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THE CLIMATE OF TONQUIN.

(Translated from *Ciel et Terre.*)

FROM May to September Tonquin is a truly tropical country, hot among the hottest, and very rainy. May and June are the most distressing, the sun is in the zenith, and the heavy rains have not come to cool the air. (In June, 1885, the temperature was $98^{\circ}\cdot5$ by day and from 95° to 97° at night.)

All through the summer physical exertion is impossible, and intellectual labour difficult. One is drowsy, overcome by the damp heat, deluged with perspiration, which there is no evaporation to relieve; the punkah is a necessity, and repose can only be obtained after repeated cold ablutions. One must not think of going out except in the early morning hours, or from 5 to 7 p.m.

The cataracts of water which fall during the burning nights of July scarcely freshen the atmosphere. During the hottest season, the difference between day and night is rarely more than 7° . "At Nam-dinh," says Dr. A. Lejeune, "during July, 1884, it was between 91° and 93° at 11 p.m. each day."

During the first fortnight of August it was still very hot (max. $92^{\circ}\cdot3$, min. $76^{\circ}\cdot1$). Towards the end of that month the mornings are fresh and the nights bearable.

During September a cyclone usually marks the end of the hot season, the mornings then become about 2° cooler; no great difference, but still very acceptable to those who have borne the summer.

In October, northerly and north-westerly winds produce true autumnal weather, the temperature becomes a tonic, a brilliant sun adorns an azure sky, while the mountains become deep violet; intellect, which has been drowsy during five months, awakens, and work can be resumed with pleasure.

Winter begins with November; one can hunt, ride on horseback, and make long excursions; the nights are fresh, the temperature falls to 61° , while brilliant sunshine prevails. The rains are over, and this is a dry month, with only a few fine rains or mists floating half-way up the mountains.

The early part of December is similar, but towards the end the sky is more often overcast, rain is more frequent, the temperature may fall to 50°, and fires in the rooms are welcome.

January is the coldest month of the year, fires are general, temperature is variable, and woollen clothing is necessary.

February is characterized by constant and penetrating mists, fires are needed to dry oneself and the wet streams down the walls. Boots or other articles of leather are covered with mould in a single day.

March is variable, but warmer, with an overcast sky, and exertion becomes irksome.

April is very damp, and the heat increases so that by the 25th the S.W. wind is fully established, and the burning tropical monotony again prevails.

To sum up, a European will find in Tonquin :—

Five good months—November to the end of March.

Five bad „ May to the end of September.

Two passable „ April and October.

IS TERRESTRIAL MAGNETISM CONCERNED IN ATMOSPHERIC MOVEMENTS ? *

From the "Electrical World" (New York), August 27th, 1887.

BY M. A. VEEDER.

THE present paper is the result of an attempt to collate certain facts observed in reference to auroras, thunder-storms and solar conditions. Each day a drawing representing the condition of the sun has been made, and upon the same page information in regard to the phenomena in question occurring on that day has been recorded as soon as received. The writer has pursued this or similar methods for several years. It would be impossible within brief limits to give any adequate synopsis of the mass of information thus secured. It is not therefore the purpose of the paper to discuss the subject fully, or to answer all or even the more important questions that will naturally suggest themselves, but rather to suggest methods of study that will be found to be fruitful.

As the result of the extended series of observations described, it has been found in general that whenever groups of faculæ with or without dark spots are appearing by rotation, or are bursting forth upon the earthward side of the sun, there is an immediate increase in thunder-storms in the lower latitudes, and probably of auroras in the higher latitudes. If, however, the aurora becomes visible nearer the equator, at such times there is an immediate, though perhaps temporary, decrease in thunder-storms, as though the aurora had taken their place. In short, the aurora and thunder-storms appear to have a common origin, and in certain localities at least a reciprocal relation to each other. Instances have been

* Read before the American Association for the Advancement of Science, New York, August, 1887.

noted also in which an aurora in the United States has been coincident with unusual electrical storms in Europe, and *vice versa*.

The relation between the various phenomena is such that if an increase of thunder-storms or auroras is noted, faculæ coming into view by rotation or bursting forth elsewhere upon the sun may be looked for with confidence. On the other hand, the appearance upon the sun of bright faculæ betokens an immediate increase in the electrical phenomena attending the storms which may be prevailing at the time anywhere on the face of the earth, unless an aurora should intervene, as has already been noted.

In general, the disturbed solar and terrestrial conditions increase or diminish in like ratio. The curious fact has been noted, however, that a single disturbance occupying the sun's disc alone, seems to have a more marked effect than a succession of such disturbances, as though variability of tension, rather than the maintenance of high tension, were most concerned in the production of the phenomena in question. Aside from this, and as a rule, however, there is an evident proportion between the extent of the disturbances on the sun and those on the earth. Neither auroras nor thunder-storms become universal, but are distributed in accordance with laws which it is not proposed to discuss at present. The point is that, under known limitations and in definite localities, there is an increase in these phenomena whenever the solar conditions are favorable, and no such increase has been noted at any other time.

As is the case with auroras and thunder-storms, the disturbances of earth currents known as magnetic storms are subject to limitations and do not prevail with equal intensity at any one time over the entire surface of the globe.

It is evident from these considerations that the phenomena in question can be adequately studied by securing information in reference to them from localities that are favorably situated only. To attempt the study of auroras and their attendant magnetic phenomena within the tropics, and of thunder-storms within the polar regions, would, for example, lead for the most part to negative results. Moreover, the various conditions that have been described are not always equally well defined in localities that are most favorably situated. Frequently the problem that presents itself is extremely complex. In the middle latitudes and during a single season it is not difficult, nevertheless, to find numerous instances that are so strongly marked that the most ordinary sources of information are sufficient to corroborate very fully the statements that have been made. It was much easier to do this with fulness and accuracy when the Signal Service authorities were making a more complete report of thunder-storms than is published in the *Monthly Weather Review* at present.

The forces manifest in thunder-storms and auroras being of the character and having the origin that has been described, the question arises as to whether these forces are concerned also in the production

of the movements of the atmosphere with which they are associated.

In the case of thunder-storms it is difficult to determine whether the electrical forces are simply superadded to ordinary storms or whether they are really concerned in the movements of the atmosphere, which are, as a rule, in progress at such times. It will be better to consider the case of auroras first, the conditions of the problem being much simpler.

By comparing the record of different years it becomes apparent that certain atmospheric movements increase or diminish in direct proportion to the number of auroras and their associated phenomena. Thus, during the spring and summer of 1886 there was a recurrence of brilliant and widespread auroras at intervals closely approximating the time of the rotation of the sun on his axis. Telescopic observation also revealed the fact that one side of the sun was much more disturbed than the other. Thus the conditions for these observations were well-nigh perfect. In close relation with the successive auroras and disturbed solar conditions then existing, there were powerful surgings to and fro of the atmosphere, as is shown most readily by the sudden and extreme changes of temperature. Thus "The Ice Saint's Festival" in May, 1886, was made the subject of articles in *Nature* and other publications because of the period of cold from the 12th to the 15th of the month, following severe storms in the United States and Europe. On June 6th again there was frost along the northern border of the United States. On July 9th there was a flurry of snow in Poquosue township, Virginia. On August 3rd there were snows and frosts in Central New York and in New England, and on August 31st there were severe frosts in the Upper Mississippi Valley. At each date mentioned there had been a brilliant aurora a few days preceding and a period of characteristic storms. The record for a similar period in 1887 presents a very marked contrast. During this year there has been no such recurrence of auroras as there was in 1886. Solar disturbances have not been wanting, but they have been less active and more uniformly distributed on all sides of the sun. Coincidentally the movements of cyclones and anti-cyclones have been less energetic, and the temperature has remained very steady as compared with 1886. Indeed, the season has been remarkable for persistent elevation of temperature over extensive areas in the United States and Europe. If the heating up of local areas, either continental or oceanic, were the proximate cause of the atmospheric movements in question, they ought certainly to have been more energetic in 1887 than in 1886, which has not been the case. There has not been entire calm, but such atmospheric perturbations as have occurred, although less violent and less extensive, have been associated with solar and terrestrial conditions similar to those which were so well defined in 1886.

It is probable, to say the least, that the variations in terrestrial magnetism which accompany auroras, and perhaps, likewise, the

related electrical phenomena which accompany thunder-storms, are in some way concerned in the larger movements of the atmosphere which cause sudden and extreme oscillations of temperature over wide areas. In winter the same relations may be traced, although not so clearly as in summer; "blizzards," as they are called, taking the place of thunder-storms. At any season the continuity of these movements appears to be broken up by a succession of impulses of the character indicated, the influence of a single well defined solar disturbance being more clearly traceable than that of a succession of such disturbances.

In short, auroras, thunder-storms and the solar conditions described, bear such relations to each other, and to storms having a steep temperature gradient, that it seems probable that the associated magnetic and electrical forces may in some way be concerned in the production of the atmospheric movements in question. If, after the facts have been sufficiently collated, it shall be found that the conclusions here suggested are justified, they may perhaps become available for purposes of weather prediction, or perhaps may be the means of showing why such predictions in certain instances are almost sure to fail. During 1886 there was, as has been shown, a periodicity of characteristic storms, continuing for several months, while during 1887 for a similar period the conditions were much more vague and ill-defined. In the one case, weather prediction might perhaps have been possible so far as the general character of the storms liable to occur was concerned, while in the other case there was no possibility of even this.

Something will have been gained, however, if the precise reason why the prediction of thunder-storms must, as a rule, fail, shall have been ascertained.

REVIEWS.

Weather Charts and Storm Warnings. By ROBERT H. SCOTT, M.A., F.R.S., Secretary to the Meteorological Council. With numerous illustrations; 3rd edition; revised and enlarged. London: Longmans, 1887. Sm. 8vo., viii-229 pages.

It has always seemed to us that editors are wrong in their general practice of not giving more than scant notice to any editions of a book except the first. When an edition differs from its predecessor chiefly in the date on the title page, the general practice is undoubtedly correct and wise; but when an author has largely revised, perhaps nearly re-written, his book, it is very hard that because it retains its old title it is to pass unnoticed.

To judge from the space devoted to barometric diagrams and weather charts in the newspapers of the present day, there must be tens of thousands of persons interested in the subject. So much the better for Mr. Scott and his publishers, for evidently no one else is in so good a position as he is for treating on *Weather Charts and Storm*

Warnings. The work commences by explaining what information is collected, and then proceeds to show how it is utilized. Here, however, we come upon a sentence, concerning which we must say a few words as we entirely disagree with it. The author is pointing out that the returns received by the office are, as regards time, not nearly frequent enough ; *with that we heartily agree*, but then he goes on to say :—

“Our own Meteorological Office, however, can only afford one at 8 a.m. from most of our stations, and at best we only get additional reports at 2 p.m. and at 6 p.m. from a limited number of places.”

We are sure that Mr. Scott does not so intend it, but to us this reads as a distinct libel upon John Bull. Here are the facts, from the *Report of the Meteorological Council* up to March, 1886—“Parliamentary Vote, £15,300”; Expended upon “Weather Information and Forecasts, £4,587 5s. 0d.” John Bull pays handsomely. The Meteorological Council spend more than two-thirds of the grant upon other objects, and then we are told that the office “can only afford, &c.” The words should be, The Meteorological Council are willing, however, to pay for only, &c.

The middle of a short notice like this is not the place to pronounce any opinion upon the merits or otherwise of the Forecasts issued by the office, and we do not do so, but we may point out that in the table on p. 167 something approaching to injustice to the office, or at any rate remarkable self-abnegation, is shown. It is a matter of calculation, and therefore we must reprint the table. The author has been discussing the proportion of successes scored by the official forecasters, and says :—

“The forecasts have been issued and checked regularly since the beginning of the year 1879, and the following are the figures of the summary for the entire period of seven years, under the same headings as those just given :—

Years.	Complete success.	Partial success.	Partial failure.	Total failure.	Total success.
1879	28	47	20	5	75
1880	35	40	16	9	75
1	34	44	16	6	78
2	44	35	13	8	79
3	48	33	11	8	81
4	51	31	11	7	82
1885	51	32	11	6	83

It will be seen that here the “total success” in the last column is the sum of the per centages of “complete success” and “partial success,” *e.g.*, in 1879—

Complete Success	28
Partial Success	47
Total Success.....	75

We think that a fairer plan would be to allow only half the value to the "*partial successes*," then we should have for the same year, 1879,—

Complete Success	28
Partial Success	$\frac{47}{2} = 23\frac{1}{2}$
<hr/>	
Total Success	51 $\frac{1}{2}$

And a similar plan should be adopted with respect to the failures. The following table shows the result:—

	Total success.		Partial success. Partial failure.		Total failure.		T.S. T.F.
1879	51 $\frac{1}{2}$	.....	33 $\frac{1}{2}$	.....	15	.....	3.4
1880	55	.....	28	.....	17	.....	3.2
1	56	.....	30	.....	14	.....	4.0
2	61 $\frac{1}{2}$	.....	24	.....	14 $\frac{1}{2}$	.....	4.2
3	64 $\frac{1}{2}$	.....	22	.....	13 $\frac{1}{2}$	.....	4.8
4	66 $\frac{1}{2}$	.....	21	.....	12 $\frac{1}{2}$	.....	5.3
1885	67	.....	21 $\frac{1}{2}$	.....	11 $\frac{1}{2}$	.....	5.8

This shows that, according to their own figures, the forecasts in 1879 and 1880 were not very valuable ; but it shows far more plainly than the other table how much they have improved ; in the one their successes are represented as having improved from 75 to 83, or by one-tenth, whereas really they have improved from 51 $\frac{1}{2}$ to 67, or by nearly one-third. The most striking result is that given by the last column, in which the total success of each year is divided by the total failure, and (except for 1880) this shows an almost regular improvement in each successive year ; the successes used to be about three times as numerous as the failures ; they are now, according to the data given, nearly six times as numerous. In fact, if the Meteorological Council have been regarding the progress of their forecasters according to the table we have quoted, they may thank us for re-working it and putting the matter in a form so much more complimentary to the office.

The chapter devoted to "The Weekly Weather Report" deals with the ill-understood question of cumulative temperature and would have been greatly improved by half-a-dozen values being worked out as examples.

As regards accuracy, the work is wonderfully near perfection ; the best proof of which is that the only errors we have noticed are that Dr. Meldrum is twice mentioned as Mr. Meldrum, and that the reference on p. 129 should be to p. 236 not to p. 351. Of how many books of 238 pages could as much be said ?

Ueber die Jährliche Periode der Richtung des Windes. Von. Prof. DR. F. AUGUSTIN. 2 parts. (Aus den Sitzungsber. d. k. böhm. Gesells. d. Wissenschaften). Prag 1886-87. 8vo. 22 + 34 pp. and 1 plate.

EVEN if we for a moment ignore entirely the *thought* which the author has bestowed upon the observations collected in these two

pamphlets, it is still our duty and our pleasure to thank him for the *labour* which he has expended in epitomising thousands on thousands of years of observations upon the direction of the wind. Like all his countrymen he is most careful to give the authority for every statement, and though he begins with a general statement of indebtedness to Buchan, Coffin, Dove, Hann, Mohn, Supan, and Wojekov, he speedily brings in Kaemtz, Schouw, Ragona, Stelling, Blanford, Köppen, Hellmann, and many others. This string of names sufficiently indicates the authenticity of the data, and the mass of materials with which the author has dealt.

Dr. Augustin points first to the Monsoons as direct proof of the dependence of periodic winds on the change of the sun's declination, and then sets to work to see to what extent similar indications of influence can be traced in higher latitudes. As a specimen of the compactness of the whole of the two papers we reprint in *fac simile* the data for a British station, Milbrook in the Isle of Jersey.

N. N.E. E. S.E. S. S.W. W. N.W.

Milbrook 49° 12' N. 2° 7' W. 4 J.

W.	5	12	7	12	19	21	16	8
F.	6	20	13	8	14	{19	14	7
S.	5	19	6	4	11	20	24	10
H.	3	17	10	8	16	23	15	8

This does not need much explanation, except, perhaps, that 4 J after the longitude means 4 Jahre, *i.e.*, mean of four years' observations, and W., F., S., H. stand respectively for winter, spring, summer, and autumn. The heavy type shows in which of the four seasons each wind is most frequent—for instance, the N., N.E., and E. all have their max. in the spring (as most of us know to our cost.)

There are 40 or 50 such tables for *selected* stations in all parts of the world, *e.g.*, Australia and Algeria, Siam and New Orleans. Then the author goes more closely into details, and gives the values for each *month* as well as each season, and there are 50 of them, besides other tables, scattered through the papers.

Dr. Augustin, from the consideration of this immense mass of data, arrives, among others, at the conclusions: (1) that the E. and N. coasts of both hemispheres have a seasonal influence deflecting the winds towards the right, and the W. and S. coasts one drawing towards the left; (2) that the wind in summer has a tendency to back from E. through N. to W., and in winter the reverse. We may very possibly be wrong, but the impression left upon our mind is that the evidence is not so accordant as one would have wished, though considering the ridiculous position of many anemometers and observatories it is perhaps all that could have been expected. One other subject may be mentioned. The apparent variation in prevalent wind direction largely depends on the trajectory of depression centres. We may have overlooked remarks upon this subject—at any rate, we

have not seen them—and so we seem to feel that the papers would have been all the better for the fusion with the excellent statistical meteorology of a little cyclonic. Be that as it may, Dr. Augustin has done a good piece of work ; we shall be glad to see some Englishman turn out something equally solid.

STORMS OCT. 29TH TO NOV. 3RD.

To the Editor of the Meteorological Magazine.

SIR,—I send you a few notes on the storms of the past week. There were great fluctuations of barometric pressure. The bar. (corrected to 32° and M.S.L.), fell from 29·751 in. at 10.45 a.m. on October 29th to 28·900 in. at 1.50 a.m. on the 30th, rose (very rapidly till 4 a.m.) to 29·590 in. at 7 p.m., fell to 29·540 in. at 4 a.m. on the 31st, rose to 29·768 in. at 6 p.m., fell rapidly to 29·040 in. at 8.40 a.m. on November 1st, rose to 29·305 in. at 4.45 p.m. on the 2nd, and fell to its lowest point, 28·740 in., at 11 p.m. on the 3rd. The greatest hourly ranges were : in falling, 0·126 in. from 11 to 12 p.m. October 29th ; and rising, 0·160 in. 2 to 3 a.m. October 30th.

The wind backed from W., at 7 a.m. 29th, to E.S.E. at 8 p.m., and blew stiffly between E.S.E. and S.S.E. till midnight, it then veered to a moderate breeze from S. at 1 a.m. on 30th ; rose to a strong N.N.W. gale from 1.45 to 2.15 a.m., was squally (from a moderate to strong breeze) from W.N.W. to W.S.W. from 5 a.m. 30th, to 4 p.m. 31st ; backed to a light S.S.W. breeze at 6 p.m., rose to a strong S.S.W. gale in a squall at 11.50 p.m., fell to a moderate breeze at midnight on the 31st ; rose to a heavy southerly gale from 6 to 9 a.m. November 1st, attaining the force of a storm (11) in the squalls, which did much damage to trees and roofs. The sea and tide were very high at this time, and did much injury to the Torquay New Pier. The wind then lulled and veered to S.W. at 10 a.m., and varied between moderate to light S.W. to W. breezes till 7 p.m. on 2nd, when it backed to S.S.W. ; it increased to a S. gale from 10 to 11 p.m., and blew a whole gale from 11.37 p.m. to 0.15 a.m. on the 3rd, veering to S.S.W. at midnight on the 2nd ; at 1 a.m. on the 3rd it lulled to a strong S.W. breeze, but rose to a gale at times during the rest of the day. The max. hourly velocities registered by the anemometer (at 41 ft. above ground, and rather sheltered from S. and N. to W.) were 49 miles (from S.) from 7 to 8 a.m. November 1st, and 42 miles (from S.) from 11 to 12 p.m. on the 2nd.

R fell from 4.50 p.m. October 29th (heavily from 7.50 to 11.22 p.m.) to 2.30 a.m., and showers from 9.20 a.m. to 5.35 p.m. 30th, and from 8 a.m. 31st, to 2.30 a.m. November 1st, then R (mostly heavy) from 3 to 8.25 a.m., showers to 4.55 p.m. (with H at 1.30 p.m.) 1st, and up to 5.10 p.m. 2nd, and R from 8.45 p.m. 2nd, to 0.35 a.m. 3rd, and showers from 1 a.m. to 11.10 p.m. (with

H at 7.30 a.m. and 5.2 p.m.) The heaviest R falls in this period were 1.25 in. on October 29th, 0.79 in. on October 31st, and 0.53 in. on November 2nd.

The temp. varied from a min. of $39^{\circ}5$ on October 30th, to a max. of $54^{\circ}6$ on November 2nd.

L was seen on the evening of the 3rd.

I am, yours truly,

EDWIN E. GLYDE.

Kirkham, Babbacombe, Torquay, Nov. 7th, 1887.

CHILL OCTOBER.

To the Editor of the Meteorological Magazine.

SIR,—I learn from the *Bath Chronicle* of November 3rd that the last month was the coldest October known in Bath for more than 20 years, or as long as meteorological observations have been taken at the Literary and Scientific Institution.

The point reached on Wednesday, the 26th, $24^{\circ}6$ F., was lower than any temperature previously recorded for that month, and the mean temperature, $45^{\circ}8$ F., was below that of any October during the same period.

I am, Sir, yours faithfully,

J. BYRON, F.R.MET.SOC.

15, Bennett Street, Bath, Nov. 5th.

The following table shows that at Camden Square, October, 1887, was the coldest for 29 years; the mean temperature at 9 a.m. and the absolute minimum being the lowest recorded for the month, and the absolute maximum the lowest with two exceptions.—ED.

OCTOBER.	
Mean temp., 9 a.m., 1859-87	$50^{\circ}1$
„ „ 9 a.m., 1887	$44^{\circ}7$
Difference	$-5^{\circ}4$
Minimum temp., 1887.....	$25^{\circ}4$
Lowest previously recorded	$26^{\circ}2$ in 1873.
Maximum temp., 1887	$63^{\circ}6$
Lowest previously recorded }	$60^{\circ}9$ in 1885.
	$63^{\circ}4$ in 1881.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, APRIL, 1887.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days	
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	0-100	°	°	inches		0-10
England, London	68·2	19	26·2	17	55·1	36·4	39·2	83	113·4	21·8	1·41	10	5·4
Malta.....	72·7	22	45·0	2	65·6	52·7	52·0	79	133·9	38·9	1·17	9	4·5
Cape of Good Hope ...	87·9	4	40·0	30	73·7	51·0	...	81	...	...	2·13	5	4·0
Mauritius.....	81·3	5	63·9	25	79·1	69·7	66·2	77	133·6	54·4	2·91	17	5·0
Calcutta.....	102·0	21a	68·2	9	93·1	74·1	70·8	60	155·6	60·4	·89	3	1·7
Bombay.....	93·5	14	73·5	1	87·4	76·6	73·5	76	146·7	62·7	·02	1	1·4
Ceylon, Colombo	91·7	2	68·8	28	87·5	75·0	72·3	78	148·0	65·5	23·80	24	6·5
Melbourne.....	90·6	2	41·3	30	68·2	51·2	51·5	76	139·0	36·3	4·84	13	5·3
Adelaide	94·5	2	47·1	16	73·2	55·5	48·5	56	143·6	35·7	2·08	6	4·4
Wellington .....	...	...	...	...	...	...	...	...	...	...	...	...	...
Auckland	73·0	1	48·0	27	69·3	56·9	56·6	80	131·0	35·0	1·98	12	6·0
Falkland Isles.....	...	...	31·8	14	...	36·4	40·7	90	108·0	25·8	2·23	21	6·7
Jamaica, Kingston.....	90·8	21	65·6	5	87·3	68·5	69·4	74	...	...	1·84	...	...
Barbados	82·0	27	67·0	6	80·0	70·0	66·0	70	148·0	...	·58	6	7·0
Toronto	71·1	10	20·0	5	48·4	30·5	30·6	70	...	10·8	1·61	11	6·3
New Brunswick, } Fredericton	63·7	10	— 2·0	1	45·3	25·5	24·7	60	...	...	3·61	11	5·0
Manitoba, Winnipeg } British Columbia, }	74·8	30	— 9·0	4	47·1	23·6	29·0	69	...	...	1·14	10	5·1
Victoria	59·0	5	29·0	3	53·0	39·3	...	...	...	...	·76	11	...

a And 22.

REMARKS, APRIL, 1887.

MALTA.—Mean temp. 58°·2; mean hourly velocity of wind 10·2 miles. Sea temp. rose from 60°·0 to 63°·5. TSS on 14th and 22nd; H on 9th. J. SCOLES.

Mauritius.—Mean pressure 30·046 in., ·037 in. above average. Mean temp. of air 1°·9, of dew point 1°·8, and rainfall 2·10 in. below their respective averages. Mean hourly velocity of wind 10·1 miles; extremes 29·3 miles on 20th, and 0·0 mile on 23rd and 24th; prevailing direction E.S.E. No T or L. Fine sky-glows after sunset almost every evening after 8th. C. MELDRUM, F.R.S.

COLOMBO.—TSS on 19 days, T on one other day. L on 4 other days. F. C. H. CLARKE, LT.-COL. R.A.

Melbourne.—Mean temp. of air 0°·8, of dew point 2°·0, mean pressure 0·100 in., rainfall 2·61 in. and humidity 3 above their respective averages; mean amount of cloud 0·6 below the average. Prevailing wind W.; strong breezes on 3 days. TSS on 2nd and 9th; L on 1st; heavy dew on 12 days. R. L. J. ELLERY, F.R.S.

Adelaide.—Rainfall ·49 in., and mean pressure ·068 in., above the average; mean temp. about the average. C. TODD.

AUCKLAND.—A fine warm month, with rainfall not half the average, and pressure unusually high. T. F. CHEESEMAN.

KINGSTON.—Rainfall ·65 in. above the average. MAXWELL HALL.

BARBADOS.—Pressure steady. Mean temp. (74°·2) 2°·0, and rainfall greatly below the average. Mean hourly velocity of wind 11·8 miles; one mile above the average. Two days were clouded. R. BOWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL, OCTOBER, 1887.

[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.			in.
II.	Dorking, Abinger	2·02	XI.	Castle Malgwyn	2·82
„	Margate, Birchington...	1·95	„	Rhayader, Nantgwillt..	3·11
„	Littlehampton	1·02	„	Carno, Tybrith	3·07
„	Hailsham	1·64	„	Corwen, Rhug	3·97
„	Ryde, Thornbrough	1·28	„	Port Madoc	4·80
„	Alton, Ashdell	1·55	„	I. of Man, Douglas	2·82
III.	Oxford, Magdalen Col...	1·96	XII.	Stoneykirk, Ardwell Ho.	1·94
„	Banbury, Bloxham	2·02	„	New Galloway, Glenlee	1·97
„	Northampton	1·68	„	Melrose, Abbey Gate...	1·41
„	Cambridge, Beech Ho...	1·47	XIII.	I. of Esk Res. [Penicuik]	2·55
„	Wisbech, Bank House..	2·02	XIV.	Ballantrae, Glendrishaig	1·89
IV.	Southend	1·13	„	Glasgow, Queen's Park.	1·57
„	Harlow, Sheering	1·66	XV.	Islay, Gruinart School..	2·37
„	Rendlesham Hall	2·57	XVI.	St. Andrews, Pilmour Cot	1·04
„	Diss	2·93	„	Balquhitter, Stronvar..	3·62
„	Swaffham	3·45	„	Dunkeld, Inver Braan..	·69
V.	Salisbury, Alderbury ...	1·33	„	Dalnaspidal H.R.S. ...	3·73
„	Warminster	2·26	XVII.	Keith H.R.S.	3·76
„	Ashburton, Holne Vic...	4·64	„	Forres H.R.S.	3·14
„	Holsworthy, Clawton...	...	XVIII.	Strome Ferry H.R.S....	5·84
„	Hatherleigh, Winsford.	4·31	„	Tain, Springfield .....	...
„	Lynmouth, Glenthorne.	4·17	„	Loch Shiel, Glenaladale	9·62
„	Probus, Lamellyn	4·58	„	S. Uist. Ardkenneth ...	2·08
„	Wincanton, Stowell Rec.	2·52	„	Invergarry	5·26
„	Taunton, Lydeard Ho ...	3·62	XIX.	Lairg H.R.S.	3·03
„	Wells, Westbury	2·96	„	Forsinard H.R.S.	3·44
VI.	Bristol, Clifton	2·48	„	Watten H.R.S.	2·49
„	Ross	2·28	XX.	Dunmanway, Coolkelure	4·76
„	Wem, Clive Vicarage ...	3·26	„	Fermoy, Gas Works ...	2·58
„	Cheadle, The Heath Ho...	2·16	„	Tipperary, Henry Street	2·26
„	Worcester, Diglis Lock	2·31	„	Newcastle West	1·33
„	Coventry, Coundon	2·05	„	Miltown Malbay	3·97
VII.	Melton, Coston	2·13	XXI.	Gorey, Courtown House	1·58
„	Ketton Hall [Stamford	2·11	„	Navan, Balrath	1·15
„	Horncastle, Bucknall ...	2·20	„	Mullingar, Belvedere ...	2·75
„	Mansfield, St. John's St.	1·91	„	Athlone, Twyford	2·46
VIII.	Macclesfield, The Park.	2·27	„	Longford, Currygrane...	1·78
„	Walton-on-the-Hill	2·75	XXII.	Galway, Queen's Coll...	3·49
„	Lancaster, South Road.	2·38	„	Clifden, Kylemore	5·39
„	Broughton-in-Furness ..	5·49	„	Crossmolina, Enniscoe..	4·36
IX.	Wakefield, Stanley Vic.	1·89	„	Collooney, Markree Obs.	2·47
„	Ripon, Mickley	3·36	XXIII.	Rockcorry	1·62
„	Scarborough, West Bank	3·16	„	Warrenpoint	2·16
„	East Layton [Darlington]	1·77	„	Newtownards .....	...
„	Middleton, Mickleton ..	1·21	„	Belfast, New Barnsley..	2·29
X.	Haltwhistle, Unthank..	2·24	„	Cushendun	1·83
„	Shap, Copy Hill	2·10	„	Bushmills	2·62
XI.	Llanfrechfa Grange	3·18	„	Stewartstown	1·48
„	Llandovery	2·91	„	Buncrana	3·54

OCTOBER, 1887.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						TEMPERATURE.				No. of Nights below 32°.			
		Total Fall.	Difference from average 1870-9	Greatest Fall in 24 hours.		Days on which '01 or more fell.	Max.		Min.						
				Dpth.	Date.		Deg.	Date.	Deg.	Date.					
I.	London (Camden Square) ...	inches	inches.	in.											
II.	Maidstone (Hunton Court)...	1.24	— 1.46	.61	29	9	63.6	8	25.4	26	7	15			
III.	Strathfield Turgiss	1.67	— .79	.67	29	10	...	...	...	...	...	...
III.	Hitchin	1.49	— 1.25	.74	29	12	62.2	8	19.6	26	10	16			
IV.	Winslow (Addington)	1.58	— .60	.69	29	13	58.0	8	24.0	25	13	...			
IV.	Bury St. Edmunds (Culford)	1.45	— 1.17	.82	29	11	62.0	28	21.0	22d	11	16			
V.	Norwich (Cossey)	2.59	+ .42	.75	29	15	62.0	8	24.0	21e	16	...			
V.	Weymouth (Langton Herring)	3.37	+ 1.04	.73	10	16	...	...	...	...	...	...
V.	Barnstaple	2.97	...	.98	29	11	60.0	2, 4a	29.0	25	4	...			
VI.	Bodmin	4.39	— 1.06	1.39	29	15	61.0	3	32.0	16	1	...			
VI.	Stroud (Upfield)	4.76	— 1.51	1.35	29	15	57.0	1, 2	48.0	4	2	9			
VII.	Church Stretton (Woolstaston)	2.61	— .40	1.20	29	9	58.0	29	26.0	25	7	...			
VII.	Tenbury (Orleton)	2.79	— 1.81	.69	9	15	57.5	4	28.0	26	4	15			
VII.	Leicester	1.92	— 1.32	.84	29	12	60.3	17	17.2	26	13	14			
VIII.	Boston	1.94	...	.94	29	14	60.0	4	23.6	22	7	21			
VIII.	Hesley Hall [Tickhill]	1.74	— .29	.92	29	12	59.0	7	24.0	22d	10	...			
IX.	Manchester (Ardwick)	1.75	...	.61	8	13	58.0	4	26.0	23	6	...			
IX.	Wetherby (Ribston Hall) ...	1.93	— 2.50	.46	8	13	55.0	2, 3	27.0	23	9	...			
X.	Skipton (Arncliffe)	1.94	— 1.42	.68	9	8	...	...	...	...	...	...
X.	Hull (Beverley Road)	2.57	— 4.69	.46	8	14	61.0	4	23.0	26	10	...			
X.	North Shields	3.29	+ .69	.81	8	15	60.0	8	28.0	26	5	8			
XI.	Borrowdale (Seathwaite)	3.23	+ .72	.86	14	14	61.5	3	27.5	26	5	7			
XI.	Cardiff (Ely)	7.89	— 8.66	2.02	26	15	...	...	...	...	...	...
XI.	Haverfordwest	3.01	— 2.22	1.14	29	11	...	...	...	...	...	...
XII.	Plinlimmon (Cwmsymlog) ...	4.39	— 2.06	1.21	27	17	58.7	3	26.0	26	3	12			
XII.	Llandudno	4.73	...	1.07	8	15	...	...	...	...	...	...
XII.	Cargen [Dumfries]	2.55	— 2.04	.84	9	14	59.1	4	31.8	26	1	...			
XIV.	Jedburgh (Sunnyside)	1.64	— 4.07	.36	28	10	60.6	1	23.6	12	10	...			
XIV.	Old Cumnock	1.42	— 1.25	.34	9	8	58.0	3, 4b	25.0	16	8	...			
XV.	Lochgilhead (Kilmory)	2.03	— 3.13	.47	30	11	59.0	1, 2	21.0	11	...	...	
XV.	Oban (Craigvarren)	3.11	— 5.21	.78	31	15	...	...	...	...	...	...
XV.	Mull (Quinish)	3.76	...	1.09	26	19	57.0	3	30.0	12	2	...			
XVI.	Loch Leven Sluices	4.97	...	1.34	31	20	...	...	...	...	...	...
XVI.	Arbroath	1.90	— 2.41	.60	27	6	...	...	...	...	...	...
XVII.	Braemar .....	.91	— 1.96	.36	9	7	61.0	3	30.0	12	5	...			
XVII.	Aberdeen	2.28	— 2.20	.56	12	16	58.7	4	26.0	16	11	24			
XVIII.	Lochbroom	2.73	...	.55	9	16	62.0	6	30.0	22e	4	...			
XVIII.	Culloden	4.42	...	.73	6	22	...	...	...	...	...	...
XIX.	Dunrobin	2.84	+ .55	...	...	...	58.0	3, 4	30.0	12	1	16			
XIX.	Kirkwall (Swanbister) .....	...	...	...	...	...	...	...	...	...	...	...
XX.	Cork (Blackrock)	4.52	...	1.66	6	27	53.9	4, 18	30.0	24	...	...	
XX.	Dromore Castle	2.69	— 2.05	1.38	31	8	66.0	7	26.0	24	3	...			
XX.	Waterford (Brook Lodge) ...	4.28	...	1.55	26	8	70.0	3	25.0	24	...	...	
XXI.	O'Briensbridge (Ross)	1.74	...	.74	31	7	63.0	1	27.0	25	2	...			
XXI.	Carlow (Browne's Hill)	2.23	...	.97	26	9	57.0	24	24.0	25	...	...	
XXII.	Dublin (Fitz William Square)	1.91	— 2.20	.71	31	9	...	...	...	...	...	...
XXII.	Ballinasloe	1.40	— 2.02	.63	31	11	59.7	27	33.4	11	0	12			
XXIII.	Waringstown	2.88	— 1.55	.77	31	11	56.0	1, 3c	28.0	26	9	...			
XXIII.	Londonderry (Creggan Res.) ..	1.97	— 1.64	.39	26	13	60.0	7	27.0	25	6	13			
XXIII.	Omagh (Edenfel)	3.06	...	.48	11	22	...	...	...	...	...	...
XXIII.	Omagh (Edenfel)	2.34	— 1.98	.38	11	16	57.0	1	28.0	...	...	...

a And 8. b And 20. c And 7. d And 26. e And 25.

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

METEOROLOGICAL NOTES ON OCTOBER, 1887.

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.—The commencement of the month was dry, and fine dry weather prevailed in the middle of the month with severe frosts and local fogs at night. The soil was very dry, and the streams were so low that millers were unable to work their mills full time. Gale on 29th.

ADDINGTON.—A very cold October, with sharp night frosts. A shade min. of 21° (which occurred twice) is a very rare occurrence. It was also very dry until the 29th, when heavy R fell. The ground was still very hard and dry at the close. From 2nd to 6th inclusive there was no sunshine. Fog on 9th and 18th. Aurora on 22nd. Ice half-an-inch thick on the lake on 26th.

CULFORD.—The month was very cold and winterly, with very high winds. S on 11th and 24th.

LANGTON HERRING.—On the whole a very fine month. Colder than any previous October for 15 years, the mean temp. being $4^{\circ}3$ below the average. The max. temp. (60°) was as low as any max. for October during 15 years, and the min. temp. (29°) is the lowest, with one exception (28° in 1881), during that period. On the night of the 29th a great storm occurred, with sudden fall of pressure. L on 10th, 11th, and 12th. Solar halos on 23rd and 29th.

BODMIN.—A very genial month, except at its termination. A heavy, but brief, S.W. gale on 30th.

WOOLSTASTON.—A severe spell of cold weather, lasting a week, set in on the 9th, on which and the two following days S fell heavily on the Shropshire hills. It became very cold again on the 24th, and the month closed with a tremendous gale on the night of the 31st. Mean temp. $44^{\circ}4$. A flock of wild geese passed over on the 9th.

ORLETON.—The rainfall till the 26th was very small, with much sunshine by day and frequent severe frosts at night, the temperature being generally very low. On the morning of the 26th the temperature fell to $17^{\circ}2$, which is the lowest registered here in October. The remainder of the month was unsettled and rainy. The mean temp. was $5^{\circ}6$ below the average of 26 years, and lower than that of October in any year except 1880. On the morning of the 10th the Cleve Hills, and other high hills, were covered with S. Pressure was generally very high and steady. The land continued very dry, and springs were very low at the close. L on 11th; fog on 5th, 6th, 18th, and 22nd.

BOSTON.—Very sharp frosts occurred on the 22nd and 26th, the canal being frozen over. S on 24th and 26th.

HULL.—A fine month on the whole. S on 11th, 23rd, and 25th.

WALES.

HAVERFORDWEST.—The first five days were fine and autumnal in character. Broken stormy weather followed from 6th to 14th, with much R, H, and L and a heavy fall of S on the whole of the Precelly range and the land about Wiston, which is about 400 feet above mean sea level. Fine autumnal, but cold, weather then prevailed for the next seven days, during which the pressure was high with N. and N.E. wind. The last seven days were stormy at times, cold and showery with, on some days, rather low temperature, and much R near the close. On the whole it was a very fine month, the R falling principally at night, and colder than usual. A terrific gale sprang up after midnight on the 31st, pressure at 8 a.m. on November 1st being 28.811 in. corrected.

SCOTLAND.

CARGEN.—A very cold month. The mean temp. ($44^{\circ}7$) being the lowest for October in 27 years, with the exception of October 1885 ($44^{\circ}0$). Pressure, until the last few days, was unusually high. N. and E. winds prevailed on 18 days, R 3.07 in. below the average of 27 years.

JEDBURGH.—Remarkably dry with a great deal of frost, which caused the fall of the leaf to be early and quick. Potatoes were lifted in good order, and free from all disease, and the cereal crops were all got in in good order.

OBAN.—The early part of the month was very fair, with a sudden change to extreme cold on the 8th, when S fell upon the hills at least four weeks earlier than usual. This lasted a week, and nearly all the autumn flowers were destroyed. Very disturbed weather prevailed after the 22nd. N. winds prevailed, and the mean humidity (72) was particularly low. Fine lunar rainbows were seen in N.W. at 8 to 9 p.m. on the 24th.

QUINISH.—Very fine until the 25th, thereafter very wet and stormy. Very heavy R (1·34 in.) on the 31st, with severe S gale at night.

ABERDEEN.—Rainfall somewhat below the average; sleet and S on several occasions.

LOCHBROOM.—With the exception of the first five days, which were beautiful, the weather was wild and wintry in the extreme. From the 9th to the 14th it was like the middle of winter, with S and sleet in the glens and severe frost, S and H on the heights. Thence to the end it was a mixture of all kinds of weather, with very few fine days. On the whole a very stormy month, more like February than the last month of autumn. Gale on 19th.

CULLODEN.—From the 10th to the 30th, with the exception of the 20th, the weather was fine. The frost on the nights of the 16th and 19th destroyed many tender flowering plants.

SWANBISTER.—Showery, but, on the whole, good for harvesting operations, being cold and windy. S on hills on 11th, 14th, and 15th. Fog on hills on 27th, 30th and 31st. H on 8th, 10th, 11th, and 14th.

IRELAND.

BLACKROCK.—Generally very fine and often bright, without R, except two showers, till the 22nd, thence frequent cold showers to the end. Mean temp. $47^{\circ}5$. Rainfall 1·34 in. below the average of 22 years. The rainfall of the year to October 31st (19·04 in.) is 16·32 in. below the average of 22 years, the fall having been deficient in every month.

WATERFORD.—But for the heavy rains after the 25th, the month would have been remarkable for its dryness. Mean temp. $46^{\circ}5$. H on 30th, S.W. gale on 31st. A few swallows seen on the 18th.

O'BRIENSBIDGE.—The finest possible weather up to the 26th, gave every facility for concluding harvest operations, and for the gathering in of an exceptionally good potatoe crop. The last six days were wild and squally; stormy on 29th and 30th, with some T and L and very low pressure.

DUBLIN.—For the most part and until towards the close a quiet, dull, cold month, with high pressure and scanty rainfall. There was a broken period from the 7th to the 12th. On the morning of the latter day the first S of the season fell. After the 25th the weather again fell into an unsettled, showery state, and on the night of the 31st a deep depression, advancing from the southwestward, brought a violent southerly gale and much R. The mean temp. ($47^{\circ}3$) was decidedly below the average ($50^{\circ}0$). In the preceding 22 years October was coldest in 1880 ($45^{\circ}4$) and in 1885 ($45^{\circ}5$). Solar halos on 20th and 29th. High winds on 7 days, attaining the force of a gale on 26th, 30th, and 31st. L on 10th; H on 9th; S on 12th. Shade temperature did not reach 60° on any day, while it fell below 40° on 12 days. The atmosphere was not once foggy. Mean humidity 82; mean amount of cloud 6·6; prevailing winds N., N.W., W., and S.W.

WARINGSTOWN.—A very fine month; autumn tints were gorgeous; the potato crop was unprecedentedly large, and there was no disease.

EDENFEL.—With the exception of a few days in the second week, and again at the end of the month, the weather throughout was fine and settled, and, although the wind was northerly on 18 days, mild, with little or no frost. Swallows did not finally leave till the 16th, more than a fortnight later than my previous latest record.

AN AIR BATH.

[From an article on the *Mammoth Cave of Kentucky*, in "*Longman's Magazine*."]

ANOTHER very interesting feature to me was the behaviour of the cool air which welled up out of the mouth of the cave. It simulated exactly a fountain of water. It rose up to a certain level, or until it filled the depression immediately about the mouth of the cave, and then, flowing over at the lowest point, ran down the hill towards Green River, along a little watercourse, exactly as if it had been a liquid. I amused myself by wading down into it as into a fountain. The air above was muggy and hot, the thermometer standing at about eighty-six degrees, and this cooler air of the cave, which was at a temperature of about fifty-two degrees, was separated (in the little pool or lakelet which is formed) from the hotter air above it by a perfectly horizontal line. As I stepped down into it I could feel it close over my feet; then it was at my knees, then I was immersed to my hips, then to my waist, then I stood neck-deep in it, my body almost chilled while my face and head were bathed by a sultry, oppressive air. Where the two bodies of air came into contact, a slight film of vapour was formed by condensation; I could wade in till I could look under this as under a ceiling. It was as level and as well defined as a sheet of ice on a pond. A few moments' immersion into this aerial fountain made one turn to the warmer air again. At the depression in the rim of the basin one had but to put his hand down to feel the cold air flowing over like water. Fifty yards below, you could still wade into it as into a creek, and at a hundred yards it was still quickly perceptible, but broader and higher; it had begun to lose some of its coldness and to mingle with the general air. All the plants growing on the margin of the watercourse were in motion, as well as the leaves on the low branches of the trees near by. Gradually this cool current was dissipated and lost in the warmth of the day.—JOHN BURROUGHS.
