

# SYMONS'S

## MONTHLY

# METEOROLOGICAL MAGAZINE.

L.]

MARCH, 1870.

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### UNDERGROUND TEMPERATURE.

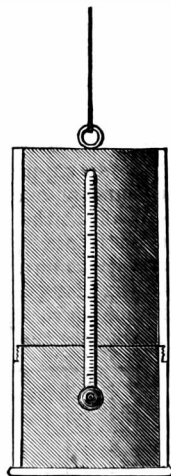
UNDER the title of "Temperature of the Earth at Great Depths," we gave in previous numbers\* of this Magazine a detailed account, with engravings, of the arrangements adopted for observing the temperature at various depths down to 1100 feet below the surface, in the bore of the late Hampstead Waterworks 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		—0·3
"	"	"	62·6	62·8	—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  $49^{\circ} \cdot 2$  in January and  $54^{\circ} \cdot 1$  in July; that at 100 feet was  $51^{\circ}$  in January and  $54^{\circ} \cdot 3$  in July; at 150 feet  $52^{\circ} \cdot 1$  in January and  $54^{\circ} \cdot 7$  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  $49^{\circ} \cdot 2$ . 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 ( $49^{\circ}$ ) 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  $51^{\circ} \cdot 14$ , and after being in a temperature of  $60^{\circ}$  for thirty-five minutes it had only risen  $0^{\circ} \cdot 02$ . 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	.....	$51^{\circ} \cdot 21$	.....	0	} Increase, April 3 to June 11, 0·89 or 0°·013 per diem.
" " 12	.....	$51^{\circ} \cdot 40$	... ..	$+0^{\circ} \cdot 021$	
" " 17	.....	$51^{\circ} \cdot 44$	.....	$0^{\circ} \cdot 008$	
" " 24	.....	$51^{\circ} \cdot 52$	.....	$0^{\circ} \cdot 011$	
" " 30	.....	$51^{\circ} \cdot 54$	.....	$0^{\circ} \cdot 003$	
" May 7	.....	$51^{\circ} \cdot 58$	.....	$0^{\circ} \cdot 006$	
" " 14	.....	$51^{\circ} \cdot 85$	.....	$0^{\circ} \cdot 024$	
" " 21	.....	$52^{\circ} \cdot 00$	.....	$0^{\circ} \cdot 021$	
" " 28	.....	$51^{\circ} \cdot 92$	.....	$0^{\circ} \cdot 011$	
" June 4	.....	$51^{\circ} \cdot 94$	.....	$-0^{\circ} \cdot 003$	
" " 11	.....	$52^{\circ} \cdot 10$	.....	$+0^{\circ} \cdot 025$	

*(To be continued in our next.)*

# COMPARABLE SOLAR RADIATION.

*To the Editor of the Meteorological Magazine.*

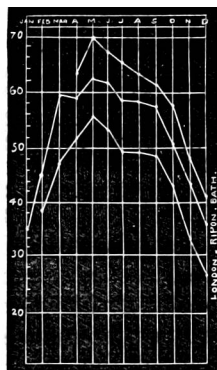
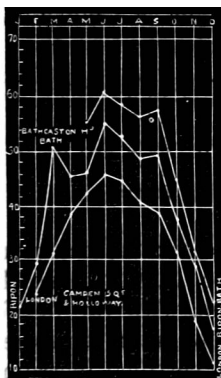
SIR,—I beg to submit to you a few results of the comparative observations of solar radiation begun last year. They must all be considered open to correction from more extended observation, for it is too soon to speak of any conclusions with confidence. I take this opportunity of thanking those who have 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, "Sandwich," 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, Aldershot 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 :—

<i>Mean humidity of the day.</i>			
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.,  $0^{\circ}67$ , 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 beg 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.

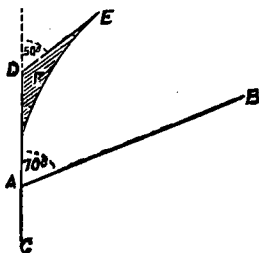
I must apologise for troubling you, but as I intend to construct a dial on Mr. Du Port's plan, I am anxious to be sure that I understand it.—I am, &c.,

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  $10^\circ$  or of  $30^\circ$ , 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 solstice. 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.

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## 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.  $25^{\circ}$  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  $32^{\circ}$  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 versa*, 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.					Days on which 40 or more fell	TEMPERATURE.				No. of Nights below 32°	
		Total Fall.	Differ- ence from average 1860-5	Greatest Fall in 24 hours.		Max.		Min.					
				Dpth	Date			Deg.	Date.	Deg.	Date.		
inches	inches.	in.			Deg.	Date.	Deg.	Date.	In shade	On grass			
I.	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	...
III.	Selborne (The Wakes) .....	3.95	+	2.24	1.51	6	11	50.5	28	17.4	11+	15	18
IV.	Hitchin .....	1.36	+	.10	.61	6	17	52.0	28	19.0	9, 11	15	...
V.	Banbury .....	2.44	+	1.01	.86	6	17	53.0	28	17.5	12	19	...
VI.	Bury St. Edmunds (Culford) .....	.78	—	.64	.35	6	9	57.0	28	17.0	10	17	21
VII.	Bridport .....	2.23	+	.17	1.16	6	12	53.0	3, 27	17.0	13	17	...
VIII.	Barnstaple .....	1.89	—	.19	.50	6	16	55.0	28	25.0	11	...	...
IX.	Bodmin .....	5.58	+	2.79	1.43	1	16	50.0	28	23.0	10§	10	17
X.	Cirencester .....	1.80	+	.19	.70	6	7	...	...	...	...	...	...
XI.	Shifnall (Houghton Hall) .....	1.76	+	.87	.39	8	12	54.0	28	18.0	11+	16	...
XII.	Tenbury (Orleton) .....	2.50	+	.93	.51	6	18	56.7	28	18.4	11	15	21
XIII.	Leicester (Wigston) .....	1.64	+	.30	.86	8	6	57.0	28	18.0	9	16	...
XIV.	Boston .....	1.30	+	.09	.54	6	16	56.0	28	22.2	11	14	24
XV.	Grimsby (Killingholme) .....	1.71	—	...	.56	6	20	60.0	28	20.5	11	12	...
XVI.	Derby .....	1.09	—	.39	.28	6	14	56.0	28	21.0	10	12	...
XVII.	Manchester .....	.86	—	1.09	.21	25	14	53.2	28	19.0	12	13	21
XVIII.	York .....	1.88	—	.50	.30	7	19	50.0	27	15.0	11	11	...
XIX.	Skipton (Arncliffe) .....	5.10	+	1.43	1.13	7	18	...	...	...	...	...	...
XX.	North Shields .....	1.95	+	.41	.35	7	24	48.8	2	24.0	25	13	...
XXI.	Borrowdale (Seathwaite) .....	...	...	...	...	...	...	...	...	...	...	...	...
XXII.	Cardiff (Town Hall) .....	...	...	...	...	...	...	...	...	...	...	...	...
XXIII.	Haverfordwest .....	3.89	+	1.03	1.37	6	9	48.9	4, 6	20.5	14	12	18
XXIV.	Rhayader (Cefnfaes) .....	3.92	+	.94	1.00	1	10	...	...	...	...	12	...
XXV.	Llandudno .....	1.53	+	.18	.29	2, 6	14	57.7	28	25.4	12	8	...
XXVI.	Dumfries .....	3.87	+	1.32	1.33	6	11	51.0	28	19.0	25	13	...
XXVII.	Hawick (Silverbut Hall) .....	2.38	...	...	.52	27	20	...	...	...	...	...	...
XXVIII.	Ayr (Auchendrane House) .....	2.45	—	.91	1.29	27	13	55.0	1	22.0	22¶	15	22
XXIX.	Castle Toward .....	5.53	+	1.79	1.14	6	17	51.0	28	17.0	25	21	23
XXX.	Leven (Nookton) .....	2.00	+	.30	.57	25	18	45.0	5*	13.0	25	19	26
XXXI.	Stirling (Deanston) .....	4.23	+	1.23	1.30	6	22	47.0	20	9.0	25	20	...
XXXII.	Logierait .....	5.68	...	...	1.75	6	11	...	...	...	...	...	...
XXXIII.	Ballater .....	6.32	...	...	3.15	6	14	44.0	2	13.0	24	17	...
XXXIV.	Aberdeen .....	3.14	...	...	.71	27	21	47.2	28	20.4	24	14	20
XXXV.	Inverness (Culloden) .....	.78	...	...	...	...	...	46.7	4	24.8	14	12	...
XXXVI.	Portree .....	6.01	—	4.22	1.64	6	14	...	...	...	...	...	...
XXXVII.	Loch Broom .....	1.16	...	...	.30	28	14	...	...	...	...	...	...
XXXVIII.	Helmsdale .....	1.81	...	...	.49	20	15	...	...	...	...	...	...
XXXIX.	Sandwick .....	2.92	+	.44	1.18	6	16	44.6	20	24.5	26	11	20
XL.	Cork .....	4.39	...	...	1.07	5	12	...	...	...	...	...	...
XLI.	Waterford .....	3.26	+	1.23	.68	5	15	42.0	6	23.0	12**	20	...
XLII.	Killaloe .....	3.01	+	.11	.59	28	14	52.5	6	25.5	11	16	...
XLIII.	Portarlinton .....	1.75	—	.28	.19	9, 28	22	49.5	27	27.0	11	8	...
XLIV.	Monkstown .....	3.05	+	1.41	.52	6	12	...	...	...	...	...	...
XLV.	Galway .....	2.72	...	...	.68	28	17	52.0	5, 7	26.0	9++	6	...
XLVI.	Bunninadden (Doo Castle) .....	4.12	...	...	.82	28	16	46.0	2, 3	24.0	11++	10	...
XLVII.	Bawnboy (Owendoon) .....	3.62	...	...	.70	1	17	53.0	6	26.0	12	11	12
XLVIII.	Waringstown .....	2.15	...	...	.43	27	17	51.0	4	25.0	9	15	23
XLIX.	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; TS 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.

W A L E S.

**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.

S C O T L A N D.

**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  $3\frac{1}{2}$  in. over the mean of the last nine years;  $3\cdot15$  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  $3\frac{1}{2}$  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  $2^{\circ}9$  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.

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

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.  $34^{\circ}9$ , nearly  $1^{\circ}$  colder than mean of last January; the coldest February since observations have been made here—1862. E 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.*





