SYMONS'S

MONTHLY

METEOROLOGICAL

MAGAZINE.

VOLUME THE TWENTY-FIFTH.

1890.

LONDON :
EDWARD STANFORD, COCKSPUR STREET, S.W.
—
1891.

INDEX.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCLXXXIX.] FEBRUARY, 1890. [PRICE FOURPENCE, or 5s. per ann. post free.

SOLAR HALOS AND PARHELIA ON JANUARY 29TH.

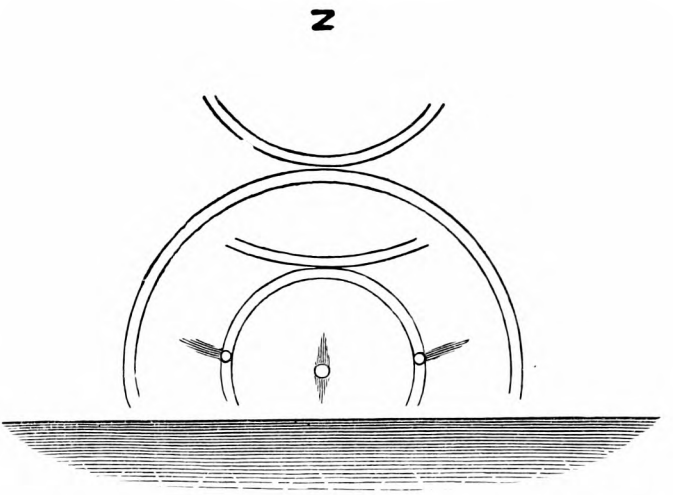
WE have been favoured with many accounts and sketches of the fine series of halos which appeared on the afternoon of January 29th. It would be wearisome to print them all, and we therefore select four fairly typical ones, and add an engraving which gives a general idea of the phenomenon when seen at its best. Some other notes will be found in the Remarks on the Month on page 15. It has been stated that the halos appeared earliest in the north, and gradually later further south; this is only partly true; we have plotted all the times that we can obtain, and the result is that the times increase as we go south-east, that is to say, are earliest in the N.W. of England. This is curiously corroborated by the series of sketches given in the *Daily Graphic* of January 31st, in which it will be noticed that the whole of the 22° halo is high above the horizon in the sketches from the Lake District, from Preston and from Liverpool, touches the horizon at York, and is partly below it at High Wycombe —that is to say, the phenomenon occurred in the N.W. of England when the sun was highest, and in the centre and S.E. of England when it was lower; this shows that the sketches were true as to solar altitude, and therefore are probably true in other respects. As the prevailing wind that afternoon was N.W., the above conclusions are justified and explained, the ice clouds which produced the halos evidently travelled with the wind from N.W. to S.E.

Our engraving is from a sketch kindly sent by Mr. Gulson, of Coventry, but there is great general similarity among the drawings, only some observers put the mock suns as sketched, and some put them precisely level with the real sun; and some make the two segments of circles drawn with the zenith as centre, much more acute, in fact one sketch shows the lower of the two as part of a circle struck from the vertex of the 45° halo as its centre.

A very similar, but more complex system, seen in Aberdeenshire, January 23rd, 1870, will be found described and illustrated in the *Met. Mag.*, Vol. V., 1870, p. 1, and a coloured representation of a system almost identical with that of January 29th, 1890, but as seen

in Sweden, October 4th, 1839, forms the frontispiece to *perfect* copies of Walker's translation of Kaemtz's "Meteorology."

We conclude with a suggestion. Will some competent person give a popular account of halos, thoroughly illustrated, and with the drawings on a uniform scale, and each halo clearly marked and named, so as to teach observers what to observe? Bravais' "*Memoire sur les Halos*" is too mathematical, and not suitably illustrated for any but advanced readers, and from it to the notes in most general treatises on meteorology the gulf is wide indeed.



SIR,—A splendid solar halo with its accompanying parhelia was observed here this afternoon (29th) at 1.34 p.m. The halo (diameter 45°) was almost perfect; the lower part, however, was slightly obliterated by the thick atmosphere near the horizon. Attached to the upper side was an inverted portion of a similar halo, brilliantly illumined on the concave side, while the lower part shewed traces of a dull red light. Again, 22½° above this, and also inverted, about 60° of arc, beautifully coloured with the prismatic tints, was clearly and distinctly visible, the red side innermost. This arc, if it had been produced, would have circled the zenith. The mock lights on each side of the principal halo, were drawn out into long cones of intensely bright light, while the sky inside the halo was of a very dark shade. The most noteworthy feature of the display, was a brilliant patch of pure white light in the north-western sky, at a distance of 90° from the western mock sun, and undoubtedly emanating from it, and which remained visible for nearly ten minutes. The whole phenomena disappeared at 2.8 p.m., the sky then being covered with streaky cirro-stratus haze from the N.N.W.

P.S.—A beautiful lunar halo was observed in the evening.

J. LOVELL.

Driffield, January 29th, 1870.

SIR,—Two parhelia or mock suns were well seen here on Wednesday afternoon last. The sun was encircled, or nearly so, with a luminous circle of above 22° radius, on the extreme limits right and left, and at about the same distance from the horizon as the sun itself, appeared two masses of light exhibiting vivid prismatic colours, the right hand or more northerly mock sun being of a distinctly violet hue.

The sunset which followed was most gorgeous. The western sky being ablaze with crimson light, and a column, rising perpendicularly from the horizon, nearly to the zenith, was of an intensely brilliant carmine colour.

I have never seen just such an effect before.—Yours, &c.,

H. SOUTHALL.

The Graig, Ross, February 4th, 1890.

SIR,—This afternoon the unusual phenomenon of a solar halo with three mock suns was visible here. The weather was fine and cold, with light wind from the north; the sun was bright, but shining through a very thin layer of cirro-stratus clouds. The parhelia appeared about half-past two o'clock; there were three, one on each side of, and one vertically over, the real sun, and all were distant 22° from it. They were all of very beautiful prismatic colours, with the commencement of lines running away from them, as if to form the full halo, but these lines did not complete the circle. From the upper parhelion there were traces of an inverted halo, but these were slight and like a broken rainbow. The sun was somewhat too low to see the fourth parhelion, if there was one. The phenomenon lasted for about three-quarters of an hour, and then faded away. On February 5th, 1887, there was also a very fine double halo visible round the sun in the morning here, but there were then only two parhelia.

CHRISTOPHER A. MARKHAM,
F.R.Met.Soc.

Sedgebrook, Northampton, January 29th, 1890.

SIR,—At about 2.50 p.m. on Wednesday, I observed a most interesting atmospheric phenomenon. The sun was shining faintly through a circular mass of clouds, and with the exception of about one-fourth part near the horizon, was surrounded with a large and well-defined ring or halo, tinged with prismatic colours similar to a rainbow, its angular diameter being about 60°. On each side of the circumference of the ring, or halo, appeared a circular disc of light resembling two other suns, but not so bright or so well defined as the real sun in the centre. In a few minutes the two circular images became fainter, and not so well defined, but they remained visible for about an hour. I have on several occasions seen the

sun surrounded with a large halo, or ring, but have never before noticed one like this with two mock suns, one on each side.

Shortly after the sun had set, the clouds in that part of the heavens were tinged with the most vivid crimson hues, forming a remarkable contrast with the sky beyond, which appeared to be of a brilliant green. It was truly a magnificent scene.

J. PHILLIPS.

Hereford, January 30th, 1890.

THE WEATHER PLANT.

SOMETIMES in trying to do good one does harm, in criticizing anything one advertises it—that is why we said nothing during the slight craze which existed upon the above subject about two years since.

We are not going to devote much space to it now that it has been tested and proved worthless; but if we put together some of the facts recorded they may afford a useful lesson.

The "discoverer" of the virtues of the plant was Mr. J. F. Nowack, a manufacturing chemist of Prague, and with him was associated a Mr. E. Bahlsen, a market gardener of the same city.

It is not clear when this discovery was made, but it appears that application was made for an English patent as far back as December, 1887. Of course the use of the plant could not be the subject of a patent, but the joint applicants for the patent stated that "certain conditions must be observed in order to cultivate Nowack's weather plant in such a manner that it can be used as a weather indicator. In order to obtain and maintain these conditions, we have constructed an apparatus which, in combination with the weather plant, constitutes the principal subject of our invention."

From that date onward, glowing accounts of the merits of the plant were sent, chiefly from Vienna, to the London newspapers, such as "32,000 observations made during the last three years tend to prove its infallibility." "The Committee of the [Vienna] Exhibition have promised Professor Nowack, a certificate to the effect that the weather forecasts made by his plants were correct in 96 cases out of 100." These statements were too much for Mr. W. Sowerby, F.L.S., the secretary of the Royal Botanic Society, who in September, 1888, wrote a letter to *The Times*, indicating his disbelief in the merit of the plant, and who at the meeting on November 10th, 1888, exhibited the plants, and stated that "the behaviour of the several specimens varied at one and the same time according to the special conditions under which they were growing."

This was of course no proof of what the plants would do *if grown inside the patented apparatus*, and this was promptly pointed out by a Mr. Radeke, who wrote to *The Times*, announcing himself as the London correspondent of Prof. Nowack, and giving among other statements the following :—

"The observatory of the Austrian Tourists' Club, on the Sonnwendstein, at an altitude of 1,511 mètres, in the Styrian Alps, well known to many English tourists, which supplies the various branches of the club with weather forecasts during the season, has now for already over a year, discarded both aneroid and ordinary barometers for that purpose, and depends for its forecast upon the weather plant alone."

We shall be greatly indebted to any of our Austrian readers, who will tell us whether the *abrus precatorius* has retained its position at the Sonnwendstein, or whether the discarded barometers have been fetched back.

We have but slight evidence respecting the sale of the plants and their stands (at £5 5s. 0d. each), but it must have been very remunerative if many were sold.

We next learn that the Austrian Crown Prince (Rudolph) had been much interested in the plant—possibly that throws some light upon the very favourable notices sent from Austria to the London press.

In the early half of 1889, little was heard of the plant, then Mr. Nowack came to England, and obtained from H.R.H. the Prince of Wales an introduction to Mr. Thiselton Dyer, F.R.S., the director of Kew Gardens.

Mr. Dyer (very wisely we think) waived the rule whereby experiments intended to promote pecuniary objects are excluded, and allowed Mr. Nowack to take a series of his plants and apparatus to Kew, Dr. Oliver, F.L.S., undertook to observe them in conjunction with Mr. Nowack, Mr. Nowack making the predictions, Dr. Oliver and Mr. Scott, F.R.S., comparing them with the facts.

Any one who desires to see the unsatisfactory result, should buy the *Kew Bulletin*, No. 37, 1890, published by Eyre and Spottiswoode, price 2d.

Our record will not be complete until we hear what has been done at the Sonnwendstein. We hope to ascertain that, in time for our next.

ROYAL METEOROLOGICAL SOCIETY.

The Annual Meeting of this Society was held on Wednesday evening, January 15th at the Institution of Civil Engineers; Dr. W. Marcet, F.R.S., President, in the chair.

The Council, in their Report, congratulated the Fellows on the generally prosperous state of the Society; the past year's work, though not in any respect exceptional, having been thoroughly successful. The total number of Fellows is 550, being an increase of 25 on the previous year; the finances are improving, and the Library is overflowing.

Mr. Baldwin Latham, M. Inst. C.E., was elected President for the ensuing year.

The retiring President, Dr. Marcet, then delivered an address on "Atmospheric Dust," which he divided into organic or combustible, and mineral or incombustible. The dust lighted up in a sunbeam, consists of countless motes, rising, falling, or gyrating, although it is impossible to follow any of them with the eye for longer than a fraction of a second. It is difficult to say how much of the dust present in the air may become a source of disease, and how much is innocuous. Many of the motes belong to the class of micro-organisms which are frequently the means of spreading infectious diseases. Many trades, owing to their dusty nature are very unhealthy. Some dust, when mixed with air, is inflammable and liable to explode. After giving several instances of explosions due to fine dust in flour mills, and coal mines, and illustrations of the same experimentally, Dr. Marcet referred to inorganic or mineral dust, and gave an account of dust storms and dust pillars in India. He then proceeded to describe volcanic dust, which consists mainly of powdered vitrified substances, produced by the action of intense heat. The so called ashes or scoriæ shot out in a volcanic eruption are mostly pounded pumice, but they also originate from stones and fragments of rocks, which, striking against each other, are reduced into powder or dust. Volcanic dust has a whitish gray colour, and is sometimes nearly white. Dr. Marcet concluded with an account of the great eruption of Krakatoa in August, 1883.

The address was illustrated by a number of lantern photographs.

RAINFALL ON BEN NEVIS.

To the Editor of the Meteorological Magazine.

SIR,—The rainfall here last month was so exceptionally great that I send a copy of the daily rainfall copied from the monthly sheets, it amounts to the large quantity of 29·421 inches. We had only four hours sunshine, less than half any previous month.

Yours, very truly,

R. C. MOSSMAN.

Ben Nevis Observatory, Fort-William, February, 3rd, 1890.

1	...	·085	12	...	1·093	22	...	·329
2	...	·059	13	...	2·045	23	...	·126
3	...	·063	14	...	3·881	24	...	·468
4	...	·123	15	...	·460	25	...	2·569
5	...	2·322	16	...	·994	26	...	·607
6	...	1·058	17	...	·653	27	...	·506
7	...	1·711	18	...	·300	28	...	·026
8	...	·719	19	...	·700	29	...	·270
9	...	1·347	20	...	1·174	30	...	1·922
10	...	1·576	21	...	·607	31	...	·831
11	...	·797						

Total for month = 29·421.

Of the heavy fall of 3·881 on the 14th—

1·68 inches fell in 2 hours.
2·45 ,, ,, 4 ,,
3·31 ,, ,, 7 ,,

REMARKABLY DRY AIR.

To the Editor of the Meteorological Magazine.

SIR,—Are not the annexed readings worthy of notice? I thought, on reading the German instruments at 2 p.m. on the 27th, that something must be wrong to produce so great a difference in winter, But as the hair hygrometer gave the humidity as only 5, I went to my own "Stevenson" in the garden, where I have dry and wet of Casella's best, and a self-recording one of Negretti's, and they all agreed; also another at my sitting-room window about 10 feet under the German cage. Jelinek's tables, which they use here for relative humidity, do not allow for such readings, and Guyot's, if I read them rightly, confirm the hair hygrometer.

I never saw solid snow go so fast. I find, on reference to former years, that five *cm.* (two inches) of solid snow which has lain for two months or more has, *at the end of March*, required two or three days to melt, but this vanished in five hours without any sun power.

The air was drying all the previous day, the relative humidity being: 8 a.m., 90 (under influence of hoar frost); 2 p.m., 68; 8 p.m., 46. It was most unpleasant to the feeling, nails and skin splitting on hands, quill pen nibs opening, ink drying in stand, &c.

Faithfully yours,

MICHAEL FOSTER WARD.

Partenkirchen, Bavaria, 29th January, 1890.

	Bavarian cage at N. window, 20 ft. abv. ground.						Stevenson's stand in garden, Two sets of thermometers.					
1890. January.	Dry.	Wet.	Diff.	Lambrecht's Hair Hygro.	Jelinek's Tables.	Guyot.	Dry.	Wet.	Diff	Hottinger's Hair Hygro.	Jelinek's Tables.	Guyot.
8 p.m. 26th	38·1	32·0	6·1	49	47	44	32·0	27·0	5·0	49	52	50
8 a.m. 27th	41·9	34·3	7·6	40	40	37	41·0	34·0	7·0	40	...	41
2 p.m. ,,	55·4	38·8	16·6	5	...	4	55·0	39·0	16·0	5	...	7
3 ,, ,,	54·7	38·8	15·9	5	...	7	53·0	39·0	14·0	5	...	14
4 ,, ,,	54·0	38·1	15·9	7	...	5	54·0	39·0	15·0	4	...	10
5 ,, ,,	54·0	37·8	16·2	7	...	4	53·0	38·0	15·0	4	...	8
6 ,, ,,	54·0	37·4	16·6	7	...	2	54·0	39·0	15·0	4	...	10
8 ,, ,,	52·5	37·4	15·1	10	...	7	53·0	38·0	15·0	6	...	8
9 ,, ,,	50·0	38·1	11·9	20	25	20	50·0	38·0	12·0	20	24	20

8 p.m. 26th, to 8 a.m. 27th, calm; 2 p.m. to 9 p.m., violent N.W. gale, with dense cir. str. travelling rapidly from N.W.

[We quite agree with Col. Ward as to the exceptional character of these records—we should have mistrusted both our eyes and our brains had we seen such differences—and yet it is not easy to see where error can have crept in. Four sets of dry and wet bulbs, and two hair hygrometers, are not at everybody's command; and they agree well, and are supported by the rapid disappearance of the snow, and by the cracking of the skin and nails.

Of course, in England we do not know what excessive dryness is. The most remarkable English cases that we can find are :-

Met. Mag. vol. xi. (1876) p. 176.	Wensleydale, Yorks.	Rev. F. W. Stow.
1877, January 2.....	Dry, 24°·5 Wet, 18°·9	Humidity, 30.
Met. Mag. vol. xxi. (1886) p. 89.	Parkstone, Dorset.	R. H. Barnes, Esq.
1886, July 4	Dry, 85°·2 Wet, 63°·1	Humidity, 28.

Of Foreign cases we select four :—

Met. Mag. vol. ix. (1874) p. 4.	Algiers.	M. Bulard.
1865, August 25 ...	Dry, 113°·0 Wet, 68°·0	Humidity ?*
Met. Mag. vol. ix. (1874) p. 112.	Meean Meer, Punjab	W. Strahan, Esq.
1873, June 19..... ...	Dry, 112°·2 Wet, 70°·2	Humidity 8.
Indian Met. Memoirs, vol. i. p. 103	Káshgár, 39°24′ N.	76°7′ E. Dr. Scully.
1875, March 7	Dry, 61°·6 Wet, 41°·4	Humidity, 6.
Indian Met. Memoirs, vol. i. p. 333	Allahabad, 25°26′ N.	81°52′ E. S. A. Hill, Esq.
1879, May 4	Dry, 111°·6 Wet, 70°·6.	Humidity, 7.

ED.]

Buys-Ballot.

ONE by one, with saddening frequency, those whose names are known to Meteorologists of all countries are leaving us. On Sunday night, February 2nd, from his well-loved home at Utrecht, passed away the spirit which gave to the world the useful "Buys-Ballot's Law," by which the author will be remembered long after his many personal friends have themselves been removed. Prof. Buys-Ballot was often in this country; he was a corresponding member of the British Association, and attended its meetings, and he was one of the nineteen honorary members of the Royal Meteorological Society. He was 72 years of age, was an Honorary Member of the Society of Arts, of the German and of the Austrian Meteorological Societies, and Knight or Commander of Orders in Austria, Netherlands, Portugal and Prussia.

Besides discharging the duties of his Professorship from 1847 to 1887, Dr. Ballot was director, indeed almost creator, of the Royal Meteorological Institute of the Netherlands. In 1883 a new island, discovered by the Dutch Meteorological Expedition, in 70° 25′ 28″ N., was named after him as Buys-Ballot's Island, and in 1887, on giving up his professorial duties, a sort of International banquet was given in his honour, and he was presented with a gold medal specially struck to commemorate the event. Dr. Ballot's earliest scientific papers were upon chemistry and physics, but for forty years nearly all his time and thought has been devoted to meteorology, and his contributions have appeared not only in Dutch, but in German, French, and English.

* No table deals with such a case.

SALT HAILSTONES.

To the Editor of the Meteorological Magazine.

SIR,—Calling back attention to page 169 of Vol. 24, I beg to say, that after an exceedingly stormy night, I, on the morning of the 19th January, observed on the window panes a slight film, which I tasted and found pretty salt, as did my niece. The coast of Ayrshire, about 30 miles off, is the nearest sea the salt could have come from, but as the wind was nearly south it may have come from the Bay of Luce in the Solway, more than twice that distance. In either case it had to cross the range of hills dividing Ayrshire from Clydesdale, where it would be projected upwards to a considerable altitude before it found a final resting at Cambuslang, 150 feet above the sea level. I do not know if there was hail during the night (min. temp. 36° Bar. below 29 inches) but during the forenoon of the 19th sleety showers fell at intervals. 0·18 inch of rain fell during the 24 hours previous to 9 a.m., with much lightning from 7 to 9 p.m.; 0·97 inch of rain in the following 24 hours, with some hail.

HENRY MUIRHEAD.

THE ANEMOMETER ON THE EIFFEL TOWER.

To the Editor of the Meteorological Magazine.

SIR,—At page 182, Vol. 24, you say:—"On the tower top the wind is, on the average, much stronger than below, which is, of course, readily explained by the absence of retardation by friction against trees and buildings, but what is not so easily explained is the further fact that the times of maximum and of minimum are almost reversed."

I should like to offer a suggestion in reference to the time-reversal of velocities.

Whatever may be the agencies by which the equilibrium of the atmosphere gets disturbed, air where dense is gravitationally compelled to move towards neighbouring localities, where the air is more rarified and therefore lighter (not *depressed* as our meteorological authorities teach the general public day-after-day). In the day-time the sun heats the ground, the warmed ground heats the contiguous air rarifying it. The cooler, denser air from whatever quarter, say, at times in summer from the Atlantic, flows towards Central Europe, to displace the rarified air. Hence arises increased surface velocity, which reaches a maximum shortly after midday, and declines as the influence of the sun declines, till its speed nearly reaches its minimum shortly after midnight, and so remains with little change till about 5 a.m., before which the ground will have reached its coolest. Then as daylight again induces rarefaction the daily course goes on as before.

I suppose that this is acknowledged as the cause of the alternation

"below." In reference to the reversal of time "above," I offer the following explanation:—

The friction of trees, &c., is held to be the reason for the relatively less velocity below. Well, during the heat of the day the lower rarified air is compelled to ascend in consequence of its own expansion, and its displacement by denser air. The uprising columns or strata will act on the higher current much in the same fashion as the trees do below, obstructing and lessening its velocity by friction. Whereas there being but little uprisal during the cooler hours of the night the obstruction will, of course, be much less.

HENRY MUIRHEAD, LL.D.

Cambuslang, January 20th.

ON THE IMPORTANCE OF CIRRUS CLOUDS, IN FORETELLING THE CHANGES OF THE WEATHER.

To the Editor of the Meteorological Magazine.

SIR,—Can you find a corner in the *Met. Mag.* for the following notes?

I recollect when only a lad an old shepherd telling me we were going to have a thaw within 48 hours, it having been a long continued frost. On enquiring how he knew, he directed me to look up to the westward, where the sky was streaked with cirrus clouds *pointing from north to south,* and sure enough the thaw came as prophesied. I have never forgotten the above incident, and from life-long observations have found the rule nearly always to come true. The reason for it being that cirrus clouds appearing in the western horizon and laying from *north to south* foretell a change in the wind to the west or south-west; and south-west winds in our district almost invariably bring warmer weather.

I have noticed the opposite, viz., when cirrus clouds form on the northern horizon, and point from *west to east,* we are going to have a change in the wind to the north, with colder weather. These changes can often be foretold long before the barometer has given notice of a change.

I find the only exception to being sure of a thaw on noticing the cirrus in the west, is in the late spring time, when our east winds are so prevalent, when probably they are too strong for the western current to assert itself sufficiently.—Yours truly,

AMOS MITCHELL.

Wolsingham, Darlington.

A NEW APPLICATION OF PHOTOGRAPHY.

Photography, according to a foreign scientific journal, is about to be put to a new use in meteorological work. The determination of the temperature of the air at different heights is an important factor

in meteorological investigations, and, as our readers may easily imagine, is a difficult problem to undertake, but the following outline of the new method suggests that something feasible has been designed. Herr Siegsfeld uses a thermometer which, by closure of an electric circuit when certain temperatures are reached, gives a light signal. Small balloons, each containing such a thermometer, will be sent up at night, and the light will affect photographically a so-called *photo-theodolite*, while the height then attained will be indicated in a mechanical way. It is hoped that this new method will enable more exact formulæ for decrease of temperature with height to be obtained.—*British Journal of Photography.*

[There may be more in this scheme than is explained, as it stands it seems to us hopelessly wild.—ED. *M.M.*]

THE NEW AVERAGE ADOPTED IN THE GENERAL TABLE.

There are two conflicting interests, between which it is necessary to decide, in compiling such a table as that on p. 14. There are more than two—there are half-a-dozen, but of only two need I write now, viz., completeness and continuity. It is evidently desirable that the column giving the difference between the fall of rain in (say) January and the average in January, should be given for as many stations as possible; this I call completness. It is also desirable that the average be that of a period long enough to give a trustworthy average. Moreover, it would not be at all uniform or satisfactory to take averages of different periods. Some of the records go back only 6 or 7 years, others to nearly the beginning of the century. When commencing this magazine, just 25 years since, I was obliged to be content with the average of the six years, 1860-5, and it was used until I had that for 1870-9, and was obliged to adopt it, because so few stations went back to 1860. It may be said, why change from 1870-79? or why not take the 20 years, 1870-89? To this I reply, because by adopting 1880-89 I can give the average for 45 stations out of 50, while by using either 1870-9 or 1870-89 I should have had a much smaller proportion, certainly less than 40 out of the 50, and as I have said over and over again in *British Rainfall* the excessive fall of rain in 1872 rendered the fall in that decade above the true average.

G. J. SYMONS.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JULY, 1889.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain. Depth.	Total Rain. Days.	Aver. Cloud.
	°		°		°	°	°	0–100	°	°	inches		0–10
England, London	80·9	5	46·1	19	71·0	54·0	52·1	73	126·3	41·4	2·64	17	6·8
Malta	104·1	20	63·3	4	86·7	69·6	64·9	67	158·8	56·6	·00	0	0·9
Cape of Good Hope.	77·0	30	38·4	...	62·5	46·0	...	...	...	...	3·31	9	5·7
Mauritius	76·4	19	58·4	6	74·3	64·8	60·9	76	123·5	48·6	2·21	17	5·6
Calcutta	92·4	13	74·8	3	88·8	78·7	79·5	86	159·3	75·1	11·99	22	7·0
Bombay	88·1	1	75·7	11	84·8	77·9	77·0	87	145·7	74·8	30·45	27	8·6
Ceylon, Colombo	86 0	22	73·0	19	84·4	76·6	72·2	78	146·8	70·6	7·43	24	7·5
Melbourne	62·1	31	31·3	12	55·4	40·6	42·1	81	110·4	23·5	1·64	8	6·4
Adelaide	65·9	30	36·3	19	57·8	43·2	43·9	79	119·0	29·0	1·21	14	5·3
Wellington	58·5	1, 24	33·0	17	53·4	40·5	39·5	76	108·0	23·0	3·15	16	4·2
Auckland	65·0	25	40·0	8	57·7	46·5	45·9	80	118·0	30·0	4·38	22	6 7
Jamaica, Kingston	94·3	28	71·9	8	90·0	73·9	73·7	77	...	...	·85	...	...
Trinidad	94·5	8	64·0	7	86·6	72·6	72·9	82	156·5	...	12·14	27	...
Toronto	88·7	8	47·7	25	78·4	59·9	60·6	75	...	41·0	3·26	13	4·5
New Brunswick, Fredericton	84·7	1	45·0	27	74·3	55·0	56·7	71	...	...	1·26	12	5·5
Manitoba, Winnipeg	92·8	17	40·3	13	75·3	52·0	55·7	73	...	...	2·38	14	5·1
British Columbia, Victoria	85·0	8, 9	40·0	2	73·2	48·2	...	...	...	...	·00	0	...

REMARKS, JULY, 1889.

MALTA.—Mean temp. 76°·9; mean hourly velocity of wind 7·7 miles. The sea temp. rose from 74°·8 to 81°·5. J. SCOLES.

Mauritius.—Mean temp. of air 0°·4, of dew point 1°·6, and R ·04 in. above their respective averages. Mean hourly velocity of wind 10·3 miles, or 1·8 below average; extremes 26·5 on 1st and 1·9 on 27th. Prevailing direction E.S.E.
C. MELDRUM, F.R.S.

COLOMBO.—TSS occurred on 13th and 14th; L only was seen on the 15th and 23rd.
J. C. H. CLARKE, LIEUT.-COL. R.E.

Melbourne.—Mean temp. of air 0°·2, of dew point 0°·7, humidity 1, and mean amount of cloud 0·1, above average; R ·08 in. below average. Prevailing wind N. and N.E.; strong on 4 days. Heavy dew on 9 days; dense fog on 10 days; hoar frost on 6 days; lunar halos on 5th and 10th. R. L. J. ELLERY, F.R.S.

Adelaide.—Barometer unusually high, the mean (30·274) being one-tenth above the average of 32 years. Mean temp. 1°·2 below average; R half the average, although the total fall for the first seven months of the year is greater than any previously recorded. C. TODD, F.R.S.

Wellington.—The first few days were fine, with fresh N.W. wind; from 5th to 14th it was showery, with S.E. and S.W. winds. The remainder of the month was generally fine, with moderate wind, chiefly N.W. S on hills on 14th; H on 7th; fog on 4 days. Mean temp. 0°·7 below the average. Rainfall half the average. R. B. GORE.

Auckland.—The early and middle parts of the month were showery and unsettled, with N.W. to S.W. winds; the close comparatively fine, with E. or N.E. winds. Mean temp. close to the average; rainfall slightly below the average.
T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL, JANUARY, 1890.

[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 Hall.	3·70	XI.	Castle Malgwyn	7·49
,,	Margate, Birchington...	1·98	,,	Builth(LlanwrtydWells)	10·61
,,	Littlehampton	2·83	,,	Rhayader, Nantgwillt..	11·44
,,	Hailsham	3·44	,,	Carno, Tybrith	9 39
,,	Ryde, Thornbrough	4·71	,,	Corwen, Rhug	6·09
,,	Alton, Ashdell.....	4·49	,,	I. of Man, Douglas	4·52
III.	Oxford, Magdalen Col...	1·86	XII.	Stoneykirk, Ardwell Ho.	3·62
,,	Banbury, Bloxham	2·70	,,	New Galloway, Glenlee	8·25
,,	Northampton	2·21	,,	Melrose, Abbey Gate...	3·96
,,	Cambridge	...	XIII.	N. Esk Res. [Penicuick]	5·35
,,	Wisbech, Bank House..	2·15	XIV.	Ballantrae, Glendrishaig	4·96
IV.	Southend	1·73	,,	Glasgow, Queen's Park.	6·14
,,	Harlow, Sheering	1·78	XV.	Islay, Gruinart School..	7·65
,,	Rendlesham Hall	1·92	XVI.	Dollar.....	5·65
,,	Diss	2·16	,,	Balquhidder, Stronvar..	18·40
,,	Swaffham	2·59	,,	Dunkeld, Inver Braan..	9·23
V.	Salisbury, Alderbury...	4·07	,,	Dalnaspidal H.R.S. ...	15·17
,,	Warminster	...	,,	Arbroath Cemetery.....	2·52
,,	Bishop's Cannings	3·05	XVII.	Keith H.R.S.	2·25
,,	Ashburton, Holne Vic....	11·99	,,	Forres H.R.S.	2·54
,,	Hatherleigh, Winsford.	3·56	XVIII.	Fearn, Lower Pitkerrie.	3·37
,,	Lynmouth, Glenthorne.	7·64	,,	Loch Shiel, Glenaladale	19·51
,,	Probus, Lamellyn	4·99	,,	N. Uist. Loch Maddy ...	10·77
,,	Launceston, S. Petherwin	6·42	,,	Invergarry	16·36
,,	Wincanton, Stowell Rec.	3·38	,,	Aviemore H.R.S.	4·69
,,	Taunton, Lydeard Ho...	3·81	,,	Loch Ness, Drumnadrochit	7·22
,,	Wells, Westbury	2·85	XIX.	Lairg H.R.S.	...
VI.	Bristol, Clifton	3·90	,,	Scourie	6·76
,,	Ross	3·61	,,	Watten H.R.S.	1·66
,,	Wem, Clive Vicarage ...	3·59	XX.	Dunmanway, Coolkelure	11·61
,,	Cheadle, The Heath Ho.	3·75	,,	Fermoy, Gas Works ...	5·18
,,	Worcester, Diglis Lock	2·55	,,	Tipperary, Henry Street	4·67
,,	Coventry, Coundon	3·27	,,	Limerick, Kilcornan ...	5·85
VII.	Ketton Hall [Stamford]	2·02	,,	Miltown Malbay.....	6·61
,,	Grantham, Stainby	2·31	XXI.	Gorey, Courtown House	4·28
,,	Horncastle, Bucknall ...	2·52	,,	Navan, Balrath	2·59
,,	Mansfield	4·26	,,	Mullingar, Belvedere...	5·18
VIII.	Neston, Hinderton	2·46	,,	Athlone, Twyford	4·66
,,	Knutsford, Heathside ...	3·20	,,	Longford, Currygrane...	4·52
,,	Lancaster, South Road.	6·66	XXII.	Galway, Queen's Coll...	5·88
,,	Broughton-in-Furness ..	8·87	,,	Clifden, Kylemore	8·37
IX.	Wakefield Prison	2·57	,,	Crossmolina, Enniscoe..	8·86
,,	Ripon, Mickley	4·77	,,	Collooney, Markree Obs.	5·07
,,	Scarborough, West Bank	2·04	,,	Ballinamore, Lawderdale	...
,,	East Layton [Darlington]	2·85	XXIII.	Warrenpoint	3·44
,,	Middleton, Mickleton..	4·05	,,	Seaforde	3·60
X.	Haltwhistle, Unthank..	3·80	,,	Belfast, New Barnsley..	3·57
,,	Shap, Copy Hill	12·47	,,	Bushmills, Dundarave...	4·36
XI.	Llanfrechfa Grange	6·71	,,	Stewartstown	3·86
,,	Llandovery	7·99	,,	Buncrana	4·60

JANUARY, 1890.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1880–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE Max. Deg	Date	Min. Deg.	Dat	No. of Nights below 32°. In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	2·46	+ ·84	·35	27	21	55·6	25	26·1	2	4	11
II.		Maidstone (Hunton Court)...	2·34	+ ·79	·49	28	22	...	...	...	...	...	...
,,		Strathfield Turgiss	3·11	+ 1·30	·41	27	25	54·1	7	20·8	2	5	18
III.		Hitchin	2·29	+ ·75	·39	27	20	54·0	9	23·0	1	6	...
,,		Winslow (Addington)	2·16	+ ·35	·41	27	23	55·0	7, 25	16·0	2	9	17
IV.		Bury St. Edmunds (Westley)	2·14	+ ·67	·30	27	19	...	...	...	...	...	...
,,		Norwich (Cossey)	2·41	+ ·92	·38	28	18	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	3·71	+ 1·37	·48	27	25	54·0	25	25·0	2	4	...
,,		Barnstaple	3·28	+ ·26	·50	27	23	56·0	25	30·0	3	...	...
,,		Bodmin (Fore Street)	7·44	+ 3·43	·73	4, 21	28	...	...	...	...	...	...
VI.		Stroud (Upfield)	3·19	+ ·99	·38	25	20	56·0	6, 9	21·0	1	5	...
,,		ChurchStretton(Woolstaston)	4·66	+ 2·50	·92	21	27	53·0	6, 31	20·5	3	10	17
,,		Tenbury (Orleton)	3·38	+ 1·24	·53	21	23	55·2	6	19·0	2	10	14
VII.		Leicester (Barkby)	2·38	...	·62	26	25	56·0	25	16·0	1	13	20
,,		Boston	1·74	+ ·35	·60	28	16	55·0	25	23·0	2	11	...
,,		Hesley Hall [Tickhill].....	2·39	+ ·62	·63	26	19	55·0	6*a*	21·0	3	10	...
VIII.		Manchester(PlymouthGrove)	3·30	+ ·84	·85	26	24	55·0	6	29·0	1, 29	5	12
IX.		Wetherby (Ribston Hall) ...	2·59	+ ·70	·64	22	14	...	...	...	...	...	...
,,		Skipton (Arncliffe)	10·65	+ 5·00	1·29	21	29	...	...	...	...	...	...
,,		Hull (People's Park)	2·36	+ ·59	·37	26	19	...	...	...	...	...	...
X.		North Shields	1·87	+ ·28	·38	8	17	57·0	7	21·0	3	11	11
,,		Borrowdale (Seathwaite).....	21·80	+ 9·62	2·70	21	27	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	5·89	+ 2·68	·80	26	24	...	...	...	...	...	...
,,		Haverfordwest	6·54	+ 2·12	·98	21	24	52·0	6, 7	22·8	1	2	4
,,		Plinlimmon (Cwmsymlog) ...	7·49	...	1·42	21	26	..	...	...	...	..	...
,,		Llandudno.....	3·68	+ 1·40	1·03	21	24	57·8	7	32·5	28	...	...
XII.	SCOTLAND.	Cargen [Dumfries]	6·29	+ 2·52	·90	21	22	53·6	31	26·8	3	7	...
,,		Jedburgh (Sunnyside).....	2·56	+ ·84	·36	22	18	54·0	6	26·0	20	12	...
XIV.		Old Cumnock	6·26	+ 2·27	·58	4	28	51·0	25	23·0	28	6	...
XV.		Lochgilphead (Kilmory).....	11·57	+ 5·43	1·13	19	30	...	...	..	...	...	...
,,		Oban (Craigvarren)	8·86	...	·80	23	30	54·0	16	31·0	23	2	...
,,		Mull (Quinish).....	10·05	+ 4·38	1·03	18	28	...	...	...	...	...	...
XVI.		Loch Leven Sluices	5·70	+ 2·80	1·20	20	17	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	2·40	+ ·43	·35	9	15	53·1	7	24·0	23	6	...
XVII.		Braemar	8·12	+ 5·43	1·51	17	24	51·7	7	14·6	23	9	14
,,		Aberdeen (Cranford)	2·83	...	·54	9	24	54·0	31	19·0	23	9	...
XVIII		Strome Ferry.....	13·55	+ 7·56	1·20	25	30	...	...	...	...	...	...
,,		Culloden	3·39	+ 1·77	1·11	20	9	55·0	16	27·0	23	6	24
XIX.		Dunrobin	...	...	...	...	...	...	...	...	.	...	...
,,		S. Ronaldsay (Roeberry).....	3·24	+ ·29	·67	24	19	50·0	30	31·0	23	5	...
XX.	IRELAND.	Cork (Blackrock).....	6·13	+ 1·53	·83	17	26	54·0	9, 31	27·0	28	5	..
,,		Dromore Castle	6·87	+ ·80	·90	4	22	54·0	16	26·0	28	...	...
,,		Waterford (Brook Lodge) ...	5·94	+ 2·38	1·12	21	22	54·0	18	29·0	29	3	..
,,		O'Briensbridge (Ross)	5·50	...	·98	26	25	54·0	11	28·0	29	7	...
XXI.		Carlow (Browne's Hill)	...	...	...	...	...	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	2·98	+ 1·12	·84	26	21	56·8	16	31·1	29	1	14
XXII.		Ballinasloe	6·08	+ 3·00	·95	26	28	50·0	11	24·0	29	16	...
XXIII		Waringstown	3·56	+ ·91	·50	6	23	55·0	11*b*	27·0	22*c*	10	19
,,		Londonderry (Creggan Res.).	4·31	+ ·89	·47	14	26	...	...	...	...	...	...
,,		Omagh (Edenfel)	4·70	+ 1·68	·71	9	28	54·0	16	30·0	22*c*	7	14

a And 7, 9, 25. *b* And 16. *c* And 28.

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

METEOROLOGICAL NOTES ON JANUARY, 1890.

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.—A very mild month; thermometer at times very high, but on the whole wet, with only six days on which R did not fall.

HITCHIN.—The highest mean temperature on record, 42°·1, the average for 40 years being 35°·8.

ADDINGTON.—The month opened with sharp frost, lasting two days. On the 2nd, dense fog; 3rd, heavy rime; the rest of the month remarkably open and mild. The max. shade temp. was 50° or above on 15 days, and 55° was reached on two occasions. Wind often very high, R falling frequently, that of the 26th and 27th causing a large flood. From 3.30 to 4 p.m. on the 29th three mock suns were seen, the right and left ones very distinct; the upper one was not so bright.

BURY ST. EDMUNDS, WESTLEY.—The month has been very mild, and vegetation is much more forward than usual.

LANGTON HERRING.—On 17 days the temp. rose to 50° or above. On the 25th the temp. was 50° at 9 a.m. and rose to 54° in the day, the highest January temp. for 19 years. A great storm occurred on the 22nd and 23rd. T on 19th and 23rd, L on the 21st, three mock suns on the 29th. A mild, wet month has brought vegetation very forward.

BODMIN, FORE STREET.—A very wet and stormy month, but very mild.

STROUD, UPFIELD.—Gales on many days. From the 17th to the 22nd (both inclusive) the air was very electrical, storm clouds about, going in different directions. Flakes of S on the 20th and 28th; hail on 21st; on the 26th a strong S.W. gale.

WOOLSTASTON.—The early part of the month was very warm, the nights being exceptionally so. Gales and wild, stormy weather commencing on the 14th marked the latter half of the month till the 27th, when S fell heavily. Mean temp. 40°·9.

ORLETON.—Severe frost on the first four days of the month, accompanied for three days by a dense fog and rime. A thaw with R then set in, and the remainder of the month till the 28th was very changeable and stormy, with great and sudden fluctuations in pressure, accompanied by strong gales of wind. There were a few fine, warm days and several frosty nights. On the night of the 26th and 27th a wet snow fell, which covered the valley 2 in. in depth and was 3 in. deep on the hills. The last three days of the month were dry and cloudy. The mean temp. was 4°·5 above the average of the last 29 years. Distant L was seen on the night of the 20th.

LEICESTER, BARKBY.—On the 29th, from 2.55 p.m. to 3.35 p.m., was seen the beauteous and remarkable phenomenon of Parhelia or mock suns, with their attendant circles of coloured light. The mock suns, about 45° apart, had strong prismatic tints, the red being on the sides from the sun and the blue on the inner or nearest sides in each case, but without the intermediate shades. The arch which passed through them and over the sun (at its centre) was ·7 of a full circle coming on each side below the mock sun, strong rays of light also stretching horizontally through them. The sun itself was blurred, the rays of light representing two cones with their bases together and their apices pointing vertically one upwards and one downwards. Another inverted arch half a circle in extent touched and rested on the arch already described; and in the zenith yet another inverted arch of half a circle, very clear and sharp, was seen, with prismatic tints on a blue sky.

MANCHESTER, PLYMOUTH GROVE.—The mean temp. was 42°·8, the highest January temp. for the last 22 years, with the exception of 1875 and 1884; the mean temp. for January in each of those years was 43°. No dense fog during the month. Snow and sleet on the 28th. The weather upon the whole was

mild, damp, and foggy, with drizzling R. The storms at the end of the month not much felt here.

HULL.—The weather generally was wet, dull, and often stormy.

WALES.

HAVERFORDWEST.—Very mild, stormy, and wet, only 7 days without R. The month commenced with severe frost, which, however, was evanescent. Storms of great violence were frequent throughout the month. Heavy T and L at times, notably so on the 18th, accompanied by a whirlwind, which cut a lane through some gigantic beech trees in Picton Woods, snapping some, uprooting others, and some were carried a distance of 100 yards into a neighbouring field. Heavy squalls of R, H, T and L again on the 24th, during which the lightning struck at a place called Hook, exploding with a loud noise, and creating great alarm. Heavy floods, with very high tide, on the morning of the 22nd; none equal to it since January, 1868.

SCOTLAND.

CARGEN.—Very stormy, mild, and unsettled, the mean temp. being nearly 4° above the average. Vegetation is unusually far advanced. The sudden fluctuations both in the thermometer and barometer have been very marked. The somewhat unusual occurrence of the night temp. being higher than the day was observed several times during the month; the most marked instance was on the 12th, the max. day temp. being 45°, the thermometer between 11.30 p.m. and midnight standing at 51°·8.

JEDBURGH.—The temp. generally has been high, with squally winds, on several occasions almost a gale. Spring flowers are far advanced.

OBAN, CRAIGVARREN.—A wild, wet month, with high temperature. The gales of the 18th and 25th were of hurricane force, and accompanied with T and L. Growth continued apace, and spring flowers were in bloom throughout. T and L, and H on the 5th, 12th, and 18th.

MULL, QUINISH.—Very wet and stormy. T and L on 5th, 13th, 18th, 21st, and 25th. Fearful gales from S.W. on 18th and 25th.

CULLODEN.—Particularly fine, and many days very mild, neither ice nor S.

IRELAND.

CORK.—Dulness, with almost constant drizzling R, has characterised the month, which had only 5 days without R.

DROMORE.—Month very stormy, but weather very open. Vegetation still going on.

WATERFORD.—T on the 5th and 23rd, H on the 17th, 18th and 21st, L on the 18th, 19th, and 21st, S on the 22nd, S.W. gale on the 25th.

O'BRIENSBRIDGE, ROSS.—T and L frequent in the early days of the month, indicating the approach of bad weather; a marked fall of temp. about the 17th, followed by violent gales of wind, heavy R and sleet, S and H.

DUBLIN.—A tempestuous, mild, and rainy month; rough southerly to westerly winds, frequently freshening into strong gales. Eleven gales were recorded here, some of them being downright tempests. On several occasions T and L accompanied the storms. The mean temp. was much above the average. A solar halo seen on the 29th; lunar halos were seen on the 7th and 27th. Fogs on the 1st, 2nd and 27th. H on 3 days, S or sleet on 5 days. Temp. exceeding 50° in the screen on 17 days, compared with 8 days in January, 1889, while it fell below 32° in the screen on only one night.

BALLINASLOE.—Wet and stormy, with high floods and violent gales.

WARINGSTOWN.—Very mild, with frequent high winds; grass in pastures growing almost as fast as in summer.

OMAGH, EDENFEL.—The R and temp. were both considerably above the January mean. From the 18th to the 26th a succession of strong gales, backing from S.E. to N.W., swept over the district, frequently accompanied by sleet and S. The end of the month was dull and mild.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCXC.] MARCH, 1890. [PRICE FOURPENCE, or 5s. per ann. post free.

METEOROLOGY IN ROUMANIA.*

IN our number for July, 1886, we noticed three of the earliest publications by Prof. Hepites, who has from the first been Director of the Meteorological Institute of Roumania. In that notice by-the-bye, there was a remark quite unconnected with meteorology to which we may perhaps be excused for referring. By direction of the Roumanian Minister for Agriculture, Prof. Hepites had made a long tour, and studied the meteorological organizations of Europe. To this we added as a foot note, "Roumania has a Minister for Agriculture, England has not yet reached such a state of advancement." Roumania had the start. England has appointed one since we wrote. We shall watch with interest their relative progress.

In the first place we must thank Prof. Hepites for printing most of his text in French as well as in Roumanian, it is more than a convenience, it is a necessity for most of the inhabitants of western Europe.

In the preface to Vol. I., Prof. Hepites points out the scarcity of old observations in Roumania, and that, therefore, his Institute has practically no averages with which to compare results; has in fact to begin absolutely *de novo*.

He wisely begins with a long and apparently complete list of notices of observations and remarks on the climate of the country, which though fragmentary were well worth collecting. To this follows a list of books, memoirs and printed notes on, or appertaining to, meteorology which have appeared in Roumania, the most remarkable feature in which is the fact that there is not one paper before 1841, and that is apparently a physical rather than a meteorological one, viz., "Asaki, Le thermomètre ou le mesureur de

* *Studiŭ aspra Climeĭ Bucurestilor in Aniĭ*, 1885–88, de Stephan C. Hepites, Directorul Institutuluĭ Meteorologic. Partea I., Temperatura aerluĭ.—Buckharest-Tipografia Academiei, Române, 1889. 4to 72 pages, 3 plates.

Annales de l'Institut Météorologique de Roumanie. Par Stephan C Hepites.—Tomes I.–III. Bucuresci, F. Göbl Fïu, 1886–89. 4to, about 600 pages each.

chaleur," published in the Icoana Lumei at Iassy, in 1841. The Institute is rapidly forming a good library, and prints very handsomely its list of books received.

Part II. of Vol. I., consists of 47, 4 to pages, describing the instruments at the Institute and how they are used. Prof. Hepites recognizing the fact that few Roumanians are acquainted with meteorological instruments has described them very fully, and illustrated his description by several excellent engravings. In his description of the pattern of barometer adopted by the Hamburg Seewarte (and which is much the same as our "Kew pattern"). Prof. Hepites ascribes the air trap to Bunten, not as is usual to Gay Lussac, and Prof. Hepites is right. Gay Lussac's barometers had no air trap, Bunten, who succeeded Mossy as an optician at 26, Quai Pelletier, Paris, invented the air trap, and showed it at the *Exposition des produits de l'Industrie Francaise*, in 1823, and having supplied barometers so trapped to various experienced men—Humboldt, Arago and others received from them the highest praise. Acting upon this information, Mr. Ellis in his valuable history of the barometer,* has already pointed out Bunten's claims, but it takes a long time to correct a widespread error.

Of thermometer stands Prof. Hepites has a large collection, oddly enough although Kew Observatory has long abandoned its old pattern (large enough for a hermit to dwell in) Prof. Hepites has one out at Buckharest.†

There is one respect in which Prof. Hepites could render very valuable service to meteorology, at little cost either of time or of trouble. He has three instruments for measuring evaporation, Piche's moistened paper, Wild's counterpoised dish, and a modification of Wild's, whereby it is made self-recording. No maker's name is given, but it looks as if it had been made by Hottinger. All these evaporators are in the Kew stand. We should be very glad if Prof. Hepites would have a large tank made like those used in the South of France, or the iron one formerly at Strathfield Turgiss, and now at Camden Square. A comparison of its results with those of Piche and of Wild, in a climate like that of Buckharest, would be extremely interesting, and of much importance to engineers.

We conclude our notice of this volume by extracting a few data for 1885 :—

Temperature.—True mean 50°·6; mean $\left(\frac{M+m}{2}\right)$ 51°·8. Absolute max. 97°·7; min. −5°·1.
Humidity.—Mean 76. Max. 100. Min. 25.
Rain.—Total 25·49 in. on 112 days. Max. fall 2·26 in. on June 21st.
Evaporation.—Total 13·87. Sunshine 1896 hours, or 42 per cent.

Tome II. is somewhat similar to Tome I., it reports the history of

* *Quar. Jour. Roy. Met. Soc.*, vol. xii., 1886, p, 138.
† Compare his engraving in vol. i., p. cx. with that of the Kew stand in *Met. Mag.*, vol. iv., 1869, p. 17.

the Institute for the year, then gives as full an account of the climate of Buckharest as can be compiled, and finishes with the observations in extenso for 1886, of these we take the same details as we have just given for 1885 :—

Temperature.—True mean 50°·7; mean $\left(\frac{M+m}{2}\right)$ 51°·1. Absolute max. 91·4; min. 11·1.
Humidity.—Mean 74. Max. 100. Min. 26.
Rain.—Total 29·34 in. on 109 days. Max. fall 2·38 on June 9th.
Evaporation.—Total 12·81 in. Sunshine 1980 hours, or 45 per cent.

We own to disappointment when we found that Tome III. was like unto Tome I. and II., very good and valuable, but wholly devoted to the Buckharest observations. Prof. Hepites has evidently a very hard struggle to obtain funds—the Roumanians are like all Europeans, willing to spend money on buildings and on instruments, but not willing to pay for brains, not willing to spend money in order to utilize the observations that are made. It is an old, old story, it is sheer waste of money and of energy to equip stations and not fully utilize the records they afford. We wonder that when the erection of a mountain observatory was proposed, Prof. Hepites did not at once say—"No, let us first get our existing system in full work, let us have the funds to reduce and publish the observations already made, and *then* we will see about the station on the Vîrful cu Dor." However, it is his business not ours, but we would have no costly new instruments, no new observatories, and not even publish any more Buckharest returns, until we had done justice to the observers throughout Roumania, by working up their returns for 1885–86 and 87.

THE MARCH FROST.

WE hope that a frost greater than has occurred in March for nearly half a century, will be fully described. We can here only give a few notes just as they have arrived:—

CAMDEN SQUARE :—

	Glaisher Stand.			Stevenson Screen.		Grass.
	Max.	Min.	9 a.m.	Max.	Min.	Min.
March 4...	40·8	15·6	20·4	41·1	18·0	12·8

Since 1859, there are only four instances of the min. on the Glaisher stand falling below 22°, viz.—

1862—March 4th	21·3
1874—March 11th	21·9
1889—March 4th	19·2
1890—March 4th	15·6

The average minimum during the 30 years, 1859 to 1888, was 25°·5, so that the above is not only by far the lowest, but nearly 10° below the average.—*G. J. Symons.*

INGLESIDE, KENLEY.—Since March came in we have had a remarkable spell of cold.

	Max. deg.	Min. deg.	Min. on grass. deg.
March 1	36·5	25	19
,, 2	29·0	24	snowed up
,, 3	29·0	20	,, ,,
,, 4	39·0	6	2
,, 5	46·0	29	27

You will thus see that we registered on March 4th the low temperature of 6°, and on the grass 2°; and on the 5th the max. was 46°, a variation of 40° in two days. On two days the ther. never rose above 29°.—*Harold Smith.*

HARTLEY, CRANBROOK.—Lowest temp. in March for 25 years.

Year.	deg.	Date.	Year.	deg.	Date.
1866...	24	1	1878...	20	25
1867...	23	17	1879...	27	25
1868...	28	25	1880...	26	29
1869...	25	4, 8	1881...	22	1
1870...	20	14	1882...	27	22
1871...	29	15	1883...	23	10, 11
1872...	26	21, 22	1884...	31	1, 3
1873...	27	1, 14	1885...	30	8, 10, 23, 25, 26
1874...	19	11	1886...	22	11
1875 ..	25	19	1887...	21	13
1876...	24	19	1888...	20	1
1877...	21	1	1889...	20	4

1890, 10° on 4th.

George Pile.

TENTERDEN.—We have had frequent S here, but very light; 5 inches deep last night (3rd) only gave ·25 in. Excessively low temp. this morning (4th), 14° on stand, and 20° at 9 a.m. I see nothing like so low as 14° even in March, 1883, or March, 1886.—*J. Ellis Mace.*

FOX GROVE, BECKENHAM.—On the morning of the 4th inst. my thermometer on an improved Glaisher stand registered a minimum of 7°·3, the correctness of the record being confirmed by a neighbour's reading of 7°·0, about 300 yards away. This temperature is not only remarkable in itself, but the more so as marking the fourth consecutive year's severe frost in March. In 1887 there was skating in London as late as March 21st, and at the club rink in the Regent's Park there was skating till March 5th (inclusive) in 1888, on March 6th, 1889, and on March 4th and 5th, 1890.—*Percy Bicknell.*

ROYAL OBSERVATORY GREENWICH :—

March 4th—Max. 35°·0; min. 13°·1; min. on grass 8°·6.

The minimum (13°·1), is the lowest that has been recorded in the month of March, since 1845, March 13th, when also 13°·1 was registered.—*The Astronomer Royal.*

FOREST LODGE, MARESFIELD.—Before sunrise yesterday morning

4th) the radiation thermometer fell to 8° and this *beneath a coating of snow.* Had the bulb been clear, it must have gone lower. It is a standard instrument.—*William Noble.*

THE OBSERVATORY, CROWBOROUGH CROSS.—

	March 3.		March 4.
Min. in shade	15°·8	.....	16°·2
,, in the open	13°·7	.....	12°·0
,, on grass	9°·6	.....	8°·7

I have not yet had time to examine past records, but I believe it to be the lowest temperature in March since 1845. (Max. in screen on 2nd only 28° !) Snow on 3rd seven inches on the level, nearly the whole of which fell in the afternoon of the 2nd—a regular blizzard. —*C. L. Prince.*

LANGTON HERRING, WEYMOUTH.—

March 3.—Min. temp. 21°, 9 a.m. 25°, 11 a.m. 27°, max. 32°
4 ,, 20° ,, 25° ,, 28°, 2.30 p.m. 32°

The minima of both days are lower than any previously recorded in March since January, 1881, and only once has a min. of 20° been recorded, viz., on February 25th, 1888. Solar halos were observed on both days.—*C. H. Gosset.*

SNOW STORM, MARCH 9TH.

To the Editor of the Meteorological Magazine.

SIR,—At 8.55 this morning, with a temperature of 32°, wind blowing from N.W. by N., snow of extreme fineness and dryness commenced to fall. The storm lasted till 9.5 a.m. I measured the depth in several places on a flat gravel walk not exposed to the wind, and found it to be exactly 1½ inches. I then measured the snow which had accumulated in the rim of my rain gauge, and it yielded ·12 in. of water, being practically one-twelfth part. The snow rapidly disappeared in the hot sunshine which followed the storm.

JAS. WATKINS.

Hurst Bank, Heaton, Bolton, March 7th, 1890.

[Old readers of this magazine may be amused at the above in illustration of some articles in our early numbers on "Periodic Snowballs on March 8th." On March 8th, this year, we had snow, hail and thunder in South Yorkshire, and there were several slight showers of soft hail and of snow in London on the 9th.—ED.]

SALT IN HAIL.

To the Editor of the Meteorological Magazine.

SIR,—Some years ago, in the course of a search for traces of Krakatoa dust in the atmosphere, examining microscopically the spot on a slip of glass where a hailstone had melted and dried up, I found a few minute crystals of chloride of sodium.

GEORGE F. BURDER, M.D.

Clifton, February 28th, 1890.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on February 19th at the Institution of Civil Engineers, 25, Great George Street, Westminster.

Mr. O. B. Cuviljé, Mr. W. Harpur, M.Inst. C.E., and Mr. H. J. Spooner, F.G.S., were elected Fellows of the Society.

The following papers were read, viz. :—

1. "Observations on the Motion of Dust, as Illustrative of the Circulation of the Atmosphere, and of the Development of Certain Cloud Forms," by the Hon. Ralph Abercromby, F.R.Met.Soc. The author has made numerous observations on the motion of dust in various parts of the world, especially on the deserts on the West Coast of South America. He finds that the wind sometimes blows dust into streaks or lines, which are analagous to fibrous or hairy cirrus clouds; sometimes into transverse ridges and furrows, like solid waves, which are analagous to certain kinds of fleecy cirro-cumulus cloud; sometimes into crescent-shaped heaps with their convex side to the wind, which are perhaps analagous to a rare cloud form called "mackerel scales;" sometimes into whirlwinds, of at least two, if not of three, varieties, all of which present some analogies to atmospheric cyclones; sometimes into simple rising clouds, without any rotation, which are analagous to simple cumulus-topped squalls; and sometimes into forms intermediate between the whirlwind and simple rising cloud, some of which reproduce in a remarkable manner the combination of rounded, flat, and hairy clouds that are built up over certain types of squalls and showers. Excessive heating of the soil alone does not generate whirlwinds; they require a certain amount of wind from other causes to be moving at the time. The general conclusion is that when the air is in more or less rapid motion from cyclonic or other causes, small eddies of various kinds are formed, and that they develop the different sorts of gusts, showers, squalls, and whirlwinds.

2. "Cloud Nomenclature," by Captain D. Wilson-Barker, F.R.Met.Soc. The author proposes a simple division of cloud forms under two heads, viz., Cumulus and Stratus, and recommends that a more elaborate and complete division should be made of these two types. In support of this proposal photographs of clouds were exhibited on the screen.

3. "An Optical Feature of the Lightning Flash," by E. S. Bruce, M.A., F.R.Met.Soc. It has been stated in the Report of the Thunderstorm Committee of the Royal Meteorological Society that there is not the slightest evidence in the photographs of lightning flashes of the angular zigzag or forked forms commonly seen in pictures. The author, however, believes that this is an optical reality, as the clouds on which the projection of the flash is cast are often of the cumulus type, which afford an angular surface. In support of this theory he exhibited some lantern slides of lightning playing over clouds.

REMARKABLY DRY AIR.

To the Editor of the Meteorological Magazine.

SIR,—The following instances, observed here by myself, may be thought worthy of being added to your list :—

	Dry.	Wet.	Diff.	Humidity.
1870, July 24, 3 p.m.	89·7	63·8	25·9	23
1886, March 9, 5.45 p.m....	36·7	28·7	8·0	43

The readings were taken on an open stand (Glaisher's). The humidities were got from Glaisher's Hygrometric Tables, 2nd edition, the number 23 being approximate only, from defect of the table.

July 24th, 1870, was a day of intense heat (max. 91°·3), with a cloudless sky and a fresh breeze, varying between south-east and east.

March 9th, 1886, was very fine, but cold, with a gale from south-east, inclining at times towards south.

In my experience it has always been the case that extreme dryness of air has been associated with considerable strength of wind, and thus the question is raised as to how far the calculated relative humidity can be relied on for indicating that which it professes to indicate. It may even be a question whether, from some points of view, the bare difference between the dry and wet bulbs does not constitute a more valuable record than the calculated humidity. Certainly nothing can more accurately represent the *drying power* of the air, for the difference between the bulbs is the direct measure of the rapidity of evaporation.

The tables used by Col. Ward must, I think, differ materially from Glaisher's. At least, I cannot with Glaisher's tables bring out from Col. Ward's data humidities at all harmonising with those which he gives for his extreme instances.

GEORGE F. BURDER, M.D.

Clifton, February 28th, 1890.

"AREAS OF RAREFACTION" OR "DEPRESSIONS."

To the Editor of the Meteorological Magazine.

SIR,—The late Dean Hook, who had a habit of soliloquizing aloud, being present at a service where the second lesson, which happened to be taken from the Epistle to the Hebrews, was given out by the reader as such a chapter from the Epistle of St. Paul to the Hebrews, said to himself, but in a voice that was quite audible to those near him, "So you have settled *that* question have you, old fellow?" The question alluded to by the Dean being of course, the much disputed one as to the authorship of the Epistle to the Hebrews.

I hope your correspondent, Dr. Muirhead, will not think me disrespectful if I say that a similar exclamation to that of the humorous Dean rose to my lips as I read his off-hand assertion that areas of

low pressure are areas "where the air is more rarified, and therefore lighter (not *depressed* as our meteorological authorities teach the general public day-by-day)."

Now this assertion of Dr. Muirhead's is probably true in regard to some of the minor inequalities of atmospheric pressure such as those to which he is chiefly referring in his letter, but, when made in the broad and sweeping way in which he has stated it in the words I have quoted, it seems to me to be a sheer paradox. Does he seriously maintain that the great gyrating low pressure systems which come to us from the Atlantic, *e.g.*, can be reasonably explained on any other theory than that of the existence of eddy like depressions in the atmospheric ocean?

Has he ever stood by the side of a stream and noticed the little "depressions" on the surface of the water where some obstacle to the even flow of the stream has given rise to a conflict of currents? And if so, has it not occurred to him that the conflict of the great atmospheric currents produced by the uneven distribution of the solar heat must inevitably give rise to similar eddy-like depressions in the atmosphere (cyclones) as well as to areas where the atmosphere is, so to speak, piled up (anticyclones). That, at any rate, appears to be the view taken by most leading meteorologists, and, though it may have its difficulties, is not to be set aside by a mere wave of the hand. If Dr. Muirhead will give us good and sufficient reasons for rejecting it, it must, of course, be abandoned; but at present it holds the field, and the burden of disproof lies with our opponents. I, for one, should like much to hear anything that can be fairly urged against it.

You, Sir, recently undertook to demonstrate the non existence of thunderbolts, and in the opinion of most, if not all of your hearers, thoroughly succeeded in doing so. I am sure you will not deny to Dr. Muirhead the opportunity of demonstrating in your columns if he can, the non-existence of those atmospheric depressions which have so long haunted the too imaginative minds of Mr. Scott and his colleagues of the Meteorological Office.

G. T. RYVES, F.R. Met. Soc.

Tean Vicarage, Stoke-on-Trent, March 6th, 1890.

REVIEWS.

Strathpeffer Spa, its climate and waters, with observations historical, medical, and general, descriptive of the vicinity. By FORTESCUE FOX, M.D. London, H. K. Lewis, 1889. 8vo. xviii., 166 pages, map and photo lithographs.

IT is quite refreshing to have a new work on a British Health Resort. Some day we suppose it will become fashionable to be acquainted with the character, and beauty of our own country, and the time may come when people will believe that it is as possible to

find strong mineral water and pure air in the British Isles, as in France, Germany or Hungary.

Meanwhile Dr. Fortescue Fox has produced an interesting and useful monograph on the rising Spa of the far North—for it is very far North—a little N.W. of Inverness; but let it not be supposed that, therefore, Strathpeffer is a mere series of cottages on a hill side—the photographs show quite the contrary—but though there are four or five hotels, we should hardly recommend any one to follow Dr. Fox's advice, and take the 8 p.m. train from King's Cross, so as to reach Strathpeffer for lunch the next day, without *previously* ascertaining that there was a vacant room. Here, however, we have to deal only with the climate, and so we refer our readers for the history of the place, of the strength of its cold sulphur water, of the scenery, antiquities, &c., to the book itself, and proceed to epitomize the 20 pages or so devoted to its climate. This section is not written by Dr. Fortescue Fox, but by a relative to whom he refers as more "competent than myself." The first paragraph that we notice certainly does not justify praise, for either the writer wrote nonsense or the printer made nonsense of what he wrote, and the writer did not find it out. Here is the sentence :—

"Contrary to natural expectations, the Strathpeffer summer is much cooler than in the south of Britain, while, strange as it seems the average winter temperature is very little lower than that of the neighbourhood of London, and some of the winter months have even been slightly warmer."

The facts here are all right; but what do the first four words mean? Would any one naturally expect the summer to be hotter 400 miles nearer the Arctic circle than in London itself? Happily this is the only paragraph to which we need object, the bulk of the article is good, the writer hits the dominating influence when he says that the mountain ranges to the west extract much of the rain from the vapour laden westerly wind, thus giving Strathpeffer a dry and pleasant climate. That influence prevails from Perthshire, through the whole N.E. of Scotland, it is it which gives the crispness and brilliancy to the air of Braemar, and it is it partly which doubtless justifies the following paragraphs respecting Strathpeffer.

"The *Summers* are decidedly cooler than in the south of England, but they are bright, breezy and dry, especially in June and August. the long days invite to an open air life and vigorous exercise, which can be enjoyed without the enervating effect of the heat that is found so trying in many parts of England and on the continent. There is also the advantage of a pure ozoniferous mountain air."

"We have seen that the *Winters* are on the average a little colder than in the neighbourhood of London, but that the nights at least are often warmer. Moreover, the days are not spoiled by the fogs and mists so often met with in the south of England; and the rain clouds have a knack of clearing off readily, so that frequent spells of

sunshine, such as are hardly known in London, make walking a delight, even though the ground may be carpeted with crisp snow."

Dr. Fortescue Fox has been keeping careful meteorological records for four years, he has recently been adding to his instruments, and we believe so placing them that the results will be rigorously comparable with those at other stations, and we wish him success, not only in his meteorological, but in his medical work.

A popular treatise on the winds: comprising the general motions of the atmosphere, monsoons, cyclones, tornadoes, waterspouts, hailstorms, &c. By W. FERREL, M.A. Ph. D. New York, Wiley & Sons; London, Trübner & Co., 1889. 8vo. viii.,—506 pages.

IN writing this important work Prof. Ferrel has conferred a benefit on meteorologists. His mastery of mathematical methods is such that hitherto his publications have been beyond the comprehension of many, who would have profited by his instruction had it been conveyed in a manner which they could understand. The author has recognised this difficulty, and done his best to meet it. The result is a very valuable work treating fully all the subjects named in the title, Opinions will differ as to whether even now the title "popular" is strictly applicable, but however widely they may differ as to that, they will agree as to the value and importance of the information conveyed. And when Prof. Ferrel brings records of facts in illustration of his theories—no novelist or dramatist would compare with him for thrilling effect. Here for instance is one item in an account of a tornado :—

"At a farm house about 16 miles N.E. of Sunk Rapids, a wedding party of 30 persons was assembled, the ceremony was just concluded when the house was struck by the tornado. The bridegroom was killed outright, as were also 15 others; seven more victims of the catastrophe have since died, and only one of the company escaped severe injury."

Or take another case :—

"The house [probably of wood, Ed. *M.M.*] of Robert Reed, 16 ft. × 24 ft., and one-and-a-half stories high, was lifted up as easily as a feather, and without, at first, cracking the timber. So quickly was it done, that before Mr. Reed, who was within, knew his danger, the building had risen the height of 25 ft. or more. The house being then enveloped in darkness, and not knowing what had happened, he started for the door, thinking it time to make good his escape, when, instead of stepping out upon the ground as he expected, he fell the above distance, injuring himself severely."

But we must not let these thrilling stories lead us away from the main features of the book. It is very well arranged, starts with two introductory chapters (I.) On the Constitution and Nature of the Atmosphere, and (II.) on the Motions of bodies relative to the

earth's surface. The general circulation of the atmosphere is then considered, the influence of the earth's rotation and of the temperature of its surface being fully examined, as well as the influence of the circulation of the air on barometric pressure, rain and climate. Then follows consideration of monsoons, cyclones, and local winds, such as Pamperos, Mistral, Bora, &c.

Tornadoes receive a long chapter to themselves, and it is doubtful whether this could have been as well done by any one else. There are others, notably Lieut. Finley, who are more familiar with the damage, but we have never seen anything like the masterly way in which their mechanical effects are reduced to measurement, and shown to be in accordance with the known laws of matter. The study of tornadoes leads naturally to hail, thunder, and dust, storms, so that the book takes altogether a wide field.

As regards the formation of hail, while we have no serious objection to raise to the theory adopted by Prof. Ferrel, we think that some indication that his statements are theory and not facts, would have been an improvement. The subject is very difficult, many explanations have been suggested, and alth. gh very probably the theory given on p. 423 is correct, it is rather forcing the matter to put the whole process in the affirmative way there adopted.

Some persons find it difficult to believe that water ever falls on the earth in a solid stream, they say "Oh, no—you mean very heavy rain," but that is *not* what is meant. Even in this country we have heard the term "Cloud breaking," and "Breaking of a cloud," and Prof. Ferrel has a very interesting section on the subject, entitled "Cloud bursts," in which he adopts precisely the view we have always held as to the facts, and proceeds not merely to quote instances, but to show that theory is quite competent to explain how and why they happen.

The author uses all kinds of measures, English and metric haphazard, and frequently changes backwards and forwards in one sentence. Miles per hour into metres per second, Barometric gradients of English inches per English miles, suddenly given as millimetres and so on. No doubt it is perfectly clear to the author, but it would save trouble to those for whom the work is intended, if one series was adopted throughout. As regards temperatures, some are in Fahrenheit, some in Centigrade, and some are not marked either F. or C., so that one has to gather which they are by examining the context.

This, however, is the only fault that we have to find with a substantial and valuable work.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, AUGUST, 1889.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	TotalRain. Depth.	TotalRain. Days.	Aver. Cloud.
	°		°		°	°	°	0–100	°	°	inches		0–10
England, London	84·4	1	44·2	25	70·5	52·6	52·7	75	125·9	40·2	1·80	16	5·7
Malta	100·0	10	64·2	30	88·0	69·9	64·9	65	147·6	58·2	·00	0	0·3
Cape of Good Hope.	80·0	24	32·4	2	63·7	47·0	...	...	...	...	5·00	7	5·3
Mauritius	76·0	30	61·4	16	73·6	64·3	58·3	71	125·6	52·5	3·68	22	5·5
Calcutta	89·9	2, 4	74·4	8	87·2	78·3	79·0	88	155·7	74·6	8·03	27	7·9
Bombay	87·7	4	75·5	7	84·9	77·8	76·2	84	139·7	74·7	10·32	31	8·8
Ceylon, Colombo	87 0	17	73·4	31	85·0	77·9	72·3	78	145·1	72·0	4·66	14	7·3
Melbourne	68·0	28	32·1	3	57·8	43·0	42·3	75	127·3	23·4	2·06	15	6·1
Adelaide	71·3	28	38·0	23	60·2	46·0	45·1	74	128·3	29·2	3·59	20	5·1
Wellington	62·0	14	35·0	19	54·8	41·7	40·3	75	110·0	25·0	2·59	15	3·7
Auckland	62·5	24	40·0	19	57·9	46·6	46·0	80	133·0	30·0	2·59	18	6·0
Jamaica, Kingston	93·5	4	69·3	10	91·1	72·1	71·9	72	...	...	2·02	...	...
Trinidad	91·0	8	70·0	var.	89·8	71·3	77·9	81	158·0	61·0	11·73	24	...
Toronto	83 9	21	45·8	6	75·4	56·1	56·3	74	...	39·0	·43	10	5·2
New Brunswick, Fredericton	84·7	30	43·0	14	74·5	54·4	57·1	76	...	...	1·82	12	4·9
Manitoba, Winnipeg	96·6	30	33·8	4	80·3	50·8	56·1	71	...	...	·95	10	5·4
British Columbia, Victoria	77·0	11	41·0	20	69·0	48·3	...	...	...	...	1·04	6	...

REMARKS, AUGUST, 1889.

MALTA.—Mean temp. 77°·9; mean hourly velocity of wind 6·9 miles. The sea temp. fell from 79°·5 to 77°·0. Averrge amount of cloud unusually low. J. SCOLES.

Mauritius.—Mean temp. of air 0°·4, and of dew point 0°·8 below, R 1·61 in. above, their respective averages. Mean hourly velocity of wind 13·0 miles, or 0·6 miles above average; extremes 27·2 on 20th, and 1·6 on 8th. Prevailing direction E.S.E. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 0°·2 below, of dew point 0°·2 above, humidity 1 above, and R ·23 in. above average. Prevailing winds N., strong on 8 days. Heavy dews on 10 days; fogs on 5 days; hoar frost on 2 days; hail on 2 days; T and L on the 11th. R. L. J. ELLERY, F.R.S.

Adelaide.—Pressure about normal. Mean temp. 0°·9 below the average. R 1·25 in. above the average, bringing the total for the year up to 23·32 in., the greatest on record during that period, and 1·03 in. above the total for the first 8 months of 1875, the previous highest record. C. TODD, F.R.S.

Wellington.—Heavy R on 3rd (1·15 in.), otherwise fine up to the 8th; from 9th to 18th generally showery; from 19th to the end pleasant weather, except on the night of 22nd, which was wet, with strong N.W. wind. Prevailing wind N.W., strong on 5 days. T on 14th, H on 14th. R half the average; mean temp. 0°·3 above average. R B. GORE.

Auckland.—On the whole a fine, mild and seasonable month. Mean temp. the same as the average; R small, being 1¾ in. under the average. T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL, FEBRUARY, 1890.

[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 Hall.	1·08	XI.	Castle Malgwyn	1·13
,,	Margate, Birchington...	·88	,,	Builth(LlanwrtydWells)	1·08
,,	Littlehampton	1·36	,,	Rhayader, Nantgwillt..	1·54
,,	Hailsham	1·20	,,	Carno, Tybrith	·59
,,	Ryde, Thornbrough	1·08	,,	Corwen, Rhug	·81
,,	Alton, Ashdell.....	·67	,,	I. of Man, Douglas	1·82
III.	Oxford, Magdalen Col...	·71	XII.	Stoneykirk, Ardwell Ho.	1·94
,,	Banbury, Bloxham	·61	,,	New Galloway, Glenlee	·97
,,	Northampton	·72	,,	Melrose, Abbey Gate...	·88
,,	Cambridge (Fulbourne).	·82	XIII.	N. Esk Res. [Penicuick]	·90
,,	Wisbech, Bank House..	·67	XIV.	Ballantrae, Glendrishaig	1·53
IV.	Southend	1·08	,,	Glasgow, Queen's Park.	·50
,,	Harlow, Sheering	·73	XV.	Islay, Gruinart School..	1·03
,,	Rendlesham Hall	·82	XVI.	Dollar.....	1·11
,,	Diss	1·06	,,	Balquhidder, Stronvar..	1·51
,,	Swaffham	·68	,,	Dunkeld, Inver Braan..	1·44
V.	Salisbury, Alderbury...	·73	,,	Dalnaspidal H.R.S. ...	2·07
,,	Warminster	·87	,,	Arbroath Cemetery.....	...
,,	Bishop's Cannings	·73	XVII.	Keith H.R.S.	1·10
,,	Ashburton, Holne Vic....	2·37	,,	Forres H.R.S.	·40
,,	Hatherleigh, Winsford.	·37	XVIII.	Fearn, Lower Pitkerrie.	·69
,,	Lynmouth, Glenthorne.	1·26	,,	Loch Shiel, Glenaladale	2·22
,,	Probus, Lamellyn	1·51	,,	N. Uist. Loch Maddy ...	·40
,,	Launceston, S. Petherwin	1·43	,,	Invergarry	1·18
,,	Wincanton, Stowell Rec.	·75	,,	Aviemore H.R.S.	·45
,,	Taunton, Lydeard Ho...	1·29	,,	Loch Ness, Drumnadrochit	·58
,,	Wells, Westbury	1·04	XIX.	Lairg H.R.S.	..
VI.	Bristol, Clifton	·58	,,	Scourie	·89
,,	Ross	·68	,,	Watten H.R.S.	1·17
,,	Wem, Clive Vicarage ...	·70	XX.	Dunmanway, Coolkelure	3·40
,,	Cheadle, The Heath Ho.	·65	,,	Fermoy, Gas Works ...	3·36
,,	Worcester, Diglis Lock	·51	,,	Tipperary, Henry Street	2·88
,,	Coventry, Coundon	·71	,,	Limerick, Kilcornan ...	...
VII.	Ketton Hall [Stamford]	1·10	,,	Miltown Malbay.....	2·60
,,	Grantham, Stainby	1·02	XXI.	Gorey, Courtown House	1·14
,,	Horncastle, Bucknall ...	1·08	,,	Navan, Balrath	·89
,,	Mansfield	·90	,,	Mullingar, Belvedere ...	1·05
VIII.	Neston, Hinderton	·65	,,	Athlone, Twyford	1·02
,,	Knutsford, Heathside ...	·64	,,	Longford, Currygrane...	1·05
,,	Lancaster, South Road.	·74	XXII.	Galway, Queen's Coll...	·95
,,	Broughton-in-Furness ..	1·26	,,	Clifden, Kylemore	2·18
IX.	Wakefield Prison	1·00	,,	Crossmolina, Enniscoe..	·53
,,	Ripon, Mickley	·98	,,	Collooney, Markree Obs.	·46
,,	Scarborough, West Bank	1·97	,,	Ballinamore, Lawderdale	...
,,	East Layton[Darlington]	·99	XXIII.	Warrenpoint	1·71
,,	Middleton, Mickleton..	·83	,,	Seaforde	1·66
X.	Haltwhistle, Unthank..	1·26	,,	Belfast, New Barnsley..	1·53
,,	Shap, Copy Hill	1·16	,,	Bushmills, Dundarave...	1·05
XI.	Llanfrechfa Grange	·58	,,	Stewartstown	1·38
,,	Llandovery	1·06	,,	Buncrana	1·03

FEBRUARY, 1890.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1880–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE Max. Deg.	Max. Date	Min. Deg.	Min. Date	No. of Nights below 32° In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	1·05	— ·83	·66	14	9	49·3	1	27·1	28	11	
II.		Maidstone (Hunton Court)...	·92	— ·88	·55	14	5	...	...	...	...	...	...
,,		Strathfield Turgiss	1·10	— ·90	·61	14	8	50·7	18	24·8	4	15	24
III.		Hitchin	·73	— 1·02	·31	14	9	51·0	1	27·0	10 *c*	16	...
,,		Winslow (Addington)	·77	— 1·39	·34	15	8	50·0	1	24·0	13	14	20
IV.		Bury St. Edmunds (Westley)	1·02	— ·54	·42	15	7	...	...	...	...	...	...
,,		Norwich (Cossey)	·64	— ·95	·26	14	5	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	·76	— 1·84	·17	14	7	50·0	17	26·0	28	13	...
,,		Barnstaple	1·02	— 2·04	·31	19	7	53·0	22 *b*	26·0	3, 4	...	...
,,		Bodmin (Fore Street)	1·71	— 3·28	1·20	16	10	...	...	...	...	...	...
VI.		Stroud (Upfield)	·68	— 1·87	·22	15	6	50·0	1	25·0	12 *d*	15	...
,,		ChurchStretton(Woolstaston)	·84	— 1·61	·28	14	12	50·0	21	24·0	13 *e*	16	22
,,		Tenbury (Orleton)	·74	— 1·74	·20	15	12	53·0	25	22·2	11	16	19
VII.		Leicester (Barkby)	·84	...	·44	15	11	51·0	1	21·0	5	19	27
,,		Boston	1·15	— ·53	·65	15	9	55·0	23	24·0	28	12	...
,,		Hesley Hall [Tickhill].....	·85	— ·64	·60	15	11	52·0	1	23·0	11	12	...
VIII.		Manchester(PlymouthGrove)	·30	— 1·75	·15	15	6	51·0	1	27·0	5, 6 *d*	13	19
IX.		Wetherby (Ribston Hall) ...	1·13	— ·45	·72	16	6	...	...	...	...	...	...
,,		Skipton (Arncliffe)	1·15	— 3·54	·47	15	11	51·0	1	29·0	9	...	...
,,		Hull (People's Park)	1·29	— ·51	·65	15	11	...	...	...	...	...	...
X.		North Shields	1·51	+ ·18	·60	15	13	54·0	1	28·0	6, 14	7	12
,,		Borrowdale (Seathwaite).....	3·74	— 8·89	1·74	1	9	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	·62	— 2·57	·23	19	8	...	...	...	...	...	...
,,		Haverfordwest	1·50	— 2·62	·80	16	7	49·5	25	23·9	6	14	22
,,		Plinlimmon (Cwmsymlog) ...	·68	...	·33	19	5	..	...	...	...	..	...
,,		Llandudno.....	1·13	— ·79	·32	15	5	49·1	1	29·0	13	...	...
XII.	SCOTLAND.	Cargen [Dumfries]	1·00	— 2·65	·44	1	5	50·8	25	23·6	9	13	...
,,		Jedburgh (Sunnyside).....	·80	— ·71	·38	15	6	50·0	23	20·0	9	16	...
XIV.		Old Cumnock	1·05	— 2·45	·47	1	8	51·0	23	18·0	27	20	...
XV.		Lochgilphead (Kilmory).....	1·23	— 3·96	·40	1	10	...	...	...	...	...	...
,,		Oban (Craigvarren)	·90	...	·31	1	11	52·2	24	29·0	28	2	...
,,		Mull (Quinish).....	1·05	— 4·42	·23	1	10	...	...	...	...	...	...
XVI.		Loch Leven Sluices	1·10	— 1·65	·60	16	4	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	1·35	— ·75	1·00	15	4	51·6	24	25·9	8	16	...
XVII.		Braemar	1·38	— 1·98	·51	15	9	49·5	25	11·8	15	22	26
,,		Aberdeen (Cranford)	1·01	...	·48	15	14	52·0	3, 23	28·0	14	9	...
XVIII		Strome Ferry.....	1·30	— 4·43	·40	28	8	...	...	...	...	...	...
,,		Culloden	·53	— 1·31	...	...	..	52·0	23	23·0	15	10	24
XIX.		Dunrobin	1·45	— ·64	·48	15	6	55·0	23	27·8	8, 15	11	...
,,		S. Ronaldsay (Roeberry).....	1·37	— 1·27	·29	15	18	48·0	23	29·0	27 *e*	3	...
XX.	IRELAND.	Cork (Blackrock).....	2·56	— 2·51	·69	12	12	55·0	20	27·0	5	9	...
,,		Dromore Castle	3·39	— 2·26	1·00	12	12	55·0	22	30·0	4	...	...
,,		Waterford (Brook Lodge) ...		— ...	...	...	...	...	...	...	...	...	...
,,		O'Briensbridge (Ross)	..	...	...	...	...	...	...	...	...	...	...
XXI.		Carlow (Browne's Hill)	1·21	— 1·87	·20	16 *a*	11	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	·80	— 1·55	·28	16	7	52·5	1	27·9	16	5	18
XXII.		Ballinasloe	·68	— 2·09	·18	1, 16	12	50·0	22	23·0	8	17	...
XXIII		Waringstown	1·53	— ·92	·42	19	11	56·0	22	25·0	4	12	21
,,		Londonderry (Creggan Res.).	·76	— 2·28	·12	17	16	..	...	...	...	...	...
,,		Omagh (Edenfel)	1·04	— 1·65	·21	17	11	50·0	2	27·0	4	7	22

a And 17. *b* And 26. *c* And 27, 28. *d* And 27. *e* And 28

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

METEOROLOGICAL NOTES ON FEBRUARY, 1890.

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 early part of the month was marked by a beneficial change, the weather being fine and dry, with a lower temperature. This colder weather continued throughout the month, and ended with a mean temp. on grass of 11°·8.

ADDINGTON.—A very dry month. During 20 years a smaller quantity of R has been recorded in February only twice, namely, ·63 in. in 1886, and ·64 in. in 1887. Frost occurred on a good many days, but was not severe. On the mornings of the 21st and 22nd rather dense fog occurred, clearing off before midday. Winds easterly nearly all through the month.

BURY ST. EDMUNDS, WESTLEY.—The month was a dry one. The mildest day was the 1st, the coldest the 28th. N. and E. winds prevailed for 24 days.

LANGTON HERRING.—A very fine, dry, cold, month, presenting a striking contrast to January. The mean temp. at 9 a.m. was 3°·1 below the average. Only once in February did the temp. rise above 49°—in January 17 times. Wind from W. on 4 days, E. on 24 days. Solar halo on the 14th. Fog on 21st and 22nd.

BODMIN, FORE STREET.—A dry month, with cold winds from N.E. and and N.W., chiefly from E. and N.N.E. Hard frost on 28th, and freezing all day.

WOOLSTASTON.—A cold, dry month, with constant frost. S on 14th, 15th 19th and 28th. Mean temp. 35°·7. A very marked solar halo was observed in the afternoon of the 28th from about 4.40 to 5 p.m.; the prismatic tints were very bright, and the mock sun on either side well defined; the upper one was only faintly indicated, and the lower one (if any) was below the horizon. There was also a very fine lunar halo the same evening.

ORLETON.—A very dry, cold and dull month, with a prevailing wind from N.E. Frequent severe frosts at night, with much fog. The sun was generally obscured by clouds or fog, but there were a few bright days. The mean temp. of the month was 3°·7 below the average of 29 years. The ground was only once covered with S, on the morning of the 20th. The bar. was very high during the greater part of the month. On the 24th at 5 p.m. great darkness with yellow fog occurred for half-an-hour, and again at the same hour on the 26th, with dark, stormy clouds. A lunar halo occurred on the night of the 28th, followed by a little S.

MANCHESTER, PLYMOUTH GROVE.—Thick fog on 6th; wet mist and thick fog on the 22nd, 23rd and 24th. S and sleet on the 20th. Cold E. wind prevailed. Mean temp. 38°·3.

HULL.—The weather up to the 24th was generally fine, but with a great amount of cloud, from that date to the end of the month it was frequently squally with showers of R, H, or S.

WALES.

HAVERFORDWEST.—Showery and cold on 1st, from the 2nd to the 15th dry, fine, and frosty, with keen easterly wind; more like March than February. The weather changed rather suddenly on the 15th, and some heavy R occurred, followed by a return of cold, but somewhat broken weather, which continued to the end of the month. The temp. was below the average, and the number of fine days above the average. Prevailing winds E., S.E. and N.W.

SCOTLAND.

CARGEN.—The mean bar. pressure for the month (30·186 in.) was unusally high, and during the last 20 years has been exceeded only three times, viz., in

January, 1880, when it was 30·234 in.; in November, 1879, 30·291 in.; and in November, 1867, 30·189 in. The mean temp. of the month (37°·9) was 1°·7 below the average, and 4°·1 below that of January. E. winds prevailed on 20 days.

JEDBURGH.—The temperature was much lower than in January, with cold E., N., and N.E. winds. Vegetation has progressed little since January.

OBAN, CRAIGVARREN.—The month was quite exceptionally dry for February, and March winds commenced on the 11th and continued throughout with a cold spell at the end. Fruit and other trees commenced to leaf and spring flowers were in bloom.

CULLODEN.—The rainfall was very small. Many days were mild and very sunny and the frosts were moderate.

IRELAND.

CORK.—Generally cold with frequent showers to the 21st; thence fine and often bright, with chilly easterly winds. Mean temp. 41°·8, nearly 0°·5 below the average.

DUBLIN.—This month was remarkable for the contrast it afforded to January. S.E. and E. winds, quiet, chiefly fine weather, frequent fogs, and low temp. took the place of the blustering S.W. gales, heavy and frequent rains, and high unsteady temp. of the preceding month. The mean temp. was 3° below that of January. The month may be regarded as a favourable one, but the amount of cloud (7·2) was much in excess of the average (6·6), and the month was notable for its foggy character. The mean temp. was 41°·5, or 1°·2 below the average. S or sleet fell on 13th and 28th. H on 7th; fog on 10 days; high winds on 6 days; gale on 12th. Temp. in shade exceeded 50° on 2 days, and on 2 days did not rise above 40°.

OMAGH, EDENFEL.—A fine, generally dry, and seasonable month, with typical easterly winds prevailing on 20 days and with neither frost nor rain sufficient to intrerupt its excellent character for farming operations.

THE WEATHER PLANT—GREAT RAINFALL.

To the Editor of the Meteorological Magazine.

SIR,—I have seen in your last number that a weather plant has been fixed as weather prophet at the tourists' house on the Sonnblick (!) I was never able to ascertain if it performed, but I believe that the whole is nothing but humbug. I know nobody who can give me reliable information about it. The weather plant has lost all interest with us, and I hear nothing about it.

In the February number of the *Zeitschrift* you will find that at the station Hermsburg (about 3,000 ft. above sea level) in the south Krain, southern foot of the Krainer snow mountains, in the month of October 1889, 1450 mm. or 57·1 inches of rain fell. In one of our early numbers I shall report details about our new stations, where rain has been most plentiful. In South Dalmatia, Bocche di Cattaro we have a station, Crkvice, 3,445 ft. above sea level where in the year 1889, more than 5,000 mm. or 200 inches of rain fell, and yet the year has been pretty normal.

Yours very truly,

J. HANN.

Hohe Warte bei Wien, 22nd February, 1890.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

CCXCI.] APRIL, 1890. [PRICE FOURPENCE, *or 5s. per ann. post free.*

BIBLIOGRAPHY OF METEOROLOGY.*

To most of our readers the last paragraph of the introduction to the second volume of the type-written edition of the "Bibliography of Meteorology" will prove a sad disappointment. It is as follows :—

> "It will be impracticable for this office to put forth any other part of this Bibliography; but possibly supplements to the subject of Part I., 'Temperature,' and Part II., 'Moisture,' may appear later."

That is to say, out of 32 sections and sub-sections two have been type-written, and the other 30 remain in manuscript in the library of the Signal Office.

We refuse to believe that a nation, wealthy and liberal in the highest degree, would consciously do so mean an action as first to invite the help of other countries in compiling a Bibliography, and by its responsible officer promise to publish it, and then, when it had received help from all quarters of the world, decline to carry out its promise, and keep the material so obtained for the use of its own officers.

We blame no one. It is the system, not any one man, who is in fault. We do not like putting ourselves in front, but we gave up something like a year of our own time towards preparing our share of that catalogue; the Royal Meteorological Society and the Royal Observatory, Greenwich, lent their MS. catalogues, and the Société Météorologique de France engaged a special assistant for many months to form a complete catalogue of its library, and sent it to England to be incorporated with the others, and for all this trouble and expenditure the result is—next to nothing.

Our readers will naturally ask—why? Because by the rules laid down, the Signal Office is not allowed to print such a work without

* *Bibliography of Meteorology*, prepared under the direction of Brigadier-General Greeley. Edited by Oliver L. Fassig, Bibliographer and Librarian to the Signal Office. Part II., "Moisture." Signal Office, Washington, 1889. 4to. Type-written, 478 pages.

the authority of Congress. General Hazen, when he promised to publish the Bibliography, never dreamed of there being any difficulty, but his successor, General Greely, although very desirous that it should be published, cannot break the laws which regulate his office. He has reported over and over again that it is desirable that it should be done, but a special vote by Congress is necessary, and we fear that few members of Congress are aware of the merits of the case.

It is really not a matter for which Europeans ought to plead strongly; it is for our friends in the States to examine the facts and act as they think worthy of their country. We are sure that if American scientists were once in possession of the merits of the question, they would soon lay the facts before the members of Congress, and that as soon as the members understood it all difficulty would be removed.

We could fill pages with resolutions and quotations from France, Germany, Belgium, and England, urging the importance of the publication, but we prefer to leave it entirely on its merits and entirely in the hands of our friends in the States.

We shall not refer to the subject again until we hear that the matter has been brought distinctly and definitely before Congress.

Turning now to Part II., we desire, in the first place, to record our appreciation of the immense labour which has been bestowed upon it in the Signal Office.

In the introduction General Greely intimates surprise or regret at the few errata and additions sent in with reference to Part I. Speaking only for ourselves, we not improbably speak for others also, when we say that the change from classification under authors to classification under subjects has thrown very great difficulties in the way of comparison and verification. The present part contains about 7,500 entries, and the only way by which we can check them is by cutting up two copies of the book (*i.e.*, one for each side of each page) and arranging the 7,000 or 8,000 slips alphabetically under authors, and not till that is done can the checking against our books and pamphlets be begun. Obviously it would take much less time to do this for all sections at once than to do it separately 32 times over. It would at the very least take one person a twelve-month to check the whole Bibliography, and hitherto we have not had such encouragement as to induce this further expenditure of time.

Even as it stands in its imperfect typography this is a wonderful book, but rather saddening on the whole, for it shows so plainly how much work has been done in duplicate. It shows how needful it is that we should have that for which we have so often pleaded in these pages, "more hard workers, more deep thinkers"; but in this world most men have to earn a livelihood, and there is a serious

mistake current with those who have money, they always want to "see something for it." They are ready enough to pay for instruments and apparatus, or for making observations, but if one man proposed to work up the subject of the composition of rain-water, and as a preliminary to devote his time to a thorough mastery of what has already been done, whereas another proposed to buy a lot of apparatus and begin *de novo*, ignoring the past, the latter would be sure to be chosen.

When one looks through this volume one cannot but think how grand an advance would be made were the mass of knowledge which is indexed in the whole Bibliography worked up by competent hands, and abstracted from the 30,000 or 40,000 volumes into 40 or 50. One cannot but believe that the present system, whereby nearly all Government money is spent, is correctly described by the words applied to it by Sir George Airy many many years ago: "Adding millions of useless observations to the millions which already exist." The popular saying that "Half the world does not know how the other half lives," is equally true of meteorologists; half of them do not know what the other half have done. This Bibliography, completed and worked up as above suggested, would annihilate this difficulty, and place the rising generation of meteorologists in a position analagous to that conferred on astronomers by the splendid work of Houzeau and Lancaster.

PRE-INSTRUMENTAL METEOROLOGY.*

IF one wishes to sueceed, the prime necessity is perseverance. Twenty one years since we inserted in this Magazine, a letter under the above title, in which a scheme was formulated for collecting and preserving the many notes as to weather, frosts, floods and other remarkable phenomena which are recorded in early literature, and in the county histories and parish registers in the British Isles. Nobody has ever disputed the desirability of this being done, but on the other hand nobody except Miss E. A. Ormerod, F.R.Met.Soc. has ever done anything towards it. She with her habitual energy and perseverance took up the idea, and as the result we have in the library of the Royal Meteorological Society, the MS. volume entitled, "Pre-instrumental Meteorology, contained in extracts from the Saxon Chronicle and Holinshed's Chronicles of England, Scotland and Ireland." But Miss Ormerod has other work on hand. Is there no one else who combines a taste for meteorology with one for archæology, and who has also a few hours a week that they could give to it? We should enjoy it ourselves, but are over-worked already, and therefore, dare not undertake to do more than to help any one, or all, who will take it up.

---

* *Meteorological Magazine*, Vol. iv. (1869) p. 38; xii. (1877) p. 179; xiii. 1878) p. 6, and xx. (1885) p. 160.

As the above references show, we have persistently tried to find a labourer for this field, we are sure that he (or she) would reap a good harvest, and we believe that a notice in some of the leading literary journals, that a centre existed where such notices would be acceptable would bring in much information with little trouble.

Just as an illustration we may refer to the *Athenæum* of March 29th, 1890, where, in a review of *The Register Booke of Inglebye juxta Greenhow, since the yeare of our Lord*, 1539. Edited by John Blackburne, Curate, we find the following :—

"It has been suggested more than once that if the information were brought together a considerable amount of weather knowledge might be gleaned from old parish registers. An instance of this kind occurs under March 14th, 1666, when we find that a widow called Anna Bland 'tempestate venti, nivis et frigoris extincta.'"

Is it too much to ask that those of our readers who are Clergy of the Church of England, and as such, custodians of the records of probably 100 or 200 parishes, shall each examine the records which he has and copy out all references to frosts, snows, storms, floods and other meteorological phenomena? Failing any better mode of publication, we are ready to insert them in these pages.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on February the 19th at the Institution of Civil Engineers, 25, Great George Street, Westminster; Mr. H. F. Blanford, F.R.S., vice-president, in the chair.

Mr. D. Balfour, M.Inst.C.E., Mr. W. Belk, M.Inst.C.E., Capt. G. A. Chaddock, Mr. W. S. Crimp, Assoc.M.Inst.C.E., Mr. G. Fellows, Dr. A. E. Garrod, M.A., M.R.C.P., and Capt. H. E. Rawson, R.E., were elected Fellows of the Society.

The following papers were read :—

1. "A Brief Notice respecting Photography in relation to Meteorological Work," by Mr. G. M. Whipple, B.Sc., F.R.A.S. The first person to use photography for obtaining meteorological records was Mr. T. B. Jordan, of Falmouth, in 1838. Some years later, Sir F. Ronalds and Mr. C. Brooke devised more complete and elaborate apparatus; the arrangement of the former being now in use at the observatories of the Meteorological Office, and that of the latter at the Royal Observatory, Greenwich. Reference was also made to Mr. J. B. Jordan's form of sunshine-recorder, and to Capt. Abney's photo-nephograph. The various photographic processes which have been employed in connection with these instruments were fully described.

2. "Application of Photography to Meteorological Phenomena," by Mr. W. Marriott, F.R.Met.Soc. The author showed how photography could be most usefully employed for the advancement

of meteorological knowledge. Much valuable information had been recently obtained from photographs of lightning and clouds. An interesting collection of such photographs was shown on the screen, together with others illustrating floods, whirlwinds, tornados, hail-storms, frost, snow, &c.

After the reading of these papers the meeting was adjourned to allow the Fellows to inspect the Exhibition of Instruments, &c., illustrating the application of photography to meteorology. Not only were specimens or drawings of nearly every photographic meteorological instrument and records from the same shown, but also a most valuable and interesting collection of photographs of clouds and other meteorological phenomena. The photographs of clouds taken by Mons. P. Garnier, of Boulogne-sur-Seine, were exceptionally fine. New meteorological instruments were also shown, as well as an ingenious working model, devised by Mr. A. W. Clayden for showing the connection between the monsoons and the currents of the Arabian Sea and the Bay of Bengal.

WHIRLWIND AT FULFORD, NEAR YORK, MARCH 8TH.

A very sudden and severe storm prevailed in the vicinity of York at about half-past two on Saturday afternoon. The sky rapidly darkened and vivid flashes of forked lightning were followed by loud peals of thunder and a heavy downfall of hail and rain. The storm was of short duration, and soon after three o'clock the sun again broke out and fine weather was experienced for awhile. Sudden gusts and showers took place at intervals. The storm seems to have touched the city lightly as compared with the devastation it created at Fulford. About half-past three a whirlwind of extraordinary violence visited Fulford, and the damage which it wrought in a short space of time is, at the lowest computation, estimated to be £100. Fulford Hall, the residence of Captain Key, and the home farm immediately adjoining, occupied by Mr. Harrison, appear to have suffered most from the violence of the storm, which was only at its height for something like a minute, and was confined to an area of about 200 square yards. The gale completely rooted up, and carried several yards, a number of very large trees, both oak and elm, and some crows which had taken refuge in their branches, were killed, the birds in some instances being dashed to pieces. A Dutch barn which is of about 96 feet in length, on Mr. Harrison's farm, was blown entirely from its foundations, carried over a hedge, and finally deposited 5 or 6 yards on the other side of the fence. Half a dozen large stacks were overturned, and some other stacks a short distance away rocked to and fro, and were all but upset. The windows of Fulford Hall bear testimony to the violence of the gale, and in some parts the slates have been torn off the roof, and other damage done. The roofs of the out-houses and dwellings in close proximity to Ful-

ford Hall have been damaged to a very great extent, whilst two bye lanes have been completely blocked by uprooted trees, hedges, and other *debris*. A notable fact is that some trees which stood just outside the area covered by the whirl-wind have scarcely been touched at all. A gentleman who witnessed the development of the whirl-wind says that it appears to have formed in the direction of Bishopthorpe, and after spending the worst of its violence at Fulford, it passed on to Heslington, where we understand considerable damage was done.—*York Herald*, March 10th, 1890.

[In order to avoid duplicate printing, this subject has been taken up by Mr. J. Edmund Clark, B.Sc., of York, whose account will be read at the meeting of the Royal Met. Soc., on April 16th, and subsequently printed in the *Quarterly Journal R. Met. Soc.*—ED.]

REVIEWS.

The Summary of a Meteorological Journal. Kept by C. LEESON PRINCE, F.R.A.S., F.R.Met.Soc., at his observatory, Crowborough, Sussex, 1889. Fcap. fol. Privately printed.

THERE are two special features in Mr. Prince's report for 1889. He draws attention to the great excess of N.E. winds in his records for the last few years. Abstracting his tables we have

			N.E.	S.W.	Excess of S.W
Average frequency,	1843-89	47 years	63	91	+28
,, ,,	1859-83	25 ,,	63	99	+36
Frequency.....	1884		75	72	— 3
Average frequency,	1885-89	5 ,,	102	72	—30

Mr. Prince very naturally remarks :—"It seems difficult to assign any physical cause for this sudden and great change in the direction of our two most prevalent winds, but it may be interesting to draw attention to the fact in the event of some comparative observations being elicited." We hope that some will be forthcoming, for it is a puzzle at present—unless indeed the large addition to Mr. Prince's house has affected the indication of his vane. Evidently the subject should be investigated in two ways—(1) by examining other records for the S.E. of England—(2) by Mr. Prince checking the indications of his vane by that of another, by low clouds, and by smoke.

The other fact which is certainly exceptional for this country, is one for which Mr. Prince gives the authority, viz., that "After the thunderstorm of June 7th, 1889, Mr. Young, of Barden Mill, Tunbridge Wells, picked up a hailstone weighing nearly or quite half-a-pound." The table in *Met.Mag.*, Vol. xiv., p. 116, shows that it must have been 3 inches in diameter, or 9½ inches in circumference.

Berliner Zweigverein der Deutschen Meteorologischen Gesellschaft. Siebentes Vereinsjahr, 1890. Privately printed, Berlin, 1890.

WE refer to this paper because it contains two notes, which we desire to bring before our readers. Like all the previous reports

it is drawn up by Dr. Hellmann, and that gives weight to the statements.

(1). A thunderstorm occurred near Berlin, on May 16th, 1889, accompanied by what is described as a rain of "unusual intensity." Prof. Dr. Petersilie having measured 22·5 mm. (·89 in.) in 20 minutes between midnight and 0·22 a.m. on 16th. Dr. Hellmann says that no equally heavy rain had previously been recorded in Berlin, and he gives the nearest approach, the entries being—

Date.	Place.	Duration.	Amount.	Rate per hour.
1883, October 6	Berlin	15 min.	·65 in.	2·60 in.
1889, May 16	Friedenau near Berlin	20 min.	·89 in.	2·67 in.

The rainfall of Berlin is not very much less than that of London (say 23½ in. against 26 in.) and yet these two rains are scarcely more than half what we have had in London, and are equalled or surpassed at dry English stations almost every year, as will be seen from the article on, "Heavy rains in short periods," in any recent volume of *British Rainfall*. Are our thunderstorms more intense than those of Berlin? Surely not, but perhaps equal electrical intensity occurring in a drier atmosphere cannot cause an equal volume of rain.

(2). Dr. Hellmann takes up the subject dealt with first by M. Lancaster, of Brussels, and investigated in the *Meteorological Magazine* for March, June and November, 1889, and gives the following interesting note:—

THE COLD PERIOD.

"The cold weather which has prevailed over West and Central Europe since the summer of 1885, has (with the exception of four months) continued throughout 1889, as is shown by the following table:—

Difference between the temperature at Berlin and the average.

	1885.	1886.	1887.	1888.	1889.
January	...	−0·2	−3·8	0·0	− 3·4
February	...	−8·1	−1·3	−6·1	− 4·5
March	...	−5·9	−1·6	−5·6	− 3·6
April	...	+1·8	0·0	−3·4	+ 0·5
May	...	+1·8	−2·2	+0·5	+10·8
June	...	−2·9	−3·2	−0·2	+ 7·6
July	...	−1·8	+1·8	−4·1	− 1·3
August	−5·6	+0·9	−1·6	−2·0	− 1·4
September	−2·5	+3·2	−0·9	−0·4	− 4·1
October	−2·5	0·0	−4·9	−2·5	− 0·4
November	−2·9	+4·0	+1·8	+0·2	+ 0·9
December	−0·4	+1·3	+0·4	+2·0	− 1·1
Year	...	−0·5	−1·3	−1·8	0·0

"Therefore, May and June, 1889, were so remarkably warm as to neutralize all the deficiencies in the other months of that year. Since the commencement of observations in Berlin, in 1719, there is no case of a warmer May and June; 1756 is the only warmer June. The immediate sequence of two such hot months is very rare—probably hardly occurs once in a century."

Cyclones of Drought and Good Seasons in South Africa. By D. E. HUTCHINS, Conservator of Forests, Knysna, with Cyclical Diagrams. *Times* Office, Wynberg, 1889. London: W. Wesley and Son. Sm. 8vo., 137 pages, 4 plates.

THIS is a remarkable little book, a review of which could be more easily written in 1900 than in 1890, as the author is so sure that he has found a perfect rule as to South African rainfall, that he predicts the character of each year from 1889 to 1938 inclusive, not in a vague general way, but in detail, and not merely for the whole Colony, but for different districts in it.

The author's calculations are primarily based on sun-spot frequency, but he complains of the sun-spots as too irregular (though he occasionally uses them), and says that Wolf's average of 11·11 years is better, but we do not see where he states from what date he begins to take this 11·11, nor what becomes of the fractions which necessarily result from it. Then he has allowances for retardation, or lagging, of one, two or three years, and cycles of all sorts of lengths, *e.g.*, 9·5 years on p. 74, 9 or 10 years p. 78, and 12·7 or probably 12½ years on p. 82. With such a variety one can of course explain anything, and we, therefore, leave his theories to the best possible test—that of the fulfilment of his predictions. We hope that they will be; we long to be able to bring to the notice of our readers some one who can win the blue riband of meteorology, and if the *Meteorological Magazine* is in existence in 1900, and we have any share in its direction, and Mr. Hutchins can bring up evidence of 10 years' success, we will do all in our power to ensure him the honour he will merit. But he must be careful; we are sure that it is accidental, not intentional, but on p. 125, he has taken 9·5 from 1831, and obtained 1822·5 = July 1st, 1822, which is what is wanted to support the theory—evidently it should be 1821·5, which makes it one year wrong.

As regards the predictions, we leave them to the future; but we ought not to omit to say that the work contains abstracts of many long registers, and much useful and interesting matter.

NOT AN EARTHQUAKE.

THERE was a report that an earthquake was felt at several places near Chelmsford on January 7th, 1890, at 0.30 and at 1.25 p.m.

Mr. Davison, of Birmingham, is at present studying British earthquakes, and therefore devoted attention to this statement, and has finally proved, beyond all dispute, that it was a mistake, the real cause of the noise, vibration, &c., being the firing of charges from one of the great 110-ton guns at Woolwich.

We had not quoted the report in these pages, but, as errors are notoriously difficult to correct, we insert this note for the benefit of future investigators.

"AREAS OF RAREFACTION" OR "DEPRESSIONS."

To the Editor of the Meteorological Magazine.

SIR,—In replying to the Rev. Mr. Ryves' letter (page 23), I take for granted that he, in common with every other F.R.Met.Soc. knows and acknowledges that the winds around a cyclone, however extensive, curve somewhat inwards towards the centre round which they whirl. That being so, the inblowing winds will tend to displace the more central portion. And as the latter cannot get downwards into the ground nor outwards into the in-pressing winds, these winds will eject it upwards and then as this process goes steadily on for days, each portion of the incurving air as it approximates near to the centre will be treated in the same fashion by the winds arriving later and get ejected upwards also. The large amount of air thus sent upwards will be forcibly compelled to go up and up till it surmounts the neighbouring anti-cyclone areas; over which it will flow, and possibly, some of it go down, there to renew the same course of action as before.

This being the only way in which the central air of a cyclone can be conceived to get ejected by the denser air around forcing its way inwards, I am unable to picture to myself the formation of a hollow cup-like depression facing skywards like that of a liquid whirlpool.

As to the liquid whirlpool, Mr. Ryves seems to forget that the water in the whirl is driven earthwards, not heavenwards as the air in the cyclone is. And it appears to me that if ever there be any cup-like hollow formed, at all, in the latter, it must be at the bottom of the atmosphere, and not at the top where he and the general public are given to place it.

I used the phrase "general public," because I have been under the impression (how generated I know not) that the meteorological authorities in using the term "depression," meant depression of the mercury in the barometer; but that the general public would naturally take it to mean a depression in the atmosphere. And now I find that my general public includes, at least, one F.R.Met.Soc.

In conclusion, I beg to thank Mr. Ryves for ventilating this subject, so that he, or I, or both of us may be put right.

HENRY MUIRHEAD, M.D.

Cambuslang, 19th March.

WHAT IS A DEPRESSION?

To the Editor of the Meteorological Magazine.

SIR,—Dr. Muirhead, in objecting to the use of the term "depression," assumes that meteorologists mean by it a depression of the *air*, and Mr. Ryves, in criticising Dr. Muirhead's views, seems to adopt the same assumption. But is this quite correct?

In its origin, at all events, the term "depression" must surely have been used by meteorologists as an abbreviated form of

"barometric depression"—that is to say, a depression of the mercurial column in the barometer; and this, I suspect, is what the term still means to most persons, although when we read of a depression "deepening" or "filling up," we do, no doubt, picture to ourselves what we conceive to be the actual state of things in the upper regions of the atmosphere.

It may be that the theoretical idea which modern meteorology seems to have infused into the word "depression" has to some extent supplanted the original idea, but so long as depressions are measured by the height of the mercurial column it is hardly possible that the original idea of the word, which I take to have been simply descriptive, can be entirely lost.

GEORGE F. BURDER, M.D.

Clifton, March 19th, 1890.

SHOWER OF SOFT HAIL.

To the Editor of the Meteorological Magazine.

SIR,—A remarkable shower of soft hail occurred here shortly before 1 p.m. on Tuesday last (April 8th). The masses of hail (they were neither "stones" nor "balls") were of irregular shape, in some cases half an inch in diameter, and appeared to be made up of small plates of ice adhering like the petals of a double marigold. The last form, on melting, was an irregular disc of ice. A noticeable point was the facility with which the masses adhered on being brought into contact, so that by merely putting them together on a sheet of paper you could get a layer three inches or more in diameter. They must have been in a peculiarly favourable condition for regelation. The shower lasted only a few minutes. There was a little rain with it, a good deal of wind, and there were two claps of thunder. We had no more during the day, but one or two violent squalls in the afternoon. In these the sky became very dark, and a sort of dark mist came on, blurring the tree outlines as a slight Scotch mist would. In one of them I was on the top of the heath, and saw this dark mist sweeping down on the more or less distant landscape from the clouds, as the squall passed over it. I imagine that it was due to the rain-drops being broken up by the violent wind. But it was unusual, as was the soft hail squall described. All came from the north, or a little west of it.—Yours truly,

B. WOODD SMITH.

Branch Hill Lodge, Hampstead Heath, N.W., April 11th, 1890.

[At Camden Square the notes on the shower are as follows:—"11 a.m.: Heavy shower of soft hail (apparently fragments of spheres), about half an inch in diameter; this lasted about five minutes. 0·50 p.m.: Three claps of thunder and some more soft hail, some of it nearly half an inch across, and very soft."—ED.]

MR. MARRIOTT ON THUNDERSTORMS.

To the Editor of the Meteorological Magazine.

SIR,—There seems to be something wrong about the statistics in the summary you give (vol. xxiv., p. 170) of Mr. Marriott's paper on "The Distribution of Thunderstorms. . . . ." It states that thunderstorms are most numerous in the south of England, yet they are given as fewest for Middlesex. It looks as though no account has been taken of the number of observers in each district, which must be done if correct proportionate numbers of thunderstorms are to be arrived at.

T. W. BACKHOUSE.

Sunderland, February 19th, 1890.

FINE METEOR ON MARCH 21ST.

To the Editor of the Meteorological Magazine.

SIR,—You may like to have an account of the splendid meteor seen by myself and many others last evening, about 9.5 p.m., to compare with other reports.

I was standing by my drive gate at that time when the road became illuminated suddenly, so that I could see every stone upon it.

Instantly looking up I saw an intensely bright meteor traverse a small portion of the sky between Ursa Major and Bootes, bursting in a shower of sparks near Arcturus.

After an interval of some three to four minutes a dull boom, more like the discharge of a piece of heavy artillery at twenty miles distance than what some people took it to be—a distant thunder peal, was distinctly heard. Whether this had any connection with the meteor I must leave to others.

I ought to say, that one man said he saw a flash of lightning in the S.W., a few minutes *afterwards*, which I did not observe, although from the low barometer, 29·2, I thought it was not improbable.

Yours very truly,

R. J. W. PURDY.

Woodgate House, Aylsham, March 22nd, 1890.

P.S. Two other persons I have just seen, who witnessed the sight declare that they heard a slight rustling sound when the meteor exploded, but I am inclined to believe that the rocket-like discharge of the body led them to imagine that they heard a sound such as usually accompanies pyrotechnic displays.

THE FROST OF THE FIRST WEEK OF MARCH.

Mr. C. HARDING, F.R.Met.Soc., having undertaken to prepare a paper upon this subject, developing and completing the notes given in our last, we refer our readers to the *Quar. Jour.* R. Met. Soc. for the full details.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, SEPT., 1889.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	TotalRain. Depth.	TotalRain. Days.	Aver. Cloud.
	°		°		°	°	°	0–100	°	°	inches		0–10
England, London	80·3	11	35·1	23	65·6	48·9	48·2	75	125·6	28·4	1·77	10	5·6
Malta	93·3	3	61·7	21	83·5	67·6	65·8	76	141·7	55·6	2·21	6	2·7
Cape of Good Hope.	...	...	...	...	...	...	...	...	...	...	...	...	...
Mauritius	77·0	28*a*	59·2	27	75·1	64·2	59·8	74	128·9	50·0	1·53	18	5·3
Calcutta	91·4	30	73·7	8	87·6	77·5	78·1	86	155·7	72·6	4·76	15	6·3
Bombay	89·5	22	75·9	2	87·1	78·2	76·4	82	145·8	71·9	2·71	13	7·0
Ceylon, Colombo	87·0	28	71·6	9	84·8	76·5	72·1	79	151·0	70·2	25·08	22	7·8
Melbourne	74·5	26	32·1	3	61·4	43·1	42·3	69	129·8	25·3	1·51	14	5·1
Adelaide	76·7	7	38·5	2	63·2	47·2	45·0	69	132·7	32·1	1·50	16	5·7
Wellington	65·5	26	39·0	1	59·6	46·6	46·3	77	130·0	28·0	4·78	17	4·0
Auckland	71·0	30	44·0	23	62·0	51·2	50·4	80	130·0	38·0	5·82	19	6·5
Jamaica, Kingston	93·4	29	68·2	24	90·5	72·7	74·0	79	...	...	4·55	...	...
Trinidad	92·0	26	63·0	11	88·0	70·0	73·1	79	157·0	58·0	3·76	20	...
Toronto	81·9	3	35·3	29	68·2	52·0	54·3	78	...	29·8	2·08	14	5·1
New Brunswick, Fredericton	85·7	2	24·9	30	71·6	49·7	55·4	78	...	...	2·52	10	7·8
Manitoba, Winnipeg	94·0	1	29·0	21	61·2	39·3	41·1	74	...	...	2·57	14	6·0
British Columbia, Victoria	73·0	6, 26	34·0	12	64·8	42·9	...	...	...	...	2·33	8	...

a And 30.

REMARKS, SEPTEMBER, 1889.

MALTA.—Mean temp. 74°·3; mean hourly velocity of wind 5·9 miles. Sea temp. fell to 75°·5. TSS on 3 days, L on 4 days. J. SCOLES.

Mauritius.—Mean temp. of air 0°·9 below, dew point equal to, and R ·06 in. above, their respective averages. Mean hourly velocity of wind 11·4 miles, or 0·7 mile below average; extremes 25·4 on 19th, and 1·7 on 14th and 27th. Prevailing direction E.S.E. C. MELDRUM, F.R.S.

CALCUTTA.—The south-west monsoon has been very light, most noticeable in the unusually light winds accompanying depressions forming in the bay. The R has not generally been below the average. C. LITTLE.

CEYLON, COLOMBO.—TS occurred on 6 days. J. C. H. CLARKE, Lt.-Col. R.A.

Melbourne.—Mean temp. of air 1°·0, of dew point 1°·3, humidity 2, amount of cloud 0·9, and R ·76 in. below the average. Prevailing wind N., strong on 9 days. Heavy dew on 9 days; hoar frost on 4 days; hail on the 1st.

R. L. J. ELLERY, F.R.S.

Adelaide.—Rainfall slightly below the average of 32 years, but the total since January 1 is still in advance of any previous record. Pressure about, and temp. nearly 2° below, the mean. C. TODD, F.R.S.

Wellington.—Showery up to the 18th, with wind chiefly from N.W., and strong; from 19th to 24th fine pleasant weather, with light variable wind; from 25th to the end showery. Mean temp. 2°·2, and R ·52 in. above the average. R. B. GORE.

Auckland.—A stormy, wet, disagreeable month. Pressure close to the average of 22 years. Mean temp. 2° and R 2·50 in. above the average.

T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL, MARCH, 1890.

[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 Hall.	2·51	XI.	Castle Malgwyn	2·57
,,	Margate, Birchington...	2·66	,,	Builth(Llanwrtyd Wells)	4·31
,,	Littlehampton	1·13	,,	Rhayader, Nantgwillt..	4·58
,,	Hailsham	2·07	,,	Carno, Tybrith	3·37
,,	Ryde, Thornbrough	1·29	,,	Corwen, Rhug	2·15
,,	Alton, Ashdell.....	1·93	,,	I. of Man, Douglas	3·05
III.	Oxford, Magdalen Col...	·72	XII.	Stoneykirk, Ardwell Ho.	1·89
,,	Banbury, Bloxham	·99	,,	New Galloway, Glenlee	3·87
,,	Northampton	1·39	,,	Melrose, Abbey Gate...	1·97
,,	Cambridge, Fulbourne..	3·52	XIII.	N. Esk Res. [Penicuick]	3·75
,,	Wisbech, Bank House..	2·34	XIV.	Ballantrae, Glendrishaig	2·78
IV.	Southend	1·70	,,	Glasgow, Queen's Park.	2·41
,,	Harlow, Sheering	1·52	XV.	Islay, Gruinart School..	3·67
,,	Rendlesham Hall	2·56	XVI.	Dollar.....	2·58
,,	Diss	3·18	,,	Balquhidder, Stronvar..	6·36
,,	Swaffham	2·52	,,	Dunkeld, Inver Braan..	2·89
V.	Salisbury, Alderbury...	1·21	,,	Dalnaspidal H.R.S. ...	6·57
,,	Warminster	1·11	,,	Arbroath Cemetery.....	..
,,	Bishop's Cannings	1·26	XVII.	Keith H.R.S.	2·14
,,	Ashburton, Holne Vic....	3·31	,,	Forres H.R.S.	2·00
,,	Hatherleigh, Winsford.	·39	XVIII.	Fearn, Lower Pitkerrie.	2·08
,,	Lynmouth, Glenthorne.	1·74	,,	Loch Shiel, Glenaladale	14·49
,,	Probus, Lamellyn	1·97	,,	N. Uist. Loch Maddy ...	5·21
,,	Launceston, S. Petherwin	1·73	,,	Invergarry	7·48
,,	Wincanton, Stowell Rec.	1·66	,,	Aviemore H.R.S.	3·24
,,	Taunton, Lydeard Ho...	1·19	,,	Loch Ness, Drumnadrochit	3·41
,,	Wells, Westbury.....	1·54	XIX.	Lairg H.R.S.	...
VI.	Bristol, Clifton	1·11	,,	Scourie	5·16
,,	Ross	·91	,,	Watten H.R.S.	2·01
,,	Wem, Clive Vicarage ...	1·13	XX.	Dunmanway, Coolkelure	5·86
,,	Cheadle, The Heath Ho.	1·53	,,	Fermoy, Gas Works ...	3·91
,,	Worcester, Diglis Lock	·92	,,	Tipperary, Henry Street	3·88
,,	Coventry, Coundon	1·64	,,	Limerick, Kilcornan ...	2·16
VII.	Ketton Hall [Stamford]	2·23	,,	Miltown Malbay.....	3·63
,,	Grantham, Stainby	2·46	XXI.	Gorey, Courtown House	2·84
,,	Horncastle, Bucknall ...	1·54	,,	Navan, Balrath	2·85
,,	Mansfield	...	,,	Mullingar, Belvedere ...	3·73
VIII.	Neston, Hinderton	1·50	,,	Athlone, Twyford	3·57
,,	Knutsford, Heathside ...	2·52	,,	Longford, Currygrane...	3·14
,,	Lancaster, South Road.	4·21	XXII.	Galway, Queen's Coll...	2·64
,,	Broughton-in-Furness ..	6·19	,,	Clifden, Kylemore	3·53
IX.	Wakefield Prison	1·30	,,	Crossmolina, Enniscoe..	3·82
,,	Ripon, Mickley	2·47	,,	Collooney, Markree Obs.	2·55
,,	Scarborough, West Bank	1·96	,,	Ballinamore, Lawderdale	..
,,	East Layton [Darlington]	1·69	XXIII.	Warrenpoint	3·59
,,	Middleton, Mickleton..	2·71	,,	Seaforde	2·35
X.	Haltwhistle, Unthank..	3·02	,,	Belfast, New Barnsley..	2·84
,,	Shap, Copy Hill	2·99	,,	Bushmills, Dundarave...	2·88
XI.	Llanfrechfa Grange	1·23	,,	Stewartstown	2·38
,,	Llandovery	3·82	,,	Buncrana	2·47

MARCH, 1890.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1880–9	Greatest Fall in 24 hours. Dpth	Greatest Fall in 24 hours. Date	Days on which ·01 or more fell.	TEMPERATURE Max Deg	Max Date	Min. Deg.	Min. Date	No. of Nights below 32° In shade.	No. of Nights below 32° On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	1·76	+ ·15	·48	19	14	66·2	28	15·6	4	7	15
II.		Maidstone (Hunton Court)...	2·59	+ 1·09	1·29	19	15	...	...	...	...	...	...
,,		Strathfield Turgiss	1·28	— ·31	·27	24	19	64·1	29	13·8	4	10	21
III.		Hitchin	2·52	+ 1·18	·93	19	13	62·0	28	15·0	3	6	...
,,		Winslow (Addington)	1·56	— ·16	·36	19	16	62·0	28	14·0	4	12	18
IV.		Bury St. Edmunds (Westley)	3·17	+ 1·62	1·30	19	11	...	...	...	...	...	...
,,		Norwich (Cossey)	2·79	+ 1·37	·68	19	16	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	1·02	— ·88	·28	24	12	58·0	29	20·0	4	7	...
,,		Barnstaple	1·66	— ·83	·43	21	10	59·0	31	18·0	4	...	..
,,		Bodmin (Fore Street)	2·94	— ·84	·62	24	17	..	...	...	...	.	...
VI.		Stroud (Upfield)	·94	— 1·25	·23	24	13	63·0	27*b*	19·0	3	6	...
,,		ChurchStretton(Woolstaston)	1·49	— ·64	·32	16	19	59·5	28	21·0	3	8	15
,,		Tenbury (Orleton)	1·57	— ·51	·42	24	14	60·8	26	14·8	4	13	16
VII.		Leicester (Barkby)	2·12	+ ·41	·84	19	21	65·0	23	12·0	3	11	22
,,		Boston	1·49	— ·04	·82	22	10	64·0	22	19·0	4	9	...
,,		Hesley Hall [Tickhill].....	1·50	— ·40	·45	19	10	63·0	28	21·0	4	11	...
VIII.		Manchester(PlymouthGrove)	3·00	+ ·78	·56	9	19	61·0	28	24·0	3	8	12
IX.		Wetherby (Ribston Hall) ...	1·56	— ·50	·62	20	7	...	...	...	...	...	...
,,		Skipton (Arncliffe)	5·16	+ ·06	·70	9	22	...	...	...	...	...	...
,,		Hull (People's Park)	1·57	— ·48	·55	19	17	...	...	...	...	...	...
X.		North Shields	1·91	— ·52	·42	20*a*	15	61·5	12*b*	26·0	4	8	11
,,		Borrowdale (Seathwaite).....	12·73	+ 2·23	1·77	9	24	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)..	1·75	— 1·23	·28	24	13	...	...	...	...	...	...
,,		Haverfordwest	2·44	— ·80	·68	24	11	55·0	30*d*	18·3	3	6	14
,,		Plinlimmon (Cwmsymlog) ...	4·89	...	·80	16	14	...	...	...	...	...	...
,,		Llandudno.....	1·71	— ·37	·33	9	16	57·0	20	25·4	4	3	...
XII.	SCOTLAND.	Cargen [Dumfries]	2·59	— ·71	·46	28	17	56·8	10*e*	22·6	3	7	...
,,		Jedburgh (Sunnyside).....	1·43	— ·53	·40	20*b*	12	59·0	16*f*	25·0	5	9	...
XIV.		Old Cumnock	3·07	— ·06	·42	16	23	60·0	31	16·0	2	11	...
XV.		Lochgilphead (Kilmory)	6·35	+ 1·89	1·31	15	24	...	...	..	...	...	...
,,		Oban (Craigvarren)	7·38	...	1·35	15	26	53·0	28	27·0	9	5	...
,,		Mull (Quinish).....	6·87	+ 3·03	1·40	15	25	...	...	...	...	...	...
XVI.		Loch Leven Sluices	2·40	— ·57	·50	9, 25	12	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	1·90	— ·50	·65	24	9	59·3	11	21·9	9	7	...
XVII.		Braemar	...	...	...	...	...	...	...	...	..	...	...
,,		Aberdeen (Cranford)	2·80	...	·77	20	19	61·0	12	22·0	8	9	...
XVIII		Strome Ferry.....	6·94	+ 2·31	1·10	15	26	52·0	15*g*	26·0	1	3	...
,,		Culloden	2·57	+ 1·03	...	...	..	57·0	12	21·0	9	10	24
XIX.		Dunrobin	4·78	+ 2·53	1·25	10	15	60·0	12*h*	23·0	9	9	...
,,		S. Ronaldsay (Roeberry).....	...	...	...	...	...	...	...	...	...	...	...
XX.	IRELAND.	Cork (Blackrock)	4·51	+ ·95	1·87	15	17	63·0	22	28·0	16	8	...
,,		Dromore Castle	5·21	+ ·79	·60	17*c*	18	60·0	25	27·0	2	...	...
,,		Waterford (Brook Lodge) ...	3·82	+ ·92	1·40	15	18	60·0	11	25·0	4	12	...
,,		O'Briensbridge (Ross)	...	...	...	..	...	...	...	...	...	...	...
XXI.		Carlow (Browne's Hill)	4·17	+ 1·80	1·34	15	18	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	3·69	+ 1·68	·98	24	17	59·6	12	31·2	3, 9	4	16
XXII.		Ballinasloe	2·66	+ ·03	·68	15	22	55·0	10	21·0	3	14	...
XXIII		Waringstown	2·64	+ ·29	1·16	15	19	59·0	27	24·0	1, 2	15	16
,,		Londonderry (Creggan Res.).	2·62	— ·11	·91	15	22	..	...	...	...	...	...
,,		Omagh (Edenfel)	2·93	+ ·42	·99	15	25	54·0	27	23·0	1	7	15

a And 24. *b* And 28. *c* And 26. *d* And 31. *e* And 15. *f* And 29. *g* And 30, 31. *h* 14.

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

METEOROLOGICAL NOTES ON MARCH, 1890.

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.—A fine, healthy month, with a sharp of frost on the 4th. Thus far, a very favourable season for vegetation of all kinds. Grass min. on 4th, 12°·4. Humble bee first seen on 15th; brimstone butterfly on 26th.

ADDINGTON.—The first four days of the month were very cold, but after the 4th, although occasional frosts occurred, they were not severe. The R, though in no great quantity, hindered work on heavy land.

BURY ST. EDMUNDS, WESTLEY.—March came in like a lion and went out like a lamb. This old saying has been very true this year. Casella's min. thermometer exposed 1 ft. from the ground registered on the 3rd, 3°; on the 4th, 6°; and on the 28th, in the shade, 61°. On the 19th, 1·30 in. of S and R fell, which caused great floods in Suffolk; spring sowing is very backward.

LANGTON HERRING.—Another dry month, the deficit for the month being 44 per cent. Notwithstanding the cold of the first four days, the temp. of the month was above the average for March for 18 years. The excess at 9 a.m. being 1°·5. The temp. on the nights of the 2nd and 3rd are the lowest recorded in March in 19 years. Solar halos were frequently observed; fogs prevailed on the 26th, 27th and 28th. The last three days of the month were very fine.

BODMIN, FORE STREET.—An exceptionally fine month. Hard frost on the 2nd, 3rd, and 4th, and frost also on 17th, 19th, 21st, and 30th. H on the 17th. Occasional high winds, very mild and fine, from 25th to 31st.

STROUD, UPFIELD.—Lunar rainbow on the 1st. Slight S on 1st and 9th.

ORLETON.—The month commenced with intense frost, the thermometer on the grass registering 11° on the 4th. The weather then changed and was warm and pleasant till the end of the month, with occasional sharp frosts. The mean temp. of the month was 2°·8 above the average of the last 29 years. Snow on the 1st 3rd, 4th, and 9th; distant T on the 17th. Damson and plum trees beginning to come out on the 26th; willow wren heard on the 29th.

WOOLSTASTON.—The month opened with severe frost, and S fell heavily on the 8th. The remainder of the month was very seasonable. Mean temp. 42°·7.

MANCHESTER, PLYMOUTH GROVE.—S fell on the 1st and 2nd, and a severe S storm occurred on the 9th, commencing at 9 a.m. and lasting about an hour. The first nine days were cold and winterly. E. winds blew on 8 days; W. on 23 days Fine, bright, and sunny on 12th, 16th, 17th, 22nd, 26th, 29th, 30th, and 31st. Mean temp. 44°·5.

HULL.—The weather during the month was nearly equally divided between fine and showery days. Generally the falls of R were not heavy, or of long duration, leaving longer periods of fine weather than is usual with such a number of days on which R fell.

WALES.

HAVERFORDWEST.—The month commenced with fine, but very cold, weather, severe N.E. winds prevailing and sharp frost, the min. on 3rd being the lowest in March since 1886; the mean temp. of the day was 26°·5; on the grass the temp. fell to 8°. This wave of cold was, however, evanescent, the temp. rising rapidly, and the rest of the month was warmer than the average. Strong westerly winds, at times reaching the force of a gale, prevailed about the 7th and 8th, 14th and 15th. A stormy, wet period from the 22nd to 24th. Prevailing winds W.N.W. and S.W.

SCOTLAND.

CARGEN.—The mean temp. of the month (43°·1) was 2°·4 above the average. Sunshine somewhat below the average. Vegetation generally very advanced; many flowering shrubs, rhododendrons, &c., in bloom at least a month earlier than usual. S on 8th, T on 16th at 1 p.m.

JEDBURGH.—Though cold and ungenial, the month on the whole was fine. The land was in fine order, and it is rarely that the seed gets such a dry bed. Vegetation progressed steadily.

CULLODEN.—The month generally was fine; frost not severe enough to injure garden produce. No S. Farm work well advanced.

IRELAND.

CORK—Generally fine, but cold, with showers. A gale in the night of the 15th, with a R of 1·87 in. Mean temp. (46°·4) 2°·4 above the average of 14 years.

WATERFORD, BROOK LODGE.—S showers on the 1st and 2nd. H on the 8th. S.W. gale on the 15th.

DUBLIN.—March was a month of contrasts. As in 1889, it opened with severe weather; warm and cold spells then succeeded each other to the close of the month, heavy falls of R occurring at times. On the whole, there was a mean temp. of 2°·0 above the average, and the R was largely in excess. Fog on the 19th, 20th, and 27th; high winds on 15 days, reaching the force of a gale on 4 days, the 7th, 8th, 10th, and 24th; S or sleet fell on the 1st, 2nd, 9th, 16th, 18th, and 23rd; H fell on 1st, 2nd, and 8th. The temp. exceeded 50° in the screen on 19 days, compared with only 2 days in February, and 17 in January, while it fell to below 32° on 4 days, compared with 5 in February, and 1 in January. On two days the thermometer did not rise to 40° in the screen. The last two days were fine, quiet, cool, and dry, the month going out "like a lamb," as it had come in "like a lion."

OMAGH, EDENFEL.—Till the end of the month, when the conditions became very favourable, there was a generally constant, though not excessive, R, and none of the trying easterly winds typical of March. The min. temp. on the 1st was the lowest of the winter.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCXCII.] MAY, 1890. [PRICE FOURPENCE, or 5s. per ann. post free.

GREAT RAINFALL AT HONG KONG, MAY 29 & 30, 1889.

IN the *Meteorological Magazine* for August last we printed a letter upon the above subject from Major Wilkinson, R.E., and gave also the remarkable, if not unprecedented, hourly record of the rainfall at the observatory.

We have recently received from Mr. Rogers Field, C.E., a copy of the report upon the storm by the Surveyor-General (Mr. Brown), and thinking it very desirable that it should be put upon record where it can be readily found, have reprinted those paragraphs which refer to the fall of rain, adding a few foot-notes by way of comment. We do not reprint the table of hourly fall, as it is given on p. 104 of our last volume; but we notice that it differs from our copy in the value for 1 p.m. on 29th, that was originally reported as 1·08, it now appears to be 0·08, and this reduces the total in the storm from 34·11 in. to 33·11 in.; but really in such a storm an inch more or less seems quite a trifle.

REPORT ON THE GREAT STORM AT HONG KONG, 29TH & 30TH MAY, 1889.

(*Presented to the Legislative Council by command of His Excellency the Governor.*)

To the HON. F. STEWART, LL.D., *Colonial Secretary.*

Surveyor-General's Office, Hong Kong,
July 27th, 1889.

SIR,—I have the honour to forward, for the information of His Excellency the Governor, the following report on the great rainstorm of 29th and 30th of May last, and damage caused thereby to public property.

2. The rainy season of the south-west monsoon appears to have set in earlier this year than usual. During the month of April over 12 inches of rain fell, and of this quantity nearly 7 inches was due to a storm on the 29th and 30th of that month, causing considerable damage to streets and roads which the Acting Surveyor General (Mr. Cooper) estimated at 3,400 rupees. The first half of May was comparatively dry. I arrived at Hongkong on the 18th of May.

The night after my arrival there was a very heavy thunderstorm, several buildings were struck by lightning, and 5·94 inches of rain were recorded during the day ending 10 A.M. on the 19th. On the three following days there was an aggregate fall of 5·88 inches, and there were showers at frequent intervals until the 28th. Early in the morning (2 A.M.) of 29th the rain began and continued almost uninterruptedly (although with greatly varying intensity) until 5 P.M. of the 30th.

3. On the morning of the 29th I was at the Peak, and such was the violence of the storm that (with some others who were staying at the Hotel) I had to wait a considerable time before the chair coolies would venture on the descent, owing to the force of the wind and rain. However we started about 9 A.M. I shall not readily forget the journey down. I followed the road as, all things considered, it appeared to me a preferable route to the tramway. Along the upper levels the gusts of wind threatened to carry us off the mountain path. During the descent the water rushed in sheets down the steep mountain slopes, the nullahs were full, and the side drains and culverts of the road overflowing. I arrived at the Government Offices about 10 o'clock. Shortly afterwards Mr. Bayne, Overseer (then in charge of streets, since deceased) came to report that the Glenealy culvert (which carries the storm water and sewage, and traverses the centre of the City, passing through Wyndham and Pedder's Streets, where several of the more important offices and public buildings are situated) had burst in several places. Before there was time to ascertain full details a watchman arrived to report that the service tank of the Tytam Water-works was in danger. Accompanied by Mr. Cooper I proceeded at once to the site. We arrived there a little before Noon, and found that the tunnel, or great culvert, 192 square feet in transverse area, which conveys the water of the Albany Nullah under the Tytam service tank was blocked, and the water that should pass through it was pouring over the concrete wall of the tank, and had washed away a large portion of the earthen bank on the down-stream side of the wall, as well as parts of the Bowen and Garden Roads, and had caused considerable damage to the banks of the Ravine. As the concrete walls of the tank were not designed, without the aid of the earthen bank, to resist the pressure of the water, there was good reason for taking immediate precautionary measures, so as to be prepared in the event of the failure of the tank. As the Murray Barracks are situated near the Harbour, in the bed of the same valley, 400 feet below the tank, which holds some 35,000 tons of water, I requested Mr. Cooper to give immediate notice to the officer in command of the Regiment there quartered, and I proceeded forthwith to inform His Excellency the General Commanding of the critical state of affairs. Orders were at once issued to clear the basement floors of men and stores.

4. I find on referring to the hourly record of rainfall kindly furnished, at my request, by the Director of the Observatory (Dr.

Doberck) that the rain began between 2 and 3 a.m. of the 29th and continned until about 1 p.m., up to which time 10½ inches of rain had fallen, of which 7¾ inches fell in the three hours before Noon (10 a.m. 3·06 inches, 11 a.m. 3·35 inches, 12 (Noon) 1·27 inches). There was then an interval of two hours without rain, after which it rained moderately until near midnight. Then began the most appalling thunderstorm within my own experience, or that, I venture to believe, of the majority of the residents in the Colony. For hours flash succeeded flash in rapid succession, and the roll of the thunder was almost uninterrupted, while the rain descended in masses. Several buildings were struck by lightning, and six coolies were killed in a matshed at the Peak. The damage to the structure, in the case of the buildings which I have had an opportunity of inspecting, was singularly slight. The storm raged with greatest intensity between the hours of 1 and 5 a.m. of the 30th. The rain that fell during that morning is so exceptional that I give below the result in detail.

5. After 6 a.m. the storm abated, but rain continued to fall until about 5 p.m., when it ceased. The total rain which fell during the storm from 3 a.m. of the 29th to 5 p.m. of the 30th, a period of 38 hours, was 33·11 inches, and of this quantity the very remarkable fall of 27·44 inches occurred in the 24 hours ending 6.30 a.m. of the 30th (nearly twenty-seven and a-half inches).

6. Before proceeding further it may be interesting to add that the total rainfall recorded for May was 48·84 inches, and for the six months ended 30th of June 75·45 inches. Comparing this with the records of the five years ending 1888, I find that the annual average is 84·84 inches, of which an average of 35·6 inches fell in the first half of the year, while the maximum monthly fall during these five years was 31·36 inches (in June, 1885). It therefore follows that the rainfall of the past half-year very nearly equals the average annual rainfall, and is more than double the quantity that fell in the corresponding period in former years, while the quantity that fell in May was one-third greater than that of any previous month, during these five years.

7. I have dwelt somewhat at length on this remarkable downpour because, as far as I am able to ascertain from the limited records accessible to me here, the aggregate rainfall during this storm is without precedent in the case of any storm of equal duration, and it is specially noteworthy that the fall during certain hours, and the maximum for 24 hours, appear (if I may be permitted the expression) to break the record. My authorities are two standard works on "Hydraulics," but the data are necessarily imperfect, as they do not extend to a later date than 1875. I would call attention, however, to this very interesting and important subject of enquiry, in the hope that my imperfect comparison may be supplemented (and corrected if necessary) by those who may have leisure for investigation, and access to more recent records. The practical importance of

the subject is manifest, since we must depend on the accuracy of the meteorological returns for guidance in designing works of drainage and water supply.

8. I should add that the observations were made at the Observatory at Kowloon, two miles north of the centre of the Victoria rainfall area. It is, I think, probable that the results may be safely assumed as indicating approximately the rainfall on the main island, but it would be well to bear in mind that the proximity of the steep mountain slopes to the City render it possible, judging by the records of analagous sites, that the rainfall in the City and on the mountain slopes above was greater, rather than less, than the rainfall at Kowloon.

9. For the purpose of comparison I will now quote some exceptional rainfalls recorded in other countries. At Nottingham, on 13th of August, 1857, $5\frac{3}{4}$ inches fell in about five hours. During my residence in Cyprus (December, 1880) a flood, disastrous to life and property, occurred at Limassol, where a fall of $5\frac{3}{4}$ inches was registered (nearly the whole falling in four hours). It is noteworthy that at Kowloon more than double this quantity fell in the same space of time. I can find no record *elsewhere* of a maximum hourly fall equal to that at Kowloon, viz., 3·4 inches, although it appears that the maximum on 30th May was slightly exceeded by an observation made at the Kowloon Observatory in July, 1886, when 3·48 inches was registered in one hour. Those who carefully observed the storm will, I think, agree with me, that when at its height the downpour was not constant for any considerable consecutive period, but that for short periods it was exceptionally severe, so that if the fall could have been measured for a limited period of say a quarter, or half an hour, I have little doubt that the result would have been at the rate of fully four inches per hour. In designing works in which it is necessary to provide for a maximum fall, it would in my opinion be unsafe, in the light of recent experience, to calculate on a smaller fall than four inches per hour.*

10. I would here remark that it may be argued that I am assuming that all the water that falls from the clouds is at once discharged into the water-courses, and that I am allowing nothing for absorption. To this I submit that in the case of a heavy rainfall, occurring on such steep slopes as those which form the background

---

* During short periods far higher rates than four inches per hour must be provided for. Even in London it will be seen from *British Rainfall*, 1878, p. 79, that for

Half a minute	the rate may be		12·0	inches an hour.
One minute	,,	,,	10·2	,,
Five minutes	,,	,,	6·7	,,
Ten minutes	,,	,,	6·2	,,
A quarter of an hour	,,	,,	5·7	,,
Half an hour	,,	,,	4·6	,,

[ED. *M.M.*].

of the City, at a time when the soil has been saturated by previous heavy rains, a careful observer will, I think, be convinced that, practically speaking, all the water that falls is discharged forthwith into the sea.

11. To return to the records of rainfall in other places, the greatest fall in 24 hours I can find registered is 20·58 inches at Madras on 21st of October, 1846. The maximum at Kowloon was 27·44 inches, or about one-third greater.

12. I may conclude my observations on rainfall by adding, that although the records of Hongkong appear to be exceptional, as regards the rain which fell in a single hour, and during periods of four hours, and of 24 hours, the recorded *monthly* and *annual* rainfall of this Colony sink into insignificance compared with those of some other parts of the world. If we take the returns for Hongkong of the past six years we find that the maximum monthly rainfall is 48½ inches, and the maximum annual fall is 109 inches, while at Cherrapungi in Assam at 4,460 feet above sea level, 243 inches have been gauged in a single month (June, 1860) and during the same year 615 inches of rain fell. The monthly and annual rainfall at Cherrapungi is therefore more than five times greater than Hongkong.

13. I have been unconsciously led into considerable length on the question of rainfall, owing to the interesting nature of the enquiry, and the phenomenal character of the late storm. The subject is not without a practical application, for as the storm was exceptional in its nature, so also was the injury that resulted to public and private property; and it is noteworthy that the periods when the greatest damage occurred coincided precisely with the hours of maximum rainfall, *i.e.* from 10 a.m. to Noon of the 29th and from 3 to 6 a.m. of the 30th. No doubt exaggerated estimates were made at the time of the loss incurred, but this was not surprising; as the ruin wrought by the uncontrollable power of this rush of water was evident on every side, and was on a scale, and of a nature, to impress the imagination.

* * * * * * *

I have the honour to be, Sir,
Your obedient Servant,
S. BROWN, *Surveyor-General.*

P.S.—Since writing the above, I find that Chambers' "Encyclopædia" (ed. 1882), and the "Encyclopædia Britannica" (ed. 1884), state that at Joyeuse (France) 31·17 inches fell in 22 hours; at Geneva (Chambers says Genoa) 30 inches in 24 hours; at Gibraltar, 33 inches in 26 hours; on the hills above Bombay, 24 inches in one night; and on the Khasia Hills* (Assam) 30 inches on each of five successive days. These falls, if correctly reported, exceed that

* Another name for Cherrapungi.

registered here, but as no details are given, nor authorities quoted I hesitate to accept these statements without further evidence.*—S. B.

GREAT RAINFALL IN CEYLON, SEPTEMBER, 1872.

[As bearing on the above-mentioned excessive rainfall in Hong Kong, we have been favoured by Sir J. Coode, Pres. I.C.E., with the following brief but very useful memorandum.—ED.]

Extract from Proceedings of the Commission appointed by the Government of Ceylon to Report upon the floods that occurred there in the latter part of September, 1872.

"The rainfall during the first twelve days of last September was very great throughout the Central and Western Provinces. At Mocha estate, in Maskeliya, 34·02 inches of rain fell in 96 hours; at Yellangoury, in Dolosbágé, 23·94 inches fell in the same time."

"From the return of rainfall published by the Director of Public Works, it appears that 17·90 inches of rain fell at Avisáwélla from the 8th to 9th September; 18·80 inches at Padapolla."

ANEMOMETERS AND DAMAGE BY GALES OF WIND.

To the Editor of the Meteorological Magazine.

SIR,—Several *gales*, commonly so-called, have swept over this district lately, and occasioned damages to structures, and trees, &c., of more or less serious extent.

The Forth Bridge has escaped damage entirely, but some materials were blown off from a truck in a passing goods train. The Exhibition had a scaffolding erecting for a panorama blown down, and the Royal Infirmary had a portion of the outside railings exposed to the S.W. gale levelled.

What is of peculiar interest is the interpretation to be placed on the readings of the anemometers observed here, and elsewhere, in face of these results by storm to structures erected on the ground.

The plate anemometers at the Inchgarvie Station, at the Bridge on the Forth (*Scotsman*, March 12th, 1890), indicated pressures at the rate of 30 lbs. per sq. ft. (78 miles per hour), for the small gauge, and 16 lbs. per sq. ft. (56 miles per hour), for the large gauge.

The anemometers at the Paris Exhibition last season (*Times*, March 13th, 1890), indicated that at the top of the Eiffel Tower, the mean velocities were 15·5 miles per hour, and at the Observatory in the City they were only 5 miles for the corresponding period.

One would expect from these observations that portions of the highest edifices or structures would have been blown down in preference to those at the lowest levels, but here in actual practice is seen the anomaly of structures being damaged at the *lowest stages*, where the pressure of the gale per sq. ft. would be least.

Again, one would imagine that large structures would suffer from

* We are rather of Mr. Brown's opinion, but have already dealt with the subject in *Met. Mag.*, vol. xxiii. (1888), p. 99.

wind more than smaller ones would do, but there is less pressure by one half by wind recorded on the large anemometers than on the smaller ones.

An explanation of this may probably be found in the greater proportion of length of edge or border to superficial area of square feet in the object assaulted, whereby the wind gets more surface of *turning friction*, and less surface for the calm centre.

A plate anemometer with respect to the action of the wind on it, is much in the same relation as the surface of the earth is to an anti-cyclone, that is, the most wind is found on the borders of the anti-cyclone, while the middle of it is taken up by a calm centre.

Thus an anemometer plate of 30 ft. square has 120 ft. of border for the wind to turn over on, and a space of 900 sq. ft. for a *calm centre* inside this border of out-flowing wind.

But a plate anemometer of 3 feet square would have, on the contrary, only a space of 9 square ft. of area for a calm centre, and a length of 12 feet for a border for the wind to turn over.

So that the length of border in the large and small square wind gauges would be as 10 to 1, but the areas for the calm centres would be as a 100 to 1 ; therefore the small plate anemometer must always indicate 2-3 times more pressure than the larger one, from having proportionately more border to area.

From this it will follow that a more suitable form of plate anemometer wonld be the circular one, while the lengths of the borders would be more approximate to the areas inside them, in both large and small gauges, and the form would also favour the anti-cyclone-like motion of the gale of wind.

Thus, a circle of 30 feet diameter would have a border of 94 feet, and an area of 706 square feet, and a circle of 3 feet diameter would have a border of 9·4 feet and an area of 7 square feet. Each of these sets would have ratios of border to border and area to area of 10 to 1, so that both large and small anemometers of a circular shape would represent the pressure of the same gale equally anywhere at the same time.

It follows from this that there would be expected to be less wind or gale pressure on solid or filled up wall surface of any structure than on any open structure, such as scaffolding, trellis-work, ballustrading, &c.

In the former case the wind would blow over it, leaving a calm centre inside of less pressure than at the edges, and in the latter the wind would pass through it with much friction on the sides of the bars, poles, pillars, &c., composing an open edifice, and there would be no calm centre at all to compensate for this.

Open structures, like scaffolding, therefore require to be supported by *struts* to withstand any wind pressures, conjoined, as these are, with increased friction.—Yours,

W. J. BLACK, F.R.C.S.E., F.R.Met.Soc.

Cal. United Service Club, Queen Street, Edinburgh.

"AREAS OF RAREFACTION" OR "DEPRESSIONS."

To the Editor of the Meteorological Magazine.

SIR,—In his letter on this subject in the Magazine for April, Dr. Muirhead has given us a very good description of the "filling up" of a low pressure system or cyclone, except that he seems to overlook the fact that the axis of revolution of a cyclone is inclined forwards in the direction of its motion, the lower part being retarded by friction against the surface of the earth, so that, while the general tendency of the revolving wind may be upwards, there will be a down-rush in the rear of the cyclone, a fact which accounts for the sudden fall of temperature commonly observed when the wind shifts to N.W., as the centre passes to the eastward of the observer in the northern hemisphere, the fall being generally far too great to be accounted for by the small difference in latitude between the points from which the northerly and southerly winds respectively originate in an ordinary cyclone.

But the point at issue between us is *not* how a low pressure system is "*filled up*," but how it *originates*—what it is in its initial stage. Dr. Muirhead maintains that low pressure systems are simply "areas of rarefaction," caused by local heat; my contention, on the other hand, is that this theory altogether fails to explain some of the characteristic features of the more important low pressure systems, such as those which at certain seasons of the year pass in rapid succession over our islands or their neighbourhood from the Atlantic (and it is chiefly these that the "meteorological authorities" whose nomenclature Dr. Muirhead finds fault with, refer to in their forecasts); and that a better explanation of them is to regard them as actual eddy-like depressions, originally formed in the great atmospheric currents which sweep over large areas of the globe.

Dr. Muirhead appears to consider this theory so ridiculous as to be quite unworthy of a F.R.Met.Soc., though it might be excusable in one of the "general public" who was ignorant of the simplest principles of meteorology. What does he think, then, of the following passage, penned by one who is not only a F.R.Met.Soc., but actually a secretary of that august body, and also secretary of the Meteorological Office—Mr. R. H. Scott?—"If we suppose the atmosphere to be a liquid, like the sea, and enveloping the earth, we may imagine that portion of it which lies over the Atlantic Ocean in our latitudes to be like a gigantic river. . . . . On the surface of such a river we often see small waves and eddies, each with its own circulation, which are carried along with the stream. If we could look at the upper surface of the atmosphere, *supposing it to be homogencous and of equal density throughout*, we should see somewhat similar conditions; what corresponds to the crest of the waves being patches of excessive pressure, while what corresponds to the eddies would be the areas of defective pressure. The surface, if suddenly congealed, would present the appearance of a number of

isolated mounds and pits, with very little level area at all. . . . . The pits would have steep sides, be deep, and of comparatively small diameter; while the mounds, on the contrary, would be flat-topped and extensive in area. The pits are what are called barometrical depressions or cyclonic systems, from the Greek word κύκλος, because the wind whirls round them; the mounds are the areas of high pressure, called anti-cyclones, because they are the opposite of cyclones." ("Elementary Meteorology," by R. H. Scott, pp. 352-3, 1st Edition). I do not overlook the importance of the qualifying words in italics, but I think I may claim, that the view which Mr. Scott here formulates in reference to the origin of low pressure systems agrees in the main with that which I advocate.

But I can claim higher authority even than that of Mr. Scott, for this view, viz., that of the late Sir John Herschel. I do not know whether he was a fellow of the Meteorological Society: if not all I have to say is (to paraphrase a well-known saying of George Stephenson), "So much the worse for the Meteorological Society." "We have," he writes, "to consider the globe as entirely and deeply covered by an atmosphere of mixed gases—highly elastic, very dilatable by heat, and of extreme mobility: expanding itself in virtue of its elasticity out into space far above the tops of the highest mountains; yet, in virtue of its compressibility, so condensed (comparatively) in its lower strata as that one-third of its total ponderable mass lies within a mile of altitude above the sea-level, nearly one-half within two, and nearly two-thirds within five miles, within which latter limit the whole would be contained were it everywhere of the same density as on the surface; so that only about one third of its total mass is free to range unimpeded by the crests of the highests Himalaya; and not much more than two-fifths can entirely clear the range of the Andes without pressure á tergo. In consequence, when driven in the state of *wind* over these or other mountain ranges it is thrown up into vast ripples or waves, which are propagated thenceforward onwards over indefinite areas of land or sea, and become no doubt the origin of a great part of those casual fluctuations of the barometer, which give so much trouble to meteorologists." ("Popular Lectures on Scientific Subjects," by Sir John Herschel, New Edition, pp. 150, 151). That seems to me a reasonable theory of the origin of low pressure systems, and one which explains the phenomena far better, at any rate as regards the larger disturbances, than Dr. Muirhead's somewhat crude theory of areas of local rarefaction. I had intended to state for Dr. Muirhead's consideration, some well-known facts observed in connection with low pressure systems, which seem to me to stand in the way of the acceptance of his theory; but I feel that I have already occupied more than my share of space in this month's magazine. If you are willing that the discussion should be continued in your columns, you will perhaps allow me to return to the subject on a future occasion. I will only, in conclusion, express the hope that the subject may be

fully and worthily discussed, and reciprocate Dr. Muirhead's wish, "that he or I, or both of us, may be set right."

G. T. RYVES.

Tean Vicarage, May 5th, 1890.

CYCLES OF DROUGHT AND GOOD SEASONS IN AFRICA.

To the Editor of the Meteorological Magazine.

SIR,—With reference to your review, last month, of my "Cycles of Drought and Good Seasons in S. Africa," I trust you will allow me a few lines to explain.

The error of one year, noted at page 125, affects the one reference only, and this not really, for an inspection of the Cyclical Diagram at page 78 will show that the rains of the 9·5 years' cycle have invariably run into a second year.

In the more recent second lecture, containing forecasts of the character of the seasons in S. Africa for the next 50 years, sun-spots, as observed, are, for forecasting purposes, discarded, and the following *three cycles only* employed: (1) 11·11 years; (2) 9·5 years; (3) 12·5 years.

In fixing dates with fractions the usual rule of taking the nearest whole figure is adopted. It is also explained in the text that with seasonal rains, as in S. Africa, the fractional half-year of a cycle becomes a whole year every two years. Thus a glance at the Cyclical Diagram for Cape Town shows that the rains of the 9·5 years' cycle—the heaviest rains at Cape Town—fall *with absolute punctuality* every nine and ten years alternately. These and all the other rains at Cape Town show a cyclical regularity, which to me, when I first studied the subject, seemed amazing. Had any one suggested such a regularity to me a few years ago, I should have viewed it with the amused incredulity that runs through your review. It is not necessary to wait ten years, as you suggest, to verify my forecasts. The odds in their favour are 49 to 1 in the case of the Cape Town meteorological records. One cannot suppose that cycles, which have rolled through their periods with unswerving regularity for 49 years, will now change, because we have mapped, and arrived at an understanding of, them! Fortunately in one sense, unfortunately in another, cyclical meteorology, as it exists in the Cape climate, is such an entirely new departure that it is difficult to get English meteorologists to examine the subject seriously.

There is every variety of climate in South Africa, from nearly rainless desert tracts to forest-clad mountains, with an average of 50 or 60 inches per year. It is certain that no writer who has not lived in the country has understood its meteorology. Most English and German writers—notably Dove recently—have fallen into the error of grouping heterogeneous stations.

It is unfortunate that "lag" rains have been misunderstood in your review. The lagging, where it occurs, is a *constant* local factor

not a promiscuous, one, two, or three years, thrown in where wanted to support a theory, as your review suggests. The nature and incidence of the lag rains of Eastern S. Africa are fully explained in the text, they being the most prominent feature in the meteorology of that portion of the continent.

I am, Sir, yours faithfully,

D. E. HUTCHINS.

Budleigh Salterton, Devonshire, 27th April, 1890.

[When an author has not merely discovered the laws of the seasons for fifty years to come, but has the odds in his favour of 49 to 1, it is natural that he should object to anything except adulation. Mr. Hutchins has not told us when his 11·11, 9·5, and 12·5 years are to start from, and, because two of his cycles have half years, seems to think that that is the only fraction with which he has to deal. Very little arithmetic is requisite to show that the matter is by no means so simple. As regards his discovery, which, if real, is probably the greatest ever made in meteorology, we adhere to our previous words, "When Mr. Hutchins can bring up evidence of 10 years' success, we will do all in our power to ensure him the honour he will merit."—ED.]

ROYAL METEOROLOGICAL SOCIETY.

THE monthly meeting of this Society was held on Wednesday evening, April 16th, at the Institution of Civil Engineers, 25, Great George Street, Westminster, Mr. Baldwin Latham, C.E., F.G.S., President, in the chair.

The Marquis of Gallidoro and Mr. J. M. Veevers were elected Fellows of the Society.

The following papers were read :—

1. "The Cold Period at the beginning of March, 1890," by Mr. C. Harding, F.R.Met.Soc. At the commencement of the month a rather heavy fall of snow was experienced in many parts of England, and very cold weather set in over the Midland, Eastern, and Southern districts, the temperature on the 3rd and 4th falling to a lower point than at any time in the previous winter. The lowest authentic thermometer readings, in Stevenson screens, were 5° at Beddington, 6° at Kenley in Surrey and Hillington in Norfolk, 7° at Chelmsford and Beckenham, 8° at Addiscombe, 9° at Reigate and Brockham, and 10° in many parts of Kent and Surrey. At Greenwich Observatory the thermometer registered 13°, which has only once been equalled in March during the last 100 years, the same reading having occurred on March 14th, 1845. During the last half-century the temperature in March has previously fallen below 20° in only three years, whilst during the whole winter so low a temperature has occurred in only eight years out of the fifty.

2. "Note on the Whirlwind which occurred at Fulford, near York, March 8th, 1890," by Mr. J. E. Clark, B.A., B.Sc. A sharp and heavy thunderstorm occurred at York about 2.30 p.m. At the

same time, or shortly afterwards, a whirlwind passed a little to the south of the city, from Bishopsthorpe to Heslington, a distance of about four miles, its width varying from three or four to 250 yards. The author made a careful survey of the track of the whirlwind, and described the damage done by it to trees, buildings, &c.

3. "On the possibility of Forecasting the Weather by means of Monthly Averages," by Mr. A. E. Watson, B.A., F.R.Met.Soc. The author's method seems to be (1) to ascertain the average temperature, rainfall, &c. of each month; (2) to consider whether the previous months had had temperatures, &c. above or below the mean, and to assume that any such departure would be compensated in the month about to commence.

REVIEW.

Différentes formes des grêlons observés au sud-ouest de la Russie. Par Prof. A. KLOSSOVSKY. 8 vo. 14 pages, 2 plates.

OUR readers will remember that we have already drawn attention to Professor Klossovsky's work on "Thunderstorms in Russia."* In the course of 1886, he organized a series of stations for the observation of thunderstorms in the south-west of Russia; there are now no fewer than 230 such stations, and in the four years 1886-89, they sent in more than 6,000 reports—that is to say, on the average each station reported six or seven storms each year. From these reports the best of those upon remarkable falls of hail have been reproduced in this pamphlet, which is accompanied by two plates giving views and sections of the most noteworthy stones, all drawn to the natural scale. The storms dealt with are in number only eight, but of some there are two or three reports.

The largest hailstone was roughly circular 2 in. in its greatest, and about 1·8 in. in its least diameter; it was somewhat foliated in outline, but on the whole perhaps more like a round nodule of iron pyrites than anything else. It fell at the village of Zélënovka, in Kherson [about 48° 30′ N. and 32° 30′ E.], in the afternoon of August 19th, 1887. It had a crystalline bluish centre, and layers of more or less opaque ice around it. This was in point of size and weight far inferior to those seen and modelled by Mr. Stratten as falling at Montereau, France, August 15th, 1888, and which have been well engraved, natural size, in the *Quart. Jour. Roy. Met. Soc.* Vol. xv. p. 48.

Another stone which fell at Ratchky, in Podolia [about 49° N., and 29° E.], somewhat resembles the lady's-hand-glass pattern, frequently seen in Bavaria by Col. Ward, and engraved in the *Meteor. Mag.* Vol. xv., 1880, p. 33.

With a staff of 230 observers scattered over the vast level plains of Southern Russia, Professor Klossovsky has special facilities for the study of the formation and motion of thunderstorms, and we anticipate with pleasure further reports from him.

* *Met. Mag.*, Vol. xxi. (1886) p. 1.

SUPPLEMENTARY TABLE OF RAINFALL, APRIL, 1890.

[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 Hall.	3·21	XI.	Castle Malgwyn	1·09
,,	Margate, Birchington...	2·25	,,	Builth(Llanwrtyd Wells)	1·47
,,	Littlehampton	2·57	,,	Rhayader, Nantgwillt..	2·05
,,	Hailsham	2·81	,,	Carno, Tybrith	1·94
,,	Ryde, Thornbrough	3·01	,,	Corwen, Rhug	1·14
,,	Alton, Ashdell.....	2·39	,,	I. of Man, Douglas	1·89
III.	Oxford, Magdalen Col...	1·03	XII.	Stoneykirk, Ardwell Ho.	1·03
,,	Banbury, Bloxham	1·14	,,	New Galloway, Glenlee	1·97
,,	Northampton	1·00	,,	Melrose, Abbey Gate...	·98
,,	Cambridge, Fulbourne..	·95	XIII.	N. Esk Res. [Penicuick]	1·50
,,	Wisbech, Bank House..	·51	XIV.	Ballantrae, Glendrishaig	1·14
IV.	Southend	1·91	,,	Glasgow, Queen's Park.	1·33
,,	Harlow, Sheering	·94	XV.	Islay, Gruinart School..	1·75
,,	Rendlesham Hall	·86	XVI.	Dollar.....	·95
,,	Diss	·91	,,	Balquhidder, Stronvar..	2·58
,,	Swaffham	·60	,,	Dunkeld, Inver Braan..	1·62
V.	Salisbury, Alderbury...	2·65	,,	Dalnaspidal H.R.S. ...	4·28
,,	Warminster	2·79	,,	Arbroath Cemetery.....	..
,,	Bishop's Cannings	1·76	XVII.	Keith H.R.S.	1·54
,,	Ashburton, Holne Vic....	4·19	,,	Forres H.R.S.	·72
,,	Hatherleigh, Winsford.	2·71	XVIII.	Fearn, Lower Pitkerrie.	1·11
,,	Lynmouth, Glenthorne.	2·90	,,	Loch Shiel, Glenaladale	4·81
,,	Probus, Lamellyn	2·99	,,	N. Uist. Loch Maddy ...	2·67
,,	Launceston, S. Petherwin	3·14	,,	Invergarry	3·75
,,	Wincanton, Stowell Rec.	3·06	,,	Aviemore H.R.S.	...
,,	Taunton, Lydeard Ho...	3·23	,,	Loch Ness, Drumnadrochit	1·66
,,	Wells, Westbury	2·62	XIX.	Lairg H.R.S.	...
VI.	Bristol, Clifton	1·14	,,	Scourie	2·31
,,	Ross	1·01	,,	Watten H.R.S.	1·39
,,	Wem, Clive Vicarage ...	1·14	XX.	Dunmanway, Coolkelure	3·83
,,	Cheadle, The Heath Ho.	1·36	,,	Fermoy, Gas Works ...	1·43
,,	Worcester, Diglis Lock	1·09	,,	Tipperary, Henry Street	1·55
,,	Coventry, Coundon	1·49	,,	Limerick, Kilcornan ...	1·09
VII.	Ketton Hall [Stamford]	.82	,,	Miltown Malbay.....	1·40
,,	Grantham, Stainby	·60	XXI.	Gorey, Courtown House	1·57
,,	Horncastle, Bucknall ...	·18	,,	Navan, Balrath	·99
,,	Mansfield	...	,,	Mullingar, Belvedere ...	1·27
VIII.	Neston, Hinderton	1·09	,,	Athlone, Twyford	1·46
,,	Knutsford, Heathside ...	1·02	,,	Longford, Currygrane...	1·34
,,	Lancaster, South Road.	1·63	XXII.	Galway, Queen's Coll...	1·67
,,	Broughton-in-Furness ..	2·54	,,	Clifden, Kylemore	2·58
IX.	Wakefield Prison	·65	,,	Crossmolina, Enniscoe..	2·31
,,	Ripon, Mickley	1·01	,,	Collooney, Markree Obs.	1·86
,,	Scarborough, West Bank	·92	,,	Ballinamore, Lawderdale	..
,,	East Layton [Darlington]	·81	XXIII.	Warrenpoint	1·67
,,	Middleton, Mickleton..	1·31	,,	Seaforde	1·24
X.	Haltwhistle, Unthank..	1·35	,,	Belfast, New Barnsley..	1·84
,,	Shap, Copy Hill	1·65	,,	Bushmills, Dundarave...	1·18
XI.	Llanfrechfa Grange	1·27	,,	Stewartstown	1·78
,,	Llandovery	2·07	,,	Buncrana	1·82

APRIL, 1890.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1880–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE Max. Deg.	Date	Min. Deg.	Date	No. of Nights below 32° In shade.	On grass.
		inches	inches.	in.								
I.	London (Camden Square) ...	2·02	+ ·28	·54	25	16	64·3	30	30·5	5	3	12
II.	Maidstone (Hunton Court)...	2·78	+ 1·08	1·23	25	11	...	...	...	...	...	...
,,	Strathfield Turgiss	1·70	+ ·10	·33	23	17	66·3	30	25·3	5	6	17
III.	Hitchin	·62	— 1·17	·23	15	15	62·0	30	28·0	1	6	...
,,	Winslow (Addington)	1·21	— ·71	·22	26	15	64·0	30	23·0	2, 5	7	15
IV.	Bury St. Edmunds (Westley)	·84	— ·82	·20	21	11	...	...	...	...	...	...
,,	Norwich (Cossey)	·91	— ·80	·20	8	15	...	...	...	...	...	...
V.	Weymouth (Langton Herring)	3·00	+ 1·12	·73	24	18	60·0	15	31·0	4, 12	3	...
,,	Barnstaple	2·54	+ ·36	·81	23	13	61·0	16	31·0	4	...	..
,,	Bodmin (Fore Street)	3·18	+ ·11	·94	24	18	..	...	...	...	..	...
VI.	Stroud (Upfield)	·97	— 1·18	·15	23	16	64·0	30	31·0	1*b*	6	...
,,	Church Stretton (Woolstaston)	1·02	— 1·32	·23	25	12	63·0	30	29·0	4	7	14
,,	Tenbury (Orleton)	1·52	— ·56	·42	15	14	65·0	30	24·2	2, 4	10	13
VII.	Leicester (Barkby)	·82	— 1·28	·16	15	14	71·0	30	20·0	1	11	20
,,	Boston	·50	— 1·21	·16	6	10	70·0	29	24·0	2*c*	7	...
,,	Hesley Hall [Tickhill].....	·33	— 1·38	·11	7	10	68·0	30	24·0	1	10	...
VIII.	Manchester (Plymouth Grove)	·74	— ·97	·27	6	12	68·0	30	29·0	11	4	9
IX.	Wetherby (Ribston Hall) ..	·65	— 1·20	·23	13	9	...	...	...	...	...	..
,,	Skipton (Arncliffe)	2·38	— 1·05	·78	6	14	63·0	30	28·0	10	6	...
,,	Hull (People's Park)	·82	— 1·10	·25	12	14	...	...	...	...	...	...
X.	North Shields	·50	— 1·17	·15	7	10	63·0	30	28·0	11	9	14
,,	Borrowdale (Seathwaite).....	4·55	— 2·59	1·50	6	13	...	...	...	...	...	...
XI.	Cardiff (Ely).....	2·12	— ·29	·38	23	17	...	...	...	...	...	...
,,	Haverfordwest	1·79	— ·84	·40	6	12	59·0	14*a*	25·0	11	7	9
,,	Plinlimmon (Cwmsymlog) ...	2·19	...	·84	6	9	...	...	...	...	...	...
,,	Llandudno.....	1·09	— ·72	·23	10	11	64·8	30	32·0	12	1	...
XII.	Cargen [Dumfries]	1·44	— ·79	·47	21	12	62·8	30	25·6	12	10	...
,,	Jedburgh (Sunnyside).....	·77	— ·93	·18	24	13	64·0	30	24·0	13	12	...
XIV.	Old Cumnock	1·91	— ·22	·40	22	13	64·0	30	20·0	10	15	...
XV.	Lochgilphead (Kilmory).....	3·15	+ ·34	·55	20	13	...	...	...	...	...	...
,,	Oban (Craigvarren)	2·09	...	·50	6	12	58·6	30	31·1	13	2	...
,,	Mull (Quinish).....	2·25	— ·73	·36	21	13	...	...	...	...	...	...
XVI.	Loch Leven Sluices	·70	— 1·52	·30	22	...	...	...	...	...	...	...
,,	Dundee (Eastern Necropolis)	·65	— 1·40	·15	21	8	64·0	2	28·4	13	5	...
XVII.	Braemar	1·81	— ·61	·36	21	17	59·3	3	21·8	14	11	23
,,	Aberdeen (Cranford)	1·46	...	·27	28	23	62·0	3	26·0	12	5	...
XVIII	Strome Ferry.....	2·47	— ·45	·86	6	13	...	...	...	...	...	...
,,	Culloden	·49	— ·55	·20	23	...	61·0	2	25·0	13	6	22
XIX.	Dunrobin	...	...	...	...	...	...	...	...	...	...	...
,,	S. Ronaldsay (Roeberry).....	...	...	...	...	...	...	...	...	...	...	...
XX.	Cork (Blackrock)	1·33	— 1·56	·21	23	14	69·0	27	30·0	2	1	...
,,	Dromore Castle	2·31	— 1·30	·52	6	12	66·0	5	31·0	2	...	...
,,	Waterford (Brook Lodge) ...	1·30	— 1·17	·28	23	15	61·0	21	28·5	4	3	...
,,	O'Briensbridge (Ross)	1·10	...	·43	6	13	61·0	30	31·0	3	4	...
XXI.	Carlow (Browne's Hill)	...	...	...	...	...	...	...	...	...	...	...
,,	Dublin (FitzWilliam Square)	1·58	— ·54	·44	15	14	63·6	20	31·2	3	1	12
XXII.	Ballinasloe	1·16	— 1·18	·19	6	16	59·0	20	26·0	3	9	...
XXIII	Waringstown	1·43	— ·99	·19	24	18	65·0	28	25·0	2	7	12
,,	Londonderry (Creggan Res.).	1·67	— ·57	·27	9	15	..	...	...	...	...	...
,,	Omagh (Edenfel)	1·72	— ·51	·33	25	16	64·0	28	30·0	2	4	8

ENGLAND. WALES. SCOTLAND. IRELAND.

a And 15, 28, 29. *b* And 3, 4, 10, 11. *c* And 5, 12.

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

METEOROLOGICAL NOTES ON APRIL, 1890.

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 weather of this month in particular, and of the spring in general, has been so pre-eminently favourable for farming operations, that the British farmer will have to look about for something else to grumble at, the only grievance in this district being that the bloom of the fruit trees has suffered from night frosts.

ADDINGTON.—Very sharp frost on 2nd and 5th, and the nights cold throughout the month. Bar. very low on 15th, 16th and 17th; on 17th a dense fog lasted all day. Swallow arrived on 15th, cuckoo heard on 16th, and nightingale on 27th. R from January 1st to April 30th 5·70 in., the least registered in the first four months of the year during 20 years.

BURY ST. EDMUNDS, WESTLEY.—A dry month, with many slight frosts. The hay crop is likely to be short in Suffolk.

LANGTON HERRING.—R ·79 in. above the average of 15 years. Mean temp. at 9 a.m. 1°·5 below the average. Solar halos were frequent. Dense fogs on 6th, 21st, and 22nd.

BODMIN, FORE STREET.—A very cold month; very high winds on several days from the N. and N.W. L on the 15th; S, sleet and H on the 10th. A splendid warm summer's day on the 30th.

STROUD, UPFIELD.—About an inch of S fell on the 10th about 6 a.m., and melted by 10 a.m. T heard in the E. and W. on the 16th.

WOOLSTASTON.—A rather cold month, especially the first fortnight, during which there were constant frosts. S fell on 10th. Mean temp. 44°·4.

LEICESTER, BARKBY.—Hailstorm and L on the 7th. First swallow seen on the 16th, cuckoo on the 24th.

BAWTRY, HESLEY HALL.—A cold, dry month.

MANCHESTER, PLYMOUTH GROVE.—The R was the smallest in April for 23 years, excepting 1873. Mean temp. 46°·8. Thick fog on the morning of the 5th; bitterly cold E. winds from 14th to 19th; the last ten days fine, and mostly bright and sunny.

HULL.—The weather during the month was generally dry, often with cold E. or N.E. winds; overcast or very cloudy from the 12th to the 24th, much less so during the early and latter parts of the month.

WALES.

HAVERFORDWEST.—A very dry, fine April. The wind blew with considerable force from N. and E. on 15 days, from the W. and S.W. on only 7 days, the remainder from N.W., consequently the temperature was below the mean, and the sky mostly cloudless, with sharp night frosts; a wholesome check was thus put to vegetation, which was unusually forward, owing to the mildness of March. Blackthorn in blossom on the 4th, horse chesnut in leaf on the 15th; cuckoo heard on the 24th.

SCOTLAND.

CARGEN.—The mean temp. of the month (44°·4) was 1°·5 below the average. Easterly winds prevailed for 18 days. Sunshine (165 hours) exactly the average. The low temp. of the month somewhat checked vegetation, which, however, was considerably in advance of what it usually is at this season. The

R of the first quarter of the year (11·32 in.) is 2·87 in. below the average of 30 years. T, L, and heavy H on 26th; T and S showers on 7th.

JEDBURGH.—N., N.E., and S.E. winds prevailed, often with frost, but there was a good deal of sunshine. Vegetation progressed little. Temp. low.

OBAN, CRAIGVARREN.—A fine seasonable month, with moderate R, and warm weather.

CULLODEN.—Little R fell during the month, and the temp. was very low, frost occurring nearly every night; vegetation much retarded.

IRELAND.

CORK—On the whole a genial month, only one shade frost. R less than half the average of 25 years. Mean temp. 50°·6, 2°·7 below the average of 14 years.

WATERFORD, BROOK LODGE.—A good deal of E. wind during the month; mean temp. 47°·3.

ROSS, O'BRIENSBRIDGE.—R small; harsh cold winds from N.E., S.E,, and N.W. prevailed, checking vegetation. A rise of temp. occurred on 27th, and the last three days were genial and pleasant. Frosts very slight.

DUBLIN.—April was generally a favourable month. The mean temp., R and rainy days were all somewhat below the average. Considered by weeks, the weather was first fine, dry and quiet; then cold and showery; then dull and cheerless; then unsettled, squally and showery, and lastly fine. Mean temp. 47°·3. Lunar halo on 24th; foggy on eight days; high winds on 11 days, on two occasions attaining the force of a gale. S or sleet on 10th, H on five days. Temp. in screen exceeded 50° on 23 days. T in W. at 0.10 p.m. on 26th.

OMAGH, EDENFEL.—The month commenced with brilliant weather, and as a seed time was excellent throughout, but the prevalence of dry easterly winds, and frequent night frosts, occasioned vegetation to be but little further advanced at the close than at the commencement.

WEATHER FORECASTING.

To the Editor of the Meteorological Magazine.

SIR,—In a report of the April meeting of the Royal Meteorological Society, published in "Nature" [April 24th, 1890, page 598], the following sentence appears:—"On the possibility of forecasting the weather by means of monthly averages, by Mr. A. E. Watson. The author is of opinion that the average values of meteorological phenomena are constant quantities, and that any variation from them is sure to be met by a compensating variation in the opposite direction."

This no doubt states a very interesting and important fact which I may be bold enough to add is quite independent of the opinion of Mr. A. E. Watson—but surely my brother Fellows of the Roy.Met. Soc., knew it before, or they could have found it in any dictionary. If "any variation from" an average is not "met by a corresponding variation in the opposite direction," so much the worse for that average.

Mr. Watson will, I hope, forgive the above remark, for I cannot believe that the report describes the subject of his paper, but I think that few readers would repress a smile at the Roy.Met.Soc,, on seeing such an account of its proceedings in the pages of our leading scientific journal.

I am, sir, yours obediently,

A F.R.Met.Soc.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

CCXCIII.] JUNE, 1890. [PRICE FOURPENCE, *or 5s. per ann. post free.*

THE GREAT DEVONSHIRE RAINS OF MAY 25TH.

We have so constantly tried to induce rainfall observers to believe that six inches of rain may fall on one day, and so rarely succeeded, that it is a great satisfaction to have a case in which, though more might have been done, the totals are accurately known—the inner vessels ran over, but the outer ones saved the overflow—and the two gauges in Tiverton collected respectively 4·85 in. and 5·20 in., of which as nearly as we can tell about four inches came down in two hours. We will in the first place give the reports which these two correspondents have kindly sent us, and also the notes from all the stations where the fall exceeded two inches.

To the Editor of the Meteorological Magazine.

SIR,—I have tested the rain gauge, and find that the outer can would hold nearly 7 inches of water without running over. We measured the contents very carefully at 9 a.m. on Monday (26th), as usual, and recorded 5·20 in. The rain commenced here at 2.15 p.m. on Sunday (25th), and was soon followed by a hail storm of unusual severity, lasting for two hours, and causing great damage, cutting through our verandah, which is canvas painted, and riddling it as if shot through by bullets. It otherwise did immense damage to garden frames, &c. The heavy rain, accompanied by terrible lightning, lasted until 4.30 p.m., when the latter subsided, but the rain continued, off and on, up till 10 o'clock, but not with any *violence* after 4.30 p.m. The devastation caused in and around Tiverton is extraordinary.

Yours very truly,

M. DICKINSON.

Broomhill, Tiverton, May 31st.

P.S.—The bottle in our rain gauge overflowed into the tin, but, it being watertight, the overflow was quite safe, and carefully measured.

SIR,—The storm on Whitsunday begun at 2.15 p.m., with lightning, followed almost immediately by loud thunder, heavy rain, and soon by large hail. The worst of the storm lasted about 2 hours, but rain

continued to fall heavily, with occasional thunder, not so near, for an hour more, and distant thunder and showers of rain occurred at intervals all the evening.

The storm began very suddenly; at 1.55 it was hot and bright, as in the morning, 82° in the shade, and no one had umbrellas. At 2.15 a few large drops were falling, and before 2.20 the thunder had begun.

The gauge was visited at 5.15 p.m., when it was still raining slightly, a jug being taken to bring in the rain for measurement. It was then found that the bottle (which we have since twice measured and found to hold 3·27 inches) had run over, and the overflow was preserved in the outer case. The bottle was emptied into the jug, but so nearly filled it that the overflow water was not then touched, and the emptied bottle was replaced. In the morning the bottle was found to contain 0·35 in., and the case 1·23 in. The fall, therefore, was, between—

2.15 and 5.15	4·50
5.15 and 9 a.m. (26th)	·35
Total to be entered to 25th	4·85

The damage is now estimated at £750 to roads, and £1,000 to private property.

The streets were re-laid in the winter, and rolled in with a steam roller, and they have only been washed bare; but as soon as you pass into a road you see the wreck of the storm, The chief damage is (to roads) E. and W. On the N. and S. the river Exe received the water from the hills, and carried it off without flooding, but the Lownam river and a small stream that flows into it, the Ailsa brook, overflowed and did much damage.

West of the town, in two directions, three steep roads meet just before the streets begin, and in both cases the main road is more like the moraine of a glacier in miniature than a civilized road. The granite blocks edging the footpath are washed up and tossed on the heaps of gravel and stones where the road was, and in one case a broken culvert completes the scene of ruin.

Owing to illness in the house I have not seen the roads on the E., but hear that they are quite as bad, with trees torn up, and a hedge washed into the middle of Tidcome-lane, which is also blocked by a broken culvert.

The damage to houses was chiefly caused by the water pipes and shoots overflowing, being choked by the large hail; the streams pouring from these caused the floods in the streets, where the gratings were also stopped.

The flood in St. Peter-street (ours) went down by 5.0 p.m., but the water in Westexe was still high at 8.30. That part of the town below the bridge is much lower than ours.

Yours truly, H. S. GILL.

Tiverton, June 2nd, 1890.

SIR,—Morning of 25th very close and sultry, about 2 p.m. distant T in the E., which became heavy and continuous by 3 p.m. About 3.30 a few enormously large drops or splashes of water fell at intervals, and shortly after a heavy downpour set in, 0·18 in. falling in 15 minutes. About this time a remarkably brilliant flash of L was accompanied by a nearly simultaneous deafening report. L became incessant and T heavy and continuous, but the R was not remarkable, and the storm subsided considerably by 4.45 p.m.

At 6 p.m. another very black storm came over from the E., and at 6.45 a very heavy downpour set in, and in about an hour, 1·56 in. of R was registered. By 8.30, the R had nearly ceased, and a black cloud in the W.N.W. (from which L was frequent) marked the retreating storm.

The total rainfall for the five hours during which these storms lasted was 2·07 in., as recorded by the registering pluviameter, 10 ft. above the ground.

The records of the various gauges are as follows :—

1890, May 25th.—A. 2·13 inches = old 5 in. gauge, 1 ft. above ground.
C. 2·21 ,, = 5 ,, 4 ,, ,,
D. 2·12 ,, = new 5 ,,
E. 2·07 ,, = 8 in. Richard recording gauge.
No rain was registered May 24th and 26th.

The barometer gave no indications of the approach of these storms, the barograph trace showing a very gentle decline. Between 2 and 7 p.m. the trace is considerably shaky, as if from the jar of the thunder, and a decided disturbance is shown about 5.15 p.m.

C. GROVER,
(Asst. to C. E. Peek, M.A.)

Rousdon Observatory, Lyme.

SIR,—Thunderstorms are not of frequent occurence here, but we had one yesterday of exceptional duration and rainfall. T was first heard about 2 p.m. The first drops of R fell at 3 p.m., and R ceased shortly after 8 p.m. At 9 p.m. I measured the fall and found it to be 2·77 in.

The fall was not quite continuous and varied much in intensity, but the gauge being far from the house I could not take the measurements at successive periods as I should have liked to do. The hour from 6 to 7 would, I believe, have shewn a most unusual rate of fall.

The heaviest falls I have previously registered were :—July 14, 1875, 2·72 in., a steady downfall for about 20 hours, without T, and December 26, 1886, 2·53 in., a violent gale, finishing with S of unusual density.

Extensive damage is reported from Lyme and Uplyme this morning.

Yours very truly,
E. L. AMES.

Clevelands, Lyme, Dorset, May 26, 1890.

SIR,—We had 2·14 in. of R on the 25th. It rained heavily from 3 to 4 p.m., but the tremendous storm was from 6·30 to 7·30 p.m., when the H and T were awful.

Great Trill, Axminster. F. J. SPARKS.

From Tiverton to Exeter is about 12 miles, and before we proceed to a general summary of the storm we think that the following note on the state of the Exe, at a little N. of Exeter will be illustrative. We have already seen that at Tiverton the rain began at 2.15 p.m., and that by 5.15 the exceptional features had passed, and the water was clearing out of the streets. Evidently, therefore, the rush into the Exe at Tiverton may be said to have been from about 4 to 6 p.m. Allow the flood to pass from Tiverton to Exeter at 5 miles an hour, then the maximum flood at Brampford Speke should be from about 6 to 8 p.m. Now for the report of Miss Gamlen's gardener. "The river was a little puddled at about 6 p.m., but in a quarter of an hour it came down like mud for two hours; I never saw anything like it. Three pigs, hedgehogs, cats, rats, a tub of barley meal, corked bottles, boxes, tins, all sorts of things floated down. At 8 p.m. it was at its height."

As regards rainfall, it was far heavier in Tiverton than anywhere else of which we have yet heard. It was, as all such storms are, very local; for instance, even at Cove, which is in Tiverton parish, but about four miles N. of the Town, the fall was only ·90 in.

We may perhaps as well dispose of the rainfall at once. There was a slight TS, with from ¼ to ½ in. of R in the S.W. of Ireland. At Swansea in S. Wales there was a local heavy R, 1·53 in. falling in 1 hr. 33 min. There were TSS with slight R over much of Cornwall and Devonshire, but though we have been favoured with many returns, the only places at which we have yet heard of an inch falling on the 25th are—

Lyme Regis (Rousdon Obs.)	2·21 in.	Lyme Regis (Holm Cleve)	3·70 in.
,, ,, (Clevelands)	2·77 ,,	Cullompton	1·08 ,,
Axminster (Great Trill)	2·14 ,,	Tiverton (St. Peter's Street)	4·85 ,,
,,	1·20 ,,	,, (Broomfield)	5·20 ,,
,, (Furzebrook)	1·03 ,,		

Reference to a map will show that these returns are (with only one exception, Cullompton, which was only just over an inch and which is about midway between) from two small areas, one of about four miles square to the W. and N. of Lyme Regis, the other about one mile square over Tiverton. As regards Lyme Regis, it is impossible to speak positively, as two observers there allowed their gauges to run over.

As regards the time and progress of the storms the facts are as confusing as is usual. The following very interesting table, prepared by Mr. Greenwood Penny, of High Bickington, Torrington, was published in the *Devon and Exeter Gazette*, and we reprint it as a useful lesson upon the subject.

Locality.	Commencement of Storm.	Killed by Lightning.			
		Man.	Horses.	Sheep.	Bullocks.
Axminster	Afternoon				
Barnstaple	"				
Black Torrington	2.30 p.m.				
Bradworthy	2 30 p.m.	.....	.....	6	
Brampford Speke	Afternoon	.....	.....	21	2
Bude	1 p.m.				
Crediton	2 p.m.				
Dawlish	3 p.m.				
Dunkeswell	Afternoon				
Exeter	1 a.m. and again evening				
East Budleigh	0.30 p.m.				
High Bickington	3 p.m.				
Holsworthy	2.15 p.m.				
Halsdon	.....	.....	.....	4	
Huish	3 p.m.	.....	..	4	
Little Torrington	1 p.m.	.. ...	1		
Moretonhampstead	.....	1	.. ...	4	
Petersmarland	3 p.m.				
Powderham	1 a.m.				
Sandford	3 p.m.				
Stratton	1.30 p.m.				
Tiverton	2 p.m.				
Topsham	2 p m.				
Witheridge	2.30 p.m.				

OTHER CASUALTIES.—Holy Trinity Church tower, Barnstaple struck 6.30 p.m. Holsworthy church tower struck 3 p.m, Mr. Payne's house at Merton struck. Outbuildings struck and burned, property of Mr. Oatway, Tawstock, near Barnstaple. House struck at Topsham (Mr. F. Underhill's). Angel Hotel and outhouses struck at Witheridge. Trees struck in many localities.

Summing up, Mr. Penny said that "the above table, compiled chiefly from reports which appeared in your columns, may be of interest in showing at a glance, the area covered by the thunderstorms of Whit-Sunday, the time of their occurrence in various localities, and the disasters occasioned by lightning alone. It will be seen that the storm of Sunday afternoon was preceded by another in the early hours of the morning, over Exeter, Exmouth, and Powderham, where the hail is reported to have done considerable damage. Another storm developed over Holsworthy at about 5 a.m., but Sunday forenoon appears to have been universally bright and fine, the temperature being unusually high for the time of the year. The second, and by far the more destructive storm, developed over the greater part of Devonshire between the hours of 1 and 4 p.m., reports of its severity having reached from Barnstable (North), Dawlish (South), Axminster (East), and from Bude and Stratton, Cornwall (West). In Mid-Devon, especially in the neighbourhood of Tiverton and Holsworthy, the severity of the storm is reported to have been almost unprecedented. The generally received opinion that summer thunderstorms arise from the rapid condensation of vapour, and consequent development of electricity, from a warm humid atmosphere by the chilling influence of cold air currents and changes of wind in its higher regions, seems to be borne out by the facts. So

extremely rapid was its formation that it came upon us in apparently calm, settled, bright summer weather, with scarcely an hour's warning. We have no records of its commencement anywhere before mid-day, and at 3 p.m. it was raging furiously over nearly the whole county. Here at High Bickington the sky was cloudless at mid-day. At 3 p.m. distant thunder was heard, the sky being then overcast to the S.E. At this hour I noticed the rapid formation of cumuli clouds in the clear sky, which soon coalesced in large rolling masses, darkening the whole heavens. In another half-hour the storm was raging in all its fury, and continued with intermissions until late in the evening. The barometer which had been steady at about 29·5 during the previons twenty-four hours, rose slightly when the storm was at its height."

But the above leaves much uncertain: take, for instance, the Lyme Regis storms. Mr. Cuthbert Peek's observer speaks of them distinctly as coming from E. and passing to W.N.W., but while the first of these was E. of Lyme Regis, torrents of rain were flooding Tiverton, which is N.W. of Lyme. Evidently, therefore, the Tiverton storm was either formed locally or came from the opposite direction. Our impression is that we shall arrive at a true knowledge of the path of storms, only by one or other, or both of two methods (1) by enormously increasing the number of observers—say to one in every alternate village, or (2) by fixing the paths of the storms by trigonometrical observations from lofty observatories like Mr. Prince's.

We need not add details as to flooded cellars, washed away gardens and fowls, nor where the pigs seen floating past Exeter had come from—all who know anything of rainfall know that with four inches of rain in three hours mischief always occurs.

OZONE AND WIND.

To the Editor of the Meteorological Magazine.

SIR,—The determination of ozone in the atmosphere, as at present conducted, is still, I suppose, somewhat lacking in exactness and certainty. Assuming, however, that the daily observations of this substance at Greenwich, published in the *Weekly Return* of the Registrar-General, are an approximation to the truth, the following analysis which I have made of the data for last year (1889) may be not without interest, even if it contain nothing very novel.

The presence of ozone was recorded, I find, on less than half the days, there being 193 days with no ozone. The quantities are represented by figures, ranging to about 17. The days with ozone were :—

0 to 1	=	46	Brot. up		142
1 to 2	=	24	6 to 7	=	7
2 to 3	=	31	7 to 8	=	4
3 to 4	=	17	8 to 9	=	6
4 to 5	=	12	9 to 10	=	3
5 to 6	=	12	10 and above		10
Carried up		142	Total		172

Thus the maximum is in the lowest category, then follow the third, the second, &c.

Now, taking out the ten highest records, and comparing with the direction of the wind, we get the following list:—

Date.	Ozone.	Wind direction.							Hor. movement, dep. from average. (miles.)
		W.S.W.	S.W.	S.S.W.	S.	S.S.E.	S.E.	E.S.E.	
1. March 8.....	17·5	...	...	x	...	x	...	...	+123
2. July 10.....	15·8	...	x	x	x	..	x	...	+ 76
3. May 31.....	12·8	...	...	x	x	...	...	...	+ 75
4. May 30.....	12·0	...	...	x	x	...	...	...	+116
5. April 4.	11·2	...	...	x	...	...	...	...	+ 3
6. Oct. 19.....	11·2	...	x	x	x	...	x	x	+ 74
7. March 7.....	10·5	...	...	x	...	x	x	...	+149
8. April 20.....	10·5	x	x	x	...	...	..	...	+111
9. April 22.....	10·5	x	x	x	...	...	...	...	...
10. July 25...	10·5	x	x	..	..	...	..	...	+206

Three things may here be noted :—

(1). The highest records are, with one exception, in the period March to July (the exception being in October). There was most ozone in the spring and early summer.

(2). The wind-directions on those days are all included in the arc W.S.W. (by S.) to E.S.E. We find in the above list that W.S.W. occurs 3 times, S.W. 5, S.S.W. 9, S. 4, S.S.E. 2, S.E. 3, and E.S.E. 1. Thus the maximum appears to have been with S.S.W.

(3). The horizontal movement of the air was in each case in excess (in one case there is no record). Doubtless the amount of movement affects the record considerably.

We may now look at the cases of no ozone. On most of those 193 days some wind-direction in the northern half of the circle is recorded (W. by N. to E.), though there may be other directions. There are, however, a certain number of cases of no ozone (34), in which the wind-directions were exclusively within the arc indicated above—viz., W.S.W. (by S.) to E.S.E.

Now we find, on examination, that in the great majority of those cases there was a *deficiency* (generally considerable) of wind. Eliminating these, we have a residuum of the following cases of no ozone, with wind in the ozone-yielding arc (as we may call it), and in excess of the average velocity :—

January 18	...	S.W.	S.S.W.	.....	+ 6
February 16	W.S.W.	S.W.	S.S.W.	.....	+58
August 28	..	S.W.	S.S.W.	.....	+74
December 10	W.S.W.	S.W.	...	.....	+88

Thus it seems that we may have a considerable amount of south-westerly wind and no ozone. It may be noted, however, that none

of these four days were in the spring and early summer, in which we find the highest proportion of ozone.

We may, again, look at the matter thus: Here is a table which shows (1) the monthly relative proportion of south wind at Greenwich last year (including reductions); (2) the daily average of the amount of ozone in each month; (3) the number of days in each month on which ozone was observed:—

	S. wind (days.)	Ozone (daily average.)	Ozone (days observed.)
January	10	0·4	8
February	4	0·3	8
March	8	2·5	17
April	13	3·6	20
May	10	3·5	24
June	8	0·7	7
July	9	2·6	21
August	11	2·1	23
September	6	0·7	9
October	12	2·4	15
November	8	0·3	7
December	12	1·0	13

Any one who will take the trouble to make out curves of these figures will find a fair general correspondence. A. B. M.

WIND CHANGES—PRE-INSTRUMENTAL METEOROLOGY.

To the Editor of the Meteorological Magazine,

SIR,—In your review of Mr. Prince's "Summary of a Meteorological Journal," you suggest, as a possible cause of the change from S.W. to N.E. in the direction of our Sussex winds, that additional building may have affected the indications of his vane. But this will not explain the phenomenon, which is a real and objective one. My own register shows precisely the same thing, and my vane, as you know, is at the top of a pretty tall mast in the middle of an acre of paddock, where it has remained unchanged, in locality and surroundings, for more years than I care to count. It is really very curious to go through back records and see how absolute the change has been. I cannot fancy that so notably-marked a phenomenon can be confined to Sussex. It must have some terrestrial—or even cosmical—cause, and, if this be so, should be evident in other localities.

The other matter on which I wished to write was suggested to me by a passage in your article on "Pre-instrumental Meteorology," which set me hunting up some records of storms and floods in our "Sussex Archæological Collections."

I have copied two or three of the most notable accounts from the "S.A.C." volumes, and enclose them.

Very sincerely yours,

WILLIAM NOBLE.

Forest Lodge Maresfield, Uckfield, May 14th, 1890.

THE GREAT STORM OF DECEMBER 8TH, 1703.

"The great storm of November 27th (Dec. 8th N.S.) 1703, in which Bishop Kidder (a Maresfield man) and his wife were killed in bed, at Wells, by the falling of a chimney stack, and Winstanley's Eddystone Lighthouse disappeared, was much felt in Sussex. Houses were untiled at Midhurst, four or five stacks of chimneys blown down at Cowdray, Osborn church steeple blown down. 'The Shoreham Market-house, an ancient and very strong building, was blown flat to the ground, and all the town shattered.' It tore the lead off Brighthelmstone Church, and overthrew two windmills. The hedges were salt twenty miles from the sea, and the grass on the Downs about Lewes so salt that the sheep would not eat it; while "the miller of Berwick, three miles from the sea, while attempting with his man to secure his mill, was so washed with flashes of sea water, which he represented as beating against them like the breaking of waves against the rocks, that they were almost strangled therewith, and forced to give over their attempt, and in consequence the mill was considerably damaged."

HEAVY THUNDERSTORM, MAY 22ND, 1728.

"May 11th (22nd N.S.) 1728, at Hurstpierpoint. A dry day until towards night, then rain, thunder, and lightning, and a very great storm and tempest. May 13th (24th N.S.). The storm on Saturday proved to be very great, especially the hail, which was prodigious. Many of the stones were as big and some bigger than hens' eggs. The windows of some houses about here were almost all broken. The corn was much injured."—*Diary of Thomas Marchant*, "*Sussex Archæological Collections*," *Vol. XXV., p.* 19.

HEAVY THUNDERSTORM, MAY 16TH, 1797.

"May 16th, 1797. On Sunday, the 7th of this month, I was engaged to officiate, at 3 o'clock in the afternoon, at St. Michael's in Lewes, for Mr. West. I had entered my carriage at half-past 1 to go there, not conceiving it possible I could be prevented, but a storm of thunder and lightning and hail came on with great violence, as we were coming from Chailey Church, after morning service. I thought it too violent to continue any time, and had no doubt of going to Lewes, but it kept increasing, and the rain came in such torrents, that before half an hour the flood was immense. The sheep stood belly deep in the Green before the house, and the orchard and lawn and the lower island pond were one sheet of water, and the rain so continued until past 3 o'clock, when the deluge was beyond description, and the water on the lawn was twelve feet deep, as I myself measured it, from where it had stood, at against the old road that intersects it. Had I have attempted to have gone to Lewes the flood at Bevan's Bridge would have rushed in at the chariot windows; indeed, it would have been useless to have attempted to pass, for at 7 in the evening a man and horse were

swimming there. But the very extraordinary part is that there was no rain at Lewes; and there the congregation was all assembled, and waiting for me with great impatience. The hail was large, and broke some panes of glass, but did no other material mischief; in truth, it was such a flood as was never known before, and as never covered anything like the ground, or fell in so short a time, at most three hours. I never saw anything like it, except some years ago in London, when the people waded knee deep in Piccadilly, and when so much of Tower Hill was torn up that they talked of an earthquake, and there was neither then nor now any wind."—*From an old Account Book kept by the Rev. Sir Henry Poole, Bart., of the Hooke, Chailey, Sussex.—Sussex Archæological Collections, Vol. XII., p.* 3.

During the same flood the stone parapet of Uckfield old bridge was carried away, and some persons standing on the bridge were drowned.

"AREAS OF RAREFACTION" OR "DEPRESSIONS."

To the Editor of the Meteorological Magazine.

SIR,—Replying to Mr. Ryves, I beg to say that I do not see that the inclination of the axis of a cyclone has much to do with the question at issue, which, he says, "is not how a system of low pressure is '*filled up*' but how it *originates*."

Twenty months ago, when I asked of the Hon. Ralph Abercromby, as a super-eminent meteorological authority, what originates the diminished aerial pressure in cyclonic disturbances, he shook his head and owned he did not know. And I am afraid that neither Mr. Ryves nor myself are yet able to help him with a theory, "crude" or other.

Mr. Ryves should not say that I assert cyclones "are caused by local heat," though I have said that heated ground warms contiguous air. Heating, likely enough, may be a cause, or concomitant, of cyclonic disturbances, but I have not said so in either of my letters.

If Mr. R. H. Scott's "Pits [that] are what are called barometrical depressions or cyclonic systems" gyrate earthwards, as liquid eddies do, they will, by forcing the air downwards, tend to elevate the barometric mercurial column, not depress it. If these wind-whirls eddy upwards they will tend to originate and evolve aerial "mounds" skywards, not pits. If not, why not? in both cases.

The quotation from Sir John Herschel does not state what originates the "*wind*" driven over mountain ranges, which is what is wanted. If the air never varies in density or velocity I do not see that the range crossed will break it into very perceptible waves; but, granted that it does so, then the undulations will be generated continuously, like waves in the rapids of Niagara, as in the case of diurnal maxima and minima, and we will require some other *fitful* originator of cyclonic disturbances, which occur only occasionally.

Waiting Mr. Ryves' next letter,

I am, &c., HENRY MUIRHEAD.

Cambuslang, 17th May.

SIR,—Being neither a meteorological authority, such as Mr. Ryves or Dr. Muirhead would invoke, nor a worshipper of any principality, I can offer no opinion here on the controversy concerning "depressions" to which your correspondents would attach any value. Neither shall I deal in this letter with the origin of terms or expressions, interesting as this may be to the historian of science after his kind, or to the etymologist and lexicographer after their kind. But is it not a little hard upon students of meteorology that we should have pages of correspondence on a necessarily much-studied branch of our subject, practically treating that branch as if it were nearly new. Projects of ventilation are useful in their way, and it is, in general, a pity that we get so little of them; but on well-exposed rising ground, under a strong breeze they seem slightly out of place. Now, after full attention has been devoted to the works of Faye, Hazen, and other oppositionists, the fact remains that the character of the current of scientific theory, on the subject vaguely treated of by your correspondents, is strong enough to be, to most of us, unmistakable. Whether, in the present state of our knowledge, Sir John Herschel would be grateful for the reference made to a statement of his, or whether living writers will be grateful for inferences drawn from their works, is a point with which we are not concerned. Beyond other varieties of the human species we (students of meteorology) suffer long and are very kind. But there is a limit even to our tender-heartedness, the probable position of which limit I should like to indicate.

What would be thought of the airing of, say, the subject of "Panmixia" in the pages of a biological periodical, without any reference to the works of, *e.g.*, Prof. Weismann? In dealing with a subject on which many authors might advantageously be referred to, it may seem invidious to mention only one. But I shall, as your correspondents give to great names the honour really due to them, mention one, and, for the sake of brevity, one only. I do not claim for Mr. Ferrel the title which he is himself, I believe, anxious to repudiate, of "the Newton of Meteorology," and I even consider that certain of his conclusions require, and will receive (I hope at his own hands) some modification. But I must ask whether correspondents have or have not, studied Ferrel's "Researches," "Recent Advances," or, in any case, his latest "Popular Treatise on the Winds." If not, they are writing on a subject to which they have given inadequate attention. And, on either supposition, they should be aware, and show themselves to be aware, that many of your readers, and (as I hope) many Fellows of the Royal Meteorological Society, possess and employ sources of information—such as those I have alluded to—which cannot with safety be utterly ignored.

I am, sir, yours very faithfully,

W. CLEMENT LEY.

May 20th, 1890.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, OCT., 1889.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute.				Average.				Absolute.		TotalRain.		Aver.
	Maximum.		Minimum.										
	Temp.	Date.	Temp.	Date.	Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	Cloud.
	°		°		°	°	°	0–100	°	°	inches		0–10
England, London	60·6	16	35·5	13	55·9	43·1	45·1	88	96·8	31·8	3·75	22	7·1
Malta	84·8	26	58·0	17	78·6	66·3	63·3	78	135·5	51·7	·65	3	3·8
Cape of Good Hope.	...	...	...	...	...	...	...	...	...	...	...	...	...
Mauritius	79·0	16*a*	63·6	1	78·0	66·8	61·7	72	135·8	55·7	1·20	21	5·4
Calcutta	90·4	1	64·7	31	86·4	74·7	75·1	84	156·0	58·1	5·76	9	4·6
Bombay	92·2	13	70·0	29	86·5	75·5	73·5	79	143·0	60·1	3·80	7	4·9
Ceylon, Colombo	87·4	6	72·0	...	85·6	76·1	71·1	76	150·0	63·5	14·99	19	6·2
Melbourne	84·5	14	37·8	12	67·7	50·7	48·7	70	144·9	30·7	2·86	11	6·7
Adelaide	88 1	22	42·0	9	73·3	53·7	50·8	63	144·2	34·8	3·61	12	5·3
Wellington	68·0	30	41·0	26, 27	61·2	47·8	46·1	74	127·0	34·0	3·20	16	3·9
Auckland	74·0	31	47·0	13	64·7	51·6	49·8	74	135·0	35·0	3·20	11	5·2
Jamaica, Kingston	93·8	8	67·8	5	89·7	71·2	71·9	76	...	...	4·20	...	...
Trinidad	91·0	7*b*	66·0	25, 26	89·0	70·4	72·5	77	159·0	60·0	6·30	19	...
Toronto	61·5	1	22·6	24	49·8	35·6	34·9	73	...	9·8	1·89	14	6·6
New Brunswick, Fredericton	60·1	1	16·8	24	50·1	34·5	38·4	83	...	...	5·17	13	6·5
Manitoba, Winnipeg	72·5	10	8·5	22	49·5	27·6	33·0	78	...	...	·86	10	5·5
British Columbia, Victoria	67·0	4	36·0	15	58·7	48·9	...	...	...	...	2·08	16	...

a And 28, 31. *b* And 25, 26.

Remarks, October, 1889.

Malta.—Mean temp. 71°·0; mean hourly velocity of wind 9·2 miles. Sea temp. fell from 77°·5 to 72°·0. TS on 17th, L on 20th and 31st. J. Scoles.

Mauritius.—Mean temp. of air equal to, of dew point 0°·2 above, and R ·70 in. below, their respective averages. Mean hourly velocity of wind 11·6 miles, or 0·2 mile below average; extremes 30·5 on 4th, and 1·9 on 1st. Prevailing direction E.S.E. C. Meldrum, F.R.S.

Ceylon, Colombo.—L seen on 1st and 2nd. J. C. H. Clarke, Lt.-Col. R.A.

Melbourne.—Mean temp. of air 2°·2, of dew point 2°·5, amount of cloud 0·7, and R ·06 in. above the average. Prevailing winds N. and S., strong on 7 days. Heavy dew on 7 days; TS on 4th. R. L. J. Ellery, F.R.S.

Adelaide.—Another wet month, R being 2½ inches in excess of the average of 32 years; the total since January 1st (28·43 in.) is the greatest on record for a similar period since 1839. Bar. about an average, and mean temp. 1°·6 above average. C. Todd, F.R.S.

Wellington.—Showery during the early part of the month, and at intervals up to the 26th, then fine for the remainder. Prevailing N.W. wind, and stormy on 20 days from that quarter. R. B. Gore.

Auckland.—Early part of the month stormy and rainy; middle and close fine and dry. Bar. pressure, mean temp., and R, all close to the average, but slightly above. T. F. Cheeseman.

SUPPLEMENTARY TABLE OF RAINFALL, MAY, 1890.

[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 Hall.	1·58	XI.	Castle Malgwyn	4·22
,,	Margate, Birchington...	1·92	,,	Builth(Llanwrtyd Wells)	2·35
,,	Littlehampton	1·77	,,	Rhayader, Nantgwillt..	3·30
,,	Hailsham	2·45	,,	Carno, Tybrith	2·02
,,	Ryde, Thornbrough	2·46	,,	Corwen, Rhug	2·49
,,	Alton, Ashdell.....	1·99	,,	I. of Man, Douglas	3·21
III.	Oxford, Magdalen Col...	1·75	XII.	Stoneykirk, Ardwell Ho.	2·94
,,	Banbury, Bloxham	1·78	,,	New Galloway, Glenlee	4·01
,,	Northampton	1·60	,,	Melrose, Abbey Gate ...	1·62
,,	Cambridge, Fulbourne..	1·89	XIII.	N. Esk Res. [Penicuick]	2 05
,,	Wisbech, Bank House..	2·30	XIV.	Ballantrae, Glendrishaig	2·86
IV.	Southend	1·50	,,	Glasgow, Queen's Park.	2·75
,,	Harlow, Sheering	...	XV.	Islay, Gruinart School..	1·69
,,	Rendlesham Hall	1·61	XVI.	Dollar.....	1·27
,,	Diss	1·86	,,	Balquhidder, Stronvar..	3·28
,,	Swaffham	2·03	,,	Dunkeld, Inver Braan..	2·41
V.	Salisbury, Alderbury ...	...	,,	Dalnaspidal H.R.S. ...	3·43
,,	Warminster	2·01	,,	Arbroath Cemetery.....	..
,,	Bishop's Cannings	1·82	XVII.	Keith H.R.S.	1·51
,,	Ashburton, Holne Vic....	2·71	,,	Forres H.R.S.	·56
,,	Hatherleigh, Winsford.	2·01	XVIII.	Fearn, Lower Pitkerrie.	·96
,,	Lynmouth, Glenthorne.	...	,,	Loch Shiel, Glenaladale	3·62
,,	Probus, Lamellyn	4·43	,,	N. Uist. Loch Maddy ...	1·16
,,	Launceston, S. Petherwin	2·50	,,	Invergarry	2·97
,,	Wincanton, Stowell Rec.	1·64	,,	Aviemore H.R.S.	1·22
,,	Taunton, Lydeard Ho...	1·90	,,	Loch Ness, Drumnadrochit	1·21
,,	Wells, Westbury	1·48	XIX.	Lairg H.R.S.	1·05
VI.	Bristol, Clifton	1·87	,,	Scourie	·99
,,	Ross	2·12	,,	Watten H.R.S.	1·83
,,	Wem, Clive Vicarage ...	1·92	XX.	Dunmanway, Coolkelure	5·49
,,	Cheadle, The Heath Ho.	2·10	,,	Fermoy, Gas Works ...	3·91
,,	Worcester, Diglis Lock	1·98	,,	Tipperary, Henry Street	3·75
,,	Coventry, Coundon	2·47	,,	Limerick, Kilcornan ...	2·75
VII.	Ketton Hall [Stamford]	2·53	,,	Miltown Malbay..	3·89
,,	Grantham, Stainby	2·72	XXI.	Gorey, Courtown House	3·29
,,	Horncastle, Bucknall ...	2·10	,,	Navan, Balrath	1·76
,,	Mansfield	...	,,	Mullingar, Belvedere ...	2·98
VIII.	Neston, Hinderton	1·71	,,	Athlone, Twyford	2·01
,,	Knutsford, Heathside ...	2·18	,,	Longford, Currygrane...	2·06
,,	Lancaster, South Road.	2·62	XXII.	Galway, Queen's Coll...	2·39
,,	Broughton-in-Furness ..	3·82	,,	Clifden, Kylemore	3·86
IX.	Wakefield Prison	2·80	,,	Crossmolina, Enniscoe..	2·27
,,	Ripon, Mickley	2·52	,,	Collooney, Markree Obs.	1·37
,,	Scarborough, West Bank	2·61	,,	Ballinamore, Lawderdale	..
,,	East Layton [Darlington]	2·29	XXIII.	Warrenpoint	1·62
,,	Middleton, Mickleton..	1·92	,,	Seaforde	1·72
X.	Haltwhistle, Unthank..	1·63	,,	Belfast, New Barnsley .	2·16
,,	Shap, Copy Hill	3·40	,,	Bushmills, Dundarave...	1·79
XI.	Llanfrechfa Grange	...	,,	Stewartstown	1·86
,,	Llandovery	2·08	,,	Buncrana	1·56

MAY, 1890.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1880–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE Max. Deg.	Max. Date	Min. Deg	Min. Date	No. of Nights below 32° In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	1·25	— ·65	·41	9	13	77·6	25	39·1	31	0	0
II.		Maidstone (Hunton Court)...	1·61	+ ·23	·55	10	12	...	...	...	...	...	...
,,		Strathfield Turgiss	2·18	+ ·31	·78	9	12	78·2	24	34·6	31	0	8
III.		Hitchin	1·92	— ·03	·56	10	11	72·0	24*a*	38·0	1	0	...
,,		Winslow (Addington)	2·00	— ·10	·40	9	13	78·0	24	33·0	31	0	6
IV.		Bury St. Edmunds (Westley)	2·26	+ ·51	·85	10	8	...	...	...	...	...	...
,,		Norwich (Cossey)	1·57	— ·10	·54	9	7	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	1·74	+ ·13	·31	16	12	76·0	25	41·0	28*f*	0	...
,,		Barnstaple	2·76	+ ·56	1·05	26	15	79·0	25	38·0	28	0	..
,,		Bodmin (Fore Street)	5·04	+ 2·51	1·40	3	19	..	...	...	...	...	...
VI.		Stroud (Upfield)	2·06	+ ·02	·84	9	14	78·0	25	35·0	30	0	...
,,		ChurchStretton(Woolstaston)	2·76	— ·11	·56	19	18	71·0	24	37·0	31	0	1
,,		Tenbury (Orleton)	2·22	— ·33	·66	19	14	76·3	24	33·0	31	0	3
VII.		Leicester (Barkby)	1·85	— ·12	·45	10	14	78·0	24	29·0?	27	4	12
,,		Boston	2·04	+ ·32	·75	10	12	80·0	22	33·0	1, 31	0	...
,,		Hesley Hall [Tickhill].....	2·61	+ ·57	·53	10	12	76·0	24	33·0	1	0	...
VIII.		Manchester(PlymouthGrove)	2·32	— ·03	·68	29	10	78·0	24	39·0	26*g*	0	0
IX.		Wetherby (Ribston Hall) ..	2·07	+ ·12	·48	12	8	...	...	...	...	...	...
,,		Skipton (Arncliffe)	3·43	— ·29	1·02	16	14	75·0	24	33·0	11	0	...
,,		Hull (People's Park)	3·05	+ 1·17	·78	10	14	...	...	...	...	...	...
X.		North Shields	1·68	+ ·07	·50	11	14	68·5	12*b*	32·0	31	1	1
,,		Borrowdale (Seathwaite).....	7·96	— ·65	1·60	16	16	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	...	...	...	...	...	...	...	...	...	..	...
,,		Haverfordwest	4·54	+ 2·18	1·18	15	19	77·6	24	34·8	30*f*	0	4
,,		Plinlimmon (Cwmsymlog) ...	1·74	...	·36	15	11	...	...	...	...	...	...
,,		Llandudno.....	1·91	— ·02	·42	16	12	74·0	24	43·3	27	0	...
XII.	SCOTLAND.	Cargen [Dumfries]	3·18	+ ·66	·91	11	15	73·8	23	33·6	31	0	...
,,		Jedburgh (Sunnyside).....	1·49	— ·41	·48	8	11	72·0	23	32·0	14	1	...
XIV.		Old Cumnock	3·28	+ ·84	·83	11	17	76·0	24	26·0	30	1	...
XV.		Lochgilphead (Kilmory).....	2·45	— ·90	·70	16	16	...	...	..	...	...	...
,,		Oban (Craigvarren)	2·77	...	·68	29	20	75·2	25	39·3	27	0	...
,,		Mull (Quinish).....	2·07	— ·88	·54	16	17	...	...	...	...	...	...
XVI.		Loch Leven Sluices	1·60	— ·96	·40	12	8	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	2·10	+ ·44	·65	16	10	70·6	23	34·8	27	0	...
XVII.		Braemar	2·16	— ·25	·55	5	18	73·0	25	28·2	2	2	7
,,		Aberdeen (Cranford)	3·40	...	·80	15	20	72·0	21	38·0	1, 3*h*	0	...
XVIII		Strome Ferry.....	1·98	— 1·37	·46	14	15	...	...	...	...	...	...
,,		Culloden	·68	— ·82	...	...	...	71·0	24	38·0	15	0	7
XIX.		Dunrobin	1·42	— ·68	·42	16	16	66·0	24	37·0	30	0	...
,,		S. Ronaldsay (Roeberry).....	...	...	...	...	...	...	...	...	...	0	...
XX.	IRELAND.	Cork (Blackrock)	3·85	+ 1·45	·54	17	21	69·0	23*c*	29·0	3, 12	0	
,,		Dromore Castle	5·67	+ 1·99	·90	2	21	72·0	25	38·0	3	0	...
,,		Waterford (Brook Lodge) ...	3·19	+ ·96	·50	17	18	72·0	24	36·0	3	0	..
,,		O'Briensbridge (Ross)	1·90	...	·31	18	18	71·0	31	38·0	1	0	...
XXI.		Carlow (Browne's Hill)	2·85	+ ·51	·47	15	19	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	2·44	+ ·51	·46	3	17	65·7	23	39·1	31	0	0
XXII.		Ballinasloe	1·65	— 1·04	·17	6, 19	20	67·0	24*d*	32·0	31	1	...
XXIII		Waringstown	1·68	— ·76	·36	29	17	76·0	24*d*	34·0	2	0	1
,,		Londonderry (Creggan Res.).	1·82	— ·70	·66	29	18	..	...	...	...	...	...
,,		Omagh (Edenfel).....	1·75	— ·72	·45	29	17	68·0	3*e*	35·0	31	0	...

a And 25. *b* And 22. *c* And 24, 28. *d* And 25. *e* And 24, 25. *f* And 31. *g* And 27, 30. *h* And 30.

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

METEOROLOGICAL NOTES ON MAY, 1890.

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.—A fine May with sufficient changes of heat and cold and wet and dry to maintain the fickle character of the month. Horse Chestnut in flower on the 8th, pink lilac on the 10th, laburnum on the 18th, small white butterfly flying on the 1st, orangetip butterfly on 17th.

ADDINGTON.—Beautiful weather from 1st to 3rd, and 22nd to 30th; nights generally cold throughout. Potatoes and kidney beans blackened by frost on the 31st. T on 7th, 11th and 19th; on 19th ·25 in. of R fell in 12 minutes.

BURY ST. EDMUNDS.—The month was favourable for agriculture, frosts being slight and few. A magnificent TS occurred on the evening of the 19th, with heavy rain, ·54 in.

LANGTON HERRING.—R of May about the average, but for the first five months of the year, 10 per cent. below the average. The mean temp. at 9 a.m., 55°·4, was 1°·7 above the average. Only once in 18 years did the temp. in May reach 75°, while this year it reached 74° on the 23rd and 24th, and 76° on the 25th, on which day there was a violent TS. T also on 8th and 24th. Solar halos on 2nd, 7th and 29th.

BODMIN, FORE STREET.—A very cold and wet month. Two very hot days, the 24th and 25th, on the latter day a TS occurred about 7.30 p.m., with a downpour of R, ·15 in. falling in a few minutes.

STROUD, UPFIELD.—T heard on 2nd, 11th 19th, and 20th; L seen on 19th and 25th.

WOOLSTASTON.—A genial growing month. Frequent T and L during the first week. Mean temp. 52°·2. H on 14th.

ORLETON.—A pleasant month, with fewer cold days than usual, the mean temp. being 1°·6 above the average of 29 years. T and L on 2nd, 6th, and 19th, with very heavy R from 8 to 9.30 p.m. on the latter date.

MANCHESTER, PLYMOUTH GROVE.—A very fine month. Summer weather from 21st to 25th. Cold winds from 26th to 31st. Prevailing wind, S.E.; mean temp. 55°·1; L on 12th.

ARNCLIFFE.—A dry month, half the R falling on two nights, 11th and 16th.

WALES.

HAVERFORDWEST.—The wettest month of the year, except January. No frost in the shade. Continual R up to the 20th, especially heavy from the 15th to the last mentioned date, after which a sudden burst of great heat prevailed, followed by a TS of great intensity on the 25th. The storm fell with its greatest violence to the N.W. and N. of the county, accompanied by a deluge of R, while at Haverfordwest only ·02 in. fell. The month ended fine, but with a great and sudden fall of temp. after the great storm. Wind principally from S.E. throughout the month.

SCOTLAND.

CARGEN.—Mean temp. of the month (52°·9) 2°·2 above the average. Some very cold nights were experienced towards the end of the month and on the morning of the 31st potatoes were partially frosted down. The extremes between day and night temp. were often great, the range on the 28th being 33° in about 12 hours. Easterly winds prevailed for 17½ days; sunshine just the average for the month. T and L on 6th and 18th, T on 7th.

JEDBURGH.—Much N., E., N.E., and S.E. wind with little sunshine. Grass and cereal crops throve, and the blossom on fruit trees was remarkably abundant.

OBAN.—A fine growing month, warm, with an ample sprinkling of showers.

CULLODEN.—Another very dry month; cereals progressing well.

IRELAND.

CORK.—On the whole a pleasant month with spells of showery weather, which were very favourable to vegetation. No frosts. Mean temp. 53°3, 0°·5 below the average of 14 years.

WATERFORD, BROOK LODGE.—T and L on the 24th, T on the 25th.

ROSS, O'BRIENSBRIDGE.—A beautiful month; no frost; abundant and brilliant sunshine; wind moderate, mostly N.E. T and L on 20th and 21st.

DUBLIN.—Although changeable and generally showery, the month was favourable from a public health point of view, and from that of agriculture. Until the 20th R fell in frequent showers; after that date, however, a succession of bright, spring-like days occurred, giving a wonderful impetus to vegetation. Mean temp. 52°·8. Lunar halo on 31st. Fog on 16th. High winds on 10 days, H on 14th, L on 24th.

ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this Society was held on Wednesday evening, May the 21st at the Institution of Civil Engineers, 25, Great George-street, Westminster, Mr. Baldwin Latham, F.G.S., President, in the chair.

Mr. W. Friese-Greene and Mr. F. H. Phillips were elected Fellows of the Society.

The following papers were read:—

(1). "Rainfall of the Globe," by Mr. W. B. Tripp, M.Inst. C.E., F.R.Met.Soc. This was a comparative chronological account of some of the principal rainfall records. The earliest record quoted is that of Paris, which commenced in 1689. The English records are taken from 1726. The rainfall observations in the southern hemisphere do not extend over a very long period; at Adelaide they were commenced in 1839, but they do not go back further than 1866 for New Zealand. The greatest fall in any particular year at the stations given by the author was 160·9 in. at St. Bernard, in 1839, and the least 3 in., at Sandiego, in California, in 1863. By combining the stations in the northern and southern hemispheres, the author finds that in recent times the years with the highest average rainfall were 1878, 1879, and 1883, and the years with the lowest average were 1854 and 1861.

(2). "Mutual influence of two pressure plates upon each other, and comparison of the pressures upon small and large plates," by Mr. W. H. Dines, B.A., F.R.Met.Soc.

(3). "On the variations of pressure caused by the wind blowing across the mouth of a tube," by Mr. W. H. Dines, B.A., F.R.Met.Soc.

In these two papers the author gives the results of some experiments on wind pressure which he has made, mostly on the whirling machine at Hersham, Surrey. From these experiments it seems probable that a decrease of pressure per square foot, with an increase of size of plate, may be taken as a general rule.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

CCXCIV.] JULY, 1890. [PRICE FOURPENCE, *or 5s. per ann. post free.*

REVIEWS.

Handbook of Meteorological Tables. By H. A. HAZEN, M.A., Assistant Professor, Signal Office. Washington, D.C. 1888. 8vo., viii. 128 pages.

WE have often heard of this volume, and are very glad to offer it a welcome on this side of the Atlantic.

Prof. Hazen by no means intends to supersede Guyot's most valuable collection, but as a practical worker he knows which tables have been most useful to himself, and in this handbook he not merely tells us what he has found useful, but he supplies every one with a copy. Like most meteorologists, he has been obliged to calculate some fresh tables for himself, and these he very properly distinguishes as "Original."

As nearly all the tables are given in duplicate, *i.e.*, both in English and in Metric values, the volume will be nearly as useful on the Continent as in America and in England, and we are rather puzzled at no publisher's name appearing on the title page, for to print a work like this is a serious matter, and one would have supposed that the author would have arranged to partly cover his outlay by its sale. There are certainly not many meteorologists who could afford to print, and to give away the whole edition of such a volume of tabular matter. It may be that he has reserved the sale to himself instead of placing the volume in the hands of any publisher, if so, some intimation of the fact, and of the price would be useful. We are not in the habit of presenting either authors or publishers with advertisements gratis, but in this case we feel that the matter ought to be cleared up, and we shall gladly insert any brief statement with which Prof. Hazen may favour us, because we feel that he must have made a considerable sacrifice to prepare and print such a volume, and that that sacrifice merits recognition at the hands of meteorologists.

Having intimated our general approval of the volume, we need only give an idea of its arrangement and contents, and point out the respects in which we think that it falls short of perfection.

It contains seven tables (conversion, &c.), relating to temperature,

nine to pressure, seven to humidity, six to wind, six to linear measures (inches into millimetres, &c.), and ten miscellaneous ones.

In the way of criticism we have little to say. There is perhaps some uncertainty or unevenness in the author's desire for precision. On p. iv., he tells us that in all the linear tables the latest value for the metre 39·3702 in., has been used, instead of the old one of 39·3709, but this is only a difference of 1 in 56209, or less than 0·001 in. in any barometric reading, and about 1 in. in a mile, a refinement far in advance of meteorology at present—and yet in Table XII., he (wisely we think), gives the barometer to hundredths of an inch only.

In the section for linear measures there is by far the best table for inches into millimetres we have ever seen; it gives the equivalent of each hundredth of an inch from 0·01 in. to 31·99 in.; but for the reverse process millimetres into inches, the table extends only from 400mm. (15·748 in.), to 800·9mm. 31·532 in.). We presume that Prof. Hazen when sending it to press was thinking solely of barometric conversions, and forgot that the table if carried down to 1mm. and up to 1000mm. (*i.e.* 1 metre), would be very valuable for rainfall work. We computed a skeleton one of this kind years ago, but have never printed it on account of the expense. We know that it seems greedy to wish for twelve pages of additional tables, but if that were too much, we would have sacrificed the 100mm. between 400 and 500mm. and given a two-page table with the equivalent of each mm. (*not* each 0·1mm.) from 1 to 1000mm.

There is a splendid table, metres into feet, going by *each metre* from 1 metre to 4009m. (say 2½ miles), but we do not get feet into metres; and oddly enough the reverse occurs with miles and kilometres which we have, though kilometres into miles we have not.

One practical illustration is worth much talk. Our readers may remember that in our February number of this year, we had a remarkable record of drought from Col. Ward, to which we added some others from India and elsewhere. One of the records was so extreme (45° between the dry and wet bulb), that we could find no table to give the humidity. Prof. Hazen's tables give it at a glance.

They are unquestionably valuable helps which must be kept handy, and replaced when worn out.

Sur la température nocturne de l'air à différentes hauteurs. Par JULIUS JUHLIN. (Présenté à la Société Royale des Sciences d'Upsal le 27 Avril, 1889). E. Berling, Upsal, 1890. 4to, 24 pages.

IT is a pity that some form of engraving is not more frequently employed on the Continent. This is an excellent little paper, but the facts would have been much more readily followed, and more permanently impressed, had the tabular values been given also as diagrams, and had there been a sketch of M. Juhlin's mast, and a

rough map showing the various localities in and near Upsala, referred to in the Memoir. Section IV., "On the influence of the soil on the temperature of the air," cannot be read with advantage by any one who is not, either provided with a map of the city, or well acquainted with its topography.

The paper is divided into four sections. In the first the author gives short accounts of the experiments upon the variation of temperature with height above the soil, made by Pictet (1778), Six (1784), Wells (1814), Marcet (1837), Lottin and Bravais (1838), Plantamour (1847), Charles Martins (1858), Prestel (1858), K. Fritsch (1861), Glaisher (1868), Wild (1872), Marie Davy (1874), Hamberg (1875), and Marriott (1882). This section is rather aggravating, because, although the brief descriptions of the nature of the experiments are interesting, the author rarely states what were the results obtained. Having taken the trouble requisite to collect the descriptions, very little more would have enabled him to add greatly to the value of the paper.

The author naturally, and very properly, calls special attention to the experiments made at Upsala in the summer of 1875 by a volunteer band of twenty university students, under the direction of M. Hamberg, and says that his researches are to be regarded as supplementing those made by M. Hamberg in summer; those by M. Juhlin being in winter, and when the ground was covered with snow. He also gracefully acknowledges help received from Prof. Hildebrandsson, and his profound gratitude to Dr. N. Ekholm, and to two students (MM. Falk and Vallner), who, as he says, "have sacrificed for me their time and their nightly rest in helping me with these fatiguing observations." We supplement this by pointing out that it was not merely for M. Juhlin that these gentlemen spent night after night in the bitter frost and snow, taking the hourly readings of the various thermometers. It was, like every bit of honest, scientific work, done to increase man's knowledge of the world in which he lives—something which will last long after those who have done it have passed away.

Years ago we ourselves had a pole about the same height as that employed at Upsala (22ft.),and a complete set of thermometers at the top. In time of frost and snow, when (at 9 p.m.) we found ourselves with the readings all entered, and ourselves and our lantern safely on *terra firma*, it was always with a feeling of great thankfulness; and with six thermometers on the mast, much snow, and temperatures below zero Fahrenheit, these gentlemen must certainly have had a rough time of it. It is a great pity that there is no sketch showing how the thermometers were arranged, and how access to them was obtained for reading. One also wants to know, if all were on one mast, whether the observer read them when climbing, and again in descending, and whether his presence and that of the lamp did or did not affect the readings.

The author's summary is as follows :—

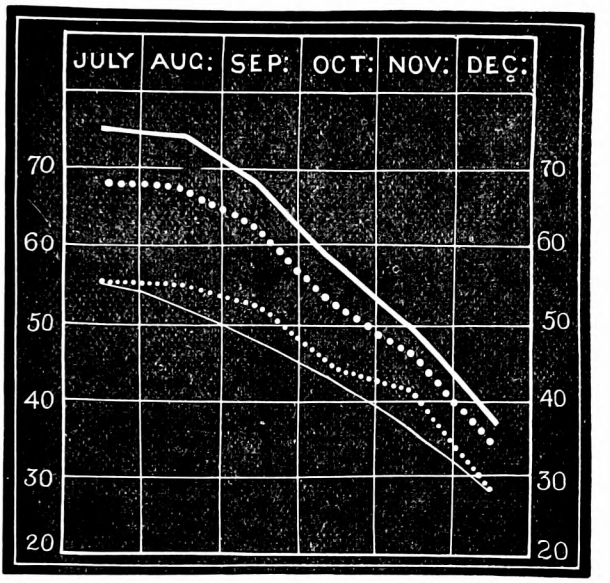
1. The decrease of temperature, due to radiation from exposed thermometers, is almost constant at all heights (above a snow surface), greater than 20 inches.
2. During clear winter nights the temperature increases with height; this begins about two hours before sunset, and lasts until about two hours after sunrise.
3. The increase of temperature with height is greater in winter than in other seasons.
4. The increase of temperature with height is a linear function of the temperature, so that the lower the temperature the more rapid is the increase.
5. During overcast and misty nights in winter there is little variation with height.
6. The variation of temperature [with height.—ED. *M. M.*] follows very closely the amount of cloud.
7. A veil of thin and high clouds diminishes but slightly the variation of temperature with height.
8. In winter the surface of snow is colder than the air around it.
9. The fact that snowy winters have usually hard and long frosts is easily explained by the physical properties of snow.
10. During winter nights the temperature on hills and lofty edifices is higher than on low ground.

We may appropriately supplement this notice with a few words respecting the temperature observations made upon the Eiffel Tower between July and December last, of which an abstract was given by M. Angot, at the Soc. Mét. de France, on the 4th of February last. He gives the following values :—

	Eiffel Tower				Parc St. Maur.				Differences.			
	Mean.	Max.	Min.	Range	Mean.	Max.	Min.	Range	Mean.	Max.	Min.	Range.
	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.
July.	61·2	67·3	55·2	12·1	64·1	75·4	55·2	20·2	−2·9	−8·1	0·0	−8·1
Aug.	60·3	67·0	54·5	12·5	62·2	74·1	52·8	21·3	−1·9	−7·1	+1·7	−8·8
Sept.	56·3	61·9	51·4	10·5	56·8	67·8	47·9	19·9	−·5	−5·9	+3·5	−9·4
Oct..	47·8	52·4	44·2	8·2	49·1	57·9	43·0	14·9	−1·3	−5·5	+1·2	−6·7
Nov..	43·2	45·9	40·3	5·6	42·6	49·1	36·6	12·5	+·6	−3·2	+3·7	−6·9
Dec..	30·7	34·4	27·9	6·5	32·5	37·0	28·6	8·4	−1·8	−2·6	−·7	−1·9
Mean	49·9	54·8	45·6	9·2	51·2	60·2	44·0	16·2	−1·3	−5·4	+1·6	−7·0

These values will be much more readily followed in a diagram, which we therefore give. The solid lines represent the values at the surface (Parc St. Maur), the dotted lines those at the top of the Eiffel Tower. Hence we see that the temperature at the top is much more equable than at the surface. As regards the maxima, the excess of heat at the surface (nearly 10° in summer) is doubtless due

to the heat rays passing through the atmosphere without producing much effect, but heating the soil directly they reach it, and so heating the stratum of air near to it. The difference at night was less marked, but there again the soil accentuates the temperature change, because it is a better radiator than air, and, therefore, while itself cooling, it cools the air in its proximity.



"AREAS OF RAREFACTION" OR "DEPRESSIONS."

To the Editor of the Meteorological Magazine.

SIR,—In reference to the intervention of Mr. Ley in this correspondence, I have only to say that if the question is one which has passed out of the stage of ventilation or discussion, and "the character of the current of scientific theory on the subject is so strong as to be unmistakable," it is a pity that Mr. Ley did not, from his point of vantage, "on the well-exposed rising ground under a strong breeze," vouchsafe some little help and guidance to the befogged and bewildered wanderers in the valley below. This would, I think, have been more in keeping with that "long-suffering kindness" which, he tells us, is a characteristic of the student of meteorology, than simply to upbraid us with our ignorance without favouring us with one ray of enlightenment. I cannot, however, accept Mr. Ley's view that this is a question on which only experts are entitled to be heard, and, therefore, though I have not had the advantage of studying Ferrel and "the Oppositionists," and at the risk of exhausting Mr. Ley's "tender-heartedness" and bringing upon myself I know not

what terrible penalty in consequence, I will now, with your permission, state as briefly as I can some facts which seem to me to go far to justify the view which I maintain, viz., that the differences observable in the height of the barometric column, at the same level at different times, and in different places at the same time, correspond to real differences in the height of the aerial column above it, and not merely to differences in the density of the air.

(I.) We know that in the equatorial regions, under the influence of the solar heat, and the indraft and pressure of cooler air from higher latitudes, enormous volumes of warm air are constantly rising to a great height and flowing over on both sides of the equator towards the poles. Let us suppose some exceptionally energetic outflow of this kind to extend some distance to the north of the equator spreading out laterally at the same time, as it would naturally tend, to do, and it is obvious that we should have over the region beneath it an area of high pressure, *not because the air there was more dense* (except in so far as the addition of another stratum of air above would tend in some degree to increase the density of those upon which it was superimposed), but because there was *more air*, *i.e.*, a greater depth of air than over the adjacent regions. If, now, we suppose two such outflows of equatorial air spreading northwards or north-eastwards, with an interspace between them, it is obvious again that in this interval we shall have an area of relatively low pressure, *not because the air there is less dense or more rarefied*, but because there is a less depth of air there than in the regions around it.

Once more, if we suppose a number of such waves or streams of air, with interspaces between them, to flow over from the equatorial regions about the same time, and, setting out at points some distance to the westward of our meridian, to extend as far north as these latitudes, it is plain that (making allowance for the easterly trend of volumes of air flowing from the equator northwards), we might expect them to pass over us as bands of alternate high and low pressure—"anti-cyclonic bands or ridges" and "troughs of low pressure," or "elongated depressions"—moving in a N.E. direction, a condition of things which we know, from the evidence of our weather charts, *does*, in fact, prevail not infrequently over our islands and their neighbourhood.

It is not suggested that the "cup-like" depressions on the one hand or the anti-cyclonic "mounds" on the other extend to the extreme upper surface of the atmosphere, variously estimated at from 50 to 200 miles. It may be safely assumed that at the lowest of these limits the air would know as little of such disturbances as the bottom of the ocean knows of the storms and currents which disturb its surface. For practical purposes, in relation to pressure, wind, cloud, vapour, heat, everything, in fact, except the reflection and refraction of light, the atmosphere may be considered to terminate at a height of 20 miles at the outside, and it is within that limit that I suppose all the movements and changes which affect the height of

the barometer to occur. Here, then, it seems to me that we have a *vera causa* which, taken in conjunction with the modifying influences of the rotation of the earth, the distribution of land and water, the configuration, contour, and elevation of the land, and possibly electricity and magnetism, will go a long way towards accounting for the differences of pressure indicated by the barometer.

(II.) On the other hand, that differences of atmospheric pressure cannot be accounted for by the supposition of differences of temperature is shown by some recent observations made by Dr. Hann at high altitudes, and communicated by him to the Academy of Sciences at Vienna on April 17th. During the great anti-cyclone which prevailed over Central Europe, including the Alpine District, in November last, Dr. Hann was able to employ observations up to a height of above 10,000 feet, and found that the depression of temperature which accompanied the anticyclone was limited to a few hundred feet above the earth, while on October 9th and 10th, during a barometrical minimum, he found that the temperature at the summit of the Sonnblick was lower than during the barometrical maximum above referred to; and as the result of these observations and others of the same nature, he comes to the conclusion, 1st, that "in barometrical maxima the conditions of pressure are not explained by conditions of temperature, but are a consequence of the movement of the air," and 2nd, that, whereas "until the establishment of mountain stations the temperature was assumed to be one of the chief causes of the form of motion of cyclones and anticyclones, future enquiries must take into account that at least up to 4 or 5 kilometres the temperature at the centre of an anticyclone may be, and probably always is, higher than in the centre of a cyclone."—See *Nature*, May 29th, 1890.

I have no cut-and-dried theory to offer in explanation of the origin of low pressure systems. I have simply maintained, in opposition to Dr. Muirhead, that we are not warranted in asserting that they are simply areas "where the air is more rarefied, and, therefore, lighter, *not depressed*," and that, on the contrary, there is some reason to believe that they do correspond to actual atmospheric depressions.

(III.) In reply to Dr. Muirhead's last letter, I have only to say—

1. That having carefully re-read the 3rd paragraph of his letter on page 9 of the February number of the *Meteorological Magazine*, if I have misrepresented him in ascribing to him the view that cyclones are caused by local heat, I think that the mistake was a very natural and excusable one.

2. That I have never denied the general accuracy of his account of the behaviour of the winds in a depression, but that, according to my view, *that* is the result, not the cause, of the depression, and that when a low pressure area is once formed, the effect will be precisely the same as regards the behaviour of the winds within it, whether the low pressure is due to the rarefaction of the air, or to the existence of a cup-like depression over the locality in question.

3. That Sir John Herschel, in the passage of his Essay on the Weather from which I quoted, *does* state what in his opinion originates the *wind* (the italics are his) in the cases described (see pp. 164, 165, 166 of the "Lectures on Scientific Subjects," New Edition, David Bogue, 1880), but the passage was too long to quote. And I may add that I venture to doubt whether his account of the matter, founded as it is in the main on acknowledged physical facts, has been so utterly exploded by recent advances in Meteorology as Mr. Ley would have us believe.

And now, having said my say, I gladly make way for others who may wish to be heard on the subject under discussion, thanking you, Mr. Editor, for your courtesy in allowing me to explain myself so fully, and not without hope that before the discussion is closed, some of the many readers of the Magazine who, as Mr. Ley assures us, "possess and employ sources of information such as those he has alluded to," may be induced to give us the benefit of their superior knowledge. In that case I will promise to act upon the exhortation addressed to Dr. Muirhead and myself by Mr. Ley in the closing sentence of his letter, and to "be aware, and show myself to be aware," that they do possess this advantage over us.

G. T. RYVES.

Tean Vicarage, July 4th, 1890.

To the Editor of the Meteorological Magazine.

SIR,—I imagine that you and your readers will thank Mr. Ley for knocking together the heads of two ignorant scribblers (I am not even a F.R.G.S.) and sending them to learn their lessons. May I point out that I called attention to an unguarded use of the term "depression" in weather bulletins, as misleading the "general public." Mr. Ryves essayed to show that I was mistaken, and I defended my position. With thanks to Mr. Ley—Yours,

HENRY MUIRHEAD.

PRESSURE ANEMOMETERS.

To the Editor of the Meteorological Magazine.

SIR,—At page 55 of the *Meteorological Magazine* Dr. Black compares an anemometer pressure plate 3 feet square with one 30 feet square, and rightly states the ratio of the areas, as 1 to 100 and of the perimeters as 1 to 10; and says, "Therefore, the small plate anemometer must always indicate 2—3 times more pressure than the large one." I fail to understand this deduction.

He proceeds to give another: "From this it will follow that a more suitable form of plate anemometer would be the circular one, while the lengths of the borders would be more approximate to the areas inside them in both large and small gauges." This is neither

a logical deduction nor a true statement of fact. If it "followed," no further proof would be necessary, though he proceeds to prove it. Unfortunately the demonstration is quite erroneous. A circular plate 3 feet in diameter and one 30 feet in diameter have their areas in the ratio of 1 to 100, and their perimeters in the ratio of 1 to 10; just as the fore-mentioned square plates have them—*not* "ratio of border to border and area to area of 1 to 10, so that both large and small anemometers of a circular shape would represent the pressure of the same gale equally anywhere at the same time." It is really a pity that such a beautifully simple deduction is as baseless as the fabric of a dream, and that all the subsequent pretty inferences drawn therefrom are equally unsubstantial.

Faithfully yours,

R. STRACHAN.

11, *Offord-road, N., June 9th*, 1890.

[We are always glad that errors when they escape us should be pointed out. Our attention having been concentrated on the accurate reproduction of the figures led to our missing the obvious fallacy that 7 is not a tenth of 706, which Mr. Strachan has fortunately pointed out.

The idea running in our mind, and possibly in Surgeon-Major Black's, though he certainly did not express it, was that if the rim produces any special effect (extending inwards for say 6 inches) and be supposed to have an extra pressure, the ratio of this annulus to the total area will decrease with increase of size of plate, and will be less with a circular plate than with a square one of equal area.—ED. *M.M.*]

ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this Society was held on June 18th, at the Institution of Civil Engineers, 25, Great George-street, Westminster, Mr. Baldwin Latham, F.G.S., President, in the chair.

Mr. C. C. Farr, B.Sc., Mr. J. Hall, A.M.Inst.C.E., Mr. C. R. Rivington, and Dr. J. L. Whitehead were elected Fellows of the Society.

The following papers were read :—

1. "On the difference produced in the mean temperature derived from daily maximum and minimum readings, as depending on the time at which the thermometers are read," by Mr. W. Ellis, F.R.A.S. In the publications issued from Greenwich Observatory, the maximum and minimum temperatures are those referring to the civil day from midnight to midnight. At many stations the observers read their instruments only once a day, viz., at 9 a.m., when the reading of the maximum thermometer is entered to the preceding civil day, and the reading of the minimum thermometer to the same civil day. Such

stations are called "Climatological Stations." The author has tabulated the Greenwich maximum and minimum temperatures according to both methods for the years 1886-89, and finds that the climatological maximum and minimum means are slightly in excess of the civil day means.

2. "On the distribution of barometric pressure at the average level of the Hill Stations in India, and its probable effect on the rainfall of the cold weather," by Mr. W. L. Dallas.—The weather over India during January, 1890, was very dry, and in marked contrast to that which prevailed during January, 1889. The distribution of barometric pressure was, however, much the same in both months. The author has investigated the records at the hill stations, and has prepared charts showing the distribution of barometric pressure from both high and low level stations. From the high level charts it appears that the mean barometric gradient in 1889 was rather more than twice that in 1890, and, considering what is known of air movements, even at moderate elevations above the earth's surface, it may be assumed that these differences in pressure were accompanied by large differences of air motion, and if it is also assumed that the evaporation over the Southern Ocean is in all years fairly comparable in amount, the deficiency of rainfall over India in the winter of 1889-90 can be attributed to diminished lateral translation of vapour, owing to sluggish movements in the upper atmosphere.

3. "On the relative prevalence of different winds at the Royal Observatory, Greenwich, 1841-89," by Mr. W. Ellis, F.R.A.S. The author gives the following as the average nnmber of days of prevalence of different winds for the 49 years 1841-89, as derived from the records of the self-registering Osler anemometer :—

N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
40	45	27	22	35	106	46	22	22

4. "On some recent variations of wind at Greenwich," by Mr. A. B. MacDowall.

5. "On the action of Lightning during the Thunderstorms of June 6th and 7th, 1889, at Cranleigh, Surrey," by Capt. J. P. Maclear, R.N.—The author examined a number of trees which had been struck by lightning during these thunderstorms, and found that those which were struck before the rain fell were shattered, while those which were struck after the rain commenced were simply scored, with the bark blown off. It seems that during rain every tree is conducting electricity, and a disruptive discharge takes place where the conductor becomes insufficient. This depends on the position of the cloud, the amount of foliage on the tree, its condition of moisture, and its connection with running water.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, NOV., 1889.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Maximum. Date.	Minimum. Temp.	Minimum. Date.	Average. Max.	Min.	Dew Point.	Humidity.	Absolute. Max. in Sun.	Min. on Grass.	Total Rain. Depth.	Days.	Aver. Cloud.
	°		°		°	°	°	0–100	°	°	inches		0–10
England, London	60·3	8	27·8	28	49·5	40·0	41·2	88	97·3	24·4	·89	8	7·0
Malta	79.9	1	49·3	25	69·0	57·2	51·8	74	127·2	42·0	1·10	8	4·1
Cape of Good Hope.	82·0	9	47·0	18	71·8	54·8	...	...	...	...	·50	...	4·9
Mauritius	81·4	24*a*	64·0	5	79·7	67·6	63·4	73	137·8	55·1	1·78	9	5·7
Calcutta	85·1	3	58·7	30	80·2	66·7	67·4	82	141·5	51·5	3·17	10	3·6
Bombay	89·6	17	66·8	19	84·8	69·8	66·4	70	137·3	52·3	·00	0	0·1
Ceylon, Colombo	87·7	...	71·0	...	85·8	74·5	70·6	77	153·0	62·0	10·29	18	5·4
Melbourne	93·2	20	41·3	12	71·1	52·1	51·6	70	146·6	35·4	4·27	13	5·6
Adelaide	98·0	19	44·6	11	78·2	57·5	50·6	54	149·9	37·5	2·11	9	4·2
Wellington	72·5	23	40·0	30	64·8	49·1	47·1	70	138·0	33·0	·95	8	3·8
Auckland	76·0	27	46·0	16	66·7	53·9	49·4	67	143·0	40·0	1·11	7	5·0
Jamaica, Kingston	92·2	4	66·5	27	89·9	69·7	69·6	73	...	...	·19	...	...
Trinidad	90·0	*b*	66·0	6	87·5	69·8	72·5	82	154·0	59·0	7·38	22	...
Toronto	56·8	2	16·9	29	43·9	33·2	34·1	81	...	8·0	3·56	20	7·5
New Brunswick, Fredericton	58·7	3	16·9	16	43·4	27·9	29·7	75	...	...	4·16	9	5·9
Manitoba, Winnipeg	52·5	8	—13·5	28	33·0	13·9	19·6	81	...	...	·72	10	5·2
British Columbia, Victoria	58·0	17	30·0	12,22	52·2	37·9	...	...	...	...	1·76	7	...

a And 28. *b* Several days.

REMARKS, NOVEMBER, 1889.

MALTA.—Mean temp., 61°·7; mean hourly velocity of wind, 9·2 miles; sea temp. fell from 72°·0 to 67°·0. L on 5 days. Lunar rainbow on 10th. Waterspout on 11th at midday. J. SCOLES.

Mauritius.—Mean temp. of air, 1°·5, of dew point, 0°·7, and R ·14 in. below, their respective averages; mean hourly velocity of wind, 9·0 miles, or 2·0 miles below average; extremes, 22·8 on 30th, and 1·6 on 26th; prevailing direction, E.S.E. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air, 1°·5, of dew point, 3°·1, humidity 3, and R 1·79 in., above average. Amount of cloud 0·4 below average. Prevailing winds, S. and S.W., strong on 7 days. Heavy dew on 11 days. Fog on 13th. TSS on 4 days, and vivid and continuous L on evenings of 9th, 15th, and 26th. H on 17th. R. L. J. ELLERY, F.R.S.

Adelaide.—Mean pressure 0·080 in. below, and temp. 0°·8 above, the average of 32 years. R more than double the average; total fall since Jan. 1 greater than any previous record. C. TODD, F.R.S.

Wellington.—Fine weather up to the 7th. with moderate northerly winds, then showery for two days, followed by fine weather up to 14th, when light rain commenced, and it continued showery until 18th; remainder of the month very fine and dry, but strong N.W. wind from 20th to 25th. R less than a quarter of the average. R B. GORE.

Auckland.—A remarkably fine and dry month, the R being much less than half the average, mean temp. exactly the average. T. F. CHEESEMAN.

TRINIDAD.—R for the month ·56 in. above the average of 25 years. J. H. HART.

JUNE, 1890.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1880–9	Greatest Fall in 24 hours. Dpth	Greatest Fall in 24 hours. Date.	Days on which ·01 or more fell.	TEMPERATURE Max. Deg.	Max. Date	Min. Deg	Min. Date	No. of Nights below 32° In shade.	No. of Nights below 32° On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	2·82	+ ·81	·53	28	17	78·2	25	40·8	1	0	0
II.		Maidstone (Hunton Court)...	1·75	+ ·13	·35	10*a*	14	...	...	...	...	...	...
,,		Strathfield Turgiss	2·76	+ ·96	·71	28	18	77·2	25	32·8	1	0	1
III.		Hitchin	1·93	+ ·07	·52	30	18	73·0	24*b*	47·0	30	0	...
,,		Winslow (Addington)	1·90	+ ·04	·34	25	20	76·0	24*b*	33·0	1	0	1
IV.		Bury St. Edmunds (Westley)	2·30	+ ·51	·50	10	13	...	...	...	...	...	...
,,		Norwich (Cossey)	3·09	+ 1·54	·50	12	18	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	2·51	+ ·28	·39	29	18	72·0	18*c*	43·0	1, 7	0	...
,,		Barnstaple	3·24	+ 1·08	·50	25	17	69·0	14	37·0	1	0	..
,,		Bodmin (Fore Street)	3·98	+ 1·23	·59	25	21	..	...	...	...	...	...
VI.		Stroud (Upfield)	2·83	+ ·44	·65	25	17	78·0	24	47·0	7	0	...
,,		ChurchStretton(Woolstaston)	1·57	— ·98	·52	10	17	71·0	23*d*	41·5	7	0	0
,,		Tenbury (Orleton)	1·93	+ ·68	·54	29	11	77·0	24	33·1	1	0	1
VII.		Leicester (Barkby)	1·79	— ·56	·35	28	14	79·0	15	38·0	14	0	0
,,		Boston	1·40	— ·49	·35	28	13	77·0	12	35·0	1	0	...
,,		Hesley Hall [Tickhill].....	1·72	— ·20	·50	30	14	74·0	9, 10	37·0	8	0	...
VIII.		Manchester(PlymouthGrove)	3·47	+ ·82	·55	30	17	74·0	10	40·0	6, 7	0	0
IX.		Wetherby (Ribston Hall) ..	1·82	— ·07	·84	11	8	...	...	...	...	...	..
,,		Skipton (Arncliffe)	6·47	+ 3·11	1·49	10	26	73·0	23	35·0	7	0	...
,,		Hull (People's Park)	3·53	+ 1·78	2·10	30	15	...	...	...	...	...	...
X.		North Shields	3·16	+ 1·61	·76	11	16	73·0	15	39·0	1, 15	0	1
,,		Borrowdale (Seathwaite).....	13·59	+ 7·01	3·49	2	25	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	2·97	+ ·54	·50	25*f*	17	...	...	...	...	..	...
,,		Haverfordwest	3·33	+ ·77	·71	8	21	68·5	25	36·2	6	0	4
,,		Plinlimmon (Cwmsymlog) ...	7·63	...	1·11	22	22	...	...	...	...	...	...
,,		Llandudno.....	2·54	+ ·77	·35	25	18	67·0	23	42·3	8	0	...
XII.	SCOTLAND.	Cargen [Dumfries]	3·96	+ 2·01	·65	10	22	67·4	23	34·6	8	0	...
,,		Jedburgh (Sunnyside).....	3·01	+ 1·27	·75	11	16	68·0	23	36·0	8	0	..
XIV.		Old Cumnock	3·79	+ 1·93	·51	5	18	71·0	10*e*	30·0	6	2	...
XV.		Lochgilphead (Kilmory).....	5·33	+ 2·23	1·04	2	23	...	...	..	...	...	...
,,		Oban (Craigvarren)	5·82	...	·99	3	23	64·8	13	39·6	8	0	0
,,		Mull (Quinish).....	6·64	+ 3·35	1·11	3	22	...	...	...	...	...	...
XVI.		Loch Leven Sluices	3·40	+ 1·65	·70	6	16	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	2·90	+ 1·40	·55	5	15	71·8	23	38·9	7	0	...
XVII.		Braemar	2·63	+ ·64	·55	3	17	65·3	15	33·2	14	0	4
,,		Aberdeen (Cranford)	1·85	...	·21	3	22	72·0	23	36·0	7	0	...
XVIII		Strome Ferry.....	5·60	+ 2·54	·72	24	24	67·0	10	...	...	...	...
,,		Culloden	1·91	+ ·95	...	...	...	69·0	10	38·0	7	0	3
XIX.		Dunrobin	3·09	+ 1·07	·64	3	16	64·0	21	37·0	8	0	...
,,		S. Ronaldsay (Roeberry).....	...	...	...	...	...	...	...	...	...	...	...
XX.	IRELAND.	Cork (Blackrock)	3·22	+ ·88	·82	7	16	80·0	23	46·0	7, 23	0	..
,,		Dromore Castle	6·35	+ 3·19	1·25	7	20	72·0	12	35·0	18	0	...
,,		Waterford (Brook Lodge) ...	3·76	+ 1·69	·92	7	19	71·0	23	39·0	1	0	..
,,		O'Briensbridge (Ross)	3·45	...	·56	7	22	74·0	26	48·0	6	0	...
XXI.		Carlow (Browne's Hill)	2·21	+ ·37	·34	7	20	...	...	...	..	...	...
,,		Dublin (FitzWilliam Square)	1·93	+ ·27	·36	11	18	72·0	5	43·2	7	0	0
XXII.		Ballinasloe	2·51	+ ·21	·53	7	23	70·0	15	41·0	7	0	...
XXIII		Waringstown	3·21	+ 1·14	·51	29	20	76·0	15	41·0	28	0	0
,,		Londonderry (Creggan Res.).	3·38	+ ·96	·35	5	25	..	...	...	...	...	...
,,		Omagh (Edenfel)	3·23	+ ·76	·36	5	25	68·0	15	44·0	28	0	...

a And 30. *b* And 25. *c* And 23. *d* And 24. *e* And 15, 26. *f* And 29.

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

METEOROLOGICAL NOTES ON JUNE, 1890.

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.—June opened with most favorable agricultural prospects. The winter was dry and equable, the spring forward, with just enough frost to mellow the land, and with sufficient rain to make all crops luxuriant. The showers in the middle of the month were very welcome, but the last fortnight, although satisfactory for the corn crops, was somewhat unfortunate for hay-making. T on 9th, 10th and 11th. Elder in flower on 7th; pink convolvulus on 19th. Meadow brown butterfly flying on 20th.

ADDINGTON.—Potatoes and kidney beans in low situations were cut down, and the foliage in some trees was blackened by frost on 1st. Frequent showers, but not much R until nearly the end, when there was also T.

BURY ST. EDMUNDS.—The month was cool, the hottest day being the 10th, with a max. of 71° in the shade. The early wheat had a very favourable time for blossoming. Very little T.

LANGTON HERRING.—Cold and wet, but there is still a little deficit in the R for the first six months of the year. Mean temp. a little below the average of 18 years. T on 12th and 13th. Much hay spoilt or injured.

BODMIN, FORE STREET.—A very wet and cold month; very few days of regular June weather. Thick mist on 22nd and 23rd.

WOOLSTASTON.—A showery, unsettled month, very unfavourable for the hay harvest. Mean temp. 56°·9.

LEICESTER, BARKBY.—L and T on 11th, 12th and 28th; T on 10th, H on 11th. (The return of 29°·0 as the minimum on May 27th, was queried by the Editor, but there was no question of its accuracy; beans, potatoes, marrows, fruit and flower blossoms were turned quite brown, and many plants killed). [We are glad that our suspicion of Mr. Pochin's thermometer was unfounded. It is a curious example of local frost. ED.]

MANCHESTER, PLYMOUTH GROVE.—Summer weather on four days, viz., 20th, 21st, 22nd and 24th. The rest of the month very changeable and unsettled. T and L on 10th and 11th. Mean temp. 58°·0.

HULL.—The weather during the month was often cloudy, sometimes overcast and rather showery,. T heard on 27th. TS on 28th.

WALES.

HAVERFORDWEST.—A month of constant R and low temp.; and the amount of bright sunshine very small. Unmeasurable moisture fell on five out of the nine days on which no R was recorded, so that there were 26 days out of the 30 *not dry*. Scarcely any hay was cut during the month, an almost unprecedented occurrence, very unfortunate as the crop was abundant. The temp. never reached 70°, and on many nights the temp. was very low for the time of the year. The weather never recovered after the great TS of May 25th, when, as no rain gauge was to be found in the locality, the storm can only be judged by the damage done. Fields were flooded, 100 yards of road at Abermawr washed away, a huge mass of stone estimated to weigh a ton displaced and washed away, at the adjoining village of Mathry. Roads deeply cut like mountain ravines, and the telegraph wires attached to the cable crossing to Ireland were fused by the lightning.

SCOTLAND.

CARGEN.—Very dull weather prevailed during the month. Duration of sunshine 156 hours; 80 hours below the average. Mean temp. 54°·6, 2° below the average. There were only eight days during the month on which rain did not fall. T on the 10th, 27th and 28th.

JEDBURGH.—R was frequent during the month, and there was much sunshine, but occasional low temperature. Crops all looked well, and growth was vigorous. T and L on 27th.

OBAN.—Wettest June for 8 years; growth of crops abundant, but heat deficient. On 24th and 25th the centre of a cyclone of unusual violence passed here.

CULLODEN.—The temp. was below the average; grass abundant, and other crops well advanced.

IRELAND.

CORK.—Changeable weather throughout. Very warm on the 23rd. R ·62 in. above the average of 25 years. Mean temp. 59°·1, being 1°·4 below the average of 14 years.

WATERFORD, BROOK LODGE.—T on 11th and 28th; fog on 13th, 14th, and 15th. H on 28th.

ROSS, O'BRIENSBRIDGE.—Showers frequent, but no large amount at any time. Day temp. below, but night temp. equal to, the average. Weather adverse to hay-making, but good for green crops. No T or L.

DUBLIN.—A cloudy, showery, windy month, of average temp. and pressure and showing a marked preponderance of S.W. and W. winds. Mean temp. 58°·1, slightly above the average. High winds on 15 days, but gales on only two occasions (3rd and 24th). The temp reached or exceeded 70° in the screen on only two days, as compared with 17 days in 1887, 1 day in 1888, and 10 days in 1889. T on 11th and 28th. H on 28th and 30th.

BALLINASLOE.—A cold, wet, and windy month.

OMAGH, EDENFEL.—No other June since 1879 has been so persistently showery and unsettled. The temp. and bar. readings also bore a suspicious resemblance to that disastrous year. No damage had, however, resulted at the close, and nothing but finer weather is required to secure a year's produce of unexampled abundance.

THE RAINFALL OF JULY 4TH-5TH, 1890.

To the Editor of the Meteorological Magazine.

SIR,—The extraordinary rain of last week here deserves to be recorded in your Magazine. In the 24 hours between 5.30 p.m. of Friday, the 4th inst., and 5.30 of Saturday the 5th, there fell 3·30 in., and of this quantity 1·67 in. fell between 7.5 and 9.30 on Saturday morning. These falls are quite unprecedented during the 16 years of my observations in Ramsgate. The eight days of this month already elapsed have given more rain than any entire month of July during those years except that of 1888.—Yours faithfully,

M. JACKSON.

The Vale, Ramsgate, July 9th, 1890.

[We have also received notes whence we add the following extracts —*Ed. M. M.*]

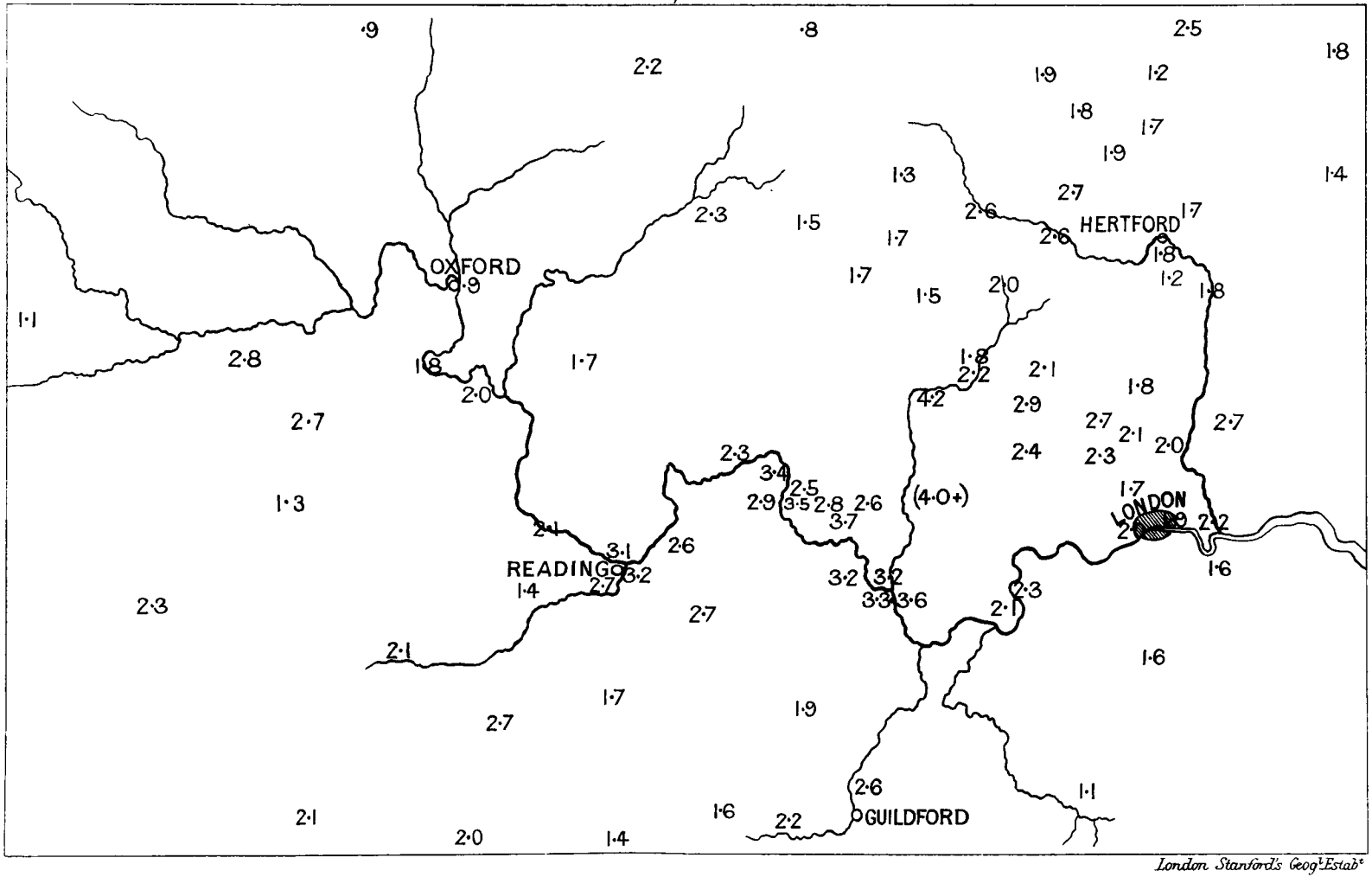
Lower Cousley Wood, Wadhurst, Sussex.—3 p.m. on 4th to 9 a.m. on 5th, 1·26; 9 am. to 4 p.m on 5th, ·44; total, 1·70 in.—F. WILKIN.

Hartley, Cranbrook, Kent.—9 a.m. 4th to 9 a.m. 5th, 1·04; 9 a.m. 5th to 9 a.m. 6th, ·50; total, 1·54 in.—G. PILE.

Tenterden, Kent.—3 p.m. on 4th to 9 a.m. 5th, 1·09; 9 a.m. 5th to 1.20 p.m., ·11; total, 1·20 in.—J. E. MACE.

Capel Lodge, Folkestone, Kent.—3.30 p.m. 4th to 9 a.m. 5th, 2·58; 9 a.m. to 9 p.m. 5th, ·32; total, 2·90 in.—E. NORTON, M.D.

DEPTH OF RAIN, JULY 17TH 1890.



London Stanford's Geog^l Estab^t

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCXCV.] AUGUST, 1890. [PRICE FOURPENCE, or 5s. per ann. post free.

THE GREAT RAIN OF JULY 17TH, 1890.

WE do not call this the St. Swithin's rain of 1890, because we wish the tradition as to the 40 consecutive days of rain to die out; but the latter half of July is not an infrequent date for a great rainfall. Cases similar to the recent fall were that of July 26th, 1867 (which we worked up fully and described in vol. ii. (1867) of this magazine, p. 75), and that of July 14th, 1875, specially treated in *British Rainfall*, 1875, and in a paper on the floods of 1875, printed in the *Proc. Inst. C.E.*

The rain of 1867 extended into two days. At two stations near Sittingbourne and Chatham the total reached 5 inches, and at seven stations it reached or exceeded 3 inches in the two days.

The rain of 1875 also extended into two days, but it was heaviest in Monmouthshire and the S.W. of England; there, at some stations, the total fall exceeded 5 inches.

The rain of 1890 fell chiefly on one day (the 17th), and though about half an inch more fell on the 18th, it was separated by a dry period, and therefore, in the following notes and in the accompanying map, we deal with the fall of the one day (the 17th) only.

We have been favoured by many of our correspondents with notes on the fall. We shall quote here those daily totals only which exceed three inches. Others are given on the map, and the whole facts will have to be thoroughly discussed in *British Rainfall*, 1890.

The largest records which we have yet received are—

4·19 in. at Moor Park, Rickmansworth, Herts.
3·68 ,, Langley, Slough, Bucks.
3·60 ,, Belle Vue, Staines, Middlesex.
3·45 ,, Taplow Court, Maidenhead, Berks.
3·37 ,, Cookham Vicarage, Maidenhead, Berks.
3·33 ,, Cooper's Hill [Staines], Surrey.
3·24 ,, Portland Place, Reading, Berks.
3·20 ,, Knowle Green, Staines, Middlesex.
3·10 ,, East Thorpe, Reading, Berks.

The following gauges ran over. As regards these stations, therefore, our knowledge is limited to the fact that the rain was greater than

4·00 in. at Hillingdon, Uxbridge.
2·08 ,, Gorhambury, St. Albans.
2·00 ,, Greenlands, Henley-on-Thames.
1·94 ,, Pinner Hill.

PHENOLOGICAL OBSERVATIONS.

(Translated from "Ciel et Terre").

The utility of these observations as an auxiliary to the study of climates has long been recognized.

In five years a phenological observer may have obtained mean dates sufficiently accurate to enable him to judge of the successive advent of the various phases of vegetation. If one has ascertained the mean date for five years of the principal phenomena, *e.g.*, when in the immediate neighbourhood of the observer the first blooms of the blackthorn open, or the first fields of barley are cut, one is in a position to decide; (1) How the station is related to one of which the averages have already been long determined; (2) How various localities are related to the principal station, whether they are colder or hotter, as indicated by the relative maturity of plants in the two localities; one obtains these results much better than if one had established and compared hundreds of thermometers and rain gauges in a hundred different positions, putting aside the impossibility of observing them all, and the difficulty of procuring and erecting them; phenological observations cost nothing, while meteorological instruments are expensive; (3) Each year, and each week of the year, one can compare the observations of the progress of vegetation with the means, and ascertain whether at one's own station the season is early, normal or late. Phenology is a species of thermometry which may even occasionally correct erroneous conclusions from thermometric records. Thus Hoffmann has remarked that it is a peculiarity of oak brushwood to leaf much later than full grown trees of the species, although, if considered from the thermometric stand-point only, one would be inclined to attribute it to the dampness and consequent coldness of the positions occupied by the brushwood. A plant is, in fact, a sort of registering thermometer, which like the thermometer shows us present temperature, but in addition the final effect of past temperatures, a result we can arrive at only imperfectly by summing up the daily mean temperatures. Phenological observations, with figures founded on comparisons, have the advantage of presenting to the mind facts easily grasped. As regards biological problems, isotherms are not necessary, because they do not give the real average temperature. That is why isotherms cannot coincide with isophanes (lines of equal phases of vegetation). Accurate observations of the phases of vegetation, and the determination of their mean value, furnish important indications as to the further progress of the plant, by the differences which they present from the normal value. But it has another result. By comparing during a year the flowering of certain plants in different places in a district, we may be able to determine the amount of heat received in each of these positions in a given time. These phenological observations enable us to examine predictions which have come down to us from remote ages, such as the speedy

arrival of winter, after the fall of the bloom of the heath, and the larch losing its leaves. Hoffmann has observed that out of 29 years, in 21 the early or late opening of the buds of the chestnut has corresponded with a following winter warm or cold. In fact, phenology may attain the same precision as meteorology, for the two modes of observation can each give only approximate values.

BALL LIGHTNING.

Dr. E. Cabellero, who is professor of physics and director of the Electrical Works at Pontevedra, has sent to the observatory at Madrid, the following account of phenomena seen by himself :—

On January 2nd (1890 ?) at 9.15 p.m., the sky being cloudless and the weather calm, a ball of fire about the size of an orange, suddenly entered the works. This ball of fire entered by a window or light, after having probably come along one of the conductors for the electric light. [Very respectfully, we think it more likely that it came along the conductors the whole distance, and not through the window ; open windows at 9.15 p.m. in January, in Madrid, scarcely seem probable, and Dr. Cabellero evidently did not see it enter, or he would not say, " par une fenêtre ou une lucarne."—ED. *Met. Mag.*]

From the window it went to the switch-board and thence to the dynamo. Twice in the sight of the frightened engineers and workmen, it darted from the switch-board to the dynamo, and from the dynamo to the switch-board, and finally fell on the ground and burst into fragments, leaving, however, no traces except by fusing some of the thick copper conductors on the switch-board. A noise like the discharge of a cannon accompanied its dissipation. The street lamps were extinguished for a few seconds, but as the dynamo was not injured the current was speedily restored.—*Ciel et Terre.*

NEW METEOROLOGICAL STATION AT POMPEI.

Although unable to accept the invitation to be present at the inauguration of the above, we are glad to devote a few lines to record that which brings, so strangely, ancient and modern times together. We are indebted to Avv. Bartolo Longo for several papers,* whence we gather that considerable ecclesiastical and charitable buildings are rising on a site near to, or actually over, Pompei. That the organizers of this new Pompei attach considerable importance to intimate relations existing between Religion and Science ; and, as one step in that direction, they have provided all the apparatus required for a second order station, with the addition of seismometers and photographic apparatus for recording the smoke from

* Le Armonie della Religione e della Civilità nella Nuova Pompei. Programma delle Feste di Maggio, 1890, and others.

Vesuvius, and have established what with some grandiloquence they term the "Osservatorio Meteorico-Geodinamico-Vulcanologico." The inauguration took place on May 15th, 1890, when many leading Italian observers were present, addresses being delivered by Padre Denza, Prof. Stefano de Rossi and others.

CAUSE OF ATMOSPHERIC DEPRESSION.

To the Editor of the Meteorological Magazine.

SIR,—In the number of this magazine for June, 1890, p. 75, occurs the following sentence, by the Rev. Clement Ley, in a letter on this subject:—"Now, after full attention has been devoted to the works of Faye, Hazen, and other oppositionists, the fact remains that the character of the current of scientific theory on this subject is strong enough to be, to most of us, unmistakable." A little later, reference is made to the work of Prof. Ferrel as being fundamental and conclusive. It is probable that meteorologists in England, and on the Continent, are not fully aware of the true inwardness (*sic*) of scientific theories in meteorology in America, nor of the extreme contradictions between such theories and the facts. Your correspondent should have stated that Prof. Ferrel is second in this field so well studied by Espy half-a-century ago. Here are Prof. Ferrel's own words. He says, in describing the force needed to maintain a storm, "This force may be furnished by the condensation of vapour ascending in the upward current in the middle of the hurricane, in accordance with Prof. Espy's theory of storms and rains." This is sufficient to show that, after all, we must go back, not to Ferrel, but to Espy. If it can be shown that Espy was entirely misled by his experimental researches, that the proofs which he thought he had were entirely incorrect, and more than all, that a careful repetition of his experiments shows that absolutely no energy can be obtained in the maintenance of storms by the liberation of latent heat from condensing moisture, and a consequent increase in the rarefaction at the centre, as he thought, then a death-blow has been struck to all theories founded upon his researches. I think it may be fairly admitted that Espy's work has been shown to be exceedingly faulty, and it may be hoped that meteorologists ere long will be enabled to cast off this millstone which has so long been dragging them down, and, by a series of careful experiments, make a fair start toward building up a science. It is an astonishing fact that students of meteorology are the only ones who have been content with vague speculations, and have not founded their science upon a firm and substantial groundwork of fact.

It is probable that nothing could emphasize the necessities of the case better than the recent most extraordinary statements of Dr. Hann, of Vienna. He has made a study of the temperature conditions at high and low stations during the passage of storms and high pressure areas, and has come to the conclusion that above the earth's surface the temperature in our storms is markedly *diminished*, while in our

high pressure areas it is *increased*. The uttter lack of faith in present theories of storm formation could hardly be better shown than by the extraordinary rapidity with which they were brushed aside by meteorologists to accept this new dictum by an *authority*.* It is true that Dr. Hann has been woefully misled by his researches, and that the temperature is certainly higher in the centre of our storms up to 14,134 ft., the height of Pike's Peak, than it is before or after the centre has passed. The surprising thing is, that no one questions the results of another, nor has faith enough in his own views to maintain them until forced to yield inch by inch.

One other point I will mention. It is hardly true that the arguments of the oppositionists have had full attention paid to them. These arguments have either been ignored as unworthy of attention, or, where an attempt has been made to answer them, the results showed how utterly weak the ordinary theories were. It is a remarkable fact that every theory of storm formation, from its beginning by an abnormal heating at the earth's surface to its maintenance by rarefactions in the upper air, due to a peculiar distribution of temperature with height, has had no fact as a basis. The present theories in meteorology can be likened to nothing better than "the baseless fabric of a vision."

H. A. HAZEN.

Washington, July 1, 1890.

SOLAR RADIATION THERMOMETERS.

To the Editor of the Meteorological Magazine.

SIR,—You have kindly sent me some back numbers of the *Meteorological Magazine* containing articles and letters on solar radiation instruments, and consequently it was only last week that I saw the letter of Mr. H. Sowerby Wallis in the number for January of this year, and it must have appeared discourteous of me not to have replied to it before.

The cases of the thermometers described in my paper to the British Association had an external diameter of 63 millimetres. The large thermometer bulb had a diameter of 11·1 mm.; it was made of white glass, and was coated with lamp black. The small bulbs were 5·6 mm. in diameter, and were made of black glass, which had, however, a smooth surface, and therefore reflected some light and heat.

The instruments have, unfortunately, been broken, but this has given me the opportunity of measuring the thickness of the cases. That which enclosed the thermometer with the large bulb had a knob of glass on it, produced by closing the bulb after the thermometer had been introduced. Two pieces of glass near the equator of the bulb were measured, and were found to have a thickness of ·52 mm.

The cases of the two small thermometers were made as nearly

* We do not follow this argument; Prof. Hazen evidently accepts Dr. Hann as an "authority," yet condemns meteorologists for doing the same thing.

uniform in thickness as possible, the thermometers having been introduced from the other ends of the tubes. The thin case had a thickness of ·59 mm, and the thick case was no less than 5 mm. in thickness, much stouter than I intended it to have been.

On looking through the back numbers, I find that the theory propounded in my paper last year was published nearly 20 years ago; for on September 26th, 1870, Mr. Henry R. Procter wrote to you a letter printed in the number for December, 1870 (*Met. Mag.* v. 183), which contains all I wrote on the subject. I need hardly say that I had no idea that I had been anticipated so completely, and no one has ever directed my attention to this letter.

In view of this theory it appeared possible that the blackening of the stem of the thermometer, as well as of the bulb, might have some influence on the readings, for additional heat would be absorbed by the blackened stem which would, by radiation, raise the temperature of the case, so it seemed of importance to diminish the length of the blackened portion of the stem.

Mr. Stow's letter of July 18, 1868 (*Met. Mag.* iii. 115), shows so clearly the necessity of blackening the stem to prevent conduction removing heat from the thermometer bulb that it seems hopeless to dispense with it; however, it appeared worth while to try some experiments on the conduction of heat along a stem. For this purpose a thermometer was placed horizontally, and a piece of filter paper was tied round the stem a quarter of an inch from the bulb, and a screen of card, with a hole in it, was fixed between the bulb and the paper. Ether was dropped on the filter paper, and at first no effect was observed. After a minute and a quarter the mercury began to fall, and in four minutes the temperature had fallen 5°, moisture being deposited on the stem, between the bulb and the filter paper. With another thermometer the temperature began to fall in 50 seconds, and at the expiration of $4\frac{1}{2}$ minutes the temperature was lowered 8·1°. The object of the screen was to prevent the cold vapour of the ether from coming in contact with the bulb, which would, of course, lower the reading.

In another experiment with the first thermometer the filter paper was placed one inch from the bulb. The paper was kept wetted with ether for 8 minutes, and the temperature fell only 0°·4. Moisture was deposited on the tube, and extended about half an inch from the paper. Probably some of this apparent fall of temperature was due to the cooling of the thread of mercury, as a considerable length of the tube was cooled. On placing filter paper on the bulbs of the thermometers and wetting it with ether, the temperature was lowered about 53°, which is probably not far from the difference of temperature between the bulb and stem of a black bulb thermometer in vacuo when the sun is shining on it. So conduction may seriously affect the readings of such an instrument, if a sufficient length of the stem is not blackened.

I still think that the blackening of the stem should be diminished

as much as possible, and perhaps another way to check the conduction would be to lessen the cross section of the stem close to the bulb, by making a narrow neck between the bulb and the tube. If the bulb and neck only were blackened, it would materially diminish the quantity of heat radiated to the inside of the case.

Faithfully yours,

HERBERT McLEOD.

Cooper's Hill, August 7th, 1890.

THE COLD WEATHER OF MARCH.

To the Editor of the Meteorological Magazine.

SIR,—Though I am very late in making this communication, yet I think that it may still interest some of your readers to know that the above cold spell reached even Madeira, and that the lowest temperature ever observed in Funchal was recorded on March 6th, 1890. I then registered in a Stevenson's screen a minimum of 43° F, and though my instruments are placed at an altitude of about 350 ft. above the sea, identically the same temperature was recorded at the Government Observatory in the town. The lowest temperature previously recorded was 45°·7 on March 11th, 1883, but this year on four consecutive nights I registered a minimum lower than that, viz.—

March 5th, 45°·0 F.	March 7th, 44°·0 F.
,, 6th, 43 ·0	,, 8th, 44 ·2

At 7 a.m. on the 7th, there was a single clap of thunder, followed by a sharp hailstorm, which quite whitened the ground, and remained for a quarter of an hour or so before melting. It caused a good deal of interest, for our native Madeira servants and others around had never previously seen any snow or hail fall, though, of course, snow falls frequently enough on the higher mountains of the island.

I am, yours truly,

H. COUPLAND TAYLOR, M.D., F.R.MET.SOC.

Madeira.

REVIEWS.

Wanderings in Search of Health, or Medical and Meteorological Notes on various Foreign Health Resorts. By H. COUPLAND TAYLOR, M.D., F.R.Met.Soc. London: Lewis, 1890. 8vo, cloth, 259 pages, 5 plates.

DR. COUPLAND TAYLOR was for some time one of our rainfall observers, but ill-health compelled him to leave the wet locality in which he had been practising, and for the last four years he has been, as the title of his book says, "Wandering in search of Health." We are glad to know that not only has he found it, but in the work before us he has recorded his views as to the *pros* and *cons* of most of the places usually visited.

It is not for us to discuss medical questions, but there is one idea which frequently recurs in this book which has startled us, and set us thinking and making some enquiries. Evidently consulting physicians (whom, by the bye, he somewhat drolly calls "consultants"), do not stand high in Dr. Coupland Taylor's opinion, and he, both on his own account and by quotations from other medical men, implies (and illustrates by examples) carelessness and want of knowledge and of judgment in the advice they give as to the localities to which phthisical patients should go. It is difficult to believe that a sweeping charge like that can be substantiated. We know that it is not true of some consulting physicians, because we could name one who is not merely wearing himself out by the thought which he bestows on each individual case, but who stops at neither distance nor expense in order, by personal inspection at various seasons, to make himself familiar with each new health resort as it comes into notice; but, on the other hand, we have just applied what seems a reasonable test with a very unsatisfactory result.

An expert on any subject should surely be well acquainted with the literature upon it. A doctor who professes to advise as to climate might be supposed to take sufficient interest in the subject to seek election into the Royal Meteorological Society, in order (even if he had not time to attend the meetings) that he might see the quarterly journal and keep himself *au courant* with the published data as to climate. We have been through the last list of Fellows, and can find only seven London medical men—and of those we believe that there is only one—who is an expert in consumptive cases. Surely there is more than one London physician who advises on climatic matters. It does look therefore as if Dr. Coupland Taylor's criticisms have some foundation.

The special characteristics of the book seem to us to be fairness and common-sense. Dr. Coupland Taylor comes down alike on the profession and on the patients. We give a specimen of each:—*Place aux Dames*: Dr. Taylor is writing of the dances at Davos—

"It is impossible to keep some ladies away from this amusement, for if there is a dance taking place in any of the hotels, they will dance all the evening, in spite of the doctor's strictest orders to the contrary, and suffer for days after in consequence."

Now for the doctors.

"At the present day but little seems known of the climate of Madeira among the medical profession at large. When a London specialist, on this subject, describes the climate to be like the atmosphere of the 'hot and well-steamed room of a patient suffering from bronchitis,' one can see how little its real climate is known and appreciated."

"Again, Prof. Charteris, in his work on 'Health Resorts,' makes the astonishing statement: 'During the season of 1881-82 there was at Davos a clear, unclouded sky from the beginning of November to the end of March.

Unfortunately I cannot obtain the statistics of the weather for that year, but the correctness—[incorrectness—ED. *M.M.*]—of the statement may be gathered from the fact that in the exceptionally fine season of 1879-80, 'perhaps one of the most perfect ever known in the Alps' (Yeo), rain or snow fell on 36 days between November and March."

The author, being himself a skilled observer and F.R.Met.Soc., the meteorological data in this book are exceptionally trustworthy; but we find one new term as to the adoption of which there may be some doubt. Dr. Taylor seems to take it for granted as if already accepted, but we never met with it before. "The absolute humidity, however, is the absolute quantity of aqueous vapour which is suspended in a given volume of air." "Absolute humidity" is of course much shorter than "Grains of vapour in a cubic foot of air," but it is liable to be confused with "Relative humidity," and there is the further question whether the term is legitimate.

The places chiefly dealt with are the Ocean, the Engadine, Davos, Madeira, Canary Isles, and Western Riviera. On each and all Dr. Taylor gives much valuable information, so that there are few practitioners or patients who would not profit by reading his book.

There is in it a large amount of useful meteorological information, and while not suggesting that it should be taken from where it is, we think that two or three pages devoted to a tabular summary of the figures scattered through the book would be a handy addition. It is well printed, and the plates are excellent specimens of some process of photographic reproduction.

Congrès International d'Hydrologie et de Climatologie.—Compte Rendu de la Deuxième Session, Paris, 1889. Doin: Paris, 1890. 8vo., 504 pages.

AT the first Congress at Biarritz, it was resolved that by exception the next should be held in Paris during the Exhibition. There had been too many Congresses, and coming as the Hydrological one did nearly the last, and in cold rainy weather it suffered seriously and afforded a painful contrast to the bright, enthusiastic and well attended one at Biarritz. It remains to be seen by the gathering at Rome in 1893, whether the Congress supplies a real need or not.

The volume before us is a handsome and substantial one. The first 250 pages are wholly medical. On some of the papers in the latter half we intend to offer a few notes.

On the precautions requisite in observing accurately the temperature of thermal springs, by M. Renou. The author called attention to the fact that mercurial thermometers rise with age, and to the possibility of avoiding this error by applying Denton's process before graduating them. He also urged that thermometers be sent to the Bureau Central or to the observatory at Parc St. Maur for verification. He expressed his belief that the majority of clinical thermometers read

too high, and that the real temperature of the human blood is 98°·33, which is his normal state. [On looking at our pocket Immisch thermometer, the red arrow for blood heat points to 98°·2, so, apparently Frenchmen and Englishmen do not differ much. ED. *Met. Mag.*] M. Renou considered that the most accurate mode of taking the temperature of a thermal spring is to place a thermometer in a bottle, sink the whole to the bottom, and after a suitable time to draw all up together. M. Youji-Wada, of Tokio, said that in Japan there was an intimate relation between the temperature of springs and the occurrence of squalls. Dr. Fines called attention to the influence of rain on the temperature and mineralization of some thermal sources. Mr. Symons explained the precautions which he had taken in determining the temperature of Pyrenean springs, and also urged that the verification of thermometers should be put in France as in England, on a commercial footing, so that verified thermometers should be the rule rather than the exception.

There is a very puzzling fact shewn by the reproduced traces of a Richard thermograph, in a paper by Dr. Lalesque, on the climate of Arcachon. Dr. Lalesque notices the fact, but offers no explanation. He gives the curves for 26 days, and on 14 of them the usual fall of temperature from sunset to sunrise is stopped or replaced by a rise between 9 p.m. and midnight. The author states that he has a Montsouris thermometer stand, and speaks much of the verification of his instruments. We can hardly doubt that the thermograph was on this stand, but if so, and suitably distant from buildings, the rise in question is a perfect mystery.

Dr. Gandy in a paper on the Climatology of the S.W. of France, tells us that as the result of the discussions at the Biarritz meeting, M. Henri Léon, of Bayonne, has established a fortnightly *Bulletin de Climatologie*, which gives the records at several stations between Arcachon and Bagnères de Bigorre. We have not yet seen that periodical, and we think that either through the printing of some extra copies of it, or by the insertion of abstracts of the records in the *Annuaire* of the *Soc. Met. de France*, the results ought to be generally accessible.

M. Mendez Guerreiro of Villa Fernando, Portugal, stated that having been charged with the establishment of a reformatory school in a marshy district, where the daily range of the thermometer was sometimes 54° F., he had planted 100,000 eucalypti, dried the marsh, equalized the rivers and brought the extreme daily range down to 32° F.

One would much like the details of this remarkable case—including evidence that the climatic conditions over that part of Portugal were identical at the two times—*i.e.*, that the difference between 54° and 32°, was really wholly due to the planting.

The volume closes with a paper on a Programme of a course of Lectures on Climatology, by M. Georges Lemoine, concerning which

we need say only that it is worthy of the author and of the attention of all who intend to treat the subject either in a volume or in lectures. There are two points upon which we should be glad of enlightenment.—(1). What experience induces M. Lemoine to recommend the Piche evaporator? (2). Where is it possible to procure one of the books recommended for study, viz., *Cours de météorologie*, by M. Millot?

Weather Forecasting for the British Islands, by means of a barometer, the direction and force of the wind, and cirrus clouds. By CAPT. H. TOYNBEE, F.R.A.S., F.R.Met.Soc., late Marine Superintendent, Meterological Office. London: Stanford, 1890. sm. 8vo., iv. 36 pages and 8 plates.

FROM the preface to this little book, we learn that after Captain Toynbee's retirement from the superintendence of the marine department of the meteorological office, the Meteorological Council requested him to go on tours round parts of our coasts, and give lectures to the seamen on storms and how to avoid them. We are not sure that the Council ever expended money more wisely. Captain Toynbee's life-long experience, his kindliness and his earnest desire to do good, would give him a hold upon his audiences such as few men could obtain, and when he had secured their attention, instead of frightening them, or sending them to sleep by abstruse technicalities, we have no doubt that many a bright story from his own experience would be brought in to fix the lessons he had to teach.

This little book seems to be one or more of the lectures written out for publication, and therefore, perhaps rather stiffer and less homely than as verbally delivered. But it is very unpretentious and practical, admirably suited for beginners, while those who know everything in it are not numerous enough seriously to affect its circulation.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JAN., 1890.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain. Depth.	Total Rain. Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		0-10
England, London	55·6	25	26·1	2	48·9	37·9	40·1	87	83·1	18·3	2·46	21	7·4
Malta	67·5	26	46·2	16	61·4	52·2	48·6	80	117·1	39·3	1·32	8	4·9
Cape of Good Hope	92·0	7	53 0	15*a*	77·7	59·6	...	...	...	...	·44	...	2·8
Mauritius	84·4	15	69·0		82·4	72·7	68·6	77	139·5	61·2	5·01	16	6·1
Calcutta	81·7	24	47·6	28	77·0	56·5	57·2	74	135·5	38·6	·77	1	8·2
Bombay	89·5	14	65·6	22*b*	84·7	68·6	63·4	65	135·9	50·5	·00	...	0·4
Ceylon, Colombo	91·4	10	66·0	25	86·9	71·1	67·2	71	151·0	58·0	·81	6	3·8
Melbourne	101·5	25	47·9	8	83·8	60·4	57·2	63	156·5	38·0	1·37	7	4·3
Adelaide	105·0	18	54·7	4	91·4	68·0	55·3	42	163·9	43·7	·62	10	3·1
Wellington	80·0	8	44·0	14	68·5	52·4	48·7	66	138·0	37·0	3·25	9	3·8
Auckland	...	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston	90·9	2, 12	62·0	14	88·9	64·5	65·8	72	...	...	·34	...	...
Trinidad	87·0	var.	64·0	16	84·3	68·8	69 7	80	158·0	...	7·76	22	...
Toronto	53·9	6	6·4	11	36·9	22·3	25·7	83	...	4·0	3·36	21	8·1
New Brunswick, Fredericton	51·8	2	—24·0	10	23·4	— 0·5	11·8	80	...	...	3·21	17	5·0
Manitoba, Winnipeg	26·4	28	—39·4	17	—2·9	—22·3	—9·0	98	...	...	·51	10	4·6
British Columbia, Victoria	47·0	27	12·0	15	37·5	27·3	...	...	...	...	3·96	15	...

a And 28. *b* And 27.

REMARKS, JANUARY, 1890.

MALTA.—Mean temp. 56°·0; mean hourly velocity of wind 11·3 miles. Sea temp. fell from 61°·0 to 60°·0. TS with H on 13th. Pressure unusually steady, and temp. much above the average. J. SCOLES.

Mauritius.—Mean temp. of air 1°·5, dew point 1°·2, and R 1·99 in., below their respective averages. Mean hourly velocity of wind 10·6 miles, or 0·6 below average; extremes, 25·3 on 20th, and 2·0 on 10th; prevailing direction, E.S.E. to E. by N. L on 15th, T and L on 17th and 18th, and T on 20th and 31st.—C. MELDRUM, F.R.S.

CEYLON, COLOMBO.—L seen on the night of the 31st. J. C. H. CLARKE, Lt. Col. R.E.

Melbourne.—Mean temp. of air 5°·3, and of dew point 4°·3 above, humidity ·01, of cloud 0·9, and of R ·42 in., below their respective averages. Prevailing wind S., strong on 6th from S., and on 9th and 21st from N., and on 29th, 30th, and 31st from S.E. and E. TS on 3 days, L on 2 days. Weather sultry and oppressive almost throughout the month. R. L. J. ELLERY, F.R.S.

Adelaide.—A most disagreeable month. Mean pressure about the average, but the mean temp. 5°·1 above previous 33 years, and greatest on record since 1858. No very hot days, but excessively humid. C. TODD, F.R.S.

Wellington.—Fine early part of the month; heavy R on the night of the 7th, and continued showery for some days; fine during latter part of the month, and very warm at times. Prevailing N.W. wind, and occasionally strong; on the whole a fine month. R. B. GORE.

TRINIDAD.—The R for January is 5·15 in. above the 25 years' average. J. H. HART.

SUPPLEMENTARY TABLE OF RAINFALL, JULY, 1890.

[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 Hall.	3·54	XI.	Castle Malgwyn	2·94
,,	Margate, Birchington...	3·62	,,	Builth(LlanwrtydWells)	4·92
,,	Littlehampton	2·97	,,	Rhayader, Nantgwillt..	2·79
,,	Hailsham	3·07	,,	Carno, Tybrith	2·40
,,	Ryde, Thornbrough	3·78	,,	Corwen, Rhug	2·64
,,	Alton, Ashdell.....	3·31	,,	I. of Man, Douglas	2·54
III.	Oxford, Magdalen Col...	2·96	XII.	Stoneykirk, Ardwell Ho.	2·84
,,	Banbury, Bloxham	2·76	,,	New Galloway, Glenlee	3·81
,,	Northampton	2·96	,,	Melrose, Abbey Gate...	2·82
,,	Cambridge, Fulbourne..	4·87	XIII.	N. Esk Res. [Penicuick]	5·15
,,	Wisbech, Bank House..	2·56	XIV.	Ballantrae, Glendrishaig	2·79
IV.	Southend	2·83	,,	Glasgow, Queen's Park.	4·33
,,	Harlow, Sheering	...	XV.	Islay, Gruinart School..	3·58
,,	Rendlesham Hall	4·91	XVI.	Dollar.....	3·51
,,	Diss	3·43	,,	Balquhidder, Stronvar..	5·15
,,	Swaffham	4·11	,,	Coupar Angus Station..	3·38
V.	Salisbury, Alderbury...	3·60	,,	Dunkeld, Inver Braan..	3·83
,,	Warminster	3·50	,,	Dalnaspidal H.R.S. ...	4·68
,,	Bishop's Cannings	3·44	XVII.	Keith H.R.S.	3·94
,,	Ashburton, Holne Vic....	4·26	,,	Forres H.R.S.	3·88
,,	Hatherleigh, Winsford.	...	XVIII.	Fearn, Lower Pitkerrie.	..
,,	Lynmouth, Glenthorne.	2·87	,,	Loch Shiel, Glenaladale	9·73
,,	Probus, Lamellyn	3·75	,,	N. Uist. Loch Maddy ...	4·93
,,	Launceston, S. Petherwin	3·73	,,	Invergarry	5·63
,,	Wincanton, Stowell Rec.	3·32	,,	Aviemore H.R.S.	3·32
,,	Taunton, Lydeard Ho...	...	,,	Loch Ness, Drumnadrochit	3·09
,,	Wells, Westbury.....	4·46	XIX.	Lairg H.R.S.	...
VI.	Bristol, Clifton	3·41	,,	Scourie	4·30
,,	Ross	3·33	,,	Watten H.R.S.	3·79
,,	Wem, Clive Vicarage ...	3·20	XX.	Dunmanway, Coolkelure	5·09
,,	Cheadle, The Heath Ho.	2·68	,,	Fermoy, Gas Works ...	2·42
,,	Worcester, Diglis Lock	1·91	,,	Tipperary, Henry Street	2·10
,,	Coventry, Coundon	2·21	,,	Limerick, Kilcornan ...	2·30
VII.	Ketton Hall [Stamford]	2·65	,,	Miltown Malbay..	4·49
,,	Grantham, Stainby	2·31	XXI.	Gorey, Courtown House	1·70
,,	Horncastle, Bucknall ...	2·04	,,	Navan, Balrath	2·02
,,	Worksop(HodsockPriory)	2·12	,,	Mullingar, Belvedere ...	2·67
VIII.	Neston, Hinderton	2·10	,,	Athlone, Twyford	2·69
,,	Knutsford, Heathside ...	2·33	,,	Longford, Currygrane...	2·95
,,	Lancaster, South Road.	3·87	XXII.	Galway, Queen's Coll...	3·29
,,	Broughton-in-Furness ..	5·29	,,	Clifden, Kylemore	5·89
IX.	Wakefield Prison	1·89	,,	Crossmolina, Enniscoe..	3·38
,,	Ripon, Mickley	1·17	,,	Collooney, Markree Obs.	3·77
,,	Scarborough, West Bank	1·65	,,	Ballinamore, Lawderdale	...
,,	East Layton[Darlington]	2·70	XXIII.	Warrenpoint	3·02
,,	Middleton, Mickleton..	1·37	,,	Seaforde	2·35
X.	Haltwhistle, Unthank..	2·14	,,	Belfast, New Barnsley..	2·59
,,	Shap, Copy Hill	4·07	,,	Bushmills, Dundarave...	...
XI.	Llanfrechfa Grange	3·32	,,	Stewartstown	1·96
,,	Llandovery	4·57		Buncrana	3·78

JULY, 1890.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1880–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE Max. Deg.	Max. Date	Min. Deg.	Min. Date	No. of Nights below 32° In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	4·20	+ 1·52	1·67	17	14	76·2	23*a*	45·1	4	0	0
II.		Maidstone (Hunton Court)...	3·53	+ 1·35	1·85	4	16	...	...	...	...	...	...
,,		Strathfield Turgiss	3·44	+ 1·05	1·73	17	19	77·6	23	41·9	4	0	1
III.		Hitchin	4·11	+ 1·39	1·88	17	19	73·0	23	44·0	11	0	...
,,		Winslow (Addington)	4·56	+ 1·27	2·20	17	21	76·0	13*b*	42·0	4*f*	0	...
IV.		Bury St. Edmunds (Westley)	5·35	+ 2·78	2·70	17	17	...	...	...	...	...	...
,,		Norwich (Cossey)	...	...	...	...	...	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	2·66	+ ·51	·61	7	19	73·0	26	46·0	4, 6	0	...
,,		Barnstaple	2·73	— ·74	·74	16	13	70·0	31	43·0	10*g*	0	..
,,		Bodmin (Fore Street)	5·07	+ ·46	1·46	16	23	...	...	...	...	...	...
VI.		Stroud (Upfield)	2·84	— ·73	·72	17	17	79·0	23	45·0	6	0	...
,,		ChurchStretton(Woolstaston)	2·10	— ·87	·43	16	22	70·0	22	44·0	12	0	...
,,		Tenbury (Orleton)	2·50	— ·36	·60	16	19	75·0	13*b*	38·0	4	0	0
VII.		Leicester (Barkby)	2·50	— ·49	·63	2	21	79·0	13	40·0	9, 11	0	...
,,		Boston	1·60	— 1·19	·33	18	16	81·0	17	41·0	6	0	...
,,		Hesley Hall [Tickhill].....	1·90	— ·77	·35	18	16	75·0	16	43·0	12	0	...
VIII.		Manchester(PlymouthGrove)	2·63	— 1·16	·39	25	16	76·0	16	43·0	11	0	...
IX.		Wetherby (Ribston Hall) ...	1·32	— 1·86	·56	16	8	...	...	...	...	...	...
,,		Skipton (Arncliffe)	5·16	— ·48	·69	7	24	76·0	20	40·0	11	0	...
,,		Hull (People's Park)	1·57	— 1·02	·28	23	15	...	...	...	...	...	...
X.		North Shields	1·43	— 1·96	·50	2	15	74·5	30	..	...	0	...
,,		Borrowdale (Seathwaite).....	13·43	+ 2·44	2·14	29	22	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	3·47	— ·59	·80	7	19	...	...	...	...	...	...
,,		Haverfordwest	4·15	— ·06	1·05	7	19	70·0	21	40·5	9	0	...
,,		Plinlimmon (Cwmsymlog) ...	5·81	...	·91	30	20	...	...	...	...	...	...
,,		Llandudno.....	1·64	— 1·36	·25	25	14	69·2	13*c*	45·0	12	0	...
XII.	SCOTLAND.	Cargen [Dumfries]	3·23	— ·70	·56	7	19	69·6	21	41·0	11	0	...
,,		Jedburgh (Sunnyside).....	2·23	— 1·21	·62	7	17	71·0	21	39·0	20	0	...
XIV.		Old Cumnock	4·36	+ ·84	·63	14	23	73·0	13	36·0	10	0	...
XV.		Lochgilphead (Kilmory).....	4·59	+ ·29	·63	13	21	...	...	..	...	...	...
,,		Oban (Craigvarren)	6·07	...	2·47	13	19	65·2	2	43·3	8	0	...
,,		Mull (Quinish).....	6·05	+ 2·00	·79	13	25	...	...	...	...	...	...
XVI.		Loch Leven Sluices	3·20	— ·42	1·00	8	14	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	3·25	— ·21	·95	7	17	77·6	21	43·2	10	0	...
XVII.		Braemar	3·35	+ ·14	1·11	7	22	69·8	21	36·8	26	0	1
,,		Aberdeen (Cranford)	2·42	...	1·12	7	23	74·0	31	40·0	19	0	...
XVIII		Strome Ferry.....	6·94	+ 2·65	·90	12	23	63·0	23	...	...	0	...
,,		Culloden	3·45	+ ·46	1·02	14	...	69·0	20	41·0	16	0	1
XIX.		Dunrobin	2·64	— ·21	·78	12	18	...	..	...	...	...	...
,,		S. Ronaldsay (Roeberry).....	...	...	...	...	...	...	...	...	...	...	...
XX.	IRELAND.	Cork (Blackrock)	2·40	— ·78	·52	7	16	75·0	21	42·0	3	0	...
,,		Dromore Castle	4·99	+ ·01	1·50	30	16	68·0	24	43·0	16	0	...
,,		Waterford (Brook Lodge) ...	2·40	— 1·13	·54	7	17	75·5	21	42·0	10*h*	0	..
,,		O'Briensbridge (Ross)	2·99	...	·65	25	22	76·0	27	44·0	7*i*	0	...
XXI.		Carlow (Browne's Hill)	1·78	— 1·74	·32	7	17	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	2·17	— ·51	·38	25	24	72·8	13	44·4	5	0	0
XXII.		Ballinasloe	2·81	— ·74	·62	25	19	67·0	13*d*	37·0	11	0	...
XXIII		Waringstown	2·77	— ·75	·70	16	21	73·0	19*e*	44·0	1, 17	0	...
,,		Londonderry (Creggan Res.).	4·01	— ·11	·65	13	26	..	...	...	...	...	...
,,		Omagh (Edenfel)	2·66	— 1·06	·65	30	24	68·0	13	43·0	10	0	...

a And 24. *b* And 23. *c* And 14. *d* And 31. *e* And 22, 25. *f* And 10, 12. *g* And 12. *h* And 17. *i* And 8, 9.

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

METEOROLOGICAL NOTES ON JULY, 1890.

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.—A very wet month, with a phenomenal downpour on the 17th. This heavy fall laid the wheat extensively, and spoiled much hay. The excessively wet weather brought about the potatoe disease, and in some places the root crops are suffering from excessive R.

ADDINGTON.—Frequent R interrupted hay-making very much. A great quantity of hay was carried away by the large flood, resulting from the heavy R on the 17th. The nights were often very cold, 36° being registered on the grass once, and 37° twice.

BURY ST. EDMUNDS. WESTLEY.—Up to the 19th the weather was cold and very wet. The 2·70 in. recorded on 17th is the greatest fall registered in 24 hours since 1856, when observations commenced. The last part of the month was favourable for the corn crops, and helped them to recover from some of the damage caused by the exceptional R. Distant T on the 2nd.

LANGTON HERRING.—Another cold month, the weather throughout being very unsettled. On the 17th (the day of heavy R), only ·21 in. fell here. The mean temp. at 9 a m., 59°·9, was 3°·4 below the average, and the lowest in July for 19 years, with the exception of 1879. At 9 a.m. on 5th the temp. was only 52°, the lowest 9 a.m. reading in July for 19 years. Fog on several days.

BODMIN, FORE STREET.—A very wet, cold, and unseasonable month. T, L and heavy R on 16th.

WOOLSTASTON.—A dreary month, with cold nights and constant R, though there were no very heavy falls; most unfavourable for the hay crop, which was generally harvested in a damaged condition. Mean temp. 56°·9.

ORLETON.—The first 12 days very cold, the max. on no day reaching 70°, but the remainder of the month much warmer, there being only four days with a max. under 70°. Mean for the month about 1° below the average. The R again slightly below the average, making six months in succession with less than an average fall. T heard only on the 2nd. [In the table for June, the difference from the average should have been —·68 in. not + ·68 in.]

LEICESTER, BARKBY.—"Catchy" weather for hay-getting. Crops rather light. Not much sunshine. L and T on the 2nd. T on 3rd.

HULL.—The weather during the month was rather showery, with a great amount of cloud, and sometimes with strong winds.

WALES.

HAVERFORDWEST.—The first week was cold and gloomy with strong gales, ending with a heavy fall of R; the second week was milder, but constantly wet and damp with a fine day in between, so it continued up to the 21st; from that to the 24th the weather improved considerably, warmer days and warm nights, with several hours of bright sunshine. Up to the 28th the weather continued tolerably fine, from that to the end very wet weather prevailed, with warm days and nights. The temp. of the month was below the average, and only once reached 70°. The potatoes are rotting extensively. Corn crops likely to be light in grain from the great absence of heat and sunlight. Hay harvesting late and precarious. Prevailing winds W., S.S.W., and N.W. There were 17 nights with the temp. below 50°, ten were at or below 45°.

SCOTLAND.

CARGEN.—The mean temp. of the month 56°·2 is 3°·1 below the average. With the exceptions of 1888 and 1862, it is the lowest for July during 30 years. The first part of the month was unusually inclement, the mean temp. of the

first 12 days being only 54°. The max. temp. never reached 70°, which with the exception of 1862, has not occurred before in July. The atmosphere throughout was highly charged with moisture, the hygrometer showing a mean difference between the dry and wet bulbs of only 1°·7, the average difference being 2°·6. There was no day on which sunshine did not occur for one or more hours, but the total number of hours is 55 hours below the average. T on the 2nd, 3rd and 4th, and H showers on 3rd.

JEDBURGH.—The temp. was below the average, still vegetation went on well. Crops of all kinds being in fair condition and promising an abundant yield Health of the district very good.

CULLODEN.—Sunshine deficient, the hay crop suffering from the heavy rains, and harvest must be late.

IRELAND.

CORK.—Very changeable throughout, with cold winds and absence of sunshine. Mean temp. 59°·6, 2°·6 below the average of 14 years.

DROMORE.—A wet month, with very little summer weather. Very little prospect of turf fuel being got dry this year.

WATERFORD, BROOK LODGE.—The weather very broken all the month, and the temp. very low; mean 57°·5.

ROSS, O'BRIENSBRIDGE.—Very little sunshine, and vapour and fog even on days when no R fell. A bad month for hay.

DUBLIN.—A very unsettled, squally, showery, cool month. Rainfall, although frequent, perceptibly below the average.

OMAGH, EDENFEL.—Notwithstanding that R fell on 24 days, and that there was not a true "summer's day" during the month, the total fall is considerably under the average. A heavy crop of hay has been well saved, and all other crops promise great abundance.

PROF. HAZEN'S TABLES.

To the Editor of the Meteorological Magazine.

SIR,—I have been pleased at the kindly notice of my meteorological tables in the July number of this magazine. My agents in London are the well-known firm of W. Wesley, of Essex Street, Strand, and Hirschfeld Bros., from either of whom the book may be purchased.

As to rainfall conversions, I am inclined to think the table as given is more satisfactory than any table for single millimetres. It is a very simple matter, and very often more expeditious to work from the body of the table to the margin than *vice versâ*. I will give a few examples. To convert millimetres to inches between 1 and 400, enter body of Table xxxi. for mms. and the inches will be found in the margin, *e.g.*, 114 mm. = 4·49 in. : 2,563 mm. = 100·9 in. : 8,103 mm. = 319·0 in., &c. To convert inches to millimetres for values above 32 in., move the decimal point one place to the right in Table xxxi., *e.g.*, 38·6 in. = 980·4 mm. : 319·9 in. = 8,125·4 mm., &c. The same plan of use will help us in getting feet into metres, and kilometres into miles.

H. A. HAZEN.

July 29th, 1890.

[Prof. Hazen is fully entitled to express his opinion, but we retain our own; if tables are so handy when used in the reverse direction, it is not obvious why any are given both ways.—ED. *M.M.*]

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCXCVI.] SEPTEMBER, 1890. [PRICE FOURPENCE, or 5s. per ann. post free.

SUNBURN.

WHY do the pale denizens of cities become more rapidly brown in some localities than in others? This does not appear a very difficult question, and yet we are not sure that Dr. Bowles* has answered it perfectly. It is, of course, rash for any one not versed in physiology to even hint that a doctor may be wrong; and very possibly we shall have to pay the penalty and be one more proof of the proverb, which we prefer not to quote, as to certain persons entering where certain spirits are wiser. But we risk the penalty in order to obtain a certain and absolute reply to the question with which we began.

Dr. Bowles has for many years spent the early summer months (*i.e.*, before the majority of tourists go there, and before much of the snow is melted) in the Alps, and in the pamphlet we have quoted strings together his experience. On the very first page there is a paragraph which epitomizes so much that we quote it verbatim:—

"It will, I think, be readily conceded by Alpine climbers that sun on snow burns more quickly than on rocks or in the heated valleys at a lower elevation, although one may feel the heat more in the two latter situations; it is when one reaches the snow that one adopts veils, masks, and snow-glasses."

In order to put Dr. Bowles's case quite clearly, we must set out in as few words as possible the principal arguments and statements in the pamphlet. All persons, however, who desire to master the subject must go back to the pamphlet and read every word of it. Now for the epitome.

(1) Glass workers, iron workers, and many others exposed to intense heat do not suffer from sunburn.

(2) Although it is much hotter in valleys than on snow-covered mountains, sunburn is found only in the cooler place.

(3) One may lie long on one's back with the face exposed to the sun, and yet not become sunburnt; therefore heat alone is not the cause.

* "Sunburn on the Alps," by Robert L. Bowles, M.D., F.R.C.P. (Lond.) London, Stanford, 1890. 8vo., 20 pages.

(4) Dr. Tyndall said that he was never more burnt on Alpine snows than while experimenting with the electric light at the North Foreland, where the heat was not great, and there was no snow.

(5) A gentleman crossed the Findelen glacier to ascend the Findelen Rothhorn (11,214 ft.); he felt no inconvenience until he was near the top, and then for about ten minutes he was on new snow; in five minutes he began to feel sunburn, and in the evening the symptoms were fully developed.

(6) A gentleman and lady say that they were never more sunburnt than on a day without a gleam of sun, on which they ascended the Pigne d' Arolla (12,472 ft.). They were so enveloped in cloud that the guides nearly lost their way, and it was so cold that the lady's hands were blue and senseless.

(7) Dr. Bowles, in order to try the preservative effect of colour, painted his face brown, and on a brilliant day, when there was much snow, ascended the Gorner Grat (10,289 ft.), accompanied by about 80 persons out of the 100 staying at the Riffel Hotel. Everyone, except Dr. Bowles, who made the ascent suffered in the evening from sunburn, but he, and the 20 who had remained near the hotel, escaped.

(8) The Fijians, who usually paint their faces with red and white stripes, invariably blacken them when they go fishing on the reef in the full glare of the sun.

(9) On the Sikhim Hills the natives blacken the skin round their eyes to palliate the glare of the sun from fresh snow.

(10) Those who winter at Davos (5,105 ft.) become extremely brown, more so than those who are there in summer, unless the latter go above the snow line.

(11) Such portions of the wood of chalets, in lofty situations, as are protected from snow glare are a dirty white; those exposed to it are brown.

Dr. Bowles considers that—

(12) Heat *quâ* heat is not the cause of sunburn.

(13) Sunburn is probably due to ultra violet rays reflected from snow.

(14) Altitude alone does not explain sunburn; one may be free from it among rocks at 10,000 ft., and suffer on descending to 6,000 ft. among snow.

(15) Captain Abney finds an excess of violet or ultra violet rays at great altitudes, and thinks that sunburn depends largely on altitude.

(16) Prof. Langley thus describes his experience when climbing to the summit of Mount Whitney (15,000 ft.) :—

"In the desert at the bottom of the mountain the heat was found almost

unbearable—237° in the sun, and not much less in the tent.* And now come the points of interest in relation to my own observations on Sunburn. The desert sun had tanned the faces of the travellers to, 'a leather-like brown.' As they ascended they found the cooler air delightful, 'but soon,' says Professor Langley, 'the cooler it grew the more the sun burnt the skin—quite literally burnt, I may say, so that by the end of the third day my face and hands, case-hardened as I thought in the desert, began to look as if they had been seared with red-hot irons, here in the cold where the thermometer had fallen to freezing at night; and still as we ascended the paradoxical effect increased; the colder it grew about us, the hotter the sun blazed above. We have all heard probably of this curious effect of burning in the midst of cold, and some of us may have experienced it in the Alps, where it may be aided by reflection from the snow, which we did not have about us at any time except in scattered patches; but here by the end of the fourth day my face was scarcely recognizable, and it almost seemed as though sunbeams up here were different things, and contained something which the air filters out before they reach us in our customary abodes. Radiation here is increased by the absence of water vapour too, and on the whole this intimate personal experience fell in almost too well with our anticipations that the air is even a more elaborate trap to catch sunbeams than had been surmised, and that this effect of selective absorption and radiation was intimately connected with that change of the primal energies and primal colour of the sun which we had climbed towards [it] to study.'"

We have already intimated that we criticize this pamphlet chiefly in order to elicit further information, and with perfect readiness—nay, desire—to be corrected where we go wrong.

As regards **2** it is as well explained by **15** as by **13**.

As **3** is a distinct statement, we cannot say more than that we were not previously aware of it.

How does the author reconcile **4** and **6** with **13**?

8 does not seem to show more than that precautions are necessary where there is no snow.

Considering the difference between a man's face and a fir plank, the support derived from the fact stated in **11** does not seem great.

* Feeling sure that this statement required explanation, we have obtained a copy of the lecture given by Prof. Langley at the Royal Institution, which Dr. Bowles has paraphrased in the above words. But he has not quite caught the facts as then stated by Prof. Langley, who said, "Close by these tents a ther-"mometer, covered by a single sheet of glass, and surrounded by wool, rose to "237° in the sun, and sometimes in the tent which was darkened for the "study of separate rays, the heat was absolutely beyond human endurance." The temperature in such a box proves little; we have seen it above 212° in England, and from an examination of Prof. Langley's official report, we fancy that he was quoting from memory, mixing up his low level and high level observations, and giving the reading of 236° which occurred, not at Lone Pine 3760 ft., but at Mountain Camp, 11,625 ft. above sea level, and when the air temperature was only 60°·8! That it was very hot in the dark tent at the low level station at Lone Pine we do not doubt, but the highest shade temperature that we can find recorded there was 91°·5 at 0·35 p.m., on August 20th, 1881, when the wet bulb (with a bad covering) read 61°·4, so that the air was extremely dry, and therefore the heat would not be serious—of course, in a dark tent it would be uncomfortable.

14 and **15** do not agree, and **16** (when toned down to less vivid language) implies that sunburn may be due to (A) the direct heating rays of the sun, (B) increased altitude, or (C) increased dryness.

We are not quite clear as to what the author calls sunburn, because sometimes he seems to imply merely the browning of the skin, at other times he refers to "face . . . immensely swollen, red and painful . . . all covered with yellow blisters." When these blisters peal off, is the new skin brown?

BROCKEN SPECTRE IN THE LAKE DISTRICT.

RETURNING yesterday, August 27th, from an ascent of Scawfell Pike with my friend Charles James Spence, of Newcastle, and our sons, we were witnesses of a rare and striking spectacle. It had rained doggedly for two hours during our descent on the Piers Ghyll side, heavy clouds beneath us obscuring the valley. Taking the most direct line for Buttermere, we went over the summit of Base Brown, 2,100 ft., by which time the rain had ceased. The mist clouds were rising and curling majestically up the sides of the mountain ranges around us, and when the sunlight, almost suddenly, at 6.15 p.m., shot through a break in the clouds, above Brandreth on our west, we all at once observed a circular double rainbow athwart the mist-cloud on the opposite, or Borrowdale, side of us. The colours were perfect, although not particularly brilliant; and the two rings of each series of colours were complete. The figures of our party were represented in shadow right across the double rainbow circle, considerably magnified, and every movement we made of our arms and legs, and the waving of our hats and waterproofs, was pantomimically repeated by our gigantic and glorified counterparts. This exciting spectacle lasted about six or seven minutes.

I have been tolerably familiar with Cumberland mountain scenery for the last forty years, and have made many ascents at all times of the day and night, but this is the first time I have witnessed this beautiful phenomenon, and as it is rare, it may be worth while to place it on record.—EDMUND PROCTOR, Loweswater, Cockermouth. —*Pall Mall Gazette.*

ERRATA IN "METEOROLOGICAL MAGAZINE," 1889.

REGULAR TABLE.

Strathfield Turgis,	Nov., should be...	...	·84 in.
Boston,	March, ,, ,, ...	...	2·17 ,,
Wetherby, Ribston Hall,	July, ,, ,, ...	...	1·69 ,,
Lochgilphead, Kilmory,	Dec., ,, ,, ...	...	7·96 ,,

SUPPLEMENTARY TABLE.

Wakefield	July, should be...	...	1·51 in.
,,	Aug., ,, ,, ...	...	3·56 ,,
,,	Nov., ,, ,, ...	...	·75 ,,
Llanfrechfa Grange,	May, ,, ,, ...	...	3·86 ,,
New Galloway, Glenlee,	Sept., ,, ,, ...	...	2·07 ,,
Tipperary, Henry Street,	Jan., ,, ,, ...	...	2·99 ,,
Galway, Queen's College,	Jan., ,, ,, ...	..	3·72 ,,
,, ,, ,,	April, ,, ,, ...	...	2·01 ,,

TWO TORRENTIAL RAINS ON AUGUST 19TH.

To the Editor of the Meteorological Magazine.

SIR,—We have had another heavy rain in this locality which you may be glad to hear of. It lasted about the same time as the July rain, but came down more in heavy storms than that rain, though it did not, I believe, cease raining all the time. It began a little before seven on the evening of the 19th, and continued to about 5 a.m. on the 20th. Here I registered 2·34 in.; at the Abingdon Sewage Farm, a quarter of a mile west of this, 1·85 in.; at Long Wittenham, one gauge 1·50 in., the other 1·58 in.; at Milton Hill, about three miles south, just under the Berkshire downs, 3·80 in. was registered, but unfortunately the gauge overflowed, but not, it is believed, to any great extent. I imagine that the heavy rainfall must have been very local, as the weather reports do not speak of any heavy rainfall.—I am, yours faithfully,

F. C. CLUTTERBUCK.

Culham Vicarage, Abingdon, August 22nd, 1890.

SIR,—The rainfall at Upminster, both for July and August, was over 4½ inches, but on only one occasion did we get the fringe of what you describe as "torrential" rain, viz., August 19th, when 1·47 in. fell in about two hours; but a mile north, in a band between Brentwood and Harold Wood, stretching from Little Warley to Noak Hill, the fall was greater than I have ever seen, and even now some of the roads are like a sea beach or the beds of mountain torrents. The rain fell in short, sharp showers, with large hot drops, and even on the sides of some of the hills was running nearly two inches deep. On my way home there was no rain at Ilford, and at Romford only a little, while at Harold Wood the water was running down the line (G.E.R.), washing the sleepers out. I could only just get over the Ingrebourne at Harold Wood, and a little farther on the water came up to the bottom of my cart, and the roar of the water and rain was so great that I could scarcely hear the thunder. About half a mile on I went out of the storm like going out of a wall of water. I know of no rain gauge in this district, but a visit to the district even now would convince you that my story is not overdrawn.—Yours faithfully,

G. P. HOPE.

Upminster Hall, Essex, September 4th.

N.B.—In some places the water rose above the marks of August 1st, two years ago.

AUTUMN CONGRESSES.

FOR some persons there is no peace. Three autumnal congresses have already been held, at each of which meteorological subjects have been discussed.

The Association Française met at Limoges, under the presidency of one of the greatest physicists of the present day, Prof. Cornu, who delivered one of those delightful addresses for which he has an unequalled reputation. We have not a complete list of the members present, but we see that Prof. Ragona, of Modena, and Mr. Lawrence Rotch, of the Blue Hill Observatory, were there as Honorary Presidents, M. Leon Teisserenc de Bort as President, and Dr. Fines as Vice-President, so that it was evidently a strong, if not large gathering. As we understand that the papers and proceedings will be reported in our contemporary the *American Meteorological Journal*, we refer our readers to its pages, as it is unwise to set up the same details in both journals.

The Sanitary Institute held its Congress at Brighton, and naturally a paper on the climate of that excellent health resort was among the best sent in—from it we have drawn up the following abstract.

On "The Climate of Brighton," by F. E. SAWYER, F.S.A.

TEMPERATURE.

The proximity of Brighton to the sea affects its climate in three ways :—

1. By reducing the mean daily range of temperature.
2. By raising the temperature in the winter months.
3. By lowering the temperature in the summer months.

The appendix to this paper contains a summary of meteorological observations for more than twenty years. From Table I. it will be seen the mean daily range of temperature yearly was 11·8 deg.; being 15·9 deg. in June, diminishing to 7·7 deg. in January. These daily ranges are of course small compared with those of inland places. The lowest temperature was 11·4 deg. on January 22nd, 1881 (the time of "the great snow-storm"). On the 15th of that month the min. temp. was 15·5 deg.; on the 17th, 16·7 deg.; and the 20th, 17·3 deg. With the exception of these four days no lower temperature than 18 deg. was recorded, viz., in December, 1870 (the winter of the Franco-Prussian War). This clearly shows the influence of the sea, as in the interior of the country we find the temperature fell below zero at many places. Fashion has, perhaps, somewhat empirically, fixed the Brighton season for the period from the end of September to the middle of December; and it is a curious fact that it is then that the advantages of Brighton are most apparent, the chills of autumn being avoided, and the mean

temperature in excess of that at Greenwich, as will be seen by the following table :—

MEAN MONTHLY TEMPERATURE.
(arithmetical mean daily max. and min. temperatures.)

	BRIGHTON. deg.	GREENWICH. deg.	DIFFERENCE. deg.
September	58·0	56·6	— 1·4
October	50·4	49·5	— ·9
November	43·8	42·4	— 1·4
Mean	50·7	49·5	— 1·2

The mitigating influence of the sea on the heat of summer is proved by the fact that the temperature has not risen above 90 deg. The highest in my own register during twenty-three years, being 86·7 deg. on July 17th, 1868. During the summer months the well-known phenomena of the land and sea breezes are particularly noticeable at Brighton, the most marked being the easterly. The land breeze N.E. or E. blows until from 10 to 11 a.m., and a morning will open very sultry and oppressive until the cool sea breeze sets in. This lasts until sunset, or sometimes until midnight, when the land breezes begin again. A cool and comfortable day is thus enjoyed, even in the height of summer. When these breezes are westerly, the land breeze is from N.W. or W., and the sea breeze from the S.W. or S., occasionally S.E. Sometimes the land breeze begins in N.E., is followed by S. or S.W. sea breeze and then a N.W. or N. land breeze again, or the reverse way, but this is not often.

The mean temperature of the year (arithmetical mean of daily max. and min. temperatures) is 49·8 deg., the monthly means ranging from 63 deg. in July to 38·8 deg. in January. The warmest month in the last twenty-three years was July, 1868, with a mean of 66·8 deg., and the coldest January, 1881, with one of 33·2 deg.

WIND.

The climate of Brighton has been classed amongst the *bracing*, but this must be from the fact that its pure air is almost always in motion rather than from any lowness of temperature, which, as already seen, is not experienced here.

From September, 1872, to December, 1874, the velocity of the wind was recorded by a Robinson's anemometer, erected at the Chain Pier-head, Brighton ; and from the observations of twenty-seven months it appears that the mean horizontal distance travelled by the wind daily during that period was 329 miles, or 13·7 miles per hour, so that there is no lack of fresh air.

RAINFALL.

The mean annual rainfall of twenty years was 28·35 inches ; and, as will be seen by Table III., the most rainy month is November, with a total of 3·40 inches ; and the driest March, with 1·67 inches.

The greatest fall in twenty-four hours was 1·99 inches, on June 22nd, 1876, being the largest recorded by any observer in Brighton. It is somewhat remarkable that no heavier fall of rain has occurred, but it may be due to the fact that the town is very free from thunderstorms.

(To be continued).

THUNDERSTORM, AUGUST 2ND.

To the Editor of the Meteorological Magazine.

SIR,—I now give you an account of a singular storm of which I was witness on August 2nd (Saturday last). It threatened rain, and thunder was heard at 3 p.m.; but that storm passed by, and I ordered the carriage to take me to a neighbour's about six miles off this place to the S.W. The house stands on an eminence, and the window of our room faces almost due N. From this window, about 5 p.m., I watched the approach of a fresh storm. The view commanded about three miles of plain, backed by wooded high ground. Having passed this high ground, the cloud swept on exactly like a black pall trailed over the surface of the ground. In front of it, and rising from the ground, was a sparse white cloud, which I took to be smoke. It was not, however, smoke, but vapour, for when the storm had passed on to be exactly over the house there showed in front of it a quantity of white curling vapour not more than 100 feet high. The rain was violent, and there were some claps of thunder, the lightning being vivid and *red*, as it always is when seen through vapour.

I account for the smoke-like vapour thus :—Just before, at 3 p.m., as I said, there had been a copious shower, followed by bright sunshine, which permitted of rapid evaporation of all the drops that hung in the vegetation. Then, when the air was full, during the bright sunshine, of invisible vapour, came the dark thick thundercloud, which suddenly reducing the temperature, caused the ascending vapour to become visible, and so seemed to swallow it up and carry it on with it, filling up the usual space between the ground and a cloud with newly-formed visible vapour.

The rainfall with us was not great for both showers together, 0·16 in. only.—Yours truly,

JOHN SLATTER.

Whitchurch (Oxon.), near Reading, August 8th, 1890.

REMARKS ON THE DISCUSSION CONCERNING BAROMETRIC DEPRESSIONS.

To the Editor of the Meteorological Magazine.

SIR,—Prof. Hazen's letter has suggested to me the following calculation, which may perhaps interest some of your readers :—

A fall of 1·00 inch of rain supplies a little over 5 lbs. of water to each square foot of surface, and the latent heat set free by the condensation of this water at ordinary temperatures is about 5,000 thermal units. Taking Joule's mechanical equivalent of heat as 772 foot pounds, we get the large amount of 3,860,000 foot pounds of energy set free over every square foot of the earth's surface on which rain falls to the depth of 1·00 in. The weight of air resting on each square foot is about 2,100 lbs. ; and thus, if the whole energy were used in imparting motion to this air, we should get the extreme velocity of about 240 miles per hour in the whole mass of air resting upon the rainfall area. For a velocity of 60 miles per hour, which is seldom exceeded in our most violent gales, only $(\frac{1}{4})^2$ of 1·00, that is, less than ·07 in. of rain, is required.

No doubt the whole of the energy set free does not take the form of direct motion ; but a large part of it must go to raising the temperature of the air, or perhaps it should be said, to counteracting the fall of temperature which causes the rain ; still, considering the small proportion of the energy that is required, even when the rain which accompanies the cyclone is moderate, it is strange that anyone should say that the cause is incapable of producing the effect.

Of course, it does not follow that because the cause assigned by Prof. Ferrel is capable of producing the effects, it must therefore be the actual cause, but it seems only reasonable to suppose that when such a large supply of energy is afforded by the condensation of vapour, some small part of it should take the form of kinetic energy and appear as wind, and I agree with Mr. Clement Ley in thinking that the indications of Prof. Ferrel's theory being the true one are unmistakable.

W. H. DINES.

SIR,—Some of your readers will, I hope, be grateful to me for having, by the mention of his name, elicited a letter from Prof. Hazen. It is common and natural that those who are in a minority should deny that their arguments "have had full attention paid to them." For my own part, I have given much attention to Prof. Hazen's publications, and I do not think that all his arguments should be "ignored as unworthy of attention." That he sometimes makes a statement which is not strictly permissible to a scientific man, and which even reads like one of the expressions of the opponents of science, is shown by the last sentence of his letter in this Magazine for August, 1890, p. 101. The law on which Ferrel's theory is chiefly based has been rightly stated by Messrs. Davis and

Curry to be "thoroughly in accord with well-tried physical principles; it has been abundantly tested by experiment, both on a small scale in the laboratory and, as we may say, on a large scale in nature; it is universally accepted by men eminent in physical study, whose original ability and careful studious work have led them to be regarded as authorities in their science, but who, being authorities, have not thereby become arbitrary and irrational. It is therefore difficult to understand why the question should be so confused by Hazen, as appears in his recent articles."

I did not, as it happens, either state or imply that the work of W. Ferrel is "fundamental and conclusive," but I implied and unhesitatingly state that no one at the present day can expect to receive attention on the subject of the formation of barometric depressions who has not given full attention to Ferrel's writings. Prof. Hazen says that I ought to have mentioned that Ferrel is "second in the field," because he draws largely (as does every scientific man) from the works of his predecessors. Ferrel derives many ideas not only from numerous cis-Atlantic predecessors, but perhaps especially from Espy, to whose work he refers not fewer than ten times in his latest treatise. Prof. Hazen himself gives a specimen of one of such references: and a student who, following my advice, reads Ferrel's works, will find this out for himself, even supposing him actually to have never heard of the "Philosophy of Storms" before. Prof. Hazen would, I presume, think it unjust to recommend the study of the works of the greatest living mathematicians, unless he at the same time mentioned Lagrange?

There is one remark of Prof. Hazen's which is suggestive. He speaks of the "inwardness" noticeable in American meteorologists. If he means that most of them give undue prominence to American sources of information, he ought, I think, to except Ferrel. If, on the other hand, he means that some of them (*pre-eminently and beyond all other men* Ferrel himself) combine with the studious collection of observations and thorough sifting of *objective* facts abundance of *subjective* and intellectual reasoning and careful mathematical demonstration, I for one cordially agree with him. The same may be said of many of our great continental meteorologists. I wish it were equally true of ourselves. To make, collect, and pigeon-hole as many observations as possible seems to be the sole object of many whom we term "meteorologists" in England. But this fact would not of itself deter many of our own ablest mathematicians from the study of meteorological problems. It is the unfortunate fecundity of pet theories, propagated by those who think a little but who do not read at all, belonging to a race which is somewhat lazy and, from a linguistic point of view, very "inward" indeed, which has lent a deterrent aspect of quackery to a most interesting branch of science. Let me take a single example from the discussion I have roughly reviewed. One writer, who is ostentatiously and professedly a non-reader, supposes our anti-cyclones and cyclones to result from air-

waves with interspaces between them, flowing polewards from the equatorial regions, unobserved over the trades, and (as I presume) the monsoons, unobserved over the tropical belts of high pressure, spreading themselves out laterally (over converging meridians), and causing our changes of pressure and weather—(*Met. Mag.*, July, 1890, p. 86)—and he both imagines this idea to be new, and apparently thinks it altogether the better for being new! How rarely do we meet with an English Guldberg, Mohn, Reye, Hann, Köppen, Woeikoff, Sprung, Ekholm, Vettin, Van Bebber, Hertz, or Helmann! How few are the meteorological treatises by an English Helmholtz. And I might well multiply names, not of *absolute authorities*, but of important writers. If the cause of this our great lack be what I suppose, we should endeavour to remedy it.—Yours truly,

W. CLEMENT LEY.

HAILSTORM, AUGUST 24TH.

SIR,—A somewhat remarkable hailstorm occurred here yesterday evening. Having been, in this locality, unaccompanied by thunder and lightning, it will not be reported in thunderstorm observations; but it was in some respects phenomenal. The day had been on the whole fine, but with passing showers, and many Cumulo-Nimbi. The min. temp. of the previous night had been very low, 40·°0 at a height of five feet from the ground. The cloud formed apparently at a short distance N.W. of the town, and rapidly increased in size and extent. Large drops of rain began to fall about 5.25 p.m., which soon changed to hail, which fell with extraordinary persistency for quite 15 minutes. The stones were of a uniform size, the largest the size of large peas. The lawn was quite white, and remained so for some time after the hail ceased, notwithstanding heavy rain, which lasted intermittently till after 6.30 p.m. The stones were drifted several inches deep in the corners of windows facing the storm. The characteristic of the storm was more that of the soft hail frequent in the spring months than of a summer thunderstorm; and this was fortunate, or from the thickness with which the hail fell, the damage would have been enormous. As I said before, no electrical phenomena occurred here, though I see that in London there was a violent thunderstorm. The shower was quite local. The evening, after 7 p.m., was clear and cold, barometer nearly steady at 29·67 in.; total fall of rain during the storm, 0·65 in., and during the 24 hours ending at 9 a.m. to-day, 0·68 in.—Your truly,

C. N. PEARSON.

24, Portland Place, Reading, August 25th, 1890.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, FEB., 1890.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	TotalRain. Depth.	TotalRain. Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		0-10
England, London	49·3	1	27·1	28	43·4	33·2	34·2	87	83·4	21·8	1·05	9	6·6
Malta	67·1	20	42·7	13	59·6	49·9	46·5	80	121·2	38·9	5·14	10	5·5
Cape of Good Hope	92·0	14*a*	50·0	1	78·4	59·9	...	...	...	...	1·27	...	3·8
Mauritius	84·0	19	68·6	2	81·8	73·0	70·8	83	138·7	63·1	11·02	27	6·4
Calcutta	90·8	26	50·7	12	83·5	59·5	58·6	67	143·4	40·5	·00	0	0·7
Bombay	89·6	22	67 6	4, 9	85·2	70·6	66·2	67	138·6	54·8	·00	...	0·7
Ceylon, Colombo	90·5	10	69·3	8	87·3	72·3	69·2	74	145·0	63·7	4·36	10	3·4
Melbourne	103·4	6	52·5	24	82·0	60·4	56·4	63	152·3	43·5	·56	5	5·3
Adelaide	97·4	2	56·0	9	85·0	64·0	56·4	54	162·0	47·4	1·93	3	3·3
Wellington	82·0	10	43·0	9	71·4	54·7	51·9	67	139·0	34·0	·24	5	3·7
Auckland	82·0	11	52·0	3	76·4	60·2	54·2	61	147·0	46·0	·07	3	3·7
Jamaica, Kingston	89·1	25	60·2	4	86·9	64·2	65·9	74	...	...	·37	...	...
Trinidad	88·0	25	62·5	12	85·1	66·0	66 6	78	157·0	60·0	·51	6	...
Toronto	53·8	4	3·0	21	35·6	19·7	25·5	85	...	0·0	3·48	22	8·2
New Brunswick, Fredericton	47·8	...	—20·9	...	27·6	2·1	16·3	75	...	...	4·17	13	4·9
Manitoba, Winnipeg	35·3	13	—36·4	26	5·7	—19·1	—1·5	97	...	...	·82	11	4·7
British Columbia, Victoria	49·0	5	12·0	26	29·0	28·9	...	...	...	...	2·33	10	...

a And 22.

REMARKS, FEBRUARY, 1890.

MALTA.—Mean temp. 54°·1; mean hourly velocity of wind 12·7 miles. Sea temp. fell to 58°·9. TSS on 5 days; L on 8th; H on 3rd, 7th and 12th; R nearly four times the average. J. SCOLES.

Mauritius.—Mean temp. of air 1°·4 below, of dew point 0°·8 above, and R 4·81 in. above, their respective averages. Mean hourly velocity of wind 7·9 miles, or 3·3 miles below average; extremes, 21·2 on 17th, and 1·7 on 1st; prevailing direction of wind, E.S.E. to E. by N. T and L on six days; T on three days, and L on two days. C. MELDRUM, F.R.S.

CEYLON, COLOMBO.—Thunderstorms occurred on three days, and L was seen on five other days. J. C. H. CLARKE, Lt. Col. R.A.

Melbourne.—Mean temp. of air 4°·8, and of dew point 3°·2 above average. Humidity 3, and R 1·36 in., below average. Prevailing direction of wind S.E. and S. Strong on eight days. The weather during the greater part of the month was very sultry and hazy, and during the earlier part, at times very oppressive. L in S.W., and W. on the evening of the 12th. R. L. J. ELLERY, F.R.S.

Adelaide.—Continued hot weather during the first part of the month, then comparatively mild; mean temp. 0°·7 above the average of 33 years; mean pressure slightly below average. C. TODD, F.R.S.

Wellington.—Very fine weather during this month, with little rainfall. Prevailing winds S.E. and S., strong on three days from N.W. Mean temp. 0°·6 above the average. R less than one twelfth of the average. R. B. GORE.

Auckland.—A fine, hot, and almost rainless month. Bar. slightly above the average. Mean temp. 1° above the average; R almost nil, and the least ever recorded for any month in Auckland. T. F. CHEESEMAN.

TRINIDAD.—R 1·30 in. below the average of 25 years. J. H. HART.

SUPPLEMENTARY TABLE OF RAINFALL, AUGUST, 1890.

[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 Hall.	3·02	XI.	Castle Malgwyn	2·69
,,	Margate, Birchington...	3·70	,,	Builth(Llanwrtyd Wells)	6·40
,,	Littlehampton	2·52	,,	Rhayader, Nantgwillt..	7·08
,,	Hailsham	3·95	,,	Carno, Tybrith	5·57
,,	Ryde, Thornbrough	3·99	,,	Corwen, Rhug	4·80
,,	Alton, Ashdell.....	3·53	,,	I. of Man, Douglas	3·84
III.	Oxford, Magdalen Col...	2·26	XII.	Stoneykirk, Ardwell Ho.	2·94
,,	Banbury, Bloxham	1·98	,,	New Galloway, Glenlee	3·09
,,	Northampton	1·60	,,	Melrose, Abbey Gate...	4·95
,,	Cambridge, Fulbourne..	1·33	XIII.	N. Esk Res. [Penicuick]	5·60
,,	Wisbech, Bank House..	2·07	XIV.	Ballantrae, Glendrishaig	2·34
IV.	Southend	2·83	,,	Glasgow, Queen's Park.	3·16
,,	Harlow, Sheering	2·78	XV.	Islay, Gruinart School..	5·10
,,	Rendlesham Hall	2·05	XVI.	Dollar.....	2·80
,,	Diss	2·44	,,	Balquhidder, Stronvar..	3·66
,,	Swaffham	2·63	,,	Coupar Angus Station..	2·05
V.	Salisbury, Alderbury...	2·62	,,	Dunkeld, Inver Braan..	2·36
,,	Warminster	2·73	,,	Dalnaspidal H.R.S. ...	4·18
,,	Bishop's Cannings	2·36	XVII.	Keith H.R.S.	4·78
,,	Ashburton, Holne Vic....	...	,,	Forres H.R.S.	4·55
,,	Hatherleigh, Winsford.	3·31	XVIII.	Fearn, Lower Pitkerrie.	3·76
,,	Lynmouth, Glenthorne.	4·11	,,	Loch Shiel, Glenaladale	9·82
,,	Probus, Lamellyn	3·52	,,	N. Uist. Loch Maddy ...	3·66
,,	Launceston, S. Petherwin	4·00	,,	Invergarry	4·07
,,	Wincanton, Stowell Rec.	3·12	,,	Aviemore H.R.S.	2·89
,,	Taunton, Lydeard Ho...	...	,,	Loch Ness, Drumnadrochit	3·25
,,	Wells, Westbury.....	2·92	XIX.	Lairg H.R.S.	3·42
VI.	Bristol, Clifton	2·93	,,	Scourie	6·14
,,	Ross	2·92	,,	Watten H.R.S.	3·83
,,	Wem, Clive Vicarage ...	3·13	XX.	Dunmanway, Coolkelure	3·95
,,	Cheadle, The Heath Ho.	3·56	,,	Fermoy, Gas Works ...	1·79
,,	Worcester, Diglis Lock	2·44	,,	Tipperary, Henry Street	2·86
,,	Coventry, Coundon	2·98	,,	Limerick, Kilcornan ...	2·60
VII.	Ketton Hall [Stamford]	1·76	,,	Miltown Malbay.....	4·77
,,	Grantham, Stainby	2·26	XXI.	Gorey, Courtown House	2·61
,,	Horncastle, Bucknall ...	1·65	,,	Navan, Balrath	3·68
,,	Worksop(Hodsock Priory)	2·15	,,	Mullingar, Belvedere ...	2·93
VIII.	Neston, Hinderton	4·30	,,	Athlone, Twyford	2·62
,,	Knutsford, Heathside ...	3·85	,,	Longford, Currygrane...	3·04
,,	Lancaster, South Road.	6·57	XXII.	Galway, Queen's Coll...	2·86
,,	Broughton-in-Furness ..	6·90	,,	Clifden, Kylemore	4·59
IX.	Wakefield Prison	3·41	,,	Crossmolina, Enniscoe..	4·36
,,	Ripon, Mickley	5·12	,,	Collooney, Markree Obs.	5·04
,,	Scarborough, West Bank	3·87	,,	Ballinamore, Lawderdale	3·98
,,	East Layton[Darlington]	5·39	XXIII.	Warrenpoint	2·87
,,	Middleton, Mickleton..	5·63	,,	Seaforde	3·05
X.	Haltwhistle, Unthank..	6·54	,,	Belfast, New Barnsley..	3·58
,,	Shap, Copy Hill	5·71	,,	Bushmills, Dundarave...	4·69
XI.	Llanfrechfa Grange	3·46	,,	Stewartstown	3·08
,,	Llandovery	4·77	,,	Buncrana	5·20

AUGUST, 1890.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1880–9	Greatest Fall in 24 hours. Dpth	Greatest Fall in 24 hours. Date.	Days on which ·01 or more fell.	TEMPERATURE Max. Deg.	Max. Date	Min. Deg.	Min. Date	No. of Night below 32° In shade.	No. of Night below 32° On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	1·55	— ·33	·40	19	13	79·7	5	40·4	31	0	0
II.		Maidstone (Hunton Court)...	2·49	+ ·80	·68	26	14	...	...	...	...	...	...
,,		Strathfield Turgiss	2·31	+ ·60	·81	19	14	78·8	5	36·0	30	0	1
III.		Hitchin	2·03	+ ·21	·43	19	18	75·0	5	39·0	31	0	...
,,		Winslow (Addington)	1·99	+ ·02	·32	26	16	80·0	5	34·0	30	0	1
IV.		Bury St. Edmunds (Westley)	2·20	·00	1·15	10	13	...	...	...	...	...	...
,,		Norwich (Cossey)	1·87	...	·57	10	14	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	2·19	+ ·26	·58	9	20	73·0	9, 12	45·0	30	0	...
,,		Barnstaple	3·03	+ ·07	·97	9	17	77·0	8	45·0	29	0	...
,,		Bodmin (Fore Street)	3·62	+ ·77	·47	9	20	...	...	...	...	...	...
VI.		Stroud (Upfield)	2·82	+ ·73	·85	9	18	79·0	6	39·0	29	0	...
,,		ChurchStretton(Woolstaston)	4·16	+ 1·40	·91	1	20	72·0	4	42·0	30	0	...
,,		Tenbury (Orleton)	2·79	+ ·67	·38	10	19	77·3	4	33·8	30	0	1
VII.		Leicester (Barkby)	2·59	+ ·15	·57	22	21	87·0	5	31·0	31	2	4
,,		Boston	1·15	+ ·97	·32	10	15	87·0	5	41·0	30	0	...
,,		Hesley Hall [Tickhill].....	2·68	+ ·52	1·02	10	18	80·0	5	38·0	31	0	...
VIII.		Manchester(PlymouthGrove)	4·52	+ 1·43	·66	10	18	77·0	4, 5	37·0	29*c*	0	2
IX.		Wetherby (Ribston Hall) ...	4·44	+ 2·10	·94	11	12	...	...	...	...	...	...
,,		Skipton (Arncliffe)	7·12	+ 2·79	1·09	22	22	78·0	5	33·0	31	0	...
,,		Hull (The Park)	3·12	+ ·48	·52	10	18	...	...	...	...	...	...
X.		North Shields	5·73	+ 2·89	2·21	13	17	78·5	4	...	...	...	...
,,		Borrowdale (Seathwaite).....	9·79	+ 1·34	1·36	15	20	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	3·58	— ·03	·81	9	18	...	...	...	...	...	...
,,		Haverfordwest	2·95	— ·23	·76	9	17	73·6	7	35·0	29	0	3
,,		Plinlimmon (Cwmsymlog) ...	5.57	...	1·00	22	17	...	...	...	...	...	...
,,		Llandudno.....	3·95	+ 1·59	·92	10	19	72·9	4	43·5	30	0	...
XII.		Cargen [Dumfries]	3·08	+ ·09	·74	14	20	73·0	4	33·4	31	0	...
,,		Jedburgh (Sunnyside).....	...	...	...	...	...	...	...	...	...	...	...
XIV.		Old Cumnock	3·45	+ ·03	·44	22	19	77·5	7	31·0	30	1	...
XV.		Lochgilphead (Kilmory).....	4·86	+ ·30	·75	15	22	...	...	37·0	30	...	...
,,		Oban (Craigvarren)	4·90	...	·94	4	19	70·3	10	41·6	31	0	...
,,		Mull (Quinish).....	5·88	+ 1·73	·97	4	20	...	...	...	...	...	...
XVI.		Loch Leven Sluices	3·00	+ ·06	1·00	13	12	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	2·65	+ ·08	·50	24	16	72·2	5	37·9	31	0	...
XVII.		Braemar	3·49	+ ·16	·95	12	21	70·2	5	31·7	31	1	3
,,		Aberdeen (Cranford)	3·28	...	·86	15	26	78·0	5	38·0	28*d*	...	...
XVIII		Strome Ferry.....	6·01	+ 1·34	·91	5	26	72·0	9, 10	39·0	31	0	...
,,		Inverness (Culloden)	3·74	+ 1·74	1·32	27	...	71·0	4, 10	37·0	31	0	1
XIX.		Dunrobin	3·46	+ 1·06	·87	26	16	70·0	16	42·5	31	0	...
,,		S. Ronaldsay (Roeberry).....	2·58	+ ·02	·43	15	20	67·0	4	44·0	30*c*	0	...
XX.	IRELAND.	Cork (Blackrock).....	1·92	— 1·40	·40	1	13	76·0	4	40·0	30	0	...
,,		Dromore Castle	4·65	— ·33	·60	17	19	70·0	18	42·0	30	0	...
,,		Waterford (Brook Lodge) ...	2·18	— 1·24	·31	9	21	70·0	7	39·0	29	0	...
,,		O'Briensbridge (Ross)	2·97	...	1·02	22	18	78·0	3*a*	44·0	31	0	...
XXI.		Carlow (Browne's Hill)	2·70	— ·27	·58	22	17	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	2·80	+ ·28	·85	22	19	74·8	4	41·5	31	0	0
XXII.		Ballinasloe	2·86	— ·32	·76	22	20	70·0	4*b*	35·0	31	0	...
XXIII		Waringstown	2·53	— ·58	·41	10	17	79·0	7	36·0	30	0	2
,,		Londonderry (Creggan Res.).	6·48	+ 2·36	1·40	14	25	..	...	...	...	...	...
,,		Omagh (Edenfel)	4·74	+ 1·25	·72	27	20	73·0	8	41·0	29	...	...

a And 4, 5, 6, 7, 8. *b* And 7, 8. *c* And 31. *d* And 29, 31.

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

METEOROLOGICAL NOTES ON AUGUST, 1890.

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.

LONDON, CAMDEN SQUARE.—*Erratum*:—Min. temp. for July 42°·4 on 12th, not 45°·1 on 4th as printed.

STRATHFIELD TURGISS.—A cold uncanny month, savouring much of autumn. With the exception of a few fine summer days from the 3rd to the 6th, the temperature was low with strong winds, and heavy rains. From the 19th the thermometer was but little above 60°. Harvest operations were seriously retarded, and the corn much damaged by the wind and R. The close of the month was very cold and unseasonable, but brighter. The first frost on the grass (31°·7) occurred on the 30th. Sharp TS on the 2nd.

ADDINGTON.—A good deal of unsettled weather occurred during the month. The 5th was the only really hot day being the only one on which the temp. in shade rose above 75°. Towards the end of the month the nights were very cold, the min. on grass falling to 31° on 30th. Heavy TS from 4 to 5 p.m. on 2nd and another on 11th.

BURY ST. EDMUNDS, WESTLEY.—The month was a cold one, the 1st and 5th being the only hot days. A very heavy R of 1·15 in. fell on the 10th, with distant T. Although R fell on 13 days, the quantities were small, and being accompanied by drying winds, most of the corn was harvested in good condition.

LANGTON HERRING.—This month like the preceeding two months was wet and cold. The mean temp. at 9 a.m. being 2°·2 below the average. The long continuance of wind from W. S.W. was noticeable. T and L on 9th, 18th and 27th.

BODMIN, FORE STREET.—On the 9th, between 9.30 and 10.30 p.m., a storm of incessant L, loud T, and a downpour of R occurred. A very cold month for August, with many rainy days. Splendid weather during] the last four days. Sharp frost on the morning of 30th.

STROUD, UPFIELD.—TS at 4 a.m. on the 19th; three or four vivid flashes of L, and a tree struck. Slight T at 9 a.m. on 16th.

WOOLSTASTON.—Another cold and sunless month, with frequent R; very prejudicial to the corn harvest. T and L on 1st and 15th. Mean temp. 56°·7.

ORLETON.—The first half of the month was very warm and pleasant, but the remainder was cold with much R, the mean temperature being nearly 1° lower than the average, though rather above that of August, 1889. Very heavy storms of R in the early mornings of 16th and 23rd. T on 16th and 27th.

BARKBY.—T on 11th, 16th, 20th, 24th, 26th, 27th and 28th. H on the 24th. Mean temp. 59°·1.

MANCHESTER, PLYMOUTH GROVE.—Summer weather prevailed on the first nine days, and on the 18th; the remainder of the month was changeable and unsettled, and very showery and cold. T on 24th and 29th. T and L on 26th. Mean temp. 58°·1.

HULL, PEARSON PARK.—The weather during the month was generally wet, especially so during the middle and latter part, but a period of fine bright weather occurred from the 3rd to the 9th.

N. SHIELDS.—T on 13th.

SEATHWAITE.—T, L and H on 25th.

WALES.

HAVERFORDWEST.—A con siderable improvement took place in the weather as regards sunshine, warmth and moisture at the begining of the month, which continued up to the 11th; t he weather then relapsed into a stormy, wet and unsettled condition, with a rather low temp. for August. During the last week the temp. was much below the average, and it was generally wet except

the last three days, which were fine and cold, with bright sunshine and high wind. Mean temp. 55°·9, 2°·8 below the average of 10 years. Prevailing winds W.S.W. and N.N.W., the latter predominant. Crops looking well, and harvest prospects favourable except potatoes, which are bad. R though frequent, not disastrous. Temp. reached 70° only four times.

SCOTLAND.

CARGEN.—Mean temp. of the month 55°·9, 2°·5 below the average. The first twelve days were very fine, the mean temp. for the period being 61°·1. For the last 19 days the mean temp. was only 52°·7, remarkably low for August. The nights of the last week were very cold, and on the 31st the thermometer fell to 33°·4, the lowest in August since 1869, when 32°·4 was recorded. Harvest operations were much interfered with, and the constant wet and low temp. greatly injured potatoes, which are much diseased. T on 29th ; H on 26th and 29th.

OBAN.—The continuance of heavy R since May last has not been interrupted, and temp. remained low throughout the month. The crops are very backward, and in many places potatoes are showing disease. The hay is seriously damaged, but much is still uncut, awaiting a fair autumn.

CULLODEN.—The month was cold and wet, and very deficient in sunshine. Crops promising, but late.

IRELAND.

CORK.—A cold and unseasonable month, with much damp and sunless weather. Mean temp. 59°·2, 2°·3 below the average of 14 years.

DROMORE.—Weather very unsettled. Crops not up to the average. Potatoes very poor, owing to blight. Turf scarce, as owing to the continuous R it is difficult to get it dry, consequently great fears are entertained in this part as to the fires for winter.

WATERFORD, BROOK LODGE.—All the early part of the month was very broken weather, but after the 27th the weather was most favourable for harvest work. Mean temp. 57°·0.

O'BRIENSBRIDGE, ROSS.—The month began with a fine week, and closed with two very fine and warm days ; nearly all the rest was rainy or misty, and as a result unfavourable to harvesting.

DUBLIN.—Except for a fine warm period, extending from the 2nd to the 5th inclusive, and for a few isolated fine but cold days afterwards, the month proved showery, cold and squally. Prevailing wind N.W., temp. 2°·5 below the average. High winds prevailed on 11 days, and attained the force of a gale on 15th and 22nd. Fog on 1st, L on 15th, TS with H on 26th. Temp. reached 70° in screen on two days. H fell on 23rd.

WARINGSTOWN.—The R of this month was less than the average of 28 years, and that of July was the same, which will surprise those who are crying out about excessive R. Very little potatoe disease in this district, except in gardens, and in the early varieties which are well-known always to be liable to its ravages. 30th and 31st, two remarkably cold nights for the season.

OMAGH, EDENFEL.—The month seemed to commence in settled summer weather, and for the first and only occasions during the year temperatures of 70° and upwards were twice registered during the first week. The second week was wet and unsettled, the third somewhat better, but from the 20th to the end a period of persistent and heavy R (amounting in the eleven days to 3·21in.) followed, accompanied by low temperatures doing much, but not irretrievable, damage to all crops, especially potatoes. A peculiarity of the bad weather of this summer has been that much of it has been accompanied by a high and steady barometer.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCXCVII.] OCTOBER, 1890. [PRICE FOURPENCE, or 5s. per ann. post free.

THE AUTUMN CONGRESSES.

(*Continued from p.* 120.)

THE BRITISH ASSOCIATION.

Whether, or not, the need for this organization is decreasing, we do not know. Probably it, like other bodies, must adapt itself to changed circumstances, and there was much evidence, at Leeds, of a desire to do so. Moreover, the scheme for the affiliation of Local Societies is solidifying, and it will undoubtedly greatly strengthen the parent, while benefiting the Corresponding societies. It is not for us to point out here the modifications in the Association which may be expedient; we have to deal only with Meteorology, but as regards it to mention, that we have heard several remarks as to the scant recognition afforded to that subject. The words Meteorology, Electricity, Magnetism, and Astronomy do not occur in the B. A. programme, all these subjects are included in Section A—Mathematics and Physics—while Chemistry, Geology, Biology, Geography, Statistics, Engineering, and Anthropology, has each a section to itself. For nearly half a century, no Meteorologist has been President of Section A, or of the Association. Hence, naturally meteorologists do not rally at the meetings, and papers get yearly more scarce. This year, Mr. Hopkinson tried, by sending in four papers, to galvanize the section, but with a Sectional Committee of 54 members, of whom not more than seven ever worked at meteorology, a strong shock is needed, and the audience, when the papers were read, was not encouragingly numerous.

We now proceed to notice the communications :—

W. J. E. BINNIE.—*On the Size of Drops Falling from a Tube.*

Mr. Binnie has designed an inexpensive form of recording rain-gauge; in it the uniformity of the size of drops is essential; this led him to researches, the result of which is given in his paper.

C. CHAMBERS, F.R.S.—*On Ferrel's Theory of the Winds.*

A very mathematical paper criticizing a review by Mr. H. F. Blanford, F.R.S., of Prof. Ferrel's last work.

DR. BUCHAN.—*Report of the Committee on the Ben Nevis Observatory.*

During the past year, observations had been made continuously at the top of Ben Nevis, and at the sea-level, at Fort William. Mr. Omond had completed an important investigation of the temperature of Ben Nevis, and of the wind force, and Mr. Rankin had photographed clouds, and other meteorological phenomena. In the autumn of last year a grant of £50 was obtained from the Government for carrying on an investigation into the number of dust particles in the atmosphere. Messrs. Omond and Rankin were still engaged with the enquiry into the direction of the winds observed at the top, and at the low level stations at the same hours, and in studying their relation to the weather of North-Western Europe. The comparative frequency with which the winds at the Observatory blow not with, but against, the isobarics of low level stations and indicated a force widely different from the barometric gradients of the weather maps of the Meteorological Office, were striking elements in the meteorology of Ben Nevis. At Fort William the mean temperature was 0°·8 under the average, the greatest defect from the mean being 1°·8 in February, and the greatest excess 5°·6 in May. The outstanding feature of the meteorology of the year was the all but unprecedentedly high temperature of May, a temperature, as regarded Scotland, only once exceeded since 1764. At the top of the Ben the excess above the mean was greater, amounting to 7°·7, as happened during all unusually high summer temperatures. The minimum temperature on Ben Nevis was 6°·4, which occurred at 7 a.m. of February 10th. This was absolutely the lowest temperature which had been recorded since the opening of the Observatory in December, 1883. The maximum was 61°·8 on July 4th. Thus the extreme range of temperature for the past year was 55°·4. The registrations of the sunshine recorded showed 634 hours of sunshine, as against 970 hours of the previous year, the latter year thus showing a half more hours. The largest number, 213, was recorded in June; the smallest, 9, in August, being the lowest that had occurred, hitherto, in any summer month. As the highest possible hours for the whole was 4,470, sunshine prevailed on the top of the Ben, in 1889, during only one hour in seven. The amount of the rainfall during the past year was 120·66 in., being about 10in. less than the average, the least rainfall being 1·94 in. in June, and the greatest 18·04 in. in December, and 17·69 in. in January. The importance of the investigations conducted at Ben Nevis in their relation to cyclones and anti-cyclones was touched upon, and in future meteorological data will be obtained with a view to better forecasts of the weather. They recommended that the committee be re-appointed, Lord McLaren being chairman, in place of Mr. Abercrombie, whose health compelled him to live abroad, and a grant of £150 will be proposed. [Only £50 was granted by the General Committee.]

DR. MILL.—*Report of the Committee for Determining the Seasonal Variation in the Temperature of the Lakes, Rivers, and Estuaries.*

G. J. SYMONS, F.R.S.—*Report of the Committee on Solar Radiations.*

An interim report, stating that the work of the Committee had been seriously interrupted by the death of Prof. Balfour Stewart, F.R.S., and by Prof. Schuster's engagements preventing his taking it up. The whole of the apparatus and correspondence had been found, and Prof. M'Leod, F.R.S., had consented to join the Committee, and make experiments with the apparatus designed by Prof. Balfour Stewart, and constructed by Mr. Casella.

A. L. ROTCH.—*On a Meteorological Observatory recently established on Mont Blanc.*

Mr. Rotch, who has lately visited M. Vallot's observatory, and who handed round photographs of it, said, that until recently, the highest meteorological station in the world was in the United States, on Pike's Peak, at an elevation of 14,134ft. above the sea, and the highest station in Europe was on the Sonnblick, in the Austrian Alps (10,170ft.). The French, who had done so much for high-level meteorology, could now claim the highest station in the world, M. Vallot having established a cabin, provided with many registering instruments at the Rocher des Bosses, 1,460ft. below the summit of Mont. Blanc, or 14,320ft. above the sea. It was hoped to maintain the instruments—which had to be attended to once in 15 days—in action during four months of the year. A series of intermediate stations was projected. Some idea of the difficulty and cost of M. Vallot's undertaking would be afforded by mentioning that the wooden observatory cost in the valley £32, but it made 120 loads for the porters, and by the time it was erected at 14,320ft. it had cost quite £400. Mr. G. J. Symons alluded to the expense of keeping up mountain observatories, where two or three attendants had to be located, and said that he was inclined to think that self-recording instruments would be successful, and if so, the cost would be greatly reduced. If they could be made to go for 15 days, they could be made to go for 31 days; indeed, it was difficult to say where the limit would be. He did not believe that tenths of degrees would be accurately recorded by such instruments, but tenths of degrees were not always of much consequence. In reply to a question, Mr. Rotch said that on account of the cost, the observatory on Pike's Peak had been abandoned.

J. HOPKINSON.—*On the Climate of Scarborough compared with that of some other Sea-side Health Resorts.*

After giving reasons for inferring that meteorological observations taken continuously during the decade 1880–89 may advantageously be utilised to deduce the most important elements of the climate of any place in the British Isles, the author showed that observations taken at Scarborough during this period fulfilled the necessary requirements as to accuracy and continuity, and also as to

uniformity with those taken at other places with which he compared the principal results.

A table, showing the monthly and annual means of temperature (mean, mean min., mean max., and mean daily range), relative humidity, cloud, and rainfall; and the extremes of temperature, at Scarborough, for this decade, was given, and the general results of comparison with the climate of four other seaside health-resorts, situated in succession at nearly equal distances round the English coast, was summarised thus :—

1880-89.	TEMPERATURE.						Humidity at 9 a.m.	Cloud at 9 a.m.	Rainfall.
	Means.				Extremes.				
	Mean.	Min.	Max.	Range.	Min.	Max.			
	°	°	°	°	°	°	%	0-10	ins.
Scarborough	47·5	42·6	52·5	9·9	10·5	83·8	83	6·6	28·26
Lowestoft	48·2	42·4	53·9	11·5	9·2	87·0	83	6·8	24·15
Worthing	49·5	43·7	55·3	11·6	13·5	83·3	83	5·9	26·55
Babbacombe	49·9	44·0	55·9	11·9	15·6	85·6	82	7·0	33·58
Llandudno.....	49·2	44·1	54·3	10·2	14·5	84·0	79	6·9	29·13
Mean	48·9	43·4	54·4	11·0	12·7	84·8	82	6·6	28·33

These figures show that Scarborough is 3 per cent. colder than the mean of the five places, has 2 per cent. less mean daily range of temperature (computed as a percentage of the mean temperature), is 1 per cent. more humid, and has the mean amount of cloud and rainfall.

J. Hopkinson.—*A Comparison of the Climate of Halifax, Bradford, Leeds, Wakefield, and Hull.*

Having shown that meteorological observations had been taken at these five manufacturing towns in the South of Yorkshire during the decade 1880-89 with sufficient uniformity and continuity for a satisfactory comparison to be made, the author gave the principal results for this purpose in the following table :—

1880-89.	TEMPERATURE.						Humidity at 9 a.m.	Cloud at 9 a.m.	Rainfall.
	Means.				Extremes.				
	Mean.	Min.	Max.	Range.	Min.	Max.			
	°	°	°	°	°	°	%	0-10	ins.
Halifax	46·5	39·6	53·4	13·8	10·0	89·0	83	7·0	36·55
Wakefield	47·7	41·0	54·4	13·4	11·5	86·8	84	7·3	28·01
Bradford.....	48·0	42·4	53·7	11·3	12·0	84·4	79	7·2	30·15
Leeds	48·8	42·6	55·1	12·5	12·0	87·0	81	6·7	25·53
Hull	47·1	39·9	54·3	14·4	6·0	85·0	81	6·3	27·07
Mean	47·6	41·1	54·2	13·1	10·3	86·4	82	6·9	29·46

In order to render more perspicuous the relation which the above values bear to the mean and to each other, the deviations per cent. from the mean were deduced (all the deviations in temperature being computed as percentages of the mean temperature), with the following result :—

1880-89.	TEMPERATURE.						Humidity at 9 a.m.	Cloud at 9 a.m.	Rainfall.
	Means.				Extremes.				
	Mean.	Min.	Max.	Range.	Min.	Max.			
	%	%	%	%	%	%	%	%	%
Halifax	− 2	− 3	− 2	+ 1	− 1	+ 5	+2	+2	+ 24
Wakefield	=	=	+ 1	+ 1	+ 2	+ 1	+3	+6	− 5
Bradford.....	+ 1	+ 3	− 1	− 4	+ 4	− 4	−3	+4	+ 2
Leeds	+ 2	+ 3	+ 2	− 1	+ 4	+ 1	−1	−3	− 13
Hull	− 1	− 3	=	+ 3	− 9	− 3	−1	9	− 8

J. Hopkinson.—*The Inland compared with the Maritime Climate of England and Wales.*

The author first endeavoured to show that the chief difficulties in making a satisfactory comparison between our inland and our maritime climate would be removed if a sufficient number of meteorological stations could be found which represent approximately the mean height and the range of the land in the interior and near the coast, and if the mean position of the inland and the maritime places were almost identical and not far distant from the centre of England. From the "Meteorological Record" of the Royal Meteorological Society he selected, as approximately fulfilling these conditions, Buxton, Woburn (Aspley Guise), Croydon (Addiscombe), Cheltenham, and Churchstoke, to represent the interior of the country; and Scarborough, Lowestoft, Worthing, Babbacombe, and Llandudno, to represent the sea-coast. The mean height above the sea of the meteorological stations at the five inland places is 469 feet, and the mean height of those at the five maritime places is 124 feet, the range in the former being from 184 to 987 feet, and in the latter from 21 to 293 feet. The mean latitude of the five inland places is 52° 12′ N., the mean longitude 1° 32′ W.; the mean latitude of the five maritime places is 52° 22′ N., the mean longitude 1° 16′ W. The mean position indicated is in each case near the centre of England (a little south of Birmingham).

The values for the decade 1880-89 for the chief elements of the climate of the five places situated on the coast having already been given in the author's paper on "The Climate of Scarborough," those for the five places situated in the interior are given in the following

table, with the means, and, for easy comparison, the means for the sea-side places and for the whole : —

1880-89.	TEMPERATURE.						Humidity at 9 a.m.	Cloud at 9 a.m.	RAIN-FALL.
	MEANS.				EXTREMES.				
	Mean.	Min.	Max.	Range.	Min.	Max.			
	°	°	°	°	°	°	%	0-10	ins.
Buxton	44·6	37·6	51·6	14·0	−4·0	82·1	85	7·3	48·09
Woburn	47·6	40·4	54·8	14·6	−1·0	86·1	83	7·5	32·06
Croydon	48·8	41·9	55·8	13·9	11·6	92·4	80	7·4	25·56
Cheltenham	47·9	40·4	55·4	15·0	−3·3	87·8	83	7·0	28·86
Churchstoke	46·7	40·4	54·8	14·4	6·9	90·7	83	6·9	24·46
Mean { Inland ...	47·1	39·9	54·3	14·4	2·0	87·8	83	7·2	31·81
Mean { Maritime.	48·9	43·4	54·4	11·0	12·7	84·8	82	6·6	28·33
Mean of all.....	48·0	41·7	54·4	12·7	7·4	86·3	82·5	6·9	30·07

The conclusion to be drawn from this table was, he considered, that in every respect, as far as concerns our comfort and most probably also our health, our maritime climate is on the whole superior to our inland climate, being warmer, owing (it is most important to observe) to the nights not being nearly so cold while the days are no hotter, the extremes of temperature being much less, the air rather less humid, the sky less cloudy, and the rainfall less.

Discussion having been invited,

Mr. Symons said that Mr. Hopkinson's papers were very interesting, and that some day corporations and other representative bodies would perhaps think that climate had something to do with the health of the people, and that it was desirable that accurate meteorological observations should go along with statistics of population. Leeds was no greater sinner in this respect than other towns, but it had not one single well-equipped meteorological observatory. There ought to be one or two places in Leeds, and one on Woodhouse Moor. He ventured to think that, as regarded the West Riding towns, many differences brought forward by Mr. Hopkinson were due to the position of the instruments among chimnies, &c., rather than differences in the five manufacturing towns themselves which were compared with Leeds. He also took exception to the new method of expressing temperature differences as percentages.

Mr. Hopkinson said that Mr. Symons' objections could only apply to the five manufacturing towns; for the other papers read, the results could be relied upon as accurate meteorological statistics. He quite agreed that it would be well to start an observatory in the neighbourhood of Leeds; and all that it would be necessary to do would be for some one to take an observation at nine o'clock

in the morning and forward it to the Royal Meteorological Society, where all the results would be worked out.

The President (Dr. Glaisher) advised Mr. Hopkinson to take other five places at the seaside and five other inland places to make another comparison, because he was rather struck with the result already obtained, viz., that the climate at the sea-coast was better than that inland; and for his own part he thought that it might have been brought about in Mr. Hopkinson's comparison by a sort of give-and-take arrangement, and was not a thing really definitely settled.

J. HOPKINSON, F.R.Met.Soc.—*On Meteorological Photography.*

The author called attention to the increasing importance attached to photography, as a means of illustrating scientific subjects, and aiding scientific research. In no science, he thought, could photography be of greater value than in meteorology, owing to the transient nature of meteorological phenomena.

The appointment of a Committee of the British Association on Meteorological Photography, by which Committee instructions to photographers would be issued with the view of instituting a systematic method of working, &c., would, he felt sure, greatly extend the interest taken in the subject and increase the scientific value of the results. The chief object of such a committee would be to investigate and report upon the means by which photography can most advantageously be applied to the elucidation of meterological phenomena, such as the forms of clouds and of lightning flashes, and the effects of storms. The Committee would also undertake the collection of photographs of such phenomena and keep a register of them, reporting the additions made each year, and would compile a bibliography of the subject.

In the study of the various forms of clouds the author believed that a satisfactory classification could best be made by the comparison of numerous photographs; the relation between cloud-forms and atmospheric pressure and temperature would be an interesting field for research; and an attempt might be made to ascertain the best means of overcoming the difficulty of photographing light clouds on a blue sky, owing to the blue rays being almost as powerfully actinic as white.

In the investigation of lightning by photograhy, special attention would be given to the appearance on the plates of so-called dark flashes, with the object of arriving at a conclusive explanation of the phenomenon; and an endeavour might be made to determine whether lightning really forms a streak or a point in excessively rapid motion.

The collection and exhibition of photographs showing the destructive effects of storms, whether the destruction or damage were wrought by rain, by wind, or by lightning, might not be considered of such scientific importance as the investigation of clouds and

lightning, but it would add much to the general interest of the enquiry.

Mr. Symons observed that they would make their section much more attractive if they exhibited photographs of meteorological phenomena, for many people thought that the study of meteorology consisted solely in the calculation of tables of figures, whereas their science was most interesting.

The President (Dr. Glaisher) said that the Committee of the Section had that morning approved of Mr. Hopkinson's proposal, and asked the Committee of Recommendations to appoint a Committee on Meteorological Photography. [This was subsequently approved by the General Committee.].

FRIESE GREENE.—*Exhibition of Photographs of Clouds.*

No paper was read respecting these large and fine photographs, but the President stated that on one of them there were four clouds shown which were not visible to the naked eye; this result had been obtained by taking the negative through yellow glass.

G. J. SYMONS.—*On the arrangements for recording Phenological Phenomena.*

This was a short paper read in the Biological Section in order to bring to the knowledge of naturalists the important work done in this subject under the auspices of the Royal Meteorological Society, and to draw attention to the simplified form now issued. Instead of occupying space with the paper, we appropriate it to advising our readers to apply for a specimen of the form to E. Mawley, Esq., F.R.Met.Soc., Rosebank, Berkhemsted, Herts, and if possible to help him in the work which he is doing for the society.

"FATHER PERRY" MEMORIAL.

THAT which men will not do for the living, they frequently will do in honour of the dead who cannot profit thereby. Our opinion of Father Perry and of his work has already been given (Met. Mag. Vol. xxiv. p. 183), such a character needs no praise, and no memorial, but when one is proposed, it becomes an insult rather than an honour if it is not supported.

A very strong committee is trying to collect £2,700, wherewith to present a 15-inch equatorial to Stonyhurst, where Perry would have used one so well. We do not allow ourselves to doubt that the amount will be raised, but all who would share in the good work should send direct to the treasurer, A. C. Thomas, Esq., Marldon Chambers, 30, North John-street, Liverpool.

HEAVY HOURLY RAINFALL ON BEN NEVIS.

To the Editor of the Meteorological Magazine.

SIR,—I enclose the hourly rainfall on Ben Nevis for the 25th, 26th, and 27th of September. You will see that the torrential downpour which did so much damage in the vicinity of Fort William, commenced at 6 p.m. of the 25th, and lasted till noon of the next day, the rainfall for these eighteen hours being 6·264 in., of which 4·514 in. fell in the 8 hours ending 5 a.m. of the 26th.

Yours very truly,

R. C. MOSSMAN.

10, Blacket Place, Edinburgh, Oct. 2nd, 1890.

September 25th.		September 26th.		September 27th.	
Hours ending.	Amount.	Hours ending.	Amount.	Hours ending.	Amount.
1	·022	1	·808	1	·100
2	·009	2	·750	2	·144
3	·042	3	·511	3	·147
4	·009	4	·369	4	·203
5	·008	5	·619	5	·108
6	·004	6	·218	6	·116
7	·036	7	·205	7	·220
8	·040	8	·160	8	·196
9	·018	9	·140	9	·168
10	·008	10	·168	10	·160
11	·028	11	·182	11	·164
Noon	·015	Noon	·154	Noon	·170
13	·013	13	·050	13	·180
14	—	14	·025	14	·150
15	·014	15	·010	15	·071
16	·008	16	·006	16	·151
17	·012	17	·005	17	·151
18	·025	18	—	18	·048
19	·227	19	—	19	·078
20	·113	20	·032	20	·024
21	·183	21	·076	21	·025
22	·269	22	·049	22	·042
23	·402	23	·083	23	·055
Midnight	·786	Midnight	·074	Midnight	·040
Sums	2·291	Sums	4·694	Sums	2·911

[This gives for the rainfall day of 25th 5·88 in., and of 26th 2·32 in., but, for the newspapers, the Ben Nevis day seems to end at 9 p.m., and that gave 5·95 in. for 26th, and 2·57 in. for 27th. All these values are, however, surpassed by the record (up to 9 p.m.) for Oct. 3rd, which was 8·07 in.—Ed.]

FURTHER REMARKS ON THE DISCUSSION CONCERNING BAROMETRIC DEPRESSIONS.

To the Editor of the Meteorological Magazine.

SIR,—I had not intended to intervene again in this discussion, but I am induced, by some remarks in this Magazine for September, 1890, pp. 121 and 122, to ask your permission to offer a few further observations by way of explanation.

The supposition that the greater fluctuations of atmospheric pressure are the result of the outflow of currents of highly heated air from the equatorial regions, so far from having been put forward by me "as new and altogether the better for being new," was avowedly a reproduction, with some modifications, of the view held by the late Sir John Herschel, and elaborated by him in considerable detail in his latest utterance on the subject (Familiar Lectures on Scientific Subjects, article, "Weather"). It was impossible to pursue the subject in detail without trespassing too far upon your space, but as my critic seems to suppose that I was writing at random and in ignorance of elementary facts, which, if I had been acquainted with them, would have prevented me from writing such unmitigated nonsense, as it seemed to him, I may now add that the powerful upward movement of the heated currents would account for the absence of any increase of pressure over the regions traversed by them in the earlier part of their course, while the fact that they were moving polewards over converging meridians would explain—(1) the greater frequency and intensity of the barometric fluctuations experienced in the temperate as compared with the tropical zones; (2) the tendency of two or more anti-cyclonic areas to coalesce; and (3) the piling up of the air in the form of huge anti-cyclones in high latitudes. Such an anti-cyclone as that which prevailed over Western Europe about the middle of last November might well have been caused in this way; it could hardly have been occasioned by cold, as temperature was quite exceptionally high at the time. I am aware that, according to the orthodox view, the influence of these equatorial currents does not extend beyond 30° or thereabouts on either side of the equator. But it is highly improbable that there should be any such uniform limit to their range. Such a supposition would involve the incredible assumption that the effective heating power of the sun is as great over water as over land, and no greater over a treeless and arid region, such as the Sahara, than over a relatively cool and moist region, like that covered by the great equatorial forest described by Stanley in "Darkest Africa." But, independently of any such *à priori* grounds, we have plenty of positive evidence, as, for instance, in the behaviour of the Krakatoa dust, to show that the overlapping upper currents extend much farther northward and southward of the equator than is commonly supposed.

My critic says that he has "roughly reviewed" this discussion. Yes! very roughly, as far, at any rate, as Dr. Muirhead and myself

are concerned. Dr. Muirhead graphically, but not too forcibly, indicated the tone and tenour of his first letter when he described him as "knocking together the heads of two ignorant scribblers and sending them to learn their lessons" (*Met. Mag.*, July, 1890, p. 88). In his latest communication he refers to us, by implication, as meteorological quacks who, by our foolish meddling with matters that are too high for us, deter better qualified men from the study of meteorological problems. I venture to think that the peculiar style of controversy adopted by our critic, and the *de haut en bas* attitude which he thinks it fitting to assume towards fellow-seekers after the truth are much more likely to "lend a deterrent aspect to a most interesting branch of science."

I entered upon this discussion with the hope that, through the courtesy of some of your readers, who had been able to devote more time and study to the consideration of meteorological problems than myself, I should obtain much valuable information upon the subject to which I had invited attention. I leave it with the conviction, forcibly impressed upon my mind by the course which the discussion has taken, that no satisfactory theory of the origin of a depression system has as yet been formulated, and that, in the existing state of our knowledge, the really wise men are the Abercrombys who, when asked their opinion upon the subject, shake their heads and confess that they do not know.

G. T. RYVES.

Tean Vicarage, October 1, 1890.

SUNBURN.

To the Editor of the Meteorological Magazine.

SIR,—I hope that the interesting question you raised at the beginning of your number for September, 1890, in the notice of Dr. Bowles's "Sunburn on the Alps," as to the cause of sunburn, will elicit a more satisfactory explanation than has been, so far, given.

Professor Tyndall's experience of having been more burnt at the North Foreland than on Alpine snows is borne out by the well-known browning or bronzing of sailors and boatmen who are much exposed on the sea. My own experience on land, in Britain and in India, from sea-level to a height of 10,000 feet and upwards, is that I have felt more burnt by the sun under light clouds and mist than under a cloudless sky. This may be partly due to the fact that one exposes oneself more freely, and protects one's skin less, during cloudy weather than in bright sunshine.

I am inclined to believe that the suffusion of the air with sunlight by means of reflection from all bright surfaces, and by refraction at the same time, has much to do with the phenomenon of sunburn.

Yours truly,

B. R. BRANFILL.

Billericay, October 1, 1890.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, MARCH, 1890.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain. Depth.	Total Rain. Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		0-10
England, London	66·2	28	15·6	4	51·1	36·5	38·1	80	103·7	12·8	1·76	14	6·9
Malta	72·2	31	40·2	3	62·8	50·4	48·0	77	129·7	34·0	1·02	8	4·5
Cape of Good Hope	96·8	18	47·2	2	77·7	57·6	...	...	...	...	·19	...	2·2
Mauritius	83·5	25	70·4	3	81·2	73·2	71·5	85	136·0	65·2	11·36	25	7·6
Calcutta	100·8	29	62·8	1	91·5	71·1	69·3	70	152·6	54·6	·33	6	3·0
Bombay	89·4	19*a*	71·8	6	85·8	74·3	69·5	71	140·0	60·9	·00	0	2·1
Ceylon, Colombo	90·5	29	71·8	4, 5	88·2	75·0	71·9	76	147·0	67·0	5·34	22	5·2
Melbourne	94·6	5, 16	49·0	1, 2	77·3	58·0	56·0	70	148·1	38·1	1·62	10	6·1
Adelaide	97·7	15	49·8	28	81·9	60·4	52·5	51	159·9	42·5	·58	3	2·7
Wellington	76·8	2	43·0	30	68·0	52·4	50·1	69	139·0	34·0	2·23	13	4·2
Auckland	78·0	3	46·0	25	72·7	57·5	54·0	68	140·0	42·0	...	...	4·7
Jamaica, Kingston	89·3	24	61·4	14	85·5	66·8	66·3	75	...	...	3·27	...	...
Trinidad	89·0	9*ab*	62·0	15	86·2	68·8	67·2	75	158·0	62·0	2·09	13	...
Toronto	53·5	25	—2·7	6	34·7	20·9	23·2	77	...	—7·1	1·48	20	6·0
New Brunswick, Fredericton	48·8	12	—11·2	...	36·2	18·5	22·6	68	...	...	4·39	16	6·6
Manitoba, Winnipeg	38·0	10	—32·2	4	19·6	— 5·5	9·3	91	...	...	1·54	14	3·7
British Columbia, Victoria	54·0	19	29·0	5	47·7	37·0	...	...	...	...	1·50	16	...

a And 24. *b* And 27.

MARCH REMARKS.

MALTA.—Mean temp. 55°·5; mean hourly velocity of wind 12·7 miles. Sea temp. rose from 59°·8 to 62°·3. J. SCOLES.

Mauritius.—Mean temp. of air 1°·2 below, of dew point 1°·7 above, and R 3·37 in. above, their respective averages. Mean hourly velocity of wind 7·1 miles, or 3·0 below the average; extremes 20·0 on 1st, and 0·0 on 20th; prevailing directon E. by N. to S.E. by E. T and L on nine days; T on two days, and L on five days. C. MELDRUM, F.R.S.

CEYLON, COLOMBO.—Thunderstorms occurred on fifteen days, and L was seen on six other days. J. C. H. CLARKE, Lt. Col. R.A.

Melbourne.—Mean temp. of air 3°·0, of dew point 4°·0., humidity 2, amount of cloud 0·5 above, and R ·44 in. below, their respective averages. Prevailing winds S.E. and S. Strong on seven days. Heavy dew on four days, TSS on four days. R. L. J. ELLERY, F.R.S.

Adelaide.—Mean temp. 0°·8 above the average. R about half an inch below the average. C. TODD, F.R.S.

Wellington.—The early part of the month was generally fine with occasional showers, the latter part showery. Prevailing winds N.W. and S.E., strong from N.W. on six days. Mean temp. 1°·9 below the average. R ·59 in. below the average. R. B. GORE.

Auckland.—The early and middle parts of the month were fine and dry; much cooler with frequent showers at the close. Mean temp. and R both close to the average; bar. pressure much above it. T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL, SEPTEMBER, 1890.

[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 Hall.	1·08	XI.	Castle Malgwyn	2·26
,,	Margate, Birchington...	·75	,,	Builth(LlanwrtydWells)	2·29
,,	Littlehampton	·95	,,	Rhayader, Nantgwillt..	2·50
,,	Hailsham	1·24	,,	Carno, Tybrith	1·85
,,	Ryde, Thornbrough	·74	,,	Corwen, Rhug	1·17
,,	Alton, Ashdell.....	·86	,,	I. of Man, Douglas	4·12
III.	Oxford, Magdalen Col...	1·02	XII.	Stoneykirk, Ardwell Ho.	2·53
,,	Banbury, Bloxham	1·39	,,	New Galloway, Glenlee	4·37
,,	Northampton	·76	,,	Melrose, Abbey Gate...	1·44
,,	Cambridge, Fulbourne..	·24	XIII.	N. Esk Res. [Penicuick]	4·85
,,	Wisbech, Bank House..	·39	XIV.	Ballantrae, Glendrishaig	5·35
IV.	Southend	·76	,,	Glasgow, Queen's Park.	3·50
,,	Harlow, Sheering	·39	XV.	Islay, Gruinart School..	6·76
,,	Rendlesham Hall	·97	XVI.	Dollar.....	4·02
,,	Diss	1·00	,,	Balquhidder, Stronvar..	7·35
,,	Swaffham	·58	,,	Coupar Angus Station..	2·98
V.	Salisbury, Alderbury...	1·61	,,	Dunkeld, Inver Braan..	3·39
,,	Warminster	1·47	,,	Dalnaspidal H.R.S. ...	4·01
,,	Bishop's Cannings	1·91	XVII.	Keith H.R.S.	2·17
,,	Ashburton, Holne Vic....	2·01	,,	Forres H.R.S.	1·40
,,	Hatherleigh, Winsford.	·79	XVIII.	Fearn, Lower Pitkerrie.	2·01
,,	Lynmouth, Glenthorne.	·99	,,	Loch Shiel, Glenaladale	11·36
,,	Probus, Lamellyn	2·45	,,	N. Uist. Loch Maddy ...	3·45
,,	Launceston, S. Petherwin	2·95	,,	Invergarry	3·60
,,	Wincanton, Stowell Rec.	1·99	,,	Aviemore H.R.S.	1·77
,,	Taunton, Lydeard Ho...	...	,,	Loch Ness, Drumnadrochit	1·74
,,	Wells, Westbury.....	1·55	XIX.	Lairg H.R.S.	3·19
VI.	Bristol, Clifton	1·43	,,	Scourie	2·47
,,	Ross	1·62	,,	Watten H.R.S.	2·58
,,	Wem, Clive Vicarage ...	·88	XX.	Dunmanway, Coolkelure	3·77
,,	Cheadle, The Heath Ho.	·75	,,	Fermoy, Gas Works ...	2·77
,,	Worcester, Diglis Lock	·81	,,	Tipperary, Henry Street	2·09
,,	Coventry, Coundon	1·30	,,	Limerick, Kilcornan ...	2·48
VII.	Ketton Hall [Stamford]	·68	,,	Miltown Malbay.....	4·64
,,	Grantham, Stainby	·87	XXI.	Gorey, Courtown House	2·10
,,	Horncastle, Bucknall ...	·65	,,	Navan, Balrath	1·99
,,	Worksop, Hodsock Priory	1·21	,,	Mullingar, Belvedere ...	3·91
VIII.	Neston, Hinderton	1·11	,,	Athlone, Twyford	3·00
,,	Knutsford, Heathside ...	·98	,,	Longford, Currygrane...	3·34
,,	Lancaster, South Road.	3·96	XXII.	Galway, Queen's Coll...	2·70
,,	Broughton-in-Furness ..	6·61	,,	Clifden, Kylemore	9·20
IX.	Wakefield Prison	1·46	,,	Crossmolina, Enniscoe..	3·03
,,	Ripon, Mickley	2·12	,,	Collooney, Markree Obs.	3·65
,,	Scarborough, West Bank	1·57	,,	Ballinamore, Lawderdale	3·64
,,	East Layton [Darlington]	1·69	XXIII.	Warrenpoint	2·27
,,	Middleton, Mickleton..	1·81	,,	Seaforde	2·19
X.	Haltwhistle, Unthank..	2·46	,,	Belfast, New Barnsley..	4·25
,,	Shap, Copy Hill	...	,,	Bushmills, Dundarave...	3·56
XI.	Llanfrechfa Grange	1·66	,,	Stewartstown	3·34
,,	Llandovery	2·36	,,	Buncrana	4·98

SEPTEMBER, 1890.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1880–9	Greatest Fall in 24 hours. Dpth	Greatest Fall in 24 hours. Date.	Days on which ·01 or more fell.	TEMPERATURE Max. Deg.	Max. Date	Min. Deg.	Min. Date	No. of Night below 32° In shade.	No. of Night below 32° On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	·65	— 1·86	·26	17	5	75·9	10	37·8	1	0	0
II.		Maidstone (Hunton Court)...	·98	— 1·61	·36	17	6	...	...	...	...	...	...
,,		Strathfield Turgiss	·75	— 1·70	·33	21	9	75·8	10	32·5	1	0	1
III.		Hitchin	·26	— 2·24	·08	17	6	72·0	5	47·0	12	0	...
,,		Winslow (Addington)	1·15	— 1·52	·65	22	11	76·0	27	34·0	1	0	1
IV.		Bury St. Edmunds (Westley)	·63	— 2·07	·19	20	7	...	...	...	...	...	...
,,		Norwich (Cossey)	·93	— 1·73	·32	21	7	73·0	10*a*	35·0	1	0	...
V.		Weymouth(LangtonHerring)	1·41	— 1·01	·41	17	8	75·0	6	44·0	1	0	...
,,		Barnstaple.....	1·64	— 1·85	·41	17	10	73·0	9	37·5	1	0	
,,		Bodmin (Fore Street)	2·28	— 2·19	1·18	17	14	...	...	...	...	...	...
VI.		Stroud (Upfield)	1·03	— 1·88	·32	17	8	74·0	6, 8*b*	47·0	21*d*	0	...
,,		ChurchStretton(Woolstaston)	·78	— 1·72	·23	17	10	74·5	9	43·0	1	0	0
,,		Tenbury (Orleton)	1·09	— 1·52	·59	17	7	77·0	9, 27	32·0	1	1	1
VII.		Leicester (Barkby)	1·64	— 1·00	·73	21	15	79·0	8	37·0	11	0	0
,,		Boston	·41	— 2·36	·17	3	5	85·0	24	40·0	13	0	...
,,		Hesley Hall [Tickhill].....	1·28	— ·88	·56	21	10	78·0	8	35·0	1	0	...
VIII.		Manchester(PlymouthGrove)	1·13	— 2·34	·20	30	15	80·0	8	42·0	1	0	0
IX.		Wetherby (Ribston Hall) ...	2·40	— ·06	·48	22	9	...	...	...	...	...	...
,,		Skipton (Arncliffe)	4·04	— ·72	1·27	30	17	79·0	8	42·0	13	0	...
,,		Hull (The Park)	1·44	— 1·00	·72	21	11	...	...	...	...	...	...
X.		North Shields	2·65	— ·01	·70	23	15	73·5	8	...	...	...	...
,,		Borrowdale (Seathwaite).....	15·88	+ 4·15	6·79	30	19	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	·87	— 2·87	·40	19	9	...	...	...	...	...	...
,,		Haverfordwest	3·02	— 1·38	1·22	17	14	70·0	6	39·0	10	0	0
,,		Plinlimmon (Cwmsymlog) ...	2·89	...	·45	23	12	...	...	...	...	...	...
,,		Llandudno.....	1·68	— ·54	·40	30	15	75·1	8	47·9	13	0	...
XII.	SCOTLAND.	Cargen [Dumfries]	3·03	— ·53	·54	20	17	71·6	6*c*	39·8	1	0	...
,,		Jedburgh (Sunnyside).....	1·64	— 1·05	·39	30	14	75·0	3, 8	43·0	13*e*	0	...
XIV.		Old Cumnock	5·72	+ 1·89	·89	2	18	72·5	8	34·0	9	0	...
XV.		Lochgilphead (Kilmory).....	8·13	+ 3·00	1·84	30	21	...	...	...	...	...	...
,,		Oban (Craigvarren)	6·80	...	1·85	30	21	70·0	8	46·0	30	0	...
,,		Mull (Quinish).....	5·86	+ ·83	1·11	25	21	...	...	...	...	...	...
XVI.		Loch Leven Sluices	3·60	+ ·81	2·20	30	8	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	2·85	+ ·34	1·35	30	8	75·6	7	42·4	1	0	...
XVII.		Braemar	3·01	+ ·15	1·08	30	16	72·2	7	37·3	13	0	3
,,		Aberdeen (Cranford)	1·51	...	·65	30	13	76·0	3, 8	41·0	29	0	...
XVIII		Strome Ferry.....	5·52	+ ·65	2·05	25	21	...	...	...	...	...	...
,,		Inverness (Culloden)	1·71	— ·74	...	...	...	74·0	7	50·0	30	0	0
XIX.		Dunrobin	2·72	+ ·13	1·30	30	11	69·5	7	40·0	6	0	...
,,		S. Ronaldsay (Roeberry).....	2·92	+ ·26	·65	30	18	63·0	7	48·0	30	0	...
XX.	IRELAND.	Cork (Blackrock).....	2·24	— ·76	·92	20	11	78·0	5, 27	32·0	26	1	...
,,		Dromore Castle	3·65	— ·38	·82	20	17	68·0	6	40·0	1	0	...
,,		Waterford (Brook Lodge) ...	2·32	— ·60	·86	20	10	72·0	3, 11	43·0	18	0	..
,,		O'Briensbridge (Ross)	3·66	...	1·43	21	16	75·0	6	45·0	22*f*	0	...
XXI.		Carlow (Browne's Hill)	2·28	— ·54	·65	20	15	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	2·47	+ ·50	·88	20	14	71·2	7	48·3	23	0	0
XXII.		Ballinasloe	3·42	+ ·63	·93	30	18	68·0	7	40·0	17	0	...
XXIII		Waringstown	3·23	+ ·07	·60	20	20	77·0	9	39·0	18*d*	0	0
,,		Londonderry (Creggan Res.).	5·57	+ 1·79	1·18	22	22	..	...	...	...	...	...
,,		Omagh (Edenfel).....	3·56	+ ·18	·86	17	19	70·0	7	43·0	9, 24	0	0

a And 19, 28. *b* And 9, 10. *c* And 7, 15. *d* And 22. *e* And 29. *f* And 23, 25.
+ Shows that the fall was above the average ; —that it was below it.

METEOROLOGICAL NOTES ON SEPTEMBER, 1890.

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.—A beautiful month, with cloudless skies and a high temperature. The R in the third week was very welcome for root crops. Numerous wild flowers in full bloom.

HITCHIN.—The driest September in the 40 years recorded here, and the hottest but one.

ADDINGTON.—The whole month very fine. In low-lying places tender plants were much injured by frost on the 1st of the month, the temp. on grass falling below 30°.

BURY ST. EDMUNDS, WESTLEY.—The R of the month is less than that of any other September since 1865, when it was ·11 in. A lovely warm month, but R much wanted at the close. T on the 17th and 23rd.

LANGTON HERRING.—A most beautiful month, and very favourable for the ingathering of the late harvest. On the 6th the temp. rose to 75°·0, only 1° below that of the hottest day (May 25th); only on the 1st did the temp. fall below 50°, and throughout the month the temp. was very equable, and the mean is 1°·7 above the average of 18 years.

BODMIN, FORE STREET.—A remarkably dry September. Brilliant and mild weather to the 16th; heavy R on the 17th; high winds on 19th, 29th, and 30th; very hot on the 28th and 29th.

WOOLSTASTON.—A warm, bright month of summer weather; a perfect harvest month. Mean temp. 58°·7.

BARKBY.—A lovely month; abundance of sunshine; temp. very high; harvest well ripened and well got. Some splendid sunsets. Mean temp. 59°·5, considerably above the average.

MANCHESTER, PLYMOUTH GROVE.—R the smallest in September for 24 years. Summer weather from the 6th to the 19th; the rest of the month very unsettled. Mean temp. 59°·7.

HULL, PEARSON PARK.—The weather during the month was unusually fine, with a small amount of cloud, and nearly free from fogs or mist.

SEATHWAITE.—Very heavy R on the 30th, 6·79 in.

WALES.

HAVERFORDWEST.—The first five days were cloudy, damp, and relaxing; after that a remarkably fine warm period set in, with constant bright sunshine; this continued until the 17th, when a rather sudden change occurred, with violent gale, and much R; the day temp. fell very much, but the night temp. continued high up to the end of the month, the mean being about the average

SCOTLAND.

CARGEN.—The mean temp of the month, 57°·6, is 3°·1 above the average, and the month was the warmest month of the year, the mean temp. being 3° above that of June, 1°·4 above that of July, and 1°·7 above that of August. On only two occasions during 31 years has the mean temp. of this month been exceeded in September, viz., 1880, when it was 58°, and 1865, when it was 60°. The night temp. was unusually high, 3°·2 above the average. On the night of the 27th the temp. did not fall below 60°·4; on only one occasion has the temp. been exceeded in September. Duration of sunshine below the average. L on 17th, 18th, and 20th.

JEDBURGH.—The weather during the month was on the whole very fine, and such as to allow the cereal crops to be generally secured except in the higher districts.

OBAN.—A very broken, wet month, typical of the whole summer season; farming operations almost arrested, and most of the corn crops obliged to

remain uncut. The R storms of the 28th and 30th produced serious floods, which did much damage.

CULLODEN.—Much sunshine throughout the month, the days being beautifully fine. Harvest well advanced by the close, except in exposed and high districts; all crops exceedingly full and heavy.

ROEBERRY.—The first part of the month was fine, the last part rough and unsettled. Heavy gale on 29th from westward, doing great damage to uncut crops.

IRELAND.

DROMORE.—The latter half of the month was very unsettled.

WATERFORD, BROOK LODGE.—Fog on 8th, 9th, 18th, and 27th. Gale from the S. on the 20th. Mean temp. 58°·1.

O'BRIENSBRIDGE, ROSS.—A short but brilliant Michaelmas summer from 4th to 14th. The last week of the month wild and wintry, wind S. and S.W.

DUBLIN.—As in 1888 and 1889, so in 1890, September proved a fine month, with a high mean bar. The prevailing winds were from warm quarters, chiefly S.W. There was no excessive R, and the temp. was remarkably high. From the 5th to the 15th inclusive conditions were anti-cyclonic, and the weather was summerlike. On the 20th a violent gale occurred, accompanied by heavy R. Taken as a whole, however, the month was very favourable from an agricultural as well as from a health point of view, and was the warmest September for a quarter of a century.

OMAGH, EDENFEL.—The month commenced in the same rainy humid weather that has been so characteristic of the summer, but from the 5th to the 15th there followed a magnificent spell of fresh, clear, warm weather, as nearly perfect as it could be. On the 16th it again became unsettled, with R and strong winds, and from the 20th to the end continued wet.

A DRY PERIOD.

To the Editor of the Meteorological Magazine.

SIR,—The deficiency in our rainfall continues with increased intensity. September, the average for which on 17 years is 2·52 in., only yielded 0·66 in. The total deficiency on the first nine months of 1890 is 6·26 in. from an average of 19·00 in. For the 12 months (October 1st, 1889, to September 30th, 1890) it is 8·68 in., from an average of 26·56 in.; and for the 16 months since June 1st. 1889, it is 11·44 in. from an average of 36·55 in. May 1889 was the last really wet month we had; of the 16 which have passed since then, only two were at all above the average, viz.: January, 1890 + 0·07 in. and March, 1890 + 0·57 in. The following have all produced considerably less than 1 inch of rain :—

		inch
1889.	June	0·55
,,	November	0·77
1890	February	0·82
,,	April	0·55
,,	September	0·66

As compared with the 13 years average (1874—1886), the deficit of the last 12 months would be 9·93 in. These results as compared with the heavy rainfalls in other parts seem remarkable.

Yours very truly,
G. H. MULLINS.

West Deyne, Uppingham, Oct. 2nd 1890.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCXCVIII.] NOVEMBER, 1890. [PRICE FOURPENCE, or 5s. per ann. post free.

HAIL INSURANCE.

IN the *Meteorological Magazine* for November, 1876, the following short letter appeared :—

HAIL STORMS—AN EXPLANATION NEEDED.

To the Editor of the Meteorological Magazine.

SIR,—I enclose a proposal for an insurance against hail, and you will see in the last paragraph that "All crops growing within twelve miles of Somersham railway station, Huntingdonshire, are charged double the usual rate," and this is the custom of all insurance companies. I shall be very glad if any of your correspondents can explain why there should be twice as many hail storms in that district as in any other district in England.

I think it is an interesting subject for meteorologists.

I am, yours faithfully,

A. S. LESLIE MELVILLE.

The Long Hills, Lincoln, Oct. 1876.

Fourteen summers have passed, we have heard of no exceptional storms in the district singled out for double charges, and the explanation needed in 1876 is equally needed in 1890.

We are not the only ones puzzled by this rule. Mr. Todd, the assistant at Cambridge Observatory, has been making enquiries, and for many years has been watching the local newspapers to see if any heavy hail storms were reported, but has not succeeded in detecting any special destructiveness in the storms in that neighbourhood, or in obtaining any evidence to warrant the extra charge.

On the contrary, in his last letter he tells us that in 1882 he received letters from Mr. Westwood Oliver, asking for any trustworthy accounts of heavy hail storms in the Somersham district, in which Mr. Oliver stated that the insurance companies had, first doubled their rates, and then finding that that arrangement failed to yield a profit, resolved to decline insurances altogether.

Somersham is on the edge of the Fen district; we have, therefore, searched Miller and Skertchley's *The Fenland*, because, both on account of the elaborate nature of the work, and of Mr. Miller's reputation as a meteorologist, any special phenomenon was pretty sure to be mentioned, but we have read the whole chapter on meteorology, extending from p. 226 to p. 293, of that work, and can-

not find even the word hail! Moreover (as our older readers will remember) Mr. Miller published during 1874-5-6 & 1877 a monthly periodical, *The Fenland Meteorological Circular and Weather Record*, and although, of course, it contains some accounts of hail storms, we have not found one within the area of which the companies seem so much afraid.

Agreeing perfectly with Mr. Leslie Melville, that this is a question for meteorologists, we invite any information bearing upon it.

Our impression is, that, in the early days of Hail Insurance, two, or perhaps three, heavy losses were incurred in that district, and thereupon some clever manager jumped to the conclusion that it was a dangerous district. The rates were put up accordingly, and they have remained excessive because there is no competition between the companies, and because the farmers have not combined to insist upon a reduction.*

The area thus surcharged is 452 square miles, or nearly 300,000 acres; it extends from near Cambridge to near Peterboro', and includes March, Ely, Chatteris and Huntingdon. Why do not the farmers form a company of their own, instead of paying double charges to strangers?

If there is any justification for the charge, we shall be very glad to afford space for its insertion.

SHARPEST FROST IN OCTOBER FOR HALF-A-CENTURY.

WHOLE winters pass sometimes without a frost as sharp as that of October 28th, 1890; we therefore give a few particulars of it.

The following table gives in column 1 the date of every year since 1840 in which the temperature at Greenwich has in October fallen below 30°; column 2 gives the lowest air temperature in those Octobers; and column 3 the date on which it was recorded. The last two columns refer to Camden Square, London, and give the minima for the same months and years as were characterized by exceptional frosts at Greenwich.

* We have often had to refer to the good work done for Meteorology by the Rev. Leonard Jenyns (now Rev. Leonard Blomefield), and although we are not aware at what date this surcharge was first made, we have an impression that Mr. Jenyns's *Observations in Meteorology* (1858), which we have just been reading while it accords remarkably with the above hypothesis, possibly gives the actual date of the origin. The following is an epitome of the facts he records. On August 2th, 1843, tremendous thunderstorms occurred in various parts of England, and in the vicinity of Cambridge (which is only just outside the surcharged area—about two miles outside to the S.S.E.), it was accompanied by tremendous hail, many rooks and pigeons, as well as smaller birds, were killed by it, the damage in the University and town was considered to exceed £25,000. One farmer at Quy (about two miles outside the radius to the S.E.) suffered to the extent of £2,000, and three hours after the storm the hail in that parish was so deep that a gentleman's horse could not pull the carriage through it, and when the owner got out to make a track for the wheels, he *sank up to his knees*. If all this had but happened inside the area instead of outside, we should have considered the puzzle solved. Is it possible that the authorities were shaky as to their geography?

It will be noticed that occasionally the dates are very different.

YEAR.	LOWEST TEMPERATURE IN OCTOBER.			
	GREENWICH.		CAMDEN SQUARE.	
	Temperature.	Date.	Temperature.	Date.
	°		°	
1842	28·3	20	No observations.	
1843	28·5	18	,,	,,
1859	26·5	24	26·6	24
1862	28·5	30	31·8	30
1868	29·3	20	27·8	19
1869	27·9	28	26·6	28
1872	29·1	14	31·8	13
1873	26·7	29	26·2	30
1877	28·2	18	30·9	19
1880	29·2	30	29·6	30
1881	26·2	17	27·3	17
1887	25·3	13	25·4	26
1888	27·9	8	28·2	8
1890	24·7	28	23·8	28

It is remarkable that instead of the last 25 years including, as theoretically it should have done, half of the instances of low temperature, it contains 10 out of 14; moreover, the lowest, and the lowest but one, have both occurred in the last four years. This last October gives the absolute lowest both for Greenwich and for Camden Square.

But it was still colder in the more central parts of England. We cannot vouch for all the following readings being from verified thermometers, with no spirit at the top of the tubes, and duly hung in Stevenson's screens, but their general consistency shows that there is not much the matter. We give the readings in the order of temperature, starting with the lowest, and in order to keep the table within reasonable length, stopping at 22°; but we may add that in the greater portion of Scotland and Ireland the weather was not at all severe.

Lowest Temperatures on 27th–28th Oct., 1890.

County.	Station.	Observer.	Temp.	Date.
			°	
Leicester ...	Barkby Vic.	Rev. E. N. Pochin... ...	16·0	27th
Derby	Willington.....	Rev. G. A. Smallwood.	16·0	28th
Roxburgh ...	Melrose, Abbey Gate ...	Mr. Dodds	17·8	28th
Ayrshire... ..	Old Cumnock	Mr. J. Ballantine	18·0	27th
Herts	Broxbourne	G. J. Newbery, Esq. ...	19·0	27th
Bucks	Winslow, Addington ...	Mr. Mathison	19·0	28th
Surrey	Reigate, Holmfels	Miss Baker	19·4	28th
Leicester ...	Loughboro', Victoria St..	W. Berridge. Esq.....	20·0	28th
Lincoln	Boston	W.H.Wheeler, Esq.CE	21·0	28th
,, ...	Horncastle (Hemingby).	Rev. E. S. Bengough ..	21·0	28th
Montgomery.	Carno (Tybrith)	Miss Marsh	21·0	27th
Yorkshire ...	Wakefield	Dr. Clarke	21·2	28th
Hampshire ..	Strathfield Turgiss	Rev. C. H. Griffith ...	21·7	28th

GREENWICH MEAN TEMPERATURES.

To the Editor of the Meteorological Magazine.

SIR,—May I point out how misleading the Greenwich method of calculating the mean temperature of months is apt to be? I do not precisely understand what that method is, but it certainly is *not* the mean of the max. and min. temperatures, but a value obtained by the aid of certain corrections, which, as we are expressly warned, are not applicable to localities other than Greenwich. This must be clearly borne in mind in making comparisons between the mean temperature of Greenwich and that of other places, as probably most people's idea of mean temperature is the mean of the max. and min.; certainly it is that of the large majority who only read their thermometers once in 24 hours.

For instance in the paper on the "Climate of Brighton," quoted in your September number, Mr. Sawyer places the mean temperature of Brighton and of Greenwich for September, October and November in parallel columns, and heads them, "arithmetical mean daily max. and min. temperatures." This is no doubt a correct description of his own Brighton values, but a totally incorrect one of the Greenwich values. The following are the actual values for Greenwich on the mean of 1841-88 :—

	Max.		Min.		Mean.	Mean in Mr. Sawyer's paper.
September.....	67·2	.....	49·1	.....	58·1	56·6
October	57·8	.....	43·2	.....	50·5	49·5
November	48·8	.....	37·6	.....	43·2	42·4

thus agreeing very closely with the Brighton values, and the whole theory as to the higher mean temperature of the latter place falls to the ground. I have taken the period 1841–88, for Greenwich, as the longest during which observations have been kept on a uniform system at the observatory, and the results made accessible to outsiders, though perhaps it would be more accurate to have taken exactly the same period as at Brighton, but Mr. Sawyer does not state distinctly what that was. I have discovered with some trouble that what Mr. Sawyer has adopted for Greenwich, are certain values called "mean temperature at Greenwich for 118 years," and probably he knows no more than I do how they have been obtained. It must, however, be evident that they are quite unsuitable for comparison with ordinary people's mean values, which in nine cases out of ten are the mean of the max. and the min.

It seems a pity that some uniform method of calculating mean temperature is not settled on authority, so that all values may be strictly comparable.

Yours faithfully,
G. VON U. SEARLE.

BAROMETRIC DEPRESSIONS.

To the Editor of the Meteorological Magazine.

SIR,—I have been very much interested in the computation by Mr. Dines, of the energy stored up in our storms in the form of vapour to be set free on its condensation. It is a little singular that, with the exception of Prof. Mohn, of Christiania, no theorist has undertaken such calculation, as far as I know, though it would seem a legitimate field for airy fancies. I can see that in Europe where storms (cyclones) have erratic paths, and very slow motion, Espy's stationary cyclone theory might be accepted largely, but in this country where storms not infrequently have velocities of 40 or 50 miles per hour, such a theory seems doubtful. More than that, it is conceded that the upper part of a storm travels twice as fast as the lower part; so Mr. Dines's steam cylinder, which must be vertical if it is to act at all, in a very few minutes would become nearly horizontal, and he would lose his ascending current, and all its supposed power. In this country, too, nearly all our rain, thunderstorms and tornadoes occur 400 miles from the storm centre. It seems to me this consideration alone is fatal to all his computations. To take a certain rainfall over a limited area, and compute the amount of energy to be developed by determining the amount of steam in the free air, would be about as valuable as it would be to compute the amount of energy stored up in an ice house, and set free when it is set on fire. If there were a rarefaction as supposed in the atmosphere due to the liberation of latent heat, would not this partial vacuum be filled almost at once by the surrounding air rushing in? Would it be possible to maintain such an uprushing current as theory demands more than a very few minutes? The great need of meteorology to-day is to establish the fact of an uprush of air in the centre of our storms, and after that is done, that would be the best proof in the world that that has nothing to do with our storms, because there is no rain there, just exactly where it should be if there is any uprush.

H. A. HAZEN.

October 21, 1890.

To the Editor of the Meteorological Magazine.

SIR,—It appears to me that when Mr. Ryves complains of the treatment he has received, he should remember the proverb, "He who plays at bowls must expect rubbers."

With respect to his letter to you, pp. 138–9, I remark when he speaks of "the piling up of air in huge anti-cyclones," he has virtually assumed what, if I remember correctly the beginning of the discussion, was the point to be proved. The term "depression" was originally applied to the curve in the daily barometric chart as affected by a cyclonic or other storm. Then when weather charts of large districts became common, the idea of depression was strengthened by the similarity to maps of districts drawn with contour lines to

denote the physical features of the earth; but that such charts denote a pit in the atmosphere any more than an anti-cyclonic area denotes a piling up, seems opposed both to observation and sound reasoning.

Your obedient servant,

JOHN SLATTER.

Whitchurch, Oxon, 23rd Oct., 1890.

To the Editor of the Meteorological Magazine.

SIR,—Nothing could possibly have been further from my intention than to inflict pain by recommending study. That the tone of my letters should have produced this result is to me a matter of deep regret.

Not being surprised that Mr. Ryves should prefer to my garrulity the reserve of my friend, the Hon. Ralph Abercromby, I wonder that he does not himself follow the wiser path. However, he has given us an interesting historical account of conclusions to be derived from Sir J. Herschel's theory, which is very far from being "unmitigated nonsense."

To return to modern times, those readers who wish to follow the most recent development of the question will find, in addition to Ferrel's works, much of interest in late papers in the "Amer. Met. Journal;" also on the anti-condensation view in the American Weekly "Science," and above all in Prof. Hann's most valuable "Remarks on the Temperature in Cyclones and Anti-cyclones," "Met. Zeitschrift," Sept. 1890, pp. 328–344.

I hope hereafter to shew that the high temperature prevailing at the altitude of a few thousand feet in our winter anti-cyclones is the necessary concomitant of the downward flow of the atmosphere in these systems. The subject, which is highly important, is too wide for a letter.

I should be the last man to wish, or to dare, to administer a "knock" to Dr. Muirhead. He appealed to common sense, and his appeal was unanswerable; observation proves that in every cyclone the winds near the earth incurve towards the centre, and curve out aloft, and in every anti-cyclone curve out near the earth's surface, and incurve above; so that we can (for once without mathematics), conclude that the air ascends in the first kind of system, and in the second descends. Thus, in a cyclone the isobaric surfaces, near the earth, are convex to the latter; somewhere above they are concentric to it; and further up they are concave to it. In an anti-cyclone, near the earth, isobaric surfaces are concave to the earth's surface; somewhere further up they are concentric to it; and further up still they are convex to it. Observation, however, everywhere indicates.

I. That these systems are far from extending to any hypothetical limit of the atmosphere.

II. That their axes are rarely, if ever, perpendicular to the earth's surface.

III. That these lines are usually far from being right lines.

Yours truly, W. CLEMENT LEY.

REVIEWS.

Note sur une trombe d'eau dont la bouche est en bas et dont le corps est horizontal et peut avoir quinze cents fois son diamètre, par M. D. COLLADON. [Extrait des *Archives des Sciences physiques et naturelles.*] Genève, 1890. 8vo. 10 pages.

THE first half of this paper deals chiefly with the views of M. Faye, as stated in his *Sur les tempêtes*, and with the very beautiful arrangement whereby Prof. Colladon produced artificial waterspouts by rotating the surface of water in a large vessel. The author also refers briefly to a case in which the upward movement of the air was rendered very conspicuous by its whisking a lot of linen laid out to dry, up to an altitude of more than 1,500 feet, and then scattering it on the other side of the town. As the sun was shining, the white linen enabled the whole phenomenon to be traced with ease.

In the latter part of the paper (in illustration of which he has been kind enough to send us two photographs) he describes a very curious phenomenon, which he calls a horizontal waterspout, which is produced at some sluices at Geneva. The sluices are of a form not usual in England, but the nature of which may be indicated by some homely illustrations. Imagine a bridge very strong, and with arches of only 4 ft. span; imagine, secondly, a series of planks like very thick Venetian blinds, which, instead of drawing up like blinds, can be rolled up like a carpet; if one of these rolls is unrolled and dropped in front of the arch it will close it, and if all the rolls are let down no water can go through the bridge. It is found that occasionally, when the centre sluices are down (*i.e.*, closed), and the side ones are up, so that the water is running through the two ends, a hollow snake-like tube of air is formed from each end, which runs back, and the two join into one; this tube varies in size, but is from half-an-inch to four inches in diameter, and has sometimes been seen to be 50 ft. long.

Water swirls have, of course, received consideration in treatises on hydrodynamics, and their paralellism with air motions has been considered, especially by Hirn*, but Professor Colladon has carried the research much further. The phenomenon is certainly a very curious one, and we are glad that its study is in such competent hands.

---

* *Etude sur une classe particulière de Tourbillons qui se manifestent, sous de certaines conditions spéciales, dans les liquides. Analogie existant entre le mécanisme de ces Tourbillons et celui des Trombes*, par G. A. HIRN. Paris, 1878. 8vo., 40 pages, 3 plates.

A Comparison between the Jordan and Campbell-Stokes Sunshine Recorders. By F. C. BAYARD, LL.M., F.R.Met.Soc. [From *Quar. Jour. Roy. Met. Soc.*]

WE call attention to this paper because we believe that few persons are aware of the difference between the records of *sunshine* by the Campbell-Stokes burning instrument, and of the *sunlight* by the Jordan photographic one.

Mr. Bayard, as the result of observations on 355 days during 1888 and 1889, found the duration to be—

	Sunshine.		Sunlight.
Summer	100		121
Autumn	100		120
Winter	100		146
Spring	100		131
Year	100		130

Stronger evidence of the necessity for avoiding confusion between the two modes of observation could hardly be imagined.

A WARM DRY SEASON.

To the Editor of the Meteorological Magazine.

SIR,—As another month has closed with a rainfall very much below the average, I think it well to write to you to mention the following facts relating to this very extraordinary season. The total rainfall for the first ten months of this year is only 19·05 in., the smallest amount registered at this place since 1830, except in the years 1842, 1844, 1854 and 1887, in all of which it was slightly less. While in London and the eastern part of the country, the ground was soaked with rain in June and July, here it has been so dry all through the summer and autumn that it has been almost impossible to work it. In many places springs have failed and are failing now, that have never been known to fail before.

Then again, although the mean temperature of the four months, June, July, August and September, was higher than in any year since 1878, except 1884 and 1887, the maximum temperature (77°·3) is the lowest but two since 1860. In the year 1862, the thermometer never rose above 75°, and in 1883, never above 77°. In 1879, the coldest summer but one (1888) on record, the thermometer reached 77°·7 one day which is slightly above the maximum for this year, and in 1888 it touched 81°·3 on the 10th of August. If, however, the number of days be taken on which the thermometer has reached 70°, it will be found that the number for this year is vastly in excess of that for either of the other years. This year the number has been 52, and in 1862, 1879, 1883 and 1888 it was respectively, 19, 15, 39 and 19.

Another curious thing about this year is that from June 8th to October 8th, the maximum was never below 60°, a length of time which is, I think, almost unprecedented.

Yours truly,

T. H. NEWPORT DAVIS.

Orleton, Tenbury, November 6th, 1890.

SUPERNUMERARY RAINBOWS.

THERE must have been exceptional uniformity in the rain showers which passed over the South-East of England on the afternoon of Sunday, August 24th, for supernumerary rainbows were seen by Captain Maclear, R.N., and by Rev. H. G. Wooley, from the neighbourhood of Guildford, and by Mr. Symons from Brighton. The phenomenon is not a very common one; it consisted of a series of bands of colour close to the violet on the inside of the primary bow. Captain Maclear described them as (proceeding inwards) Red, Green, Purple, Green, Purple; Mr. Wooley, in the same order, called them Neutral, Purplish red, Neutral, Purplish red, Neutral, Purplish red; and Mr. Symons as Red, Green, Red, Green, Red, Green.

Captain Maclear very neatly describes them as "not very bright nor definite, but patchy in density and colouring, and this patchiness varied in position." These supernumerary arcs were at no time more than 20° of the total bow, but they were sufficiently distinct to attract the attention of many who were not meteorologists.

GREAT RAINS AT MADRAS, 1803-88.

To the Editor of the Meteorological Magazine.

SIR,—In the account of the great rainfall at Hong Kong in your May number there is a reference to the fall at Madras in 1846. Perhaps the enclosed return (sent me by a brother) of the rainfall registered at the Royal Observatory, Madras, in 24 hours, during the present century, may interest some of your readers.—Yours faithfully,

C. S. PRINGLE.

Beckenham, 15th September, 1890.

Rainfall in 24 *hours in the present century, as registered at the Royal Observatory, Madras.*

			Inches.				Inches.
1803.	Nov.	18	8·27	1836.	Nov.	27	7·77
1811.	May	(?)	16·38	,,	Nov.	20	9·65
1813.	Nov.	3	7·90	1846.	Oct.	21	20·58
1815.	Nov.	28	8·63	1851.	May	4	11·45
1819.	Sept.	12	10 00	,,	Nov.	4	7·90
1820.	May	9	11·12	1857.	Oct.	24	18·04
1822.	Nov.	4	7·83	1864.	Nov.	18	9·35
1825.	Oct.	29	8·88	1866.	Dec.	5	7·99
1827.	May	9	12·08	1872.	May	18	13·01
				1888.	Oct.	31	9·20

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, 1889.

REGULAR readers of the *Magazine* will be familiar with the fact that in the Annual Summaries of the Climate of the British Empire, the extremes are monopolised year after year by the same stations.

For the last five years Adelaide has recorded the highest temp. in shade, reaching 112°·4 in 1886, but Calcutta has once or twice approached it very nearly. The opposite extreme is similarly held by Winnipeg, but without rivalry, for only once does any other station come within 20° of it. With an extreme min. of —46°·4, or nearly 80° below freezing point, a rival is perhaps neither to be expected nor desired. Winnipeg might well boast of a *lively* climate, for in addition to the above it holds the first rank for extreme range (the temp. in 1886 having risen to 103°) for mean daily range, for lowest mean temp., and is robbed by Toronto of another well deserved glory from the fact that readings of the min. on grass are not taken. Still one more honour has to be added to the long list, for this year Winnipeg has the smallest rainfall.

The least mean daily range is affected by the absence from the table of Barbados, but Mauritius has an almost equally uniform climate. Similarly Bombay usurps the place usually held by Colombo, which year after year records a mean temp. exceeding 80°.

Adelaide, in addition to the highest temp. in shade and in sun, has the driest atmosphere, the mean humidity in the five years ranging from 56 to 63; this station has also once recorded the smallest rainfall.

For moisture several of the insular stations run very closely together, but London—perhaps by the aid of its fogs—carries off the palm most frequently, and for amount of cloud it comes near the head of the list.

Malta, with little more than half the cloud of London, added to its other attractions, seems very enticing to a denizen of the metropolis with its winter mantle of fog.

SUMMARY.

Highest Temperature in Shade .....109°·0 at Adelaide on January 13th.
Lowest Temperature in Shade..... – 42°·6 at Winnipeg on February 23rd.
Greatest Range in Year .....139°·2 at Winnipeg.
Least Range in Year ....26°·4 at Mauritius.
Greatest mean Daily Range.....24°·5 at Winnipeg.
Least mean Daily Range..... .....9°·9 at Mauritius.
Highest mean Temperature.....80°·5 at Bombay.
Lowest mean Temperature .....35°·9 at Winnipeg.
Driest Station .....Adelaide mean humidity, 63.
Dampest Station ....London mean humidity, 81.
Highest Temperature in Sun .....170°·7 at Adelaide.
Lowest Temperature on Grass..... – 18°·6 at Toronto.*
Greatest Rainfall .....73·79 in. at Trinidad.
Least Rainfall ..... 14·95 in. at Winnipeg.
Most Cloudy Station.....London, average amount, 6·6.
Least Cloudy Station.....Malta, average amount, 3·7.

* There being no grass min. thermometer at the other Canadian stations.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE FOR 1889.

Stations. *Those in Italics are South of the Equator.*	Absolute.				Average.					Absolute.		Total Rain.		Average.
	Maximum.		Minimum.		Max.	Min.	Mean.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	Cloud.
	Temp.	Date.	Temp.	Date.										
	°		°		°	°	°	°		°	°	in.		0—10
England, London ...	84·5	June 6	19·2	March 4	56·8	42·7	49·8	43·2	81	126·3	13·5	23·84	169	6·6
Malta	104·1	July 20	40·8	March 17	72 3	58·9	65 6	55·6	75	158·8	34·9	26·04	89	3·7
Cape of Good Hope.	98·3	January 24	32·4	August 2	70·2	53·5	61·9	...	...	...	...	30·98	...	5·0
Mauritius	84·4	January 2, 14	58·0	June 18	78·5	68·6	73·6	64·8	76	142·3	48·5	56·19	208	5·9
Calcutta	101·8	May 2	48·6	January 2	86·7	71·1	78·9	70·8	75	161·2	37·4	57·47	129	4·1
Bombay	94·3	March 6	63·8	January 15	86·1	74·9	80·5	71·9	76	147·7	49·8	67·84	103	3·9
Melbourne	99·8	December 26	31·3	July 12	67·2	50·0	58·6	48·6	71	152·3	23·4	27·14	125	5·9
Adelaide.....	109·0	January 12	36·3	July 19	71·7	53·9	62·8	49·3	63	170·7	29·0	30·87	143	5·1
Wellington	80·0	January 24	31·5	June 13	62·1	48·6	55·4	47·2	75	139·0	23·0	31·37	155	4·1
Trinidad.....	96·0	May 10	60·0	January 19	88·8	70·1	79·5	72·4	78	161·5	54·0	73·79	...	..
Toronto	88·7	July 8	—11·3	February 6	53·2	37·7	45·5	39·1	77	...	—18·6	31·24	179	6·3
New Brunswick, Fredericton.....	91·7	May 19	—33·0	February 24	52·7	32·7	42·7	37·3	74	...	...	39·15	148	5 8
Manitoba, Winnipeg	96·6	August 30	—42·6	February 23	48·2	23·7	35·9	30·2	77	...	...	14·95	132	5·2
British Columbia, Victoria	85·0	July 8, 9	24·0	January 14	58·7	41·8	50·2	...	...	...	...	18·56	103	...

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, APRIL, 1890.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	TotalRain. Depth.	TotalRain. Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		0-10
England, London	64·3	30	30·5	5	54·9	38·7	37·6	83	110·9	23·2	2·02	16	5·9
Malta	75·9	18	45·3	30	67·0	54·7	51·9	78	132·3	37·3	·64	5	4·7
Cape of Good Hope	91·3	1	44·2	14	62·8	54·7	...	...	...	...	2·14	...	5·9
Mauritius	82·4	1	66·8	27	79·3	70·7	68·7	83	139·4	58·8	10·24	22	6·8
Calcutta	105·6	24	67·2	28	95·1	76·5	74·6	71	155·8	61·0	1·00	3	2·5
Bombay	92·8	12	74 5	1	88·4	78·0	74·1	74	144·2	63·5	·01	1	3·0
Ceylon, Colombo	90·1	2	73·0	29	87·6	75·3	72·9	79	149·0	70·0	14·27	27	7·1
Melbourne	87·5	7	40·0	28	69·6	50·6	50·2	71	136·2	34·8	1·82	6	4·6
Adelaide	85·1	5,6	46·4	17	74·4	55·1	49·8	58	144·0	37·6	1·00	7	4·3
Wellington	72·0	11	43·0	24	65·5	53·3	51·0	73	135·0	35·0	3·71	11	4·7
Auckland	72·0	1	50·0	23	68·4	57·3	54·5	74	135·0	40·0	5·52	18	6·6
Jamaica, Kingston	90·3	20	65·0	25	86·3	67·9	66·9	72	...	...	·26	...	...
Trinidad	88·0	11*a*	66·0	3	84·4	70·0	70·1	80	157·0	61·0	7·62	21	...
Toronto	68·4	13	23·5	1	51·7	32·8	32·3	69	...	15·0	2·11	14	5·1
New Brunswick, Fredericton	67·8	23	11·7	2	47·7	27·5	24·0	52	...	...	1·77	7	4·2
Manitoba, Winnipeg	69·8	19	8·4	1	49·2	26·0	29·3	70	...	...	1·21	10	4·9
British Columbia, Victoria	70·0	28*b*	24·0	12	55·7	36·9	...	...	...	...	·86	6	...

a And 21, 28. *b* And 29, 30.

REMARKS.

MALTA.—Mean temp. 59°·3; mean hourly velocity of wind 11·8 miles. Sea temp. rose from 60°·6 to 62°·9. J. SCOLES.

Mauritius.—Mean temp. of air 1°·7 below, of dew point 0°·6 above, and rainfall 4·61 in. above, their respective averages. Mean hourly velocity of wind 8·2 miles, or 2·6 below the average; extremes 21·7 on 6th, and 1·8 on 24th; prevailing direction E.S.E. to E. by N. T and L on nine days; L on five days. Unusually bright and prolonged skyglows before sunrise and after sunset after the 24th.
C. MELDRUM, F.R.S.

CEYLON, COLOMBO.—Thunderstorms occurred on sixteen days, and L only was seen on ten days. J. C. H. CLARKE, Lt. Col. R.A.

Melbourne.—Mean temp. of air 0°·9, and of dew point 0°·8 above average, humidity 1, amount of cloud 1·3 and R ·45 in. below average. Prevailing winds N., S.E., and S. Strong on four days. Heavy dew on nine days, L on the 21st.
R. L. J. ELLERY, F.R.S.

Adelaide.—Mean temp. 0°·5 above the average. The weather, on the whole, was fine and pleasant, but somewhat dry for the season. C. TODD, F.R.S.

Wellington.—Strong winds on the 1st and 2nd, but generally fine weather up to the 11th; from 11th to 18th very showery, unpleasant and oppressive; the remainder of the month fine, with moderate winds, chiefly N. and N.W. Mean temp. 2°·4 above, and rainfall very near, the average. R. B. GORE.

Auckland.—A wet stormy month, the rainfall being 2½ in. above the average. Mean temp. slightly above the average. T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL, OCTOBER, 1890.

[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 Hall.	1·25	XI.	Castle Malgwyn	4·98
,,	Margate, Birchington...	1·43	,,	Builth(LlanwrtydWells)	5·24
,,	Littlehampton	1·29	,,	Rhayader, Nantgwillt..	4·61
,,	Hailsham	1·61	,,	Carno, Tybrith	3·24
,,	Ryde, Thornbrough	1·24	,,	Corwen, Rhug	2·66
,,	Alton, Ashdell.....	1·57	,,	I. of Man, Douglas	2·17
III.	Oxford, Magdalen Col...	1·14	XII.	Stoneykirk, Ardwell Ho.	2·59
,,	Banbury, Bloxham	1·13	,,	New Galloway, Glenlee	3·65
,,	Northampton	1·31	,,	Melrose, Abbey Gate...	1·88
,,	Cambridge, Fulbourne..	2·16	XIII.	N. Esk Res. [Penicuick]	4·35
,,	Wisbech, Bank House..	1·07	XIV.	Ballantrae, Glendrishaig	2·19
IV.	Southend	·89	,,	Glasgow, Queen's Park.	3·00
,,	Harlow, Sheering	1·67	XV.	Islay, Gruinart School..	5·02
,,	Rendlesham Hall	1·33	XVI.	Dollar.....	5·15
,,	Diss	1·49	,,	Balquhidder, Stronvar..	6·52
,,	Swaffham	1·89	,,	Coupar Angus Station..	2·06
V.	Salisbury, Alderbury...	·56	,,	Dunkeld, Inver Braan..	2·18
,,	Warminster	...	,,	Dalnaspidal H.R.S. ...	7·17
,,	Bishop's Cannings	1·23	XVII.	Keith H.R.S.	5·04
,,	Ashburton, Holne Vic....	2·67	,,	Forres H.R.S.	2·88
,,	Hatherleigh, Winsford.	...	XVIII.	Fearn, Lower Pitkerrie.	2·54
,,	Lynmouth, Glenthorne.	3·09	,,	Loch Shiel, Glenaladale	19·61
,,	Probus, Lamellyn	3·11	,,	N. Uist. Loch Maddy ...	9·23
,,	Launceston, S. Petherwin	3·16	,,	Invergarry	7·75
,,	Wincanton, Stowell Rec.	1·87	,,	Aviemore H.R.S.	4·27
,,	Taunton, Lydeard Ho...	...	,,	Loch Ness, Drumnadrochit	4·54
,,	Wells, Westbury.....	2·05	XIX.	Lairg H.R.S.	7·73
VI.	Bristol, Clifton	1·67	,,	Scourie	8·18
,,	Ross	1·25	,,	Watten H.R.S.	4·63
,,	Wem, Clive Vicarage ...	1·60	XX.	Dunmanway, Coolkelure	4·19
,,	Cheadle, The Heath Ho.	2·30	,,	Fermoy, Gas Works ...	1·53
,,	Worcester, Diglis Lock	1·09	,,	Tipperary, Henry Street	2·71
,,	Coventry, Coundon	1·72	,,	Limerick, Kilcornan ...	2·12
VII.	Ketton Hall [Stamford]	1·24	,,	Miltown Malbay.....	3·65
,,	Grantham, Stainby	1·11	XXI.	Gorey, Courtown House	1·51
,,	Horncastle, Bucknall ...	·90	,,	Navan, Balrath	1·19
,,	Worksop, Hodsock Priory	1·01	,,	Mullingar, Belvedere ...	2·06
VIII.	Neston, Hinderton	2·96	,,	Athlone, Twyford	2·44
,,	Knutsford, Heathside ...	2·36	,,	Longford, Currygrane...	2·29
,,	Lancaster, South Road.	3·26	XXII.	Galway, Queen's Coll...	2·81
,,	Broughton-in-Furness ..	6·08	,,	Clifden, Kylemore	6·12
IX.	Wakefield Prison	·65	,,	Crossmolina, Enniscoe..	3·39
,,	Ripon, Mickley	·74	,,	Collooney, Markree Obs.	4·18
,,	Scarborough, West Bank	2·21	,,	Ballinamore, Lawderdale	2·94
,,	East Layton[Darlington]	1·60	XXIII.	Warrenpoint	1·37
,,	Middleton, Mickleton..	2·07	,,	Seaforde	1·47
X.	Haltwhistle, Unthank..	2·25	,,	Belfast, New Barnsley..	3·14
,,	Shap, Copy Hill	2·30	,,	Bushmills, Dundarave...	3·47
XI.	Llanfrechfa Grange	1·23	,,	Stewartstown	1·86
,,	Llandovery	4·80	,,	Buncrana	3·96

OCTOBER, 1890.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average, 1880–9	Greatest Fall in 24 hours. Dpth	Greatest Fall in 24 hours. Date.	Days on which ·01 or more fell.	TEMPERATURE Max. Deg.	Max. Date	Min. Deg.	Min. Date	No. of Night below 32° In shade.	No. of Night below 32° On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	1·20	— 1·69	·28	25	13	68·5	4	23·8	28	2	7
II.		Maidstone (Hunton Court)...	1·05	— 2·41	·38	26	10	...	...	...	...	...	...
,,		Strathfield Turgiss	1·15	— 1·69	·31	25	16	67·0	5	21·7	28	4	8
III.		Hitchin	1·57	— 1·50	·45	7	11	64·0	1, 4*c*	29·0	27	1	...
,,		Winslow (Addington)	1·24	— 1·85	·38	7	12	72·0	4	19·0	28	7	11
IV.		Bury St. Edmunds (Westley)	1·85	— 1·42	·54	7	13	...	...	...	...	...	...
,,		Norwich (Cossey)	1·69	— 2·15	·32	31	14	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	1·18	— 2·36	·27	25	14	65·0	6	32·0	28	1	...
,,		Barnstaple.....	2·90	— 2·19	·62	31	14	69·0	15	33·0	20	0	...
,,		Bodmin (Fore Street)	4·50	— 1·50	·83	26	20	...	...	...	...	...	...
VI.		Stroud (Upfield)	1·37	— 1·66	·37	25	12	67·0	3	29·0	27	2	...
,,		ChurchStretton(Woolstaston)	2·12	— 1·65	·44	6	18	64·5	4	31·0	28	2	6
,,		Tenbury (Orleton)	1·33	— 1·88	·32	7	16	69·5	4	26·8	28	5	7
VII.		Leicester (Barkby)	1·37	— 1·78	·43	16	13	68·0	6	16·0	27	5	14
,,		Boston	·85	— 2·26	·18	15	11	75·0	4	21·0	28	4	...
,,		Hesley Hall [Tickhill].....	·86	— 2·24	·20	28	11	69·0	12	24·0	28	3	...
VIII.		Manchester(PlymouthGrove)	2·38	— ·99	·45	16	18	70·0	12	23·0	27	2	8
IX.		Wetherby (Ribston Hall) ...	·62	— 2·51	·14	16*a*	5	...	...	...	...	...	...
,,		Skipton (Arncliffe)	4·45	— 1·58	·81	6	20	64·0	1	29·0	27	2	...
,,		Hull (PearsonPark)	1·19	— 2·46	·24	26	14	...	...	...	...	...	...
X.		North Shields	2·42	— ·53	·65	26	16	65·0	5	..	...	...	4
,,		Borrowdale (Seathwaite).....	11·64	+ 1·05	1·56	14	21	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	2·15	— 2·39	·47	7	17	...	...	...	...	...	...
,,		Haverfordwest	3·10	— 2·05	·65	6	18	64·0	6	35·1	9	0	4
,,		Plinlimmon (Cwmsymlog) ...	6·51	...	1·18	6	16	...	...	...	...	...	...
,,		Llandudno.....	1·74	— 1·65	·32	25	16	66·3	10	35·8	23	0	...
XII.	SCOTLAND.	Cargen [Dumfries]	1·50	— 1·76	·44	14	12	62·4	12	23·0	28	4	...
,,		Jedburgh (Sunnyside).....	1·54	— 1·11	·26	14	13	64·0	4	29·0	28	3	...
XIV.		Old Cumnock	3·70	+ ·30	·58	14	19	62·0	5, 10	18·0	27	9	...
XV.		Lochgilphead (Kilmory).....	6·33	+ 1·54	·97	14	27	...	...	27·0	27	3	...
,,		Oban (Craigvarren)	8·76	...	1·75	2	26	58·0	12	32·5	26	0	...
,,		Mull (Quinish).....	7·83	+ 2·54	1·16	2	27	...	...	...	...	...	...
XVI.		Loch Leven Sluices.....	3·10	+ ·14	1·00	31	12	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	2·00	— ·24	·50	30	12	64·6	5	29·0	28	3	...
XVII.		Braemar	4·45	+ ·84	1·15	16	21	61·0	10	28·4	27*f*	3	11
,,		Aberdeen (Cranford)	3·54	...	·61	1	22	72·0	12	31·0	27	4	...
XVIII		Strome Ferry.....	10·41	+ 4·74	2·11	28	29	...	...	...	...	...	...
,,		Inverness (Culloden)	3·73	+ 1·48	·77	1	...	63·0	5	29·0	26*f*	3	7
XIX.		Dunrobin	...	...	...	...	...	...	...	...	...	...	...
,,		S. Ronaldsay (Roeberry).....	4·74	+ 1·01	1·26	2	24	60·0	12*d*	32·0	27	1	...
XX.	IRELAND.	Cork (Blackrock).....	1·24	— 2·43	·62	6	8	69·0	4	35·0	1, 26	0	...
,,		Dromore Castle	5·59	— .05	1·50	6	14	64·0	7	32·0	26	1	...
,,		Waterford (Brook Lodge) ...	1·46	— 2·36	·58	6	11	65·0	4	35·0	2*g*	0	...
,,		O'Briensbridge (Ross)	3·43	...	1·26	6	16	67·0	1	37·0	16	0	...
XXI.		Carlow (Browne's Hill)	2·18	— 1·11	·75	6	17	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	·64	— 2·74	·16	25	11	65·2	5	34·2	27	0	3
XXII.		Ballinasloe	2·01	— ·98	·30	24	18	60·0	10*e*	31·0	27	3	...
XXIII		Waringstown	1·80	— ·91	·32	6	15	64·0	4	31·0	26	2	5
,,		Londonderry (Creggan Res.).	3·50	— ·17	·43	15	21	..	...	...	...	...	...
,,		Omagh (Edenfel)	2·81	— ·29	·32	6*b*	19	61·0	5	33·0	26	0	3

a And 30. *b* And 25, 30. *c* And 5, 6. *d* And 13. *e* And 11. *f* And 28. *g* And 26, 27.
+ Shows that the fall was above the average ; —that it was below it.

METEOROLOGICAL NOTES ON OCTOBER, 1890.

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.—A fine mild open month with a high temperature in the early portion. A very sharp and short burst of cold occurred from 25th to 28th, the grass min. on the morning of the latter day, falling to 18°·9.

ADDINGTON.—There were many very fine days during the month, but dense fogs occurred on 11th and 22nd. Towards the end of the month a remarkable and sudden change of temp. occurred; on the morning of the 28th the min. in shade fell to 19°, it was cold all day, frosty in the evening up to 7 o'clock, when a change took place, and by 9 a.m. on the 29th the temp. had risen to 47° and to 59° by mid-day.

BURY ST. EDMUNDS, WESTLEY.—A beautiful autumnal month; very mild, except on the 27th, when there was a sharp frost; S fell on 26th.

LANGTON HERRING.—On the whole a very fine month. The temp. which in the last week was remarkably variable, was on the whole a little less than 1° above the average for 18 years. On the 28th the min. was 32°, on the 30th the max. was 61°, the greatest range remembered in so short a time. Fogs on 12th, 13th and 22nd; T on 26th.

BODMIN, FORE STREET.—Splendid weather to the 24th; on the 26th and 27th H, sleet, heavy R, high wind, T and L, then much milder to the end; the last night very stormy and wet.

STROUD, UPFIELD.—This neighbourhood was greatly in want of water, most of the springs having run dry, and many wells failed.

WOOLSTASTON.—A beautiful autumn month; mean temp. 49°·8. A heavy storm of H occurred on the 15th, and S fell lightly on 25th, and two following days.

ORLETON.—Another very fine dry month, with the R much below the average. Rather unusual extremes of temp. occurred; many of the days being quite hot, and others excessively cold for the time of year. Mean temp. of the month slightly above the average. A heavy snow storm on the morning of the 26th, covered the ground to a depth of 1½ inches on the high ground.

BARKBY.—A fine month. Sudden and very hard frost on the 16th, and the leaves of many kinds of trees came off in one night; considerable scarcity of water, brooks and springs very low. T and L on 15th, T L and H on 16th.

MANCHESTER, PLYMOUTH GROVE.—Fine autumn weather from 2nd to 13th and also on the 18th, 19th, 24th and 30th. On the morning of the 27th, the min. on grass fell to 17°, the lowest temp. in October for 24 years, The rest of the month very unsettled, cold, wet and stormy. H on 25th. Sleet on 28th. Mean temp. 48°·5.

HULL, PEARSON PARK.—The weather during the month was generally fine; often bright and clear, but showery from the 24th to the end.

WALES.

HAVERFORDWEST.—Generally damp and wet throughout, but some very fine days with bright sunshine, as R frequently fell during the night. On the 26th the wind veered to N.W., with much lower temp., H fell in vast quantities through the day, with squalls of wind, and a terrific display of L occurred from 6 to 9 p.m.; a terrible H storm, accompanied by loud T, occurred on the morning of the 27th, Precelly was white and the air very cold. The month ended wet and milder. Prevailing winds W. and N.W.

SCOTLAND.

CARGEN.—The mean temp. of the month 49°·4, is 1°·4 above the average, the fluctuations of the bar. and ther. during the month were very marked, pressure varying on several occasions upwards of half an inch in 24 hours. The first 17 days of the month were unusually mild, the mean temp. on eight nights

during the first thirteen, ranging from 50° to 55°·8. Sudden alterations in temp. occurred in the latter part of the month; the min. temp. on the night of the 28th being 23°, on the 29th 49°·2, on the 30th 34°, and the 31st 45°. On the whole the month was gloomy and damp. Sunshine considerably below the average.

JEDBURGH.—The weather on the whole was very seasonable and favourable for all out-door work, and the cereal crop in high districts was all secured in good order. Snow on 26th.

OBAN.—After so wet a summer such a large R in October was most unexpected. All harvesting ceased, and the corn remained out in many places to the close of the month.

MULL, QUINISH.—The wettest summer and autumn ever known in this district.

ROEBERRY.—A very rough and wet month throughout, with a heavy fall of S on 27th.

IRELAND.

CORK.—An unusually fine month. Mean temp. 53°·3.

DROMORE.—The latter part of the month was very wet and stormy, with very heavy showers of H on 25th and 26th. The mountains being white with S winter seems to be setting in very early.

WATERFORD, BROOK LODGE.—Mean temp. 51°·8. S on the Comeragh Mountains on the 26th; L on 27th

O'BRIENSBRIDGE, ROSS.—Two periods of six days each of very fine autumn weather occurred. Temp. high for the season; stormy winds from S.W. in the last week.

DUBLIN.—The month will be remembered as one of the driest, finest and mildest Octobers on record. During the first fortnight the temp. was almost always above the average; on the 25th a cold period set in, which culminated on the 27th, and was followed by mild, dull and damp weather to the end of the month. Mean temp. 51°·7, considerably above the average. High winds on 14 days, attaining the force of a gale on the 15th only. Fogs on the 8th, 9th, 11th, 12th and 22nd; L on the 26th; S and sleet on the morning of the 26th; H on the 15th.

WARINGSTOWN.—A most beautiful month on the whole; all late farming operations satisfactorily cleared up. Gardens in beauty to the end. Potato crops in this district excellent.

OMAGH, EDENFEL.—With but little intermission the weather was fine, mild and favourable up to the 23rd, thence to the end very wet, with heavy S on the night of the 25th. Bright aurora on 21st.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCXCIX.] DECEMBER, 1890. [PRICE FOURPENCE, or 5s. per ann. post free.

EXCESSIVE FROST IN NOVEMBER.

IN our last number we had to record an October frost unapproached for at least half a century. We now have to notice a more exceptional frost in November.

This November frost was an extremely remarkable one; (1) because it occurred in the daytime; (2) because it was so local.

As will be seen further on, the temperature fell much lower at other places than it did at Greenwich, or at Camden Square, but as long records are available at those places, it will be well first to examine what occurred at them.

Greenwich.—November 23rd was quite exceptionally warm; the average was 54°·9, which was higher than on any day in the third decade of November during the 60 years, 1814 to 1873. Then a rapid fall of temperature set in, and on the 28th the maximum was 26°·9, the minimum was 18°·3, and the mean 21°·8, which is nearly 2 degrees colder than any other day in November during the above-named long period of 60 years.

Camden Square.—Out of the 32 Novembers ending with that of 1889 there has been one (1888) in which there was no frost, there have been 14 in which the temperature fell below 27°, and four in which it fell below 23°, these cases being as follows:—

AIR TEMPERATURES IN NOVEMBER BELOW 23°.

1858.....	20°·1 on the 24th	1871.....	21°·0 on the 19th
1861.....	21°·8 on the 19th	1887.....	22°·1 on the 17th

In 1890 it fell below all these, excepting 1858—viz., to 20°·8 on the 29th.

It is necessary to explain why the minimum at Greenwich is stated to be on the 28th and at Camden Square on the 29th. The minimum (as will be further explained subsequently) occurred nearly at the same time, 4—5 p.m. on the 28th, at both places, but at Greenwich for many years it has been the custom to record the temperatures as they would have been if read off at midnight. We believe that no readings are now really taken at that hour, but the theory has survived the practice. This minimum was therefore on the Greenwich system correctly set down to the 28th. The rule, however, for

climatological stations is that the maximum read on any morning is to be entered to the day before, but the minimum to the day on which it is read, because in an overwhelming majority of cases the minimum occurs in the early morning hours, and therefore belongs to the day on which (at 9 a.m.) it is read. Hence, in accordance with rule, the entry at Camden Square is for November 29th.

It will probably be most convenient if we reduce the many letters and notes with which we have been favoured, into the form of paragraphs, and sort them into counties, taking the usual "Rainfall" order, and taking the stations in each county as nearly as may be in the order of increasing latitude, *i.e.*, from south to north. The exceptional phenomena of the afternoon and evening of November 28th having been confined to the S. and S.E. of England, records from other parts are not generally quoted. Sharp weather prevailed in most parts of the country, and in the eastern counties it was much colder on the 30th than on the 28th. In those cases in which we are aware of the pattern of thermometer stand, we shall use the abbreviations Stev. for Stevenson's, and Gla. for Glaisher's.

MIDDLESEX.

Edith Road, Kensington.—Min. in Stev. 22°·2.—G. VON U. SEARLE.

Royal Botanic Gardens, Regent's Park.—Temp. in Stev. on November 28th, max. 25°·0; min. 20°·5; 3 p.m. 22°·5; 9 p.m. 23°·0.—W. SOWERBY.

Camden Square, London.—The lowest temp. was 20°·8 on Gla. and 21°·6 in Stev. The Richard thermograph sheet shows that the temperature fell steadily from noon to 5.5 p.m. on the 28th, when the above-mentioned minimum occurred; and it did not rise 1° until about 1 a.m. on the 29th, after which it rose steadily.—G. J. SYMONS.

Pinner Hill.—Min. on 28th, 21°.—H. E. SELLWOOD.

SURREY.

Hall Place, Cranleigh, Guildford.—This house faces S., and is 233 ft. above sea level; at 8 p.m. on 28th a ther. outside a S. window 15 ft. above ground, read 12°, at 11 p.m. 20°, and at 4 a.m. on 29th 22°. —E. S. ROWCLIFFE.

Abinger Hall, Dorking.—The 28th was bitterly cold, our ther. standing at 20° to 22° all day, and going down to 1° for a short time in the evening.—G. PAYNE.

Brockham, Betchworth.—Minimum in Stev., 4°·5.—A. CHEALES.

Holmfels, Reigate.—Min. on 29th, 2°.—F. T. BAKER.

Emlyn House, Leatherhead.—The ther. in my garden, 3 ft. above ground and about 40 ft. above the river Mole, fell until 7 p.m. of 28th, when it registered 5°; there was very little wind.—A. T. MILLER.

Caterham.—In the valley between Caterham and Purley two persons had thermometers which fell to 2°.—CECIL E. BYRON.

Coulsdon.—This village is 520 ft. above sea-level, and here the temperature fell to 4°.—CECIL E. BYRON.

Ingleside, Kenley.—The temperature here fell to 9° in the stand and to 3° on the snow.—HAROLD SMITH.

Purley.—A thermometer outside a greenhouse read 5° at 6 p.m. on the 28th; the severity lasted only about two hours, say 5 to 7 p.m. The fingers of my left hand were so chilled in driving up from the station that on the fifth subsequent day I had recovered feeling in only two of them.—CECIL E. BYRON.

Wallington.—Min. in Stev. on 28th, 10°·3.—F. C. BAYARD.

Ormesby House, Grange Road, Sutton.—Temperature on snow on 28th, at 4.30 p.m., 4°; at 6.30 p.m., 7°; at 7 p.m., 12°; at 9 p.m., 15°·5; and at 11.45 p.m. it had again fallen, and stood at 4°·5, although no apparent change had taken place in the sky, which was uniformly clouded over.—W. THURTELL.

Addiscombe, Croydon.—Minimum in Stev., 10°·3.—E. MAWLEY.

Kew Observatory.—On November 28th, the max. was 25°·5 at 0.35 p.m., from which it fell steadily until 4.8 p.m., when the min. of 21°·5 was reached, and it remained within 1° of that point until after midnight.—G. M. WHIPPLE.

> SEVERE FROST IN SURREY.—The weather here on the 28th ult. was phenomenal with regard to the severe frost. We registered at four o'clock on the above date 24° frost Fahr. [*i.e.*, 8° F.], and at six o'clock the mercury showed 6° below zero. After that time it gradually rose above zero. In the Rev. W. Wilks' garden at Shirley, two miles from here, the thermometer registered 2° below zero; at Warmington, four miles, 5½° below, and at Riverhead, near Sevenoaks, 1° below zero. The shrubs here are turned quite black, the Aucubas especially seem ruined. I may mention that our thermometer registered the above at 6 inches from the ground. Enclosed herewith are a few leaves of shrubs and ivy to show the result.—R. H. COPPIN, *Addington, Croydon.* [The temperatures recorded are extremely low, but the thermometer is too near the ground. The leaves sent are blackened, and evidently the injury is severe.].—*Journal of Horticulture.*

We reprint this paragraph without assuming any responsibility for the accuracy of the thermometers. On the one hand, the records support each other, while on the other hand, one cannot but suspect that there must have been spirit at the top of the tubes or errors in the thermometers themselves.

KENT.

Dungeness.—Min. in air between 8 a.m. 28th and 8 a.m. 29th, 18°.—MET OFF. WEATHER REPORT.

Hythe.—Min. in air on 28th, 15°.—H. B. MACKESON.

Cranbrook.—Min. temp. lower than for 25 years, viz., 10°.—G. PILE.

Goudhurst.—Min. 11°; lowest ever recorded in November.—J. S. CLARKE.

Colebrook Park, Tonbridge.—This house is half-way between Ton-

bridge and Tonbridge Wells, and 350 ft. above sea level; I have usually two Rutherford min. thermometers in use, each about 2 ft. above the ground, and about 300 yards apart; one is an ordinary one by Negretti & Zambra, the other divided on its stem by Beck; each recorded 8° for the evening of the 28th. Finding it very cold, I, in the afternoon of the 28th, put out a third thermometer—a mercurial one. It read as follows:—4.30 p.m., 15°; 5 p.m., 11°; 6.15 p.m., 9°·5; 11 p.m., 14°; but the indices of each of the Rutherford's showed 8°, to which it must have fallen some time between 6.15 and 11 p.m. The night was intensely bright and still.—W. A. SMITH.

East Malling, Maidstone.—A Six's thermometer here fell to 8°. —W. A. SMITH.

Tower Fields, Keston, Farnborough.—The following are the temperatures during the afternoon and evening of 28th:—2 p.m., 21°; 4 p.m., 17°; 6.30 p.m., 14°; 8 p.m., 17°; 10 p.m., 22°; 11 p.m., 23°.—G. BUCHANAN, M.I.C.E.

Foxgrove Road, Beckenham.—On returning from town I felt it very cold; I looked at the thermometer, it was then (6.30 p.m.) 15°, but had been down to 8°; at 10.30 p.m. it had risen to 19°. Thermometer by Browning, 4 ft. from ground, facing N. It is most remarkable that this low temperature should have occurred during the daytime. I am told that there was a gleam of sunshine just before sunset. Was the sudden clearing of the sky the cause of the intense cold?—C. S. PRINGLE.

Foxgrove, Beckenham.—Temp. on Gla. stand on November 28th, 9 a.m., 23°·4; about 5 p.m., minimum 10°; 6.30 p.m., 17°; 10.30 p.m., 19°; max. of day, 27°·5.—P. BICKNELL.

Royal Observatory, Greenwich.—Max. on Gla. stand, November 28th, 26°·9; min., 18°·3; min. in Stev. 18°·0; min. on grass, 18°·1. The temperature fell quite steadily to the min. at 4.20 p.m., and then rose with equal steadiness, rising 0°·8 by 5.5 p.m.—W. ELLIS.

SUSSEX.

Church House, Heene, Worthing.—Min. in Stev. 14°·9, the lowest that I remember recording during 22 years.—W. J. HARRIS.

Prestonville Road, Brighton.—Min. 16°·2; on grass 14°·5.—F. H. PHILLIPS.

South Park, Bodiam, Hawkhurst.—The thermometer here fell to 13° before midnight on 28th, the lowest I have recorded for ten years.—L. M. JACKSON.

Observatory, Crowborough Cross.—Min. in Stev. 11°·3; exposed at 4 ft., 8°·6; on snow, 3°·2. Unprecedented in November during the present century.—C. L. PRINCE.

HAMPSHIRE.

East Tisted Rectory, Alton.—I wonder whether you have received record of any frost equal to that in this notoriously cold valley. My thermometer, 4 ft. above ground, and under its little penthouse

board as usual, stood at 1°, and so did another which had been verified at Kew.—F. HOWLETT.

Ashdell, Alton.—Min. in air on 29th, 14°.—F. CROWLEY.

Strathfield Turgiss.—Min. on 29th in Stev., 17°·6; on grass, 14°·5. —C. H. GRIFFITH.

HERTFORDSHIRE.

Broxbourne.—Min. 17°·0 on 29th.—G. J. NEWBERY.

The Grange, St. Albans.—Min. in Stev., 19°·0.—J. HOPKINSON.

Rosebank, Berkhamstead.—Min. in Stev. 21°·6, and on grass 20°·8 for 29th, but lower for 30th, viz., 20°·0, and 9°·0 on grass. —E. MAWLEY.

Hamels Park, Buntingford.—Min. for 29th 16°.—E. WALLIS.

Hitchen.—Min. 18° on 28th.—W. LUCAS.

BUCKINGHAMSHIRE.

Addington, Winslow.—Min. in Stev., 22° on 28th, 22° on 29th, and 20° on 30th.—J. MATHISON.

OXFORDSHIRE.

Magdalen College, Oxford.—Min. in air on 28th, 22°·5.–E. CHAPMAN.

NORTHAMPTONSHIRE.

Castle Ashby.—Min. 21°·0 on 28th.—R. G. SCRIVEN.

CAMBRIDGESHIRE.

Observatory, Cambridge.—Min. in air between 8 a.m. on 28th and 8 a m. on 29th, 20°.—MET. OFF. WEATHER REPORT.

ESSEX.

Sheering, Harlow.—Min. in air on 29th and on 30th, 16°.—E. HILL.

SUFFOLK.

Bishops Hill, Ipswich.—Min. 17° on 29th and on 30th.—G. A BIDDELL.

Rendlesham Hall, Woodbridge.—Min. in air on 30th, 17°. —RENDLESHAM.

NORFOLK.

Denver Rectory, Downham.—Unprecedentedly low minima for November. Ther. has no spirit at the top of the tube, and is in Stev. Min. on 27th, 23°·7; 28th, 22°·5 (lowest since 1862); 29th, 26°; 30th, 17° (record of 28th further beaten).—J. M. DU PORT.

Cossey, Norwich.—Min. 5° on 30th.—ALBERT J. CULLEY.

East Dereham.—Min. at 4 ft. above ground, 17° on 29th.—G. H. COOPER.

WILTSHIRE.

Alderbury, Salisbury.—Min. in air on 28th, 11°.—R. S. HUTCHINGS.

Bishops Cannings.—Min. in air on 29th, 10°.—C. W. HONY.

DORSET.

Heatherlands, Parkstone, Poole.—About 5 p.m. on 28th temp. fell to 20°, and it continued to fall until just before 9 p.m on that day,

when it reached the very low point of 16°·2 in the air and (some time during the evening or night), 7°·9 on the grass.—R. H. BARNES.

Langton Herring, Weymouth.—Min. 17°, being 4° lower than has been recorded in November during 19 years; on the grass the min. was 12°.—CLEMENT H. GOSSET.

DEVONSHIRE.

Babbacombe, Torquay.—Min. on 29th, 22°·3 in Stev., and 21°·8 on grass.—E. E. GLYDE.

Druid, Ashburton.—Min. on 29th, 19°·7.—FABYAN AMERY.

Woodway, Teignmouth—Min. on 29th, 21°·6 in Stev., and 17°·0 on grass, the lowest since commencing observations in 1879.—G. W. ORMEROD.

Barnstaple.—Min. 20° on 29th.

SOMERSETSHIRE.

Wells.—Min. on 29th in air, 22°, and on grass, 16°.—R. J. MANNING.

LEICESTERSHIRE.

Barkby, Leicester.—Min. 16°·0 on 29th.—E. N. POCHIN.

RUTLANDSHIRE.

Ketton Hall [Stamford].—Min. on 29th, 25°; on 30th, 11°.—F. COVENTRY.

LINCOLNSHIRE.

Boston.—Min. 13° on 30th.—W. H. WHEELER.

Hemingby, Horncastle.—Min. on 30th, in air, 8°·6.—E. S. BENGOUGH.

JERSEY.

Hastings Terrace, St. Heliers.—Min. 20°·0.—W. J. LANCASTER.

Noirmont, St. Aubins.—Min. in air between 8 a.m., 28th, and 8 a.m, 29th, 16°.—MET. OFF. WEATHER REPORT.

We may now epitomize the facts—as regards intensity and time. It is noteworthy that of all the records from verified thermometers in Stevenson's screens, only one is below 10°, viz., that at Brockham, near Dorking, where 4°·5 was recorded.

The temperatures below even that are, in the order of intensity, the following :—*

Coulsdon, Surrey.....	4°	East Tisted, Alton, Hants ...	1°
Holmfels, Reigate, Surrey...	2°	Riverhead, Sevenoaks, Kent	—1°
Caterham Valley, ,, ...	2°	Shirley, Surrey.....	—2°
Abinger Hall, Dorking ,, ...	1°	Warmington, Surrey	—5½°

Nearly all these stations are in the district of which the Meteorological Committee of the Croydon Microscopical Society is representative. We shall be glad to hear that they have investigated these and other records in their district and ascertained which are correct, which errors are due to spirit being lodged in the top of the tubes, which to faulty instruments, and which to bad exposure.

* We have omitted the records of 4° at Sutton, and of —6° at Addington, because in each case the thermometer was on, or close to, the snow.

Apparently, however, it can hardly be doubted that in the air the temp. on November 28th fell nearly to zero, and on snow below it.

The examination of the precise time of the phenomenon, which has necessitated plotting a large number of observations, tends to confirm our impression that it was a very local one—a down-rush of cold air, with probably a clear sky, allowing radiation for a short time in the vicinity of Caterham—and occurring between 4 and 6 p.m. In proof of its local character, it may be sufficient to give the temperature at four hours at Greenwich, Kew, and Camden Square :—

	3 p.m.	4 p.m.	5 p.m.	6 p.m.	Min.
	°	°	°	°	°
Greenwich	20·8	19·5	19·0	21·0	18·3
Kew	23·0	22·1	22·0	22·4	21·5
Camden Square	22·8	22·5	21·7	21·0	20·8
Kew warmer than Greenwich...	+2·2	+2·6	+3·0	+1·4	+3·2
Camden Sq. warmer than ,, ...	+2·0	+3·0	+2·7	+0·0	+2·5

This shows plainly that the intensity of cold was increasing in directions S. and E. of Kew and of Camden, and beyond Greenwich, in that direction, is the district of Kent and Surrey, whence the lowest records have been sent. So few hourly records have been received that we can say only that there is some indication that the minimum occurred later at stations furthest towards S. and E., but nowhere later than 7 p.m.

BAROMETRIC DEPRESSIONS.

To the Editor of the Meteorological Magazine.

SIR,—Professor Hazen appears to have misunderstood the object of my letter. I understood him to say that the liberation of latent heat by the condensation of vapour could be shown to be physically incapable of supplying the energy of the cyclone, and I made the calculation (which he now implies to be inapplicable) simply with the view of combating his statement.

It is not probable that the axis of the cyclone is vertical, at least in temperate latitudes, neither does Ferrel's theory require that it should be so, but it is not at all clear how the upper part is to travel twice as fast as the lower, and the whole to remain one single storm for several days. Might we not as well say that the locomotive of a train travels twice as fast as the carriages? There can be little doubt about the ascensional current in the central parts of a cyclone—it follows inevitably from the fact of the inclination of the wind direction to the isobars, for there is no other possible direction in which the air, moving towards the centre, can escape. Also, the central parts of a cyclone are those in which the rain chiefly falls.

The same rule applies to thunderstorms, which are well known to be small secondary depressions, and that they chiefly occur in the south-eastern quadrant of the cyclone is often brought forward in support of Ferrel's theory.

W. H. DINES

ROYAL METEOROLOGICAL SOCIETY.

The opening meeting of the session of the Royal Meteorological Society was held on Wednesday evening, November 19th, at the Institution of Civil Engineers, when the President, Mr. Baldwin Latham, M.Inst.C.E., delivered an address on "The Relation of Ground Water to Disease."

The pages of history show that when the ground waters of our own or of other countries have arrived at a considerable degree of lowness, as evidenced by the failure of springs and the drying up of rivers, such periods have always been accompanied or followed by epidemic disease. In all probability, ground water in itself, except under conditions where it is liable to pollution, has no material effect in producing or spreading disease. As a rule, it is only in those places in which there has been a considerable amount of impurity stored in the soil that diseases become manifest, and the most common modes by which diseases are, in all probability, disseminated, are by means of the water supplies drawn from the ground, or by the elimination of ground air, into the habitations of the people. It is found that the periods of low and of high water mark those epochs when certain organic changes are taking place in the impurities stored in the ground, which ultimately become the cause, and lead to the spread, of disease. Mr. Latham defines "ground water" as all water found in the surface soil of the earth's crust, except such as may be in combination with the materials forming the crust of the earth. It is usually derived from rainfall by percolation, and it is also produced by condensation. In dry countries ground water is principally supplied by the infiltration from rivers, as for example, in the Delta of the Nile.

If but little water passes into the ground for a long period it naturally leads to the lowering of the water line, and to the drying of the ground above the water-line; and it is curious to note with reference to smallpox, that this disease generally occurs after there has been a long absence of percolation, and a consequent drying of the ground. On the other hand, smallpox is unknown when the ground has long been wet, or is receiving moisture by condensation or capillarity.

The study of the level of underground water shows that certain diseases are more rife when the water is high in the ground, and others when the water is low. The conditions that bring about and accompany low water, however, have by far the most potent influence on health, as low water years are, without exception, unhealthy. As a rule, the years of high water are extremely healthy, except, as often happens, when high water follows immediately upon markedly low water; on the rise of the water an unhealthy period invariably follows.

Mr. Latham has found those districts for which the water is drawn from springs are usually more subject to epidemics and disease

than districts supplied from rivers or extended areas, or from sources not liable to underground pollution. In the case of Croydon, one portion of the district (under three-fourths) is supplied with water taken direct from the ground, whilst the remaining portion is supplied with water from the river Thames. It is curious to note that even so recently as 1885, the zymotic death-rate in the district supplied with underground water was twice as great as in that part of the district supplied from the Thames; and in that year 41 deaths from smallpox occurred in Croydon, every one of which occurred in the district supplied by the underground water.

Mr. Latham, in his address, dealt largely with zymotic diseases as affected by ground water, and showed that cholera ordinarily breaks out when there is least ground water; a high air and earth temperature is also necessary for its development, and, as a rule, the low-lying districts are favourable to the production of these high temperatures. Smallpox is almost always preceded by a long period of dryness of the ground, as measured by the absence of percolation. Typhoid fever is most prevalent after a dry period, on the first wetting of the ground or percolation from any cause. The condition essential to the development of diphtheria is a damp state of the ground, marked by extreme sensitiveness to percolation of rain. Scarlet fever follows the state of dryness of the ground, which is essential for its development, and occurs in the percolation period. The conditions that precede smallpox are those favourable for the development of scarlet fever, and, like smallpox, the dampness of the ground for any considerable period in any particular locality may check its development or render it less virulent, and it is most rife in low water years. Measles are least prevalent at the low water periods, and mostly rife at and near high water periods. Whooping cough follows the percolation period in its incidence, increasing with percolation and diminishing as the waters in the ground subside. Diarrhœa is generally more prevalent in a low water year than in other years; that is, with a very much colder temperature in a low water year there is a very much higher death-rate from this disease.

METEOROLOGICAL PHOTOGRAPHY.

As stated in the October number of this Magazine, a Committee of the British Association was appointed at Leeds to assist, foster, and systematize the application of photography to meteorology. The Committee has already commenced work, and prepared blank forms and instructions, copies of which will with pleasure be supplied by the Secretary, to whom, of course, all communications and offers of co-operation should be forwarded. It is most desirable that our readers, whether themselves photographers or not, should bring this effort to the knowledge of all their photographic friends, both in this country and abroad. The Committee consists of G. J. Symons, F.R.S. (Chairman), Professor R. Meldola, F.R.S., John Hopkinson, F.L.S., F.G.S., Arthur W.Clayden, M.A., F.C.S., F.G.S., (secretary), "Warleigh," Palace Road, Tulse Hill Park, London, S.W.

REVIEW.

Klimaschwankungen seit 1700 *nebst Bemerkungen über die Klimaschwankungen der Diluvialzeit.* Von Dr. EDUARD BRUCKNER, a.o., Professor der Geographie an der Universität zu Bern. [*Geographische Abhandlungen herausgegeben von* Prof. Dr. ALBRECHT PENCK, Band IV., Heft 2.] Wien, E. Hölzel, 1890. 8vo. viii.—324 pages, 13 diagrams, and one plate.

THIS work is essentially one for thoughtful persons. It is one the compilation of which would frighten most men, by the vastness of the subject, and by the mass of material to be dealt with. It is an attempt to ascertain the existence, and, if any, the amount of climatic variation which our earth has undergone, both in remote and in historic times, and to this end Dr. Brückner has employed chiefly six varieties of data.

(1) The dates of the opening and closing of navigation on Russian rivers.
(2) Records of severe winters.
(3) The dates of the vintages in France. (These have been recorded for more than three centuries.)
(4) Details of annual rainfall.
(5) „ „ „ temperature.
(6) Sunspot frequency.

One fact will sufficiently indicate the labour compressed into this work—it contains returns from 804 stations for an aggregate of more than 36,000 years; another will illustrate the thoroughness with which it has been executed, the foot-notes, chiefly references to other writers upon the subjects, must number considerably over 500.

It will probably afford the best general idea of the scope of the work if we give the titles of each of the ten chapters, and say a few words on each.

The first deals with the present state of the question as to climatic changes, begins by defining climate, and then notices successively the changes during prehistoric (geologic) times, discusses briefly the question of alterations during historic times—(*a*) as regards rainfall, (*b*) as regards temperature—and ends by criticising somewhat severely sunspot and other cycles.

The second chapter is devoted wholly to the variations in the level of the Caspian Sea, which are shown to be almost entirely dependent upon, and synchronous with, climatic changes, and that though very uncertain, they seem to be of long period.

In Chapter III. Dr. Brückner deals with the variations in other seas and lakes which have no outlet, taking not merely those of Europe, but also illustrations from Asia, America, Africa, and Australia, Mr. H. C. Russell's observations on Lake George being especially useful.

In Chapter IV. he passes on to the question of the discharges of

rivers, and records of their levels, and concludes that his researches thus far have shown that there are considerable oscillations of climate, that they are approximately, but not strictly, synchronous over the globe, but that it is not clear whether they are produced by rainfall or by temperature, or a mixture of the two, nor what is the primary cause.

In Chapter V. Dr. Brückner attacks, in a very thorough and able way, the problem of the secular variation of rainfall. He has collected returns from nearly all parts of the world, reduced the values to their equivalent percentages, and given the results in considerable detail. But he has allowed himself such free scope in filling up missing years, in order to increase the number of records available for discussion, that, while we accept the tables as probably correct, and certainly representing what Dr. Brückner believes to be so, all the values must not be accepted as the arithmetical results of perfect records. Considering this fact, it is rather amusing that twice over he brings up English records in order to condemn them. It would take too much space to deal with both cases, but the examination of one has led us to notice that the Paris observations partly corroborate the great drought indicated by the Lyndon observations from about 1728 to 1767, to which attention has often been directed. Quoting from Mr. Symons's table,* Dr. Brückner finds two records for part of that time, which run on long afterwards; he compares their mean ratios thus :—

* "Report of the British Association, 1866," p. 286.

Lyndon—Chatsworth	1761–69	—6·8
,, ,,	1770–98	+4·9
	Difference	11·7

and adds, "therefore are the amounts of rain before 1770 about 11 or 12 per cent. too small." We do not see the reason for the "therefore;" it would have been equally fair to say "therefore are the amounts of rain [at Chatsworth] too large." But Dr. Brückner proceeds to say that a similar indication is afforded by the following values :—

	mm.	inches
Lyndon (Rutland), 1737–69 (23 years)	mean 538 =	21·18
,, ,, 1770–98 (29 ,,)	,, 637 =	25·08

And on the strength of the above, he has cut the record into two portions. He may be right; it is very difficult to say whether he is or is not; but the existence or non-existence of that great drought cannot be so easily disposed of, and it is droll in the extreme to find that on page 136 Dr. Brückner charges the Paris records with being *wrong in the same direction as the Lyndon ones, and at about the same date*, and on p. 191 he gives that very year 1770 as closing a dry period, "eine Trockenperiode 1756-70."

(To be continued.)

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, MAY, 1890.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Maximum. Date.	Minimum. Temp.	Minimum. Date.	Average. Max.	Min.	Dew Point.	Humidity.	Absolute. Max. in Sun.	Min. on Grass.	Total Rain. Depth.	Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
England, London	77·6	25	39·1	31	65·5	45·8	44·1	68	120·2	34·0	1·25	13	4·9
Malta	80·4	6	53·0	4	73·3	58·8	56·8	76	139·4	47·8	·61	4	3·5
Cape of Good Hope	84·8	1	41·0	19	64·7	50·0	...	...	...	...	5·93	...	5·9
Mauritius	79·5	1	59·8	25	76·4	65·3	62·2	76	132·7	52·3	·82	7	4·2
Calcutta	105·4	8	67·2	16	95·3	77·1	76·8	74	157·8	66·8	5·34	15	4·2
Bombay	92·2	2	78 0	10	89·7	80·0	75·2	73	142·8	69·8	·06	2	2·5
Ceylon, Colombo	...	...	...	...	...	...	...	...	...	...	...	...	..
Melbourne	73·5	14	37·7	9	62·9	46·5	48·6	81	122·1	30·2	2·35	11	7·0
Adelaide	...	...	...	...	...	...	...	...	...	...	...	...	...
Wellington	68·0	2,3	37·0	12	58·3	46·4	...	...	110·0	28·0	3·86	18	4·0
Auckland	68·0	22	40·0	13	63·3	51·1	49·2	74	125·0	30·0	4·33	20	5·8
Jamaica, Kingston	89·2	15	67·5	2	87·2	71·0	69·7	73	...	...	1·22	...	...
Trinidad	89·5	19	65·0	20	85·9	69·5	70·1	79	158·5	62·0	5·14	15	...
Toronto	77·0	31	28 ·1	8	59·0	41·1	42·2	74	...	20·0	2·62	23	6·6
New Brunswick, Fredericton	70·8	20	30·0	12	60·4	41·0	43·7	70	...	...	9·08	20	7·2
Manitoba, Winnipeg	78·6	29	17·3	1	55·2	30·4	34·0	68	...	...	1·15	10	5·6
British Columbia, Victoria	71·0	5,25	38·0	1,18 29	63·8	43·3	...	...	...	...	·98	7	...

REMARKS.

MALTA.—Mean temp. 64°·5; mean hourly velocity of wind 10·4 miles. Sea temp. rose from 62°·9 to 72°·0 TSS on 1st, 27th, and 31st. J. SCOLES.

Mauritius.—Mean temp. of air 2°·0, of dew point 1°·9, and R 3·52 in. below, their respective averages. Mean hourly velocity of wind 8·5 miles, or 1·6 below average; extremes 27·9 on 3rd, and 1·6 on 2nd; prevailing direction S.E. by E. to E.S.E. Unusually intense skyglows before sunrise and after sunset throughout the month. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 1°·2, of dew point 2°·5, humidity 3, amount of cloud 0·4, and R ·25 in. above their respective averages. Prevailing winds N.E. and N., strong on 18th and 28th. Heavy dew on 11 days. Fog on 8 days. R. L. J. ELLERY, F.R.S.

Wellington.—On the whole a showery month, although the total R was nearly an inch below the average. Strong wind from S. on 11th and 31st, and from N.W. on 28th and 29th, otherwise moderate in force. H on 11th and 12th. Temp. very near the average. R. B. GORE.

Auckland.—Showery and unsettled almost throughout. Mean temp. and pressure close to the average. R slightly above the average. T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL, NOVEMBER, 1890.

[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 Hall.	3·03	XI.	Castle Malgwyn	6·74
,,	Margate, Birchington...	2·60	,,	Builth(LlanwrtydWells)	8·31
,,	Littlehampton	2·71	,,	Rhayader, Nantgwillt..	10·26
,,	Hailsham	3·47	,,	Carno, Tybrith	9·58
,,	Ryde, Thornbrough	2·84	,,	Corwen, Rhug	7·41
,,	Alton, Ashdell.....	2·11	,,	I. of Man, Douglas	9·81
III.	Oxford, Magdalen Col...	1·51	XII.	Stoneykirk, ArdwellHo.	9·74
,,	Banbury, Bloxham	2·25	,,	New Galloway, Glenlee	13·09
,,	Northampton	2·68	,,	Melrose, Abbey Gate...	4·47
,,	Cambridge, Fulbourne..	2·06	XIII.	N. Esk Res. [Penicuick]	8·25
,,	Wisbech, Bank House..	2·58	XIV.	Ballantrae, Glendrishaig	8·60
IV.	Southend	2·74	,,	Glasgow, Queen's Park.	6·42
,,	Harlow, Sheering	2·11	XV.	Islay, Gruinart School..	10·23
,,	Rendlesham Hall	3·28	XVI.	Dollar.....	6·80
,,	Diss	5·06	,,	Balquhidder, Stronvar..	11·80
,,	Swaffham	3·42	,,	Coupar Angus Station...	6·52
V.	Salisbury, Alderbury...	1·76	,,	Dunkeld, Inver Braan..	6·39
,,	Warminster	2·30	,,	Dalnaspidal H.R.S. ...	8·28
,,	Bishop's Cannings	2·31	XVII.	Keith H.R.S.	4·68
,,	Ashburton, Holne Vic....	7·03	,,	Forres H.R.S.	2·83
,,	Hatherleigh, Winsford.	2·83	XVIII.	Fearn, Lower Pitkerrie.	2·78
,,	Lynmouth, Glenthorne.	4·45	,,	Loch Shiel, Glenaladale	...
,,	Probus, Lamellyn	5·47	,,	N. Uist. Loch Maddy ...	9·14
,,	Launceston, S. Petherwin	4·75	,,	Invergarry	8·64
,,	Wincanton, Stowell Rec.	2·55	,,	Aviemore H.R.S.	3·20
,,	Taunton, Lydeard Ho...	...	,,	Loch Ness, Drumnadrochit	3·10
,,	Wells, Westbury.....	3·07	XIX.	Lairg H.R.S.	5·18
VI.	Bristol, Clifton	2·55	,,	Scourie	5·39
,,	Ross	2·05	,,	Watten H.R.S.	3·80
,,	Wem, Clive Vicarage ...	4·16	XX.	Dunmanway, Coolkelure	11·27
,,	Cheadle, The Heath Ho.	5·97	,,	Fermoy, Gas Works ...	5·08
,,	Worcester, Diglis Lock	2·14	,,	Tipperary, Henry Street	4·71
,,	Coventry, Coundon	3·53	,,	Limerick, Kilcornan ...	4·44
VII.	Ketton Hall [Stamford]	3·90	,,	Miltown Malbay.....	6·69
,,	Grantham, Stainby	3·64	XXI.	Gorey, Courtown House	4·37
,,	Horncastle, Bucknall ...	2·45	,,	Navan, Balrath	...
,,	Worksop, Hodsock Priory	3·23	,,	Mullingar, Belvedere ...	6·76
VIII.	Neston, Hinderton	5·72	,,	Athlone, Twyford	6·72
,,	Knutsford, Heathside ...	6·04	,,	Longford, Currygrane...	6·54
,,	Lancaster, South Road.	6·48	XXII.	Galway, Queen's Coll...	7·15
,,	Broughton-in-Furness ..	13·78	,,	Clifden, Kylemore	15·66
IX.	Wakefield Prison	2·71	,,	Crossmolina, Enniscoe..	9·98
,,	Ripon, Mickley	3·80	,,	Collooney, Markree Obs.	7·35
,,	Scarborough, West Bank	2·91	,,	Ballinamore, Lawderdale	8·83
,,	East Layton [Darlington]	4·26	XXIII.	Warrenpoint	5·50
,,	Middleton, Mickleton..	3·73	,,	Seaforde	8·64
X.	Haltwhistle, Unthank..	5·01	,,	Belfast, New Barnsley..	9·58
,,	Shap, Copy Hill	8·16	,,	Bushmills, Dundarave...	7·89
XI.	Llanfrechfa Grange	4 35	,,	Stewartstown	7·52
,,	Llandovery	7·30	,,	Buncrana	7·79

NOVEMBER, 1890.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1880–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE Max. Deg	Date	Min. Deg.	Date	No. of Nights below 32°. In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	1·62	— 1·04	·34	6	17	58·1	23	20·8	29	6	17
II.		Maidstone (Hunton Court)...	3·69	+ ·76	·90	25	21	...	...	...	...	...	...
,,		Strathfield Turgiss	1·62	— 1·10	·43	6	18	58·3	23	17·6	29	10	17
III.		Hitchin	1·89	— ·79	·42	6	21	57·0	23	18·0	28	8	...
,,		Winslow (Addington)	2·16	— ·77	·43	6	21	58·0	23	20·0	30	12	17
IV.		Bury St. Edmunds (Westley)	2·93	+ ·38	·65	23	17	53·0	23	15·0	29	...	...
,,		Norwich (Cossey)	3·34	+ ·77	·70	23	16	...	...	5·0	30	2	8
V.		Weymouth(LangtonHerring)	2·63	— 1·03	·42	9	21	57·0	1*a*	17·0	29	7	...
,,		Barnstaple	3·83	— ·78	·57	6	18	59·0	9,14	20·0	29	...	..
,,		Bodmin (Fore Street)	6·67	+ 1·20	·75	4	28	...	...	...	...	...	...
VI.		Stroud (Upfield)	2·10	— 1·23	·37	6	21	58·0	16*b*	22·0	29	7	...
,,		ChurchStretton(Woolstaston)	4·96	+ 1·44	1·33	8	23	59·5	19	21·0	27	7	16
,,		Tenbury (Orleton)	2·95	— ·19	·82	6	22	60·6	23	21·8	30	10	12
VII.		Leicester (Barkby)	3·07	+ ·78	·52	23	21	59·0	23	16·0	29	16	25
,,		Boston	2·86	+ ·66	·72	23	19	60·0	1	13·0	30	10	...
,,		Hesley Hall [Tickhill].....	2·95	+ ·93	·51	6*h*	23	59·0	19	21·0	27*f*	13	...
VIII.		Manchester(PlymouthGrove)	5·02	+ 2·02	1·02	22	23	58·0	19	26·0	26	7	18
IX.		Wetherby (Ribston Hall) ..	2·72	+ ·65	·61	7	11	...	...	...	...	...	..
,,		Skipton (Arncliffe)	9·71	+ 2·96	1·71	6	27	55·0	19	...	...	7	...
,,		Hull (PearsonPark)	3·03	+ 1·02	·65	23	19	...	...	...	...	...	...
X.		North Shields	3·28	+ 1·25	·99	23	19	57·0	19	..	...	...	..
,,		Borrowdale (Seathwaite).....	25·48	+10·69	2·69	6	23	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	4·42	— ·49	·67	6	24	..	...	...	...	..	..
,,		Haverfordwest	6·95	+ 1·09	·85	6	22	59·0	22	22·0	29	5	9
,,		Plinlimmon (Cwmsymlog) ...	...	...	..	...	...	...	...	...	...	...	...
,,		Llandudno.....	5·81	+ 2·72	·99	6	21	58·0	2	29·1	30	3	...
XII.	SCOTLAND.	Cargen [Dumfries]	9·28	+ 4·72	2·32	6	20	56·4	19	22·0	27	9	...
,,		Jedburgh (Sunnyside).....	4·16	+ 1·66	1·30	8	17	56·0	19*c*	20·0	29	14	...
XIV.		Old Cumnock	8·11	+ 3·14	1·20	6	22	57·0	19	14·0	26	13	...
XV.		Lochgilphead (Kilmory).....	11·91	+ 4·62	2·37	6	25	...	...	...	...	...	...
,,		Oban (Craigvarren)	10·49	— ·19	1·30	29	25	58·6	20	23·9	27	3	...
,,		Mull (Quinish).....	10·06	+ 3·07	1·66	29	26	...	...	...	...	...	...
XVI.		Loch Leven Sluices	6·70	+ 2·74	2·00	7	15	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	4·65	+ 1·95	1·45	6	17	55·9	19	23·5	29	8	...
XVII.		Braemar	5·03	+ ·45	1·32	6	18	54·0	19	10·0	27	12	25
,,		Aberdeen (Cranford)	5·56	...	1·35	6	25	60·0	19	21·0	27*g*	8	...
XVIII		Strome Ferry.....	7·81	— ·07	·83	6	27	...	...	...	...	...	...
,,		Inverness (Culloden)	1·93	— ·56	...	...	...	55·0	19	23·0	27	6	23
XIX.		Dunrobin	3·47	+ ·64	.97	6	14	57·5	19	24·8	27	8	...
,,		S. Ronaldsay (Roeberry).....	5·29	+ 1·87	·83	1	24	52·0	30	32·0	26*h*	2	..
XX.	IRELAND.	Cork (Blackrock)	5·21	+ ·58	82	8	19	61·0	22*d*	23·0	28	8	...
,,		Dromore Castle	12·38	+ 6·70	1·70	2	23	57·0	11	22·0	28	...	...
,,		Waterford (Brook Lodge) ...	4·53	+ ·86	·73	6	23	59·0	22*a*	26·5	9	9	..
,,		O'Briensbridge (Ross)	6·99	...	1·16	1	25	55·0	20	25·0	28*i*	...	...
XXI.		Carlow (Browne's Hill)	4·35	+ 1·29	·73	6	26	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	4·21	+ 1·38	·63	10	27	63·0	19	26·3	29	3	16
XXII.		Ballinasloe	6·50	+ 2·59	1·15	6	25	56·0	2	19·0	29	11	...
XXIII		Waringstown	8·11	+ 5·01	1·42	6	25	58·0	19	20·0	26	9	14
,,		Londonderry (Creggan Res.).	8·01	+ 3·49	1·47	6	28	..	...	...	...	...	...
,,		Omagh (Edenfel)	7·23	+ 3·36	1·23	6	26	55·0	14*e*	22·0	27*g*	6	11

a And 19, 23. *b* And 19. *c* And 20. *d* And 23. *e* And 18, 19, 22, 23. *f* And 30.
g And 28. *h* And 27. *i* And 29.

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

METEOROLOGICAL NOTES ON NOVEMBER, 1890.

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 TURGIS.—The first three weeks were mild and uniform in temp.; a very decided change occurred on the 23rd, when severe weather set in, and continued to the end. The grass min. thermometer registered 14°·5 on the morning of the 29th. A short, sharp squall occurred at 6.45 p.m. on the 21st, accompanied by heavy R.

HITCHIN.—The 23rd was the hottest day so late in November ever recorded here, and the 28th was the coldest since 1858.

ADDINGTON.—From the 14th to 23rd the max. temp. in shade was rather high, but from thence to the end it was very cold, the min. shade temp. on the 27th, 28th, 29th, and 30th being 23°, 22°, 22°, and 20°; on the evening of the 30th it began to thaw, the wind changing to S.W. The month was very free from fogs. Snow on 3 days.

BURY ST. EDMUNDS, WESTLEY.—The month was mild and favourable for agriculture till the 25th, when great cold set in, and continued till the end, with a considerable fall of S.

LANGTON HERRING.—From the 1st to the 18th the weather was wet and mild; the last five days were unprecedentedly cold. On the night of the 28th the temp. fell to 17° in shade, and on the grass to 12°. Taking the whole month, the temp. was very slightly below the average. The range of temp. was the greatest in any month for the last 19 years, being 40°. A solar halo was observed on the 15th, L on the 2nd, T and L on the 9th.

BODMIN, FORE STREET.—A very stormy, wet, and cold month. The first 10 days very wet and stormy, and it continued showery until the 25th, when H fell with very high wind; hard frost from the 26th to the end of the month, and bitterly cold wind; S on the 27th and 28th. The coldest November for many years.

STROUD, UPFIELD.—A fine, warm month, till the last few days. Gales on the 1st and 6th, L on the 9th, S on the 25th, 28th, 29th, and 30th.

WOOLSTASTON.—The first half of the month was wet, cold, and stormy, strong gales with very heavy R occurring from 6th to 8th. The weather then became quite genial, and the 18th, 19th, and 20th were warm summer days. Another gale occurred on the 23rd, and after this it became extremely cold, S falling on 27th and 28th. Mean temp., 42°·1.

ORLETON.—Temp. a little above the average. Heavy R on 5th, accompanied by a great gale of wind, the worst for several years. On the 20th the temp. was 60°, and on the 23rd 60°·6, the latter being the highest so late in the year for 30 years, though on November 18th, 1875, the temp. rose to 61°·3. From the 25th to the end of the month the weather was very cold, the maxima on the 27th and 28th being 33°·4 and 33°·2 respectively. S on the 27th and 28th.

BOSTON.—S on the 26th and 27th, eight inches deep.

MANCHESTER, PLYMOUTH GROVE.—Fine autumn weather on 1st, 5th, and 10th. Wet mist on 13th, 17th, and 18th; many damp and foggy days up to the 17th, but no dense fogs during the month. Heavy fall of S on 27th. On 26th and 28th the min. on grass fell to 20°. Mean temp. 42°·8.

HULL, PEARSON PARK.—From the 1st to the 12th the weather was generally showery; then mist or fog prevailed until the 21st; this was followed by stormy weather, often with heavy falls of S and H nearly to the end of the month.

WALES.

HAVERFORDWEST.—One of the most remarkable Novembers that I have observed. The first six days were very stormy, especially on the night of

the 6th; the wind exceeded in force in this gale any gale since the memorable one of December 8th, 1886 (lowest bar. 28.927 in.). The R was continuous, and greatly above the average. The temp. was, up to the 23rd, greatly above the mean; a sudden and abrupt change took place on the 24th, the wind shifted to N.N.E., and the mean temp. of the six days from the 24th to the 29th inclusive was 30°·8. I never registered such continuous cold in any previous November. The month ended mild and wet. Prevailing winds, W. and S.W.

SCOTLAND.

CARGEN.—The first half of the month was extremely wet and stormy; 6·73 in. of R fell during the first 14 days, 2·32 in. falling on the 6th. During 31 years this fall has only been exceeded once, viz., 8th February, 1869, when 2·34 in. fell. Sharp frost prevailed from 26th to 29th, the minimum temp. ranging from 26°·4 to 22°. TS on the 10th.

JEDBURGH.—Winter manifested its appearance by S and frost, but to no great extent. Out-door work was not stayed in any way. Great stillness prevailed in the atmosphere, and there was almost no fog.

OBAN.—R almost constant throughout the month, and in great quantity. Crops still remain exposed to the weather, and farming operations were at a standstill. There were no heavy gales. At the close, a sharp frost occurred with some S. So continuous a rain for nearly six months is without previous record in this district. Most of the crops are lost, but potatoes on elevated gravel beds are of fine quality, quite superior to those of the dry season of 1889.

CULLODEN.—The weather was very changeable; much R fell at intervals, with occasional high winds from W. and N.W. A slight earthquake occurred on 15th, at 10 minutes before 6 p.m.

ROEBERRY.—A very coarse, wet month; the wettest since 1882.

IRELAND.

CORK.—Almost incessant R to the 17th, then mostly fine to the 23rd, and heavy squalls on the 24th. The last week fair and frosty, except the 29th and 30th, which were wet and foggy. Mean temp. 44°·1.

DROMORE.—Very wet, with a very severe frost during the last week.

WATERFORD, BROOK LODGE.—Gales on 2nd and 7th; fogs on 18th, 19th, and 20th; S on 26th and 27th. Ripe strawberries gathered on the 8th.

O BRIENSBRIDGE, ROSS.—The heaviest November R since 1883; much L and heavy gales in the first half of the month, sharp frosts on 27th, 28th, and 29th, and the month closed with a return of misty and mild weather.

DUBLIN.—A wet, stormy, cheerless month, reminding one of November, 1888, which was the wettest and most stormy for more than a quarter of a century. The weather remained open until the 24th, when a spell of snow-storms and bitter cold set in with peculiar suddenness. The S storm on the night of the 26th was the heaviest experienced since the memorable storm of January, 17th, 1881. High winds on 12 days, attaining the force of a gale on five. Fogs on four days, H on five days, sleet and S on 26th, 27th, and 28th. On the 30th the S rapidly disappeared, under the influence of a S.W. gale and warm R.

BALLINASLOE.—Very wet and cold; floods very high in both Shannon and Suck.

OMAGH, EDENFEL.—During the first 25 days R was almost incessant, with occasional strong winds, and on the 6th a gale, but generally with mild humid air and extreme dampness. On the 25th a slight fall of snow was followed by three days of dry, clear, keen frost, and on the 29th by a return to R and humidity. The wettest November in at least 26 years.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCC.] JANUARY, 1891. [PRICE FOURPENCE, *or 5s. per ann. post free.*

OUR THREE HUNDREDTH NUMBER.

To have been enabled to edit every one of three hundred consecutive monthly numbers is not given to many, and, looking back over the work of a quarter of a century, a feeling of thankfulness is naturally predominant.

We lay no claim to brilliancy or to financial success, or to a large circulation; but we are conscious of the friendliness of nearly all the leaders of Meteorological progress in both hemispheres. Perhaps because it is so small, but, be the reason what it may, we rejoice to know that the *Meteorological Magazine* has the highest honour which a book can have—that of being read. We know that this is so, because when we make a mistake (and of course the Editorial "we" is fallible), whether in dealing with Russia, America, or our Australian colonies, the very next mail is sure to tell us of it; and we rejoice that this is the case, for our whole aim has ever been to help forward the science which we love, and the best way to do that is to stamp out error wherever it can be found.

The 300th number tempts us much to draw up a resumé of the progress of the quarter of a century; but the temptation must be resisted, for irrespective of the impossibility of pronouncing judgment on the mass of facts and opinions contained in the 25 volumes, time and space are both wanting.

We have naturally had before us the question of preparing a general index. We believe that it would be very useful, but how the time and cost of preparing and printing it could be provided is not evident.

THE FROST OF 1890-91.

WE are very glad to announce that this subject will be brought before the Fellows of the Royal Meteorological Society by a paper by a member of its Council, Mr. Charles Harding. Therefore, in accordance with our usual hatred of duplicate work, we shall here offer only some very general remarks, and shall pass on to Mr. Harding the mass of data, with which we have been favoured.

In the first place, as regards intensity. At Camden Square, the lowest was, on December 22nd, on Glaisher 14°·9, in Stevenson 17°·3. In 1860 and in 1867 the min. on Glaisher fell to 6°·7, therefore the intensity at that station has not been excessive on the present occasion. Reference to the table for January, 1867, in the *Meteorological Magazine* will show that 13 stations (just half of the whole number reporting) had minima of 10° or less. Reference to the table in the present number gives only 7 such stations, and they are but one-fifth instead of half of all those reporting.

As regards snow, we have had much less than in 1881. Therefore there is nothing very exceptional either in the intensity of the frost, or the depth of the snow.

But there has been one very unusual feature—the persistency of low temperature.

We do not assume that we have looked up all the cold periods, or that the following notes are perfect, but offer them *ad interim* and *quant val.* They are, of course, almost all taken from Mr. Glaisher's tables.

MEAN TEMP. AT GREENWICH BELOW 32°.

			Consecutive days.
1814.	January,	from 1 to 26, both inclusive	26
1823.	January,	from 9 to 26	18
1838.	January,	from 8 to 21	14
1855.	January and February;	from January 17 to 24, from January 27 to February 2, and from February 7 to 23	17
1860.	December,	from 18 to 29	12
1866.	December	From December 31 to January 5; and from	
1867.	January	January 12 to 22	11
1870.	December	From December 21 to January 4	15
1871.	January		
1881.	January,	from 12 to 27	16
1890.	December	From December 10 to January 12, with the exception of December 26th and of January 1 and 4, on which days the mean temp. exceeded 32° by 0°·9, 1°·0 and 3°·0 respectively. If these days be ignored, the total length of the frost would become	33
1891.	January		

THERMOMETERS.

To the Editor of the Meteorological Magazine.

SIR,—In a note attached to a paragraph from the *Journal of Horticulture* in the December issue of your Magazine, reference is made to the doubtful accuracy of thermometers in gardens. I suspect

many are inaccurate. Several years ago, when I had charge of the gardens at Branston Hall, Lincoln, the present proprietor, A. S. Leslie Melville, Esq., induced me by his example, to take interest in meteorological observations. I found there nine thermometers in use, and had an opportunity of having them tested. Only one was correct. Some of the others were from two to five degrees too high, varying in different parts of the scale. A short time ago a Surrey gardener told me his thermometer registered 27° of frost (5° on the scale) and he had left the indicator in position to "show how cold it had been." Having a suspicion that something was wrong I made a journey to the garden in question. There, sure enough, was the indicator at 5°, the spirit then registering 34°. I particularly drew the attention of the gardener to that fact, because I saw what he had overlooked, some of the spirit towards the top of the tube. A few sharp jerks lowered it into position, and instead of the instrument registering 34° it registered a trifle more than 38°. He then saw that his "27 degrees of frost" ought to have been something less than "23 degrees," a little more than 9° above zero, instead of 5°. The frost, however, must have been unusually severe in Surrey, as at the Royal Horticultural Society's meeting, on December 9th, not only were aucubas shown blackened and soft, but leaves of the much hardier—ivy and rhododendron—were in a similar condition.

On asking for a shilling thermometer in an optician's shop in London, one was handed to me out of the drawer. I placed it on the counter and asked for another, then for a second and a third, and on seeing they all differed, the attendant willingly handed out more. Out of twenty-five, five were uniform, and one of these was chosen. I gave it to a neighbour for his little greenhouse, and it answers its purpose; but whether it is accurate or not I am not able to say, though it is probably nearer being correct than many are on which reports of frost are founded.

J. WRIGHT.

171, *Fleet Street, London.*

EARLY METEOROLOGY.

To the Editor of the Meteorological Magazine.

SIR,—You have dealt so often in the *Meteorological Magazine* with Pre-Instrumental Meteorology, that I am sure to awake your interest, and perhaps that of many of your readers, if I call your attention to the oldest regular record of weather of which I am aware.

Till now I was of the opinion that in Italy might be found the beginning of continuous weather observations (XV. century), without being able to say who first made such observations, only because the state of learning was then much higher in Italy than in all other European countries; and for the reason that more than one century later almost all meteorological instruments were invented in that country. But now I suppose this primacy is to Old England.

Reading in an early volume of the "Philosophical Transactions," I found in a paper published by Robert Plot, of Oxford (Number 169, 1685, March 23rd, page [931]), the following most interesting passage, which seems to be quite overlooked or forgotten :—

"The industrious *Walter Merle*, Fellow of *Merton* Coll. . ., observed the weather here at *Oxford* every day of the month, seven years together, *viz.*, from *Jan.*, 1337, to *Jan.*, 1344; the MS. copy of which *Observations* are yet remaining in the *Bodleyan* Library."

I suppose that it will be easy for you to ascertain if that MS. is still remaining there. If it is still existing, as I hope, efforts should be made by all means to have it published *in extenso*. It would be, without doubt, the most important historic document of meteorological observations. Tycho Brahe's *Meteorologiske Dagbog*, embracing the years 1582 till 1597, has been published by the Danish Academy of Sciences; how much more interesting would it be to have published observations made two centuries and a half earlier ?

I remain, Sir, faithfully yours,

GUSTAVUS HELLMANN.

Berlin, December 9th, 1890.

[We tried to trace this MS. many years ago and failed. An Oxford friend has promised to make a fresh search in the course of a month, and we shall be happy to report the result.—ED.].

HAIL INSURANCE.

[Usually questions in which money is an essential feature are keenly debated, but it does not seem to be so with regard to the above. The only local notice which we have yet seen was a leader in the *Hunts County Guardian*; the writer seems to think that there is no justification for the extra charge, for he quotes the last sentence of our article introducing it by the following confirmatory words, "The Editor [of the *Met. Mag.*] comes to what appears to be a common-sense solution of the problem." If there existed any local impression that hailstorms in that district were extra frequent or extra violent, surely the leader writer of the county paper would know of it.

On the other hand we are very glad to have received the following letters, which may be regarded as evidence on the other side. That from the Secretary of the Insurance Company is most important, and we are much indebted to him for it. Unfortunately, it leaves us in as great a meteorological puzzle as ever; we thought that the injury was due to storms of exceptional violence; it appears that it is their exceptional frequency which creates the increased risk, but to what is this extra frequency due ? After Mr. Vickers' statement we are not free to question the fact, although, as stated above, it does not seem to be known to the Editor of the local paper. But we have not the least wish to pry into the affairs of any company, and therefore should have preferred a statement of the percentages of loss in and outside the radius—or the ratio of one to

the other—either would give the data which we, as meteorologists, require, but would (fortunately) not give the slightest clue to the amount of business done by any company. Mr. Vickers may rest assured that we have no intention of trying to float a company, but we do intend to try to find out why hailstorms do twice as much damage in that part of the country as anywhere else.

As regards the second letter, bad as the storm was, it is only stated to have extended over $\frac{3}{4}$ mile by 3 miles; that is only about two square miles out of the 452 charged double, or less than $\frac{1}{2}$ per cent. We hope that the subject will be further elucidated.—ED.]

To the Editor of the Meteorological Magazine.

SIR,—Our attention has been drawn to the article on "Hail Insurance" in your November issue; and I beg to suggest that it is calculated to give—as it is evidently written under—a wrong impression. The article says, "Fourteen summers have passed, we have heard of no *exceptional storms* in the district singled out for double charges." This, and one or two other expressions, seem to denote the idea that specially severe visitations are the cause of the extra rate in the Somersham radius. Such is not the case, however. It is simply that the district is peculiarly liable to hail storms.

While there have, perhaps, been no *peculiarly* disastrous hail storms in the Somersham radius during the period you mention—fourteen years—yet it would be erroneous to suppose that those which have occurred have been so slight as to cause no damage.

We have—since we derive a considerable amount of business from the area named—been at some trouble to ascertain the facts, so far as our experience goes, and the result of our investigations shows that but a poor prospect would await a "company of their own," if the farmers of the neighbourhood adopted your suggestion, and formed one.

There has been a total profit, during the whole period, of about £500, and this is, of course, with the surcharge.—Yours faithfully,

B. VICKERS, *Secretary.*

The Midland Counties Insurance Co., Lincoln.
December 31st, 1890.

SIR,—I have just been reading in the *Meteorological Magazine* for November, the article on "Hail Insurance." There was a very serious hailstorm about 1878, at Sawtry (which, as far as I can make out from the map, is just within 12 miles of Somersham) and extending in a narrow strip about three-quarters of a mile broad for two or three miles at least from Sawtry, in the direction of Somersham.

It occurred one Sunday in August, and the harvest was to commence generally in that district the next day; but on the land over which it passed no harvest was ever reaped, for the hail was so violent that it threshed the corn, and cut the straw to shreds, the root crops were also quite destroyed. I visited the place soon after and it was quite desolate, all the leaves were cut off the trees or

blackened on them, and the bark of the young shoots was cut and bruised. One farmer told me that he lost £1,700 worth of crops, and that he had not insured on account of the double rate. I did not see the storm myself, but a friend (since dead) told me that he measured several stones and found them 6 in. round, and that several tiles were broken on his house. All his poultry exposed to the storm were killed. I forget what year it happened, but, if it were of any use, fuller particulars could no doubt be obtained from persons living in the place.—Yours faithfully,

GEORGE KNOWLES.

Syrencot, Figheldean, Amesbury, S.O., Dec. 9th.

ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this Society was held on Wednesday evening, December 17th, at the Institution of Civil Engineers, 25, Great George Street, Westminster; Mr. H. F. Blanford, F.R.S., Vice-president, in the chair. Dr. T. Fowler, Mr. A. Greg, and Mr. H. Woolcock, C.E., were elected Fellows of the Society.

The following papers were read :—

1. "Note on a Lightning Stroke, presenting some features of interest," by Mr. R. H. Scott, F.R.S. On January 5th, a house near Ballyglass, Co. Mayo, was struck by lightning, and some amount of damage done. A peculiar occurrence happened to a basket of eggs lying on the floor of one of the rooms. The shells were shattered so that they fell off when the eggs were put in boiling water, but the inner membrane was not broken. The eggs tasted quite sweet. The owner's account is that he boiled a few eggs from the top of the basket, the rest were "made into a mummy," "the lower ones all flattened, but not broken."

2. "Note on the effect of Lightning on a dwelling house," by Mr. A. Brewin, F.R.Met.Soc. This is an account of the damage done to the author's house at Twickenham, on September 23rd, 1890.

3. "Wind Systems and Trade Routes between the Cape of Good Hope and Australia," by Capt. M. W. C. Hepworth, F.R.Met.Soc. The author is of opinion that the best parallel on which commanders of vessels, navigating the South Indian Ocean between the Cape of Good Hope and the Australian Colonies, should run down the longitude is between the 41st and 42nd parallels during the winter months, and between the 45th and 46th parallels during the summer months.

4. "Report on the Phenological Observations for 1890," by Mr. E. Mawley, F.R.Met.Soc. Taking the year ending August, the weather of the autumn, winter, and spring, and of the first summer month, could scarcely have been more favourable for vegetation; while that of July and August proved altogether as unpropitious.

5. "The Climate of Hong-kong," by Dr. W. Doberck, F.R.Met. Soc. This is a discussion of the meteorological results at the Hong-kong Observatory, and at the Victoria Peak, during the five years, 1884-88.

REVIEW.

Klimaschwankungen seit 1700 *nebst Bemerkungen über die Klimaschwankungen der Diluvialzeit.* Von Dr. EDUARD BRUCKNER, a.o., Professor der Geographie an der Universität zu Bern. [*Geographische Abhandlungen herausgegeben von* Prof. Dr. ALBRECHT PENCK, Band IV., Heft 2.] Wien, E. Hölzel, 1890. 8vo. viii.—324 pages, 13 diagrams, and one plate.

(*Continued from our last.*)

In concluding our notice of this important chapter, we give a tabular summary of the author's results for the whole globe. It should be mentioned that all his values are given for lustra, *i.e.*, five-year periods, *e.g.*, 1871-5 ; 1876-80 ,&c.; and he finds approximations to these periods in all parts of the world, although sometimes a dry period in one locality may last on while a wet one has set in elsewhere.

Dry Periods.		Wet Periods.	
1716–1735	20 years.	1691–1715	25 years.
1756–1770	15 ,,	1736–1755	20 ,,
1781–1805	25 ,,	1771–1780	10 ,,
1826–1840	15 ,,	1806–1825	20 ,,
1856–1870	15 ,,	1841–1855	15 ,,
		1871–1885	15 ,,

The sixth chapter deals with variations of barometric pressure, and is largely based on Dr. Hann's work, published as an earlier volume of the same series ; tne seventh, with temperature ; and the eighth, with the closing and opening of rivers, the time of vintage (based chiefly on Angot's work), the occurrence of severe winters, based chiefly on Pilgram's work* (which seems to be scarce). At the end of this chapter the author becomes definite as to the periodicity of the oscillations of climate, and fixes the average period to a tenth part of a year with a variability of about eight months, "eine Periode 34·8 $\pm$ 0·7 Jahren." Important, even extraordinary, as is the mass of data which the author has collected, we think that he is very courageous to express so definite an opinion.

We are too anxious to assist all who think that they can find a clue to the laws of weather changes to be hard upon anyone, and we are neither friends nor foes to sunspot theories, but we cannot help noting that 34·8, divided by 3, gives 11·6, which does not differ much from a value one has heard of before.

However, be the verdict on the 34·8 years what it may, it is certain that by compiling this important work Dr. Brückner has done good service, and we regret that we know of no English publisher who would venture upon such a publication in our own language. The nearest that we have had to it, *Man and Nature*, by the Hon. G. P. Marsh, must, however, have been a success, as we have three editions of it.

* *Anton Pilgrams Untersuchungen über das Wahrscheinliche der Wetterkunde durch vieljährige Beobachtungen.* Zwei abtheilungen. Wien, 1788. 4to.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JUNE, 1890.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	TotalRain. Depth.	TotalRain. Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
England, London	78·2	25	40·8	1	69·0	50·9	49·3	73	124·8	36·9	2·82	17	6·5
Malta	86·2	25	58·1	3	79·1	63·4	61·4	74	140·2	49·8	·08	1	1·3
Cape of Good Hope	...	...	...	...	...	...	...	...	...	...	...	...	...
Mauritius	77·0	22	56·6	14	74·1	63·5	60·3	77	127·7	45·6	1·52	16	5·1
Calcutta	95·7	1	71·4	6	89·7	78·0	78·9	84	156·3	70·9	13·40	21	6·9
Bombay	90·1	8	74 5	19	85·4	77·6	76·8	85	141·0	72·0	24·55	28	9·2
Ceylon, Colombo	87·7	9	73·8	17	85·4	77·9	73·8	78	146·0	72·0	1·87	15	7·7
Melbourne	66·0	5	38·0	30	58·7	48·0	47·8	83	115·0	31·9	1·71	13	7·4
Adelaide	67·8	7	39·6	29	61·3	49·9	49·0	79	130·3	32·0	4·22	17	6·6
Wellington	63·0	15	37·3	28	56·6	45·1	43·6	77	105·0	30·0	2·28	18	4·0
Auckland	65·0	27	44·0	23	60·5	50·9	48·9	79	116·0	35·0	3·74	16	6·7
Jamaica, Kingston	91·6	13	70·3	18	89·1	73·0	69·8	68	...	...	·44	...	...
Trinidad	89·0	19	65·0	30	85·5	70·0	70·7	77	156·0	62·0	9·68	22	...
Toronto	86·6	25	42·1	8	...	...	57·2	75	...	...	4·87	13	5·0
New Brunswick, Fredericton	83·2	17	37·5	12	...	...	49·0	73	...	...	5·14	17	7·0
Manitoba, Winnipeg	96·5	26	36·3	7	...	...	...	...	...	...	2·15	10	5·0
British Columbia, Victoria	74·0	5, 6	36·0	13	...	...	...	...	...	...	2·10	12	...

REMARKS.

MALTA.—Mean temp. 70°·0; mean hourly velocity of wind 9·0 miles. Sea temp. rose from 72°·0 to 77°·0. Thunderstorm on 5th. J. SCOLES.

Mauritius.—Mean temp. of air 1°·8 below, mean dew point 0°·2 below, and rainfall ·36 in. below their respective averages. Mean hourly velocity of wind 10·9 miles, or 0·6 below average; extremes 25·8 on 26th, and 1·7 on 6th; prevailing direction S.E. Unusual skyglows before and after sunrise throughout. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 3°·4, of dew point 4°·5, humidity 3, amount of cloud 0·8, above their respective averages. R ·27 in. below average. Prevailing winds N., strong on 8 days. Heavy dew on 8 days. Fog on 6 days. Lightning on the 12th. R. L. J. ELLERY, F.R.S.

Adelaide.—The mean pressure was very low, 0·116 in. below the average; the mean pressure in June has been only four times lower during 33 years. The mean temp. 55°·6 was 2° above the average; the nights particularly being warm; the mean min. (49°·9) being 3°·1 above the average. Dew was registered on 14 nights, but there was an entire absence of frost. Although the number of rainy days was just the average, the total precipitation was 1·43 in. above the average. C. TODD, F.R.S.

Wellington.—Generally showery, but some fine pleasant weather at intervals; the rainfall below the average. Prevailing winds S.E. and N.W., strong from latter quarter on 7th and 17th. Hail on 1st. Mean temp. 1°·8 above the average. Rainfall less than half the average. R. B. GORE.

Auckland.—Warm and mild for the season, the mean temp. being 2 degrees above the average, and the rainfall only about half the average. T. F. CHEESEMAN.

SUPPLEMENTARY TABLE OF RAINFALL, DECEMBER, 1890.

[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 Hall.	·68	XI.	Castle Malgwyn	...
,,	Margate, Birchington...	·73	,,	Builth(LlanwrtydWells)	1·42
,,	Littlehampton	·68	,,	Rhayader, Nantgwillt..	1·60
,,	Hailsham	·48	,,	Carno, Tybrith	1·03
,,	Ryde, Thornbrough	·88	,,	Corwen, Rhug	·84
,,	Alton, Ashdell.....	·80	,,	I. of Man, Douglas	2·68
III.	Oxford, Magdalen Col...	·55	XII.	Stoneykirk, Ardwell Ho.	2·64
,,	Banbury, Bloxham	·58	,,	New Galloway, Glenlee	1·80
,,	Northampton	·55	,,	Melrose, Abbey Gate...	1·36
,,	Cambridge, Fulbourne..	·48	XIII.	N. Esk Res. [Penicuick]	2·55
,,	Wisbech, Bank House..	·45	XIV.	Ballantrae, Glendrishaig	2·53
IV.	Southend	·57	,,	Glasgow, Queen's Park.	1·04
,,	Harlow, Sheering	·41	XV.	Islay, Gruinart School..	1·47
,,	Rendlesham Hall	·59	XVI.	Dollar.....	2·32
,,	Diss	·78	,,	Balquhidder, Stronvar..	1·43
,,	Swaffham	·48	,,	Coupar Angus Station..	1·77
V.	Salisbury, Alderbury...	1·01	,,	Dunkeld, Inver Braan..	1·29
,,	Warminster	1·83	,,	Dalnaspidal H.R.S. ...	1·54
,,	Bishop's Cannings	1·16	XVII.	Keith H.R.S.	1·80
,,	Ashburton, Holne Vic....	4·80	,,	Forres H.R.S.	·51
,,	Hatherleigh, Winsford.	2·31	XVIII.	Fearn, Lower Pitkerrie.	·39
,,	Lynmouth, Glenthorne.	2·58	,,	Loch Shiel, Glenaladale	...
,,	Probus, Lamellyn	4·57	,,	N. Uist. Loch Maddy ...	1·56
,,	Launceston, S. Petherwin	4·44	,,	Invergarry	·65
,,	Wincanton, Stowell Rec.	2·07	,,	Aviemore H.R.S.	1·09
,,	Taunton, Lydeard Ho...	...	,,	Loch Ness, Drumnadrochit	·62
,,	Wells, Westbury.....	1·51	XIX.	Lairg H.R.S.	·77
VI.	Bristol, Clifton	1·30	,,	Scourie	1·73
,,	Ross	1·15	,,	Watten H.R.S.	1·21
,,	Wem, Clive Vicarage ...	·64	XX.	Dunmanway, Coolkelure	7·51
,,	Cheadle, The Heath Ho.	·79	,,	Fermoy, Gas Works ...	2·23
,,	Worcester, Diglis Lock	·80	,,	Tipperary, Henry Street	2·73
,,	Coventry, Coundon	·80	,,	Limerick, Kilcornan ...	2·41
VII.	Ketton Hall [Stamford]	·51	,,	Miltown Malbay.....	2·35
,,	Grantham, Stainby	1·58	XXI.	Gorey, Courtown House	2·68
,,	Horncastle, Bucknall ...	·68	,,	Navan, Balrath	...
,,	Worksop, Hodsock Priory	·60	,,	Mullingar, Belvedere...	·94
VIII.	Neston, Hinderton	·80	,,	Athlone, Twyford	2·06
,,	Knutsford, Heathside ...	·61	,,	Longford, Currygrane...	1·82
,,	Lancaster, Southfield ...	·15	XXII.	Galway, Queen's Coll...	2·20
,,	Broughton-in-Furness ..	·96	,,	Clifden, Kylemore	4·39
IX.	Wakefield Prison	·77	,,	Crossmolina, Enniscoe..	1·59
,,	Ripon, Mickley	·58	,,	Collooney, Markree Obs.	2·52
,,	Scarborough, West Bank	·99	,,	Ballinamore, Lawderdale	2·45
,,	East Layton [Darlington]	·93	XXIII.	Warrenpoint	3·00
,,	Middleton, Mickleton..	·83	,,	Seaforde	2·46
X.	Haltwhistle, Unthank..	·70	,,	Belfast, New Barnsley..	2·44
,,	Shap, Copy Hill	·44	,,	Bushmills, Dundarave...	1·74
XI.	Llanfrechfa Grange	1·56	,,	Stewartstown	1·66
,,	Llandovery	1·01	,,	Buncrana	2·16

DECEMBER, 1890.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1880–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE Max. Deg.	Max. Date	Min. Deg	Min. Date	No. of Nights below 32° In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	·68	— 1·39	·21	18	9	43·7	4	14·9	22	25	27
II.		Maidstone (Hunton Court)...	·59	— 1·65	·20	20	5	...	...	...	...	...	...
,,		Strathfield Turgiss	·85	— 1·16	·25	18	10	43·9	5	7·5	22	24	27
III.		Hitchin	·67	— 1·36	·18	18	10	44·0	4	5·0	21	26	...
,,		Winslow (Addington)	·62	— 1·83	·23	18	10	42·0	3,4	1·0	22	26	28
IV.		Bury St. Edmunds (Westley)	·78	— 1·46	·16	19	10	42·0	4	6·0	21	...	...
,,		Norwich (Cossey)	·51	— 1·72	·15	3	6	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	1·63	— 1·47	·85	18	12	43·0	1,3	18·0	31	24	...
,,		Barnstaple	1·04	— 3·65	·45	1	7	45·0	4,5	21·0	31	...	...
,,		Bodmin (Fore Street)	5·81	+ ·47	1·55	18	20	...	...	...	...	...	...
VI.		Stroud (Upfield)	1·08	— 1·37	·43	18	11	41·0	1,4	17·0	14	27	...
,,		ChurchStretton(Woolstaston)	·81	— 2·24	·13	25	16	44·5	1	17·0	20*b*	28	29
,,		Tenbury (Orleton)	1·32	— 1·05	·41	18	13	45·0	1	1·5	22	25	26
VII.		Leicester (Barkby)	·49	— 1·65	·13	4	12	44·0	1	3·0	21	27	31
,,		Boston	·49	— 1·36	·20	26	4	44·0	4	12·0	21*c*	25	...
,,		Hesley Hall [Tickhill].....	·53	— 1·45	·14	4	12	44·0	4	10·0	21	28	...
VIII.		Manchester(PlymouthGrove)	·37	— 3·07	·33	19	2	45·0	1,4	10·0	19	21	30
IX.		Wetherby (Ribston Hall) ...	·67	— 1·77	·23	18	5	...	...	...	...	...	...
,,		Skipton (Arncliffe)	1·05	— 5·76	·18	24	10	48·0	2	19·0	13	17	...
,,		Hull (PearsonPark)	·86	— 1·41	·21	4	11	...	...	...	...	...	...
X.		North Shields	1·30	— 1·04	·28	25	13	50·0	1	...	...	...	...
,,		Borrowdale (Seathwaite).....	1·21	—13·60	·32	25	9	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	2·51	— 2·48	·83	18	11	50·0	1	19·0	31	22	30
,,		Plinlimmon (Cwmsymlog) ...	·86	...	·40	1	5	...	...	...	...	...	...
,,		Llandudno.....	1·31	— 1·65	·20	1*a*	11	...	...	...	...	...	...
XII.	SCOTLAND.	Cargen [Dumfries]	·95	— 3·07	·56	2	4	51·8	1	18·0	14	25	...
,,		Jedburgh (Sunnyside).....	1·71	— ·49	·70	26	10	48·0	2	12·0	13*d*	16	...
XIV.		Old Cumnock	1·71	— 3·36	1·20	2	7	53·0	1	17·0	20	26	...
XV.		Lochgilphead (Kilmory).....	1·53	— 5·84	·40	1	10	...	...	...	...	...	...
,,		Oban (Craigvarren)	1·37	...	·61	1	7	52·0	1	26·6	19	7	...
,,		Mull (Quinish).....	1·51	— 6·06	·43	1	10	...	...	...	...	...	...
XVI.		Loch Leven Sluices	2·70	— ·61	1·10	3	10	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	2·20	+ ·12	·90	2	13	52·5	1	22·7	22	13	...
XVII.		Braemar	·43	— 2·04	·09	4	14	51·8	1	16·0	21	24	29
,,		Aberdeen (Cranford)	3·02	...	·83	2	25	56·0	1	18·0	21	10	...
XVIII		Strome Ferry.....	1·58	— 6·21	·37	1	13	...	...	...	...	...	...
,,		Inverness (Culloden)	·55	— 1·38	...	...	...	55·0	1	23·0	7,18	22	29
XIX.		Dunrobin	·71	— 2·66	·29	26	7	56·0	1	25·0	18	13	...
,,		S. Ronaldsay (Roeberry).....	1·47	— 2·19	·19	27	18	53·0	1	31·0	19	2	..
XX.	IRELAND.	Cork (Blackrock).....	3·64	— ·52	·81	18	13	52·0	1	25·0	16	13	...
,,		Dromore Castle	4·89	— 1·74	·80	11	13	57·0	21	25·0	30	...	...
,,		Waterford (Brook Lodge) ...	3·62	— ·02	·82	18	14	51·0	1	24·0	31	13	..
,,		O'Briensbridge (Ross)	2·48	...	1·53	10	8	51·0	1	24·0	*e*	24	...
XXI.		Carlow (Browne's Hill)	2·56	— ·56	·75	18	13	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	1·86	— ·30	·60	2	11	53·9	1	24·1	21	8	23
XXII.		Ballinasloe	1·89	— 1·53	·90	11	10	49·0	1	18·0	21*c*	26	...
XXIII		Waringstown	2·68	— ·36	1·30	2	17	54·0	1	22·0	21*c*	18	23
,,		Londonderry (Creggan Res.).	1·82	— 2·39	·98	18	14	...	...	...	...	...	...
,,		Omagh (Edenfel)	2·01	— 1·67	·66	18	16	52·0	1	18·0	20	17	23

a And 18, 22. *b* And 31. *c* And 22. *d* And 14. *e* frequently.

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

METEOROLOGICAL NOTES ON DECEMBER, 1890.

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.—A month of unprecedented severity. With the exception of the interval from the 3rd to the 6th, there was uninterrupted frost, the maximum on 14 days not reaching the freezing point, while on the 22nd, the minimum in the Stevenson stand dropped to 7°·5, and on the grass (the snow having been swept away) fell to 4°·5 (both thermometers being in exact working order, and Kew corrections applied). The snow was not heavy, the greatest fall yielding ·25 inch on the 18th.

ADDINGTON.—Remarkable for the small amount of R and the long-continued frost, (lasting, without a single break, from the 7th until the end) often of great severity. From the 13th until the end, the max. shade temp. was never above 32°. The coldest December recorded here.

BURY ST. EDMUNDS, WESTLEY.—The month was remarkable for the high and very steady bar., the variation in the last ten days not exceeding a tenth of an inch. It was also extremely cold, with very severe frosts and wind, chiefly from the east.

LANGTON HERRING.—An exceptionally cold month, the absolute max. being only 43°, while the previous lowest max in December was 50° in 1879. The lowest max. in January has been 48° in 1881, and in Feburary, 48° in 1873. Comparison with other cold months shows :—

	MEANS.		
	9 a.m.	Min.	Max.
December, 1878 ...	33°·5	29°·8	38°·3
January, 1879 ...	32°·8	30°·1	36°·7
January, 1880 ...	33°·6	31°·5	38°·0
January, 1881 ...	29°·9	27°·8	36°·0
December, 1890 ...	31°·0	29°·0	34°·5

The mean max. was 10°·1, the mean min. 7°·7, the mean at 9 a.m. 8°·9 below the average.

BODMIN, FORE STREET.—A very cold month, with more than the average R and exceedingly hard frost, especially in the last week. Very little snow, but high cold N.E. winds; one of the old fashioned Decembers, and the coldest for many years.

STROUD, UPFIELD.—The max. temp. in shade, was above 32°, on only 11 days.

WOOLSTASTON.—A very severe month. The frost, which commenced on the 3rd, continued throughout with only some occasional slight thaws of an hour or two duration, but no exceptionally low temperature, was reached. S fell on 10 days, but not very heavily. Mean temp., 29°·4.

ORLETON.—The coldest December recorded here; the mean temp. 29°·8, being 8°·5 below the average of 29 years. On 13 days the temp. never reached 32°, and the max. for the month, 45° on the 1st, is the lowest max. registered in any month. On the night of the 21st, the thermometer on the grass fell to —1°·7, the lowest reading since January 3rd, 1867. The Teme and the Severn were both frozen over on 22nd. Deep S on 18th and 23rd. Fine S on 8th, 25th. 26th, 27th, 30th and 31st.

LEICESTER, BARKBY.—Mean temp. of month 28°·7. Min. temp. for the 13th, 14th, 20th, 21st, 22nd, and 29th respectively, 12°, 13°, 5°, 3°, 8°, 10°.

MANCHESTER, PLYMOUTH GROVE.—Mean temp. 32°. Dense fog on the 14th, 15th, 20th, and 21st. On the 19th and 21st the grass min. fell to 5°. S on the 19th.

HULL, PEARSON PARK.—The weather during the month was generally overcast, often with mist or fogs and frost, more or less severe every night, except the 1st, 4th, 5th, 8th, 9th and 10th. Slight falls of H or S occasionally on and after the 15th. Winds very cold, generally easterly.

WALES.

HAVERFORDWEST.—The month commenced rainy and mild, but on the 4th the wind shifted to the N. and N.E. ; temp. fell rapidly, and persistent frost prevailed to the end of the month ; severe at the middle, and especially so in the last week, when the temp. was uniformly low day and night, and did not exceed 32° on seven days. The night temp. was rather low at times, but did not approach the severity of 1870, '74, '78 and '79 Decembers. The temperature was, however, much below the mean. Winds from the 8th to 24th chiefly N. and N.E., while in the last seven days it blew with great bitterness and force from the E.

SCOTLAND.

CARGEN.—The mean temp. of the month is 5°·3 below the average. Easterly winds (N.E., E. and S.E.) prevailed for 23 days, generally with more or less fog, only 25 hours of sunshine being recorded ; while the average is 57 ; E the smallest recorded in December. On several occasions the barometer fluctuated more than half an inch in 24 hours, but produced little change in the general character of the weather.

JEDBURGH.—The weather was still though cold, and although the degree of frost was considerable, country work was not delayed.

OBAN.—Immediately after the 2nd fair and cold weather set in, which lasted to the close, and has been very beneficial to the farmers.

CULLODEN.—Continued frost during the whole month, without, however, either snow or fog. Weather otherwise pleasant. Very little R.

IRELAND.

CORK.—A cold raw and damp month. S at night on 30th, and most of the 31st, but it all disappeared in the night. Mean temp. 39°·3.

DROMORE.—The beginning of the month was wet, and it continued so till the last week, when easterly winds set in and it became bitterly cold, with a hard frost till the 31st, when there was a slight sprinkling of snow.

WATERFORD, BROOK LODGE.—A good deal of easterly wind during the month. Mean temp. 38°·5. H showers on the 11th. Gale from S.W. on the 18th. S on the 27th and 30th.

O'BRIENSBRIDGE, ROSS.—Sharp frosts very frequent, and the mean temp. for 24 hours often below 32°. Prevailing wind, N.E., and very bitter in the last week.

DUBLIN.—A very cold, dull, foggy month, with much cloud (7·6) and prevalent E. winds. Mean temp 39°·2, 2°·1 below the average. In December, 1878, the coldest in the 25 years ending 1889, the mean temp. was 32°·8. High winds on 10 days, gales on 2. Fog on 10 days ; S or sleet on 3 ; H on 6 days. Very dry piercing E. winds, from 28th to 31st.

WARINGSTOWN.—Frost, sharp and pretty continuous, but not remarkable here.

EDENFEL.—The mild wet weather of November extended in a modified degree to the 7th of this month, when it gave place to a cold period, that occupied with but little intermission the rest of the month. On the 18th and 19th a considerable quantity of S fell, but except on the nights of 19th, 20th and 21st, during which the temp. on the surface of the S reached 13°, there was no continuance of severe frost.

END OF VOL. XXV.