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THE FROST — EARTH TEMPERATURES AND
WATER PIPES.

WHEN we concluded the article on page 23 of our last number with the words, "Respecting earth temperatures and water pipes we hope to be able to say something next month," we little thought what was before us.

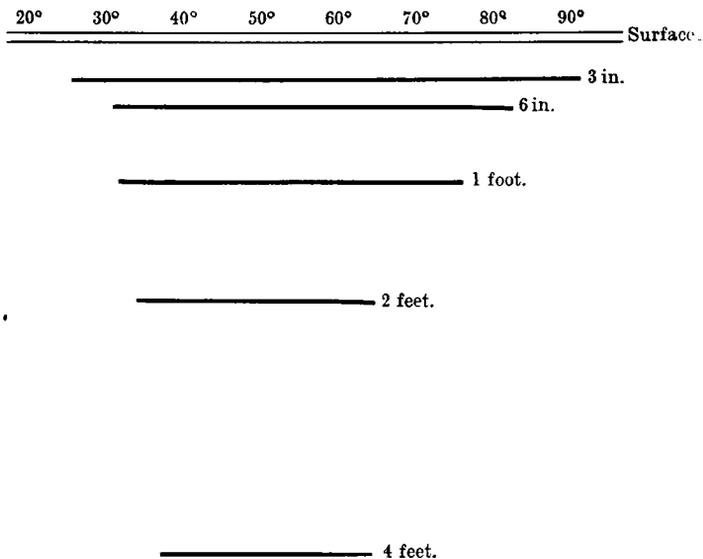
For years past, certainly for more than half a century, there has been a gradually increasing number of stations giving daily records of the temperature of the soil at different depths.

Now that over a large portion of England (not in London only as Londoners seem to imagine), there have been thousands of water pipes burst by the expansion of the contained water in freezing, we hoped that the records of these thermometers would supply ample details. The *Royal Meteorological Society* kindly allowed us to copy the records sent to it, and we have incorporated in some others, but the result is that the records of the thermometers and the facts as to the water pipes seem to be at variance, and to show that the thermometers are wrong—a very disheartening fact (if it is a fact) for those who, like ourselves, have been recording them for a quarter of a century.

Of course, an inference like this must be supported, and should not be mentioned without some reasons being given. And first of all, it may be convenient to inform those who have not previously considered the subject, that the yearly mean temperature of the soil down to say 10 ft. does not vary much, and also that at 10 ft. the difference between the summer and winter is trifling, but the nearer we come to the surface the greater is the influence of season.

From a paper read before the Royal Botanic Society in 1877, and based upon tri-daily observations for six years (1871-76), we take the following facts.

These values are reproduced in the following diagram, which, we trust, is self-explanatory:—



	Absolute Lowest.	Diff.	Mean.	Diff.	Absolute Highest.
At a depth of 3 inches ...	26·2	23·5	49·7	43·3	93·0
„ „ „ 6 „ ...	31·0	19·2	50·2	33·8	84·0
„ „ „ 1 foot ...	32·0	17·9	49·9	27·3	77·2
„ „ „ 2 feet ...	33·0	16·5	49·5	17·8	67·3
„ „ „ 4 „ ...	37·0	13·0	50·0	16·0	66·0

Therefore, these observations, showed no case of a frost penetrating two feet, and only one case of its just reaching one foot.

We may now turn to the figures for 1895, and in the first place we will deal only with records obtained at a depth of one foot, because those observations are the most numerous. We did intend to give the observations *in extenso*, but the following abstract shows so steady a relation between the mean and the absolute minimum, that we see no necessity for printing two pages of figures when the facts can be brought out more prominently by an abstract.

In the table on page 39 we give for February, 1895, the mean temperature at the depth of one foot, and the lowest temperature at that depth at nearly twenty stations.

We have already seen that the deeper the thermometer is buried the less will it feel the frost. The following table shows that at 1 foot frost occurred at only 10 stations out of 18, and our previous table and diagram show that the minima are higher for each foot of depth—and, as far as we can see, the logical sequence of this is that the observations show that at no station could frost have occurred at a depth of 2 ft. 6 in.

And this conclusion (we do not say that we believe it), can be sup-

ported by some other records. We are not aware of any observations at the depth of 2ft 6 in., but there are a few at 2 ft. and at 4 ft.

Earth Temperatures at 1 foot in February, 1895.

STATION.	COUNTY.	Mean Temp.	Minimum.	Min. below Mean.
Lowestoft	Suffolk	29 ^o 0	28 ^o 2	0 ^o 8
Regent's Park, London	Middlesex	30 ^o 8	28 ^o 2	2 ^o 6
Wallington	Surrey	31 ^o 9	30 ^o 4	1 ^o 5
Shaftesbury	Dorset	31 ^o 9	30 ^o 8	1 ^o 1
Bolton	Lancashire	32 ^o 2	31 ^o 0	1 ^o 2
Stowell	Somerset	32 ^o 2	31 ^o 0	1 ^o 2
Camden Square	Middlesex	32 ^o 3	30 ^o 9	1 ^o 4
Harestock, Winchester	Hampshire	32 ^o 3	31 ^o 7	0 ^o 6
Southwell	Notts	32 ^o 6	32 ^o 0	0 ^o 6
Rousdon Observatory	Devon	32 ^o 7	31 ^o 7	1 ^o 0
Bennington	Herts	32 ^o 7	32 ^o 0	0 ^o 7
Norwood	Surrey	32 ^o 9	32 ^o 1	0 ^o 8
Tunbridge Wells	Kent	32 ^o 9	31 ^o 9	1 ^o 0
Rounton	York, N.R.	33 ^o 0	32 ^o 0	1 ^o 0
Hodsock	Notts	33 ^o 0	32 ^o 2	0 ^o 8
Margate	Kent	33 ^o 4	32 ^o 6	0 ^o 8
Somerleyton	Suffolk	33 ^o 8	33 ^o 0	0 ^o 8
Tavistock	Devon	34 ^o 0	33 ^o 4	0 ^o 6

In the above table the stations are grouped in the order of their mean temperature, and some results are remarkable. The coldest station, Lowestoft 29^o0, is within a short walk of the hottest but one, Somerleyton 33^o8. We believe that the thermometers at both stations have been verified, but think that re-verification is desirable. There is, however, one important factor respecting underground thermometers, concerning which sufficient precision has not been enforced. We have seen no printed rule as to whether the ground in which they are sunk is or is not to be always open to the sun when it shines. Unfortunately, we did not begin observations on this point ourselves until the frost was nearly over, but we have had two thermometers each 1 foot deep, and within 100 feet horizontally, the one reading 1^o2 above the other. We do not suggest that all or any of the above minima require lowering by 1^o2, we merely say that in winter the sun has enough power, when it shines, to make one patch of ground, at 1 foot below the surface, 1^o2 warmer than another.

There are many other features in the table which need explanation, such as why the absolute minimum at Wallington was nearly 2^o below Norwood, and why that at Regent's Park was nearly 3^o below Camden Square.

In the following table we give all the minima at 1 ft., 2 ft., and 4 ft., at all stations arranged in our usual sequence, and in the last three columns some figures, to which no further weight must be

attached than this; that according to the information at present available, they represent what appears to have been the temperature at the respective depths, if the several thermometers may be regarded as accurate.

		Observed Minima.			Observed and Estimated Minima at			
		1 ft.	2 ft.	4 ft.	1 ft.	1ft. 6in.	2 ft.	2ft. 6in.
Middlesex.	Camden Sq.	30·9	°	37·1	30·9	32·7	34·1	35·1
„	Roy. Bot. Soc.	28·2	34·0	34·8	28·2	31·0	34·0	33·4
Surrey.....	Wallington	30·4	...	...	30·4	32·2	33·6	34·6
„	W. Norwood ...	32·1	...	...	32·1	33·9	35·3	36·3
Kent	Tunbridge Wells	31·9	...	...	31·9	33·7	35·1	36·1
„	Margate	32·6	35·8	40·0	32·6	34·4	35·8	37·3
Hampshire	Harestock	31·7	34·2	38·4	31·7	33·4	34·2	35·8
Herts	Bennington	32·0	...	...	32·0	33·8	35·2	36·2
Suffolk ...	Lowestoft.....	28·2	31·9	36·8	28·2	30·9	31·9	33·3
„	Somerleyton ...	33·0	...	37·4	33·0	34·8	36·2	37·2
Dorset.....	Shaftesbury	30·8	...	...	30·8	32·6	34·0	35·0
Devon	Tavistock	33·4	...	...	33·4	35·2	36·6	37·6
„	Rousdon	31·7	35·5	38·1?	31·7	33·8	35·5	36·2
Somerset..	Stowell	31·0	...	...	31·0	32·8	34·2	35·2
Notts	Southwell.....	32·0	...	...	32·0	33·8	35·2	36·2
„	Hodsock	32·2	...	...	32·2	34·0	35·4	36·4
Lancashire	Bolton	31·0	33·2	35·6	31·0	31·9	33·2	34·3
„	Blackpool.....	...	...	36·8	30·5	32·3	33·7	34·7
York N.R.	Rounton	32·0	...	...	32·0	33·8	35·2	36·2

From this we see that, according to the thermometers,—

Frost penetrated to 1 ft. at 11 stations.

„ „ 1ft. 6in. 3 „

„ „ 2ft. 1 station.

„ „ 2ft. 6in. no station.

The fact that ice formed in many pipes buried 2ft. 6ins. is, we believe, indisputable, indeed, we have statements of its being found at depths exceeding 3 ft., but space will not allow us to enter into details this month, nor to point out what may be the explanation of the apparent discordance.

Erratum.—Mr. von V. Searle has pointed out that the table at the top of p. 22 is not complete; we were aware of it when we wrote “The following are minima,” instead of writing “The following are *all the* minima,” but had forgotten it when we wrote the concluding words of the sentence. We do not think that lower readings are omitted, but that in some years there were other days with min. below 10°—this is certainly the case with Jan. 7th, 1841, on which it fell to 9°·8; and on Jan. 4th, 1867, when it fell to 7°·7; therefore, in each of those years, as in 1895, there were two consecutive days with minima below 10°.

THE GREAT GALE IN THE MIDLANDS ON MARCH 24TH.

THERE can be no question as to this having been locally, one of the heaviest gales for many years. We have not space to report fully, but reproduce two typical descriptions, and a few others will be found in the "Notes on the Month" on p. 51.

To the Editor of the Meteorological Magazine.

SIR,—On Sunday, March 24th, at 9 a.m., the wind was S.S.W., force 5; then it increased, and must have been blowing 6, 7, or perhaps 8 towards noon, with small showers, and a smart one about 0.30 p.m. At 1 p.m. the wind was about force 8 from S.W., but it was not till 1.30 p.m. that I became alarmed. Direction was then W.S.W., and sky quite as much blue as cloudy. The wind was so furious, with distinct blasts of greater force, that I went to a window which commands a view of the main gable of the house, where slates had gone in the gale of February 11th, 1894. It was clear that they would go again. They trembled and shivered; one edge-slate slipped down, was caught by the wind, hurled over the house, and smashed on a door-step on the other side. One by one others went away, and at 2 so many were flapping and quivering that I had great fears for the roof itself. At 2.10 damage to the slates ceased, *not* by a change in the direction of the wind, but by abatement of its force. Meantime the cross above the weathercock on the church spire (copper, and 2 feet long) had been torn away by the wind, and the rod of the weathercock was shaking terribly. Some said they saw the stone-work of the spire move. This I could *not* see, nor can I see any sign of cracking since.

When it was safe to go out, I found that the village street was full of thatch. Every house with thatch was showing a hole somewhere. Chimney-pots, ridge-tiles, and slates had gone more or less from every house; but the destruction to the trees was the worst. Just outside my garden five large elms were lying side by side, torn up by the roots. This I fancy was done by one blast between 1.50 and 2, for exactly in the direction towards which these pointed, which was a few yards to the south of my vicarage, three solid chimney-pots had been carried away from a very substantial farmhouse, and, still in the same straight line, close to another farmhouse, seven large trees lay together (poplars, a Scotch fir, a larch, and a kind of ash), and further on, still in the same line, lay two large elms, torn up by the roots also. I have counted 19 large trees down within a very short half-mile of my house, not counting broken limbs of trees, and I am by no means sure that I have seen all.

The damage to thatch, tiles, &c., may supply a good measure of the force of the wind as compared with that of other gales; but the tearing up of the trees I judge to be due in great part to the late frost. The seven great elms torn up by the roots, already mentioned, were in low-lying hollows, where frost had gone deepest, and where

the ground has since been unusually loose for about two feet from the surface. On higher ground the roots had held for the most part (not always), and the tree stems had snapped near the ground, or some way up.

But whether to trees or to buildings, no gale since I have been here has done damage in any way comparable to this, and no one pretends to remember anything approaching to it. I wish I had had any means of calculating the angle to which a fir tree opposite my study window bent without breaking!

By 3 p.m. the wind had much abated; by 4 it had ceased to be at all remarkable, and by sunset was not more than a fresh breeze. There was much lightning about 8 p.m. in N.W.

The hurricane may be said to have lasted from 1.30 to 2.15, and the very worst of it from 1.50 to 2. The extreme force might certainly be put as high as 11, perhaps even at 12. Had the extreme fury continued for an hour, there is no knowing how the house roofs would have stayed on.—Yours very truly,

H. A. BOYS.

Easton Mauduit Vicarage, Northampton.

To the Editor of the Meteorological Magazine.

SIR,—The comparatively scanty accounts in the London papers of Sunday's storm lead me to suppose that the intensity in the metropolis was very much inferior to that experienced in this county, where it is stated that, as far as the disastrous results are concerned, nothing like it has been experienced since 1703.

I well remember the great gale of the 14th of October, 1881, and the numbers of trees which were then blown down, but it was *not to be compared* with that of the 24th of March, 1895. Older men than myself speak of the great "May" gale of 1860, with which they compare the recent one, but all admit that even that did not equal the awful and destructive hurricane we have just passed through.

My own experiences of Sunday were as follows. After a stormy night, with rain, at 9 a.m. the wind was blowing a moderate gale from W.S.W., the sky was clouded, the barometer (corrected and reduced), was 29.28 ins. Temp. dry, 51°.6; wet, 51°0. The min. had been as high as 47°8. During the forenoon the wind slightly increased and the sky partially cleared. At 2 p.m. the barometer had fallen to 29.09 ins., and the wind was blowing a fresh gale nearly due W. At 3 p.m. the hurricane began in earnest, and a few minutes later my garden wall was blown over. At 3.30 p.m. the gale was at its height, the barometer being 28.99 ins. The gusts were something terrific. The water was being blown out of the river like dense clouds of smoke over the adjoining marshes, and the spray could be felt in my garden, 60 feet above it. Rockland and Surlingham Broads were compared to "bonfires," so great and dense were

the clouds of spray being blown out of them. Three signal posts on the line were blown down, and roofs were swept of tiles by the 100, chimney-pots blown down, and in many instances stacks of chimneys blown through the roofs. At Blofield Church the service was suspended, the lead on the roof was rolled up like parchment, many of the trees in the churchyard were uprooted, and the congregation was unable to leave by the usual door owing to the falling masonry. At Strumpshaw (the adjoining parish) a whole plantation of larch trees was laid flat, not a tree left standing, and the grounds of Brundall House, noted for the great variety of beautiful trees and shrubs were left a perfect wreck, large trees being piled one on the top of another. On a farm near here 300 trees were blown down and in a park near East Dereham it is said that 1100 trees were uprooted. In some parts of Norwich the houses look as if they had been bombarded, the roofs being stripped of tiles, chimney stacks fallen through the roofs, and windows blown in. Nothing the least approaching it has happened in my recollection, nor of anyone, even of old people with whom I have come in contact.

After 3.30 p.m. the barometer rose briskly, and from 4 p.m. the gale gradually abated. At 9 p.m. the barometer had risen to 29.34 ins., the wind was W.N.W., about force 6, and there was much distant lightning.

I see that in the *Quarterly Journal Roy. Met. Soc.*, 1874 (p. 111), it is stated that a "hurricane that tears up trees and throws down buildings" has a velocity of 110.48 miles per hour. I should think, therefore, that the most violent gusts on Sunday afternoon must have been but little short of force 12.

Yours very truly,

ARTHUR W. PRESTON.

Bradestone House, Brundall, Norwich, 26th March, 1895.

P.S.—I have since ascertained that the damage caused in Norfolk by the gale of the 24th ult. is far more extensive than I was then aware of. On three estates I hear of 2,000 trees being blown down, and on another of 1,700.

I have recently been in Suffolk, where they also experienced a severe gale, but the results appear trifling when compared with the devastation wrought in this county.

To the Editor of the Meteorological Magazine.

SIR,—A severe S.W. gale, apparently at its height from noon till 1 p.m., as during that time 10 great forest trees were blown down to my knowledge (principally elm) within a mile of here, and various other damage was done. Rainfall only .03 in. ; lightning at night.

ROSE E. STANTON.

Upfield, near Stroud, Gloucestershire, March 24th, 1895.

SNOW FROM A CLOUDLESS SKY.

To the Editor of the Meteorological Magazine.

SIR,—The 6th of February was a brilliant day here, but at intervals some snow crystals and minute spiculæ of ice fell without any visible cloud, and unaccompanied by any other form of snow.

These corresponded, for the most part, with Figs. 89, 98, 104 and 132 in the series of snow crystals published in the Fifth Annual Report of the Roy. Met. Soc.

Snow crystals also fell on February 1st, 2nd, 7th, 8th, 14th and 15th, in endless variety of forms.

Yours truly,

C. LEESON PRINCE.

The Observatory, Crowborough, Sussex, March 29th, 1895.

REVIEWS.

Meteorological Work in Australia: A Review, by Sir C. TODD, K.C.M.G., F.R.S. [? "Excerpt Report Australian Association for the Advancement of Science."] 8vo, 25 pages, 1 plate.

At the first meeting of the Association at Sydney, in 1888, Mr. Russell epitomized the work in Astronomy and Meteorology done in Australia up to 1860; in the present paper Sir Charles Todd deals with the period from 1860 to 1892. Incidentally, he gives some figures so startling and so important that we at once proceed to extract them. We must, however, first explain where "Alice Springs" is, because some of our readers may not know.

Sir Charles Todd was appointed Government Astronomer of South Australia in 1856, and with that appointment was joined that of Director of the Telegraph service. Towards the end of the sixties, the wonderful undertaking of erecting a line of telegraph right across Australia from South to North (about 2,000 miles) was commenced, and finished in 1872 by Sir Charles; and Alice Springs is the name of a telegraph station not many miles from the centre of the vast continent of Australia.

We will now let Sir Charles tell his own tale:—

"At Alice Springs there is a large evaporation tank similar to that at the Adelaide observatory, which it may be convenient here to describe. It consists, first, of a brick tank lined with cement; internal measurement, 4 ft. 6 in. square and 3 ft. 2 in. deep. Inside this tank is another, made of slate, 3 ft. square and 3 ft. deep, leaving an intervening space between it and the larger tank of 7 in. Both tanks are filled to the same level, or to within 3 in. or 4 in. of the top, fresh water being added as required. The evaporation is measured by a graduated vertical rod, which is carried by a float placed in a vertical cylinder of copper 4 in. in diameter (perforated at the bottom) standing in the inner tank. The rod is graduated to $\frac{1}{10}$ th of an inch, and is read off by means of a fixed vernier to $\frac{1}{100}$ th

of an inch. A rain gauge is placed by the side of the tank, and both the evaporation and the rainfall are read at 9 a.m. and 9 p.m.

“As the question of evaporation is an important one in connection with water conservation, I give below the mean evaporation at Adelaide, deduced from twenty-three years' observations, and at Alice Springs, in the centre of the continent, during the years 1890, 1891 and 1892.

Evaporation at Adelaide.		Evaporation at Alice Springs.		
Mean of Twenty-Three Years.		1890.	1891.	1892.
	Inches.	Inches.	Inches.	Inches.
January	8·93	—	12·84	14·02
February	7·23	11·20*	13·84	10·55
March	6·03	11·99	11·85	8·72
April	3·60	6·00	5·04	7·18
May	2·13	4·76	4·48	4·66
June	1·38	3·15	2·66	3·95
July	1·46	4·44	3·82	4·21
August	2·03	5·43	5·81	5·69
September	3·02	—	7·78	8·17
October	4·86	11·22	8·23	9·84
November	6·50	11·73	9·26	11·87
December	8·36	13·79	12·94	11·49
Year	55·53	—	98·55	100·35

* Twenty-seven days.

Greatest [evaporation] in one year at Adelaide ... 60·95 in. in 1876.
 Least [evaporation] in one year at Adelaide 47·39 in. in 1892.
 Average rainfall at Adelaide for 54 years 21·08 in.
 Average rainfall at Alice Springs for 19 years..... 11·25 in.

We have heard that when fixing the telegraph there was one station (and we rather think that it was Alice Springs) to which drinking water had to be sent several hundred miles. With the supply which its present name indicates, and with a mean rainfall of 11½ inches, it is now, doubtless, independent, but it will need something to keep up an evaporation of 100 inches a year.

Bodenphysikalische und Meteorologische Beobachtungen mit besonderer berücksichtigung des Nachtfrostphänomens, von THEODOR HOMEN, Privatdocent an der Universität zu Helsingfors. Mayer and Müller, Berlin, 1894, 225 pages and two plates.

WE have never seen a satisfactory explanation of the reason why persons who write in German do their work with such thoroughness. We have here a book written by a member of the University of Helsingfors (just where the Baltic narrows to become the Gulf of Finland), which is in many respects a model. Twelve years ago he wrote a short paper on nocturnal frosts ; and in the pre-

sent book he carries on the investigation with fresh instruments, and in relation, not merely to night frosts, but to dew and to evaporation. The work seems to us to have only one failing, and that is one rather usual with German books—an absence of woodcuts. A sketch of one or two of his thermometers in position, a process-photo of one of his experimental groups, and an outline plan showing the sites of the observations, would have made it more easy to appreciate fully the conditions of the experiments.

The author explains the pattern of the thermometer used, and the precautions taken to ensure accuracy. He had about thirty-six thermometers, thirty of which were in groups of six each. Each group had its bulb at the respective depths below the surface of—

0 $\frac{3}{4}$ in. 2 in. 4 in. 8 in. 1 ft. 4 in.

and the five groups were respectively placed in—

- (1) Open sandy heath, with scanty grass.
- (2) Sandy heath, but very shady, with small pine trees.
- (3) Loamy soil, bearing wheat.
- (4) On an open moor or bog.
- (5) On a field of rye reclaimed from the moor or bog.
- (6) In a fir plantation on the same moor or bog.

Three observers took part in the work, and the whole thirty thermometers were read hourly from 11 a.m. on August 12th, 1892, till 4 p.m. on the 14th, *i.e.*, for 53 consecutive hours, and from 4 a.m. September 6th, 1892, to midnight, September 8th-9th, *i.e.*, for 68 hours. These observations are printed *in extenso*.

We notice one erroneous entry; whether a mistake in the observation or a misprint, we cannot tell, but certainly the reading of the 5 cm. thermometer at 3 p.m. on August 14th was 16°·0 not 15°·0; otherwise the tables are remarkably accurate.

We cannot, of course, quote the figures *in extenso*, but roughly the results for August 12th to 14th are:—

Daily Range of Temperature.			
	Open Heath.		Fir Plantation on a Moor or Bog.
Surface.....	27·5 F.	.....	12·5 F.
$\frac{3}{4}$ in. below	18·0	.....	6·5
2 in. ,,	13·0	.....	3·0
4 in. ,,	8·5	.....	1·0
8 in. ,,	5·0	.....	0·5
16 in. ,,	1·1	.....	0·0

In subsequent sections, the author deals with the capacity of the various strata of the soil for heat, the temperature exchanges between the soil and the atmosphere, and the amount of water found in the various layers of earth.

He then deals with the amount of dew and its mode of production, giving notes from Aristotle, Gersten, Six, Wilson, Wells, Fusinieri, Stockbridge, Chistoni, Aitken, Wollny, Russell, Masure, Marié-Davy, Flauguergues, Raddi, Nacca, Gasparin and Dines, and

finishing up with original experiments by himself with various flannels and other woven materials.

The next section is the weakest in the book. It is devoted to evaporation, and is almost wholly based upon records with Dr. Wild's apparatus, the important work done by French engineers, and copied in this country, in America, and Australia, being apparently unknown to Professor Homén.

The last sections are devoted to explaining the production of night frosts and their prediction.

No one ought to write on the above subjects until he has made himself familiar with what the author has done.

An Essay on Southerly Bursters by H. A. HUNT, Second Meteorological Assistant, Sydney Observatory. [Excerpt Journal Royal Soc. of N. S. Wales.] 8vo, 48 pages, four photo plates.
[Awarded the Prize of £25 offered by the Hon Ralph Abercromby, for the best Essay on Southerly Bursters, May 2nd, 1894.]

MR. ABERCROMBY is to be congratulated on this the first outcome of his donation to the Royal Society of New South Wales. The writer is evidently more at home in weather forecasting, and in the study of synchronous observations, than in literary work, but as he says (although had he been a more practised scribe he would have left it to others to say), he has devoted "a vast amount of patient research," and the result is, we think, very satisfactory.

We do not like the name "Southerly Burster" so well as its precursor, "Brickfielder," and Mr. Hunt's reason for the change seems to us rather insufficient; however, he ought to know if anyone does, and this is his statement:—

"In the early days of Australian settlement, when the shores of Port Jackson were occupied by a sparse population, and the region beyond was unknown wilderness and desolation, a great part of the Haymarket was occupied by the brickfields, from which Brickfield Hill takes its name. When a 'Southerly Burster' struck the infant city, its approach was always heralded by a cloud of reddish dust from this locality, and, in consequence, the phenomenon gained the local name of a 'brickfielder.' The brickfields have long vanished, and with them the name to which they gave rise, but the wind continues to raise clouds of dust as of old, under its modern name of 'Southerly Burster.'"

The essay contains a mass of information generally well arranged, and will, we think, remain for some time the best paper upon the subject.

The investigation of the Helm Wind by the Royal Meteorological Society left upon our mind the impression that its importance had been considerably exaggerated, but Mr. Hunt's paper, and especially plates v., vi. and viii., have reminded us of it, for the plates represent rolls of cloud similar to those which we understood prevailed during a Helm Wind, and formed the Helm and the Helm Bar.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, SEPTEMBER, 1894.

STATIONS. <i>(Those in italics are South of the Equator.)</i>	Absolute.				Average.				Absolute.		Total Rain.		Aver. Cloud.	
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.		
	Temp.	Date.	Temp.	Date.										
England, London	71·2	1	36·7	28	63·0	48·0	48·1	79	0·100	113·6	31·6	1·05	11	6·6
Malta.....	95·8	5a	65·0	23	87·3	71·6	68·4	76	...	145·7	60·4	·23	1	2·1
<i>Cape of Good Hope</i> ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
<i>Mauritius</i>	79·0	25	61·4	5	76·5	64·7	61·1	75	...	129·4	52·3	1·88	16	5·7
Calcutta.....	90·6	22	75·8	21	87·6	77·8	78·6	89	...	158·7	74·3	6·52	15	7·2
Bombay.....	86·2	4	73·3	22	83·1	75·7	74·9	86	...	139·3	71·5	12·04	25	8·4
Ceylon, Colombo	87·6	21	69·6	6	85·6	76·7	72·5	80	...	148·5	68·0	·78	15	7·5
<i>Melbourne</i>	71·2	20	36·1	29	60·5	43·6	43·7	74	...	124·9	30·0	2·69	19	5·5
<i>Adelaide</i>	77·0	20	37·2	6	64·3	45·5	44·9	72	...	140·6	31·8	1·02	16	4·5
<i>Sydney</i>	79·8	22	45·3	18	64·1	49·9	49·0	76	...	135·8	32·5	4·62	22	5·4
<i>Wellington</i>	64·0	8	36·0	3,16	56·6	45·2	42·1	73	...	125·0	23·0	5·03	19	4·8
<i>Auckland</i>	69·0	11	35·0	3	59·9	48·1	47·3	77	...	130·0	31·0	5·08	21	6·4
Jamaica, Kingston.....	92·9	21	70·6	19	90·1	73·8	71·8	77	...	...	...	1·55	6	4·4
Grenada.....	87·2	12	69·8	29	84·1	74·9	72·8	77	...	155·0	...	12·16	26	4·9
Trinidad	91·0	c	69·0	26	89·1	71·4	71·5	81	...	172·0	67·0	5·48	12	...
Toronto	84·1	2	38·9	26	71·5	53·7	54·7	78	...	...	30·0	5·48	14	5·2
New Brunswick, Fredericton	77·7	22	29·5	27	67·2	46·4	48·3	72	...	...	...	2·60	8	6·1
Manitoba, Winnipeg ...	85·0	5	26·8	17	65·8	42·3	...	...	...	...	...	2·18	11	5·7
British Columbia, Esquimalt	68·0	10	40·2	23	60·2	47·6	50·4	89	...	...	...	3·73	17	6·2

a—and 14. b—and 19. c—Various.

REMARKS.

MALTA.—Adopted mean temp. 77°·6, 3°·0 above the average. Mean hourly velocity of wind 8·2 miles. Thunder storm on 30th. Lightning on 18th and 19th. No rain, except a few drops on 18th, before the night of 30th. September, 1893, was the first rainless September recorded in 12 years. J. F. DIBSON.

Mauritius.—Mean temp. of air equal to, dew point 1°·3 above, and rainfall ·42 in. above, their respective averages. Mean hourly velocity of wind 11·1 miles or 0·9 below average; extremes 25·3 on 1st, and 1·6 on 6th; prevailing direction, E.S.E. to E. by N. C. MELDRUM, F.R.S.

Adelaide.—Mean temp. 2°·2 below the average of 37 years. Rain ·80 in. below the average. C. TODD, F.R.S.

Sydney.—Mean temp. 1°·7 below, humidity 6°·1 above, and rainfall 1·41 in. above, their respective averages. H. C. RUSSELL, F.R.S.

Wellington. On the whole a showery month, with occasional intervals of fine weather; prevailing southerly weather and strong wind from that quarter from the 1st to 3rd and 19th and 20th. Thunder hail and snow on 2nd; fog on 8th. Mean temp. same as average; rainfall ·77 in. above average. R. B. GORE.

Auckland.—A wet, stormy and disagreeable month. Slight snow storm on the 3rd, the first snow recorded in Auckland for fifteen years. Rainfall about 1·50 in. in excess. Barometric pressure and mean temperature both considerably below the average. T. F. CHEESEMAN.

JAMAICA, KINGSTON.—Cyclone to the North on 23rd. Mean hourly velocity of wind 3·8 miles; prevailing direction S.S.E. Island rainfall a little less than, and Kingston rainfall one-third of, their respective averages. R. JOHNSTONE.

TRINIDAD.—Rainfall 2·05 in. below the average of 30 years. J. H. HART.

SUPPLEMENTARY TABLE OF RAINFALL,
MARCH, 1895.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			
II.	Dorking, Abinger Hall.	2·20	XI.	Lake Vyrnwy	4·67
„	Birchington, Thor	1·11	„	Corwen, Rhug	1·52
„	Hailsham	2·45	„	Carnarvon, Cocksidia ...	4·71
„	Ryde, Thornbrough	2·07	„	I. of Man, Douglas	4·43
„	Einsworth, Redlands ...	2·13	XII.	Stoneykirk, Ardwell Ho.	3·88
„	Alton, Ashdell	1·96	„	New Galloway, Glenlee	4·35
III.	Oxford, Magdalen Col...	1·34	„	Melrose, Abbey Gate	3·71
„	Baubury, Bloxham	2·53	XIII.	N. Esk Res. [Penicuick]	5·40
„	Northampton, Sedgebrook	2·28	„	Edinburgh, Blacket Pl..	2·80
„	Alconbury	1·54	XIV.	Glasgow, Queen's Park.	1·17
„	Wisbech, Bank House..	2·01	XV.	Inverary, Newtown	6·25
IV.	Southend	1·24	„	Islay, Gruinart School..	1·15
„	Harlow, Sheering	1·18	XVI.	Dollar	4·57
„	Colchester, Lexden	1·21	„	Balquhider, Stronvar.	5·01
„	Rendlesham Hall	1·78	„	Ballinluig	1·47
„	Diss	1·79	„	Dalnaspidal H.R.S. ...	4·87
„	Swaffham	2·32	XVII.	Keith H.R.S.	3·95
V.	Salisbury, Alderbury ...	1·74	„	Forres H.R.S.	2·74
„	Bishop's Cannings	2·67	XVIII.	Fearn, Lower Pitkerrie.	1·42
„	Blandford, Whatcombe .	2·81	„	Loch Shiel, Glenaladale	7·75
„	Ashburton, Holne Vic. ...	4·04	„	N. Uist, Loch Maddy ...	2·38
„	Okehampton, Oaklands.	3·28	„	Invergarry	5·23
„	Hartland Abbey	3·03	„	Aviemore H.R.S.	3·05
„	Lynmouth, Glenthorne.	4·07	„	Loch Ness, Drumnadrochit	7·20
„	Probus, Lamellyn	3·30	XIX.	Invershin	2·18
„	Wellington, Sunnyside..	3·05	„	Scourie	3·98
„	Wincanton, Stowell Rec.	2·68	„	Watten H.R.S.	1·97
VI.	Clifton, Pembroke Road	2·27	XX.	Dunmanway, Coolkelure	7·48
„	Ross The Graig	2·13	„	Fermoy, Gas Works ...	2·42
„	Wem, Clive Vicarage ...	2·17	„	Killarney, Woodlawn ...	5·10
„	Cheadle, The Heath Ho.	2·49	„	Caher, Duneske	3·82
„	Worcester, Diglis Lock	1·62	„	Ballingarry, Hazelfort...	2·61
„	Coventry, Coundon	2·19	„	Limerick, Kilcornan ...	2·93
VII.	Ketton Hall [Stamford]	1·81	„	Ennis	2·76
„	Grantham, Stainby	2·37	„	Miltown Malbay	4·16
„	Horncastle, Bucknall ...	2·10	XXI.	Gorey, Courtown House	2·86
„	Worksop, Hodsck Priory	1·52	„	Athlone, Twyford	3·55
VIII.	Neston, Hinderton	2·56	„	Mullingar, Belvedere ...	3·41
„	Preston, Haighton	3·29	„	Longford, Currygrane...	3·67
„	Broughton-in-Furness..	6·21	XXII.	Woolawn	4·22
IX.	Ripon, Mickley	2·64	„	Crossmolina, Enniscoe..	5·04
„	Melmerly, Baldersby ...	2·17	„	Collooney, Markree Obs.	4·04
„	Scarborough, South Cliff	1·57	„	Ballinamore, Lawderdale	4·11
„	Middleton, Mickleton...	3·53	XXIII.	Lough Sheelin, Arley ...	3·36
X.	Haltwhistle, Unthank..	3·41	„	Warrenpoint	3·84
„	Bamburgh	2·42	„	Seaforde	3·01
„	Keswick, The Beeches...	5·28	„	Belfast, Springfield ...	4·24
XI.	Llanfrechfa Grange	4·20	„	Bushmills, Dundarave...	3·59
„	Llandoverly	5·40	„	Stewartstown	3·49
„	Castle Malgwyn	4·56	„	Buncrana	4·00
„	Builth, Abergwessin Vic.	8·52	„	LoughSwilly, Carrablagh	3·91
„	Rhayader, Nantgwiltt..	5·67			

MARCH, 1895.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which 0.1 or more fall.	TEMPERATURE.				No. of Nights below 32°.
		Total Fall.	Difference from average 1880-9.	Greatest Fall in 24 hours		Max.		Min.		In shade.	On grass.	
				Dpth	Date			Deg.	Date			
I.	London (Camden Square) ...	1.42	- .19	.38	26	14	63.7	22	23.7	3	7	17
II.	Maidstone (Hunton Court)...	1.52	+ .02	.26	9	19	...	...	...	...	...	...
III.	Strathfield Turgiss	1.44	- .15	.43	25	19	66.0	22	22.8	14	13	23
IV.	Hitchin	1.94	+ .60	.59	27	14	60.0	21	24.0	2	11	...
V.	Winslow (Addington)	1.56	- .16	.29	26	16	61.0	22	19.0	3	11	19
VI.	Bury St. Edmunds (Westley)	1.93	+ .38	.32	27	15	57.0	21 ^b	25.0	4	...	...
VII.	Norwich (Brundall)	1.86	...	.28	3	19	61.2	23	23.0	3	8	19
VIII.	Weymouth (Langton Herring)	2.33	+ .43	.43	26	19	55.0	20 ^b	23.0	4	8	...
IX.	Torquay (Cary Green)	3.11	...	.60	26	15	61.9	20	29.4	4	1	12
X.	Polapit Tamar [Launceston]..	3.03	+ .50	.50	26	16	62.5	22	27.0	13	8	14
XI.	Stroud (Upfield)	2.37	+ .18	.39	27	21	61.0	21	26.0	3	11	...
XII.	Church Stretton (Woolstaston)	1.99	- .14	.25	28	18	61.0	22	22.0	3	8	19
XIII.	Tenbury (Orleton)	1.74	- .34	.26	26	16	63.5	21 ^b	20.8	3	11	15
XIV.	Leicester (Barkby)	1.67	- .04	.39	30	18	61.0	23	20.0	2, 3	15	24
XV.	Boston	1.96	+ .42	.32	9	15	65.0	17	25.0	4	11	...
XVI.	Hesley Hall [Tickhill].....	1.50	- .40	.37	9	13	62.0	18	25.0	3	11	...
XVII.	Manchester (Plymouth Grove)	2.93	+ .71	.46	23 ^c	20	57.0	18	25.0	3	10	13
XVIII.	Wetherby (Ribston Hall) ..	1.00	- 1.06	.35	10	9	...	...	...	...	...	...
XIX.	Skipton (Arncliffe)	4.93	- .17	1.09	23	23	...	...	...	...	...	...
XX.	Hull (Pearson Park)	1.68	- .37	.30	24	19	60.0	17 ^b	24.0	3	11	14
XXI.	Newcastle (Town Moor)	2.22	- .41	.46	9	17	...	...	...	...	...	...
XXII.	Borrowdale (Seathwaite).....	13.39	+ 2.89	4.41	23	26	...	...	...	...	...	...
XXIII.	Cardiff (Ely)	4.65	+ 1.67	1.01	27	17	...	...	...	...	...	...
XXIV.	Haverfordwest	4.33	+ 1.09	.93	23	25	57.8	17	27.8	18	4	15
XXV.	Aberystwith (Gogerddan) ...	5.16	+ 2.18	.81	23	18	55.0	25	21.0	3	15	...
XXVI.	Llandudno	3.47	+ 1.39	.47	24	21	...	...	...	...	...	...
XXVII.	Cargen [Dumfries]	3.22	- .08	.68	23	13	57.8	21	25.8	3	7	...
XXVIII.	Jedburgh (Sunnyside) .....	...	...	...	...	...	...	...	...	...	...	...
XXIX.	Colmonell	4.16	...	.73	8	20	59.0	22	25.0	2	5	...
XXX.	Lochgilphhead (Kilmory)	4.42	- .04	.74	23	20	...	...	21.0	2, 3	13	...
XXXI.	Mull (Quinish)	4.25	+ .41	.86	24	16	...	...	...	...	...	...
XXXII.	Loch Leven Sluices	3.60	+ .63	.80	28	12	...	...	...	...	...	...
XXXIII.	Dundee (Eastern Necropolis)	2.30	- .10	.85	27	17	58.9	21	25.0	3	11	...
XXXIV.	Braemar	2.29	- .35	.77	28	16	49.2	21	13.8	12	18	24
XXXV.	Aberdeen (Cranford)	4.04	...	1.07	28	21	58.0	16 ^c	24.0	2	11	...
XXXVI.	Strathconan [Beaully]	4.22	- .10	1.00	29	9	...	...	...	...	...	...
XXXVII.	Glencarron Lodge	8.91	...	1.04	23	26	52.8	22	18.0	2	9	...
XXXVIII.	Cawdor [Nairn]	4.18	+ 2.14	1.21	28	21	...	...	...	...	...	...
XXXIX.	Dunrobin	2.92	+ .67	.45	28	22	55.5	16	30.0	1	4	...
XL.	S. Ronaldsay (Roeberry).....	1.85	- .69	.24	20	26	50.0	16	22.0	2	8	...
XLI.	Darrynane Abb-y	4.47	...	.93	23	22	...	...	...	...	...	...
XLII.	Waterford (Brook Lodge) ...	3.33	+ .43	.84	23	14	60.0	21	27.0	5, 7	3	...
XLIII.	O'Briensbridge (Ross)	4.33	...	.84	23	18	...	...	...	...	...	...
XLIV.	Carlow (Browne's Hill)	3.48	+ 1.11	.57	24	18	...	...	...	...	...	...
XLV.	Dublin (Fitz William Square)	2.75	+ .74	.57	27	19	58.7	16	29.5	13	5	10
XLVI.	Ballinasloe	3.27	+ .64	.64	27	19	57.0	16	24.0	4 ^d	12	...
XLVII.	Clifden (Kylemore)	9.65	...	1.70	7	21	...	...	...	...	...	...
XLVIII.	Waringstown	3.34	+ .99	1.10	27	21	60.0	17 ^b	25.0	4 ^e	10	19
XLIX.	Londonderry (Creggan Res.)..	3.61	+ .88	.65	20	27	...	...	...	...	...	...
L.	Omagh (Edenfel)	3.50	+ .99	.49	27	26	54.0	23	25.0	4	8	13

a And 24. b And 22. c And 21. d And 12, 13. e And 13.

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

METEOROLOGICAL NOTES ON MARCH, 1895.

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.

STRATHFIELD TURGISS.—March opened with changeable weather, with showers of sleet and S, and with a low mean temp. Towards the middle of the month the weather became more genial, but the end of the month was very unsettled, with heavy gales of wind. Snowdrop in flower on 1st, palm blossom on 7th, daisy in flower on 16th, humble bee first seen on 22nd.

ADDINGTON.—The first fortnight cold, afterwards milder and a few fine days. From the 24th until the end the bar. was very low, and a heavy gale occurred on the 24th, its greatest violence being between 1 p.m. and 2 p.m. A great deal of damage was done—many trees uprooted, and others wrenched in two at heights ranging from three to 15 feet from the ground, much injury also to buildings and stacks.

BURY ST. EDMUNDS.—A favourable month generally, with little east wind. Remarkable for the very severe gale of Sunday, the 24th. The wind had been rough all the morning, but began to blow violently about 2 p.m., and continued tremendous till 3.30 p.m., when it gradually subsided. The greatest force of the gale was about 2.55 p.m. The corn stacks had the tops blown off, and sheaves of corn were carried a great distance; straw stacks suffered much, and slates and tiles went in all directions; many fine trees had their tops blown off. A remarkable cloud of a yellow red colour, which appeared to be at least 10 miles in length, was formed in the North by the sand blowing off the light lands. I consider this the heaviest gale in Suffolk since 1857, when I first reported to you. S on 2nd, 3rd, and 4th.

NORWICH, BRUNDALL.—The fine weather of the middle fortnight brought up the month's mean temp. to slightly above the average. The devastating hurricane on the afternoon of the 24th—the most severe on record in these parts—will make the month a memorable one. S daily from 1st to 5th.

LANGTON HERRING.—The mean temp. at 9 a.m. 40°·8 is 0°·7 below the average of 24 years. The dense fogs on the 22nd, 23rd and 24th were the most notable feature of the month; fogs occurred also on the 9th, 15th, and 27th. L on the night of the 23rd. A very high wind on the 24th, which, however, did no damage in this neighbourhood. Solar halo on the 11th.

TORQUAY, CARY GREEN.—Rainfall ·12 in. above the average; wet days exactly the average. Mean temp. 43°·8 or 1°·2 above the average. Amount of sunshine 151 hours 20 minutes, being 2 hours above the average; three sunless days.

POLAPIT TAMAR.—Rather wetter than March usually is, and an absence of the characteristic bleak east wind that usually prevails. S on 3rd.

STROUD, UPFIELD.—About half an inch of S on the ground on 2nd, and S showers on 3rd and 4th. Aurora seen at 8.30 p.m. on 13th. S.W. gale on 24th, greatest force apparently from noon to 1 p.m.; many forest trees blown down; S.W. gale also on 28th.

WOOLSTASTON.—The early part of the month was cold, with frost nearly every night, and S fell on the 2nd. The last fortnight was more genial. A heavy gale raged on the 24th, which became a terrific hurricane about 1 p.m., uprooting trees, levelling stacks, and blowing down chimneys in all directions, in the course of about 10 minutes. Severe storms of H occurred the same evening. Mean temp. 41°·7.

TENBURY, ORLETON.—A fairly favourable month; cold and dry till the 19th, then much warmer with frequent R to the end. Great gale on 24th, doing an immense amount of damage, and L at night. S on 2nd and 3rd. The temp. reached 50° on 11th, for the first time since December 26th.

LEICESTER, BARKBY.—A cold and wet month, except for a few days in the middle. Fearful hurricane, doing much injury, with R, L and T, for nearly three hours on 24th. Mean temp. 41°·2.

HESLEY HALL.—Heavy gale, with T, L and H on 24th. Frost on 11 out of the first 17 days; none after.

MANCHESTER, PLYMOUTH GROVE.—S on 3rd, and S and sleet on 5th. Dense fog on 18th; thick fog and wet mist on the 7th. Very stormy weather on 24th and 25th, with T and L.

WALES.

HAVERFORDWEST.—A fall of S on the 3rd, covering the ground, was followed by a couple of days' hard frost; continuous R then set in until the 15th, but although R fell on 25 days or nights, yet there were a great many hours of bright sunshine and fine weather; these factors, taken together with the sharp night frosts, combined to bring the land into a favourable condition for ploughing and sowing. The weather became unsettled, cold and stormy from the 18th, and in the night of the 23rd a strong gale arose, and a terrific squall at 11 a.m. on 24th in a few minutes unroofed houses, and blew down trees, and nearly took several persons off their feet. Squally wintry weather continued to the end of the month.

GGERDDAN.—Very stormy and cold throughout the month, with very little sunshine.

SCOTLAND.

CARGEN.—A dull, sunless month. Duration of sunshine only 82 hours, the average for 36 years being 128 hours. The mean bar. reading also is exceptionally low, 1861 and 1876 being the only years with a lower mean for March. The changes of both temp. and pressure were great and sudden. Owing to the long continued frost which lasted almost uninterruptedly for ten weeks from December 29th, 1894, to March 9th, 1895, vegetation is unusually backward.

COLMONELL.—Rainfall '96 in. above the average.

ROEBERRY.—Mean temp. 39°·6.

IRELAND.

DARRYNANE ABBEY.—On the whole a wet but mild month, with some very fine, warm days in the middle.

WATERFORD, BROOK LODGE.—Mean temp. 44°·3. T on 25th and 30th. H on 24th and 30th. The Comeragh, Carlow and Wexford mountains were covered with new S on the 3rd.

O'BRIENSBRIDGE, ROSS.—More than average R for March, with very cold and wintry weather, especially at the close of the month. Great storm on 24th and 25th, with much L and T. Vegetation late.

DUBLIN.—A changeable, dull and rather rainy month. The cold weather which had prevailed through January and February lasted until the 13th, when the ther. touched 50° in the shade, for the first time since December 25th, 1894. A mild spell followed, continuing to the 24th, after which temp. fell again, and remained below the average to the end of the month. Mean temp. 44°·1, one degree above the average. Fog on 6 days. High winds on 13 days, reaching the force of a gale on the 23rd, 24th and 28th. S or sleet fell on 4 days, and H on 6 days. The temp. exceeded 50° in the screen on 13 days. Brilliant aurora borealis on the 13th. L on the 24th.

EDENFEL.—The month was generally stormy, rainy and unsettled, with little frost or S, but more R than was suitable for the prosecution of farm work, already extremely backward from the prolonged and severe winter.