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ON THE ABSENCE OF DEW BENEATH A CLOUDLESS
NOCTURNAL SKY.

By CHARLES TOMLINSON, F.R.S.

MANY of the most striking phenomena of Nature had been accurately observed long before they were generalized or reduced to law. Thus the ancients noticed that dew is formed abundantly on clear moonlight nights, and they attributed its formation to the action of the moon, naming that luminary *rorifera luna*, or dew-making moon. There is also a beautiful passage in Tasso's *Gerusalemme* (VI. 103), which embodies a similar idea, namely, that the moon produces the cold.

*Era la notte, e'l suo stellato velo
Chiaro spiegava, e senza nube alcuna :
E già spargea rai luminosi, e gelo
Di vive perle la sorgente Luna.*

Which may be thus closely translated :

It was the Night, and she, her starry veil
Unfolded clearly in the cloudless air ;
The rising Moon now shed her radiance pale,
And frost of living pearls was scattering there.

The nocturnal formation of dew during warm dry weather is so necessary to the well-being of vegetable life, that the absence of it during periods of drought is attended with loss and inconvenience.

Such occasions must be comparatively rare, I suppose, in this country ; but some years ago, in the month of August, I paid a visit to my late brother-in-law, the Rev. H. Windsor, at his Vicarage, at Kensworth, near Dunstable, during a time of severe drought. There had been no rain for some weeks, and the usual prayer for rain had been offered up in the church.

The Vicarage is situate on clay at the edge of a valley of denudation, extending east and west. The lowest part of the valley consists

of gravel on chalk ; on the south flank, clay with veins of gravel ; and on the north, clay and chalk. The width of the valley is about 360 yards.

Three sets of observations were made with thermometers resting on the ground, and suspended $3\frac{1}{2}$ feet in the air. The first set, A, was in the Vicarage field, where the grass was much burnt up ; the second set, B, at the lowest point of the valley, amidst scanty clover and dry, withered vegetation ; the third set, C, was in the Vicarage kitchen-garden.

In A, at 2 p.m., the upper thermometer reading was 82° F, and the lower 115° . At 10 p.m. the readings were 48° and 42° , with no appearance of dew on the ground, and a clear, calm sky above.

The observations, B, in the valley may be given more in detail :—

11th August.	$3\frac{1}{2}$ ft. above ground.	On ground.
Sun on—11.30 a.m.	69 $\frac{1}{2}^{\circ}$	82 $^{\circ}$
1 p.m.	75	96
4	72	90
5	68	75 $\frac{1}{2}$
6	62	62 $\frac{1}{2}$
7	55	53
Sunset—7.30	49	48
Clear sky—7.45	47	46
8	48 $\frac{1}{2}$	45
8.30	45	42
9	42	42
10	41	39

The observations, C, call for no particular remark. At 10 p.m. the readings were 47° and 44° .

On the 12th August, the readings at B in the valley were taken every quarter of an hour from 7 to 9 p.m., as follows :—

	$3\frac{1}{2}$ ft. above ground.	On ground.
7 p.m.	68 $^{\circ}$	66 $^{\circ}$
Sunset— .15	66	63
.30	63 $\frac{1}{2}$	60 $\frac{1}{2}$
.45	61 $\frac{1}{4}$	57 $\frac{1}{2}$
8	58 $\frac{1}{2}$	56
.15	56	55
.30	54 $\frac{1}{2}$	54
.45	53 $\frac{1}{2}$	53 $\frac{1}{2}$
9	52 $\frac{1}{2}$	52

On crossing the fields at 10 p.m. there was a bright moon in the south, and a cloudless sky, as it had been for some hours, but there was no trace of dew. The grass in a meadow on the opposite side of the valley was quite dry to the touch on sweeping the hand over it ; the turnips and clover in the valley were singularly cold to the touch, but not at all wet or even moist. In the Vicarage field the grass was not so much burnt as on the opposite side, but there was no trace of wet. The hand swept over it imparted a keen sense of cold, but not of moisture.

On the 15th, a very curious observation was made on a grass plot near the house surrounded by trees. In the evening, after the sun

had been off the plot for some hours, the grass was still warmer than the air, the readings being 64° and 60° .

On the 16th August, at 7.40 p.m., the readings were 58° and 56° . There were two ground thermometers—one on a growing turnip leaf, and another on the mould by the side, but both read 56° . The morning was warm to the touch, but the turnip leaf uncomfortably cold : no moisture was perceptible. At 7.50 the three readings were

57°

55°

55°

The leaves of the turnips (swedes) were so cold and clammy, that it was difficult to persuade one's self that they were not wet ; but the feeling of moisture proceeded probably from the warm hand. Next morning the register left on the mould marked 50° , and a few scanty beads of dew were noticed on the turnip leaves.

It should be remarked that in a miniature glade of grass, formed by a few trees, the grass had maintained its freshness, and had traces of scanty dew late at night.

On the 17th, the readings in the valley, at 8 p.m., were 48° and 46° ; and next morning scanty beads of dew, formed doubtless some hours later, were observed on the swedes.

During these observations the greatest difference between the dry and wet bulbs was 11° , viz., 75° and 64° , corresponding to 4.9 grains of vapour in a cubic foot of air.

ROYAL METEOROLOGICAL SOCIETY.

THE concluding monthly meeting of this Society for the present Session was held on Wednesday evening, the 18th inst., at the Institution of Civil Engineers ; Mr. R. H. Scott, F.R.S., President, in the chair. Dr. Benjamin A. Gould, Director of the Cordova Observatory, Argentine Republic, was elected an honorary member. The following papers were read :—

(1.) "The Equinoctial Gales—Do they occur in the British Isles ?" By Mr. R. H. Scott, F.R.S. The period investigated was the fourteen years 1870–84, and only those storms were selected which had attained force 9 of the Beaufort scale at more than two stations. The results show that the storms are all but exclusively confined to the winter half-year ; and also that, for a certain interval, the stream of storm depressions sets over the British Isles, and then for a time takes another path, leaving this country at rest. In some years there are as many as four or five storms in a fortnight ; and in others, there are none, or only one. It is further shown that there is no strongly-marked maximum at either equinox.

(2.) "On the physical significance of concave and convex barographic or thermographic traces." By the Hon. R. Abercromby, F.R. Met. Soc. The author shows that a falling barogram is convex when the rate of the fall is increasing, concave when decreasing ;

and conversely, that a rising barogram is convex when the rate is decreasing, concave when increasing. As the rate of barometric change is proportional to the steepness of the gradients which are passing, and the wind also depends on the gradients, the author suggests the following rules for judging the coming force of a gale, from the inspection of a barogram :—A convex barogram is always bad, with a falling barometer, and good with a rising one ; and a concave trace is sometimes a good sign with a falling barometer, and not always a bad indication with a rising one. The convexity or concavity of a thermogram is likewise shown to depend on the rate of thermal change. A method is given by which the distribution of diurnal isothermals over the globe can be deduced from the diurnal thermograms in different latitudes ; and it is shown that the shape of diurnal isotherms on a Mercator chart, for a limited number of degrees of latitude, is similar to the shape of the curve of diurnal temperature range, if we turn time into longitude, and temperature into latitude, on a suitable scale.

(3.) "Maritime losses and casualties for 1883, considered in connection with the weather." By Mr. C. Harding, F.R. Met. Soc.

(4.) "The Helm Wind." By the Rev. J. Brunskill, F.R. Met. Soc. This is an account of a wind peculiar to the Crossfell range ; and its presence is indicated by a belt of clouds, denominated the "helm," which settles like a helmet over the top of the mountain, and a "helm bar," which forms a line parallel therewith.

(5.) "Climate of the Delta of Egypt in 1798 to 1802 during the French and British Campaigns." By Surgeon-Major W. T. Black, F.R. Met. Soc. The author has collected and discussed the meteorological observations made in Egypt during the French and British Campaigns at the beginning of the present century.

On the previous evening (Tuesday), a large number of the Fellows dined together at the Holborn Restaurant to commemorate the favour recently granted by Her Majesty the Queen of according to the Society permission to adopt the prefix "Royal." Mr. R. H. Scott, F.R.S., the President, occupied the chair, and gave the toast of the "Queen and Royal Family." Dr. R. J. Mann proposed "The Royal Meteorological Society," to which Mr. G. J. Symons, F.R.S. (Secretary), responded. Mr. P. Phipps, M.P., gave the health of the "President," to which Mr. Scott replied. The remaining toasts were "The Officers of the Council," proposed by Mr. H. S. Eaton, and responded to by Dr. Tripe (Secretary) ; "The Visitors," proposed by Mr. J. K. Laughton, coupled with the name of Mr. R. McLachlan, F.R.S., and the "Lady Fellows of the Society," proposed by Prof. E. D. Archibald, and acknowledged by Mr. H. Perigal (Treasurer).

ON HYGROMETRY.

By M. JULES JAMIN.

[WE are indebted to Mr. R. H. Scott for calling attention to a very important memoir on the above subject by the eminent French physicist, M. Jules Jamin, and also for the loan of the "*Comptes Rendus*" for June 30th, 1884, in which it is published. We at present limit ourselves to printing a translation *in extenso*.—ED.]

M. Mascart publishes annually in the *Annales du Bureau Météorologique de France* the observations made at nearly a hundred stations spread over the whole country, and the same is done by every state in Europe. These documents are precious stores of meteorological facts whence every one can draw. I have already extracted the pressure of the layer of atmosphere between the base and the summit of the Puy de Dôme ; I am now going to make some general remarks upon hygrometry.

On looking over the table of relative humidity, one is astonished at its uniformity. The means for all months, and for all seasons, are nearly alike. Thus we have for Clermont Ferrand for noon during 1880—

Feb.	June.	Aug.	Sept.	Oct.
593	599	570	569	622.

It is obvious that there must be great differences between the hygrometric condition of the air in February and in August ; therefore if the tables do not show much difference it is probable that the system of reduction is faulty.

This system consists in expressing the relation $\frac{f}{F}$ of the observed elastic force f , to the maximum force F , which the vapour would have at the same temperature if the air were saturated ; this is known as relative humidity. Now for a given air, of permanent composition, the quotient $\frac{f}{F}$ varies, (1) with the proportion of vapour ; (2), with the altitude and barometric pressure, since f is proportional to this pressure ; (3) and chiefly with the temperature which changes the value of F ; it is therefore a function of three independent variables, it is especially a function of t , and one cannot hope that it will render evident variations in the quantity of vapour. In order to recognize them it is necessary to eliminate the disturbing influences of pressure of altitude and of temperature, but that is easily done.

When chemists are analyzing air, they determine the proportions of oxygen, nitrogen, and carbonic acid ; to be logical they should add the proportion of watery vapour. Since this vapour is a gas obeying the same laws as other gases, with reference to expansion and contraction, there is no reason for measuring it differently.

Let f^* be the vapour tension, H the total atmospheric pressure, $H-f$ that of dry air we have—

$$\text{Weight of vapour ... } P = \frac{v (1 \cdot 97 \cdot 293) (0 \cdot 622) f}{(1 + av) 760}.$$

$$\text{Weight of dry air ... } P' = \frac{v (1 \cdot 97 \cdot 293) (H-f)}{1 + at 760}.$$

$$\frac{P}{P'} = 0 \cdot 622 \frac{f}{H-f}$$

$\frac{P}{P'}$ is then the relation of the weight of vapour to that of dry air, it is independent of pressure and temperature, since f and $H-f$ follow the same laws, it varies only with the proportion of vapour and measures it; it expresses *hygrometric richness* in weight, and $\frac{f}{H-f}$ measures its volume.

It must be noticed that observations do not give directly the relation usually preserved, $\frac{f}{F}$. In fact the condensation hygrometer measures f , which is a function of the pressure and therefore of the altitude; the dry and wet bulb hygrometer determines $\frac{F-f}{H}$; but a calculation has to be made in order to pass from the facts observed, and which may then be forgotten, to the function $\frac{f}{F}$, the only thing which is preserved; but the introduction of F brings in the variations due to temperature which cover the influence of vapour and complicate the result. It would not be more difficult to calculate $\frac{f}{H-f}$ and to keep it only for calculation, preserving only $\frac{f}{F}$; one would thus replace a complex function, which teaches nothing, by the precise weight or volume of the hygrometric component of the atmosphere.

I therefore propose that in meteorological tables *relative humidity*, $\frac{f}{F}$, should be replaced by *hygrometric richness* $\frac{f}{H-f}$.

In order to justify this proposal, I will give you one example. I select the measures made at Clermont Ferrand in 1880, by M. Alluard, and published in the *Annales Météorologiques*. No very marked differences are to be found in the different months; the values decrease from morning up to 3 p.m., which (as M. Angot has shown) proves the influence of temperature, but there is no evidence of changes of humidity.

* To avoid confusion we have adopted M. Jamin's notation, and left the formulæ unconverted, *i.e.*, in metric units.

	CLERMONT—Relative Humidity.					
	6 a.m.	9 a.m.	Noon.	3 p.m.	6 p.m.	9 p.m.
Janvier	85·3	89·6	79·5	79·5	89·6	90·3
Février	80·4	71·6	59·2	54·7	74·3	77·7
Mars	83·9	59·8	68·3	39·0	52·6	69·5
Avril	81·9	71·6	63·7	61·5	71·5	76·6
Mai	75·9	58·7	49·3	49·3	54·7	70·8
Juin	82·5	64·4	58·9	58·1	65·2	81·2
Juillet	79·8	60·1	48·0	47·4	57·5	79·3
Août	86·9	66·2	57·0	57·9	71·6	83·8
Septembre	88·6	67·9	56·9	55·1	73·3	83·4
Octobre	84·9	74·2	62·9	62·2	78·7	85·5
Novembre	88·2	80·8	70·4	73·0	82·6	85·4
Décembre	81·7	77·2	70·8	69·7	79·1	82·6

The following is the same table modified by the substitution of $\frac{f}{H-f}$ for $\frac{f}{F}$. To avoid decimals the results have been multiplied by 100,000.

[With every respect for M. Jamin, we are bound to point out that the following is *not* the same table. The former gives the observations at only Clermont Ferrand, *i.e.*, at the base of the mountain ; the following table gives both the Clermont Ferrand values (called the Plain), and those for the Puy de Dôme (called the Summit).—ED. M. M.]

		6 a.m.	9 a.m.	Noon.	3 p.m.	6 p.m.	9 p.m.	$\frac{F}{H-F}$
Janvier	Plaine	410	444	526	560	500	459	380
	Sommet	473	395	439	458	437	446	514
Février	Plaine	606	660	727	715	727	696	646
	Sommet	609	607	671	657	626	626	617
Mars	Plaine	635	776	862	749	795	814	666
	Sommet	663	676	715	733	712	688	779
Avril	Plaine	842	932	946	945	967	898	876
	Sommet	740	756	791	807	775	535	687
Mai	Plaine	981	1019	1001	1012	979	969	917
	Sommet	831	868	877	883	868	830	823
Juin	Plaine	1249	1268	1291	1270	1278	1497	1106
	Sommet	973	1036	1099	1130	1094	1023	944
Juillet	Plaine	1534	1607	1566	1567	1668	1599	1377
	Sommet	1240	1304	1384	1427	1402	1380	1354
Août	Plaine	1482	1588	1581	1611	1808	1663	1318
	Sommet	1267	1348	1383	1428	1426	1452	1250
Septembre	Plaine	1269	1472	1460	1435	1499	1418	1137
	Sommet	1129	1173	1128	1264	1275	1263	1125
Octobre	Plaine	1092	1109	1108	1125	1139	1115	946
	Sommet	900	896	945	981	985	810	926
Novembre	Plaine	674	719	770	783	727	714	649
	Sommet	627	618	650	650	639	630	599
Décembre	Plaine	644	715	832	930	812	816	765
	Sommet	658	669	702	724	699	663	665

We see immediately from this last table—

- (1). That hygrometric richness increases from morning till noon, or 3 p.m., and afterwards decreases as the sun descends, and during the night; this is due to two causes, to evaporation during the day, and to the expansion of the atmosphere.
- (2). That the richness increases from January to July or August, and then decreases; that it varies from 0.005 to 0.018, that is to say that it is three or four times greater in summer than in winter. We find also that it increases in hot countries, and is even greater at Laghouat than at Marseilles; hence we must conclude with M. Dove that there is less dry air in summer than in winter in the northern hemisphere.
- (3). The hygrometric capacity of the air, that is to say the maximum of vapour which it can contain, is expressed by $\frac{F}{H-F}$. Now temperature and F decrease with elevation; on the other hand H decreases equally [? Ed.]. These are two inverse causes of variation; experience shows that the capacity decreases but very slowly. Similarly the richness is always rather less at the summit of the Puy de Dôme than at its base.
- (4). The last column of the table measures the total capacity during the night during the period of lowest temperature. It is generally greater than the richness at 6 a.m., but not always, whence we may conclude that the air is saturated at all heights when the temperature is at its minimum. This explains all the condensations of vapour which generally take place at night.

To sum up; the values of $\frac{f}{F}$ only teach us the degree of dryness or relative humidity; they do not measure the quantity of vapour.

On the contrary, the relation $\frac{f}{H-f}$ measures the hygrometric composition of the air, and brings out the changes produced by day, night, summer and winter, at various altitudes and latitudes.

This is why, I repeat, that it would be well to suppress the values of $\frac{f}{F}$ and to substitute for them $\frac{f}{H-f}$. M. Mascart and M. Angot have been good enough to undertake the calculations which this will involve, and the results will be published in the *Annales du Bureau Central Météorologique*, after having been communicated to the Academy.

REMARKABLE RAIN.

To the Editor of the Meteorological Magazine.

SIR,—The rainfall of Saturday night and Sunday morning, the 28th and 29th of June, must be reckoned among the heaviest falls that have been observed here. Between 10.30 p.m. on Saturday, and 9 a.m. on Sunday, there fell no less than 2.44 inches. The temperature on Saturday reached a maximum of 85°. The movements of the barometer were comparatively trifling, the total fall between 9 a.m. on Saturday and 9 a.m. on Sunday being about 15 hundredths of an inch. The rain fell in very heavy storms, and was accompanied with a good deal of lightning and thunder.

The following are the most remarkable falls of rain previously recorded here :—

On March 11–13, 1859, 3.04 inches fell in 48 hours.

On August 6, 1865, 2.68 inches fell in 24 hours, and of this about 2¼ inches fell within four hours.

On July 14–15, 1875, 3.08 inches fell in 38 hours, and about 2.9 inches in 24 hours.

On October 21–24, 1882, about 3.7 inches fell within an interval of 60 hours.

GEORGE F. BURDER.

Clifton, June 30th, 1884.

HYDROLOGY.

To the Editor of the Meteorological Magazine.

SIR,—The word “hydrology” was used in the last century, for J. G. Wallerius published at Stockholm, in 1748, a work entitled *Hydrologia, eller Beskrifning af Vatten Riket*. See Poggendorff, *Biog.-lit. Handwörterbuch*, t. II., p. 1252.—Yours faithfully,

A. LANCASTER.

Bruxelles, June 26th, 1884.

[Our Belgian friends are always to the front in bibliographical matters, and M. Lancaster in the above note carries the employment of the word back nearly a century. We have never seen the above work, and it does not appear in any printed catalogue in our possession. We cannot recollect whether or not it is in the MS. catalogue sent to the United States Signal Office, and the only reference to it in our own MS. catalogue is the apparently incomplete one :—

WALLERIUS, J. G.—*Hydrologia, eller Watturiket, Stockholm, 1748.*

There seem to be three editions of it, for M. Lancaster quotes the title in Danish, and the following extract from the Royal Society Catalogue implies that it was printed in German and translated into French :—

WALLERIUS, Johan Gotsch. — *Minéralogie, ou description du Règne Minéral. Ouvrage traduit de l'Allemand. Tome 2. [Minéralogie with Supplement and Hydrologie.] 2 parts in 1 vol. 8vo, Paris, 1753–59.—ED.]*

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, DEC., 1883.

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	54·9	13	28·3	7	44·9	36·4	36·6	89	72·3	23·7	·75	14	7·4
Malta	68·5	9	42·8	27	60·4	50·9	46·5	74	110·2	36·5	4·08	12	4·8
Cape of Good Hope ...	...	...	...	...	...	...	...	...	...	...	...	...	...
Mauritius	85·0	5	64·8	15	82·2	72·5	68·3	76	137·6	55·8	4·02	13	6·3
Calcutta	78·8	3	46·7	24	73·2	53·9	53·1	73	136·5	36·6	2·54	2	2·0
Bombay	85·6	11	63·0	17	82·6	66·5	59·5	61	136·5	46·2	·00	0	1·6
Ceylon, Colombo	86·2	5	68·1	29	84·6	71·6	68·6	73	146·5	63·0	7·32	8	7·5
Melbourne	99·3	29	46·2	4	74·7	54·0	48·8	61	157·0	36·0	1·60	12	5·9
Adelaide	100·0	28	49·5	25	80·7	58·7	49·0	48	158·9	40·4	·90	10	3·4
Wellington	72·3	18	43·3	10	64·0	50·9	...	...	140·0	40·0	3·53	12	...
Auckland	76·0	28	50·0	30	67·3	56·4	52·6	72	147·0	42·0	4·33	19	6·9
Falkland Isles	60·8	9	32·1	21	51·0	38·7	38·9	75	...	...	3·18	21	6·8
Jamaica	89·8	19	63·6	10	85·6	68·3	67·9	78	...	56·3	·17	...	4·7
Barbados	81·0	1*	69·0	var.	79·0	71·0	73·0	86	143·0	65·0	5·48	17	6·0
Toronto	48·7	12	—4·0	23	33·1	18·5	24·0	82	97·0	—10·0	1·46	22	8·1
New Brunswick, Fredericton	43·9	8	24·0	23	29·3	5·6	16·5	88	...	...	3·34	17	6·3
Manitoba, St. Andrews	...	...	...	...	...	...	...	...	...	...	...	...	...
British Columbia, Yale	...	...	...	...	...	...	...	...	...	...	...	...	...

* And 10 and 11.

REMARKS, DECEMBER, 1883.

MALTA.—Violent gale on 13th; from noon to 3 p.m. the wind maintained a velocity of 45 miles an hour, and in a violent gust part of a stone wall was thrown down; Mean temp. 55°·0; temp. of sea ranged from 67° to 61°; mean hourly velocity of wind 11·9. J. SCOLES.

Mauritius.—Rainfall 1·96 in., and mean temp. 0°·5 below average; mean hourly velocity of wind 10·6 miles, extremes 50 miles and 0 miles, direction S.E. to N.E. L on 4 days, T and L on 3 days. Unusual sunsets and sunrises were observed more or less during the whole month, but not so intense as in September and October. Generally there were two red glows. The first commenced at 14m. after sunset, and lasted about 24m., and the second commenced at 38 m. after sunset, and lasted till 1h. 17m. after sunset. In the mornings the first red glow began about 1h. 26m. before sunrise. All the prismatic colours were observed, especially on December 8th and 10th. By January 28th, the phenomenon had nearly disappeared, the principal and almost only colours being yellow and orange. The secondary illumination had ceased. C. MELDRUM, F.R.S.

Ceylon.—Thunder on 4 days. J. H. SYMONDS.

Melbourne.—Mean temp., pressure, and humidity all about the average; rainfall 79 in., and temp. of dew point 1°·5 below the average; prevailing winds S. and W.; strong breezes on 9 days; heavy dust storm on 5th; hot wind on 29th; T and L on 3 days, and T or L alone on 4 other days. R. L. J. ELLERY, F.R.S.

Adelaide.—An unusually low bar. reading occurred on 11th, accompanied by a dust storm (believed to be the heaviest since 1851), and followed in the evening by a heavy TS with destructive H; the mean temp. (69°·7) was 1°·3 below the average, and the max. was unusually low. The average amount of cloud was slightly below the average, but the rainfall and wet days were rather in excess. C. TODD.

Wellington.—Up to the 19th it was generally fine, but at times dull, and there was some strong wind; the 10th and 11th were stormy, and after the 19th the weather was showery, squally, and unpleasant; mean temp. 3°·7 below the average, rainfall slightly below it. R. B. GORE.

Auckland.—Weather on the whole cold, wet, and unseasonable; pressure and temp. considerably below the average; rainfall largely in excess.—T. F. CHEESEMAN.

Falkland Isles.—Snow fell for several hours on 21st, a most unusual occurrence.

F. E. COBB.

BARBADOS.—Mean temp. ($75^{\circ}0$) the same as the 23 years average; wind from N. E. all the month but two days; mean hourly velocity 11 miles, extremes 20 miles and 2 miles; rainfall and evaporation very near the average.

R. BOWIE WALCOTT.

SEVERE THUNDERSTORMS.

To the Editor of the Meteorological Magazine.

SIR,—The violent thunderstorms of the past ten days have done immense mischief in this neighbourhood, and the local newspapers are full of records of casualties and accidents of different descriptions, which it would be impossible to enumerate in your pages.

When I mention that on Friday, the 4th inst., I calculated that upwards of two hundred flashes struck objects within five hundred yards of this house, and that in my own small garden, which, inclusive of my house, occupies scarcely one acre of ground, two flashes have, during the series of storms, struck and injured the trees, you will admit that the bombardment was somewhat hot.

On the 4th inst., at 1.30 p.m., a thunderstorm slowly formed in south-west by south. The sky shortly afterwards became one of remarkable grandeur. The Cirrus, pouring off the summit of the storm, spread in the form of a half-open fan, far past the zenith to the north-north-east, the ice-cloud hanging in dense tubercles. That the altitude of these tubercles was upwards of five miles could be ascertained, when the storm was about four miles distant by the time interval of the thunder. The flashes were not then too numerous to admit of this calculation. The thunder after each flash was first heard in the direction of the storm, then rolled through the zenith, and was last heard in the direction of the clear sky in the north-north-east. From the duration of the claps, as well as from other data, it is certain that the fan-shaped conducting cloud extended for a distance of more than fourteen miles in front of the storm.

The storm, which occupied the centre or apex of the fan, increased enormously in intensity, and by the time it had reached this place the flashes were unusually frequent, sometimes three, and at one time four occurring in a second. A light Easterly breeze, which had prevailed before the storm, gave way, as usual, to a strong South-West squall during its passage, but returned, soon after the storm had passed to the North-Eastward.

One episode, which occurred while the storm was at its height, is perhaps worth mentioning. A flash just missed my kitchen-chimney and struck an elm-tree in the kitchen-garden, twenty-five yards from the house. From this it passed through the boughs to another tree, down which it stripped the bark, until it arrived opposite the wet thatch of a cowshed, through which it passed to the ground. Two cows belonging to me were in the shed at the time, fastened by iron chains round their necks. One of the animals escaped uninjured, the other was knocked down senseless. I had her dragged out into

the meadow, where, as soon as the storm had cleared, she was surrounded by a ring of agriculturists and members of the grazing interest. Each of these proposed a different remedy, but all agreed that death was in any case inevitable, for the all-sufficient reason that, though they had all seen animals killed, they had never previously happened to see one only paralysed, by lightning. Three-quarters of an hour after the accident, the cow got up and walked about, though with stiff limbs and neck.

On the 8th inst., another severe thunderstorm arose from the same quarter, under similar meteorological conditions, and passed over this village at the same hour, 3.30 p.m., the cannonnade being again very close.

On the 9th, incessant thunder commenced in the east-south-east, at 1.30 p.m., and soon after in the S.E. and S. The part of this storm which was in south-south-east came over this place at 3.30, and was most exceptionally severe. The nearest flash struck a large elm in my carriage drive, passing into my front gate, which is of iron, and hurling pieces of bark nearly to the front door, as well as against some houses on the other side of the road.

All the storms of this period were preceded by the "Turret-cloud," which I have described in *Modern Meteorology*, p. 131-133.—Yours very truly,

W. CLEMENT LEY.

Ashby Parva, Lutterworth, July 13th.

[We shall be glad of newspaper and other reports of damage by these storms.—ED.]

A HEAVY INDIAN RAINFALL.

To the Editor of the Meteorological Magazine.

SIR,—I may mention that twenty years ago I was well acquainted with the locality in India where the great fall of rain, recorded at page 76 of your last number took place; and that very soon after the line of rail was opened from Bosawul for a few miles towards Jubbulpoor, a similar fall of rain took place, which carried away a bridge, and part of a village, which had stood in the same spot above a century. The train coming up soon after the catastrophe, was precipitated into the torrent, and all (I think) were lost, including Holkar's minister. My impression is that this took place at the Sookee Nullah, which is mentioned at page 76; at all events, it was not many miles from Bosawul, for the line was then open for only about 30 miles above that junction. Exact information could be given of this by the Company.

There was also a similar fall about 100 miles higher up the line, about the same time, which carried away the Towah bridge in its early stages, when that river rose in the gorge about 90 feet in a few hours.

But such storms are rare. Personally I never recorded, or saw recorded above some seven inches of rain in that part of India in 24 hours, during several years of residence there in the Forest department.—Your obedient Servant,

C. PEARSON, LIEUT.-COL.

Downton, Kington, New Radnor.

SUPPLEMENTARY TABLE OF RAINFALL,
 JUNE, 1884.

[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	1.99	XI.	Carno, Tybrith	1.40
"	Margate, Birchington...	.71	"	Corwen, Rhug	1.89
"	Littlehampton	1.15	"	Port Madoc	1.43
"	Hailsham	2.44	"	I. of Man, Douglas .....	.69
"	I. of W., St. Lawrence.	2.00	XII.	Stoneykirk, Ardwell Ho.	.55
"	Alton, Ashdell	2.00	"	Melrose, Abbey Gate ...	.88
III.	Winslow, Addington ...	1.32	XIII.	N. Esk Res. [Penicuik]	1.45
"	Oxford, Magdalen Col...	2.05	XIV.	Ayr, Cassillis House ...	.98
"	Northampton .....	.66	"	Glasgow, Queen's Park.	.77
"	Cambridge, Beech Ho...	1.19	XV.	Islay, Gruinart School..	.71
IV.	Southend	1.21	XVI.	St. Andrews, Newton Bk	.40
"	Harlow, Sheering	1.67	"	Balquhiddier, Stronvar..	1.69
"	Diss .....	.95	"	Dunkeld, Inver Braan..	.39
"	Swaffham .....	.99	"	Dalnaspidal H.R.S. ...	1.17
"	Hindringham .....	...	XVII.	Keith H.R.S.	2.07
V.	Salisbury, Alderbury ...	2.86	"	Forres H.R.S.	1.04
"	Warminster	3.90	XVIII.	Strome Ferry H.R.S....	3.13
"	Calne, Compton Bassett	2.75	"	Lochbroom	1.60
"	Ashburton, Holne Vic..	1.07	"	Tain, Springfield .....	.92
"	Holsworthy, Clawton...	1.67	"	Loch Shiel, Glenaladale	4.42
"	Lynmouth, Glenthorpe.	2.02	"	Invergarry	1.47
"	Probus, Lamellyn	2.34	XIX.	Lairg H.R.S. ....	...
"	Wincanton, Stowell Rec.	2.94	"	Forsinard H.R.S.	1.38
"	Taunton, Fullands	2.42	"	Watten H.R.S.	1.29
VI.	Bristol, Clifton	3.87	XX.	Dunmanway, Coolkelure	.95
"	Ross	4.05	"	Fermoy, Gas Works ...	1.70
"	Wem, Sansaw Hall .....	...	"	Tralee, Castlemorris ...	1.26
"	Cheadle, The Heath Ho.	2.06	"	Tipperary, Henry Street	.55
"	Worcester, Diglis Lock	2.74	"	Newcastle West .....	.60
"	Coventry, Coundon	2.15	"	Milton Malbay	1.37
VII.	Melton, Coston .....	.96	"	Corofin	1.14
"	Ketton Hall [Stamford]	.72	XXI.	Carlow, Browne's Hill..	.84
"	Horncastle, Bucknall ...	.45	"	Navan, Balrath	1.03
"	Mansfield, St. John's St.	.87	"	Mullingar, Belvedere ...	1.08
VIII.	Macclesfield, The Park.	1.31	"	Athlone, Twyford .....	.85
"	Walton-on-the-Hill	1.39	XXII.	Galway, Queen's Col....	.90
"	Lancaster, South Road.	.90	"	Clifden, Kylesmore	2.47
"	Broughton-in-Furness ..	.74	"	Crossmolina, Enniscoe..	1.02
IX.	Wakefield, Stanley Vic.	.61	"	Carrick-on-Shannon ...	.49
"	Ripon, Mickley	1.04	XXIII.	Dowra .....	...
"	Scarborough .....	.47	"	Rockcorry	1.49
"	East Layton [Darlington]	.63	"	Warrenpoint .....	.39
"	Middleton, Mickleton ..	.21	"	Newtownards	1.25
X.	Haltwhistle, Unthank..	.60	"	Belfast, New Barnsley ..	.90
"	Shap, Copy Hill .....	.64	"	Cushendun .....	.71
XI.	Llanfrechfa Grange ...	2.20	"	Bushmills .....	.81
"	Llandovery	2.99	"	Stewartstown	1.60
"	Lower Solva .....	.24	"	Donegal, Revelin Ho....	...
"	Castle Malgwyn	1.42	"	Buncrana	1.35
"	Rhayader, Nantgwillt..	2.10	"	Carndonagh .....	.65

JUNE, 1884.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Table 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.			
											inches	inches.	in.
I.	London (Camden Square)	2.84	+	.17	1.47	5	7	81.7	27	40.6	1	0	1
II.	Maidstone (Hunton Court)...	1.17	—	.90	.32	4	7	...	...	...	...	...	...
III.	Strathfield Turgiss	2.50	+	.40	.90	6	8	83.3	28	33.9	1	0	0
III.	Hitchin	1.39	—	.74	.47	5	10	78.0	27	42.0	7, 14	0	...
IV.	Banbury	1.87	—	.57	.75	28	8	80.0	27 ^a	34.0	1	0	...
IV.	Bury St. Edmunds (Culford)...	1.33	—	.94	.50	6	9	82.0	28	37.0	16 ^b	0	...
V.	Norwich (Cossey) .....	.51	—	1.71	.16	8	9	80.0	13 ^c	41.5	26	0	0
V.	Weymouth (Langton Herring)...	2.90	...	...	1.02	28	9	...	...	...	...	...	...
"	Barnstaple	1.69	—	1.03	.55	28	8	82.0	28	40.0	1	0	...
"	Bodmin	1.18	—	2.03	.26	6	14	73.0	26 ^d	43.0	7, 10	0	0
VI.	Cirencester	3.29	+	.80	1.30	28	8	...	...	...	...	...	...
"	Church Stretton (Woolstaston)...	3.02	+	.15	1.04	28	9	78.0	28	42.0	10	0	0
"	Tenbury (Orleton)	2.82	+	.08	1.55	28	9	82.0	13	32.5	1	0	1
VII.	Leicester	1.86	...	...	.57	6	12	83.0	28	33.6	1	0	1
"	Boston .....	.46	—	1.79	.18	8	7	81.0	13	42.0	17	0	...
"	Grimsby (Killingholme).....	1.02	—	1.35	.31	6	9	78.0	13	39.0	1	0	...
"	Hesley Hall [Tickhill].....	.68	...	...	.39	8	7	84.0	27	34.0	1	0	...
VIII.	Manchester (Ardwick).....	.88	—	2.28	.27	8	7	82.0	28	45.0	1	0	0
IX.	Wetherby (Ribston Hall) ...	.66	—	2.21	.29	8	4	...	...	...	...	...	...
"	Skipton (Arnccliffe) .....	.61	—	3.21	.18	8	12	85.0	28	37.0	3	0	...
X.	North Shields	1.35	—	.68	.47	8	8	79.0	13	38.0	1	0	0
"	Borrowdale (Seathwaite).....	1.47	—	6.34	.44	24	10	81.0	28	39.0	4	0	...
XI.	Cardiff (Ely).....	2.28	—	.78	1.60	28	9	...	...	...	...	...	...
"	Haverfordwest .....	.43	—	2.60	.12	1, 28	7	80.0	27	35.0	9	0	1
"	Plinlimmon (Cwmsymlog) ...	2.07	...	...	.80	28	8	...	...	...	...	...	...
"	Llandudno	1.18	—	.82	.69	28	6	81.0	28	41.5	10	0	...
XII.	Cargen [Dumfries] .....	.46	—	2.71	.11	29	10	82.6	28	38.0	14	0	...
"	Hawick (Wilton Hill) .....	.44	...	...	.19	5	6	...	...	...	...	...	...
XIV.	Douglas Castle (Newmains)...	.69	—	2.32	.23	29	5	...	...	...	...	...	...
XV.	Lochgilhead (Kilmory).....	1.35	—	2.49	.45	1	9	85.0	28	35.0	8, 9	0	...
"	Oban (Craigvarren)	1.81	...	...	.48	1	17	78.0	28	38.0	13	0	...
"	Mull (Quinish)	1.21	...	...	.40	1	11	...	...	...	...	...	...
XVI.	Loch Leven Sluices .....	.30	—	2.47	...	...	...	...	...	...	...	...	...
"	Arbroath .....	.37	—	2.24	.12	16	10	68.0	12 ^f	41.0	6	0	...
XVII.	Braemar .....	.80	—	2.29	.16	1	15	80.7	28	52.0	9	2	5
"	Aberdeen .....	.98	...	...	.36	22	12	73.0	28	38.0	5	0	0
XVIII.	Skye (Sligachan)	4.63	...	...	1.50	2	13	...	...	...	...	...	...
"	Culloden .....	.97	—	1.28	.30	23	6	75.0	29	37.0	6	0	2
XIX.	Dunrobin .....	.80	...	...	.25	21	8	68.5	29	39.5	5	0	...
"	Orkney (Sandwick)	1.59	—	.21	.34	12	16	65.0	30	41.7	5	0	1
XX.	Cork (Blackrock) .....	.70	—	2.85	.14	28	7	84.0	24	43.0	8	0	0
"	Dromore Castle	1.56	...	...	.45	10	7	72.0	23	40.0	19	0	...
"	Waterford (Brook Lodge) ...	.56	...	...	.17	3	6	76.0	21	37.0	1	0	2
"	Killaloe .....	.35	...	...	.12	1	6	81.0	14	42.0	2	0	...
XXI.	Portarlington .....	.54	—	1.89	.21	1	9	77.0	27	41.0	13	0	...
"	Dublin (Fitz William Square)...	1.25	—	.95	.55	3	10	75.4	13	43.1	1	0	0
XXII.	Ballinasloe .....	.63	—	2.56	.17	1	11	72.0	27	38.0	14	0	0
XXIII.	Waringstown .....	.84	—	1.82	.24	7	8	85.0	27	33.0	9	0	0
"	Londonderry (Creggan Res.)...	1.45	...	...	.32	1	13	...	...	...	...	...	...
"	Omagh (Edenfel)	1.35	—	1.70	.32	29	17	78.0	28	42.0	1 ^g	0	0

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

a And 28. b And 17. c And 26, 28. d And 27. f And 13. g And 6, 9, 13.

METEOROLOGICAL NOTES ON JUNE.

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.

STRATHFIELD TURGISS.—The continuance of fine weather enabled farmers to make their hay in excellent order; wheat promises to be better than for many years past; barley and peas look well; roots need rain. T on 4th, TS on 5th; first wheat ears on 8th; hay cut on 9th.

BANBURY.—T and L on 6th; T on 7th and 8th; T, L, and heavy R on 28th.

CULFORD.—A very hot, dry, month; hay crops very poor; everything suffering from want of rain.

LANGTON HERRING.—A very fine month; with temp. slightly above the average; distant T was heard on the 7th and 11th, and on some other days, and a rather violent TS occurred on the evening of 28th, 1.02 in. of R falling between 9 p.m. on that day and 2 a.m. on 29th. From 12th to 22nd, the weather was perfect for haymaking, but the crop is light.

ORLETON.—The temp. was low on the first nine days, with much cloud, frequent falls of R, and distant TSS; the weather then became unusually bright and dry, with a prevailing N. wind and cold nights. On the 28th the temp. rose to 81°·7, followed after midnight by distant T, and an immense fall of R 1.73 in. in less than 20 hours, which apparently did not extend far to the E.; the drought before this had very seriously affected all vegetation, except the wheat crop. The mean temp. of the month was about a quarter of a degree above the average of 23 years. Distant T on six days.

LEICESTER.—From 8th to 28th very little R fell, and both fields and gardens were much in need of moisture, but a refreshing R occurred on 29th.

BOSTON.—Rainfall of the month the smallest recorded in June since 1868, in which year the fall during the three months, May, June, and July, was only 1.25 in. Wheat in ear on 10th.

KILLINGHOLME.—A very dry month, great inconvenience caused by want of water for all purposes.

ARDWICK.—A very dry fine month, but the night temp. was rather low, which, with the drought, was injurious to vegetation; the health of the city was threatened by the want of R to flush the sewers, and in some parts of Lancashire, owing to the want of water, several works had to be partially or entirely closed; refreshing showers fell at the end of the month. Hay and straw short.

ARNCLIFFE.—Hay crop light, owing to want of R, and pastures much dried up.

WALES.

HAVERFORDWEST.—Temp. about the average, it rose to 70° twice in the first 17 days, but with these exceptions was low day and night, particularly up to the 10th, before which date it rarely reached 60°; the 9th was remarkably cold, the min. on grass being as low as 27°·5; after the 18th the temp. increased considerably, but from the 27th to the end of the month, the weather was unsettled, and in some places much R fell, accompanied by T and L. Rainfall the smallest since 1859, the year of the memorable drought, when .30 in. fell. Hay crop very light; wheat looks well on good land; public health remarkably good, and death rate very low.

LLANDUDNO.—A month of fine dry and sunny weather, but the mean temp. was about 2° below the average; more than two-thirds of the R fell on the 28th and 29th, a TS occurring on the first-mentioned day. The winds were light and variable; duration of bright sunshine 202 hours. Hay crop very light, and pastures suffered much from drought.

SCOTLAND.

CARGEN.—Light and variable winds prevailed during most of the month ; the mean temp. was $0^{\circ} \cdot 7$, and the duration of sunshine 15 hours below the average ; from May 17th to June 30th only $\cdot 50$ in of R fell, and the crops generally suffered from drought.

CRAIGVARREN.—One of the finest and most genial months experienced for many years ; it produced a golden hay crop, and left vegetation in a most luxuriant state, on 30th an unusually heavy white mist prevailed for 20 hours over the sea, stopping all steamboat traffic.

ABERDEEN.—The month on the whole was fine, the first six days were fair followed by a week of showery weather, and it was again showery from 21st to 26th ; the remainder of the month was fine, though not always bright.

CULLODEN.—The weather was very dry all through the month, little R fell and that at long intervals, doing no good to pastures or grain crops, which at the close were suffering considerably.

SANDWICK.—The rainfall was irregular, heavy falls occurring in some districts, while others were parched ; the temp. was low during the first part of the month, owing to northerly winds, but it became warm during the latter part, the temp. in shade rising to 65° , and in sun to 110° . There was a strong breeze of about 40 miles an hour on the morning of the 25th.

IRELAND.

CORK.—Dry weather prevailed during the greater part of the month, with a high and steady bar ; from May 13th to June 21st R fell on only nine days, the amount scarcely exceeding $\cdot 50$ in. ; no TSS.

DROMORE CASTLE.—Fine weather with heavy dews at night ; all crops very promising.

WATERFORD.—Rainfall $2 \cdot 69$ in. below the average of 10 years, and number of wet days 10 below the average. T on 13th and 29th ; thick fog on 12th. The country is very parched, and the crops very backward.

KILLALOE.—The loveliest June in a record of 39 years ; max. temp. in shade 79° to 80° on several days. Only twice during the past 39 years was the rainfall of June less than one inch. viz., 1849, $\cdot 73$ in. ; 1870, $\cdot 71$ in.

DUBLIN.—The month as a whole was very fine, dry, and warm, though it was cold and showery at the beginning ; mean temp. very near to the average of 20 years. Rainfall the smallest in any June since 1877, when only $\cdot 92$ in. fell, and number of wet days also small. L on 3rd and 28th ; distant T on 30th. Prevailing direction of wind N.W. ; mean humidity 74 ; mean amount of cloud $6 \cdot 7$.

BALLINASLOE.—The driest month during 12 years, warm and pleasant.

WARINGSTOWN.—A very dry month, and the last week intensely hot.

EDENFEL, OMAGH.—The month afforded the longest continuance of summer weather that has been experienced for many years.