the 19th.

NORTH SHIELDS.—S, L, and H on 10th; S also on 9th and 11th.

WALES.

HAVERFORDWEST.—Stormy and cold; the middle very wet. Splendid aurora on the evening of the 19th. S fell on six days in small quantities.

CEFNFAES.—The month has been cold and damp, with much wind and fog.

LLANDUDNO.—Though cold on the 11th, there was L in the evening, with H showers; S on the distant hills, continuing to the end of the month; H on 12th and 13th. The aurora seen, more or less, every evening during the week from the 7th to the 12th.

SCOTLAND.

DUMFRIES.—The first eleven days fine, with some frost; from 12th to 25th showery, with occasional frosts; S on the 10th, 11th, and 12th.

HAWICK.—Charming weather till the 9th; very stormy on 10th and 12th; the remainder of the month, on the whole, genial and mild, and both gardening

and husbandry operations are well forward. Curlers were on the ice on the 11th, and enjoyed a game.

CASTLE TOWARD.—The first week calm and comparatively mild; the second cold, with frosty nights; S and sleety showers on the 14th, which lay on the hill tops for some days; the last week fine, with a rising bar.

NOOKTON.—Fine, mild, and calm from 1st to 9th; S showers on 10th; clear, brisk, easterly winds on 11th; meteor at 9 p.m. on 18th; fine from 24th to the end.

LOGIERAIT.—Several heavy fogs, but a fine month.

BALLATER.—A sharp S storm about the 10th, and cold throughout.

ABERDEEN.—Red aurora on 8th; S, sleet, and H on the 9th, 10th, and 11th; S two inches deep on the 10th. A rather dry month, but dull, with days colder and nights milder than the average. Mean temp. 39°·4; max. in sun, on 1st 81°·9; min. on grass, 19°·1, on 14th; temp., R, and bar. below the average. Winds generally very light; winds from N., N.W., and S. above the average.

PORTREE.—This month has been stormy and very squally. T and L on 10th and 11th; frost and S from 10th to 19th; no R after the 26th.

LOCHBROOM.—A wet month; not one dry day from the 3rd to the 21st, then two fine days, and then R to the 26th, and very keen frosts to the end, but the farmer has been able to use his plough successfully in preparing the soil for the spring operations.

SANDWICK.—November has been drier than the mean and somewhat colder, particularly during the first part, owing to the prevalence of northerly winds from the 3rd to the 18th, but many days were fine, and the wind generally moderate. Lunar rainbow on the 11th; on the 8th, a curious double rainbow, with a perpendicular pillar of the same colours extending from the end of the inner up to the outer bow; 18th, aurora to zenith and S., red sometimes, wind 40 miles an hour from 10 a.m. to 2 p.m.; wind 40 miles an hour from 5 p.m. on 25th to 4 a.m. on 26th, 50 miles an hour for two hours at first.

IRELAND.

DOO CASTLE.—Fine month on the whole; there were some nights of very severe frost.

WARINGSTOWN.—The first and last weeks fine.

LECKPATRICK.—Very cold month, the coldest for the last seven years; the number of cold nights (as in October) unprecedented. Rainfall about half my average, while October was double.

OZONE PAPERS.

SIR,—I also, as a beginner, went in for ozone, and came to the same conclusion as Mr. Thrustans. Ozone papers, in my opinion, are a delusion and a snare. I have looked at them at 9 p.m., and found them as black as 8, and even more. The next morning they were as white as when first hung up.

More than this, I have hung a paper at 9 a.m., seen it at noon *darkened*. Then came rain and wind, and at 3 p.m. the paper was white again. The stand I hung these papers in was a Stevenson's, into which I thought no rain could get, but I cannot help thinking rain has something to do with it.

I was so disgusted with the whole business that I have not bothered myself about ozone since.—Your obedient servant,

October 24th. HARRY CHICHESTER, F.M.S.

Although our last number was twice the usual size, and contained nearly three times the usual quantity of matter, and we have this month also increased our usual size, the insertion of several esteemed communications is unavoidably deferred.—ED.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

LX.] JANUARY, 1871. [PRICE FOURPENCE, or 5s. per ann. post free.

THE CHRISTMAS FROST OF 1870-71.

IN accordance with the precedent of 1867, we this month devote considerable space to records of the recent frost—we might almost say the present, for up to this date, January 12th, it has hardly broken.

We think it may be expedient to say a few words by way of preface (1) on what we deem the limits of editorial responsibility with reference to returns of this nature, and (2) on causes of discrepancy.

It is very customary to prefix to the correspondence columns of journals, and to the whole volumes of papers published by scientific societies, a notice that the editor or society, as the case may be, "is not responsible for the facts and opinions stated in the following papers." Possibly this notice has some legal force, if so, we also hereby repudiate responsibility. We should not have referred to this subject had not a very eminent gentleman, who, unavoidably, has published as many erroneous observations as we have, lately said that he "looked at it as a very serious thing that people will publish observations without having satisfied themselves that those observations are correct." How is it possible to do this? There is not an observatory, public or private, where all the observations are correct, and it is mere affectation to assume that it can be otherwise.

Mr. Glaisher and Mr. Buchan, by visiting the various stations and examining all the instruments and their positions, Kew Observatory, by testing the instruments before use, and Mr. Symons, by touring about among the rain gauge stations, each do what they can to ensure an approach to accuracy, and if they use reasonable care in printing the returns we do not see what more could be expected. But surely none of them would presume to say that the observations they publish *are* correct. They may strive to minify the sources of error, but they cannot exclude them. Why even Mr. Griffith might read a thermometer 2° or 3° too low, and who could detect it? Hence we repudiate responsibility, because we cannot "satisfy ourselves that the observations are correct." We are confident that our correspondents are, at least, the equals of any existing body, but they, we, and all mortals, not excepting our critic, are fallible.

Minimum Temp. in Air from December 22*nd*, 1870, *to January* 1*st*, 1871.

Station.	Observer.	22	23	24	25	26	27	28	29	30	31	1
Middlesex-Bot.Gar Regent'sPk.	W. Sowerby, Esq. ..	22·5	17·0	14·0	12·0*	23·0	22·0	25·5	21·0	18·5	17·0	21·0
Camden Square	G. J. Symons, Esq. ...	23·2	18·6	15·3	14·0*	27·2	21·7	24·0	25·0	19·8	18·2	21·0
Hadefield Park, Uxbridge	W. F. Vernon, Esq	...	...	...	10·0*	...	...	...	..	...	...	...
Surrey—Pyports, Cobham	G. Dines, Esq.	...	...	...	...	..	...	..	...	...	1·2*	...
Kent—Riverhead, Sevenoaks ...	Rev. J. B. Murdoch...	...	..	...	4·0*	...		..	...	...	...	...
Bromley Common	Rev. A. Rawson	...	...	...	4·0*	...	...	...	...	...	...	...
Chiselhurst	F. Nunes, Esq.....	22·0	14·5	11·7	10·2*	11·3	21·9	23·4	21·9	15·4	12·3	14·3
Foxgrove, Beckenham	P. Bicknell, Esq.....	22·9	13·3	9·3	6·0*	26·4	18·0	24·3	20·8	11·3	6·0*	13·8
Eltham Green	Mr. E. J. C. Smith ...	23·6	16·0	10·9	9·1	12·8	20·8	25·6	21·0	11·2	15·0	14·8
Greenwich Observatory	J. Glaisher, Esq.	20·4	17·6	15·3	9·8*	22·7	22·0	25·4	22·0	19·0	15·8	19·2
Crossness	F. E. Houghton, Esq..	...	...	...	9·0*	..	...	...	...	...	9·0*	...
Sussex—Worthing	W. J. Harris, Esq. ...	24·0	19·4	21·2	21·1	23·4	23·4	23·6	26·3	18·9*	19·9	20·9
Hants—Newport, I. of W.	E. G. Aldridge, Esq ..	...	...	19·0*	...	...	...	...	...	...	21·5	...
The Vyne, Basingstoke	DeWiggett Chute, Esq.	...	9·0	4·0	2·0	9·5	10·0	12·0	19·0	3·0	3·0	—2·0*a*
Strathfield Turgiss	Rev. C. H. Griffith ...	20·5	11·2	7·4	4·0	6·4	10·7	20·5	23·1	6·3	4·0	2·7*
Herts—Berkhampstead	W. Squire, Esq.	21·5	15·5	9 5	6·0*	19·0	19·0	26·0	26·0	11·5	12·5	9·0
Cambridge—Abington Pigotts...	G. Pigott, Esq.	...	...	...	...	...	...	...	...	...	6·5*	...
Cambridge Beech Ho.	J Nutter, Esq.	...	...	...	10·0*	...	...	...	...	...	...	...
Essex—Audley End	Mr. J. Bryan	...	...	...	4·8*	...	...	...	...	...	...	..
Suffolk—Culford	Mr. P. Grieve	...	...	...	1·0*	...	...	...	...	...	...	...
Norfolk—Dickleboro', Diss ...	Mr. F. Dix	...	...	4·0	0·0*	17·0	18·0	20·0	22·0	12·0	9·0	...
Shadwell Court, Thetford	*The Times*	...	...	...	—3·0*	..	...	...	...	...	...	...
Stanford Vic., Watton	,, ...	...	12·0	5·0	—9·0	—8·0	19·0	...	...	...	...	...
Wereham, Brandon	Mr. F. R. Hawkes ...	7·8	8·3	3·2	1·9	19·0	15·8	16·8	20·0	12·0	4·8	...
Norwich	C. M. Gibson, Esq. ...	...	...	8·5	5·5	...	...	..	...	...	...	...
Reepham	*The Times*	...	13·5	0·0	—2·0	14·0	...	...	...	...	...	...
Hillington Rec., Lynn	Rev. H. Ffolkes	...	12·0	4·0	5·0	28·0	20·0	14·0	29·0	11·0	9·0	3·0
,, Hall, ,, ...	,, ,, ...	...	5·0	—5·0	...	...	...	...	...	...	...	—1·0
Wilts—Imber, Salisbury Plain...	Rev. W. Slatter	...	...	10·0*	...	...	..	...	...	...	12·0	...
Pen Hill, Swindon	T. Arkell, Esq.	...	...	...	...	...	...	...	...	...	..	1·0
Dorset—Frome Vanchurch	Rev. P. H. Newnham	...	...	7·7*	...	...	...	...	...	...	..	...
Longthorns, Blandford	J. C. Mansel, Esq. ...	...	...	7·0*	...	...	...	...	...	...	...	...
Devon—Dartmoor	Mr. Watts.....	..	15·0*	...	...	...	...	...	...	..	...	..
Sidmouth	S. Chick, Esq.	...	18·0*	...	...	...	...	...	...	...	..	...
,, (Belgrave)	Dr. Mackenzie	22·8	19·4	21·2	22·4	22·7	25·3	25·3	29·0	25·5	21·2	...
Meshaw, S. Molton.....	Rev. W. H. Karslake..	...	13·0	...	...	...	..	...	...	...	13·0	...
Great Torrington	Rev. S. Buckland ...	...	...	...	...	...	...	...	...	...	...	19·0
Somerset—Bath...	Dr. Barter.....	...	...	13·3	...	...	...	...	...	...	...	...

Station.	Observer.	22	23	24	25	26	27	28	29	30	31	1
Gloucester—Cheltenham	F. Layard, Esq.	...	...	7·0	...	...	...	...	...	...	8·0	12·0
Boyce Court, Newent	Gen. Drummond	19·0	11·0	5·5	4·5*	12·0	12·0	18·0	27·0	17·0	5·5	8·0
Hereford—Hampton Ho.	*The Times*	...	10·0	6·0	3·0	15·0	...	...	...	...	...	...
Rocklands, Ross	J. M. Herbert, Esq.	...	...	...	..	...	...	...	...	...	0·0	...
Stafford—Enville, Stourbridge	*The Times*	...	..	2·0	—1·0	20·0	15·0	...	...	...	...	...
Wolverhampton	J. Thrustans, Esq.	19·5	13·7	12·9	9·3	12·3	14·7	18·4	23·6	18·0	7·2	4·9*
Church Eaton, Penkridge	Rev. F. Pyndon Lowe	...	—4·0	5·0	4·0	...	...	...	...	...	...	..
Worcester—Bromsgrove	G. Dipple, Esq.	..	...	...	5·8	...	...	...	...	..	...	...
Moseley	T. Plant, Esq.	...	...	...	8·0	..	...	...	..	...	...	...
Warwick—Leamington	S. U. Jones, Esq.	...	...	...	8·0	...	...	...	...	...	...	...
Birmingham	D. Smith, Esq.	...	...	10·7	...	...	..	...	...	...	11·0	...
Leicester—Belmont Villas	H. Billson, Esq.	18·0	12·5	9·0	7·0	22·0	18·5	...	...	...	...	...
Freeman's Comm., Leicester	,, ,,	15·0	12·0	6·0	5·0	...	...	...	...	...	...	...
Lincoln—Boston	Dr. Adam	23·2	15·2	11·3	11·4	14·0	24·6	27·0	29·2	17·2	9·0	4·0*
Bucknall, Horncastle	W. Carter, Esq.	21·5	14·5	2·0	5·0	21·0	23·0	23·0	29·0	21·0	11·0	...
Appleby, Brigg	Rev. J. E. Cross	...	—0·4	6·3	..	...	...	...	..	...	...	...
Nottingham—Highfield Ho.	E. J. Lowe, Esq.	...	12·3	10·9	6·1	26·7	...	...	...	...	...	...
Ollerton	H. Horncastle, Esq.	...	..	...	5·0	...	...	...	...	...	4·0	...
Welbeck Abbey	Mr. Tillery	...	...	13·0	...	...	...	...	...	...	...	...
Derbyshire—Buxton	E. J. Sykes, Esq.	...	...	...	—1·5	...	...	...	...	...	...	..
Lancashire—Holker, Cartmel	Mr. Wilson	...	14·0*	...	...	...	...	...	...	...	...	...
Yorks—High Hazles, Sheffield	Mrs. Hounsfield	20·0	18·0	13·0	16·0	25·0	20·0	21·0	27·0	25·0	17·0	...
Willow Hall, Halifax	Louis J. Crossley, Esq.	...	...	...	...	...	...	...	...	...	10·0*	..
Malton Nurseries	*The Times*	...	11·5	8·0	7·0	20·0	20·0	20·5	19·0	3·0	...	...
,, Town	,,	...	18·0	14·0	13·0	21·0	24·0	25·0	23·0	..	...	...
Beadlam Grange	J. H. Phillips, Esq.	...	..	...	...	...	...	...	...	...	4·0*	...
Hawsker, Whitby	Rev. F. W. Stow	...	19·7	20·5	...	...	...	...	18·5	20·0	9·0	16·5
Middlesboro'	W. Fallows, Esq.	10·0	...	...	...	..	...	...	20·0	7·0	6·0	...
Durham—Stockton	*The Times*	...	5·0	9·0	12·0	...	...	...	...	...	...	..
Westmoreland—Casterton	S. Morris, Esq.	...	...	...	...	...	...	...	...	...	8·5	...
Kendal	R. J. Nelson, Esq.	..	...	...	...	..	...	...	...	...	10·0*	...
Grasmere Rectory	Mr. E. Tucker, Jun.	14·0	14·5	16·0	28·0	17·0	24·0	28·0	27·0	23·0	20·0	26·0
High Close, Loughrigg	E. B. W. Balme, Esq.	21·0	18·0	17·0	18·0	25·0	23·0	24·0	24·0	28·0	23·0	26·0
Wales-Pembroke-Haverfordwst	E. P. Phillips, Esq.	16·0	19·0	17·0	19·3	11·0	17·0	28·0	16·0	1·0	18·0	...
Wales—Glamorgan—Merthyr	T. J. Dyke, Esq.	...	...	13·0	...	...	...	...	...	...	...	...
Denbigh—Trevalyn Hall	B. T. Griffith, Esq.	18·8	15·2	13·5	11·5	21·0	14·0	18·4	27·9	19·6	3·6	9·8
Carnarvon	Major Mathew	20·0	11·0	13·0	14·0	14·0	12·0	15·0	30·0	18·0	9·0*	13·0
Ireland—Galway—Ballinasloe	J. Kempster, Esq.	...	...	...	...	...	...	...	...	...	19·0*	...
Antrim—Carrickfergus	A. Sutherland, Esq.	..	19·0*	..	...	...	...	...	...	...	...	...

* Denotes Minimum of the Period.

To descend, however, from generalities to particulars: in the few pages following, we give lists of temperatures; the responsibility for the accuracy of those observations rests with the authors, but surely a little rests with ourselves. Suppose we printed a letter from, say, Dover declaring that the temperature there had not fallen below 32°; the writer would be responsible for an incorrect statement, but surely we should be blameable for printing that which was obviously erroneous. Hence we arrive at the conclusion that the responsibility of all observations rests with the observers, and that our editorial duty is to exercise a reasonable supervision.

Let us now consider the second prefatory subject, viz., causes of discrepancy, and they are principally threefold—(1) instrumental, (2) position, (3) observational. Instrumental: owing partly to the increased desire of the observers for accuracy, and partly to the reasonable price at which tested thermometers can now be purchased, we believe that most of those used by our correspondents have been tested, and were, therefore, when supplied, correct within a few tenths of a degree. Unfortunately there is no mercurial minimum thermometer yet invented which is available for universal use. Several have been produced, but none is perfectly satisfactory, therefore Rutherford's minimum is still generally employed, and it has one serious disadvantage, to which attention cannot be too often directed; the spirit evaporates, and condenses at the upper end of the tube, leaving the column shorter by the amount so transferred, and, therefore, causes the thermometer to read and register that much too low. Where the spirit is coloured this error is readily noticed, but when it is uncoloured or bleached by exposure it is liable to pass unnoticed. Observers cannot be too careful in watching against this error. Irrespective of the visibility of the fluid at the top of the tube, it is, of course, readily detected by occasional comparison with a mercurial thermometer. In most cases the thermometer can be restored to its original accuracy by swinging it sharply, bulb downwards, and leaving it to stand for an hour or so in that position before re-hanging it horizontally on its ordinary hooks.

Position: by this we do not mean locality, but mode of hanging, variety of stands, influence of walls, and a series of small details on which hitherto no information has been available. Until Mr. Gaster completes his discussion of the Strathfield Turgiss experiments we should be unwise to say very much on this head; but even on what are supposed to be proper stands the variation has been shown* to be 5°. Surely we want no further evidence of the necessity for adopting identical arrangements.

Observational: unless a man was so absurdly thoughtless as to register the position of the *wrong end of the index*, viz., that nearest to, instead of that farthest from, the bulb, we do not see how any systematic mistake could be made in the reading. A serious one was,

* *Meteorological Magazine*, Vol. IV., p. 186.

however, often made in registering, and, in spite of repeated warning in these pages, we fear is still too frequent; we refer to the entry of the temperature to the wrong day. The minimum temperature indicated by the thermometer when read at 9 a.m. is the minimum of that day, and is always to be so entered; too frequently it is spoken of as the cold of the night of the previous day, hence leading to confusion. The following extract from a letter recently received from a careful observer is so apposite, that we are sure that he will excuse our quoting it:—

"A *stringent* rule ought to be issued on authority in regard to other instruments as well as the rain gauge, *e.g.*, when the minimum of the thermometer is noted at 9 a.m., as it should be, the float should not be moved again till the next day at the same hour. I have reason to believe that the notion is not uncommon that the minimum applies to the *night* immediately preceding, not to the previous 24 hours. In winter, especially, the temperature at 9 a.m. on one day is much lower than that of the following night. It might be well to record the *minimum* of each *night*, but that is not done or aimed at under the present system."

A certain number of rules are printed on the back of the forms issued by the Meteorological Society to English observers, and on those supplied by the Scottish Meteorological Society to their observers; others may be picked up elsewhere, but some are contradictory, some confusing, and all are incomplete. What is required is a compact but copious little manual, which should be rigidly obeyed by every one desiring to be considered a regular observer. Doubtless most of us would have to relinquish some pet practice, but we envy not that man's disposition who would prefer continued anarchy rather than that his individual complacency should be disturbed.

Our remarks on modes of observation have run to such a length, that those on the frost itself must be shorter than we had intended. Perhaps as stray observations are still coming in daily we may have to refer to the subject in our next. In either case it will be desirable to add a few remarks to the numerous notes with which we have been favoured, and to the table on pages 202 and 203. In the first place, we may mention that that table does not contain all the minima to be found in this number, as, in order to save space, those at our regular stations are not (with one or two exceptions) repeated. Such of our readers, therefore, as desire to investigate the details of the frost thoroughly, must combine the information on page 217 with that on pages 202 and 203.

The frost seems to have been severely felt first in the South-Western Counties on December 23rd, the temperature at Sidmouth running down to 19°, and at inland stations to 7° or 8°. On 24th it was most severe along a narrow line running N.N.W. from the Isle of Wight. At Newport it fell to 19°.

The 25th was, however, at most stations, in fact at almost all eastern ones, the date of greatest cold; for its general distribution we must refer to the general tables, but as its greatest intensity was in Norfolk, and several returns from that county have reached us since the general tables were printed, we are induced to give in geographical order

(from S. to. N.) the minimum temperatures on Christmas morning in the County of Norfolk :—

Dickleborough, Diss.. ...	0·0	Bethel Street, Norwich ...	+5·5
Shadwell Court, Thetford ...	—3·0	Thorpe ,, ...	+5·0
Stanford Vic., Watton ..	—9·0	Mattishall, Dereham... ...	—3·0
Wereham, Downham ...	+1·9	Dereham	+3·0
Kimberley, Wymondham ...	—6·0	Reepham	—2·0
Carleton, ,, ...	—7·0	Hillington	+4·0

All the above stations at which the temperature fell below zero are within a tract 25 miles long, from S.W. to N.E., and less than 10 miles broad, of which Watton is nearly the centre ; and from the vicinity of Watton comes the lowest reported temperature, this of course is comfirmatory of its accuracy. Again, Kimberley is within two miles of Carleton ; one reports —6·0, the other —7·0 ; this again is satisfactory.

Without a thaw, the temperature rose from this depression, but on the 31st December, and 1st January, it again fell considerably, and remarkably low temperatures are reported from South Wales.

Our readers will notice two returns from Grasmere, which are interesting, as showing the influence of altitude, Grasmere Rectory is only 219 ft. above sea level, while High Close is 553 ft., the temperature at the higher station being always the warmer.

To the Editor of the Meteorological Magazine.

SIR,—Doubtless you will receive many communications with respect to the late very severe cold weather, and in order that you may be able to compare the temperature of the south coast with that of London and other places, I beg to forward you my memoranda from Dec. 21st, 1870, to Jan. 2nd, 1871. Thermometers at 4 ft. from ground :—

Date.	Temp. at 9 a.m.	Max. in air.	Min. in. air.	Min. on grass.
Dec. 21 ...	30·7 ...	31·5 ...	30·3 ...	30·2
,, 22 ...	25·5 ...	27·0 ...	24·0 ...	22·1
,, 23 ...	21·7 ...	28·0 ...	19·4 ..	16·0
,, 24 ...	32·5 ...	33·5 ...	21·2 ...	15·5
,, 25 ...	23·0 ...	29·7 ...	21·1 ...	18·3
,, 26 ...	29·9 ..	33·2 ...	23·4 ...	21·1
,, 27 ...	27·5 ...	29·7 ...	23·4 ...	12·6
,, 28 ...	29·1 ...	31·7 ...	23·6 ..	21·8
,, 29 ...	29·2 ...	31·2 ...	26·3 ...	17·4
,, 30 ...	21·2 ...	28·1 ...	18·9 ..	11·4
,, 31 ...	21·8 ...	28·3 ...	19·9 ...	16·5
1871. Jan. 1 ...	23·9 ...	32·2 ...	20·9 ...	16·2
,, 2 ...	27·8 ...	29·2 ...	23·6 ...	21·9

From the above you will perceive that the morning of Dec. 30th was the coldest registered here.

I find that in the frost of December, 1855, the extreme in shade was 17°·5 ; in December, 1860, 17°·9 ; and January, 1867, 18°. These latter figures I have taken from the Registrar-General's reports, as supplied by the late Dr. Barker.

My thermometers are all certified ones, and are situated 21 ft. above sea level.—Yours obediently, W. J. HARRIS, F.M.S.

Worthing, Jan. 3rd, 1871.

To the Editor of the Meteorological Magazine.

SIR,—We have just passed through a period of such unusually low temperatures that I send you a few extracts from my diary, in case you can find a corner for them in your next number of the *Meteorological Magazine*.

Date.	Max.	Min.	Min. on grass.
1870, Dec. 21	30·2	29·6	26·5
,, 22	25·8	20·5	14·0
,, 23	25·8	11·2	11·8
,, 24	25·4	7·4	10·0
,, 25	26·0	4·0	10·0
,, 26	33·5	6·4	9·8
,, 27	29·4	10·7	9·0
,, 28	32·4	20·5	22·8
,, 29	33·3	23·1	15·3
,, 30	26·9	6·3	2·8
,, 31	26·3	4·0	—2·7
1871, Jan. 1	29·3	2·7	—2·2
,, 2	26·8	6·4	25·2
,, 3	35·8	23·3	24·2
,, 4	35·9	28·3	27·3
,, 5	41·8	5·0	8·0

This is the coldest wave of polar current we have experienced in this neighbourhood since the 3rd of January, 1867, when the minimum on grass was—3°·0.

The cold has caused the formation of very thick ice. In the Loddon, ice 7 inches thick has accumulated around the bay in which my registration thermometers are placed, and it is so solid that as yet it is impossible to get at them, even with pickaxe and lever. In the evaporation tank the ice is now 9 inches thick; at one time I feared the entire mass of water would freeze, to the destruction of all the thermometers therein..

The poor birds have had a bad time of it, several having been found here frozen to death, whilst the wild ducks, unable to procure food in their own natural element, have ventured, with singular boldness, to our parks and homesteads. Many a poor mole, too, I have found stark and dead just beneath the snow, having ventured out in some less frozen or sun warmed corner, and after working his way in a curiously marked meandering course over the snow in the endeavour to re-enter the bosom of mother earth, has, at last, been obliged to succumb, and been frozen to death.

Roots and sheep-keep have been much damaged and rendered inaccessible by the intense frost, so that the attacks on our small hay-stacks have been so formidable as to give rise to apprehensions of failure of supply, or, at least, of great increase of price before we can cut hay again. There has, however, been sufficient snow to protect the wheat plants.—Yours, &c.

CHAS. H. GRIFFITH.

Strathfield Turgiss, January, 1871.

To the Editor of the Meteorological Magazine.

DATE.	Thermometer.			Rainfall.		Wind.	Thermometer.					Ther. at Hillington Hall Gardens.
							a.m.			p.m.		
	Min.	Max.	Mean.	rain	snow		9,	12	3,	7,	11	Min.
	deg.	deg.	deg.	in.	in.		deg.			deg.		deg.
Friday 23	12	30	21·0	...	5·0	N.	20,	28	...	...	...	+5
Saturday 24	4	23	13·5	·09	...	S.W.	9,	...	...	...	...	—5
Sunday 25	5	33	19·0	...	3·0	S.W., N.E.	7,	13	16	...	31	...
Monday 26	28	37	32·5	...	...	N.E.	35,	31	31	...	32	+6
Tuesday 27	20	33	27·5	...	4·0	N.E.	20,	...	30	32	32	...
Wednes. 28	14	36	25·0	·04	3·5	E.N.E.	28,	...	34	32	33	...
Thursday 29	29	35	32·0	·20	5·5	N.E.	31,	33	...	29	27	...
Friday 30	11	29	20·0	·09	7·0	N.E.	13,	...	26	15	28	...
Saturday 31	9	35	22·0	...	...	N.E.	30,	32	...	12	3	...
Sun., Jan. 1	3	27	15·0	...	...	S.E.	25,	26	..	13	25	—1
Monday 2	11	...	...	...	..	S.E.	27,	..	...	..	..	...

It should be remarked that at the Hall gardens the thermometer always is lower than at the Rectory. The situation is lower, and near water; but this will not account alone for the great difference. The Hall thermometer is completely exposed: mine is in a wooden case, like one of those represented in a former number of your *Meteorological Magazine*. It stands quite in the open and unsheltered; a free current of air passes through, but wet and wind cannot find an entrance. But is not the plan of affixing a thermometer to an exposed wall (for minimum purposes) or on a piece of bare board, after all, the most correct index of the cold?

H. FFOLKES.

Hillington Rectory, Lynn.

To the Editor of the Meteorological Magazine.

SIR,—Thinking many of your subscribers would be sending you their temperature readings during the late severe frost, I enclose mine.

Dec.		Max.		Min.
21	...	35·8	...	34·6
22	...	26·6	...	22·8
23	...	32·6	...	19·4
24	...	36·2	...	21·2
25	...	33·4	...	22·4
26	...	36·2	...	22·7
27	...	32·3	...	25·3
28	...	33·3	...	25·3
29	...	33·1	...	29·0
30	...	31·8	...	25·5
31	...	36·6	...	21·2

Lowest temp. 19°·4, on 23rd; highest, 54°·8, on 14th. Wind chiefly N., N.E., and E. Adopted mean temp. of month, 35°·7, or 8°·5 below average of last 5 years (1865—69); daily range, 9°·5.

J. INGLEBY-MACKENZIE, M.B., F.M.S.

Sidmouth.

To the Editor of the Meteorological Magazine.

SIR,—The frost which set in on St. Thomas's day has proved the most severe that I have had to record since I first began to keep a

record of the weather, fifteen years ago. The following figures taken from my diary will serve for comparison with those of other observers.

1870.	Max.	Min.	Range.	Mean.
Dec. 21	29·1 ...	27·8 ...	1·3 ...	28·4
,, 22	25·7 ...	19·5 .	6·2 ...	22·6
,, 23	26·0 ...	13·7 ...	12·3 ...	19·9
,, 24	24·6 ...	12·9 ...	11·7 ...	18·7
,, 25	28·8 ...	9·3 ...	19·5 ...	19·1
,, 26	33·4 ...	12·3 ...	21·1 ...	22·8
,, 27	28·6 ...	14·7 ...	13·9 ...	21·7
,, 28	32·2 ...	18·4 ...	13·8 ...	25·3
,, 29	32·8 ...	23·6 ...	9·2 ...	28·2
,, 30	26·6 ...	18·0 ...	8·6 ..	22·3
,, 31	20·3 ...	7·2 ...	13·1 ...	13·7
Means	28·0	16·1	11·9	22·1

The monthly mean from December, 1870, here, was 31°·6, being the coldest December I have yet recorded. —Yours, &c.,

JOHN THRUSTANS, F.M.S.

Merridale, Wolverhampton.

P.S. The minimum temp. this morning, January 1, was 4°·9.

To the Editor of the Meteorological Magazine.

SIR,—The minimum temperature attained here during the present frost was 13°·3, on the morning of 24th. On Christmas morning, 1860, my thermometer registered 10°·4, the lowest during 25 years (1846-1870).—Faithfully yours, C. S. BARTER, M.B.

27, *Paragon, Bath, 29th December*, 1870.

To the Editor of the Meteorological Magazine.

SIR,—The following are the readings of the maximum and minimum thermometers in the shade, 4 ft. above the ground, at Bucknall, Lincolnshire, from 21st to the end of December :—

Date.	Max.	Min.	Date.	Max.	Min.
21 ...	30·5 ...	29·5	27 ...	31·5 ...	23·0
22 ...	28·5 ...	21·5	28 ...	34·0 ...	23·0
23 ...	21·5 ...	14·5	29 ...	34·0 ...	29·0
24 ...	18·0 ...	2·0	30 ...	30·0 ...	21·0
25 ...	26·0 ...	5·0	31 ...	20·5 ...	11·0
26 ...	32·0 ...	21·0			

The mean temps. on the 23rd, 24th, and 25th, were respectively below the average, —21·8, —29·6, and —24·3. On the 26th the mean temp. rose 11 degrees.

My thermometers are by Casella, and have been verified at Kew.

Yours, &c., W. CARTER.

Bucknall, Horncastle.

To the Editor of the Meteorological Magazine.

SIR,—The 1st of this month was the coldest day I recollect. The maximum thermometer in shade was 21°, and there was a most bitter south wind. The minimum was 12°, the lowest for nearly ten years.

Yours, &c., T. W. BACKHOUSE.

West Hendon House, Sunderland,
January 6th, 1871.

To the Editor of the Meteorological Magazine.

SIR,—Absence from home has alone prevented me sending you at an earlier date the following notes as to the temperature at this place. Lat. 54° 32′ N.; Long. 1° 44′ W. Altitude, 251·8 ft. Observations taken daily at 9 a.m.

Date.	Min.	Date.	Min.	Date.	Min.	Date.	Min.
Oct. 11...	28·9	Nov. 15...	23·0	Nov. 29...	28·5	Dec. 17...	20·5
,, 15 ..	28·5	,, 16...	28·0	,, 30...	27·0	,, 18..	27·0
,, 27...	29·5	,, 17...	23·0	Dec. 1...	30·0	,, 21...	26·5
Nov. 2...	25·0	,, 18...	25·0	,, 2...	26·0	,, 22...	16·0
,, 3...	28·0	,, 19...	23·7	,, 3...	29·0	,, 23...	7·5
,, 7...	27·5	,, 20...	28·0	,, 7...	28·0	,, 24...	0·5*
,, 8...	26·5	,, 21...	32·0	,, 8...	23·0	,, 25...	14·5
,, 9...	25·0	,, 22...	29·5	,, 9 ..	24·0	,, 26...	21·0
,, 10...	27·0	,, 23...	31·0	,, 10...	31·0	,, 27...	14·0
,, 11 ..	29·0	,, 26...	27·5	,, 12...	29·0	,, 28...	11·0
,, 12...	27·5	,, 27..	31·0	,, 14...	25·0	,, 29...	18·5
,, 13 .	28·5	,, 28...	26·0	,, 16...	24·0	,, 30...	20·0
,, 14...	28·0						

* ½° above zero.

I left home on the 30th, and wrote to a friend to take the readings, and he could not do so until Jan. 2, when he found the register marked 3° below zero, and I have no doubt this indicated the night of the 30th-31st, as the same evening the thermometer at Middlesboro'-on-Tees was at 11 p.m. 1° above zero.

Jan. 3.....	17·0	Jan. 6.....	30·0
,, 4... ..	8·0	,, 7.....	33·0
,, 5.....	7·0	,, 8.....	25·0

If you find any of these memoranda useful for the "Magazine" I shall be glad.—Yours, truly,

A. ATKINSON.

Gainford, near Darlington, Jan. 7th, 1871.

To the Editor of the Meteorological Magazine.

SIR,—The frost which set in on December 21st, has been very severe in this district. I send you the minimum temperatures recorded here daily up to the present date by Casella's self-registering thermometer, suspended on a wooden stand on the "Glaisher" principle. The stand is fixed at some yards' distance from the house on the N.E. side, and the thermometer bulbs are 4 feet above the ground.

Dec. 21...	30·0 deg.	.....	Dec. 28...	18·4 deg.	
,, 22...	18·8 ,,	.....	,, 29 ..	27·9	,,
,, 23...	15·2 ,,	.....	,, 30...	19·6	,,
,, 24...	13·5 ,,	.....	,, 31...	3·6	,,
,, 25...	11·5 ,,	.....	Jan. 1 ..	9·8	,,
,, 26...	21·0 ,,	.....	,, 2 ...	25·5	,,
,, 27...	14·0 ,,	.....			

The extraordinarily low minimum of the 31st December is the lowest temperature experienced here for 10 years, viz., since December 25th, 1860, when 3°·3 was recorded. The maximum in shade on the 31st was only 20°. Snow has fallen at intervals to the total depth of

about 2·1 inches. The eclipse of the sun on December 22nd was very favourably seen here, the sky being nearly free from cloud at the time.

Yours faithfully,

BOSCAWEN T. GRIFFITH.

Trevalyn Hall, Wrexham, Denbighshire, Jan. 2nd, 1871.

To the Editor of the Meteorological Magazine.

SIR,—I enclose you a statement of the temperature experienced here during the late severe frost. One of the thermometers, (a minimum one), being placed in the shade, five feet above the ground, and not by a wall; the other (a minimum one) placed on the grass at night, three fingers above the ground. The daily maximum and minimum I have very accurately observed myself. I have sent this, hearing you were desirous of collecting facts connected with this particular frost.—

Yours truly, E. TUCKER, JUN.

The Rectory, Grasmere, Jan. 9th.

Date.	8 a.m.	Max.	Min. in air.	Min. on grass.
1870, Dec. 20	42·0	43·0	30·0	28·0
,, 21	30·0	32·0	23·0	18·0
,, 22	26·0	29·0	14·0	9·0
,, 23	14·0	26·0	14·5	11·0
,, 24	18·0	24·0	16·0	9·0
,, 25	18·5	31·0	28·0	26·0
,, 26	33·0	36·0	17·0	14·0
,, 27	24·0	35·0	24·0	19·0
,, 28	29·5	33·0	28·0	25·0
,, 29	30·0	33·0	27·0	21·0
,, 30	29·0	33·5	23·0	19·0
,, 31	25·0	26·5	20·0	17·0
1871, Jan. 1	22·0	29·0	26·0	25·0
,, 2	27·0	28·5	26·5	25·0
,, 3	27·0	32·0	9·0	5·0
,, 4	9·0	28 5	28·0	27·0
,, 5	38·0	42·0	36·0	32·0

OZONE OBSERVATIONS.

To the Editor of the Meteorological Magazine.

SIR,—I do not think the remarks made by Mr. Chichester in your December number on this subject should be allowed to pass unnoticed, as they are so completely at variance with the spirit and principles of scientific investigation. That for many years ozone observations have been taken with scrupulous care by eminent meteorologists, and with ordinary care by thousands of observers, is well known. It is also equally well known that the number of facts thus elicited, and the progress made in connecting the phenomena in the way of causation have not been quite so satisfactory as was anticipated. Several able observers have devoted their time to the discussion of extensive series of results, and all, I believe, are agreed that upon the whole the present method of observation is sufficiently good for those who have but limited time. Indeed, the mere fact that 9 a.m. readings are thought worth tabulating and recording by Mr. Glaisher should have been,

one would think, a sufficient guarantee to Mr. Chichester that in adopting such a course he would not be altogether wasting his time, or, at any rate, that he would not be the victim of a wide-spread delusion and snare. But to come to the facts. This observer made up his mind to "go in" for ozone—*i.e.*, he seriously resolved to do what in him lay to help on this interesting investigation. In a very short time Mr. Chichester, like every other ozone observer who has taken readings for a fortnight in spring, autumn, or winter, discovered some curious effects, but, unlike other observers, he was so astonished and disheartened by them that he at once threw up the investigation and unhesitatingly pronounced it a "delusion and a snare." The observed effects were these :—Putting out his paper at 9 a.m., he saw it was untinted, but on looking at noon it was darkened. Now this was most interesting and stimulating to Mr. Chichester, as it would be to any true observer of natural agents and their effects. On examining his paper at 3 p.m. its discolouration was complete. Here, then, was another and still more stimulating phenomenon, and I do not envy the natural philosopher who could witness such phenomena as these and resist their charm ; but, with a true instinct, Mr. Chichester noted the fact that between noon and 3 p.m. "rain and wind" had come. Here, then, were simultaneous effects occurring. What was their relation? were they links in a chain of phenomena? were they bound together by a law of causation? Surely these questions presented themselves to the observer and made him resolve that, if possible, he would find an answer. Surely he at once began to observe his papers every twelve hours, or every six hours, or even, engagements permitting, every three hours. Not so : because the 9 a.m. readings did not tell him exactly all the infinite conditions of the passing aerial tide during the previous 24 hours, he abruptly closes the series, declares himself to have been shamefully deceived, and makes a vigorous resolution that he will never again "bother himself" about ozone.

But Mr. Chichester finds much comfort in learning that he has a fellow victim. He finds that Mr. Thrustans also has suffered and come to the *same* conclusion as himself. Now I do not find this. I find that Mr. Thrustans on discovering the insufficiency of 9 a.m. readings tried morning and evening observations. What better plan could any observer have adopted? and I shall not be surprised to learn that this gentleman, if time allows, will soon try six-hourly readings.

It is precisely these surprises and disappointments, which constantly meet the patient investigator of natural phenomena, that impart such interest to his labours, and stimulate him in the pursuit. The methods are varied ; simultaneous series or successions of phenomena reveal themselves ; he watches their combined, and, if possible, their separate effects ; he changes or increases his hours of observation ; and thus he is enabled to eliminate all that is not relevant, and, finally, to seize the simple or combined causes of the effect or effects produced.

Yours truly,

JOSEPH GLEDHILL, F.G.S., F.M.S.

Park Road Observatory, Halifax.

SOLAR RADIATION.

To the Editor of the Meteorological Magazine.

SIR,—I am obliged to Mr. Stow for his comments on my letter in the "Magazine," but I think he is a little premature in soothing himself with the great perfection attained by the thermometers "*in vacuo*" of Messrs. Casella, and Negretti, for he seems quite to forget the fact, which I before pointed out, that my two Casella thermometers, B and C, though both are blackened on the bulbs and part of the stems, had a *mean* difference of 3°, and occasionally varied from one another by 6°, B however having the larger bulb (according to Mr. Stow himself) the difference from that cause alone should have been the *reverse* way.

Surely this difference must arise in a great measure from imperfect exhaustion of the jackets, and we now know what that means, viz., low temperatures. Not that I at all wish to blame any of the manufacturers for carelessness in the troublesome process of exhaustion: quite the contrary, I think that most of these instruments, from what I have seen, are models of sensitiveness and finished workmanship.

Mr. Stow, I presume in a somewhat satirical vein, talks about my "conjuring up a ghost;" if he refers to the large mean difference of 15°·4 between Pastorelli's thermometer (A) and that of Casella (B), as the said ghost (if ghost at all), it must be a decidedly tangible one! but not of my "conjuring up," since we have found it haunting the instruments of both those eminent makers, Messrs. Casella and Pastorelli. If, however, I have assisted in any measure in laying this "ghost," as Mr. Stow terms it, I shall have been fully repaid for the work I have already had on "Solar Radiation Temperatures."

Yours very truly,

FRANCIS NUNES, M.A., F.M.S.

Heathfield Lodge, Chislehurst, Kent, Dec. 23rd.

P.S. With regard to the subject of thermometers with *unexhausted* jackets, as far as I can judge from my experiments up to the present time, I confess I am favourably impressed with their working.

To the Editor of the Meteorological Magazine.

SIR,—My attention has been directed to an article by Mr. F. W. Stow in your Magazine of this month in explanation of the different indications given by some solar thermometers made for Mr. Nunes.

Mr. Stow explains this difference as owing to an indifferent vacuum in the thermometer A, supposing that by some unfortunate accident air had found admission during the process of manufacture. With respect to this explanation, I can only say that both thermometers supplied to Mr. Nunes were made under my supervision with the greatest care. If air has found admission into A with the attention bestowed upon it in the manufacture, it must indeed be owing to an extraordinary accident. But I recollect that other solar thermometers

of similar construction have recorded equal and even greater differences. Mr. Stow himself says, in Vol. III. of your Magazine, page 149, of the sources of discrepancy between solar thermometers :—"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 14°."

Even your experiments cited in the same volume, page 114, gave these results :—

"5. Compared them all lying near together on a rather burnt-up grass plot; found differences amounting to 10°, and variable, sometimes A was lowest, sometimes B, and so on."

I have no doubt, if your space would allow of it, I could cite other cases of similar observed differences, but I believe these to be sufficient to make the above explanation less probable than it would be if the observed difference in the indications by the two thermometers of Mr. Nunes were a solitary case, else we have to suppose it is rather a common case for air to find admission into solar thermometers in the final process of exhaustion; this, however, is not very probable, as Mr. Stow assures us in his last letter that Mr. Casella guarantees all those instruments that he makes to be within three-quarters per cent. of an absolute vacuum; now the thermometers used in your experiments were made by Mr. Casella, I am therefore inclined to believe that there most be other causes besides which produce this discrepancy. I therefore intend to ask Mr. Nunes for the return of the supposed faulty thermometer, in order to find out the cause of the difference. If I should succeed in this, I will inform you of the results.

Perhaps there may be a difference in the absorbing power of the various lamp black.—Yours truly,

F. PASTORELLI.

208, *Piccadilly.*

DIFFERENCE BETWEEN READINGS OF MERCURIAL AND ANEROID BAROMETERS.

To the Editor of the Meteorological Magazine.

SIR,—Your correspondent, Mr. J. Knox, bases his comments on the difference between readings of his mercurial and aneroid barometers on what seems to me to be mere assumption. Apparently he is not aware that the aneroid is an instrument peculiarly susceptible to changes of temperature, even when said to be "compensated" for temperature. Accordingly the differences found by him are easily accounted for on the very safe supposition that his aneroid is either not at all, or very badly, compensated. Thus the mean difference, in August of +·021 may be set down against mean temperature 63°; that in September, +·012, against 58°; and that in October, −·014, against 51°. The temperatures quoted are mean values for London; they may have been different for the particular time and place, but that will not affect the

explanation. The aneroid was evidently reading too high in 63°, and too low in 51°, in accordance with the usual behaviour of aneroids, which have good vacuums, but are not compensated. The idea of such variations of the indications of pressure predicting coming changes of weather is rather absurd. Mr. Knox should state whether or not his aneroid is compensated for temperature. At a future time I may offer a short explanation of the theory of compensation for this very practically useful, but in a scientific point of view rather uncertain instrument. Yours truly,

R. STRACHAN.

11, *Offord Road, London, N., 30th November*, 1870.

P.S. As none of your reports of the aurora of October 24th, 1870, speak of its appearance so late as 11 p.m., it may be interesting to describe what I witnessed at that time. I had not seen it earlier, and my attention was then drawn to it by the crimson glare, as from a fire, visible through a window facing north. From the roof of the house I got a fine view. The stars were very bright and numerous, the sky being intensely blue. A dull grey arch of cloud seemed to extend about 15 degrees above the horizon, at the magnetic north, which was the radiant point of the display. From this arch at N.W. by N. and at N.E. by N. (by compass) two broad bands of crimson streamers extended to about 60 degrees above the horizon. The stars were visible through the streamers, and no other colours were noticed. I did not watch it for more than ten minutes.

THE WINTER.

To the Editor of the Meteorological Magazine.

SIR,—The mean temperature of December, 1870, at the Royal Observatory, Greenwich, was 33°·6, which is 6°·1 below Mr. Glaisher's adopted average of 50 years, and 5°·5 below the average of 99 years.

A clerical error occurred in Table I. of my last letter. Instead of January to March, 1771, it should be January to March, 1772. If your readers will kindly alter 1771 to 1772, the table will be correct.

I am, &c.,

GEORGE D. BRUMHAM.

Barnsbury, January, 1871.

METEOROLOGY IN THE UNITED STATES.

The United States' Government commenced on the 1st of November the publication of a daily record of the state of the weather in various parts of that country. In so vast a territory the variations are great. On the first day the thermometer did not exceed 51 deg. at Boston, but reached 75 deg. at Omaha, 80 deg. at Lake City, Florida. The pressure of the wind was ·02lb. per square foot at Nashville, Tennessee; ·08lb. at New York and some other places; 3lb. at Cheyenne, Omaha, and Pittsburg, Pennsylvania.—*The Times.*

THE SOLAR ECLIPSE.

To the Editor of the Meteorological Magazine.

SIR,—I hoped to have sent you a report on the influence of the eclipse on thermometers in sun and shade; but as none of my regular correspondents appear to have taken any observations, with the exception of yourself and Mr. Leighton Kesteven, I had better defer it, in the hope of obtaining some. May I beg your readers to send me a copy of any observations taken, stating the thermometers used, and how placed?

I am, &c., F. W. STOW.

Hawsker, Whitby.

[We have been favoured with some notes on the above by the Rev. Hugh Ingram, of Steyning, Sussex, and Dr. Radford, of Sidmouth, and we think that the best plan will be to defer their insertion till our next, so that the subject may then be completely considered.—ED.]

REVIEW.

Quarterly Report of the Meteorological Office (Published by authority of the Meteorological Committee), *Part II., April—June*, 1869. London: Stanford, 4to., 60 pages, 36 plates.

This second issue of the fac-simile records of the seven observatories is evidently equal in accuracy to the first part, which was fully noticed in these columns. The only difference in the two numbers is in the *partial* adoption of a suggestion in one of our notices of the first part. The paragraph ran as follows:—

"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."

In the part now under notice, four extra copies of the scales are given, so that they may be cut out and used in measuring the curves. We at first thought that paper had been substituted for horn in order to secure extreme accuracy. Paper varying in its dimensions under the different processes of printing might not agree *precisely* with the horn scales, but similar paper, similarly treated, agrees very closely. On examination it appears that the spare curves are on different paper from that used for the rest of the plates, hence this cannot have been the reason, and while accepting the partial adoption of our suggestion as a proof of its soundness, we adhere to the opinion that, all things considered, horn is the proper material.

The daily journal possesses its usual completeness, and the curves are as clearly printed as in the previous number—we could not award higher praise.

DECEMBER, 1870.

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	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	3·07	+ 1·57	·55	15	18	57·2	14	14·0	25	19	23
II.		Maidstone (Linton Park)	3·68	+ 1·85	·66	14	22	59·0	14	13·0	24	22	...
,,		Selborne (The Wakes)	3·29	+ ·54	·81	13	15	53·0	14	5·0	25	24	24
III.		Hitchen	2·60	+ 1·29	·40	13	19	55·0	14	5·0	30	21	...
,,		Banbury	2·20	+ ·53	·63	13	17	55·0	14	6·0	25	25	...
IV.		Bury St. Edmunds (Culford)	4·01	+ 2·52	1·16	19	23	56·0	14	1·0	25	19	26
V.		Bridport	3·84	+ ·47	·91	16	13	54·0	13†	14·0	23‖	20	...
,,		Barnstaple	2·42	— ·70	·43	17	12	58·5	14	15·0	31	17	...
,,		Bodmin	3·70	— 1·54	·64	13	17	53·0	13	15·0	31	12	16
VI.		Cirencester	2·20	— ·09	·77	13	10	...	...	...	...	...	...
,,		Shiffnal (Haughton Hall)	2·41	+ ·73	·82	19	14	53·0	14	7·0	25	23	...
,,		Tenbury (Orleton)	2·01	— ·45	·46	13	20	56·8	14	4·5	31	20	25
VII.		Leicester (Wigston)	2·72	+ 1·20	·73	20	11	55·0	14	9·0	23·*	22	...
,,		Boston	3·86	+ 2·37	1·07	19	24	56·0	14	9·0	31	15	24
,,		Grimsby (Killingholme)	4·15	..	·79	8	22	55·0	14	9·5	24	14	...
,,		Derby	2·07	+ ·52	·49	13	17	56·0	14	9·0	25	18	...
VIII.		Manchester	2·53	+ ·20	..	...	...	..	...	...	...	..	..
IX.		York	3·16	+ 1·36	·51	13	19	51·5	20	11·0	31	16	...
,,		Skipton (Arncliffe)	4·23	— ·32	1·06	9	14	47·0	15	4·0	31	23	...
X.		North Shields	5·21	+ 3.01	·73	6	26	54·0	19	13·3	23	15	20
,,		Borrowdale (Seathwaite)	6·50	—10·45	...	..	...	...	...	...	...	...	...
XI.	WALES.	Cardiff (Town Hall)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	2·62	— 2·21	·72	14	8	54·0	13	1·0	30	22	27
,,		Rhayader (Cefnfaes)	2·46	— ·83	1·00	13*	9	53·0	...	5·0	31	17	...
,,		Llandudno	3·21	+ 1·01	·81	19	14	54·7	14	19·2	23	17	...
XII.	SCOTLAND.	Dumfries	1·95	— 1·51	·70	12	9	52·0	19	12·5	24	18	...
,,		Hawick (Silverbut Hall)	1·64	...	·27	14	15	...	...	0·0	23	...	...
XIV.		Ayr (Auchendrane House)	2·05	— 1·97	·68	18	8	50·0	14‡	9·0	26	19	22
XV.		Castle Toward	4·19	— 1·16	1·26	14	12	51·0	19	17·0	22	21	27
XVI.		Leven (Nookton)	3·40	+ ·62	·66	14	20	47·0	18§	6·0	23	21	26
,,		Stirling (Deanston)	2·87	— 1·33	·92	14	16	51·3	19	4·5	23	26	28
,,		Logierait	2·70	...	·63	8	11	...	...	...	...	...	...
XVII.		Ballater	5·02	...	1·40	8	10	47·0	19	—0·5	23	24	..
,,		Aberdeen	5·40	...	1·35	19	18	47·0	19	11·2	27	17	27
XVIII		Inverness (Culloden)	2·88	...	1·16	19	19	47·6	18	21·7	28	18	28
,,		Portree	6·21	— 9·42	1·63	31	13	...	...	...	...	...	...
,,		Loch Broom	4·88	...	1·96	17	17	...	...	...	...	...	...
XIX.		Helmsdale	5·82	...	1·13	14	24	...	...	...	...	...	...
,,		Sandwick	5·52	+ 1·55	·72	14	22	46·0	4	19·0	27	16	24
XX.	IRELAND.	Cork	3·98	...	1·78	11	7	...	...	...	...	...	...
,,		Waterford	2·42	— 2·00	·66	13	13	52·0	14	23·0	9	14	...
,,		Killaloe	3·00	— ·49	·90	11	8	...	...	...	...	...	...
XXI.		Portarlington	1·93	— 1 27	·53	14	18	51·5	18	12·0	9	20	...
,,		Monkstown	2·61	— ·01	·69	13	16	...	...	...	...	...	...
XXII		Galway	3·65	...	1·02	18	13	49·0	5	21·0	9, 27	17	...
,,		Bunninadden (Doo Castle)	3·41	...	·72	13	13	42·0	5††	13·0	25	22	...
XXIII		Bawnboy (Owendoon)	...	...	..	...	...	...	...	...	..	..	..
,,		Waringstown	2·42	...	·57	11	13	52·0	14	6·0	23	18	27
,,		Strabane (Leckpatrick)	3·42	..	·69	11	13	50·0	18§	10·0	30	26	30

*And 18. †And 14. ‡And 18, 19. §And 19. ‖And 24, 31. **And 24. ††And 9, 20.
+ Shows that the fall was above the average ; —that it was below it.

METEOROLOGICAL NOTES ON DECEMBER.

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

ENGLAND.

LINTON PARK.—An unsually severe wintry month; rather deep S on ground from 8th to 13th, and again from 21st to the end. Frost very sharp on 23rd, 24th, 25th and 31st; winds mostly from the N. and N.E, but never very high. Bar. low on the 14th, with heavy R that day; ther. lower than for 20 years excepting 1853, 1854, 1855 and 1867, at the same time it was higher on the 14th than usual for December, being 59°.

SELBORNE.—The coldest December I have ever recorded and November the same. In these two months ther. below freezing (on grass) on 43 days; prevailing winds N. and N.E. the first week the middle S.W. and the latter end N.E.; on the 3rd ther. was highest at 7 p.m.; dense fog on 11th and 16th; fog on 12th; min. 31·8; at noon R, then sudden rise to 48·5; 22nd heavy S early morning; very fine after the eclipse 30th. S now 4 in. deep.

BANBURY.—Max. temp. below 32 on 9 days; aurora on 17th.

CULFORD.—From the 12th to the 14th the weather was comparatively mild; the remainder of the month has been excessively cold; in fact the coldest December during the last 12 years; the 24th was also the coldest day we have experienced during that time; the max. temp. being 22° and the min. 1°, making the mean 11°.5. On the same day in 1860 (the 24th) the max. temp. was 28° and the min. —3·0, or 3 degrees below zero, which give a mean of 12°.5. The mean temp. of the whole month was 30° 92.

BRIDPORT.—Of the total rainfall (3·84) 3·44 fell in six successive days from the 11th to the 16th inclusive; S fell to the depth of 1¾ inches on the 27th; good skating on the 10th, and also from the 23rd to the end of the month. On the 31st the min. temp. was as low as 14° early in the evening, but rose to 25 by 11 p.m.; and a slight thaw with a southerly wind on the 1st January. Eclipse of the sun on 22nd seen to great advantage.

BODMIN.—Average temp. of the month 35 3. On the 26th S fell in 4 hours to the depth of 4·70 inches, and formed one-thirteenth that depth of water when melted.

SHIFNAL.—An unusually cold December. For although the rainfall was in excess of average, and on one day the 19th, ·82 in, the temp. was below 32° on 23 nights; on that of 24th it sank to 7°; the severest frost since the same night of 1860. 3 inches of S fell on the 9th and 1 inch on 21st, and again on 28th. No high winds and the prevailing ones from N.W. and N.E. interchangably; great quantites of hips and haws; scarcely any holly berries. By the end of the month the wood-pigeons and plovers, which have been in such flocks, quite deserted us.

ORLETON.—Cold and cloudy with frequent frost; a little S and much fog till the 12th, then warm and rainy till the 16th filling the rivers; S again and cold from the 20th to the end of the month, with much fog and rime; all the rivers frozen over on the morning of the 31st; temp. fell to 4°.5 in the shade to 0° on the grass plot; and the max. was only 17°. Remarkably cold month, nearly 9° below the average. Bar. very high on 1st and very low on 14th; great winds on 12th and 14th; aurora on 17th. Eclipse well seen.

WIGSTON.—The remarkable feature in the month has been that the mean of the max. temp. during the [? last] eleven days of the month was only 27°·3. S fell nearly continuously for 24 hours on the 9th; about 4 inches deep on the level.

KILLINGHOLME.—The last 10 days more severe than any we have had since 1860. Surely Mr. Brumham must be enrolled amongst the prophets. Lunar coronæ on 6th, and 11th. Cock crowing at 11 p.m. on 6th; high wind at night from W. on 18th.

DERBY.—December has been an unusaully severe month, being 2°·5 below the mean of seven consecutive years. On Christmas Eve the temp. fell to 9°, being the lowest reading recorded since Christmas Eve, 1860, when it fell to 2°.

Although the present frost is more sustained in its rigour than that of 1860, yet the destruction of shrubs and trees cannot be so serious, as the frost of that year, unlike this, came on suddenly preceded by a late and genial autumn, which provoked the growth without maturing the young wood. The rainfall of the year is 7·14 inches below a 21 years' mean.

YORK.—Solar halo at 12 a.m. on 16th; mock sun at 12.30 a.m. and aurora at 8 to 9 p.m. on 17th. S continually from 21st to 31st.

NORTH SHIELDS.—Auroræ on 15th, 16th and 17th; T on 21st; solar halo on 23rd; T and L on 25th.

WALES.

HAVERFORDWEST.—A very severe month; the coldest December in my register of 24 years. S fell in small quantities twice, covering the ground to the depth of 2 in. on the level; R fell in considerable quantities during the month; the wind was generally from the N.E. and E.S.E.; a great number of bright days with clear frost; the frost was most severe, even on the sea coast, the S lying close to the high water level, and the icicles hanging from the cliffs resembled the interior of stalactite caverns; they were of enormous size and length. Min. in air 1°, on snow —6°.

CEFNFAES.—A cold, foggy month; wind generally N.E; temp. low, and nights frosty; some days of bright sunshine.

LLANDUDNO. Fog at 4 p.m. on 8th; two peals of T at 2 p.m. on 12th; 22nd, fine but frosty; eclipse well seen.

SCOTLAND.

DUMFRIES.—The first week of the month was mild and fine, the middle stormy and wet; from 21st to close, weather very severe; frost intense, with S on several days 2 to 4 in. deep; mean temp. for the month 34°·5; rainfall 1·93 in. below the average of five preceding years.

HAWICK.—Very stormy on the 8th and 14th; temp. at zero on the night of 23rd; since the 20th the ground has had a covering of 4 in. of S, and the ponds nd streams a thick sheeting of ice.

AUCHENDRANE.—With a great increase in the number of icy days and polar winds, and with a mean temp. greatly below that of the mean of December, and with the low capacity of the air for vapour not fully saturated, the bar. and bar. range were not much below their mean, while the rainfall and evaporation, force of wind and amount of cloud, were all below their respective December means; the temp. of the night compared with that of the day was very low, and the hoar frost and snowfall, although slight, stopped altogether solar radiation. On the 22nd the eclipse was well seen here. The last week was the most wintry, particularly Christmas day; the night temp. on the 26th fell to 9° and 7° respectively, and rose on the 29th to 26° and 24°; winds, 11 polar, 11 equatorial, andf 9 calm or variable, and our only gales were on the 14th, 18th, 19th, and 31st, rom S.W. and S., all equinoctial.

CASTLE TOWARD.—The month began calm, dry, and comparatively mild, but was changeable and wet from the 12th to the 18th; thence to end, hard frost, with alternate fog and sunshine. Temp. of earth 18 in. deep, on 1st January, 1871, ground trenched in September, 45°, in October, 44°, November, 43°, December, 41°·5, and undug, 42°.

DEANSTON.—Beginning of month cloudy, and slight frosts, then S, sleet, and R; middle of month wet and stormy. On 21st, S, and very severe frost from 22nd to 28th, the lowest being 23rd, 4°·5, 24th, 16°, 25th, 9°, 26th, 12°, 27th, 6°·8, 28th, 15°·7.

LOGIERAIT.—Intense frost from 21st to 31st; no great depth of S. Eclipse visible for about half-an-hour.

BALLATER.—After the first week very stormy weather throughout; S remained on the ground the whole month, and the frost during the last nine days was very intense, being half-a-degree below zero on 23rd, 3° above on 27th, 5° on 22nd and 28th, and 7° on 26th.

ABERDEEN.—A dull, cold month, with very heavy R; S storm from 21st to

31st, with intense cold ; auroræ on 13 nights ; red aurora a.m. on 14th (and min. bar.) and on 16th ; fine lunar rainbow on the 4th ; temp. on grass on 27th, 4° ; soil frozen 1 ft. 6 in. deep.

PORTREE.—T and L during the night of the 16th ; a heavy gale from the W. the night of 15th, and from the N.W. on the night of the 6th ; continued very squally during the 7th, 8th, and 9th ; H and S on 7th and 8th ; frost from 10th to 13th ; on 21st a very severe frost set in, with N.E. winds ; on the evening of 24th S fell thick till the depth of 10 in. was reached ; it continued fair and frosty up to the 31st, when a heavy gale came on from S., and a thaw set in with R, which continued from 9 p.m. the whole night.

LOCHBROOM.—The first two days were fine ; from 3rd to 18th wet and drizzly, with a great flood on the 17th ; thereafter to the 31st the frost was continuous, and very severe ; a fine thaw set in on the last night. On the whole this has been a bad month for farmers and graziers, telling severely upon their flocks and fodder, and more especially upon the turnips.

SANDWICK.—December has been wetter and colder than the mean, wetter indeed than it has been since 1854, and colder than I recollect December to have been, the exposed min. ther. being as low as 6° on the morning of the 28th ; wind 40 miles an hour from 9 a.m. on 15th to 7 p.m., and 50 miles an hour from 1 to 2 p.m. ; bright aurora coruscating to zenith and to S. on the 17th.

IRELAND.

LECKPATRICK.—The coldest month ever registered here, the mean temp. being nearly 7° below the average ; rainfall a little below the average. The last three months of the year were each much below the ordinary average temp.; S on 11th and 24th.

END OF VOLUME V.

G. SHIELD, Printer, 30, Sloane Square, Chelsea, S.W.

ERRATA.

The following errors in the monthly tables of rainfall and temperature in Vol. IV. for 1869, have been detected by comparison with the yearly returns from the several stations :—

			Total rain. in.		Total rain. in.
Barnstaple.....	September.....	*for*	6·75	*read*	6·00
Orleton	June	,,	1·12	,,	1·02
Seathwaite	December	,,	17·77	,,	17·75
Logierait	November	,,	2·54	,,	2·50
Portree	June	,,	3·09	,,	3·32
Cork	September.....	,,	5·05	,,	5·15
Killaloe	December	,,	6·19	,,	6·50
Leckpatrick	February	,,	4·22	,,	4·27

The following misprints also exist :—

Page 56—"Migratory Birds," *for* Hillingdon, *read* Hillington.
,, 186—Min. temperatures, Kirkby Lonsdale, *for* —4·0, *read* +4·0.