C. F. HERVÉ MANGON,

Vice-Président de l'Académie des Sciences,
Ancien Ministre,
Ancien Député,
Ingénieur en Chef des Ponts et Chaussées en retraite,
Président du Conseil du Bureau Central Météorologique,
Membre du Conseil de la Société Météorologique de France,
Membre de la Société Nationale d'Agriculture,
Vice-Président de la Société d'Encouragement pour l'Industrie Nationale,
Commandeur de la Légion d'honneur.

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SYMONS'S

MONTHLY

METEOROLOGICAL

MAGAZINE.

VOLUME THE TWENTY-THIRD.

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INDEX.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCLXV.] FEBRUARY, 1888. [PRICE FOURPENCE, or 5s. per ann. post free.

ENGLISH THUNDERSTORMS.

THIRTY-TWO years ago I started single-handed a system of collecting information respecting English thunderstorms. I was (as I always have been) most kindly helped by observers in many parts of the country, and I rejoice to think that several of them have proved life-long friends, and are among the best meteorological observers of the present day. I gathered material, which competent authorities have recently examined and spoken highly of; but in those days I was young, unknown, and without influence. I worked up the data to the best of my ability, with what result I proceed to relate.

First attempt.—Paper prepared with the title, "On the Thunderstorms of 1857," accepted by the British Meteorological Society, read at its meeting on June 9th, 1858, when the great engineer, Robert Stephenson, was presiding, but not even the title of the paper was recorded in the publication of the Society.

Second attempt.—In 1859 another paper was prepared, dealing with the phenomena recorded during the years 1857 and 1858. This I took to the Aberdeen meeting of the British Association. It was accepted, read in Section H, led to a long and complimentary discussion, in which the late Earl of Rosse, Prof. (now Sir) William Thomson and other distinguished men took part, but again the paper was excluded from the volume, the title only being printed.

Third attempt.—In 1860 I prepared a paper, embodying 1889 separate observations of thunderstorms made in England during the three years 1857, 1858 and 1859, and presenting with the necessary maps and diagrams such an epitome of the subject as had never before been prepared. This I took to the British Association Meeting at Oxford, and this time I was rewarded by the publication of an abstract extending to 27 lines. So much for three years' work. Maps, tables, diagrams all went into the waste basket together. This is the way to encourage young workers!

However, that is all in the dim past. And now that once more an attempt is to be made to deal with the subject, I hope that we shall be able to show that, as our French friends would say, "*Nous avons changé tout celá.*"

The initiative now is being taken by the Hon. Ralph Abercromby, with some support from the Royal Society, and the hearty co-operation of the Royal Meteorological Society, and I hope that I may add of the readers of the *Meteorological Magazine.*

The following is the circular which has been issued, and it will be seen from it that the work is so easy that everyone is competent to become a reporter, and that all communications are to go to Mr. W. Marriott, Ass. Sec. Roy. Met. Soc. :—

Royal Meteorological Society.

30, GREAT GEORGE STREET,
WESTMINSTER, S.W.

SIR,

The Council of the Royal Meteorological Society have appointed a committee to collect observations on British Hail and Thunder Storms from volunteer observers.

The objects which they hope to attain thereby are :—

I. A knowledge of the nature and causes of the different kinds of Thunder Storms; attention having been specially called to the subject by the great loss of life and property during the past summer.

II. A discovery of the localities where Hail and Thunder are most frequent and destructive.

III. If possible, to obtain an increased power of forecasting Hail and Thunder, whereby it is hoped that eventually damage to persons, stock, and property, may be lessened.

Volunteers can select to observe in either Class A, B or C, but this division into classes need not be closely followed.

Class A (no instruments required).—Simple records of the times when Thunder, Lightning, Rain or Hail begin and end, when they are loudest, brighest, or heaviest.

Class B (no instruments required).—A record, in addition to the above of the direction and force of the wind before, during and after the storm, and of the times when it changed.

Class C (good instruments required).—In addition to both the above, careful observations on the shape and motion of Clouds and, if possible, frequent readings of the barometer, dry and wet bulb thermometers.

The general nature of the observations required will be easily gathered from an inspection of the enclosed sample form.

The Council would be very pleased if you would assist them by becoming an observer under any class, but if you are unable to do so, perhaps you would favour them by handing this circular to some one else, or by furnishing the Council with the names of persons who are likely to be interested in Hail or Thunder observations.

It is believed that many intelligent young persons, of each sex,

would be willing and capable of making observations in the A or B Class.

In the event of a favourable reply, a stock of forms and a copy of instructions will be forwarded.

All communications should be addressed to the Assistant Secretary, Mr. W. Marriott.

J. W. TRIPE
G. J. SYMONS } *Secretaries.*

It is evident that the present effort is not quite in the same direction as was mine. The present attempt is to dissect the storms, to ascertain their characteristics, their anatomy so to speak, whereas in my early attempts I aimed specially at ascertaining the intensity of the storms, the extent and nature of damage to life and property, whether or not there were indications of selectiveness in the action of lightning upon terrestrial objects. But I have no doubt that all useful material will be fairly dealt with, and that instead of going into the waste basket it will be printed and issued to all contributors.

G. J. SYMONS.

THE JANUARY BLIZZARD.

WE are astonished to find that few Englishmen know what a blizzard is, and that in many dictionaries the word is not to be found.

When we were recently asked, "What is a blizzard?" we replied by asking another question, "Do you remember the snow storm of January 18th, 1881?" because, if so, that is the nearest English equivalent to a blizzard. Perhaps our reply would have been improved by joining with the mention of that snow storm a reminder of the Eurydice squall, but the addition would not have been important.

We hope that the January number of the Weather Bulletin of the United States Signal Office will give us full details of the recent blizzard, which has wrought much damage in Dakota and the N.W. States, but in the interim we think that the principal features may be described as—

(1) Rapid fall of temperature to a point below zero, *i.e.*, 32° at least below freezing.
(2) The formation of ice needles, instead of snow.
(3) Steep barometric gradients, causing a gale from a polar quarter.

All these features are requisite to produce that which we understand by a blizzard. Cold alone, wind alone, snow alone, or any two of them alone, will not produce the full discomfort of a genuine blizzard. Dry, calm, cold is by no means unpleasant, and though a gale with a low temperature is very trying, it needs the painful effect of an atmosphere loaded with ice-needles to account for the frenzy which unprotected exposure to a blizzard not unfrequently produces. We have just used the word frenzy. Some may think that it is too

strong, but if the fact that those who die from exposure to blizzards have not unfrequently torn off all their clothing be not a proof of frenzy, we do not know what would be.

Those of our readers who were in the south of England on January 18th, 1881, will now see why we called that an English blizzard. There was low temperature, not of course below zero, as recently in Dakota and other States; there was such a gale that we remember seeing the Robinson anemometer on Hankey's buildings flying round with only two arms left out of the four; and there was ice-needle snow so fine and so dry that it went through keyholes, window sashes, and all sorts of places where snow had hardly ever gone before.

And, as shown in the *Meteorological Magazine* for February, 1881, the loss of life and property in the southern half of England was proportionally great.

The true blizzard is an American phenomenon, and rightly has an American name; but when our weather so nearly approaches its characteristics as it did in 1881, we might not unwisely adopt the name.

ROYAL METEOROLOGICAL SOCIETY.

The monthly meeting of this Society was held on Wednesday evening, the 18th ultimo, at the Institution of Civil Engineers, 25, Great George-street, Westminster; Mr. W. Ellis, F.R.A.S., President, in the chair.

Messrs. C. H. Blackley, M.D., H. E. Brameld, E. S. Bruce, W. Forrest, J. Groves, M.D., C. Harrison, M.D., G. C. Harrison, N. R. Haswell, R. Laing, H. J. Lloyd, H. T. H. Mead, C. Perks, W. R. Pike, J. L. Rushton, M.D., and J. H. Walker were elected Fellows of the Society.

The paper read was "The Non-Instrumental Meteorology of England, Wales and Ireland," by Mr. G. M. Whipple, B.Sc., F.R.A.S., F.R.Met.Soc. This is a discussion of the observations of wind, cloud, thunderstorms, hail, snow, &c., made at the stations of the Royal Meteorological Society during the eight years, 1878-1885, and published in the *Meteorological Record*. The S.W. wind is the most prevalent, and blows on the average 74 days in the year; the W. wind occurs almost as frequently, blowing 65 days. The least dominant winds are the S.E. and N., which occur on 27 days, and the N.E. on 32 days. Thunderstorms are most frequent in the eastern and midland counties, and least frequent in the north of Wales.

After the reading of this paper the Annual General Meeting was held. The report of the Council showed the Society to be in a satisfactory condition, the number of Fellows being 522.

Mr. Ellis, in his presidential address, reviewed briefly the work and position of the Society, remarking that such a society, whilst

unable to carry out expensive original or experimental work, could yet act with great advantage in inciting volunteer workers throughout the country to united action, of which one recent example was the ready response to the request of the Society for photographs of lightning, an excellent collection of which had been obtained, and which would shortly be exhibited; in addition to which, arrangements were being made for the more systematic observation of thunderstorms. Referring to the question of sympathetic relation between sun spots and magnetism and meteorology, he thought that any complete treatment of the question in its meteorological aspect seemed to require that it should be dealt with in a much more comprehensive manner than before, for which purpose observations more nearly covering the surface of the globe might be necessary, if indeed not necessary also for the solution of many other meteorological questions, the present meteorological stations being distributed over the earth in isolated clusters. The attention given to synoptic charts was most important, but the general meteorological characteristics of places should also still continue to be studied. After remarking upon other matters, he laid before the meeting, tables showing the monthly means of amount of cloud from observations made in three different series at the Royal Observatory, Greenwich, extending in all from 1818 to the present time. In concluding, Mr. Ellis said that at one time the science of meteorology seemed likely to form an exception to the general rule of advance, for more than any other it has required the united action of many workers, but the field of inquiry opened out of late years allows us already to talk of the new or modern meteorology, phrases typical of the advance achieved, although the knowledge gained seems only to remind us of how much has yet to be done.

The following gentlemen were elected the officers and council for the ensuing year:—

President, William Marcet, M.D., F.R.S., F.C.S.—*Vice-Presidents*, Francis Campbell Bayard, LL.M.; William Ellis, F.R.A.S.; Charles Harding; Richard Inwards, F.R.A.S.—*Treasurer*, Henry Perigal, F.R.A.S., F.R.M.S.—*Trustees*, Hon. Francis Albert Rollo Russell, M.A.; Stephen William Silver, F.R.G.S.—*Secretaries*, George James Symons, F.R.S.; John William Tripe, M.D., M.R.C.P.Ed.—*Foreign Secretary*, Robert Henry Scott, M.A., F.R.S., F.G.S.—*Council*, Hon. Ralph Abercromby; Robert Andrew Allison, M.P.; Edmund Douglas Archibald, M.A.; William Morris Beaufort, F.R.A.S., F.R.G.S.; Henry Francis Blanford, F.R.S., F.G.S.; Arthur Brewin; George Chatterton, M.A., M.Inst.C.E.; William Henry Dines, B.A.; Henry Storks Eaton, M.A.; Baldwin Latham, M.Inst.C.E., F.G.S.; Edward Mawley, F.R.H.S.; Charles Theodore Williams, M.A., M.D., F.R.C.P.

REVIEW.

Bulletin Météorologique du département de l'Hérault publié sous les auspices du Conseil Général. Année 1886. Boehm et Fils, Montpellier, 1887. 4to. 96 pages and 17 plates.

IT would be a capital thing if the nominal leaders of British meteorological work could be compelled to go for a month's tour to the principal observatories on the Continent. They could hardly complain of it as a hardship, and the experience which they would gain would be worth all its cost. They would get a host of new ideas, and learn that England has not a monopoly of all the good methods for carrying on meteorological work, even if they did see a few things of which they would not approve. Such as the perversity whereby our French friends spoil their records with the Stokes-Campbell sunshine recorder by using any slip of blue paper which may come handy, instead of the proper cards. They maintain that the price of the regular cards is far too high. We do not say that they are wrong, but surely the proper course is to induce a French paper maker to bring out identical cards at a reasonable price, instead of the present makeshift plan, which renders all utilization of French sunshine records, and all comparison between them and those made in the British Isles, impossible. They would not, we believe, find that error at Montpellier, as other and very beautiful methods are adopted by Prof. Crova, to whom we owe the volume we are about to notice.

This is the 14th annual report upon the Meteorology of the Department of l'Hérault, which extends from the Mediterranean on its S.E., tothe ridge of the Cevennes, which forms its N.W. boundary. We shall state briefly the contents of the volume, adding such comments and criticisms as may seem desirable.

(1). Complete tables of the observations made in 1886 at the observatory of the National Agricultural School, Montpellier.

We are not sure that Prof. Crova does himself justice here. He has a very fine set of self-registering instruments (as will be shown later on), and our impression is, that observations for their control are made at intervals during the day. In these tables, however, the 9 a.m. readings of barometer, temperature, hygrometer and direction and force ofwind are alone given, with, of course, max. and min. temperatures, total daily rainfall, and total evaporation. We regret to find that the civil year is not adopted, but one running from December 1st to November 30th; but we may quote a few values, nevertheless:—Mean 9 a.m. pressure reduced to sea level, 29·989 inches; absolute max. temp., 98°·8; mean max., 69°·7; mean, 58°·5; mean min., 47°·2; absolute min., 20°·3; mean humidity, 66. Total evaporation (by a Piche instrument), 64·57 inches (!) Total rain, 29·76 inches.

(2). Abstracts of the observations at two other stations in Montpellier, viz., the Jardin des Plantes and the Normal School.

These agree fairly well with those at the observatory, but the school rain return looks too small; the total is only 22·60 in. against 29·76 in. and 32·68 in. at the other stations. Perhaps it is on a roof? or some decimal points have been misplaced?

(3). Complete observations from the station of Fraïsse.

But the report does not tell us where Fraïsse is, and although we have searched five atlases (including a large but rather old French one) and sundry gazetteers, guide books, &c., we cannot find it. Probably it is in the Cevennes, for we are told that its altitude is 3051 feet, and the total rainfall, 69·69 in., and the mean temperature only 48°·7, or less than that of London. We hope that next year Prof. Crova will give the latitude and longitude.

(4). Summary of observations at Clermont l'Hérault.

This is a well-known town, formerly called Clermont de Lodéve, it is W. of Montpellier, and therefore further inland, 295 ft. above sea, cooler than Montpellier (mean temp. 55°·0). Total rain 25·90 in.

(5). Monthly rainfall at 18 stations belonging to the *Ponts et Chaussées*, and at 2 kept by private observers.

These stations are grouped according to the river basins in which they are situated, one of them being on the summit of the Sommail at the altitude of 3314 ft., and others, Cette for example, being at sea level. The greatest fall in 1886 was 63·82 in. at La Salvetat in the basin of the Agout, at an altitude of 2303 ft., and the least, 13·58 in., at Lunel, in the extreme N.E. of the department, on the road towards Nismes.

(6). A notice by Prof. Crova on the actinometric observations made at the observatory by M. Houdaille, illustrated by two tables and two plates.

(7). Note by Prof. Crova on his electrically recording actinometer.

These sections must be reserved for separate notice, as we do not appear to possess a copy of one of Prof. Crova's papers, which is necessary to enable us to do them full justice. And even if we had a copy, it would probably be wiser to devote a separate notice to his important work in this direction.

(8) On the rainfall in 1886, by M. Houdaille.

In this article, after pointing out the relation of the monthly, seasonal, and total fall in 1886 to the average, the author proceeds to deal with the number of days of rain. It appears that the average number with 0·02 in. or upwards is only 49, but in 1886 the number was quite unusually great, reaching 90, 15 of them being in October, and being of course related to the great floods of that year, when for miles between Marseilles and Lyons, the view from the windows of the railway carriages was almost limited to water and trees. In 1884 M. Houdaille designed a pattern of self-recording rain gauge, and in the present volume he gives two sheets of reproductions of the records. The ratio of the ordinates to the abscissæ is about 0·10 in. of rain to 1 hour, the diagrams being twice that scale, and beautifully lithographed, every detail of all but the

most insignificant rains of the year (except in September, while the apparatus broke down) is given on these two quarto sheets.

(9). Annual variation in the humidity of the soil.

This is an excellent note by M. Houdaille, of which we must give a brief *resumé*. The mean humidity of upper layers of the soil and its variation with depth at first sight appear little related to meteorology; but it is easy to prove the intimate relation between the temperature of the air and that of the soil, and that between atmospheric humidity and the water contained in arable land. In fact, just as the amount of nocturnal radiation depends partly on the surface temperature and partly on that of the soil below the surface, so is the amount of evaporation from the surface of the soil modified by the amount and distribution of the water in the layers beneath.

Experience has shown that with a sandy soil evaporation changes little, as long as the water in the superficial layer remains within certain limits. If the soil could part only with the water in this superficial layer, evaporation would soon be stopped for want of supply, and herein the store of water in the soil below the surface enters as the modifying cause.

In that southern climate the soil sometimes, especially in summer, becomes dried a foot deep; below this is found a soil containing much water, and it is the rate at which this water can be drawn to the surface which regulates the amount evaporated. This rate is itself variable, because it depends on the character of the soil and on the thickness of the layer through which it has to be drawn. In fact the soil may be regarded as a series of capillary tubes of different diameters. If the layer through which the water has to be raised be thin, all the tubes would act, but the thicker the layer the smaller would be the tubes which would act, and therefore the slower the transmission. Hence one sees why there can be no agreement between the indications of the evaporimeters generally used by meteorologists and the actual loss from the surface of the ground.

The plan adopted has been to take about $\frac{1}{4}$lb. weight of soil from within two inches of the surface, and (by a boring tool) similar weights from depths of 1ft. 8in. and 3ft. 3in. respectively; to put them immediately into glass jars, and subsequently to evaporate them to dryness in a Weisnegg stove, thus determining precisely the amount of water each had contained. Identical methods were adopted with two different soils, one naturally much denser and wetter than the other.

The author then gives the values obtained at each of the three depths and on each soil on twelve occasions during the two years 1885—86 (only four times, however, in 1886), and adds diagrams of the results. We prefer to wait until the series is longer before offering any opinion upon them.

(10). The progress of vegetation during the year, and the influence of meteorological phenomena upon it.

This section (by M. Chabaneix) treats of what are known as

phenological phenomena, but the method adopted at Montpellier we have never seen elsewhere. Closely adjoining the meteorological instruments a portion of the gardens is devoted to a series of plants, trees, &c., specially selected and planted with a view to systematic observation. The total number is 63, but they are all so compactly arranged that they are easily and constantly under the eye of the observer; this ensures early and systematic record, while the same tree, plant, &c., being observed each year, the observations are more rigorously comparable than those made hap-hazard. We may, however, suggest that perhaps a tree 5 years old and one 25 years old, even if under identical conditions of soil and climate, would not come into leaf simultaneously, *i.e.* that there is a personal element as well as the generic one.

(11). Meteorological and agricultural notes collected and co-ordinated by M. Chabaneix.

Abstracts of the meteorological observations in each month, and notes upon the influence of the weather changes on agriculture. We do not understand why the rainfall given here (p. 83) should for ten months agree precisely with that on p. 16, but should suddenly differ as under for—

	Page 16.		Page 83.
September	161·5 mm.	.....	157·5 mm.
October	285·5 ,,	.....	234·2 ,,

It is not a misprint, for the same values are given on pp. 79 and 80.

(12). Evaporation from soil.

A note upon M. Chabaneix's work in this direction is being prepared for *British Rainfall*, 1887, with the necessary engraving, and therefore we need not remark upon it here.

(13). Monthly plates reproducing the curves of the self-registering and other instruments at the observatory.

These are excellent. The only criticism which we have to offer is that it is rather puzzling to find a series of weather symbols of which several differ from those adopted by the International Congress, and some are identical in form, but different in what they denote. The following are illustrations:—

	○	⊕	△	⩓
International	Solar halo.	Solar corona.	Soft hail.	Hail.
Bulletin de l'Hérault	Fine.	Fog.	White frost.	Frost.

As, however, the explanation is repeated on every plate, no serious mischief can result.

Our readers will now form a fair idea as to the high value of the *Bulletin Météorologique du département de l'Hérault.*

"GOAT'S HAIR" CLOUD.

To the Editor of the Meteorological Magazine.

SIR,—May I ask some of your readers to favour me with their ideas of the form of cirrus cloud, to which the name "goat's hair" is popularly applied?

What I want to know specially is, whether the name refers simply to a bundle of white fibres on a blue sky, or whether the term is applied to the dark fibrous clouds seen over rocky cumulus before thunder or heavy rain.—I am, &c., &c.,

RALPH ABERCROMBY.

21, *Chapel-street, London, S. W.*,
Jan. 16th, 1888.

LOW TEMPERATURE IN FEBRUARY.

To the Editor of the Meteorological Magazine.

SIR,—The exceptionally low temperature of last night for the month of February induces me to send you a note of it. Yesterday was a clear, cold day, with a max. of 30°, and a keen N.E. wind; by 10 p.m. the min. in shade stood at 20°, and at 6 o'clock this morning it stood at 9°, and the grass thermometer at 5°. I have no record of so low a reading in February; ice on lake 3 inches thick.

I am, sir, yours obediently,

JOHN MATHESON.

Addington, 2nd February, 1888.

EXTRAORDINARY WHIRLWIND AT JARROW-UPON-TYNE.

A correspondent, telegraphing from Jarrow, says that at about twelve o'clock last night, during a severe snow-storm, what is supposed to have been a whirlwind passed along the Grange-road, Jarrow. A cart, in which were George Atkinson, James Teesdale, and the driver, was passing up the street at the time. The snow was seen to be circling round in a curious fashion in advance, and the driver was called upon to stop the horse. Before he could do so, however, the horse and cart were caught up by the wind carried a short distance, and then thrown down. Atkinson was carried a distance of 150 yards before touching the ground, when he was thrown on his back, his leg being badly injured by coming in contact with the wall of a house. Teesdale was thrown against some iron railings, to which he clung until the storm had abated, while the driver was carried into Gray-street and deposited with force against the door of a house. The seat of the trap was found in Perry-street and the rug in Bodale-street, about 250 yards

distant. A number of persons collected and the horse was found to be badly injured. A shop window was blown in at the same time, and the chimney of the Prince of Wales Hotel was blown down. The hurricane lasted about a minute.—*St. James's Gazette*, 30*th January*, 1888.

WHITE FOG BOWS.

To the Editor of the Times.

SIR,—I observed the beautiful phenomenon, described by Professor Tyndall in your columns of the 12th inst., here on the 22nd of December last at 10.30 a.m.

The sky at the time was clear, except round the horizon. The shaded thermometer at 9 a.m. had been 29° Fahrenheit; sun just peeping through the clouds over the lower hills which form the south bank of the estuary of the Shannon. It was still freezing in the shade.

The bow was perfectly white, except near the cloudy horizon, where it became slightly opalescent, but no prismatic colours were discernible. I could see nothing peculiar in the state of the atmosphere, but the bow (which I watched for 15 or 20 minutes) gradually faded away as the sun rose clear above the cloudy horizon, and a rapid thaw set in during the next hour or so, the maximum shaded thermometer that day registering over 45°.

The white bow over the Shannon (which was singularly calm) was most beautiful, but part of the fascination was doubtless in the novelty of the sight. I wish Professor Tyndall would explain to a humble unscientific observer why the bow is white and not prismatic, and under what conditions the "minute aqueous particles" are formed, and how they may be discerned.

MONTEAGLE.

Mount Trenchard.

[We have reason to believe that Dr. Tyndall never saw this letter. It would require his ability to explain the details as to why a rainbow is coloured and a fogbow white, but the rough outline of the explanation is that the water particles producing a fogbow are not large enough to produce the coloured bow.—ED.]

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JULY, 1887.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Date.	Absolute. Minimum. Temp.	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	88·8	3	45·6	18	78·9	55·6	53·8	67	133·4	43·8	1·07	9	3·9
Malta	100·2	24	68·0	11	88·8	71·5	67·3	67	158·4	60·5	·00	0	0·7
Cape of Good Hope	70·0	27	37·0	...	61·4	46·2	...	87	...	...	2·90	16	7·3
Mauritius	75·2	18	57·0	30	73·2	62·7	59·0	75	127·6	47·3	1·96	22	4·9
Calcutta	92·4	17	76·4	10*b*	87·1	78·2	77·5	82	155·9	73·1	18·19	27	8·7
Bombay	87·1	1	74·3	4	82·9	76·3	75·5	87	142·7	72·9	30·98	28	9·0
Ceylon, Colombo	85·9	30	73·8	15	84·6	75·8	69·3	73	145·7	68·8	1·18	6	6·4
Melbourne	59·9	25	34·9	11	55·0	43·8	43·7	80	113·0	27·3	2·68	17	7·4
Adelaide	61·5	18	36·5	12	57·3	46·2	44·6	76	119·7	30·6	2·57	26	6·3
Wellington	...	...	...	...	...	...	...	...	...	...	...	...	...
Auckland	63·0	7*a*	35·5	4	57·6	46·3	45·5	79	123·0	26·0	5·92	24	7·0
Falkland Isles	...	...	20·2	2	...	33·4	36·2	95	89·0	24·0	1·65	20	7·1
Jamaica, Kingston	93·3	21	69·0	2	90·3	72·4	71·9	70	...	...	7·10	...	...
Barbados	83·0	var.	69·0	19	82·0	73·0	70·6	83	143·0	...	10·04	20	6·0
Toronto	97·2	16	57·2	24	83·4	62·9	62·4	70	...	51·0	·66	9	4·6
New Brunswick, Fredericton	91·7	2	47·0	16	73·3	58·9	61·2	77	...	...	2·91	16	6·2
Manitoba, Winnipeg	93·2	6	39·0	22	78·8	53·4	57·1	70	...	...	1·98	13	5·4
British Columbia, Victoria	77·0	19	38·0	10*c*	68·6	46·7	...	...	...	..	·27	2	...

a And 11. *b* And 15. *c* And 16.

REMARKS, JULY, 1887.

MALTA.—Mean temp. 79°·2. Mean hourly velocity of wind 6·2 miles. Sea temp. rose from 78°·1 to 84°·3. Earthquake shocks on 17th. J. SCOLES.

Mauritius.—Mean temp. of air 1°·1, of dew point 0°·3, and rainfall ·51 in. below average. Mean pressure 30·214 in., ·018 above average. Mean hourly velocity of wind 11·1 miles, 0·6 mile below average; extremes 29·3 miles on 9th, and 1·9 miles on 6th, 22nd, and 29th; prevailing direction E.S.E. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 2°·1, of dew point 2°·4, mean amount of cloud 1·2, and rainfall ·99 in. above the average; mean pressure ·120 in. below average. Prevailing wind N.; strong on 10 days. L on 16th, 17th and 19th; H on 31st; fog on four days, heavy dew on three, and hoar frost on two days.

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

Adelaide.—Mean ressure 30·119 in., ·055 in. below the average of 30 years, Mean temp. same as average, but diurnal range 3°·3 less. Rainfall average. C. TODD.

AUCKLAND.—A wet, stormy, and disagreeable month. Rainfall 1·50 in., and mean temp. slightly above average, pressure considerably below average.

T. F. CHEESEMAN.

KINGSTON.—Rainfall 4·07 in. above average. MAXWELL HALL.

BARBADOS.—Pressure not steady. Mean temp. (76°·7) the same as the average of 30 years. Mean hourly velocity of wind 1·3 miles below the average of 15 years. Rainfall considerably below average. Severe TS on 20th, a boy being killed and two houses burnt by L. R. BOWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL, JANUARY, 1887.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	1·19	XI.	Castle Malgwyn	2·23
,,	Margate, Birchington...	·79	,,	Rhayader, Nantgwillt..	2·75
,,	Littlehampton	1·22	,,	Carno, Tybrith	1·83
,,	Hailsham	1·08	,,	Corwen, Rhug	1·45
,,	Ryde, Thornbrough	1·12	,,	Port Madoc	3·26
,,	Alton, Ashdell.....	1·29	,,	I. of Man, Douglas	1·95
III.	Oxford, Magdalen Col...	·70	XII.	Stoneykirk, Ardwell Ho.	1·95
,,	Banbury, Bloxham	·81	,,	New Galloway, Glenlee	?6·31
,,	Northampton	·89	,,	Melrose, Abbey Gate...	1·74
,,	Cambridge, Beech Ho...	·54	XIII.	N. Esk Res. [Penicuick]	2·95
,,	Wisbech, Bank House..	·83	XIV.	Ballantrae, Glendrishaig	3·35
IV.	Southend	·75	,,	Glasgow, Queen's Park.	2·82
,,	Harlow, Sheering	·82	XV.	Islay, Gruinart School..	3·39
,,	Rendlesham Hall	1·52	XVI.	St. Andrews, Pilmour Cot	1·74
,,	Diss	1·18	,,	Balquhidder, Stronvar..	8·29
,,	Swaffham	1·11	,,	Dunkeld, Inver Braan..	1·67
V.	Salisbury, Alderbury...	1·15	,,	Dalnaspidal H.R.S. ...	5·68
,,	Warminster	·81	XVII.	Keith H.R.S.	1·98
,,	Bishop's Cannings	1·10	,,	Forres H.R.S.	1·70
,,	Ashburton (Holne Vic.).	2·58	XVIII.	Strome Ferry H.R.S....	5·53
,,	Hatherleigh, Winsford.	1·25	,,	Fearn, Lower Pitkerrie.	1·41
,,	Lynmouth, Glenthorne.	1·58	,,	Loch Shiel, Glenaladale	12·23
,,	Probus, Lamellyn	2·17	,,	S. Uist. Ardkenneth ...	...
,,	Launceston, S. Petherwin	1·82	,,	Invergarry	6·25
,,	Wincanton, Stowell Rec.	1·58	XIX.	Lairg H.R.S.	2·05
,,	Taunton, Lydeard Ho...	·99	,,	Forsinard H.R.S.	1·72
,,	Wells, Westbury.....	1·50	,,	Watten H.R.S.	1·60
VI.	Bristol, Clifton	1·11	XX.	Dunmanway, Coolkelure	6·73
,,	Ross	·69	,,	Fermoy, Gas Works ...	4 00
,,	Wem, Clive Vicarage ...	1·00	,,	Tipperary, Henry Street	4·91
,,	Cheadle, The Heath Ho.	1·29	,,	Limerick, Kilcornan ...	2·13
,,	Worcester, Diglis Lock	·84	,,	Miltown Malbay.....	2·36
,,	Coventry, Coundon	·78	XXI.	Gorey, Courtown House	3·49
VII.	Melton, Coston	·80	,,	Navan, Balrath	1·21
,,	Ketton Hall [Stamford	1·00	,,	Mullingar, Belvedere ...	1·95
,,	Horncastle, Bucknall ...	·78	,,	Athlone, Twyford	2·43
,,	Mansfield, St. John's St.	·61	,,	Longford, Currygrane...	2·41
VIII.	Knutsford, Heathside ...	1·58	XXII.	Galway, Queen's Coll...	2·47
,,	Walton-on-the-Hill... .	1·44	,,	Clifden, Kylemore	4·33
,,	Lancaster, South Road.	1·66	,,	Crossmolina, Enniscoe..	3·31
,,	Broughton-in-Furness ..	2·82	,,	Collooney, Markree Obs.	3·34
IX.	Shipley, Esholt Vic. ..	·74	XXIII.	Rockcorry.....	1·99
,,	Ripon, Mickley	·97	,,	Warrenpoint	1·77
,,	Scarborough, West Bank	1·29	,,	Seaforde	3·14
,,	East Layton [Darlington]	·97	,,	Belfast, New Barnsley .	2·77
,,	Middleton, Mickleton ..	1·09	,,	Cushendun	3·09
X.	Haltwhistle, Unthank..	1·70	,,	Bushmills	2·23
,,	Shap, Copy Hill	2·89	,,	Stewartstown	1·63
XI.	Llanfrechfa Grange	1·57	,,	Buncrana	2·66
,,	Llandovery	2·28	,,		

JANUARY, 1888.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1870–9	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) ...	·90	— 1·45	·24	2	9	51·8	8	23·1	1	15	23
II.		Maidstone (Hunton Court)...	·67	— 1·90	·21	21	8	...	...	...	...	...	...
,,		Strathfield Turgiss	·87	— 1·68	·18	21	11	52·1	8, 10	17·5	30	20	26
III.		Hitchin	·60	— 1·62	·12	20	12	52·0	9	22·0	29	17	...
,,		Winslow (Addington)	·85	— 1·70	·20	20	15	53·0	23	16·0	30	21	24
IV.		Bury St. Edmunds (Culford)	·86	— ·98	·29	29	9	48·0	8, 22	12·0	29	19	...
,,		Norwich (Cossey)	1·01	— ·69	·25	31	10	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	1·35	...	·43	20	16	49·0	22	24·0	30	12	...
,,		Barnstaple.....	2·56	— 1·70	·56	20	11	53·0	10	30·0	1	...	...
,,		Bodmin	2·96	— 3·55	·66	4	22	50·0	9	19·0	30	13	14
VI.		Stroud (Upfield)	·69	— 2·30	·21	2	10	52·0	8	20·0	29	18	...
,,		ChurchStretton(Woolstaston)	·76	— 2·67	·17	20	13	58·0	9	24·0	1, 30	18	20
,,		Tenbury (Orleton)	·66	— 2·33	·14	20	11	55·5	8	15·3	30	20	23
VII.		Leicester	·81	...	·25	20	14	53·4	8	20·0	30	17	...
,,		Boston	·74	— ·98	·20	28	10	58·0	9	8·0	30	19	...
,,		Hesley Hall [Tickhill].....	·55	...	·12	2	14	57·0	8	20·0	30	18	...
VIII.		Manchester (Ardwick).....	1·44	— 1·80	·28	30	11	47·0	24	25·0	20	16	...
IX.		Wetherby (Ribston Hall) ...	·48	— 1·74	·18	3	6	...	...	...	...	...	...
,,		Skipton (Arncliffe)	3·28	— 3·65	·93	3	16	55·0	10	21·0	19	16	...
,,		Hull (People's Park)	·81	— 1·10	·20	28	13	...	...	...	...	...	...
X.		North Shields	1·40	— ·44	·40	31	14	57·0	8	21·5	30	14	...
,,		Borrowdale (Seathwaite).....	8·32	—10·43	1·80	25	16	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	1·99	— 2·72	·56	1	17	...	...	...	...	...	...
,,		Haverfordwest	2·85	— 3·42	·71	20	18	50·3	22	21·9	29	12	17
,,		Plinlimmon (Cwmsymlog) ...	2·73	...	·82	20	13	...	...	...	...	...	...
,,		Llandudno.....	1·24	— 1·72	·30	5	16	57·2	9	25·8	19	9	...
XII.	SCOTLAND.	Cargen [Dumfries]	2·90	— 3·21	·68	3	14	52·0	8*a*	21·0	19	13	...
,,		Jedburgh (Sunnyside).....	1·38	— ·70	·60	31	11	53·0	8	18·0	19	15	...
XIV.		Old Cumnock	3·60	— 1·04	·58	3	13	54·0	9	16·0	28	16	...
XV.		Lochgilphead (Kilmory)	5·71	— 2·16	1·21	24	16	...	...	...	...	...	...
,,		Oban (Craigvarren)	5·78	...	1·07	4	18	55·0	23	25·0	28	11	...
,,		Mull (Quinish).....	5·56	...	1·08	4	15	...	...	...	...	...	...
XVI.		Loch Leven Sluices	1·90	— 1·92	·50	26	9	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	2·20	— ·25	·50	4	12	53·8	9	24·8	2	11	...
XVII.		Braemar	3·18	+ ·40	1·05	4	14	53·1	9	16·0	19	18	21
,,		Aberdeen	1·76	...	·24	3,25	20	56·0	10	22·0	20	15	...
XVIII		Lochbroom	3·22	...	·73	25	18	...	...	...	...	...	...
,,		Culloden	1·27	— ·50	...	...	...	54·0	9	19·0	19	11	21
XIX.		Dunrobin	1·83	...	·57	25	10	57·0	9	23·0	20	14	...
,,		Kirkwall (Swanbister)..... ..	...	...	...	...	..	...	...	...	...	...	..
XX.	IRELAND.	Cork (Blackrock).....	5·15	— ·87	1·81	3	16	54·0	8, 21	24·0	28*b*	5	..
,,		Dromore Castle	5·94	...	2·41	3	13	60·0	8	30·0	1	...	...
,,		Waterford (Brook Lodge) ...	3·61	...	1·14	3	17	55·0	21	22·0	30	7	...
,,		O'Briensbridge (Ross)	1·92	...	·47	4	12	52·0	...	24·0	29	11	...
XXI.		Carlow (Browne's Hill)	2·93	— ·69	·83	3, 4	11	...	...	...	..	...	...
,,		Dublin (FitzWilliam Square)	1·25	— 1·01	·35	1, 3	9	58·8	9	25·9	29	3	17
XXII.		Ballinasloe	2·69	— 1·67	1·03	4	13	50·0	8,9	19·0	29	11	...
XXIII		Waringstown	1·87	— 1·54	·41	1	12	55·0	9	19·0	27*c*	11	16
,,		Londonderry (Creggan Res.).	2·41	...	·46	4	17	...	...	...	...	...	...
,,		Omagh (Edenfel)	2·47	— 1·30	·82	4	12	51·0	7, 24	20·0	28	12	15

a And 24, 25. *b* And 29. *c* And 28.

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

METEOROLOGICAL NOTES ON JANUARY, 1888.

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, dry, healthy month, with considerable range of pressure and a complete absence of S until the 30th and 31st.

HITCHIN.—The driest January on record here, as fog accounted for some of the registered rainfall. The streams, springs, and wells were lower than ever before known.

ADDINGTON.—Rainfall much below the average. From the 7th to the 14th fog occurred every day, dense all day on 9th, 11th, and 12th, exceptionally so on the afternoon and night of the 12th, Very high wind prevailed all day on the 26th. S showers on 31st.

CULFORD.—Fine during the greater part of the month. Sharp frost and deep S on the 29th. More or less fog on 7 days.

LANGTON HERRING.—The most noticeable feature of the month was the long continued fog, lasting almost without intermission from the 8th to the 14th inclusive. Rainfall 1·79 in. below the average. The mean temp. at 9 a.m. and the mean min. temp. were each 1°·5 below the average, and the mean max. temp. was 2° below the average. On the 9th a faint, white rainbow was observed.

BODMIN.—The mean pressure was singularly high and fogs were exceptionally frequent. Mean temp. 38°·2.

WOOLSTASTON.—The genial weather of the early part of the month was succeeded by a dense cold fog, lasting from 10th to 14th. The remainder of the month was cold, with a good deal of frost. Mean temp. 37°·1. S on 30th and 31st.

ORLETON.—The fluctuations of temperature and pressure during the month were very great, and the fall of R was very small. Mean temp about 1° below the average of 27 years. Frosty nights prevailed and there were several slight falls of S, coverng the ground, but at no time to the depth of half an inch. Dense fog prevailed on the 9th till 9 a.m., followed by a cloudless sky till night, when a dense fog came on, which continued till the 14th, and was succeeded by a cloudy sky and dry frost for many days. Very high wind on 26th and again in squalls on 31st.

MANCHESTER.—An average winter mouth. S fell slightly on three or four occasions, and from the 9th to the 14th there was a continuous and dense damp fog, which rendered road or marine traffic difficult and dangerous.

HULL.—The weather of the month was chiefly remarkable for the large amount of cloud and the frequency of fogs and mists.

WALES.

HAVERFORDWEST.—A dense fog commenced on the 7th and lasted till the 13th. When driving at night it was impossible to see the horse's head. The fog again came on on the 20th, and lasted till the 24th. The highest reading of the barometer was on the 9th, when it reached 30·667 in. (corr.) It never froze hard enough to permit skating. Rainfall exceeded half an inch on one day only.

SCOTLAND.

CARGEN.—The meteorological conditions of the month were somewhat remarkable. For 11 days, from 9th to 19th, the pressure was unusually high, thick fog prevailed, and only two hours of sunshine were recorded. No R fell, but the atmosphere was nearly at saturation point during the whole of the period. Mean pressure 30·092 in., ·368 in. above the average. 38 hours of sunshine were recorded, only 11 of which occurred from 1st to 21st. A few nights of sharp frost were experienced, but the cold in no case lasted long.

JEDBURGH.—Generally mild and quiet. Spring flowers in bloom. Nest building was frequent, and a mavis was reported to b sitting on eggs on 25th. Pressure generally high. S three inches deep on 31st.

OBAN.—The month was decidedly mild, the only cold period being from 9th to 19th. S.W. to E. winds prevailed. Wall flowers and other spring plants were in bloom all the month. Gales on 4th, 21st, 25th, and 30th.

LOCHBROOM.—Up to the 25th the weather was more like summer than winter. From that date to the close variable weather occurred, with S and sleet every day on the lower grounds, and very severe and deep S with drifts on the elevated grounds, the high hills being one deep sheet of S without a break.

CULLODEN.—Very fine throughout, with many days very fine and warm, and with a greater amount of sunshine than usual. All labour was well forward at the close.

IRELAND.

BLACKROCK.—The first six days were wet, cold and stormy, then, with the exception of a few fine days, it was misty, raw and damp, with R mostly at night. Mean temp. (42°·5) 2°·4 above the average. Gale on 31st.

O'BRIENSBRIDGE.—A fortnight of unusually fine weather, bright, calm and warm, prevailed from the 6th to 20th, and there was very little wintry weather at all.

DUBLIN.—During the greater part of the month the weather was open, although changeable. Warm, damp, squally weather prevailed during the first week, with heavy southerly gales. The mean temp. (42°·1) was perceptibly above the average (41°·4), and the mean pressure (30·192 in.) was ·311 in. above the average. High winds were noted on 12 days, gales on 4. Fog on 10 days. H on 1st and 19th; S or sleet on 1st, 30th, and 31st. Mean humidity 87; mean amount of cloud 6·3.

WARINGSTOWN.—The water supply was not replenished, springs being still very deficient.

EDENFEL.—A remarkably fine and mild month, with a calm and perfectly rainless period from 7th to 19th. R fell mostly at night. S on 1st only.

THE RAINFALL OF HULL.

SOME years since Mr. Harold Smith prepared a summary of the rainfall observations made by him at Hull, and allowed us to have the pleasure of presenting a copy to each of our readers.

Mr. Smith having removed to Surrey, his long and valuable record has terminated, and he has now prepared an abstract of the whole 30 years, and has favoured us with copies, which we are very glad to have the pleasure of issuing with this number.

It will be seen that 1887 was the driest of the whole 30 years, being only 69 per cent. of the average, and 1872 the wettest, being no less than 40 per cent. in excess. April is usually the driest month, but February has only 0·01 in. more, so that they may be considered as identical; October (as is so frequently the case in the British Isles), is the wettest month, followed, however, by August instead of by July, as is, we think, most usual, but there is evidently some tendency to heavy rains in August, for a quite original and very useful little table of the number of days in each month with 1 inch or more of rain shows the striking facts: (1) that while the average number of such days *per mensem* is $4\frac{1}{2}$, August had 12; and (2) their number in August is 50 per cent. greater than in any other month in the year.

RAINFALL:

RESULTS OF 30 YEARS' OBSERVATIONS ON THE BEVERLEY ROAD, HULL,

From October 1st, 1857, to September 30th, 1887.

YEARLY FALL.

Year.	Fall in Inches.	*Days.
1858	22·42	135
1859	21·12	170
1860	31·74	205
1861	19·97	163
1862	23·69	174
1863	24·63	155
1864	18·27	152
1865	23·80	170
1866	29·20	202
1867	24·10	184
1868	26·54	163
1869	28·29	189
1870	25·81	172
1871	25·69	170
1872	36·51	221
1873	22·09	180
1874	20·19	176
1875	28·37	178
1876	30·77	191
1877	29·33	222
1878	27·86	212
1879	25·92	189
1880	31·94	172
1881	27·61	194
1882	33·91	205
1883	29·39	215
1884	19·26	173
1885	26·44	189
1886	27·18	213
1887		

	Inches.	Days.
Average	26·02	187
Wettest Year —1872	36·51	221
Year with largest number of Days—1877	29·33	222
Driest Year—1887	18·05	174
Year with least number of Days—1858	22·42	135

AVERAGE YEARLY FALL IN EACH 5 YEARS.

Years.	Inches.	Days.
1858 to 1862	23·79	169
1863 to 1867	24·00	173
1868 to 1872	28·57	183
1873 to 1877	26·25	189
1878 to 1882	29·44	194
1883 to 1887 (computed)	24·06	192

QUARTERLY FALL.

	Wettest Quarters		Average.		Driest Quarters.	
	Year.	Inches.	Inches.	Days.	Year.	Inches.
First Quarter...	1872	8·60	5.34	49	1858	1·50
Second ,, ...	1882	8·69	5.36	41	1887	3·02
Third ,, ...	1880	11·53	7.53	40	1864	3·59
Fourth ,, ...	1882	14·08	7.78	53	1857	2·08

Having removed from Hull in November, I have been unable to complete 1887 with my own observations, but my friend, Mr. LAWTON, whose gauge is about half-a-mile from where mine was, has kindly given me his Fall for November and December. Completing the year by that means the total Fall for 1887 amounts to 18·05 inches 174 days.

The past year has been remarkable for its fine summer. During June only ·04 of rain was measured, the driest month, consequently, in the 30 years, in fact, since April, 1852, when only ·02 fell. The year itself is the driest in the period; nevertheless, the extraordinary dry six months from October, 1857, to March, 1858, when only 3·58 fell, stand unparalleled. The statistics for periods of five years continue to show, in the number of days, a high average, but the average Fall during the last quinquennial period shows a large decrease. That decrease has been very much felt throughout the country, and the question of water supply should have the most serious attention of those in authority, as a series of dry years would be very disastrous to our large towns, which are so dependent on an adequate supply of water both for health and business purposes. A Table has been compiled showing the Rainfall over Central England for the last 160 years. From this Table it appears that 19 out of the 30 years of my observations are over the average and 11 below, thus showing that during that time we have had a high average. The five years ending 1858 were all below the average. Where would our water supply come from now, if we had five similar years?

The wettest half-year was the second half of 1880, when 29·27 fell.

MONTHLY FALL.

	Wettest Months.		Average.		Driest Months.	
	Year.	Inches.	Inches.	Days.	Year.	Inches.
January ...	1863	3·48	1·84	16	1880	·17
February...	1881	3·27	1·64	16	1858	·26
March	1876	3·65	1·85	17	1875	·81
April	1882	3·83	1·63	14	1875	·47
May	1869	4·69	1·78	14	1859	·47
June.....	1860	4·32	1.97	13	1887	·04
July	1880	4·86	2·23	13	1869	·25
August ...	1881	5·34	2·67	13	1861	·45
September	1866	5·34	2·63	15	1865	·47
October ...	1880	5·87	2·86	18	1879	·81
November	1875	5·76	2·42	18	1862	1·04
December	1868	6·54	2·50	18	1873	·30

Number of Days on which 1 inch or more fell in the 30 years.

January	2
February	0
March.....	2
April	3
May	3
June	2
July.....	8
August	12
September	8
October	7
November	2
December	5
	54

Heaviest Fall in one Day, 2·00 on August 21, 1858.

Average Rainfall for the 20 Years 1860 to 1879.

At Hull.....	26·16	At Hunstanton	21·41
,, Leeds	23·93	,, London ...	26·46
,, Sheffield ...	31·97	,, Exeter.....	33·22
,, Malton ...	27·95	,, Penzance	44·15
,, Manchester	34·66	,, Belfast ..	34·57
,, Bolton.....	46·38	,, Seathwaite, Cumberld.	144·50
,, Lincoln ...	22·28		

Fall of Rain at the Stye, Head of Borrowdale, in 1872, amounted to 243·98 inches.

HAROLD SMITH, F.R. Met. Soc.

Ingleside, Kenley, Surrey,
January, 1888.

* Days—by "Days" is meant the number of days in which any Rain was measured, without any reference to quantity

A Fall of One Inch of Rain is equal to 100 Tons per Acre.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

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ISONEPHS—MAPS OF CLOUD-PREVALENCE OVER THE GLOBE.*

THE various publications of the French Meteorological Office contain so many interesting memoirs that they furnish rather an *embarras de richesse*, and, we are afraid, suffer accordingly.

We feel, indeed, that we owe an apology to M. Teisserenc de Bort, for not earlier noticing his work. One reason for the delay is, however, so complimentary to the author, that we may perhaps be excused for mentioning it—the paper is so useful that it has frequently been absent when we were about to notice it.

The author begins with some notes upon other Meteorological Maps; and it seems to us that it may be useful to complete his history, as far as we are able, leaving it to others, if they will kindly do so, to correct us; so that eventually a perfect list may be formed

Wind.—First mapped by Halley, more than two centuries ago, and published in the *Philosophical Transactions*, Vol. XVI, 1686.

Temperature.—Isotherms, or lines indicating localities having similar mean temperatures, first drawn by Humboldt, in 1817.

Pressure.—Isobars, or lines indicating where the sea level pressure is equal, were certainly drawn as early as 1839; because our copy of Berghaus's *Physikalischer Atlas*, published in 1849, contains a Map entitled "Uebersicht der mittleren Barometerstände am Meere und der oscillationen des Luftdruckes," which bears the foot note, Gotha, J. Perthes, 1839, Second Edition, 1849. This map shows more details of barometric range than of mean barometric pressure; but it gives both, showing even the low barometer off Cape Horn, by assigning to it a mean pressure of 330 Paris lines (= 29·31 in.), or considerably lower than any other place on the globe. M. Teisserenc de Bort rightly draws attention to the map of Western Europe, published by M. Renou, in the *Annuaire* of the French Meteorological Society, in 1864, as probably the earliest complete series of isobars of the pattern now adopted; and to Mr. Buchan's, in 1869, as the first for the whole globe.

* Etude sur la distribution moyenne de la Nébulosité a la surface du Globe, par M. Léon Teisserenc de Bort. Annales du Bureau Central Météorologique de France, 1884 - Météorologie Générale, 4to, 1886.

Rain.—The earliest rainfall map of which we are aware is not entitled to rank in this list—because there was no attempt at indicating by lines, or shading, the areas of large and of small rainfall. It was a map of England, issued in March, 1840, by J. Atkinson, of Carlisle, and showed the average rainfall by figures printed over the sites at which the observations had been made. We believe that, as with isobars, so with isohyetals, or lines of equal rainfall, priority rests with Dr. Perthes; as the map in Berghaus's Atlas above quoted, bears date, "Gotha, J. Perthes, 1841, Second Edition, 1849."

Cloud.—Just as we owe to M. Renou the first complete set of isobars, so do we owe to him the first set of isonephs,* or lines of equal prevalence of cloud. These he gave in an excellent paper in the *Annuaire*, of the French Meteorological Society, in 1879; but it treated only of part of Western Europe and Northern Africa, and was, as the author himself stated, only a preliminary.

It is to a thorough investigation of this subject that the present memoir is devoted, and the work reflects the highest credit on the author. He has spared no trouble in collecting information, or in so treating the data as to obtain the best results. He does not pretend that his charts will not require revision at some future time, he recognizes their imperfections, but he has given us not only such maps as we have never had before, but in our opinion, maps of very high excellence.

Nine large quarto pages are devoted to a list of, and notes upon, the documents which have been used in the construction of the charts.

When we state that he has evidently discussed the monthly values from at least 680 stations in various parts of the globe, for a gross total of more than five thousand years, besides working up more than 100,000 observations upon the amount of cloud over the Atlantic; we need say nothing more as to the zeal and labour devoted to the work.

As regards accuracy, M. Teisserenc de Bort remarks—"The most nearly accurate manner of forming charts to represent any Meteorological element is to group observations made simultaneously all over the globe. Unfortunately, stations of which long continued and synchronous observations exist are a few in number, and there are many breaks in the series; while, as regards observations made at sea, they are grouped according to localities and to months, rather than chronologically."

He then proceeds to explain how he has endeavoured to minimize the effect of these evils—and this has led us to make a little investigation, which is we think useful, as indicating the amount of precision attainable in the estimation of the amount of cloud, and also instructive as to the variability in the amount from year to year.

We have taken from Mr. Glaisher's tables, as published by the

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* ἴσος, equal; νέφος, cloud.

Registrar-General, the mean amount of cloud in each quarter of each year for the ten years, 1876-85, at Camden Square, London, N.W., and at Blackheath, London, S.E., the distance between them being 7 miles. The values are as follows :—

	Camden Square.					Blackheath.				
	March.	June.	Sept.	Dec.	Year.	March.	June.	Sept.	Dec.	Year.
1876...	6·7	5·7	5·3	7·5	6·3	7·0	5·3	5·1	7·4	6·2
7...	6·7	5·9	5·5	5·6	5·9	6·7	5·8	6·0	5·9	6·1
8...	7·4	6·2	5·8	7·0	6·6	7·5	6·1	6·2	7·3	6·8
9...	7·4	6·7	7·0	6·8	7·0	7·7	6·8	6·5	7·4	7·1
1880...	6·7	6·5	6·2	6·9	6·6	6·4	6·0	6·4	6·8	6·4
1...	7·2	5·8	5·9	6·6	6·4	7·5	6·3	6·5	6·7	6·7
2...	6·9	6·0	6·2	7·2	6·6	6·3	5·5	5·7	7·0	6·1
3...	6·5	5·7	6·0	6·7	6·2	6·2	5·7	5·9	6·9	5·8
4...	6·9	6·0	5·2	6·7	6·2	6·9	6·1	4·4	6·9	6·1
1885...	6·8	5·5	5·7	6·8	6·2	6·3	4·8	5·2	7·1	5·9
Mean.	6·9	6·0	5·9	6·8	6·4	6·9	5·8	5·8	6·9	6·3

This shows :—

(1). That the difference in the quarter between the two stations is usually only $\pm$ 0·3, only exceeded 0·5 on four occasions, and only once reached 0·8.

(2). That the difference in the year is usually $\pm$ 0·2, and reached only 0·4 and 0·5 once in the ten years.

(3). That the usual difference between the mean amount in two successive years is only $\pm$ 0·3.

(4). That at Camden Square, the least cloudy year was to the most cloudy as 100 : 119 ; and at Blackheath, the corresponding values were 100 : 122.

These values seem to us very satisfactory, and show the close agreement of trained observers, and thereby indicate that observations of this class are probably more accurate than most persons supposed. They also show that the amount of cloud is not an element which varies greatly from year to year. Rainfall, we know, varies between two consecutive years by about one-fifth of its average amount, the above table shows that cloud varies by only about one-sixteenth. The wettest year has, we know, more than twice the rainfall of the driest ; the above figures show that the most cloudy year has only one-fifth more cloud than the clearest one.

From this it seems to follow that M. Teisserenc de Bort, need not anticipate any material change in his isonephs, except in those parts of the world from which he has failed to obtain any information at all, and they are few in number, as any one will soon find out who tries to compile a list of unrepresented districts.

We have devoted so much space to the examination of the amount of confidence to be placed in the work, that we have to pass over the important pages in which M. Teisserenc de Bort considers the

relation of cloud areas to those of high and low barometric pressure, and to say a few words respecting the maps. They are on Mercator's projection, about 2 ft. by 1 ft., and possess that neatness and distinctness which characterizes all that is issued by the French Meteorological Office. There are 13, one for each month and one for the year. The most marked features are three areas where the average amount of cloud exceeds 7; the largest nearly covers the N. Atlantic, between lat. 47° N., and 62° N., and then sweeps away over the Gulf Stream to the North of Norway and Nova Zembla; the next is an oval extending W.S.W. to E.N.E. in the North Pacific, S.W. of Alaska; and the third takes Patagonia and all places S. of 50° S.

The least cloud is reported for a large tract covering the Sahara and much of the interior of Northern Africa, Arabia, Persia and part of Afghanistan.

Smaller areas with similarly little cloud are Central South Africa, and Central Australia.

There are in the following little table which we have drawn up from M. Teisserenc de Bort's large ones, some crumbs of comfort for Britishers, for which we ought to be more grateful than many of us a re.

Mean Annual Amount of Cloud (Overcast sky=10.)

Hamburgh ...	7·0	Bayonne	6·1	Milan	5 3	Corfu	4·2
Brussels	6·9	Dublin.....		Sydney		Rome	4·1
St. Petersburgh	6·7	Melbourne ...	6 0	Wellingtn. NZ		Cape Town...	4·0
Moscow	6·6	Paris		Buda Pesth ..	5·1	Valparaiso ...	3·9
Cracow	6·5	Christiania ...	5·9	Florence	5·0	Lucknow.....	3·5
London		Vienna.....		Madras		Nice.....	3·4
Berne	6·4	Aberdeen ...	5·7	Mexico		Smyrna	
Copenhagen..		Utrecht		New Orleans.	4·9	Pekin	3·3
Berlin	6·3	Yokohama ...		Lisbon.....	4·7	Algiers	3·1
Edinburgh ...		Oporto.....	5·6	Buenos Ayres	4·6	Lahore.....	2·7
Geneva		Toulouse.....		Bombay	4·4	Cairo	1·9
Stockholm ...	6·2			Calcutta	4·3	Athens.....	1·7
				Naples.....			

Who would have expected Brussels to be more cloudy than London? Berlin, Edinburgh and Geneva to be equally cloudy, and more so than Stockholm, Utrecht, Christiania or Dublin? In fact the equality between Dublin and Bayonne, is one of the most surprising features in the whole table—and we throw no doubt upon the accuracy of either record.

The paper is one which marks a distinct step in Meteorology, and on which the author is to be warmly congratulated.

THE BOLIDE OF NOVEMBER 20TH, 1887.

To the Editor of the Meteorological Magazine.

SINCE your issue for December last, in which you printed a considerable amount of information on the subject of the Bolide of the 20th of November, I have obtained a mass of additional materials, and the inquiry may now be said to be closed.

I purpose discussing the whole fully, for the Herts Natural History Society, and in the meantime may summarise the results already arrived at.

As regards the effects and distribution of the sound-waves originating in the passage through the air, or explosion, of the meteorite, or from both causes, records of the sound have been obtained from about 150 localities, the area covered being 105 miles in its extreme length from Westley, near Bury St. Edmund's, in the east, to Upper Lamborne, near Swindon, in the west, and of width varying from 15 to 20 miles, and extending into 11 counties. This area may be outlined by the following places :—On the north, Bury St. Edmund's, Newmarket, Cambridge, St. Neots, Risely (Beds), Bedford, Bow Brickhill (Bucks), Buckingham, Sulgrave (Northants), with an isolated observation near Leamington, Brackley (Northants), Bicester, Sandford, Oxford, Pusey, and Upper Lamborne ; and on the south, Wantage, Upton (Berks), Reading, Bisham (near Maidenhead), Prince's Risborough, Wendover, Aldbury (Herts), Watford, Hatfield, Albury (Herts) and Saffron Walden.

Looking at the distribution of sound over this area alone, the course of the meteorite may perhaps be laid down on a line of which Bury St. Edmund's and Upper Lamborne are extreme points. If regard is had to the localities from which evidence of a particular loudness in the sound has been received it is more difficult to come to a decision as to the course of the meteorite, but on the whole this consideration points to a line rather more to the northward, of which perhaps Newmarket and Wantage might be terminal points.

From a number of observers their impressions as to the direction from which the sound noticed reach them have been obtained, but there is much variety in these reports, and it is difficult to bring them into even tolerable harmony. Generally throughout Cambs, Essex, Herts and Beds, *i.e.*, the eastern half of the area affected, the sound came from the west and south-west. In the west there is a greater variety of direction. The fair inference upon this seems to be that no explosion took place within any of the former counties, but that further to the westward, at one or more centres, explosions took place. This conclusion is also supported by the descriptions given of the character of the sound. In the western section in some places a series of explosions (in one case as many as five) are recorded, all of them apparently distant ; but the general estimate of the nature of the sound was that it was of some duration and like thunder. More to the west it is often described as a single explosive sound like that of a cannon. It is probable, therefore, that in the earlier part of its observed course—possibly at a great elevation—a rushing sound, with perhaps minor detonations, gave rise to the noise noticed, and that at certain points in its later course—or at one point only—a breaking up of the main mass of the meteorite occasioned one or more distinct and very loud reports.

There is some ground for associating an explosion with the district a little south of Ampthill, in Bedfordshire, both on account of the loudness of the sound experienced there, and also from a well-marked convergence of lines of sound from places to the westward upon that point. But, however this may be, it is pretty clear that explosions took place somewhere in the neighbourhood of Thame, and again further to the west, near Wantage.

The meteorite was *seen* apparently from two points—certainly from one. As to the doubtful record (if it is doubtful), there is very little to say. I have received two letters from an observer at Solihull, near Birmingham, referring to what appeared like "an ordinary sky-rocket, just at the *moment after* it has spent itself in the air." This is stated to have been noticed "full south." The information is rather meagre—but the time (8.20) is that of the meteorite—and it seems improbable that anything else to which such a description as that given would apply, would be seen by any coincidence exactly at that time, and in broad daylight. If we take this observation to refer to a final explosion of the meteorite in the neighbourhood of Wantage, the direction would be a little to the E. of S., and the distance 60 miles. Thame would be nearly S.E., at about the same distance. If either of these points is adopted, the elevation, to enable an observer at such a distance to notice the explosion (probably at an angle of not less than 15° above the horizon,) might perhaps be put at 20 miles and upwards.

The Hertford observations are far more definite and important, and as I have visited the locality, may, I think, be accepted with considerable confidence.

The meteorite was seen from an upper window, which faces about N.N.W. It was first observed at a point about N.E., and at an elevation of about 20°. It passed across the view to the W., disappearing behind a projecting building at about W.N.W., at an elevation of about 13°. At a point about N.W. a piece appeared to fall. No sound was heard at Hertford, although the shock was felt within a few miles to the N. and W.

If we take N.E. as the exact point of first appearance, Bury St. Edmund's, 46 miles distant, may be assumed as the approximate locality over which the meteorite was first seen. The height there above the earth might perhaps be as much as 20 miles, if the angle of elevation somewhat exceeded 20°. If N.E. is too far to the E., and an allowance is made for some error in this direction, Newmarket might be a better estimate of the locality.

The point at which a fragment of the meteorite was observed, from Hertford, to become detached, if taken accurately as N.W., might perhaps be associated with the apparent centre of sound distribution in Bedfordshire already referred to, which lies due N.W. of Hertford; but some variation must be allowed in fixing such a point, and possibly it should be more to the westward. The point

of disappearance might possibly be as far W. as Aylesbury, which would be 32 miles distant, and at the estimated angle of elevation, would give a vertical height at that place of only 7½ miles. This small elevation is perhaps hardly consistent with the meteorite travelling so far westward as Wantage, and one is rather inclined to argue from the Hertford observations, that the course of the meteorite was somewhat further to the north than that deduced from other data.

The course and elevation will probably never be fixed with any great accuracy, but at all events we have not only disposed completely of the widespread idea that an earthquake occurred on November 20th, but have also obtained a sufficiently accurate general notion of the cause of the sounds and other phenomena so widely noticed on that day.

H. GEORGE FORDHAM.

Odsey Grange, Royston.

THUNDERBOLTS.

TWICE in this Magazine have I reported searches after thunderbolts. The first thunderbolt turned out to have been manufactured for fun by a young chemist; the second was the soot and part of the brick of a chimney fused by lightning into a cake with the cinders in the grate below. I intend exhibiting some other specimens of so-called thunderbolts at the meeting of the Royal Meteorological Society on March 21st, and shall be very thankful if any one who has, or can procure, a *reputed* thunderbolt, will be kind enough to send me full particulars, and to lend me the specimen.

G. J. SYMONS.

62, *Camden Square, N. W.*

RAINFALL IN NORWAY.

"The Norwegian town of Bergen has always had the character of being an excessively 'wet' place, but the amount of rain that fell there during the year 1887 seems to beat the record. It amounted to no less than 111 in., against 88 in. during 1886 and about 78 in. for the previous years, whereas the normal amount of rain there is only 67 in. The greatest amount of rain for any 24 hours was 2·91 in. There are two places in Norway that can boast a still greater amount of rain than Bergen, viz., Florö and Demmestan, where the annual amount of rain exceeds that of Bergen by 5·90 and 8·85 in. respectively. At Florö, the greatest amount of rain for any 24 hours was 4·36 in., or about half the annual amount of rain at Alten in Finmark. The average of the annual amount of rain in Christiania is only 26·38 in."—*Engineering*, Vol. xlv., p. 122 (3rd February, 1888).

ROYAL METEOROLOGICAL SOCIETY.

THE monthly meeting of this Society was held on Wednesday evening, the 15th ult., at the Institution of Civil Engineers, 25, Great George Street, Westminster; Dr. W. Marcet, F.R.S., President, in the chair.

Mr. T. S. Ainge, Mr. J. C. Bell, F.R.G.S., Mr. C. A. Markham, Surgeon-Major S. Smith, Mr. J. T. Tibbles, and Dr. J. Walther were elected Fellows of the Society.

The following Papers were read :—

1. "Electrical and Meteorological Observations on the Peak of Teneriffe," by the Hon. Ralph Abercromby, F.R.Met.Soc. The author made a trip to the Island of Teneriffe, in October 1887, for the purpose of making some electrical and meteorological observations, and now gives some of the results which he obtained, which may be summarised as follows :—The electrical condition of the Peak of Teneriffe was found to be the same as in every other part of the world. The potential was moderately positive, from 100 to 150 volts, at 5 ft. 5 ins. from the ground even at considerable altitudes; but the tension rose to 549 volts on the summit of the Peak, 12,200 ft., and to 247 volts on the top of the rock of Gayga, 7,100 ft. A large number of halos were seen associated with local showers and cloud masses. The necessary ice-dust appeared to be formed by rising currents. The shadow of the Peak was seen projected against the sky at sunset. The idea of a south-west current flowing directly over the north-east trade was found to be erroneous. There was always a regular vertical succession of air currents in intermediate directions at different levels from the surface upwards, so that the air was always circulating on a complicated screw system.

2 "Rainfall of South Africa, 1842-1886," by Mr. W. B. Tripp, M.Inst.C.E., F.R.Met.Soc. The author gives the rainfall statistics from all those stations situated in South Africa which possess records of 10 complete years and upwards. He remarks upon the chronological succession of wet and dry years, and the consecutive years above and below the mean; and also describes the seasonal distribution of monthly maxima, and the extent over which monthly rains prevail. He concludes by comparing the curves of rainfall with those of sunspot energy.

3. "Some Methods of Cloud Measurements," by Mr. Nils Ekholm. As exact cloud measurements afford almost the only easily available means of determining motions in the upper regions of the atmosphere the author describes some methods which seem to him likely to give the best results. He also details the plans adopted at the Swedish Polar Station, Cap Thorsden, in Spitzbergen, and at the Upsala Observatory, for determining the direction and angular velocity of the clouds, and for making direct measurements of the height and absolute motions of the clouds.

EARTHQUAKE IN SCOTLAND.

To the Editor of the Meteorological Magazine.

SIR,—It will interest you to have the following account of the earthquake shock here on the 2nd inst. The time was not noted, but many persons were awakened in the early morning by what seemed to be the roll of a carriage along the road, and one gentleman (who was at Cannes during the earthquake of last year) distinctly felt the shock, which lasted three or four seconds, and recognised the familiar rumbling noise, and states that the time was a few minutes after 5 a.m. It was also distinctly felt along the shores of Loch Linnhe to Port William, and thence along the great glen of the Caledonian Canal to Inverness. In the latter place several persons left their houses, and the daily papers have done full justice to their accounts.

On the other side of the Loch (Linnhe) we have accounts of the shock and rumbling from Loch Buie and Tobermory (Mull), and also along the shores of Loch Creran and Loch Leven to Ballachulish in the S.E.

It is noticeable that the tremors were felt only on the sea-shore levels, and not on the hills in the immediate neighbourhood. The captain of a steamer at Ballachulish observed (or heard) a large wave washing the shore, "while the sea was perfectly calm before and after," about the hour of the earthquake.—Yours truly,

G. WOULFE BRENAN.

Craigvarren, Oban, February 11th, 1888.

P.S. The meteorological conditions that were prevalent the evening previously were—disturbed weather, with a moderate gale and a falling bar. and temperature high; but the rain and gale moderated about midnight, and it was quite calm, I believe, at the time of the earthquake.

[Our correspondent will perhaps excuse our adding as a sort of P.S. an epitome of the reports in the *Scotsman* of February 3rd, which one of our correspondents kindly sent us. First, as to the time; it was dark, the early morning of February 2nd, and the time quoted varies from "between 4 and 5," the very unscientific report of the meteorological observer at Loch Buie in Mull, to 5.15 at Perth, and it is evident that besides the observers being sleepy and in some cases frightened, many of the clocks were wrong. Fortunately, the shock stopped the large clock in the tower of the High Church of Inverness at four minutes past 5 a.m., which is apparently as near the truth as we shall get.

As Mr. Brenan states, the shock was most violent between the Isle of Mull and Inverness, but it was felt S.E. as far as Edinburgh and N.W. up to Loch Carron, or about 120 miles from S.W. to N.E. and about 130 from N.W. to S.E. At Fort William it is stated that a concrete house was cracked, and that a basin of milk was thrown off a shelf. Several clocks were stopped at Inverness, and at Nairn one was thrown off a shelf.—ED.]

WHITE FOG BOWS.

To the Editor of the Meteorological Magazine.

SIR,—Is the editorial note to the letter on p. 11 a correct explanation of the absence of colour in fog bows, viz., that the water particles are not large enough? In viewing a single dew drop close to the eye, the smaller, and consequently the more perfectly spherical, the drop, the more perfect is the rainbow and the more distinct its spectra, though less brilliant than in a larger drop; so that one would suppose that if the particles are very small in a fog bow, the colours would be more distinct than in a rainbow, other things being equal. The explanation proposed by one writer that the want of colour was owing to the abundance of drops, so that each interferes with the rays from the others, seems a possible one, but I do not know whether it is very likely.—Yours truly,

T. W. BACKHOUSE.

Sunderland, March 6th, 1888.

THE SNOWSTORM OF FEBRUARY 14th.

To the Editor of the Meteorological Magazine.

SIR,—Perhaps you are collecting accounts of the great snowstorm of Shrove Tuesday. No doubt different parts of the country experienced the force of it in different degrees. Here it began to snow early in the morning; by 9 a.m., when melted and measured it gave 0·23 in., it ceased snowing at 11 a.m., at which time it was 6 in. deep. Snow began to fall again between one and two o'clock, by five o'clock it was 8½ in. deep, and by ten it was 12 in., and still snowing. To avoid waste by the heaping of the rain gauge or the blowing away of the snow, I melted it twice during the day. When I measured at 9 a.m. Wednesday, I had 1·49 in. So I think I am perfectly safe in supposing that snow fell to the depth of 18 inches in 24 hours, though with the foot-rule I did not measure a greater depth on the level than 13 in., but it was perfectly level; there was no blowing and drifting. We have had snow on every day since the 11th, altogether measuring 1·95 in.—I am, Sir, yours obediently,

JOHN MATHISON.

Addington, 16th February, 1888.

[Large as is the value here assigned to the depth of the snow, it is certainly not excessive; very careful measurements at Oxford gave 20·4 inches, and others at Little Wittenham, near Abingdon, 19 inches.—ED.]

UNIVERSAL DICTIONARY OF CLIMATE.

MANY things have lately combined to indicate the rapid progress of scientific work in South America; hence perhaps we ought not to be surprised at the Herculean labour which the Imperial Observatory of Rio de Janeiro now undertakes.

The circular and forms issued by M. Cruls, the director of the observatory may be epitomised as follows—and we may also mention at once, that a supply of blank forms has been sent to the Royal Meteorological Society, and that doubtless a copy will be supplied to any one who possesses a series of accurate observations of reasonable length, and is willing to co-operate by supplying the data required from his own station.

Briefly, then, M. Cruls points out that there does not exist any work giving methodical, complete, and uniform tables of climatic data for the whole globe. That even where abstracts exist, they vary endlessly in form, in the data given, and in the scales employed; besides which hundreds of volumes must be searched in order to collect them.

The Imperial Observatory of Brazil has prepared a form which appears to us excellent, erring neither by asking too much nor too little, and invites observers throughout the world to do their share by filling up the forms and sending them to Rio de Janeiro. On thier part the Brazilian authorities undertake to classify, print and publish the materials, and to send two copies to every one who contributes acceptable data. This offer is so handsome that we think that it may be well to reproduce the sentence *verbatim*.

"L'observatoire impérial de Rio de Janeiro se fera un devoir d'offrir deux exemplaires du *Dictionnaire Climatologique Universel* aux observatoires et institutions météorologiques qui auront bien voulu répondre à son appel, et qui seront ainsi autant de collaborateurs d'une œuvre devenue, par cela même, en quelque sorte internationale."

EXHIBITION OF APPARATUS CONNECTED WITH ATMOSPHERIC ELECTRICITY.

The Ninth Annual Exhibition of the Royal Meteorological Society will be held, by kind permission of the Council of the Institution of Civil Engineers, at 25, Great George-street, Westminster, on Wednesday, the 21st instant, and will consist of apparatus connected with atmospheric electricity, including lightning conductors, photographs of lightning, and damaged objects, and of such new instruments as have been invented and first constructed since the last exhibition.

The President, Dr. W. Marcet, M.D., F.R.S., will deliver an address at 7 p.m, on "Atmospheric Electricity," illustrated by experiments, and Mr. G. J. Symons, F.R.S., will make a short communication on "The Non-existence of Thunderbolts," elucidated by accounts of searches after them and the exhibition of specimens.

The exhibition will remain open till Friday, the 23rd instant, and will, we feel sure, well repay a visit and maintain the high character of the exhibitions of the Society.

Those who are not Fellows of the Society should apply for invitations to Mr. W. Marriott, the Assistant Secretary, at 30, Great George-street, S.W.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, AUGUST, 1887.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Date.	Minimum. Temp.	Date.	Average. Max.	Min.	Dew Point.	Humidity.	Absolute. Max. in Sun.	Min. on Grass.	TotalRain. Depth.	Days	Aver. Cloud.
	°		°		°	°	°	0–100	°	°	inches		0–10
England, London	88·5	6	42·5	15	74·4	52·5	45·7	55	129·2	40·3	3·15	8	5·0
Malta	98·6	18	67·9	25	90·1	73·0	67·1	62	148·2	63·0	·56	2	1·2
Cape of Good Hope	77·0	25	33·7	7	63·6	46·4	...	...	...	...	3·98	12	5·2
Mauritius	74·6	2	54·6	18	71·9	60·8	56·4	71	123·6	42·1	2·11	20	5·0
Calcutta	90·9	17	75·9	2	87·5	78·1	77·1	80	156·7	73·4	10·28	23	8·1
Bombay	85·4	7	73·5	31	83·1	75·7	74·7	85	144·3	71·7	17·59	29	8·7
Ceylon, Colombo	87·0	3·29	71·8	7	85·2	75·5	69·4	74	146·0	67·5	4·85	18	7·0
Melbourne	72·1	25	33·6	2	57·6	43·4	44·2	80	119·9	26·7	·96	11	5·9
Adelaide	76·5	24	36·6	12	61·3	46·1	44·4	70	129·7	29·9	1·37	18	5·0
Wellington	...	...	...	...	...	...	...	...	...	...	...	...	...
Auckland	61·0	23	35·0	13	55·7	43·6	42·6	77	121·0	28·0	1·39	14	3·7
Falkland Isles	...	...	19·0	3	...	29·7	31·1	88	102·0	17·5	2·58	25	7·3
Jamaica, Kingston	90·9	1	69·3	13	89·1	72·1	72·7	78	...	...	3·63	...	...
Barbados	86·0	7	70·0	8*a*	83·0	73·0	73·8	83	142·0	...	10·97	21	6·0
Toronto	90·1	4	45·1	25	76·0	56·4	54·6	65	...	39·0	1·99	9	5·4
New Brunswick, Fredericton	82·2	2	42·0	29*b*	71·6	51·8	55·4	76	...	...	4·63	14	4·7
Manitoba, Winnipeg	88·0	7	33·3	25	74·3	47·0	52·7	75	...	...	1·49	15	5·1
British Columbia, Victoria	82·0	11	38·0	30	68·6	45·8	...	...	...	...	·01	1	...

a And 9, 19. *b* And 31.

REMARKS, AUGUST, 1887.

MALTA.—Mean temp. 80°·9. Mean hourly velocity of wind 6·2 miles per hour. Sea temp. fell from 85°·0 to 81°·9. TSS on 7th and 27th. J. SCOLES.

Mauritius.—Mean temp. of air 2°·3, and of dew point 2°·2 below, and rainfall ·36 in. above average. Mean pressure 30·174 in., ·018 in. below average. Mean hourly velocity of wind 11·6 miles, 0·3 mile below average; extremes 27·9 miles on 29th, and 1·8 miles on 20th; prevailing direction S.E. to E.S.E. The mean temp. (66°·3) was the lowest for August since observations commenced in 1875. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air the same as the average of 29 years; temp. of dew point 2°·2 above average; humidity 6 and pressure ·154 in. above average; rainfall ·93 in., and mean amount of cloud 0·3 below average. Prevailing wind N.; strong on 4 days. Dense fog on 11th. L on 26th, and 27th; heavy dew on 10 days; hoar frost on 3 days. R. L. J. ELLERY, F.R.S.

Adelaide.—Mean pressure 30·212 in., one-tenth of an inch above the average. Mean temp. about the average. Rainfall nearly an inch below average. Weather generally fine and pleasant. C. TODD.

AUCKLAND.—The early part of the month was showery and unsettled; the middle and close were very fine, with light southerly winds and cold nights. Pressure considerably above average; mean temp. nearly three degrees below average; rainfall not much more than a quarter of the average and the smallest recorded for August. T. F. CHEESEMAN.

BARBADOS.—Pressure steady. Mean temp. (77°·2) the same as the average. Mean hourly velocity of wind 1·3 miles below the average. Rainfall much above the average. Severe TS on 9th. R. BOWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL, FEBRUARY, 1887.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	1·30	XI.	Castle Malgwyn	·91
,,	Margate, Birchington...	2·58	,,	Rhayader, Nantgwillt..	1·35
,,	Littlehampton	1·15	,,	Carno, Tybrith	1·00
,,	Hailsham	1·68	,,	Corwen, Rhug	1·12
,,	Ryde, Thornbrough	·85	,,	Port Madoc	2·57
,,	Alton, Ashdell.....	·79	,,	I. of Man, Douglas	·63
III.	Oxford, Magdalen Col...	3·38	XII.	Stoneykirk, Ardwell Ho.	·58
,,	Banbury, Bloxham	1·24	,,	New Galloway, Glenlee	·52
,,	Northampton	2·04	,,	Melrose, Abbey Gate...	2·23
,,	Cambridge, Beech Ho...	·99	XIII.	N. Esk Res. [Penicuick]	2·65
,,	Wisbech, Bank House..	2·12	XIV.	Ballantrae, Glendrishaig	1·21
IV.	Southend	1·18	,,	Glasgow, Queen's Park.	·71
,,	Harlow, Sheering	·76	XV.	Islay, Gruinart School..	1·84
,,	Rendlesham Hall	2·17	XVI.	St. Andrews, Pilmour Cot	1·16
,,	Diss	2·51	,,	Balquhidder, Stronvar..	·84
,,	Swaffham	2·33	,,	Dunkeld, Inver Braan..	·19
V.	Salisbury, Alderbury...	1·09	,,	Dalnaspidal H.R.S. ...	1·04
,,	Warminster	1·79	XVII.	Keith H.R.S.	2·65
,,	Bishop's Canuings	·88	,,	Forres H.R.S.	1·16
,,	Ashburton Holne Vic....	·87	XVIII.	Strome Ferry H.R.S....	3·65
,,	Hatherleigh, Winsford.	1·79	,,	Fearn, Lower Pitkerrie.	1·00
,,	Lynmouth, Glenthorne.	1·03	,,	Loch Shiel, Glenaladale	6·77
,,	Probus, Lamellyn	1·38	,,	S. Uist. Ardkenneth ...	...
,,	Launceston, S. Petherwin	·92	,,	Invergarry	2·92
,,	Wincanton, Stowell Rec.	1·25	XIX.	Lairg H.R.S.	1·36
,,	Taunton, Lydeard Ho...	·69	,,	Forsinard H.R.S.	2·28
,,	Wells, Westbury.....	1·18	,,	Watten H.R.S.	1·72
VI.	Bristol, Clifton	1·74	XX.	Dunmanway, Coolkelure	·61
,,	Ross	1·10	,,	Fermoy, Gas Works ...	·93
,,	Wem, Clive Vicarage ...	·68	,,	Tipperary, Henry Street	1·13
,,	Cheadle, The Heath Ho.	·87	,,	Limerick, Kilcornan ...	1·03
,,	Worcester, Diglis Lock	·56	,,	Miltown Malbay.....	1·31
,,	Coventry, Coundon	·90	XXI.	Gorey, Courtown House	·83
VII.	Melton, Coston	2·11	,,	Navan, Balrath	·41
,,	Ketton Hall [Stamford]	1·90	,,	Mullingar, Belvedere...	·65
,,	Horncastle, Bucknall...	1·50	,,	Athlone, Twyford	·55
,,	Mansfield, St. John's St.	1·64	,,	Longford, Currygrane...	·80
VIII.	Knutsford, Heathside ...	1·14	XXII.	Galway, Queen's Coll...	·62
,,	Walton-on-the-Hill.....	·64	,,	Clifden, Kylemore	2·09
,,	Lancaster, South Road.	1·47	,,	Crossmolina, Enniscoe..	1·67
,,	Broughton-in-Furness ..	1·75	,,	Collooney, Markree Obs.	1·72
IX.	Shipley, Esholt Vic. ..	1·26	XXIII.	Rockcorry.....	·05
,,	Ripon, Mickley	1·76	,,	Warrenpoint	·46
,,	Scarborough, West Bank	1·85	,,	Seaforde	·33
,,	East Layton [Darlington]	.81	,,	Belfast, New Barnsley..	·83
,,	Middleton, Mickleton..	·71	,,	Cushendun	1·92
X.	Haltwhistle, Unthank..	1·12	,,	Bushmills	1·52
,,	Shap, Copy Hill	1·25	,,	Stewartstown	·40
XI.	Llanfrechfa Grange	1·10	,,	Buncrana	1·38
,,	Llandovery	·80	,,		

FEBRUARY, 1888.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1870–9	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) ...	·77	— ·87	·31	13	14	52·0	6	19·1	2	20	23
II.		Maidstone (Hunton Court)...	1·64	+ ·02	·77	13	13	...	...	...	...	...	...
,,		Strathfield Turgiss	1·52	— ·23	·42	13	11	52·7	6	11·8	2	20	26
III.		Hitchin	1·30	— ·30	·29	14	14	51·0	6	15·0	25	22	...
,,		Winslow (Addington)	2·73	+ ·92	1·49	14	15	51·0	4	9·0	2	22	25
IV.		Bury St. Edmunds (Culford)	2·10	+ ·33	·33	16	12	50·0	7	7·0	2	22	...
,,		Norwich (Cossey)	1·60	— ·15	·45	14	12	...	...	9·0	2	...	...
V.		Weymouth(LangtonHerring)	·56	...	·20	11*a*	6	51·0	9	20·0	25	20	...
,,		Barnstaple.....	1·61	— 1·58	·49	13	11	53·0	8*b*	25·0	25	...	...
,,		Bodmin	1·48	— 3·39	·42	13	18	49·0	6	20·0	2, 20	20	20
VI.		Stroud (Upfield)	1·65	— ·60	·36	13	14	56·0	9	20·0	1, 16	...	...
,,		ChurchStretton(Woolstaston)	·41	— 2·09	·07	2	12	50·5	4	19·0	26	22	23
,,		Tenbury (Orleton)	1·06	— 1·41	·31	14	17	51·5	4, 7	14·5	17	22	23
VII.		Leicester	·81	...	·26	3	8	...	...	...	...	...	...
,,		Boston	1·46	— ·32	·58	14	7	55·0	8	19·0	2	21	...
,,		Hesley Hall [Tickhill].....	1·18	...	·36	19	11	52·0	6	22·0	14*d*	...	...
VIII.		Manchester (Ardwick).....	1·18	— 1·01	·21	11	14	48·0	6	24·0	14	22	...
IX.		Wetherby (Ribston Hall) ...	1·07	— 1·08	·35	20	8	...	...	...	...	...	...
,,		Skipton (Arncliffe)	2·10	— 2·54	·72	19	15	50·0	8	12·0	13	19	...
,,		Hull (People's Park)	1·49	— ·76	·45	14	18	...	...	...	...	...	...
X.		North Shields	·97	— ·87	·23	19	14	54·5	6	21·0	14	17	17
,,		Borrowdale (Seathwaite).....	2·97	— 8·48	·78	2	14	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	·92	— 2·74	·60	13	8	...	...	...	...	...	...
,,		Haverfordwest	·85	— 3·60	·27	2	12	50·2	6	24·3	16	17	21
,,		Plinlimmon (Cwmsymlog) ...	2·09	...	·56	2	12	...	...	...	...	...	...
,,		Llandudno.....	·44	— 1·85	·12	16	11	48·2	7	26·2	17	10	...
XII.	SCOTLAND.	Cargen [Dumfries]	·73	— 3·08	·29	10	6	51·6	5	12·4	12	20	...
,,		Jedburgh (Sunnyside).....	1·17	— ·59	...	...	11	51·0	8	18·0	17	22	...
XIV.		Old Cumnock	1·94	— ·92	·43	12	16	48·0	4, 6	10·0	15	20	...
XV.		Lochgilphead (Kilmory)	2·15	— 2·24	·62	12	10	...	...	...	...	...	...
,,		Oban (Craigvarren)	2·08	...	·52	4	12	51·3	5	19·7	16	16	...
,,		Mull (Quinish).....	2·70	...	·48	4	13	...	...	...	...	...	...
XVI.		Loch Leven Sluices	·70	— 2·26	·20	17	6	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	·65	— 1·90	·15	16	10	53·6	5	16·3	16	15	...
XVII.		Braemar	·49	— 2·18	·25	18	13	50·2	5	4·0	16	22	26
,,		Aberdeen	2·05	...	·57	14	22	54·0	5	10·0	16*e*	15	...
XVIII		Lochbroom	3·02	...	·49	7	20	...	...	...	...	...	...
,,		Culloden	1·20	+ ·15	...	...	...	52·0	6	15·0	16	20	24
XIX.		Dunrobin	1·86	...	·35	6	13	53·0	5	20·0	16	17	...
,,		Kirkwall (Swanbister)..... ..	...	...	...	...	..	...	...	...	...	...	...
XX.	IRELAND.	Cork (Blackrock)	·27	— 4·32	·06	18	9	54·0	3	22·0	26	15	...
,,		Dromore Castle	·62	...	·30	16	5	...	...	...	...	...	...
,,		Waterford (Brook Lodge) ...	·80	...	·18	13	12	52·0	3, 4	19·0	16	16	...
,,		O'Briensbridge (Ross)	·44	...	·10	13	16	52·0	6*c*	24·0	14	19	...
XXI.		Carlow (Browne's Hill)	·89	— 2·03	·20	2	12	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	1·10	— 1·06	·27	25	14	51·4	3	24·8	14	12	22
XXII.		Ballinasloe	·54	— 1·97	·15	2	15	48·0	3	18·0	16	22	...
XXIII		Waringstown	·49	— 1·76	·17	2	11	53·0	4	16·0	13	20	21
,,		Londonderry (Creggan Res.).	1·59	...	·25	10	18	...	...	...	...	...	...
..		Omagh (Edenfel)	·62	— 1·66	·20	17	12	49·0	4	17·0	14	22	...

a And 13. *b* And 9, 10. *c* And 7, 8. *d* And 26. *e* And 17.
+ Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON FEBRUARY, 1888.

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 cold cheerless month, with a good deal of S in places. The reports of the wheat plant were not very satisfactory, but the covering of S was beneficial.

HITCHIN.—The coldest February but one since the Crimean winter, 1855.

ADDINGTON.—A somewhat remarkable month. The night of the 1st was intensely cold. From the 3rd to the 10th very fine weather prevailed. On the 11th S began to fall and the ground was covered from that date to the close. A severe S storm occurred on the 14th, from which date the temperature was low, so that the S wasted very slowly. S on 12 days.

CULFORD.—Severe weather prevailed the greater part of the month, with S on 10 days.

LANGTON HERRING.—A very dry month. A few grains of sleet or flakes of S fell on 8 days, but the quantity was not sufficient to register. The coldest February in 17 years. The only five months in that time in which the temperature was lower were January 1881, January 1879, December 1879, December 1878, and January 1880. The mean temp. was exactly 34°, very nearly six and a half degrees below the average. The mean min. temp. (31°·2) was 6°, and the mean max. (39°·0) was 7° below the average. The min. temp. in shade (20° on the 25th) was the lowest in February for 16 years.

BODMIN.—No other February is remembered so bitterly cold. Bodmin, however, was singularly favoured in escaping the S, all falls having been of short duration, though it fell on 8 days. Mean temp. 34°·4.

WOOLSTASTON.—After a few genial days in the early part of the month, the weather became intensely cold, with continued E. and N. winds. S fell on 9 days, but the quantity was insignificant. All the brooks and streams were abnormally low at the close, with every probability of scarcity of water. Mean temp. 33°·6.

ORLETON.—The 1st and 2nd were cold days, with S covering the hills, and more S fell on the 2nd, changing to R at night. From the 3rd to the 10th the weather was fine and pleasant, with temperature much above the average. Frost then set in again and continued, with frequent falls of S, till the end of the month with a very low temperature. Light S fell on the 13th and 14th to the depth of six or seven inches, with a rough wind, which caused great drifts, filling up many of the narrow roads on the high lands. After the 10th very cloudy weather prevailed, with a dry, rough N. wind, which dried up the light falls of S almost as fast as they fell. The precipitation was not half the average quantity, and of the total fall about an inch fell as S. The mean temp. was 4°·4 lower than the average of 27 years and was only lower in 1873, 1875, and 1886.

MANCHESTER.—A fairly wintry month, with rather low night temperature. There were several falls of S, but generally slight, the heaviest being on the 11th, 12th, and 19th.

ARNCLIFFE.—A very wild month, with the most continuous cover of deep S remembered, the mail cart being blocked for 14 days, post being carried on horseback.

HULL.—Remarkable for the large quantity of cloud and for the frequent, though not heavy, falls of H, S, and sleet. N., N.E., and N.W. winds prevailed.

NORTH SHIELDS.—More or less S fell on 15 days. Fog on 4th; H on 29th.

WALES.

HAVERFORDWEST.—The driest February in the last 40 years and one of the coldest. The Precelly Hills were covered with S more or less for nearly three weeks, although very little S or R fell in the lowlands. The frost was at times severe, but broken by sudden thaws. Altogether the weather was changeable and the N.E. blast severe. Mean temp. 34°·3.

LLANDUDNO.—The early part of the month was generally dull and calm. S was seen on the distant mountains on 12th and several S showers fell at night, but soon disappeared. The ground was covered again with nearly an inch and a half of S on the morning of the 17th, but it nearly all melted during the day. There was a N. gale on the night of the 15th and a heavy E. gale all day and night on the 19th. H on the 11th. The latter part of the month was generally fine and cold.

SCOTLAND.

CARGEN.—From the 11th to the close the weather was extremely cold, and the mean temp. of the month (35°·7) was 4°·1 below the average. N. or E. winds prevailed from the 13th to the close. R, sleet and 3 inches of S fell on 10th; S showers on 13th; 2 inches of S on 16th.

JEDBURGH.—After the 10th the weather was cold and ungenial, with very little wind, and from the 13th the ground was continually covered with S. Vegetation, which was then advanced, was completely stopped. The thrush was heard singing on the mornings of the 7th and 8th, and a good deal of nesting was done.

CUMNOCK.—The mean temp. was below 32° every night after the 9th.

OBAN.—An extremely dry February. The early part was warm, the latter part very cold at night, with a high daily range under a long continuance of high pressure. S on 10th, 12th, and 16th.

ABERDEEN.—The month opened with fair weather and moderate N.E. and N.W. breezes. Temperature was very low from the 10th to the 18th. Pressure was high during the last six days. The month on the whole was cloudy. Fog on 8th and 21st. A gale on 20th.

LOCHBROOM.—With one exception (the 13th) it rained or snowed, or both, every day from 1st to 21st; on 14 of these days S fell. From the 22nd to the close, beautiful, bright frosty weather prevailed, with a clear moon every night, and fine warm sunshiny days; delicious weather, only too frosty for ploughing as a rule.

CULLODEN.—A very severe month, frost, with more or less S, prevailing from the 9th to the close, in consequence of which, work of every kind was at a standstill.

IRELAND.

BLACKROCK.—A cold, winterly month, at times misty, with a few slight S showers. Wind N., N.E., or N.W. on 16 days. The fifteenth month in succession with R below the average of 23 years. Mean temp. (38°·4), 4°·2 below the average.

DROMORE.—Very dry and cold, with strong E. winds. Vegetation made some progress in the early part of the month, but was at a standstill later.

WATERFORD.—A very hard, dry month, with S in small quantities on several days, and wind principally easterly. With the exception of 1886, the driest February in 30 years. Mean temp. 37°·5.

O'BRIENSBRIDGE.—Almost all the moisture of the month consisted of melted S, frequent but very light falls occurring. N. and N.E. winds prevailed, and temperature was generally low by day as well as by night.

DUBLIN.—Notwithstanding a spell of mild weather, which lasted from the 3rd to the 10th, February proved to be a very cold and snowy month. Even in Dublin S and H fell on 11 days, and the mean temp. (38°·5) was no less than 4°·7 below the average. The amount of cloud was very great, 7·3. It is remarkable that during the mild fine weather of the earlier part of the month the wind was generally N.W. High wind on 11 days; gale on 2nd; fog on 15th and 16th. Mean humidity 83.

BALLINASLOE.—The smallest R for February since 1875, when ·90 in. fell. H storm on 11th. S on five days.

EDENFEL.—A remarkably dry, cold month, with R smaller than even June, 1887, and actually the smallest since June, 1865. Frost more or less severe prevailed on 22 nights, but did not, except thrice, continue during the day, or prevent farm labour, nor was there any S beyond occasional light showers, never altogether covering the ground. The question of water supply was becoming exceedingly serious at the close.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCLXVI.] MARCH, 1888. [PRICE FOURPENCE, or 5s. per ann. post free.

THE SNOWSTORMS.

NORTH EAST ENGLAND AND EAST SCOTLAND, MARCH 11TH TO 16TH, 1888.

Several of our correspondents, besides sending accounts of the depth of snow at their own stations, sent also copies of newspapers, some of them, like the *Scotsman* and the *Newcastle Daily Chronicle*, of March 16th, containing reports of the storm filling many columns. Altogether, we think that the columns of newspaper reports, omitting all duplicate statements, would, if joined into one column, be more than 40 feet long.

As the storm seems to have been as bad as, some say even worse than, that of February 28th to March 2nd, 1886,* we have formed a *précis* of this mass of material, and proceed to state the facts as concisely and as accurately as possible.

As to date.—The Newcastle reports say that the storm should really be regarded as having begun on the 11th, because although the earlier falls of snow had in the towns disappeared by the 14th, much was still lying on the high lands.

Blocks on the railways.—These were very serious; they began earliest in the North. The only one North of Aberdeen, and but a slight one, was to the train (on the Turriff and Macduff line in Aberdeenshire) going North from Inveramsay, which on leaving Rothie Station at 8.40 a.m., ran into a drift so deep that the train had to be backed, and the wreath charged twice before it could get through. This, however, as we have stated, was the only block in the North of Scotland, and although not quite the earliest, we mention it first so as to finish with that district.

The first block, in order of time (and, we believe, the only one on the line where one most expects a block—the Highland line) took place at its southern extremity near Stanley Junction, about 10 miles N. of Perth, at 6 a.m., on the 15th. It will, however, save time and space to give the list in tabular form. It must be understood that this list is not perfect, but merely as nearly so as we

* See *Met. Mag.*, Vol. XXI. (1886), p. 17.

can make it—*e.g.*, there are many blocks recorded for which the time is not given, so that this must not be regarded as a complete list of the blocks:—

	Designation of train.		When and where blocked.
	Perth to Blair Athol	6 a.m.	N. of Stanley Junctn., Perthshire.
(1)	Dundee to Anstruther	6.5 a.m.	Kingsbarns, Fifeshire.
	Anstruther to Edinburgh	6.40 a.m.	St. Monans, Fifeshire.
(2)	Markinch to Leslie	8.30 a.m.	Leslie, Fifeshire.
	Dundee to Perth	9.15 a.m.	Longforgan, Perth.
	Longniddry to Haddington	9.30 a.m.	Longniddry, Haddington.
	Drem to N. Berwick	10 a.m.	Dirleton, Haddington.
(3)	Blairgowrie to Dundee	10.20 a.m.	near Dundee, Forfar.
	Montrose to Bervie	Noon	North Water, Kincardine.
	Stirling to Crieff	Noon	Tullibardine, Perth.
(4)	Berwick to Newcastle	1.50 p.m.	Smeafield, Northumberland.
(5)	Newcastle to Berwick	4.40 p.m.	Longhirst, Northumberland.
(6)	Morpeth to Newcastle	5 p.m.	Seghill, Northumberland.
(7)	Newcastle to Berwick	5.5 p.m.	Smeafield, Northumberland.
(8)	Blyth to Newcastle	5.15 p.m.	Backworth, Northumberland.
	Alnwick to Morpeth	5.42 p.m.	Acklington, Northumberland.
	Blyth to Newcastle	6.50 p.m.	Hartley, Northumberland.
(9)	Sunderland to Hartlepool	7 p.m.	Seaton, Durham.
	Alnwick to Coldstream	8.45 p.m.	Mindrum, Northumberland.
(10)	Sunderland to Hartlepool	10 p.m.,	Murton, Durham.

(1). This is the same train, so probably the block at Kingsbarns was cut.

(2). Ran into a snow wreath, and in backing to charge at it again, some carriages went off the rails.

(3). Blocked near Lochee just outside Dundee, was eventually pulled through by three engines, but the snow was up to the carriage windows.

(4). This was the first English train blocked; it was a slow train coming south from Berwick, and it stuck at Smeafield, which is about two miles north of Belford.

(5). This was a goods train going north, and as it stuck at Longhirst, near Morpeth, it blocked the down line, other trains gradually accumulating behind it. In the efforts at night to get it out, a curious accident occurred. A snow plough was sent to the rescue on the other line of rails; it found the train, and then passed on so as to get on to the down rails and come back and so clear a path for the imbedded train to proceed; but what with the difficulty of seeing in the darkness and snow, and what with their brakes not acting in consequence of the snow, they drove into the stationary train and lifted its front engine on to the top of the plough, thus making matters worse than before.

(6). This is the same train as (8), so that the block cannot have been serious.

(7). This was the 4.35 p.m. express from Berwick; it was shunted to the down line so as to pass the train No. (4), but it also, though drawn by four engines, stuck fast, and about 40 passengers had to pass the night in the train.

(10). This train was sent on the down line so as to pass the one No. (9) which had stuck at Seaton at 7 p.m.; it did so, picking up the passengers from it, but they were no better off, for it itself stuck fast at, or near the next station.

From the above table it will be seen that, with the exception of the block on the Bervie branch N. of Montrose, there was a tolerably steady progression southwards in the localities blocked. For example, the mean time of first block for each county was—Fife, 7.5 a.m.; Perth, 9.5 a.m.; Haddington, 9.45 a.m.; Forfar, 10.20 a.m.; Kincardine, noon; Northumberland, 5.40 p.m; Durham, 8.30 p.m.

Area.—We have laid down, on a map, every block recorded, and from this it appears that (excepting the little one in Aberdeenshire already mentioned) all were on the East of Scotland or the North-east of England—in fact, so closely do they follow the coast line that (except one near Bowes, in North Yorkshire, where the line is nearly 1,400 ft. above the level of the sea) we do not find a single block thirty miles inland. It is, therefore, useless to give a map for a sinuous line, following the coast at about thirty miles inland, and running out to sea a few miles north of Montrose for the northern limit, and at the mouth of the Tees for the southern limit, would include the area of every important stoppage.

Duration.—The fall of snow ceased on the 16th, and on the 18th every railway line was re-opened, so that altogether it did not last a week, but near Berwick some roads became blocked on 14th, and were not clear until 22nd.

Blocked trains.—We have no idea of the total number, but there were said to be 24 on the Newcastle and Berwick line alone.

Isolated towns.—Some towns were absolutely unapproachable, either by train or road, such as, for instance, Kinross, although served by three lines of railway; but generally one road remained passable when others were blocked. Rothbury, Northumberland, is said to have been snowed up for five days.

Telegraphs.—These suffered very slightly, considering the heaviness of the storm. Perhaps they are now put up more strongly than in past years.

Depth of snow and size of drifts.—The true depth of snow when it falls during a hard gale is impossible to determine; taking the newspaper records in groups, they give 9 inches for Forfarshire, Fife, and Kinross, 12 inches for the south-eastern counties of Scotland, and 16 inches for Northumberland and Durham. As regards drifts, we may quote a few details. At Markinch, in Fifeshire, where it took 45 men eight hours of daylight to get out one engine. The Longhirst drift on the main line of the N.E. railway was said to be 12 ft. deep and two miles long, and to have had 700 men employed in clearing it. In March, 1886, the N.E. Railway Company are said to have paid £2,500 for labour alone, and the impression appears to

have prevailed in the district that the outlay for the same purpose will have been greater this year. However, they may be consoled by remembering that no lives were lost, and that this is only the second time in 30 years that their line has been blocked for 24 hours.

Previous storms.—We have already referred to our own account of the 1886 storm; we close this article with a short extract from the *Newcastle Daily Chronicle*:—

1636.—What may be considered one of the longest frosts on record in this part of the country is that which began in the middle of September, 1636, and continued until the following April—seven months in all. The modes of locomotion at the time were of the most primitive kind, and the long-continued frost is stated to have been attended by disastrous consequences to man and beast. The cattle of the hills and folds succumbed in hundreds to the severity of the weather, and their unfortunate proprietors were subjected to a financial loss, from the effects of which many of them never recovered. In addition, the necessities of the people were for a lengthened period anything but fully met.

It is somewhat strange, however, in reviewing the effects of winter severity to find, that the old-fashioned winters of which some people speak so glibly, have been succeeded by others that have taken place at a totally different period of the season. The old storms, like the long frost recorded above, began generally about October or November, and continued during the remainder of the year. In recent years the winters have been open and generally fine until after Christmas, and nearly all the great storms that have taken place in the North of England during the present century have been witnessed in the first, second, or third months of the year.

1814.—On January 14th, a hard frost was experienced on Tyneside. The Tyne, from St. Peter's upwards, was completely frozen over, and the people of Newcastle held high carnival upon the ice. Tents, according to the local historian, were erected upon it, fires lighted, and donkey races and other sports held.

1823.—What is described by the chroniclers of the day as being a dreadful snowstorm was raging in the North of England on February 4th, 1823. The local roads, such as they were, became entirely blocked, and communication between villages, hamlets, and large towns was thoroughly cut off. Stage coaches and mail coaches were then the conveyances most familiar to the public, and at the Turf Hotel, Collingwood Street, and at one or two other old hostelries in Newcastle, exciting scenes were witnessed. Travellers who had come to the town a day or two before were compelled to remain, and what was perhaps of more importance to the public, both inside and outside of Newcastle, all postal communication was, for the time being, brought to an end. For a whole week, the north and west mail coaches neither reached nor were despatched from Newcastle, and it was only when on one day thirteen saddle horses with messengers were despatched northwards that communication with the outer world was again established.

1854 (?).—About 34 years ago, for a few days, a similar scene was witnessed, for the Tyne down to St. Lawrence was firmly ice-bound, tents were pitched, vendors of all sorts of commodities did a thriving trade, and hundreds of per-

sons disported themselves upon the ice. At that time the only weak parts in the glassy sheet were near the Quay edge, and keelmen and steamboatmen—who were, for the time being, idle—took advantage of that circumstance, and by making bridges of planks over their craft, and by levying toll, they turned to profitable account the inclemency of the weather. There are yet in the land of the living many persons who will recollect not only the stirring pastimes of the pleasure-seekers, but the exciting work performed by the steamers afterwards employed to break up the ice as the thaw began. These vessels were strengthened at the stem for the work, and as they slowly moved up the river and cut their way through the resisting barrier of ice, hundreds of towns-people assembled on the quays and bridges to witness the work going on. That work was, however, but slowly performed, and it was a long time before full traffic on the river could be resumed.

1886.—The great snowstorm which began on the 1st of March, two years ago, and continued for two days, must be well remembered. There had never been so serious a downfall of snow witnessed by this generation. The blocks that ensued on the local railways were a serious impediment to traffic, costing the companies thousands of pounds, and involving many persons in a great sacrifice of time and money. Many were the adventures of the imprisoned passengers on the railways, and the recollection of the incident down the north line in which the prssengers were driven to great straits for food will be recalled with grim humour by some who played a part in that conspicuous incident of the storm. For the first time, probably, since 1823, the villages lying to the north and west of Newcastle were effectually cut off from communication with the town. The expense thrown upon local boards and other authorities was very great. In some instances hundreds of men had to be emplcyed in clearing a way through the snow, and the enormous and lofty snow cuttings made in the Kenton, Ponteland, and Dudley portions of the district will probably never be forgotten by those who saw them. Postal and telegraphic communication was interrupted for many miles, milk from the country—to the very serious loss of the dairymen—could not be brought into the town, and on the hills of Allendale, and in the neighbourhood of Rothbury, hundreds of sheep were lost.

ON THE CONTINENT.

Nor must it be supposed that the British Isles alone have suffered in this way. Here is one illustration :—On Sunday night, March 25th, a Paris correspondent said that a thousand soldiers and navvies succeeded in freeing the trains which were in distress near Chartres, about 40 miles S.W. of Paris, but owing to fresh falls of snow the railway was still blocked up. Traffic was interrupted between Compiègne and Clermont, about 50 miles N. of Paris. There were two feet of snow in the streets of Montpelier, only seven miles from the Mediterranean, and the roads leading to Avignon were snowed up. In Spain some of the railways were blocked for a week.

SNOW AND ROSES.

We may also mention with advantage a short note which appeared recently in the *Globe*, in which it is stated that the question of pre-

venting railways being drifted up has been much discussed in Austria and Hungary, and that—

A rose-hedge is now said to be the most effective defence. More than a mile of one of the Hungarian railways has been this winter kept clear of drifts by a rose-hedge about 6½ feet high and 3¼ feet thick, although this section of the line had always in previous years been liable to be blocked. The rose best adapted for this purpose is the rose of Provins, now incorrectly corrupted into the rose of Provence. But doubtless there are many other kinds equally serviceable: the essential thing is that the hedge shall offer a solid obstacle to the drifting snow. It will be a great improvement, certainly—apart from all practical considerations—if we could be induced to make our lines of railway blossom with the rose. At present, the banks which border our lines are neither useful nor ornamental. Here and there a little kitchen garden flourishes, or a fowl-keeping station-master cultivates sunflowers for his birds. But there is no serious attempt either to grow cabbages or cabbage roses along the lines. In Brittany the lines run between small fruit-gardens, with innumerable pear and apple trees trained espalier fashion at the sides; and the practical cultivation of fruit-trees is adopted along the high roads in Germany. We might take a leaf out of our neighbours' books either in the useful or ornamental direction.

"BLIZZARD" IN NEW YORK, MARCH 12th.

In our number for February last we gave, as a sort of explanation of the newspaper accounts of the terrible damage in Dakota and other States, a definition of what Americans know as a blizzard.

Since that was written there has appeared in the *Leisure Hour* for April a descriptive account of the disaster, by Miss Gordon Cumming, which we can strongly recommend to the notice of our readers.

New York has also had such a snowstorm as it appears hardly ever to have had before, and if not a perfect blizzard, quite sufficiently near it to satisfy the most *exigeant* New Yorker. Our impression is that it was not a perfect blizzard, *i.e.*, that it did not fulfil conditions (1) and (2) on p. 3 of this Magazine.

The following telegram gives as good a general idea of the storm as the fuller accounts which have since been received:—

A "BLIZZARD" IN NEW YORK.

NEW YORK, MARCH 12.

This city lies helpless to-day in the grip of a genuine Western "blizzard." It began at midnight, and when the city awoke the streets were filled with huge banks of snow. The wind was blowing a gale; the air was so thick with snow that it was impossible to see for any distance. When people ventured into the streets the wind took away their breath. The snow blinded their eyes, and progress was almost a physical impossibility. Not a train, car, or omnibus was able to run. The elevated railroad attempted to run, but by eight o'clock was completely blocked. The trains were standing in lines, miles long, filled with impatient merchants, bankers, and brokers, striving to get to town to business. It was difficult to realise for some time that a great

city could be made so helpless. Passengers got into the cars for three or four hours, hoping to be able to proceed. The wind blew so hard that it shook the railway carriages, and caused the whole structure to tremble. Long after the hope of getting on had gone, the passengers hesitated to leave the cars, because the blinding snow made the task of reaching home not only difficult, but dangerous. They ventured out by twos and threes, ploughing their way through drifts which stood from five to ten feet deep along the Fifth Avenue, Broadway, and all the great thoroughfares to the nearest hotels and club houses. When they reached them their hair and beards were masses of ice and snow, making them look like visitors from the Arctic regions. Here and there cabs were seen, with horses covered with sleet and the drivers almost blinded with the snow, struggling to make headway. Only a few people succeeded in reaching their business places. About twenty men were at the Stock Exchange at the hour of opening, and the Exchange adjourned, deliveries to be made to-morrow. None of the other Exchanges transacted business. The banks were not opened, and at the time I send this off it looks as if no evening papers would be published, as the editors and compositors are unable to reach the offices. All the trains from the outside districts are blockaded, as the storm extends over a wide area, and it is thought that many other cities are in the same condition as New York.

LATER.

During the afternoon the weather became warmer, but the wind continued high, and the air was still thick with snow. The elevated railroad was able to run a few trains at long intervals, but the tramways are entirely suspended. Very few shops are open in any part of the city, and business of all kinds is suspended. Some of the evening papers have managed to get out editions, but the delivery of them throughout the city is practically impossible. No such storm has been seen here for many years.

THE DENSITY OF SNOW.

Everybody seems to be talking of, and writing about, snow this winter (to say *winter* on April 4th, but it has been snowing again to-day), and M. Lancaster, of Brussels, has so good an article in the last number of our excellent contemporary, *Ciel et Terre*, that we must say a few words about it; but only a few, as our readers should read the whole article, which occupies ten pages. The paper is divided into two parts—the first historical, the second analyzing the observations made at the Monastery on the Great St. Bernard during the 20 years, 1862–81.

M. Lancaster traces back measures of the yield of snow to Sédileau, who, in 1692, found snow to be five or six times less dense than water, and then he quotes De la Hire (1711) 12 to 1, Mairan (1749) 10 to 1, Musschenbrook (1751) from 19 to 1 down to 5·6 to 1, but on the average 10 to 1. He then quotes values from nearly every country in Europe (except Russia, where they ought to know most about it), and reports fully the very careful observations made by Colonel Ward at Rossinière, in Switzerland. The broad result is to

confirm the results arrived at by British investigators, namely, that snow may in very rare cases be so light that 35 inches may be required to produce 1 inch of water; or so dense that 5 inches will be sufficient; and that the general average is between 14 to 1 and 9 to 1.

In the second section, M. Lancaster shows that the St. Bernard observations give about $9\frac{1}{2}$ to 1, but that the value varies according to the season, being 12 to 1 in winter and 5 to 1 in summer. He then takes the observations for the three years, 1878–80, and groups the mean snow ratios according to the mean temperature of each day. His table converted into English scale gives the following values :—

Density.	Temperature.	Difference.	Density.	Temperature.	Difference.
6 : 1	35°·6		10 : 1	26°·6	
		—1°·8			—1°·8
7 : 1	33 ·8		11 : 1	24 ·8	
		—1 ·8			—3 ·6
8 : 1	32 ·0		12 : 1	21 ·2	
		—2 ·7			—5 ·4
9 : 1	29 ·3		13 : 1	15 ·8	
		—2 ·7			—7 ·2
			14 : 1	8 ·6	

It will be seen that the density of snow decreases with lower temperature, but as the difference is a decreasing one, there is perhaps some other cause besides the temperature. One would like to know *exactly* the method adopted by the monks in making the observations. Moreover it is not improbable that at that great altitude (8,173 ft.) the general character of the snow differs from that at stations within a few hundred feet of the level of the sea.

ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this Society was held on Wednesday evening, March 21st, at the Institution of Civil Engineers, Great George Street, Westminster; Dr. W. Marcet, F.R.S., President, in the chair.

Dr. G. E. Scholefield and Col. W. S. Young were elected Fellows of the Society.

The President (Dr. Marcet) delivered an address on "Atmospheric Electricity." He first mentioned the experiments by Franklin in America in 1752, who succeeded in obtaining the electricity of a storm-cloud by conducting it along the string of a kite sent into the cloud. De Romas in Europe repeated the experiment, and having placed a wire within the twine his kite was attached to, obtained sparks of nine or ten feet in length. The characters of the two kinds of electricities were next described : the vitreous, or positive, which was produced by rubbing glass, and the resinous or negative, obtained by rubbing sealing wax or other resinous substance ; and it was shown by bringing

suspended balls of pith within the influence of these electricities, that electricities of different kinds attract each other, and those of the same kind repel each other. De Saussure's and Volta's electroscopes were next described, pith balls being used in the former, and blades of straw in the latter, for testing the electricity. With the object of measuring the force of electricity, Sir W. Thomson's electrometer was mentioned, in which the electricity is collected from the air by means of an insulated cistern letting out water drop by drop, each drop becoming covered with electricity from the atmosphere, which runs into the cistern where it is stored up, and made to act upon that portion of the instrument which records its degree or amount. The atmosphere is always more or less electrical, or in other words, possessed of electrical tension, and this is generally positive; while the earth exhibits electrical characters of a negative kind. The effects of atmospheric electricity were classed by Dr. Marcet under three heads :—1st. Lightning in thunderstorms; 2nd. The formation of hail; 3rd. The formation of the Aurora Borealis and Australis. Dr. Marcet next proceeded to show a representation of a flash of lightning, which he produced by throwing on a white screen the image of an electric spark two or three inches in length, enlarged by means of the lens of an optical lantern to six or eight feet in length. After alluding to the protecting power of lightning conductors and their construction, Dr. Marcet explained the formation of hail and of waterspouts, and exhibited an instrument by Prof. Colladon, of Geneva, for showing the formation of waterspouts. He concluded his address with a few remarks on the Aurora Borealis and Australis, the formation of which was illustrated by De la Rive's experiment, which consisted of successive discharges of electric sparks through a partial vacuum while under the influence of a powerful magnet; sheets of electric light were seen assuming the form of bands, and possessed of a certain rotating motion.

Mr. G. J. Symons, F.R.S., read a short communication entitled "The Non-existence of Thunderbolts; elucidated by accounts of searches after them and the exhibition of specimens of things supposed to be thunderbolts."

In connection with this meeting, a very interesting exhibition of instruments was arranged in the rooms of the Institution of Civil Engineers. The exhibition was devoted chiefly to instruments connected with atmospheric electricity. There were various forms of electrometers, including those formerly in use at the Greenwich and Kew Observatories. Numerous patterns of lightning conductors were exhibited, together with models of churches, houses, chimney-shafts, and ships, showing the various methods of protection. The Postal Telegraph Department showed a number of lightning protectors used for telegraph purposes. Many objects damaged by lightning were exhibited, including lightning conductors, telegraph apparatus, portions of rafters, trees, &c., also the clothes of a man

torn off his body by lightning. An interesting collection of meteorites, and some alleged thunderbolts were shown, the latter being of very various origin. There were also several new meteorological instruments exhibited, which had been brought out during the past twelve months.

One of the special features of the exhibition was a valuable and interesting collection of more than fifty photographs of lightning flashes. Many of these were taken during the great thunderstorm which occurred in London on August 17th last year, others had been taken in various parts of the world.

The exhibition included also a large number of photographs of damage by lightning, and photographs of clouds and meteorological instruments, as well as records of atmospheric electricity, &c.

THE EFFECT OF SNOW ON THE SPRINGS.

To the Editor of the Meteorological Magazine.

SIR,—A recent correspondence in the *Times* has raised the question of the comparative value of snow and rain in supplying the springs, and it has been asserted confidently that snow is more efficacious for that purpose than an equivalent quantity of rain. I venture to express an opinion that the reverse of this statement would be nearer the truth, although I doubt the wisdom of laying down any general law upon a matter in which so much must depend on the circumstances of each case and upon the precise terms of the comparison.

If the snow has been preceded by a long and severe frost, and has fallen with a low temperature, when a thaw comes, the surface of the ground will probably remain for some days impervious to moisture, and meanwhile more or less of the product of the melting snow will find its way directly into the streams and rivers. On the other hand, if the snow has not been preceded by any considerable frost, and especially if it has commenced with rain, when the thaw comes, the ground, being scarcely if at all frozen, will readily absorb the water.

In either case the rate of the thaw will greatly influence the result. With a rapid thaw, a quantity of the water must inevitably be lost. With a very slow thaw, even when the ground has been frozen to some depth, time will be given for the ice within it to melt, and the bulk of the water may be saved for the soil and the springs.

It has been stated that the loss by evaporation will be less with snow than with rain. I believe this to be an error. Rain in winter is generally accompanied with a very moist air, in which evaporation is almost *nil*. A deep snow, on the contrary, not unfrequently marks the commencement of a period in which the air is particularly dry and evaporation very active. Moreover, rain, sinking at once into

the soil, is removed from the influence of evaporation, while snow may present an evaporating surface during several weeks. In this matter observation confirms what theory suggests. A striking instance came under my notice in the deep snow of February last. Some days after the fall I placed a number of circular boards, 8 inches in diameter, on the top of the snow, that I might more easily measure the depth of any subsequent fall. No further fall of any moment occurred, but after an interval which I omitted to note—it may have been a week or more—I observed that each of the boards was mounted on a tump of snow about an inch above the general surface, and shelving off to nothing at the circumference of the board. It was evident that the snow had suffered a loss of one inch in depth from some cause other than subsidence or thaw, for each of these causes would have produced at least as much effect underneath the boards as around them. There can, I think, be no doubt that an inch of snow had been lost by evaporation, which had proceeded freely over the general surface, less freely under the outer part of the board, and not at all under its central part.

I have said that in comparing snow and rain as regards their effect upon the springs, much will depend upon the precise terms of the comparison. In the case of snow, the rate of fall is of no consequence; in the case of rain, it is important. If we compare the fall of an inch of water as snow with the fall of an inch of water as rain, the fall of rain being comprised within one hour, the advantage will probably lie with the snow as a feeder of the soil and the springs. But if we suppose the fall of rain to be uniformly distributed over 24 hours, the tables will be turned. In the first case, a large quantity of the rain will be wasted; in the second case, it will be wholly absorbed.

To put the matter fairly, mention should be made of two circumstances which must tend to diminish the loss of water in the melting of snow over frozen ground. The one is, that the water from the melting of the upper strata of the snow, percolating through the lower strata, will help to thaw the ground. The other is, that a certain quantity of the water will be retained in the unmelted snow, ready to be absorbed by the soil when the soil is sufficiently thawed to receive it.

Speaking broadly, and omitting the less important details, one may say that, as regards the proportion of water saved and the proportion lost, snow and rain both follow the same law; only, in the case of snow, it is not the rate at which it *falls*, but the rate at which it *thaws*, that has to be considered.

GEORGE F. BURDER, M.D.

Clifton, 5th April, 1888.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, SEPTEMBER, 1887.

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.	TotalRain. Depth.	Days.	Aver. Cloud.
	°		°		°	°	°	0–100	°	°	inches		0-10
England, London	69·5	6	34·3	29	62·8	47·9	46·5	74	118·6	31·4	1·81	19	6·1
Malta	93·4	10	65·7	24	86·8	71·1	67·0	69	148·6	61·0	·28	4	2·5
Cape of Good Hope	90·0	4	40·2	22	73·8	48·8	...	...	...	...	·88	4	4·7
Mauritius	77·4	28	55·1	9	74·7	63·4	58·5	71	129·0	44·0	·86	10	5·2
Calcutta	91·3	9	76·6	24	87·3	78·3	76·9	80	153·6	72·8	9·54	21	8·0
Bombay	86·7	8	73·4	22	83·2	75·5	73·9	83	149·2	69·4	18·23	19	7·3
Ceylon, Colombo	87·0	27*a*	72·8	1	85·2	75·7	69·6	73	145·5	69·5	·48	6	6·0
Melbourne	73·1	18	35·2	20	59·3	44·2	43·5	74	125·5	29·0	2·71	19	6·0
Adelaide	79·2	30	40·5	25	63·3	46·3	44·8	70	136·9	31·7	2·52	21	5·0
Wellington	...	...	...	...	...	...	...	...	...	...	...	...	...
Auckland	63·0	25	40·0	15	59·2	47·6	45·9	75	122·0	35·0	4·18	19	7·0
Falkland Isles	49·1	25	23·2	21	40·2	31·5	32·3	86	118·9	21·4	1·49	21	8·3
Jamaica, Kingston	93·1	9	69·6	4	90·4	72·4	72·8	74	...	...	3·32	...	...
Barbados	86·0	23*b*	71·0	18*c*	84·0	73·0	...	80	...	...	7·77	15	5·0
Toronto	79·1	13	35·1	24	65·8	47·2	48·1	71	...	29·4	1·17	9	5·6
New Brunswick, Fredericton	76·1	6	31·0	26	64·4	43·7	48·0	76	...	...	1·41	7	5·2
Manitoba, Winnipeg	83·8	19	23 2	23	67·3	40·5	44·8	71	...	...	1·77	12	4·3
British Columbia, Victoria	78·0	6	30·0	21	64·8	43·5	...	...	...	...	1·16	5	...

a And 29. *b* And 24. *c* And 19.

REMARKS, SEPTEMBER, 1887.

MALTA.—Mean temp. 78°·0. Mean hourly velocity of wind 8·0 miles. Sea temp. fell from 81°·9 to 78°·5. TS on 27th. J. SCOLES.

Cape of Good Hope.—The driest September but one (1865) since 1840. W. ELLERTON FRY.

Mauritius.—Mean temp. of air 1°·0, of dew point 1°·0, and rainfall ·76 in. below average. Mean pressure 30·198 in., equal to average. Mean hourly velocity of wind 11·4 miles, 0·8 mile below average; extremes 25·8 miles on 11th, and 1·6 miles on 29th; prevailing direction S.E. by E. to E.S.E. C. MELDRUM, F.R.S.

COLOMBO.—Rainfall 4·19 in. below the average. F. C. H. CLARKE, LT.-COL. R.A.

Melbourne.—Mean temp. of air 1°·5 and mean pressure and mean amount of cloud slightly below average. Rainfall ·42 in. and mean temp. of dew point and mean humidity slightly above average. Prevailing winds W. and N.; strong on 8 days, with heavy squalls on 6 days. Dense fog on 14th; H and sleet on 7th, L on 1st and 18th, T on 11th; heavy dew on 4 days. R. L. J. ELLERY, F.R.S.

Adelaide.—Unusually cold and squally. Mean temp. 2°·3 below the average of 30 years. Mean pressure 30·025 in., ·043 in. below average. Rainfall ·72 in. above average. Gales on 10 days. C. TODD.

AUCKLAND.—A showery, squally, and unsettled month. Rainfall ·75 in. above the average of 20 years; mean temp. 1° 2 and pressure ·24 in. below average. T. F. CHEESEMAN.

Falkland Isles.—The coldest and worst September on record. Mean temp. 3°·4 below the average of 9 years and 1°·2 below that of 1886, the coldest of those years; frost on ground on 23 nights. F. E. COBB.

KINGSTON.—Earthquake on 23rd at 6.45 a.m. MAXWELL HALL.

BARBADOS.—Pressure steady, but a sudden fall occurred on 28th, followed next day by a fall of 2·13 in. of R in 3 hours. Mean temp. (77°·6) 0°·9 above average; mean hourly velocity of wind 1·7 miles, and rainfall considerably below average. R. BOWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL, MARCH, 1888.

[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	4·17	XI.	Castle Malgwyn	4·02
,,	Margate, Birchington...	3·20	,,	Rhayader, Nantgwillt..	6·49
,,	Littlehampton	3·64	,,	Carno, Tybrith	3·71
,,	Hailsham	4·48	,,	Corwen, Rhug	2·08
,,	Ryde, Thornbrough	4·11	,,	Port Madoc	2·67
,,	Alton, Ashdell.....	4·35	,,	I. of Man, Douglas	3·41
III.	Oxford, Magdalen Col...	2·98	XII.	Stoneykirk, Ardwell Ho.	2·06
,,	Banbury, Bloxham	2·84	,,	New Galloway, Glenlee	2·85
,,	Northampton	2·66	,,	Melrose, Abbey Gate...	3·62
,,	Cambridge, Beech Ho...	2·33	XIII.	N. Esk Res. [Penicuick]	4·90
,,	Wisbech, Bank House..	2·52	XIV.	Ballantrae, Glendrishaig	1·77
IV.	Southend	1·84	,,	Glasgow, Queen's Park.	2·88
,,	Harlow, Sheering	3·21	XV.	Islay, Gruinart School..	3·11
,,	Rendlesham Hall	4·05	XVI.	St. Andrews, Pilmour Cot	3·13
,,	Diss	3·42	,,	Balquhidder, Stronvar..	4·62
,,	Swaffham	2·38	,,	Dunkeld, Inver Braan..	4·57
V.	Salisbury, Alderbury...	3·41	,,	Dalnaspidal H.R.S. ...	4·32
,,	Warminster	3·57	XVII.	Keith H.R.S.	2·93
,,	Bishop's Cannings	3·60	,,	Forres H.R.S.	3·39
,,	Ashburton, Holne Vic....	9·49	XVIII.	Strome Ferry H.R.S....	4·23
,,	Hatherleigh, Winsford.	5·34	,,	Fearn, Lower Pitkerrie.	2·36
,,	Lynmouth, Glenthorne.	4·84	,,	Loch Shiel, Glenaladale	6·73
,,	Probus, Lamellyn	4·21	,,	S. Uist. Ardkenneth ...	...
,,	Launceston, S. Petherwin	5·19	,,	Invergarry	4·63
,,	Wincanton, Stowell Rec.	3·26	XIX.	Lairg H.R.S.	2·01
,,	Taunton, Lydeard Ho...	3·92	,,	Forsinard H.R.S.	2·36
,,	Wells, Westbury.....	3·11	,,	Watten H.R.S.	1·89
VI.	Bristol, Clifton	3·54	XX.	Dunmanway, Coolkelure	4 69
,,	Ross	3·84	,,	Fermoy, Gas Works ...	2 42
,,	Wem, Clive Vicarage ...	2·08	,,	Tipperary, Henry Street	2·86
,,	Cheadle, The Heath Ho.	2·86	,,	Limerick, Kilcornan ...	2·68
,,	Worcester, Diglis Lock	2·61	,,	Miltown Malbay.....	3·47
,,	Coventry, Coundon	2·53	XXI.	Gorey, Courtown House	2·66
VII.	Melton, Coston	2·51	,,	Navan, Balrath	4·14
,,	Ketton Hall [Stamford]	2·70	,,	Mullingar, Belvedere...	4·11
,,	Horncastle, Bucknall...	2·43	,,	Athlone, Twyford	3·69
,,	Mansfield, St. John's St.	2·84	,,	Longford, Currygrane...	3·80
VIII.	Knutsford, Heathside ...	1·94	XXII.	Galway, Queen's Coll...	2·94
,,	Walton-on-the-Hill... .	2·39	,,	Clifden, Kylemore	5·66
,,	Lancaster, South Road.	3.25	,,	Crossmolina, Enniscoe..	5·42
,,	Broughton-in-Furness ..	4·24	,,	Collooney, Markree Obs.	3·74
IX.	Shipley, Esholt Vic. ..	4·04	XXIII.	Rockcorry.....	3·63
,,	Ripon, Mickley	4·89	,,	Warrenpoint	2·83
,,	Scarborough, West Bank	2·91	,,	Seaforde	4·64
,,	East Layton [Darlington]	4·23	,,	Belfast, New Barnsley .	4·39
,,	Middleton, Mickleton ..	2·40	,,	Cushendun	3·31
X.	Haltwhistle, Unthank..	3·53	,,	Bushmills	2·99
,,	Shap, Copy Hill	4·68	,,	Stewartstown	3·40
XI.	Llanfrechfa Grange	4·89	,,	Buncrana	3·43
,,	Llandovery	4·99	,,		

MARCH, 1888.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1870–9	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) ...	3·34	+ 1·73	·39	13	20	54·5	10	24·7	2	14	22
II.		Maidstone (Hunton Court)...	3·01	+ 1·43	·42	10	22	...	...	...	...	...	...
,,		Strathfield Turgiss	3·41	+ 2·01	·36	26	21	60·5	8	19·6	2	16	24
III.		Hitchin	2·86	+ 1·38	·51	11	20	57·0	10	23·0	1	20	...
,,		Winslow (Addington)	2·99	+ 1·23	·35	10*a*	19	57·0	10	13·0	2	20	24
IV.		Bury St. Edmunds (Culford)	3·07	+ 1·51	·80	12	15	52 0	10	18·0	2	24	...
,,		Norwich (Cossey)	2·27	+ ·58	·46	11	16	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	3·01	...	·45	10	17	52·0	10*b*	23·0	1	15	...
,,		Barnstaple.....	3·80	+ 1·31	·60	24	20	55·0	9, 10	22·0	2	...	...
,,		Bodmin	4·89	+ 1·73	·79	10	20	54·0	10	20·0	2	18	19
VI.		Stroud (Upfield)	3·70	+ 1·89	·48	8	22	56·0	10	21·0	1	...	...
,,		ChurchStretton(Woolstaston)	2·26	+ ·10	·49	11	15	52·5	10	22·5	2	22	25
,,		Tenbury (Orleton)	3·07	+ 1·20	·47	24	20	57·6	9	20·0	2	21	23
VII.		Leicester	1·87	...	·30	10	17	51·0	8, 29	24·0	2	21	...
,,		Boston	2·10	+ ·81	·40	22	14	58·0	9	25·0	5	13	...
,,		Hesley Hall [Tickhill].....	2·30	...	·40	11	16	61·0	9	26·0	24	23	...
VIII.		Manchester (Ardwick).....	1·56	— ·89	·35	9	15	54·0	9	26·0	2	19	...
IX.		Wetherby (Ribston Hall) ...	3·68	+ 1·55	·90	12	14	...	...	...	...	...	...
,,		Skipton (Arncliffe)	4·63	— ·13	1·03	11	19	52·0	9	19·0	1	19	...
,,		Hull (People's Park)	2·10	+ ·29	·47	11	21	...	...	...	...	...	...
X.		North Shields	4·69	+ 3·24	1·39	29	23	58·0	10	23·5	26	21	22
,,		Borrowdale (Seathwaite).....	9·62	— ·27	1·82	9	20	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	5·02	+ 2·33	·66	8	19	...	...	...	...	...	...
,,		Haverfordwest	3·37	+ ·18	·71	12	15	53·0	9, 10	21·0	1	15	21
,,		Plinlimmon (Cwmsymlog) ...	3·44	...	·70	22	15	...	...	...	...	...	...
,,		Llandudno.....	2·11	+ ·23	·55	11	18	56·0	8	25·7	2	17	...
XII.	SCOTLAND.	Cargen [Dumfries]	2·61	— ·17	·74	14	16	52·6	10*c*	21·6	5	21	...
,,		Jedburgh (Sunnyside).....	2·06	+ ·49	·49	29	14	55·0	10	22·0	2	23	...
XIV.		Old Cumnock	3·00	+ ·07	·85	7	16	55·0	8	16·0	16	24	...
XV.		Lochgilphead (Kilmory)	4·60	— ·01	1·25	7	14	...	...	...	...	...	...
,,		Oban (Craigvarren)	3·52	...	1·13	7	13	55·8	8	23·8	17	18	...
,,		Mull (Quinish).....	3·14	...	·92	7	15	...	...	...	...	...	...
XVI.		Loch Leven Sluices	4·90	+ 2·78	·90	16	17	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	3·35	+ 1·59	·55	28	13	51·9	7	23·6	17	21	...
XVII.		Braemar	2·78	+ ·59	·77	7	21	49·5	8	2·0	17	27	29
,,		Aberdeen	3·37	...	·54	10	21	54·0	8	17·0	28	21	...
XVIII		Lochbroom	4·71	...	1·21	7	18	...	...	...	...	...	...
,,		Culloden	2·66	+ ·91	...	...	...	54·0	9	22·0	28	19	29
XIX.		Dunrobin	3·40	...	1·05	7	15	51·0	6	25·5	21*b*	18	...
,,		Kirkwall (Swanbister)..... ..	...	...	...	...	..	...	...	...	...	...	..
XX.	IRELAND.	Cork (Blackrock).....	3·06	+ ·30	1·07	10	21	56·0	6*d*	25·0	24*e*	18	..
,,		Dromore Castle	5·51	...	1·12	10	18	...	...	...	...	...	...
,,		Waterford (Brook Lodge) ...	3·17	...	·84	10	17	54·0	10	24·0	17*f*	15	...
,,		O'Briensbridge (Ross)	3·80	...	1·26	10	18	52·0	9	26·0	2	14	...
XXI.		Carlow (Browne's Hill)	3·34	+ 1·23	·69	14	19	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	3·75	+ 2·02	1·01	11	18	58·6	8	26·9	17	11	26
XXII.		Ballinasloe	3·09	+ ·71	·64	28	19	53·0	8	21·0	20	24	...
XXIII		Waringstown	3·43	+ 1·37	1·13	11	17	59·0	8	20·0	16*g*	20	23
,,		Londonderry (Creggan Res.).	2·96	...	·65	11	22	...	...	...	...	...	...
,,		Omagh (Edenfel)	3·01	+ ·92	·77	11	24	51·0	9	24·0	19*a*	17	25

a And 27. *b* And 28. *c* And 21. *d* And 10, 22. *e* And 26. *f* And 24, 25. *g* And 19.
+ Shows that the fall was ab the average; —that it was below it.

METEOROLOGICAL NOTES ON MARCH, 1888.

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 cold, wintry month, more like January than March, with a slight burst of warmth on 12th and 15th, followed by a severe paroxysm of cold and S, with E. winds. Vegetation at a standstill. The birds, puzzled by the continued cold, refuse to pair or build. Gale on 11th.

HITCHIN.—A very cold, ungenial month; such a backward season never known before. None of the spring flowers out and no spring corn sown.

ADDINGTON.—A cold, comfortless month, the max. temp. for many days in succession not rising above 36°, and with E. winds it was very cold. The R was, with one exception, the greatest in any March during 17 years. Pressure towards the end of the month was unusually low. Very little of the usual March work had been done in gardens at the close. Stormy on 10th and 11th, with a large flood on the latter day; ground white with S on 14th, 17th, 20th, 25th, and 26th, the depth on the latter day being two inches.

CULFORD.—Very cold all the month. S on seven days.

LANGTON HERRING.—R 1·24 in. above the average of 13 years; mean temp. 3°·4 below the average of 16 years, during which period March has been colder only in 1883 and 1887. Stormy on 11th and 28th. Fog on four days.

BODMIN.—A remarkably cold month. Mean temp. 38°·8.

STROUD.—A very cold, snowy month. S on six days. S.S.W. gale on 11th.

WOOLSTASTON.—Another very cold month. S fell on five days. L on 28th, and a severe storm of T and L on evening of 29th. Mean temp. 39°·5.

ORLETON.—Severe frost occurred on the first six mornings; a change of wind to the S.W. then took place, followed by very unsettled weather and a higher temp. On the 11th the wind returned to the N. and the remainder of the month was very cold, with frequent falls of S, which covered the hills till nearly the close, but was never more than six or seven inches deep. Pressure was generally low and specially so on 11th and 28th. The wind was generally cold and rough, and the mean temp. was 3°·3 below the average of 27 years, but was not so low as in 1887. Much distant L was seen in the S. after 8 p.m. on the 29th, and distant T was heard on 15th.

MANCHESTER.—A very wintry month, with S falls and cold winds; the night temp. was low and there were occasional severe frosts.

HULL.—The month was remarkable for the prevalence of slight frosts, and the frequent, though generally not heavy, falls of R, S, or sleet, with variable winds.

NORTH SHIELDS.—S on seventeen days.

SEATHWAITE.—In the three days 7th to 9th 5·25 in. of R fell.

WALES.

HAVERFORDWEST.—A very cold, inclement month, but not so cold as March, 1886 or 1887. The 1st was the most severe day of the winter, its mean temp. being 27°·5. Very stormy and wet on 11th, with bar. 28·850 in. (cor.) A very cold, frosty period set in on 12th, lasting to 20th, with bitter E. winds. It was very stormy and cold from 25th to 28th, the bar. on the latter day falling to 28·476 in. (cor.) The remainder of the month was cold, but fine.

SCOTLAND.

CARGEN.—The coldest March recorded (mean temp. 36°·7) with the exception of 1883, when the mean temp. was °·4 lower. Pressure unusually low; N. and E. winds prevailed on 21 days; vegetation very backward; sunshine 99 hours, 30 below the average. S on seven days.

OBAN.—Until the 10th disturbed weather, with moderate R prevailed;

thereafter it was fine, with temp. and pressure below the average and much dryness and a high ozone register.

DUNDEE.—Snow lay on the ground during the month, and shrubs, such as rhododendron, ligustrum, &c., suffered from frost.

ABERDEEN.—The month on the whole was wet, rough, and unseasonable. Gale, with heavy sleet showers, on 28th.

LOCHBROOM.—The month on the whole was stormy and severe; the first third was very mild, the second third was dry, with severe frost, and the last third was frosty, with S, sleet, and R almost daily.

CULLODEN.—The month was very severe, but without any heavy S; frost prevailed from the 12th to the end and labour was greatly retarded.

IRELAND.

CORK.—Cold and showery, with a few slight falls of S. The seventeenth successive month with less than the average R.

WATERFORD.—R ·21 in. above average. S on the Comeraghs on 15th; T on 29th. [The remark last month should read, "With the exception of 1887, the driest February in 30 years."]

ROSS.—Fairly good March weather; very cold about the middle, and in the latter part of the month. N. and N.E. winds prevailed. Many light showers of S.

DUBLIN.—The month was very cold, except for a brief period from the 6th to the 10th inclusive and also on 21st and 22nd. The precipitation, which was very large, was chiefly in the form of S or sleet and H, and the winds, which were high and squally, came principally from polar points of the compass. Mean temp. 39°·8, the month being the coldest March for at least a quarter of a century.

EDENFEL.—After having enjoyed an unusually dry and open winter until March 7th, the weather from that date to the end of the month was most inclement. S, sleet, R, and frost prevailed, occasionally accompanied by N. gales of much severity. All vegetation was arrested and farm labour at a standstill.

ERRATUM.

In the *Meteorological Magazine* for March, page 21, line 11 from bottom, for "western" read "*eastern.*"

THICKNESS OF CALM ATMOSPHERE.

To the Editor of the Meteorological Magazine.

SIR,—At Sydney, N.S.W., on June 7th, 1886, the smoke from the chimney of a large sugar factory, distant 4,490 feet from the Observatory, was observed to rise up in a vertical line until the top was 25° high; there a light wind bent it on one side. The Observatory stands 146 feet above the water, and it appears that the smoke rose straight up, and was not influenced by any lateral motion of the wind, or in other words, the air was quite still up to an altitude of 2,225 feet. The day was remarkably calm all through, but the great altitude to which the smoke rose surprised me, as I had never before seen it rise so high. As to weather, we were in the middle of an anti-cyclone, which lasted about a fortnight. Highest barometer 30·52 in.; on the 7th it was 30·42 in. Perhaps the above may be interesting, as it affords one good measure of the depth of calm atmosphere at Sydney. H. C. RUSSELL, F.R.S.

Sydney Observatory, 7th February, 1888.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCLXVIII.] MAY, 1888. [PRICE FOURPENCE, *or 5s. per ann. post free.*

THUNDERSTORMS.*

IT is evident that the study of thunderstorms is taking, and will take, a prominent place in meteorological work. In our February number we printed the circular recently issued by the Royal Meteorological Society. Since that we have had to report (p. 40), Dr. Marcet's address on Atmospheric Electricity at the meeting of the Society, and Mr. Symons's paper on Thunderbolts on the same occasion, and the grand collection of electrical apparatus, lightning conductors, &c., shown at the Society's exhibition. At the Royal Society Soirée on May 9th, between 50 and 100 photographs of lightning flashes were shown, and we understand that many photographers, both professional and amateur, are on the *qui vive* for a storm to obtain further views. Certainly they are necessary, for the enigmas are very numerous—the greatest of all being the so-called dark flash on one of the photos sent to the Royal Meteorological Society. The following list of the photographs exhibited at the Royal Society will show how widespread is the interest in the subject :—

4. *Exhibited by the Royal Meteorological Society.*

Photographs of Flashes of Lightning.

1881, July 15th,	Brighton.
1884, Aug. 9th,	Tynemouth. By M. Auty (2 photos.)
1886, July	Ramsgate. By G. F. Harvey.
1886, Oct. 6th,	Bournemouth. By Dr. Drewitt (2 photos.)
1887, Aug. 17th,	Pimlico, London. By G. C. Baker.
,, ,,	London. By E. A. Barton (2 photos.)
,, ,,	Streatham. By J. H. Bateman.
,, ,,	Croydon. By G. Corden (5 photos.)
,, ,,	Brixton. By J. Gray.
,, ,,	Battersea. By G. J. Ninnies.
,, ,,	Regent Street. By J. Robinson & Sons.
,, ,,	Westbourne Grove, W. By E. S. Shepherd (7 photos.)
,, ,,	Belsize Park. By W. Shuter (3 photos.)
,, ,,	Highbury. By Capt. A. S. Thomson.
,, ,,	Wandsworth. By C. H. Wordingham.

* *Les Orages dans la Péninsule Scandinave.* Par H. Mohn et H. Hildebrand Hildebrandsson [Except Trans. Soc. Roy. d. Sciences]. Upsal, E. Berling, 1888, 4to, 55 pages and 12 maps.

1884, July 12th,	Mount Vernon, New York. By G. R. Allerton (2 photos.)
,, ,,	Enlargements of ditto.
1885, Aug. 1st,	Philadelphia. By W. N. Jennings.
1886, July,	Greenwich, Conn. By Dr. H. G. Pippard.
,, ,,	Enlargement of ditto.
1887, June 22nd,	Philadelphia. By W. N. Jennings.
1887, July 17th,	Dubuque, Iowa. By G. E. Davis (2 photos.)
,, ,,	Irvington-on-Hudson. By R. H. Lawrence (2 photos.)
1887, Aug. 2nd,	Alleghany Mts. By L. S. Clarke (2 photos.)
,, ,.	Enlargements of ditto.
1886, May 12th,	Auteuil, Paris. By C. Moussette (photograph and enlargements).
1886, May 26th,	Rougemont, near Tours. By H. Schleusner and E. B. Vignoles.
1887, June 25th,	Auteuil, Paris. By C. Moussette (2 photos.)
1887, July 13th,	Fontainebleau.
1884, Nov. 14th,	On board H.M.S. Neptune, between Madeira and Gibraltar. By Dr. Puddicombe, R.N.
1885, Oct.	Amzinto, Natal. By R. Harris.
1887, Mar. 15th,	Calcutta. By G. L. Molesworth.

Other indications of the activity prevailing respecting this subject are afforded by the hearty response accorded to the circular, which we have already mentioned, inviting co-operators, and by the fact that the Chairman of the Committee, the Hon. Ralph Abercromby, is understood to have visited the heads of several of the larger thunderstorm organizations in Northern Europe, so that the records may be worked up in the best manner possible.

We may also mention that Messrs. Richard Frères, of Paris, are constructing for Mr. Symons a very complicated apparatus (Brontometer)—Βρόντη (thunder), Μέτρον (measure) — for recording the details of thunderstorms, so as to investigate the peculiar barometric oscillations which occur during them. A full description of this instrument will be given when it is completed, but some notion of its exceptional character will be afforded by our mentioning that the barometer curve for a single day would be 120 feet long. Most persons will recognize that as an unprecedentedly open sale. Then we have had the *Mann* lectures on Lightning Conductors, by Dr. Oliver Lodge, F.R.S., the remarkable experiments and statements in which will, undoubtedly, lead to a keen controversy as soon as they are published.

As for the literature, it is becoming very extensive—we cannot deal with it all. The Italian work is especially good, but on the present occasion we take only the report from Norway and Sweden.

We have a little rectification to make with respect to the first paragraph in this Scandinavian report. It is as follows:—

"C'est, comme on le sait, LE VERRIER, qui le premier organisa pour l'étude des orages un réseau de stations pourvu des instructions

et des formulaires, qui dans la suite ont été, presque sans changements, adoptés dan la plupart des pays."

Le Verrier had few, if any, greater admirers than the writer of these lines, but it is robbing Le Verrier of nothing worth his retaining to ask whether he *was* the first to issue rules and blank forms for the record of thunderstorms. Le Verrier's first *Atlas des Orages* was, we believe, for 1865; the February number of this magazine showed what Mr. Symons was doing seven years previously, or in 1858; but we have before us the stronger evidence of one of the blank forms prepared by him in 1856, and issued early in 1857, to all the observers then sending quarterly returns to Mr. Glaisher. We print the quarto form in 8vo by changing the type and reducing the blank spaces, but in all other respects it is *verbatim et literatim*. Considering that the form was issued thirty-two years ago, there is not perhaps much fault to be found with it, and until we have some fresh evidence, we hold that Le Verrier was *not* the first. Perhaps, however, somebody can unearth a form older still; if so, we shall be happy to be the means of bringing it forward.

STORM REPORT

——:o:——

Station at_____ Observer_____ Date_____

A Storm Cloud was observed in the_____at_____it passed_____
and disappeared in the _____at _____
Thunder was first heard at_____most violent at _____last heard at_____
Lightning was first seen at_____most brilliant at _____last seen at_____
its colour was _____and it was mostly_____
Rain began at _____ most violent at _____ceased at _____
Hail fell at_____its size was_____ its shape was _____
Yesterday the weather was and the wind was _____during the storm
the wind became_____and after it was_____and the weather was_____
Remarks.

	Barometer Corrected.		Temperature.			
Day	at____a.m.	at____p.m.	Max.	Min.	Rain	Ozone
" Before						
" of Storm						
" After						

Electrometer Observations.	Ozone Observations.	Miscellaneous Observations

Now we pass to the more pleasant duty of noticing the rest of this work.

Messrs. Mohn and Hildebrandsson tell us that while Le Verrier's first report was for 1865, the next countries to establish such a system were Norway in 1867, and Sweden in 1871, and the authors state that these observations led to the discovery of the general laws of the origin of these phenomena and of their extension, as well as to the determination of their daily and annual periods.

M. Fron, who has so long had charge of this class of work in France, early found that thunderstorms are not isolated phenomena, but are intimately related to barometric minima appearing in front of, and usually travelling from W. to E. with, them.

The authors' researches on Scandinavian storms have led them to detect two classes of thunderstorms—those already mentioned, which are always the most frequent, and in winter the only ones, and of which their name, "orages de tourbillon," may perhaps be translated into "cyclonic thunderstorms," and the others heat storms; these are largely due to intense solar radiation, and thence to an ascending current of heat and vapour, and they are the prevailing storms of summer. These heat storms are in Sweden more frequent and more violent than the cyclonic ones.

Similar organizations have since been established in other countries, in 1879 in Bavaria, and, soon after, another in Würtemburg, both under the direction of Prof. von Bezold. Here also the two classes are found. And from the thunderstorm maps of these countries it was noticed that storms generally occurred when the isobars indicated a tendency towards the creation of secondary depressions.

The important works of Ciro Ferrari on the thunderstorms of Northern Italy are then referred to, and it is shown that in Italy, as in Scandinavia, the thunderstorms may practically be reduced to the two types above quoted, and the same is reported for Belgium.

Details are next given of a few typical storms, with illustrative maps.

Section III. deals with variations in the indications of meteorological instruments during the passage of storms over Upsala Observatory, and is illustrated by several diagrams reproducing the indications of the self-recording instruments. This section is very interesting, but would, in our opinion, have been still better had the phenomena of thunderstorms and of V shaped depressions been kept distinct. However, we are much indebted to the authors for bringing together several valuable opinions respecting the cause of the peculiar barometric oscillations which we have already mentioned. We do not think that Prof. Mascart's views on the subject have yet been laid before English readers, and we therefore reproduce them :—

"The examination of these curves shows a very simple relation—*the barometer rises as soon as the rain begins.* It is, however, to be noticed that this is not the case if rain is frequent and abundant, and

if the sky is entirely overcast, but only when there are heavy partial showers, and when the sky is partly free from clouds.

"The cause of these rapid changes of pressure seems obvious. In the circumstances just indicated the air is not very damp. The rain in falling through a non-saturated atmosphere is partially evaporated, and the vapour thus locally developed produces a local increase of pressure—small it is true, but sometimes reaching 0·08 in. The influence of vapour suddenly and locally produced is sufficient to produce a slight variation.

"The diminution of pressure during storms may be explained by the opposite phenomena. Everybody has noticed that storm clouds are formed locally, and the conversion of a certain quantity of water from vapour into droplets may be expected to produce a diminution of pressure. As a rule, the decrease of pressure is more gradual than the increase."

Upon these views by Prof. Mascart the authors proceed to remark as follows :—

"These ideas seem to us to give the explanation of the phenomena, and it seems all the more probable since we have shown that *every rain which falls torrentially* (*sous forme d'averse*), *and even hail at a temperature below* 32°, *is followed by identical variations in the indications of the instruments, whether it be followed by thunder or not.* We thus arrive at the surprising result that during a thunderstorm the thunder itself and the other electrical phenomena are the secondary and not the primary phenomena. This agrees with M. Edlund's explanation of the production of electricity during thunderstorms, where he states that "The intense and violent liquefaction of the water vapour in the atmosphere is the principle cause of the excessive electric tension in the disruptive discharges of thunderstorms."

Section IV. explains the normal conditions which produce thunderstorms in Norway.

Section V. deals with the altitude of storm clouds, quoting Kaemtz (about 4,000 feet), Hann (about 4,600 feet), Reimann (that as seen from the Schneekoppe (5,246 feet), 55 per cent. pass below, while there is blue sky above the mountain, 30 per cent. envelop the summit in vapour, and only about 15 per cent. are wholly above it), Kolbenheyer (who from Babiagora (5,660 feet) saw a storm wholly below him). The authors then give an epitome of Sohncke's researches on the origin of the electricity of thunderstorms, showing that balloon experiments have indicated that during hot summer months the isotherm of 32° F. is usually at about 10,000 feet, and is rarely so low as 6,000 feet. Above this level clouds are necessarily formed of ice particles, below it of water particles. He has, moreover, demonstrated experimentally that a particle of ice becomes charged with electricity at 32° F. if a stream of warm and saturated air be directed upon it, and hence he argues that electricity is developed by the friction of two currents of air, one charged with

vapour, the other with ice needles. Ekholm and Hagström have found that at Upsala the tops of storm clouds are rarely 10,000 feet high, and their bases about 4,600 feet, or about the same as Hann found in the Alps. Another proof that the storm clouds are at a low level is afforded by the fact that whatever be their direction the motion of cirri is not thereby affected.

Section VI. deals with the question of lightning without thunder in Sweden, and shows that in that country almost every silent flash can be plausibly connected with some distant storm.

Section VII.—Statistics. This deals with the geographical distribution of storms in the Scandinavian Peninsula, with the hour at which they are most frequent (3 to 5 p.m.), and also the month (July). The authors then discuss the relation between storm frequency and mean barometric pressure. Finally, they give statistics respecting hail, which is rare in Scandinavia; in Norway hail only accompanies one storm in nine, and in Sweden one in eleven; and the records of insurance companies show that the loss is very small, the average loss being in Sweden 6 francs in 10,000, while at Berlin it is 63, and at Madgeburg 90 in 10,000.

RAINFALL AVERAGES.

To the Editor of the Meteorological Magazine.

SIR,—In this month's *Meteorological Magazine*, p. 48, it says for *Cork*:—"The seventeenth successive month with less than the average R." But on p. 46 the figures are 3·06 + ·30; and this appears to me correct, for referring to the rainfall during March in each of the four years, 1884-7, the "Total Fall" and "Difference from average" give the average for the month in question as 2·76.

Yours truly,

T. W. BACKHOUSE.

West Hendon House, Sunderland, April 24th, 1888.

[We are glad that Mr. Backhouse has called attention to this subject, as possibly others may have thought as he did that there was an error—whereas there is not. To ensure uniformity in the *table* the differences from the average are all taken from that during one period, 1870-79, and that average for March, is, as stated by Mr. Backhouse, 2·76, and March 1888, was therefore, correctly entered as + 0·30.

The *remarks* are however left as nearly as possible in the *ipsissima verba* of the observers. Our valued correspondent at Cork has a consecutive record for 23 years, and in his remarks referred to the average of that period, which is 3·34 in., and of course 1888, giving 3·06 in., was as he stated below the average. The difficulty would of course be obviated if the observers always stated to what average they referred, but whether or not, after the present explanation, it is necessary to repeat it every time that an observer refers to an average may be open to question.—ED.]

REVIEWS.

In pursuit of a Shadow. By a LADY ASTRONOMER. London: Trubner & Co., 1888. 8vo, 130 pages.

THIS is a charming little book, which we believe that few who begin will leave until they have finished. There is not much meteorology in it, though it is written by a meteorologist who is also an astromoner, and is the daughter of an observer whose record goes back nearly half a century. It is a plain, but extremely interesting, account of an expedition undertaken by the author and a lady friend to Kineshma, N.E. of Moscow, in order to be on the central line of the Solar eclipse of August last. The pamphlet tells how they went, what they saw and did not see, and how they came back, and in so doing gives one a clearer idea of phases of Russian life than many a book of ten times its size and cost.

The Natural Law of relation between Rainfall and vegetable life and its application to Australia, by F. A. VELSCHOW, C.E. London: Stanford, 1888, 8vo., 40 pages, 1 plate.

WE really can hardly deal seriously with this pamphlet. The opening sentence of the Preface is as follows:—

> If the object of this paper has been obtained, it will appear from its pages *why* the regularity of downpour depends directly on one particular quality appertaining to vegetable life. It will also be proved that vapour rarefies the atmosphere instead of increasing its specific gravity, as is now supposed, for which reason the barometrical measurement of the height of mountains has hitherto turned out a failure.

It is news to some of us that the barometrical measurement of "the height of mountains has hitherto turned out a failure," and when we dive into the body of the pamphlet to find the data on which this sweeping assertion is made, we find the following paragraph:—

> The mistake introduced into the calculation is sometimes very considerable. Professor Tyndall has thus found the astonishing difference in altitude of 500-600 ft. when taking measurements of mountains in the Alps, whose height had previously been exactly measured by trigonomical (sic.) survey. How is this enormous variation in the result possible? Surely the instruments he used were the best that could be produced, and would show the difference in altitude, temperature and humidity to a fraction of a degree; and also there can be no doubt whatever that an observer of Professor Tyndall's acquirements would make most careful observations, but still the result has proved to be a failure.

There is no reference to tell us whence this statement is quoted, and until the author shows that he is familiar with, and demonstrates the fallacies in, one single good work on barometric measurements *e.g.*—Williamson's, we confine our remarks to saying that we at any

rate are not yet convinced that the barometrical measurement of the height of mountains is a failure.

The author has a theory as to the existence of what he calls an air cushion over central Australia—and this he says (p. 23) is protected against flowing off by the low coast mountains, and he gives a diagram to illustrate this. We fear that his diagram has misled him, because if the air cushion existed, and if its dimensions and those of the mountains were as represented, the said mountains might have the effect he supposes. But the diagram could not within any reasonable space be printed on the true scale, the vertical scale as given is enormously greater than the horizontal one. As drawn, the mountain range of Queensland is 35 miles high, whereas Silver's *Australia and New Zealand* states that "few points exceed 3,000 ft.," which agrees very well with the author's own expression, "low coast mountains." We believe that if the author were to redraw his diagram on the true scale, say for example 8 ft. long, and then were to draw the mountain ranges as they should be, about one twentieth of an inch high, he would see the improbability of such an undulation, keeping his cushion in its place even if it existed.

Although we cannot accept the author's theories, we are glad to be able to strongly support the object which he has in view, namely the desirability of endeavouring to increase the study and the practice of forestry in Australia, and we agree with him, that it is desirable to attempt the acclimatization of foreign trees, but the Colonists must be careful, some of the trees might be as prolific as the rabbits.

THE DROUGHT.

MARCH was wetter than the average at the majority of British stations, and April (except in the S.W. of England and in Ireland) has had nearly an average fall. The result has been that as regards town dependant upon storage reservoirs the prospects of holding out throughout the summer have greatly improved. From the *Gas and Water Review* and other sources we collect the following notes:—

Leeds Water Supply is now in a satisfactory state. Thanks to the rain, the reservoirs have filled, and the storage supply is equal to 166 days, as compared with 126 at the same period last year. The total storage is 3,446,000,000 gallons, contrasted with 2,593,000,000 gallons at the same time last year.

Bradford.—The total water stored on April 27th was 1,541,921,000 gallons, being 143,518,000 gallons more than on the same date in 1887.

Halifax.—On April 20th, 1,062,267,000 gallons were in the reservoirs, or about 15,000,000 gallons more than on the same date last year.

Manchester.—This city is at present supplied from a series of

Manchester. We understand that the city is now again enjoying constant service, and that the manager has no fear of serious deficiency this year. The following letter confirms this :—

"To the Editor of the *Manchester Courier*.

SIR,—The rainfall here during April has been 2·48 inches, bringing up the total for the first four months of 1888 to 9·65 inches. Although this quantity is much below the average, still the reservoirs in the Longdendale Valley have filled up considerably during the last few weeks.—Yours, &c.,

JAMES SIDEBOTTOM.

Millbrook, Hadfield, May 1, 1888."

From other parts of the country dependent on springs we have very different reports.

ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this Society was held on Wednesday evening, the 18th ult., at the Institution of Civil Engineers, 25, Great George-street, Westminster, Dr. W. Marcet, F.R.S., President, in the chair.

Dr. E. Hale, B.A., B.C., Mr. R. Lawson, LL.D., F.S.S., and Mr. S. Walker were elected Fellows of the Society.

The following Papers were read :—

1. "Jordan's New Pattern Photographic Sunshine Recorder," by Mr. J. B. Jordan. The improvement in this instrument over the previous pattern of Sunshine Recorder consists in using two semi-cylindrical or D-shaped boxes, one to contain the morning and the other the afternoon chart. An aperture for admitting the beam of sunlight is placed in the centre of the rectangular side of each box, so that the length of the beam within the chamber is the radius of the cylindrical surface on which it is projected; its path therefore follows a straight line on the chart at all seasons of the year. The semi-cylinders are placed with their faces at an angle of 60° to each other. They are fixed on a flat triangular plate, which is hinged to a suitable stand, having levelling screws attached, and fitted with a graduated arc as a means of readily adjusting and fixing the cylinders to the proper vertical angle for the latitude of the station where used.

2. "On the Meteorology of South-Eastern China in 1886," by Dr. W. Doberck, F. R. Met. Soc. This paper gives the results of observations made at the custom-houses and lighthouses by officers of the Imperial Chinese Maritime Customs. In summer there is very little change of temperature with latitude. The temperature depends upon the distance from the nearest seacoast, and is greatest at stations farthest inland. The highest mean temperature occurred in July and the lowest in January. The north-east monsoon blows from September to June, and the south monsoon during July and

reservoirs in the Longdendale Valley, between Woodhead and August; the latter does not blow with half the force of the former. Rainfall is greatest in Northern Formosa and least in Northern China. Along the east coasts of Formosa and Luzon the winter is the wet season, while in China July seems to be the wettest month of the year.

3. "Lightning in Snowstorms," by Prof. A. S. Herschel, F.R.S.
4. "Insolation," by Mr. Rupert T. Smith, F.R. Met. Soc.

PAMPHLET EXCHANGE.

Copies of the following pamphlets can be had on application, provided the cost thereof be enclosed in the same cover. When all the copies have been distributed, the stamps (less postage) will be returned.

Author.	Title.	Price.
HANN, DR. J.	Bericht erstattet dem zweiten Internationalem Meterologen-Congress ueber die Beobachtungen auf hohen Bergen und im Luftballon	2½d.
,, ,,	Theorie des Psychrometers	2½d.
,, ,,	Bemerkungen zur täglichen Oscillation des Barometers	2½d.
,, ,,	Ueber die Beziehungen zwischen Luftdruck und Temperatur-Variationem auf Berggipfeln	2½d.
HELLMANN, DR. G.	Die täglichen Veränderungen der Temperatur der Atmosphäre in Norddeutschland	2½d.
,, ,, ,,	Feuchtigkeit und Bewölkung auf der Iberischen Halbinsel	3½d.
,, ,, ,,	Vorschläge an den Meteorologencongress	3d.
,, ,, ,,	Der zweite internationale Meteorologencongress abgehalten zu Rom im April, 1879	2½d.
,, ,, ,,	Ueber den jährlichen Gang der Temperatur in Norddeutschland	3d.
,, ,, ,,	Ueber gewisse Gesetzmassigkeiten im Wechsel der Witterung aufeinanderfolgender Jahreszeiten	2½d.
,, ,, ,,	Klima des Brocken	2½d.
JELINEK, DR. C.	Ueber die Reduction der Kappeller'schen sogenannten Stations-Barometer, d.h. Gefäss-Barometer mit unbeweglichem Boden	2½d.
ROTCH, A. L.	The Blue Hill Meteorological Observatory; an Account of its Foundation and Work	2½d.
,, ,,	Results of Observations at the Blue Hill Meteorological Observatory in 1886	3d.
SCOTT, R. H.	Notes on the Reports of Wind Force and Velocity during the Tay Bridge Storm, December 28th, 1879	2½d.
,, ,,	On a Series of Barometrical Disturbances which passed over Europe between the 27th and the 31st of August, 1883	2½d.
,, ,,	On the History of Thermometers	2½d.
,, ,,	Climatology of the Sea	2½d.
WALLIS, H. SOWERBY	The Snow Storm of January 18th and 19th, 1881	3d.
ANON	Review of Dr. Wild's Regenverhältnisse des Russischen Reiches	2½d.

62, Camden Square, N.W. G. J. SYMONS.

BRAZILIAN RAINFALL.

We are indebted to one of our English observers, Mrs. Behrens, for the valuable data in the following table:—

The average, 142 inches, is very high, but the locality is apparently at a considerable elevation on the eastern or Atlantic slope of a chain of mountains. We cannot find any records kept in the same neighbourhood; the nearest are on the west side of, and far away from, the mountains, but they have 82 and 90 inches respectively. It would add much to the value of this record if our correspondent can obtain for us details as to the pattern of gauge, its position, height above sea level, &c.

Rainfall in inches at Alto da Serra (between Santos and San Paolo) Brazil. Lat. 23° 40 S.; Lon. 46° 20′ W. (about 200 miles W.S W. of Rio de Janeiro.)

Year	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887
January	14·0	14 7	18·1	6·7	15·4	12·4	19 5	31·4	20·2	20·1	27·8	7·5	23·2	8·1	30·0
February ...	7·3	17·5	19·1	15·8	20·1	12·1	14·1	28·0	22·5	26 9	11·7	22·4	6·3	29·1	5·2
March.....	27·8	6·9	17·0	14·6	10·4	17·2	10·2	16·0	27·6	13·3	14·5	9·7	10·8	13·8	10·9
April	8·4	31·5	10·5	4·5	13·0	12·6	7·1	13·3	19·7	21·8	13·3	2·7	7·3	15·9	7·6
May.....	7·2	8·5	5·2	6·7	10·5	12·0	4·3	7·4	4·2	6·6	4·7	17·0	7·4	1·2	11·3
June	6·7	10·8	7·9	7 2	7·2	9 6	6·4	6·6	14·7	10·8	2·0	6·3	6·5	5·2	2·2
July	6·8	11·0	8·6	0·8	5 3	6·9	2·5	2·7	8·9	14·2	6·1	17·5	5·3	9·1	7·8
August	9·0	4·9	3·1	8·8	13·9	12·0	5·4	3·1	9·7	5·3	11·0	12·1	4·8	12 9	1·2
September ..	9·4	9·7	8·9	5·3	7·0	10·8	5·4	11·7	9·4	9·2	9·7	6·8	12·1	7·7	17·7
October	10·3	13·8	9·3	17·8	13·7	9 7	3·7	9·6	4·8	12·3	7 8	19·8	13·2	11·7	25·0
November ..	10·5	8·7	8·1	14·7	14·1	13·9	2 9	13·4	12·8	12·5	13·1	18·1	4·3	12·3	7·4
December ...	14·0	19 0	28·1	18·1	11·0	16·1	11·8	17·3	14·4	12·2	17·0	15·9	13·0	19·7	22·9
Totals	131·4	157·0	143·9	121·0	141·6	145·3	93·3	160·5	168·9	165·2	138·7	155·8	114·2	146·7	149·2

MONTHLY MEANS.

Jan.....	17·94	May ...	7·61	Sept. ...	9·39
Feb.... ..	17·21	June ..	7·34	Oct. ...	12·17
March...	14·71	July ...	7·57	Nov. ...	11·12
April ..	12·61	August..	7·81	Dec. ...	16·70

ABSTRACT OF YEARLY TOTALS (15 YEARS.)

Max.....	1881	168·9	Ratios	119
Mean		142·18		100
Min.	1879	93·3		66

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, OCTOBER, 1887.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Maximum. Date.	Minimum.	Minimum. Date.	Average. Max.	Min.	Dew Point.	Humidity.	Absolute. Max. in Sun.	Min. on Grass.	TotalRain. Depth.	Days.	Aver. Cloud.
	°		°		°	°	°	0–100	°	°	inches		0-10
England, London	63·6	8	25·4	26	53·2	39·0	38·7	78	103·4	23·2	1·24	9	6·0
Malta	98·4	1	49·6	27	74·7	63·1	58·6	75	142·7	45·2	8·80	12	5·7
Cape of Good Hope	...	...	...	...	...	...	...	...	...	...	...	...	...
Mauritius	80·7	18	57·7	27	76·4	66·4	62·0	75	134·5	48·4	3·46	12	6·1
Calcutta	91·0	6	63·2	27	85·4	72·7	71·2	70	154·2	56·4	2·57	6	4·3
Bombay	92·1	27	71·7	31	87·8	76·3	73·3	76	145·2	63·0	2·79	4	3·2
Ceylon, Colombo	87·7	3	70·8	2	84·8	73·4	72·5	81	146·8	67·6	13·43	25	7·5
Melbourne	82·1	26	38·1	24	65·7	47·8	48·0	73	133·0	33·3	2·83	11	5·6
Adelaide	90·5	25	43·2	23	71·5	52·1	46·9	58	152·0	34·1	2·73	13	4·4
Wellington	71·0	29	36 0	7	58·9	45 6	45 5	78	131·0	32 0	7 24	17	4·0
Auckland	72·0	29	40·0	2	62·2	50·2	51·1	83	140·0	31·0	3·24	20	6·7
Falkland Isles	62·1	27	29 6	21	47·9	35·1	38·4	82	118·0	21·7	1·18	12	7·0
Jamaica, Kingston	91·5	2	66·6	24	88·0	71·1	72·0	79	...	...	9·59	...	...
Barbados	88·0	10	69·0	19	83·0	73·0	71 5	79	...	...	8·51	16	5·0
Toronto	65·9	8	19·4	30	52·1	35·5	38.6	76	...	12·2	1·63	16	6·3
New Brunswick, Fredericton	63·7	5	15·8	27	52·8	34·5	37·4	74	...	...	3·12	10	5·4
Manitoba, Winnipeg	64·0		— 2 8	26	44·7	20·6	25·7	72	...	...	·46	9	5·7
British Columbia, Victoria	64·0	11*a*	30·0	23	55·3	40·0	...	...	...	...	2·75	12	...

a And 28.

REMARKS, OCTOBER, 1887.

MALTA.—Mean temp. 67°·6; starting at 81° on the 1st, it fell steadily to 56° on 27th. The total range, 48°·8, was 50 per cent. above the average. R more than double the average of 5 years. Mean hourly velocity of wind 10·6 miles. Sea temp. fell from 78°·5 to 69°·0. On the 19th a heavy storm with E.N.E. wind yielded 3·50 in. of rain in about 10 hours. Among the hills at Rabato and Torri Labiat 6½ in. and 7½ in. were registered. H on 27th. TS on 7 days. L on 4 other days. J. SCOLES.

Mauritius.—Mean temp. of air 0°·7 below, and of dew point 0°·9 above the average. R 1·60 in. above the average. Mean hourly velocity of wind 11·1 miles, 0·9 mile below average; extremes 25·3 miles on 6th and 1·9 miles on 22nd; prevailing direction S.E. by E. to E. by S. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 0°·1, of dew point 1°·8, and mean humidity 3° above average. Rainfall, pressure, and cloud slightly below average. Prevailing wind W.; strong on 10 days. TSS on 2 days; L on 2; heavy dew on 14th and 26th; fog on 1 day. R. L. J. ELLERY, F.R.S.

Adelaide.—Mean temp. average, and pressure slightly above average. Rainfall an inch above average, making the total for the 10 months nearly three inches in excess of the annual average. C. TODD.

WELLINGTON.—On the whole unpleasant, changeable, and stormy. Prevailing wind N.W.; strong on 9 days. Mean temp. 1°·4 below, and rainfall 2·41 in. above average. Slight earthquake shocks on 6th; H on 1st; T on 21st; fog on 28th. R. B. GORE.

AUCKLAND.—An average spring month; rather showery, with variable winds, but no heavy rain or storms of importance. Mean pressure and mean temp. slighty below, rainfall slightly above, average. T. F. CHEESEMAN.

BARBADOS.—Pressure steady and slightly above average. Mean temp. (77°·4) 0°·5 above average; mean hourly velocity of wind 1·7 miles above average; rainfall considerably below average. R. BOWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL, APRIL, 1888.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	2·14	XI.	Castle Malgwyn	2·07
,,	Margate, Birchington...	1·03	,,	Rhayader, Nantgwillt..	2·49
,,	Littlehampton	1·29	,,	Carno, Tybrith	3·19
,,	Hailsham	1·28	,,	Corwen, Rhug	1·59
,,	Ryde, Thornbrough	1·52	,,	Port Madoc	3·57
,,	Alton, Ashdell.....	1·76	,,	I. of Man, Douglas	2·83
III.	Oxford, Magdalen Col...	1·59	XII.	Stoneykirk, Ardwell Ho.	1·45
,,	Banbury, Bloxham	2·12	,,	New Galloway, Glenlee	2·82
,,	Northampton	1·81	,,	Melrose, Abbey Gate...	2·20
,,	Cambridge, Beech Ho...	1·47	XIII.	N. Esk Res. [Penicuick]	2·10
,,	Wisbech, Bank House..	1·35	XIV.	Ballantrae, Glendrishaig	1·94
IV.	Southend	1·31	,,	Glasgow, Queen's Park.	1·60
,,	Harlow, Sheering	1·82	XV.	Islay, Gruinart School..	2·19
,,	Rendlesham Hall	1·44	XVI.	St. Andrews, Pilmour Cot	1·42
,,	Diss	1·73	,,	Balquhidder, Stronvar..	3·54
,,	Swaffham	1·68	,,	Dunkeld, Inver Braan..	1·50
V.	Salisbury, Alderbury...	1·99	,,	Dalnaspidal H.R.S. ...	2·57
,,	Warminster	2·47	XVII.	Keith H.R.S.	2·12
,,	Bishop's Cannings	2·31	,,	Forres H.R.S.	1·35
,,	Ashburton, Holne Vic....	3·47	XVIII.	Strome Ferry H.R.S....	3·06
,,	Hatherleigh, Winsford.	1·51	,,	Fearn, Lower Pitkerrie.	1·58
,,	Lynmouth, Glenthorne.	1·88	,,	Loch Shiel, Glenaladale	6·34
,,	Probus, Lamellyn	1·56	,,	S. Uist. Ardkenneth ...	2·38
,,	Launceston, S. Petherwin	1·98	,,	Invergarry	2·81
,,	Wincanton, Stowell Rec.	2·16	XIX.	Lairg H.R.S.	2·19
,,	Taunton, Lydeard Ho...	2·66	,,	Forsinard H.R.S.	2·49
,,	Wells, Westbury.....	2·45	,,	Watten H.R.S.	2·03
VI.	Bristol, Clifton	1·77	XX.	Dunmanway, Coolkelure	3·87
,,	Ross	1·70	,,	Fermoy, Gas Works ...	1·75
,,	Wem, Clive Vicarage ...	1·39	,,	Tipperary, Henry Street	2·37
,,	Cheadle, The Heath Ho.	1·46	,,	Limerick, Kilcornan ...	1·39
,,	Worcester, Diglis Lock	1·39	,,	Miltown Malbay.....	1·99
,,	Coventry, Coundon	2·02	XXI.	Gorey, Courtown House	1·71
VII.	Melton, Coston	2·18	,,	Navan, Balrath	2·00
,,	Ketton Hall [Stamford]	2·85	,,	Mullingar, Belvedere...	2·42
,,	Horncastle, Bucknall ...	1·90	,,	Athlone, Twyford	2·12
,,	Mansfield, St. John's St.	2·61	,,	Longford, Currygrane...	2·46
VIII.	Knutsford, Heathside ...	1·47	XXII.	Galway, Queen's Coll...	1·48
,,	Walton-on-the-Hill.....	1·18	,,	Clifden, Kylemore	3·38
,,	Lancaster, South Road.	1·95	,,	Crossmolina, Enniscoe..	2·48
,,	Broughton-in-Furness ..	2·19	,,	Collooney, Markree Obs.	2·03
IX.	Shipley, Esholt Vic. ..	3·02	XXIII.	Rockcorry.....	2·14
,,	Ripon, Mickley	2·71	,,	Warrenpoint	1·97
,,	Scarborough, West Bank	1·90	,,	Seaforde	1·82
,,	East Layton [Darlington]	2·34	,,	Belfast, New Barnsley..	1·95
,,	Middleton, Mickleton ..	1·59	,,	Cushendun	1·95
X.	Haltwhistle, Unthank..	1·85	,,	Bushmills	1·98
,,	Shap, Copy Hill	2·77	,,	Stewartstown	1·58
XI.	Llanfrechfa Grange	1·58	,,	Buncrana	2·41
,,	Llandovery	2·17			

APRIL, 1888.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1870–9	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) ...	2·37	+ ·35	·66	18	13	64·8	30	27·7	6	10	12
II.		Maidstone (Hunton Court)...	1·30	— ·55	·34	23	17	...	...	...	...	...	...
,,		Strathfield Turgiss	1·96	+ ·05	·44	23	13	62·2	30	23·5	6	10	18
III.		Hitchin	1·78	— .17	·29	17	20	63·0	15	26·0	5	10	...
,,		Winslow (Addington)	2·06	— ·25	·53	19	20	62·0	28	23·0	6	11	15
IV.		Bury St. Edmunds (Culford)	1·31	— ·48	·34	23	14	60 0	16	20·0	6	13	...
,,		Norwich (Cossey)	1·48	— ·38	·27	23	17	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	1·33	...	·30	16	14	59·0	28*c*	27·0	6	8	...
,,		Barnstaple	·99	— 1·39	·22	16	11	57·0	17	27·0	9	...	...
,,		Bodmin	1·77	— 1·56	·48	16	17	54·0	13*e*	27·0	10	8	10
VI.		Stroud (Upfield)	1·92	— ·53	·35	17	16	62·0	13	28·0	6	6	...
,,		ChurchStretton(Woolstaston)	2·68	+ ·36	·70	20	20	59·5	14	27·0	3,6,7	10	13
,,		Tenbury (Orleton)	1·15	— 1·02	·34	19	16	64·6	28	23·8	7	9	12
VII.		Leicester	...	...	...	...	...	...	...	...	...	...	...
,,		Boston	2·22	+ ·33	·64	19	19	65·0	14*f*	26·0	7,10	10	...
,,		Hesley Hall [Tickhill].....	1·31	...	·19	24	19	63·0	30	25·0	6	9	...
VIII.		Manchester (Ardwick).....	1·57	— ·46	·27	19	17	59·0	30	30·0	3	8	...
IX.		Wetherby (Ribston Hall) ...	2·78	+ ·27	·82	21	14	...	...	...	...	...	...
,,		Skipton (Arncliffe)	3·25	+ ·19	·57	29	21	58·0	14	26·0	7	7	...
,,		Hull (People's Park)	1·69	— ·04	·35	15*a*	21	...	...	...	...	...	...
X.		North Shields	1·41	— ·59	·26	20	19	64·0	28	28·0	7	8	11
,,		Borrowdale (Seathwaite).....	7·35	+ 2·41	1·46	28	17	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	1·39	— ·95	·22	16*b*	13	...	...	...	...	...	...
,,		Haverfordwest	1·70	— 1·12	·45	29	18	59·0	15	26·0	8	7	10
,,		Plinlimmon (Cwmsymlog) ...	4·88	...	·67	12	17	...	...	...	...	...	...
,,		Llandudno.....	1·96	+ ·08	·59	29	19	57·8	15	32·0	6	1	...
XII.	SCOTLAND.	Cargen [Dumfries]	1·54	— ·75	·29	16	10	59·4	28	26·0	7,9	9	...
,,		Jedburgh (Sunnyside).....	1·95	+ ·25	·47	18	19	62·0	14	26·0	9	12	...
XIV.		Old Cumnock	1·81	+ ·15	·36	12	17	60·0	14	22·0	2,8	10	...
XV.		Lochgilphead (Kilmory)	3·03	+ ·40	·69	26	17	...	...	...	...	...	...
,,		Oban (Craigvarren)	2·62	...	·43	26	17	56·1	24	28·0	22	4	...
,,		Mull (Quinish).....	2·74	...	·47	26	17	...	...	...	...	...	...
XVI.		Loch Leven Sluices	1·50	— ·71	·30	16	10	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	1·25	— ·87	·30	22	12	60·8	14	25·2	9	7	...
XVII.		Braemar	1·35	— ·73	·27	22	18	54·8	14	23·2	9	14	23
,,		Aberdeen	1·96	...	·46	15	21	60·0	14*g*	30·0	7	5	...
XVIII		Lochbroom	4·56	...	·72	19	22	...	...	...	...	...	...
,,		Culloden	1·06	— ·29	...	...	...	57·0	14*h*	28·0	9	9	19
XIX.		Dunrobin	1·96	...	·34	10*c*	12	54·5	26	28·0	26	8	...
,,		Kirkwall (Swanbister)..... ..	2·73	...	·40	10	22	52·3	16	27·6	9	6	...
XX.	IRELAND.	Cork (Blackrock)	1·88	— 1·22	·60	30	15	62·0	27	27·0	1	4	...
,,		Dromore Castle	3·58	...	·83	30	13	...	...	...	...	...	...
,,		Waterford (Brook Lodge) ...	1·63	...	·47	30	14	58·0	11*i*	24·0	9	7	...
,,		O'Briensbridge (Ross)	1·96	...	·21	10*d*	17	59·0	28	30·0	3,6	6	...
XXI.		Carlow (Browne's Hill)	1·90	— ·67	·43	30	19	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	1·99	— ·12	·34	30	17	60·6	14	28·8	9	1	11
XXII.		Ballinasloe	1·57	— ·69	·38	30	16	58·0	14	24·0	9	8	...
XXIII		Waringstown	2·03	+ ·14	·42	18	11	64·0	14	23·0	8	7	11
,,		Londonderry (Creggan Res.).	2·32	...	·43	19	23	...	...	...	...	...	...
,,		Omagh (Edenfel).....	2·13	+ ·13	·46	19	21	57·0	16	29·0	2 8	5	...

a And 19. *b* And 17. *c* And 15. *d* And 30. *e* And 29. *f* And 18. *g* And 16. *h* And 16, 17. *i* And 13.

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

METEOROLOGICAL NOTES ON APRIL, 1888.

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.—More springlike. The excellent condition of the land enabled farmers to put in a large amount of seed. Wheat was doing well and grass assuming its spring livery of emerald green at the close. Sand martins seen on 3rd; humble bee on 11th; brimstone butterfly on 13th; first swallow on 16th; nightingale heard on 19th; cuckoo on 20th. H on 2nd.

ADDINGTON.—A great deal of very cold weather was experienced, especially from 22nd to 26th, with strong N.E. wind; summer visitors arrived about their usual time notwithstanding. Swallows on 15th; cuckoo on 21st. The max. temp. rose above 60° on three occasions. H on 3rd and 17th; S on 3rd, 5th and 8th.

CULFORD.—Cold most of the month. S showers on 7th, 8th and 9th.

LANGTON HERRING.—R ·98 in. below the average; mean temp. at 9 a.m. (44°·0) 3°·2 below the average and the lowest in April for 17 years; the absolute min. temp. was also the lowest in April during the period. Vegetation very late. Parhelia on 9th; solar halo on 27th; fog on 12th, 17th and 28th.

BODMIN.—A singulary backward month. Mean temp. 44°·3.

WOOLSTASTON.—A cold, backward month. Mean temp. 42°·7; S on 24th.

ORLETON.—The first ten days were very cold, with severe frost each night and much cloud in the day; mean temp. 10° below the average of the month, and a strong wind from N. and E. The wind then changed to S. and W., and the following 9 days were warmer than the average of the month. Another cold period set in on the 19th, with rough N.E. wind, and continued till the 27th. The last 4 days were warm. Mean temp. 4° below the average of 27 years, being 0°·8 lower than in 1887, and only 1°·3 above that of April, 1879. Pressure was generally below the average, but the fluctuations were not great although strong winds were frequent. Chiff-chaff seen on 10th; swallows on 17th; cuckoo heard on 19th. S half an inch deep at 9 a.m. on the 4th; flakes of S fell on 5th and 10th. Fog on 12th.

BOSTON.—S on 2nd, 3rd and 4th; swallow seen on 22nd.

HESLEY HALL.—S on 2nd and 3rd; T and L on 17th, 18th and 19th.

MANCHESTER.—On the whole a cold April, cold E. winds prevailing; vegetation backward; T on 17th and 18th.

HULL.—Generally cold, with a great amount of cloud, and during the early part frequent, though not heavy, falls of sleet, S or H, and during the latter part showers of R or drizzle.

NORTH SHIELDS.—H on 1st, 2nd, 11th, and 17th; S on 2nd, 3rd, 4th, and 11th; TS on 17th.

WALES.

HAVERFORDWEST.—The first 9 days were of the same character as the preceeding month, cold and wintry. From that date to the 23rd R fell every day in small quantities, and the temperature rose. The month on the whole was much finer and milder than any April for some years past; crops looking much better than could have been expected.

SCOTLAND.

CARGEN.—The mean temp. (42°·7) was 3°·4 below the average. The average temp. for the first four months of the year is 42°·2, this year it has been 38°·5. Vegetation very backward, no tree being in leaf at the close. L on 15th.

JEDBURGH.—Generally very cold and ungenial. Though much R fell the dry wind kept the ground dry, but agricultural work was retarded. There has

not been so late a seed time for several years. In high districts the lambing season was attended by much death, owing to the wet, cold weather. S on 1st, 2nd and 3rd ; high winds from 20th to 25th.

OBAN.—Fair and seasonable weather prevailed until the 25th, the month closing with gales and R. Rainfall much below the average from the commencement of the year to the end of this month. All growth backward. Heavy H storm on 19th, and T heard within a few miles of Oban.

QUINISH.—A cold, backward month.

BRAEMAR.—Cold and unsettled. T on 19th, followed by S and sleet ; heavy gale on 28th.

LOCHBROOM.—A very boisterous and wintry month. S on low grounds on 8 days and almost daily on the hills. Much seed was unsown at the close, and half the potatoes were not planted. Everything was very late and spring work has seldom been so backward. The last week was like mid-winter and floods prevailed. H on 11th, 12th, and 20th.

CULLODEN.—Very cold and ungenial. Vegetation made no progress, seed-time was late, and grass and all pastures were exceedingly backward. From 1st to 11th and from 20th to 27th dry, cold E. winds prevailed. T was heard once.

SWANBISTER.—Unusually wet and cold ; agricultural operations very much retarded. S on 3rd, H on 11th.

IRELAND.

BLACKROCK.—A cold, harsh month and a late spring, though temp. fell below 32° only four times. The eighteenth month successively with R below average.

O BRIENSBRIDGE.—Frost occurred every night to the 7th, then cold showers with H and sleet, and generally wintry weather prevailed to the 20th. The close of the month was very stormy and harsh.

DUBLIN.—A generally cold, cloudy, changeable, showery month, with average pressure and a preponderance of polar winds. With the exception of 1879 and 1887 the coldest April since records commenced in 1860 ; mean temp. (45°·6) 2°·2 below average. Solar halos on 9th, 28th, and 29th ; fog on 5th and 6th ; high winds on 15 days ; gale on 30th ; S or sleet on 4th and 8th ; H on 5 days. Mean humidity 80 ; mean amount of cloud 7·1.

BALLINASLOE.—Cold, raw, and very disagreeable. Winds principally N. and E.

EDENFEL.—With the exception of the third week, which was mostly soft and balmy, the weather was raw and backward, vegetation making but little progress and being at the close a full fortnight in arrear, even hedges being still brown. The swallow did not appear till the 25th, and of the cuckoo and land rail there was still no sound at the close.

EARTHQUAKE IN NORTH WALES.

Major Mathew has favoured us with the following note :—

The observer at Rhiwbrifdir, Merioneth, reports April 11th "Gloomy, with a shock of earthqnake at 7.10 p.m."

From other sources we learn that it was felt as far south as Dolgelly, and as far east as Llangollen.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCLXIX.] JUNE, 1888. [PRICE FOURPENCE, or 5s. per ann. post free.

Hervé Mangon.

BORN 31st JULY, 1821. DIED 15th MAY, 1888.

THE *Bureau central Météorologique de France* has lost the President of its Council, meteorologists of many countries have lost an ever accessible and kind friend, while French agriculture has lost a great benefactor.

Trained in the two splendid schools—*Ecole Polytechnique* and *Ecole des Ponts et Chaussées*—Hervé Mangon commenced public life as a railway engineer, but his tastes always tended towards the development of the agricultural value of land by means of irrigation and of drainage; he was among (if he was not absolutely) the first to impress this subject on his countrymen. Of his Instructions upwards of 11,000 copies were issued, and the extra revenue derived through the adoption of his advice has been estimated at £560,000 per annum. It says little for the country which he loved that he was made Minister of Agriculture only in March, 1885, and in a very few months was turned out of office, not of course for any fault of his, but simply because the Brisson Cabinet was overthrown. Sometimes a few words will show the character of the man. The writer may therefore quote the parting words of M. Hervé Mangon while he was yet Ministre:—"My dear ——,— There is no knowing how long I shall be here, but while I am I will do all that I can for my country."

We can hardly do justice to his services to meteorology, because he was so quiet and unassuming that much which he did never came before the public, but probably this will be remedied by a worthy notice in the *Annuaire de la Soc. Mét. de France*, of which society he was four times President. The iron tower which he erected at his country seat has already been illustrated in these pages (*Met. Mag.*, vol. xx., p. 65), and his name is also associated with improvements and modifications of thermometers, rain gauges, anemometers, &c. But we think that his greatest service to meteorology has been rendered in his capacity of President of the Council of the French Meteorological Office. We neither desire, nor attempt, to assign the proportion of credit due to M. Hervé Mangon and to Prof. Mascart,

but we maintain, as we have often intimated, that the publications of that office are a credit to France and most valuable to the whole meteorological world. Moreover, it was Hervé Mangon who, as President of the *Société Météorologique*, issued the invitations for the International Meteorological Congress at Paris in 1878, which was attended by such leaders as Buys Ballot, Denza, Hoffmeyer, Tacchini and others, and which helped France out of the isolated position into which (through the war) she had drifted as regarded the International Congresses.

The world is the worse for the loss of such a man, of whom Gaston Tissandier has well said—

"Le biographe qui voudrait donner l'exemple d'une belle existence, toujours dignement remplie, depuis de modestes débuts jusqu' aux plus grands honneurs, ne pourrait mieux faire que de retracer la vie de M. Hervé Mangon."

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on Wednesday evening, May 16th, at the Institution of Civil Engineers, 25, Great George Street, Westminster; Dr. W. Marcet, F.R.S., President, in the chair.

Mr. T. W. Gatward and Mr. N. Simmons were elected Fellows, and Prof. D. Colladon an Honorary Member of the Society.

The following communications were read :—

1st. "Report of the Wind Force Committee on Experiments with Anemometers conducted at Hersham, Surrey," by Mr. G. M. Whipple, B.Sc., and Mr. W. H. Dines, B.A. A whirling apparatus with arms 29 feet radius was rotated by means of a small steam engine. On the arms of this whirler four different anemometers were placed. Each experiment lasted fifteen minutes, the steam pressure remaining constant during the run. For the Kew Standard Anemometer, with arms 2 feet long, the experiments give a mean value for Robinson's factor (hitherto always taken as 3·0) of 2·15; and for two smaller instruments the factor is 2·51 and 2·96. Mr. Dines's Helicoid Anemometer gave very satisfactory results, the mean factor being 0·996.

2. "On the measurement of the increase of Humidity in rooms by the emission of Steam from the so-called Bronchitis Kettle," by Dr. W. Marcet, F.R.S. The author described a number of experiments which he had made by filling a room with steam from a bronchitis kettle, and ascertaining the rise and fall of the relative humidity from readings of the dry and wet bulb thermometers. He found that the air in the room could not be saturated, the relative humidity not exceeding 85 per cent., and he also indicated that perhaps experiments of this kind could be made to throw light upon the rate at which the air in rooms was renewed.

MR. VELSCHOW'S REPLY TO THE REVIEW OF HIS PAMPHLET.

To the Editor of the Meteorological Magazine.

SIR,—In your issue for May I find myself challenged to "demonstrate the fallacies in one single good work on barometric measurements."

The work by Williamson, to which I am referred, does not contain one single record of the actual measurement of any mountain. The only work on the subject I can discover, which goes to the extent of taking synchronous readings of barometers and hygrometers is Prof. S. P. Langley's "Professional Papers, Signal Service, No. XV., War Department, U.S."

On page 191 is a table showing the results obtained by measuring the altitude between the sea-level and Lone Pine. Of these circa 40 measurements I have in the following table reproduced the 10 highest and the 10 lowest, arranged according to the height.

Table of Barometric Measurements of Altitude between Sea-level and Lone Pine, Mount Whitney.

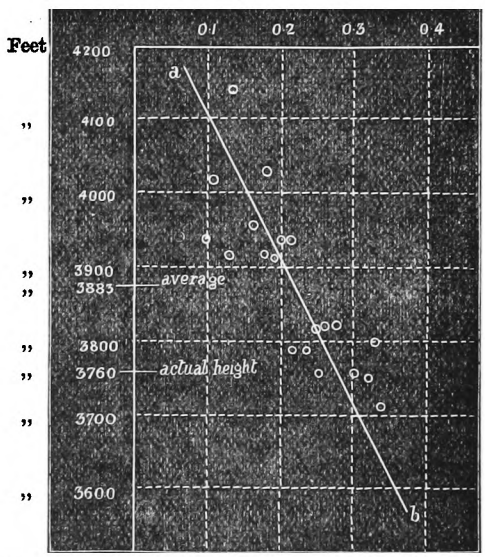
Time of Observation. 1881.	Results in feet.	Weight of vapour in inches of mercury.	At Lone Pine.	
			Relative Humidity per cent.	Temperature °Fah.
Aug. 26, noon.	10 highest results. 4140	0·1354	10·3	87·8
Aug. 26, 9 p.m.	4030	0·1823	28·8	65·7
Sept. 3, noon.	4020	0·1060	8·7	85·4
Aug. 29, noon.	3960	0·1627	15·6	80·6
Aug. 25, noon.	3940	0·2081	18·1	83·6
Sept. 3, 9 p.m.	3940	0·0960	13·5	69·1
Aug. 24, noon.	3940	0·2158	16·0	88·6
Aug. 17, noon.	3920	0·1782	14·9	84·6
Sept. 2, noo..	3920	0·1302	9·9	87·8
Aug. 24, 9 p.m.	3915	0·1931	29·0	67·2
Aug. 20, 9 p.m.	10 lowest results. 3820	0·2787	35·5	72·0
Aug. 19, noon.	3820	0·2615	17·8	91·3
Aug. 23, 9 p.m.	3815	0·2508	38·3	66·7
Aug. 18, 9 p.m.	3800	0·3314	78 0	54·7
Aug. 31, 9 p.m.	3790	0·2190	45·7	57·6
Aug. 30, 9 p.m.	3790	0·2352	53·1	55·6
Aug. 27, 9 p.m.	3760	0 2543	68·0	51·0
Aug. 21, 9 p.m.	3760	0·3034	38·4	72·2
Aug. 22, 9 p.m.	3750	0·3232	70·1	56·7
Aug. 19, 9 p.m.	3710	0·3405	71·5	57·6
Sept. 7, 9 p.m..	3625	no record.		
Sept. 6, 9 p.m..	3620			

Alongside of each of these figures will be found a number representing the weight of the vapour contained in the atmosphere at

the time of observation. These latter numbers are obtained by multiplying the relative humidity at Lone Pine (see table in Langley, page 177) with the elastic force of vapour (Glaisher's tables).

The difference between max. and min. result is 4,140 — 3,620 = 520 feet, or 14 per cent. of the trigonometrically surveyed height, 3,760 feet, and so long as the quicksilver cannot be guaranteed to give a more reliable result, I believe I may safely repeat that "barometric measurements have hitherto been more or less a failure." As to the likely cause of the variability, it will be noticed that the amount of vapour in the atmosphere was much less when the 10 highest results were obtained than when the 10 lowest were obtained, and, as the following diagram may illustrate, the results seem to be

Inches of mercury.



pretty nearly in reverse proportion to the amount of vapour in the atmosphere. The line a—b shows the general tendency of the figures. That these do not follow this line more closely just shows that it is not sufficient to measure the humidity only at one end of the air-column. Besides, there seem to be other causes of error; it will thus be noticed that the 10 highest results are generally from observations taken at noontide, when the thermometers showed a high temperature, while the 10 lowest results are all, except one, from observations taken at 9 p.m. This may, for instance, indicate that it is unsafe to judge of the temperature of the air-column after sunset from thermometers placed near the earth's surface owing to the radi ation of heat.

Having hereby, as I hope, given a satisfactory answer to your question regarding a subject which has only been mentioned casually in my little pamphlet, may I now have removed your objection to deal seriously with the main subject of the same, namely, the law of circulation of the atmosphere, and I shall conclude

by challenging you, without provocation, but by way of returning a compliment, to demonstrate a single fallacy in my theory, as I think you have treated it somewhat lightly by simply stating that you cannot accept it.—Yours very respectfully,

FRANZ A. VELSCHOW, C.E.

London, June, 1888.

[We are not going to allow anyone to say that he does not have fair play in these pages, and therefore we insert Mr. Velschow's letter and engrave his diagram; but we have some facts to mention which seem to contradict his statement and argument.

We are sorry to seem hard on any author, but we cannot without protest allow anyone to pronounce "a failure," work which from the time of Pascal downwards has occupied some of the finest intellects that the world has produced. And surely he should bring some evidence worthy of consideration in support of his statements. De Luc, Shuckburgh, La Place, Gay Lussac, Gauss, Ramond, Bailly, Bessel, Ritter, Baeyer, Humboldt, Oltmanns, Delcros, Guyot, Loomis, Benzenberg, Williamson, Airy, A. J. Ellis, Neumeyer, Rühlmann —is it likely that they have all been working upon "a failure?"

Mr. Velschow states that Williamson's book "does not contain one single record of the actual measurement of any mountain." We reprint on p. 70 the very first table which we turned up in Williamson (1) because it appears hard to reconcile its existence with Mr. Velschow's statement; (2) because it shows that good barometric observations properly reduced give results subject to an uncertainty of only about 51 ft. in 3,636 or 1 foot in 70, *i.e.*, 1·4 per cent. instead of 14 per cent., as shown by Mr. Velschow's extract from Langley. And that this accuracy is not exceptional could be proved over and over again. Here is another case (*American Meteorological Journal*, June, 1887). Prof. Hazen gives the synchronous readings at Mount Washington (6,279 ft.) and at sea level for every day in September, 1885. The greatest variations in the computed pressure are +·10 and −·05 in., say 160 ft. in 6,279, or about 2½ per cent. instead of 14. Mr. Velschow states that the "only work on the subject which I can discover, which goes to the extent of taking synchronous readings of barometers and hygrometers, is Langley's." We have casually given him two; we have only time to give one more, but it will provide him with ample materials. It is *Annales du Bureau Central Météor. de France*, 1884, part II. He will find there every three hours throughout the year (that is 2,920 times repeated) the readings of barometer, and for more than 2,000 of these times the temperature, relative humidity, wind and cloud also at the stations at the foot (1,273 ft.) and on the summit (4,813 ft.) of the Puy de Dôme.

One would have thought that before attaching the word failure to barometric measurements any writer would have been careful that

HYPSOMETRICAL TABLE. (*From Williamson "On the use of the Barometer," p. 167.*)

From Simultaneous Observations taken at the Base and on the Summit of Monte Diablo, California, May and June, 1859.

DATE.	AT BASE.				ON SUMMIT.				$A \log \frac{h}{H}$	Wandering from the Mean.		T. + Parts 3, 4 & 5.	Wandering from the Mean.		Diff. of Alt.	Wandering from the Mean.		½ Sum of Temp.	½ Sum of Rel. Hum.	Cor. for Hum.
	Bar.	Ther.	Force of Vapor	Rel. Hum.	Bar.	Ther.	Force of Vapor	Rel. Hum.		+	−		+	−		+	−			
1859	in.	deg.	in.	per ct.	in.	deg.	in.	per ct.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	deg.	per ct	ft.
May 22	29·740	54 3	·365	86·5	26·038	49·8	·243	70·0	3473·0		52·6	166·8	49·1		3639·8		3·5	52·0	78·2	15·9
23	·881	54 3	·351	83·4	·161	50·9	·280	74·9	3473·6		53·2	171·1	44·8		3644·7		8·4	52 6	79·2	16·4
24	·815	63·4	·337	59·8	·150	54·7	·226	51·3	3426·8		6·4	218·1		2·2	3644·9		8·6	59·1	55·5	14·3
25	·834	65 8	·258	43·8	·213	58·3	·242	49·2	3380·6	39·8		237·8		21·9	3618·4	17·9		62·0	46·5	13·3
26	·799	70 9	·327	46·1	·227	67·1	·320	47·5	3336·0	84·4		286·4		70·5	3622·4	13·9		69·0	46·8	16·7
27	·782	63·7	·335	61·2	·126	61·1	·260	45·9	3421·9		1·9	243·3		27·4	3665·2		28·9	62·4	53·6	15·3
28	·866	57·3	·362	77·5	·145	48·2	·229	71·8	3476·6		56·2	172·4	43·5		3649·0		12·7	52·8	74·6	15·7
29	·815	60·1	·378	73·0	·145	53·7	·249	59·4	3431·9		11·5	202·0	13·9		3633·9	2·4		56·9	66·2	15·9
30	·813	59·5	·339	66·7	·141	53·5	·183	45·1	3434·0		13·6	199·1	16·8		3633·1	3·2		56·5	55·9	13·3
31	·733	63·1	·315	56·3	·115	57·2	·174	36·9	3389·9	30·5		224·2		8·3	3614·1	22·2		60·2	46·6	12·5
June 1	·621	71·2	·359	48·9	·072	65·0	·235	37·5	3334·3	86·1		279·6		63·7	3613·9	22·4		68·1	43·2	15·0
2	·756	58·3	·360	77·5	·101	60·5	·197	37·5	3424·0		3·6	220·6		4·7	3644·6		8·5	59·4	57·5	14·9
3	·891	56·6	·355	77·5	·181	52·4	·236	64·6	3462·4		42·0	185·2	30·7		3647·6		11·3	54·5	71·0	15·7
Mean	29·796	61·4	·339	66·0	26·140	56·3	·160	53·2	3420·4	37·1		215·9	30·6		3636·3	12·6		58·9	59·2	15·0

the data upon which he relied were unexceptionable—instead of that, here are the facts as to Prof. Langley's observations to which Mr. Velschow has devoted so much space.

On the very page to which the author refers us, and which therefore he surely has read, Prof. Langley enumerates the data employed—"(1.) Summaries of barometric, thermometric, and relative humidity readings at San Diego and San Francisco; (2) the same for Lone Pine; (3) the same for Mountain Camp; (4) the same for Peak of Whitney."

Now San Francisco is 230 miles N.W. of Lone Pine, San Diego is 270 miles S.S.E. of it! Why England alone is not large enough to give the equivalent of these distances, but by taking the British Isles we can nearly find it. The barometric measurement of heights is pronounced "a failure," because (taking corresponding British localities) observations on the top of Snowdon do not give constant differences as compared with sea level values determined from observations made at Guernsey, and at Malin Head, the northernmost point of Ireland.* Who would have expected that they should?

Having been obliged to deal at such length with the author's facts, we owe it to our readers not to occupy space with consideration of his theory. It will be time enough to do that when the heads of the various meteorological offices in Australia and New Zealand find, by its compelling the weather forecasters of our antipodes to recognise its presence, that the "air cushion" really exists.]—ED.

THUNDERSTORMS—BRONTOLOGY.

[WE have much pleasure in inserting the following letter from Dr. Hellmann. There seem to be few things that our German friends have not done; they were clearly the first as to thunderstorm, or rather Brontological research, though they let the subject slumber for a long while (half a century); and now it also turns out that they were the first to use derivatives of Βροντος for designating thunderstorms. Dr. Hellmann's invaluable *Repertorium* shows that Prof. Peter Ahlwardt, in 1745, published a work entitled "Bronto-Theologie oder vernünft u. theol. Betrachtungen über den Blitz u. Donner." Now that the observation of thunderstorms is being actively pursued, we certainly think that Brontology would be a useful word. We have yet to learn that our friends have made a Brontometer.—ED.]

To the Editor of the Meteorological Magazine.

SIR,—Your interesting remarks on systematical observations of thunderstorms induce me to put you in mind of a German Society especially created for the study of thunderstorms so early as 1820.

* On the Continent the equivalent would be to compare the Puy de Dome with stations at about the distances of Paris on the one side and Barcelona in Spain on the other.

Some particulars about this "Gesellschaft zur Beobachtung der Gewitter" may be found in my "Repertorium," p. 917-18. The blank forms for record, I am sorry to say, I have never seen, but I will endeavour to get one from old archives at Halle, supposing that any one is still remaining. I am very curious to read a full description of your brontometer* to be constructed by Richard Brothers.—I am, Sir, yours most truly,

GUSTAV HELLMANN.

Berlin, Margarethenstrasse 2, May 21st, 1888.

We append for the convenience of those who have not Dr. Hellmann's "Repertorium" a free translation of the paragraph referred to in his letter.

SOCIETY FOR THE OBSERVATION OF THUNDERSTORMS, 1820-25.

"The initiation of this Society was undertaken by J. S. C. Schweigger, shortly before he removed from Erlangen to assume his duties as Professor of Physics at the University of Halle. On March 25th, 1820, he read a paper before the Philosophical Society, at Halle, "On thunder clouds and storms, and on a Society for observing their formation and precise path," so as to obtain from that old-established Society its authority and support. This he obtained, and a resolution inviting the co-operation of the members of all German scientific societies, and especially of such as were interested in Meteorology, was signed the same day.

"This is, as far as I know, the first society exclusively devoted to the study of thunderstorms, and this was followed 45 years afterwards by the organization in France, under Le Verrier, of the *Commissions météorologiques départementales.* The Scandinavian, Belgian, and Italian systems soon followed, but in Germany there was nothing until the establishment of the Bavarian system in 1879.

"The appeal of the Halle society seems to have been well met. Many volunteer observers came forward, especially in South Germany, so that, in 1823, more than 500 blank forms were issued. However, the direct result of these observations was only trifling; the observations were edited by Messrs. K. L. G. Winckler and J. K. Bullmann.†

"For the first year they received reports from 52 stations, but the number decreased to 23 in 1825, which is the last I have seen. Indirectly the organization was very useful as leading to the firm establishment of meteorological observations in Thuringia and Wurtemburg."

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* Perhaps we may revive the old, short, and characteristic word, "Brontology" (German, Brontologie) for all relating to thunderstorms.

† Tabellar. Zusammenstellg. v. Gewitterbeobb, i. J. 1821-25, by J. K. Bullmann. Jahresb. naturf. Ges. Halle, 1821-26.

ADDITIONAL RAINFALL OBSERVERS.

FOR so exceptional a year as 1887 it is imperative to use every effort to render the account as nearly perfect as possible. Therefore, before printing off *British Rainfall*, 1887, I have issued the following letter to a considerable number of country newspapers, and a somewhat similar one was sent to *The Times*. The result has been to obtain about twenty records of which I was previously unaware. I have no doubt that some readers of this Magazine can tell me of others, and I shall be much obliged by their so doing.

G. J. SYMONS.

*To the Editor of*_____

SIR,

Twenty-three years since, you allowed me through your columns to invite the co-operation of your readers in developing the organization for the collection, preservation, and publication of records of the amount of rain falling annually in different parts of the country. Thanks to the help then received, our organization is now a powerful one, with nearly three thousand correspondents in almost all parts of the British Islands from Shetland to Jersey, and from Lowestoft to Valentia, off the coast of Kerry.

The year 1887 was quite an exceptional one, dry at many places beyond all modern precedent, and we are consequently anxious to collect every trustworthy record which was kept. I therefore ask your permission to invite any of your readers who have not yet communicated with me on the subject to do so at once, when blank forms, instructions, &c., will be sent by return, and post free.

I append a list of the returns from_____ as, if you can find room for it, much unnecessary correspondence will probably be saved, and it will be of general interest not only as showing who are now helping us, but also as giving the relative rainfall during last year at the various localities.

I venture to press for promptitude, as we are anxious to print the Annual volume very shortly.

Your obedient Servant,

G. J. SYMONS, F.R.S.

62, Camden Square, London, N.W., May, 1888.

EARTHQUAKE IN NORTH WALES.

To the Editor of the Meteorological Magazine.

SIR,—I have been surprised that so little has appeared in the papers, respecting the earthquake of April 11th, in North Wales and in Shropshire. I did not experience the movement myself, but a tradesman residing within about a quarter of a mile from my house, told me that he very distinctly felt the tremor, and also heard the rumbling sound which preceded it. I give the account as nearly as I can in his own words:—

"I was sitting (he said) at work, by myself in my workshop" (a

small building close to his own house), between 6 and 7 o'clock in the evening "I first heard (he said) a distant rumbling sound coming from the direction of Chirk (North East), I thought it was distant thunder, but all at once the ground was shaken, and the window glass rattled. I then (he continued) got up and looked out of doors, and could see no sign of thunder clouds about. A little while after I entered my own house, and asked my family if they had heard the thunder, but they had not, nor felt any shock. When (he stated) I went to Oswestry on Saturday, the 14th, I was told that there had been an earthquake in the neighbourhood."

Trusting that the above account may prove interesting to the readers of your *Meteorological Magazine.*

I remain, Sir, yours faithfully,

A. R. LLOYD.

Walden House, near Oswestry, May 18, 1888.

DROUGHT IN 1888.

To the Editor of the Meteorological Magazine.

SIR,—I send herewith a statement of the rainfall at this place for the last five months. 1887 was a remarkably dry year, but the deficiency in the rainfall this year has been much greater.

Average of previous 16 years	12·02 in.
Last year (1887)	9·19 ,,
Driest previous season (1880)	8·50 ,,
This year (1888)	7·29 ,,

I may add that the amount given above for 1888 is corrected by the addition of ·30 in. for snow, which was not caught in the gauge in consequence of its sheltered position and the strong, driving wind. I arrived at the result by comparing it with two other gauges in an open situation. This is in the March amount.

Yours truly,

SAML. KING.

Elswick Lodge, near Poulton-in-the-Fylde, June 2nd, 1888.

ERRATUM IN *MET. MAG.*, MAY.

A very curious and vexatious error in our last number escaped the notice of editor and of printer—what should have been the top line of page 57 was inserted at the top of page 58.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, NOV., 1887.

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	55·4	4	22·1	17	45·7	36·4	37·6	93	89·9	18·7	3·40	18	7·4
Malta	74·8	8	49·6	21	68·0	57·3	55·2	83	125·2	41·9	1·21	9	5·4
Cape of Good Hope	...	...	...	...	...	...	...	...	...	...	...	...	...
Mauritius	82·3	25	65·2	7, 24	79·5	68·9	63·0	71	137·5	55·6	·60	13	5·6
Calcutta	85·0	10	59·8	25	81·1	64·7	62·5	63	142·0	49·4	·24	1	2·4
Bombay	91·1	3	68·0	30	87·6	73·8	69·0	69	145·2	55·2	1·02	1	2·4
Ceylon, Colombo	88·7	21	71·3	22	86·2	73·5	71·9	80	147·0	66·8	6·54	19	5·1
Melbourne	89·3	25	41·5	17	66·9	49·7	48·8	71	141·8	32·9	3·66	14	5·6
Adelaide	100·5	24	45·0	8, 14	75·6	53·9	47·0	52	159·2	33·6	·94	8	4·4
Wellington	67·0	26*a*	39·0	10	61·9	47 3	48·1	80	136·0	35 0	5 14	16	4·3
Auckland	70·0	1	46·0	17	64·8	52·6	49·1	71	140·0	40·0	2·45	18	7·7
Falkland Isles	69·4	22	32·8	20	54·6	40·0	42·5	79	123·0	28·6	1·05	12	7·0
Jamaica, Kingston	91·1	13	64·0	29	88·6	70·3	71·0	78	...	...	1·89	...	...
Barbados	83·0	4,5*b*	69·0	1	81·0	73·0	72·4	85	...	...	7·79	17	6·0
Toronto	57·6	7	6·4	29	41·1	28·5	29·4	77	...	5·0	2·80	15	6·8
New Brunswick, Fredericton	60·2	28	— 2·5	30	40·4	23·0	25·5	72	...	...	3·60	13	6·2
Manitoba, Winnipeg	58·6	1	—31·4	27	28·4	6·3	17·2	84	...	...	1·01	8	5·0
British Columbia, Victoria	60·0	9	22·0	23 *c*	48·2	36·9	...	...	...	...	5·57	13	...

a And 27, 28. *b* And 6. *c* And 24, 25.

REMARKS, NOVEMBER, 1887.

MALTA.—Mean temp. 61°·7 ; mean hourly velocity of wind 10·4 miles. Sea temp. fell from 69°·0 to 64°·3. TS on 28th. Mists on 24th and 25th. J. SCOLES.

Mauritius.—Mean temp. of air 0°·4, and of dew point 0°·4, and rainfall ·71 in. below average. Mean pressure (30·089 in.) ·007 in. above average. Mean hourly velocity of wind 10·8 miles, 0·5 mile below average ; extremes 25·3 miles on 27th and 1·9 miles on 24th ; prevailing direction E.S.E. C. MELDRUM, F.R.S.

COLOMBO.—TSS on 9 days ; L on 10 other days. J. C. H. CLARKE, LT.-COL. R.A.

Melbourne.—Mean temp. of air 1°·4, and mean amount of cloud 0°·4 below average. Mean temp. of dew point 0°·3, mean pressure ·085 in., humidity 4, and rainfall, 1·15 in. above average. Prevailing winds S. and S.E. ; strong on 6 days. Heavy squalls on 11th and 12th. T on 4 days ; L on 3 days ; H on 11th. R. L. J. ELLERY, F.R.S.

Adelaide.—The first half of the month was unusually cool. Mean temp. 2° below the average of 31 years. Mean pressure 30·024 in., ·028 in. above average. Rainfall about the average. C. TODD.

WELLINGTON.—On the whole an unpleasant month and showery, especially in the first half. Prevailing wind N.W. ; frequently strong. Sharp shock of earthquake on 11th. Mean temp. (54°·6) 1°·9 below average. Rainfall ·97 in. above average.
R. B. GORE.

AUCKLAND.—A cold, cloudy month, with an unusual preponderance of S.W. winds. Pressure slightly, mean temp. quite 2°, and rainfall ·25 in. below average.
T. F. CHEESEMAN.

BARBADOS.—Pressure rather unsteady. Mean temp. (76°·8) the same as the average of 30 years ; mean hourly velocity of wind 1·1 miles above the average of 15 years. N.E. winds on 24 days and S.E. on 6 days. Rainfall somewhat below average.
R. BOWIE WALCOTT.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, DEC., 1887.

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.	TotalRain. Depth.	Days.	Aver. Cloud.
	°		°		°	°	°	0–100	°	°	inches		0–10
England, London	53·8	8	24·3	27	42·8	33·2	34·7	87	74·7	19·2	1·38	13	6 8
Malta	68·0	3	45·2	31	63·1	53·3	49·8	79	119·0	43·1	1·04	11	5·2
Cape of Good Hope	...	...	...	...	...	...	...	...	...	...	...	...	...
Mauritius	84·0	31	68·2	3	81·4	71·8	65·5	71	137·7	58·5	2·41	20	5·6
Calcutta	78·8	1	51·3	30	76·1	56·1	53·2	58	132·5	39·4	·00	0	1·6
Bombay	88·9	8	66·0	22	85·1	70·1	64·5	66	144·0	53·0	·16	3	1·8
Ceylon, Colombo	89·8	2	70·8	10*a*	85·2	72·3	71·2	82	151·2	67·5	6·98	22	7·7
Melbourne	94·5	13	46·1	5	76·3	56·3	54·7	67	146·2	41·1	5·13	13	5·0
Adelaide	98·1	13	48·1	4	83·0	61·2	52·0	50	151·6	39·2	1·86	10	4·0
Wellington	75·0	24	44·0	4*b*	64·7	51·2	51·7	84	150·0	36·0	3 12	11	4·3
Auckland	79·5	24	49·0	6	69·6	55·6	51·4	67	145 0	38·0	1·77	8	6·5
Falkland Isles	66·0	12	33·0	15	55·9	39·8	42·2	75	129·0	26·7	3·37	19	6·6
Jamaica, Kingston	91·3	23	56·7	4	88·0	65·7	67·0	74	...	...	·08	...	...
Barbados	84·0	2,3	67·0	16	80·0	71·0	71·0	83	...	...	8·69	12	6·0
Toronto	47·1	4	0·0	30	33·2	22·5	25·3	83	...	—10·6	3·40	19	8·4
New Brunswick, Fredericton	47·8	11	—12·7	31	26·6	12·0	17·3	80	...	...	4·14	16	5·3
Manitoba, Winnipeg	38·0	16	—41·7	29	8·5	— 10·4	3·5	93	...	...	1·35	.	5 2
British Columbia, Victoria	51·0	17	29·0	27	45·6	37·6	...	...	...	...	9·18	:	..

a And 31. *b* And 14, 28.

REMARKS, DECEMBER, 1887.

MALTA.—Mean temp. 57°·3; mean hourly velocity of wind 12 9 miles. Sea temp. fell from 64°·3 to 59°·0. L on 5th, H on 24th. J. SCOLES.

Mauritius.—Mean temp. of air 0°·9, of dew point 2°·0, and rainfall 2·72 in. below average. Mean pressure 30·023 in., ·017 in. above average. Mean hourly velocity of wind 13·4 miles, 1·9 miles above average; extremes 24·8 miles on 22nd and 30th, and 1·8 mile on 28th. Prevailing direction E. TS on 13th. C. MELDRUM, F.R.S.

COLOMBO.—TSS on 6 days; L on 2 other days. J. C. H. CLARKE, LT.-COL. R.A.

Melbourne.—Mean temp. of air 3°·2, of dew point 4°·3, humidity 3, pressure ·136 in., and rainfall 2·73 in. above average; mean amount of cloud 0·6 below average. Prevailing winds S. and N.; strong on 5 days. Heavy TSS on 18th, 23rd, and 30th. Incessant L and distant T on the evening of 12th; L on 10th, 11th, and 22nd. Hot and oppressive on 7 days. R. L. J. ELLERY, F.R.S.

Adelaide.—Mean pressure 30·022 in., ·083 in. above the average of 31 years. Mean temp. a degree, and rainfall an inch above average. The rainfall for the year (25·70 in.) was 5·63 in. above the average of 30 years and was exceeded only twice during that period. C. TODD.

Wellington.—The early part of the month was showery, with prevailing S.E. wind; the middle was fine, with generally N.W. wind; the latter part showery. T on 11th. Rainfall ·81 in., and mean temp. (57°·9) 2°·9 below average. R. B. GORE.

Auckland.—An unusually dry and fine month. Rainfall not half the average of 20 years. Mean temp. 2° below the average. T. F. CHEESEMAN.

KINGSTON.—The rainfall was remarkably deficient, only one-eighth of the average for the island falling. On the 4th the min. temp. at Kingston (56°·7) was the lowest recorded during the eight years observed here. R. JOHNSTONE.

BARBADOS.—Pressure unsteady. Mean temp. (75°·5) the same as the 30 years average. Rainfall considerably above the average. Prevailing winds N.E. on 24 days, S.E. on 7 days. R. BOWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL, MAY, 1888.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	1·70	XI.	Castle Malgwyn	1·71
,,	Margate, Birchington...	·66	,,	Rhayader, Nantgwillt..	2·34
,,	Littlehampton	1·84	,,	Carno, Tybrith	1·37
,,	Hailsham	1·27	,,	Corwen, Rhug	1·22
,,	Ryde, Thornbrough	2·04	,,	Port Madoc	1·90
,,	Alton, Ashdell.....	2·70	,,	I. of Man, Douglas	2·09
III.	Oxford, Magdalen Col...	1·18	XII.	Stoneykirk, Ardwell Ho.	3·55
,,	Banbury, Bloxham	1·42	,,	New Galloway, Glenlee	5·32
,,	Northampton	·92	,,	Melrose, Abbey Gate...	1·23
,,	Cambridge, Beech Ho...	·59	XIII.	N. Esk Res. [Penicuick]	1·35
,,	Wisbech, Bank House..	·83	XIV.	Ballantrae, Glendrishaig	3·42
IV.	Southend	·42	,,	Glasgow, Queen's Park.	2·43
,,	Harlow, Sheering	·99	XV.	Islay, Gruinart School..	2·74
,,	Rendlesham Hall	·99	XVI.	St. Andrews, Pilmour Cot	1·74
,,	Diss	·80	,,	Balquhidder, Stronvar..	8·45
,,	Swaffham	·95	,,	Dunkeld, Inver Braan..	4·98
V.	Salisbury, Alderbury...	2·09	,,	Dalnaspidal H.R.S. ...	5·71
,,	Warminster	2·21	XVII.	Keith H.R.S.	1·49
,,	Bishop's Cannings	1·15	,,	Forres H.R.S.	·97
,,	Ashburton, Holne Vic....	4·65	XVIII.	Strome Ferry H.R.S....	3·85
,,	Hatherleigh, Winsford.	1·76	,,	Fearn, Lower Pitkerrie.	1 30
,,	Lynmouth, Glenthorne.	1·70	,,	Loch Shiel, Glenaladale	...
,,	Probus, Lamellyn	1·63	,,	S. Uist. Ardkenneth ...	...
,,	Launceston, S. Petherwin	1·83	,,	Invergarry	4·84
,,	Wincanton, Stowell Rec.	1·42	XIX.	Lairg H.R.S.	...
,,	Taunton, Lydeard Ho...	1·52	,,	Forsinard H.R.S.	2·84
,,	Wells, Westbury.....	1·13	,,	Watten H.R.S.	2·51
VI.	Bristol, Clifton	1·40	XX.	Dunmanway, Coolkelure	3·56
,,	Ross	1·34	,,	Fermoy, Gas Works ...	3·51
,,	Wem, Clive Vicarage ...	·48	,,	Tipperary, Henry Street	2·85
,,	Cheadle, The Heath Ho.	·77	,,	Limerick, Kilcornan ...	2·52
,,	Worcester, Diglis Lock	1·01	,,	Miltown Malbay.....	3·57
,,	Coventry, Coundon	1·05	XXI.	Gorey, Courtown House	2·13
VII.	Melton, Coston	1·13	,,	Navan, Balrath	2·24
,,	Ketton Hall [Stamford]	·92	,,	Mullingar, Belvedere ...	2·30
,,	Horncastle, Bucknall ...	·90	,,	Athlone, Twyford	2·20
,,	Mansfield, St. John's St.	1·05	,,	Longford, Currygrane...	2·72
VIII.	Knutsford, Heathside ...	·64	XXII.	Galway, Queen's Coll...	2·87
,,	Walton-on-the-Hill.....	·92	,,	Clifden, Kylemore	6·14
,,	Lancaster, South Road.	1·60	,,	Crossmolina, Enniscoe..	3·42
,,	Broughton-in-Furness ..	2·26	,,	Collooney, Markree Obs.	2·79
IX.	Shipley, Esholt Vic. ..	·65	XXIII.	Rockcorry.....	2·35
,,	Ripon, Mickley	1·05	,,	Warrenpoint	1·79
,,	Scarborough, West Bank	·77	,,	Seaforde	3·47
,,	East Layton [Darlington]	1·32	,,	Belfast, New Barnsley..	...
,,	Middleton, Mickleton..	1·50	,,	Cushendun	3·45
X.	Haltwhistle, Unthank..	1·29	,,	Bushmills	2·45
,,	Shap, Copy Hill	3·45	,,	Stewartstown	3·04
XI.	Llanfrechfa Grange	2·33	,,	Buncrana	2·93
,,	Llandovery	1·80			

MAY, 1888.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1870–9	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) ...	1·18	— ·74	·33	16	7	77·2	19	35·3	11	0	3
II.		Maidstone (Hunton Court)...	·81	— 1·21	·42	16	5	...	...	...	...	...	...
,,		Strathfield Turgiss	1·67	— ·01	·58	17	8	75·1	19	31·9	11	1	18
III.		Hitchin	1·15	— ·84	·40	2	7	73·0	19	32·0	10	1	...
,,		Winslow (Addington)	1·32	— ·91	·44	17	8	74·0	19	34·0	9*e*	0	6
IV.		Bury St. Edmunds (Culford)	·80	— 1·10	·30	17	4	78 0	18	28·0	27	5	...
,,		Norwich (Cossey)	·69	— 1·12	·23	29	6	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	1·58	...	·45	17	7	68·0	24	38·0	11*f*	0	...
,,		Barnstaple.....	1·16	— ·94	·24	16	11	72·5	25	36·0	5	0	...
,,		Bodmin	2·07	— ·77	·49	3	14	69·0	24	35·0	5	0	...
VI.		Stroud (Upfield)	2·00	— ·30	·45	17	11	76·0	19	38·0	3, 4	0	...
,,		ChurchStretton(Woolstaston)	·90	— 1·49	·26	29	11	74·0	19	36·0	4, 11	0	5
,,		Tenbury (Orleton)	·77	— 1·66	·26	9	7	74·8	19	31·3	4	2	8
VII.		Leicester (Barkby)	·86	— 1·02	·30	29	7	80·0	20	29·0	11*f*	4	...
,,		Boston	·72	— 1·05	·22	29	9	79·0	18	31·0	11	1	...
,,		Hesley Hall [Tickhill].....	·54	...	·26	29	7	80·0	19	33·0	16	0	...
VIII.		Manchester (Ardwick).....	·72	— 1·51	·33	3	8	77·0	19	38·0	3	0	...
IX.		Wetherby (Ribston Hall) ..	·90	— ·92	·34	29	7	...	...	...	...	...	...
,,		Skipton (Arncliffe)	2·93	— ·19	·93	2	12	...	...	...	...	...	...
,,		Hull (People's Park)	·67	— 1·21	·28	29	9	...	...	...	...	...	...
X.		North Shields	·38	— 1·47	·24	29	4	70·5	20	30·5	10	1	2
,,		Borrowdale (Seathwaite).....	8·17	+ 1·19	2·22	29	14	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	1·99	— ·61	·41	2	14	...	...	...	...	...	...
,,		Haverfordwest	2·16	— ·53	·62	29	13	72·8	24	34·0	14	0	5
,,		Plinlimmon (Cwmsymlog) ...	1·54	...	·32	16	10	...	...	...	...	...	...
,,		Llandudno.....	·74	— ·88	·20	16	11	76·9	19	37·8	12	0	...
XII.	SCOTLAND.	Cargen [Dumfries]	2·91	+ ·38	·88	29	12	78·8	19	30·0	10	1	...
,,		Jedburgh (Sunnyside).....	·98	— ·81	·26	29	10	76·0	19	29·0	29	2	...
XIV.		Old Cumnock	2·68	+ ·28	·67	29	13	79·0	19	27·0	9	6	...
XV.		Lochgilphead (Kilmory).....	5·78	+ 3·02	1·52	29	19	...	...	...	...	...	...
,,		Oban (Craigvarren)	5·34	...	·98	29	19	72·8	19	35·0	10	0	...
,,		Mull (Quinish).....	4·18	...	·81	29	18	...	...	...	...	...	...
XVI.		Loch Leven Sluices	2·50	+ ·21	·40	13*a*	9	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	1·75	— ·19	·55	29	9	65·5	21	34·2	11	0	...
XVII.		Braemar	3·39	+ ·97	1·02	29	16	71·7	19	27·3	29	4	14
,,		Aberdeen	1·20	...	·37	29	12	70·0	7	30·0	27	2	...
XVIII		Lochbroom	4·46	...	1·40	31	17	...	...	...	...	...	...
,,		Culloden	·99	— ·79	...	...	...	77·0	19	30·0	29	1	12
XIX.		Dunrobin	2·62	...	·42	16	18	64·5	7	31·5	10	2	...
,,		Kirkwall (Swanbister)..... ..	...	...	...	...	...	...	...	...	...	...	...
XX.	IRELAND.	Cork (Blackrock).....	3·24	+ 1·08	·53	18	14	73·0	22*b*	36·0	4	0	..
,,		Dromore Castle	3·80	...	·77	18	11	...	...	...	...	...	...
,,		Waterford (Brook Lodge) ...	2·42	...	·75	29	11	70·5	24	34·0	12	0	...
,,		O'Briensbridge (Ross)	2·55	...	·67	19	16	73·0	24*c*	42·0	13*g*	0	...
XXI.		Carlow (Browne's Hill)	2·48	+ ·36	·75	29	12	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	·98	— ·74	·25	29	11	68·7	7	36·9	4	0	7
XXII.		Ballinasloe	2·53	+ ·12	·46	29	18	68·0	22*d*	33·0	4	0	...
XXIII		Waringstown	2·83	+ ·72	1·30	29	11	77·0	23	31·0	8	3	4
,,		Londonderry (Creggan Res.).	2·12	...	·55	29	18	...	...	...	...	...	...
,,		Omagh (Edenfel)	2·24	— ·11	·68	29	16	72·0	23	31·0	8	1	...

a And 20, 30. *b* And 23, 24. *c* And 27. *d* And 25, 26. *e* And 11, 12. *f* And 12. *g* And 14.
+ Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON MAY, 1888.

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.—Vegetation made progress, which, though steady, was by no means rapid, owing to cold nights and blasting easterly winds. The rains of the 16th and 17th produced most wonderful plant-development. There was abundant sunlight, but R and a warmer atmosphere were much required at the close. Ash in flower on 5th; beech in leaf on 7th; elm in leaf on 13th; oak in leaf on 19th. Wasp first seen on 8th; meadow brown butterfly on 26th.

ADDINGTON.—A dry month, with very high wind and showers on the first three days. R much needed at the close to help on the hay crop, which promised to be both light and late. The nights were generally very cold, the min. temp. exceeding 50° only twice. H on 3rd; much L in N.W. on the evening of 18th. Nightingale heard on 9th.

LANGTON HERRING.—On the whole a very fine month. Mean temp. at 9 a.m. (52°·9) 0°·7 below the average of 16 years. From 17th to 28th the weather was very fine. Fog on 6th, 7th, 8th, 17th and 18th; distant T on 18th. Owing to the long winter, the season was very backward. Hawthorn not in bloom till 26th; blackthorn still in bloom at the close.

BODMIN.—A remarkably fine month. Mean temp. 54°·1.

WOOLSTASTON.—The first fortnight was very cold and backward, but the latter part of the month was more genial. Springs were quite exceptionally low, and in some cases altogether ceased running. Swallows were very late in arriving, and very few in number. Very vivid L on 18th; T and L on 19th.

ORLETON.—The weather was generally fine, with more than the average number of clear days and cold nights, and a prevalence of N. and E. winds. Mean temp. 0°·4 above the average of 27 years. R not one-third of the average. Pressure generally high and steady, but very rough winds on 1st, 3rd, 19th and 30th. Solar halo on the 9th. Damson and cherry trees generally in blossom about the 8th, and apple trees about the 23rd.

BOSTON.—The mean temp. was not below the average, although the nights were cold and the weather of part of the month was very ungenial. All vegetation was backward. R 1·07 in. below the average of 20 years. Cuckoo heard on 5th.

MANCHESTER.—On the whole a very fine month, but cold winds prevailed through the greater part; towards the middle, the temperature rose somewhat, but, after reaching 77° on the 19th, it fell off again. Vegetation, however, made rapid progress from that time. T on 19th.

HULL.—Generally fine, with light clouds and frequent strong cold winds.

WALES.

HAVERFORDWEST.—A fine May, with an absence of frost, except very slight white frosts. From the 17th to 25th, it was warm, with bright sunshine; then three rather cold nights, from 25th to 27th, checked vegetation somewhat. The last three days were cold and stormy, and the wind injured the young leaves a good deal, especially those of the horse chestnut in exposed situations. The whitethorn blossomed on the 28th; the ash and the oak were in leaf nearly contemporaneously—if there was any difference, it was rather in favour of the ash. All crops, and the country generally, were looking extremely well at the close. The R from January 1st was 1·22 in. less than that of the corresponding period in 1887, but the different distribution produced very different results.

SCOTLAND.

CARGEN.—Great fluctations of temperature occurred on several occasions. Vegetation was very backward, lilac and laburnum being ten days or a fortnight later than usual. Several horses and some cattle were killed in the district by a severe TS on the 19th; TSS on 16th and 18th also; H on 4th.

JEDBURGH.—Remarkably dry, with cold E. and N.E. winds generally. On several days the temperature was high, but the night temperature was always low. The dry state of the ground allowed it to be well prepared for the turnip and potato crop. Pressure high throughout. Cuckoo heard on 11th; corncrake on 18th.

OBAN.—The early portion of the month was cold, and was succeeded by heat from the 17th to the 26th, when growth rapidly started; at the end, however, the temp. was even lower than at the beginning. In connection with the severe TS in Glasgow and Edinburgh on the 19th, which was but slightly felt here, we experienced an extraordinary heat wave throughout the whole of the day, which exhibited a temperature previously quite unknown at the time of year within my experience of eight years. At 10 p.m. on that day, the wind suddenly shifted from a perfect calm in S.S.E. to S.W., and blew a whole gale (force 9) for about 15 minutes, accompanied by R. The total rainfall was the heaviest in May for many years, but everything was backward at the close for want of continued heat. H on 4th, 19th and 31st. T on 17th, 18th and 19th.

LOCHEROOM.—The first third of the month was really wintry, the next third was beautiful. On the 19th there passed over the country one of the most terrific thunderstorms remembered. Thence the weather continued fine till the 30th, when it again changed to severe cold, and the last day was one of the wildest ever seen at the time of year. T on 4th and 19th; H on 3rd and 8th; S on 2nd, 3rd and 8th.

CULLODEN.—A month of low temperature, with continued frost at night. T on 19th, with a beautiful display of L for several hours at night.

IRELAND.

BLACKROCK.—Just the variable, moist and warm weather required to bring vegetation to its normal state. The total rainfall to the end of May was 3·17 in. below the average of 23 years.

DROMORE.—A fine month, with good growth; all crops promising at the close.

WATERFORD.—Mean temp. 50°·9; rainfall ·15 in. above the average. H on 2nd; fog on 7th and 22nd; S.W. gale on 30th. Corncrake heard on 6th.

O'BRIENSBRIDGE.—The mean temp. (57°·6) was above the average of 10 years. With sufficient R, and many dry, warm days; vegetation was in a forward state at the close, and orchards and hedgerows were in finest bloom.

DUBLIN.—Very stormy, rough and unsettled, both at the beginning and at the end. May was, nevertheless, a bright, dry, pleasant month. The rainfall was scanty, and in an anticyclonic period, lasting from 20th to 26th, the sky was for the most part cloudless. As in May, 1887, there was a preponderance of polar winds. The gales of 1st, 2nd, 3rd, 30th and 31st, were very severe for the season. Mean temp. (52°·5) 0°·6 above the average. T on 2nd; H on 2nd and 3rd; solar halo on 15th; fog on 10th, 11th and 27th. Mean humidity 74; mean amount of cloud 4·4.

EDENFEL.—The month commenced with stormy backward weather, with considerable falls of H and R, succeeded on the 6th by a fine, bright, growing period, during which the advance of vegetation was magical. The third week was again inclement and rainy, but from the 20th to the 28th there followed a brilliant spell of early summer, warm and clear, changing a season which in the beginning of the month was a full fortnight late with the hawthorn hardly in leaf, into one earlier by a week than the average, with oak and ash in leaf and blossom, and a most luxuriant general vegetation. The last three days were very wet.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCLXX.] JULY, 1888. [PRICE FOURPENCE, or 5s. per ann. post free.

RAINFALL OF SPAIN AND PORTUGAL.*

PERHAPS there is climatic reason for it, but at any rate the fact is noteworthy, that the first general treatise on the amount of cloud in the Peninsula, and the first general treatise on its rainfall, are due not to a Spaniard, not to a Portuguese, but to a German. Dr. Hellmann has such a capacity for work that we should not be much surprised to receive some morning a complete treatise on the Climate of English Health Resorts, with descriptions of all the instruments used, and biographies of the observers, all worked up in Berlin.

The present is not Dr. Hellmann's first paper on Peninsula rainfall. He wrote a short one in Spanish ("Distribucion de la lluvia en la Peninsula Ibérica") in 1887, but the present is a really complete treatise.

Rainfall observations, though commenced in England in 1677, and at Paris Observatory in June, 1688, do not seem to have been made either in Spain or Portugal until nearly a century later, and then they were very fragmentary. Dr. Hellmann can, therefore, give nothing for the 17th century, and only two records, one for four years (1783-86, at Mafra, near Lisbon), and one for two years (1785-86, at Lisbon), for the 18th century.

The years 1816 and 1817 are noteworthy in rainfall annals, as those for which the outrageously erroneous observations were published for Coimbra, in the valley of Mondego, which has really a rainfall of 35 inches, was variously reported to have a mean rainfall of 224 or of 119 inches. In Symons's "Rain, How, When, Where, and Why," published in 1867, this value is marked with a query, though further on, in the same work, it is apparently supposed to be correct. However, Dr. Hellmann shows that even up to 1883 the 13th edition of Brockhaus's "Konvers-Lexicon" perpetuates the error, whereby this pleasant little town has the unjust reputation of being the wettest place in Europe. But what with the Peninsular War and other subsequent political troubles, the final result is that

* Die Regenverhältnisse der Iberischen halbinsel, von G. Hellmann. [Excerpt Zeits. der Gesell. für Erdkunde zu Berlin]. Berlin: W. Pormetter. 1888. 8vo. 98 pages, 1 coloured map.

there are only two records which extend back beyond 1850, and they only go to 1836 and to 1837 respectively—and one of them ceased in 1864. How scanty is, therefore, the information as regards the secular variation of rainfall in Spain and Portugal as compared with their nearest neighbour, France, or with Germany, or the British Isles, need not be pointed out. One register, Lisbon, is continuous for 49 years, one other reaches 35 years, and there are 26 each extending from 16 to 29 years, so that by differentiating from these Dr. Hellmann has been able to compute fairly trustworthy means for 76 stations. He points out, however, what must not be forgotten, that most rain gauges in these countries are from 15 to 60 feet above the ground, and therefore the mean values are too small. As, however, his table of mean annual rainfall is undoubtedly by far the best yet given, we append a conversion and translation of it :—

Mean and Extremes of Rainfall in Spain and Portugal.

Province— Station.	Altitude. feet.	Years of Observation.	Mean. in.	Yearly Rainfall. Max. in.	Yearly Rainfall. min. in.	Ratio, $\frac{M}{m}$
Basque and Asturia—						
San Sebastian	82	5	53·0	—	—	—
Vergara	551	7	51·1	—	—	—
Orduña	994	1	28·8	—	—	—
Bilbao	52	25	47·0	53·5	35·4	1·5
Santander	33	5	34·0	—	—	—
Oviedo	738	30	35·1(?)	—	—	—
Galicia—						
La Coruña	82	6	34·0	—	—	—
Santiago	863	25	64·8	92·0	37·1	2·5
Orense	472	13	38·0	55·6	27·3	2·0
Pontevedra	39	2	64·6	—	—	—
La Guardia	26	2	55·7	—	—	—
Portugal—						
Montalegre	3182	4	54·5	—	—	—
Porto	328	20	52·6	80·3	31·9	2·5
Moncorvo	1362	6	25·9	—	—	—
Guarda	3409	20	38·0	64·8	23·1	2·8
Vizéu	1621	4	61·9	—	—	—
Serra da Estrella	4728	5	137·8	—	—	—
Coimbra	463	20	35·3	52·8	20·0	2·6
Mafra	771	4	37·2	—	—	—
Lissabon	295	29	29·3	45·1	17·3	2·6
Campo Maior	945	19	21·9	34·9	11·9	2·9
Evora	1027	13	24·1	37·3	13·7	2·7
Lágos	43	16	20·3	30·9	12·6	2·5
Andalusia—						
San Fernando	95	35	28·6	50·0	11·9	4·2
Tarifa	46	16	26·4	48·1	14·3	3·4
Tanger (Africa)	33	6	28·0	—	—	—
Gibraltar	49	16	29·8	—	—	—
Málaga	75	6	24·3	—	—	—
Archidona	2165	1	15·9	—	—	—
Sevilla	98	21	16·1	34·6	6·3	5·5
Jáen	1926	13	25·7	46·7	16·9	2·8
Granada	2198	22	22·1	48·5	12·3	3·9

MURCIA AND VALENCIA—											
Cartagena	20	...	3	...	13·6	...	—	...	—	...	
Murcia	138	...	20	...	13·3	...	22·6	...	7·6	...	3·0
Alicante	13	...	22	...	16·0	..	26·6	...	7·2	...	3·7
Yecla	1969	...	1	...	13·8	...	—	...	—	...	—
Albacete	2251	...	17	...	13·3	...	22·0	..	7·0	...	3·1
Carcagente	98(?)	...	28	...	22·7	...	—	...	—	...	—
Valencia	59	...	22	...	15·9	...	28·2	...	7·0	..	4·0
Palma (Mallorca)	66	...	18	...	17·4	...	24·1	...	9·4	...	2·6
Mahon (Menorca)	33(?)	...	5	...	27·2	...	—	...	—	...	—
CATALONIA—											
Barcelona	69	...	21	...	22·4	...	38·5	...	10·7	...	3·6
Igualada	1017	...	2	...	20·0	...	—	...	—	...	—
Lérida	492	...	2	...	10·7	...	—	...	—	...	—
Balaguer	755	...	3	...	15·7	...	—	...	—	...	—
Berga	2362	...	1	...	36·1	...	—	...	—	...	—
Olot	994	...	2	...	40·3	...	—	...	—	...	—
ARAGON AND NAVARRE—											
Teruel	3005	...	5	...	15·1	...	—	...	—	...	—
Molina de Aragon	3465	...	2	...	19·7	...	—	...	—	...	—
Zaragoza	656	...	22	...	13·0	...	22·2	...	8·5	...	2·6
Barbastro	1037	...	2	...	17·7	...	—	...	—	...	—
Huesca	1598	...	20	...	22·1	...	33·8	...	13·6	...	2·5
Jaca	2690(?)	...	1	...	27·2	...	—	...	—	...	—
Logroño	1220	...	2	...	15·4	...	—	..	—	...	—
Pamplona	1532	...	2	...	25·4	...	—	...	—	...	—
OLD CASTILE AND LEON—											
Oña	1906	...	1	...	19·1	...	—	...	—	...	—
Búrgos	2822	...	21	...	21·5	...	30·6	...	12·6	...	2·4
Soria	3504	...	18	...	25·7	...	34·2	...	16·8	...	2·0
Valladolid	2346	...	22	...	12·7	...	17·4	...	5·6	...	3·1
Palencia	2461	...	1	...	15·7	..	—	...	—	...	—
Leon	2789	...	6	...	16·7	...	—	...	—	...	—
Salamanca	2671	...	21	...	10·8	...	14·6	...	4·9	...	3·0
Segovia	3297	...	2	...	19·3	...	—	..	—	...	—
'Avila	3609	...	1	...	23·1	...	—	...	—	...	—
NEW CASTILE AND ESTRAMADURA—											
El Escorial	3018	...	4	...	27·0	...	—	...	—	...	—
Madrid	2149	...	29	...	14·9	...	23·2	...	9·1	...	2·6
Villaviciosa	2185	...	9	...	14·1	...	—	...	—	...	—
Guadalajara	2231	...	3	...	12·2	...	—	...	—	...	—
Ciudad Real	2247	...	10	...	15·9	...	26·2	...	12·1	...	2·2
Cáceres	1148	...	1	...	22·8	..	—	...	—	...	—
Badajoz	561	...	15	...	14·0	...	23·6	...	5·1	...	4·6
Valdesevilla	912	...	2	...	10·2?	...	—	...	—	...	—

We have, therefore, Castille, Murcia and Valencia, with the small rainfall of less than 16 in., and the smallest fall of all (11 in.) at Salamanca. There are three areas of heavy fall. (1.) In the Mountains of Serra d'Estrella (138 in.). (2.) About 60 in. near Cape Finistere. (3.) About the same amount on the S.W. slopes of the Pyrenees. Dr. Hellmann gives reasons for believing the astonishing records from Serra d'Estrella, but until we hear positive details respecting the gauge, and that there has been no muddle in the size

of the measuring glass (as at Stornoway), we are rather afraid that it may turn out another Coimbra. Is it not curious that it is reported to be twice as great as at any station either in the Galician Mountains or in the Pyrenees ?

The author then gives a table of the mean monthly fall, which brings out very prominently the excessive drought of the Spanish summers. There are twelve stations at which the mean yearly fall in July or August, is less than $\frac{1}{4}$ in. ; at Badajoz, the mean amounts are June 0·32, July 0·20, August 0·12. Dr. Hellmann describes so well the effects of these droughts when vegetation withers beneath a burning sun in a cloudless sky, and everything is covered with thick white dust, that he must surely have had personal experience of the weary waiting for the first of the autumn rains.

(To be continued.)

WATERSPOUTS IN THE EAST RIDING OF YORKSHIRE.

A VILLAGE INUNDATED AND CROPS DESTROYED.

About one o'clock on Saturday afternoon, June 9th, whilst a party of engineers (forming the Government survey for Yorkshire) were out in the neighbourhood of Langtoft, about eight miles N. of Driffield, they observed what appeared to be a dense cloud of smoke approaching from the sea. Driven furiously by the wind, it suddenly burst close to the village, and appeared to sweep everything before it. The water was observed rolling down the hill into the village like a dark brown wall, and many of the people were seized with panic. It was the villagers' dinner-hour, and some having their doors open, the flood rushed in, and in a moment, almost, the cottages were deep in water, the smaller articles of furniture being set afloat and swept out of the rooms. The flood came in such swirling force that many people were obliged to hold by the doors or something firm to prevent their being carried away. Great alarm was occasioned amongst the inhabitants, as the place was quickly flooded, the women and children having to seek refuge from the inrushing waters in the upper rooms of their houses, which were three and four feet deep at the base.

The waterspout caused immense destruction to the field where it fell, ploughing three huge holes seven feet deep, and denuding this and other fields of nearly all the surface soil. The farms of Messrs. Savile, Featherstone, Wilson, and Shipley suffered most ; seven acres of turnips in one case were washed away, and cereal crops were also largely spoilt. Hundreds of tons of soil, boulders, and gravel are said to have been rooted up and carried down with the flood, strewing the village streets and the highways in their progress with an admixture of these substances. Much land was completely bared to the rock and will be a great loss to the occupiers. A field gate

was washed away and travelled a distance of over a hundred yards before its progress was stopped at a bridge. The villagers' gardens are in some instances wasted by the washing away of soil, and the produce and seedlings were also destroyed. A grass field in the occupation of Mr. Sharp may now be seen covered with a deposit of soil by the action of the waterspout, and it will not be of much service this year.

The Rev. T. D. Speck, Vicar of Langtoft, stated that he tasted the flood water and found it salt, so that it would appear to have come from the sea, which is probably fifteen miles distant from the village; or the salt taste may be accounted for by the fact that one of the damaged fields had recently been covered with coarse salt manure.

When the flood subsided towards Saturday night, it was necessary to clear the streets of the deposited mud and stones. Some of the boulders found in the streets weighed several stones each, and had been carried a long distance.

There was a similar flood some 30 years ago, but it did not cause anything like so much destruction as this has done.

Another, nearly simultaneous, destructive waterspout is reported from the same district, the locality being seven miles S.W. from Langtoft, where the one above reported caused so much damage, namely, at Towthorpe, near Fimber, on the Malton and Driffield Railway. The area of destruction was more confined than in the Langtoft waterspout, this descended with great force upon a field of turnips on the farm of Mr. Farthing, the result being total destruction of the crop, and the laying bare of the field to the chalk rock. The waterspout also washed up the posts and rails (along with soil) forming part of the fencing, drove the water out of the ponds and filled them up with the soil it had carried from the field. The weight of water also forced large holes in the field, as at Langtoft. The damage will be very considerable, and the field will be valueless except for chalk. The waterspout fell about the same time as at Langtoft—between noon and one o'clock—and is described as of a conical shape, or as an eye-witness graphically put it, "Like Sir Tatton Sykes's monument coming down the wrong way up."

Further information from reliable sources (whilst confirming the particulars already published) is to the effect that the phenomenon was observed by numbers of persons in the neighbourhood of Cottam, Sledmere, and Langtoft, and is described as being of large proportions. The column of water presented in the distance the appearance of smoke; it passed through the air at a great rate, and whilst it drifted along appeared to ascend and descend at short intervals. Until the news of its destructive character had been made known there was, however, no idea in the minds of those who witnessed it that the phenomenon was a waterspout. The flood came down the village without a moment's warning, and exclamations were heard "Oh, here's a flood coming!"

The streets of Langtoft are still in a sorry plight with the deposited mud, and men have been employed every day clearing them.—*Driffield Observer, June 16th.*

ROYAL METEOROLOGICAL SOCIETY.

The concluding meeting of this society for the present session was held on June 20th, at the Institution of Civil Engineers, 25, Great George-street, Westminster, Dr. W. Marcet, F.R.S., President, in the chair.

Mr. F. de B. Collenette, L.R.C.P., M.R.C.S., Mr. J. Ewart, M.R.C.S., Mr. F. A. Velschow and Mr. J. T. Wills, F.R.G.S., were elected Fellows of the society.

The following papers were read:—

1. "First Report of the Thunderstorm Committee." (See notice under the title "Brontology.")

2. "The Cold Period from September, 1887, to May, 1888," by Mr. C. Harding, F.R.Met.Soc. The mean temperature for each of the nine months from September, 1887, to May, 1888, was below the average, while for October there has been no corresponding month as cold during the last half century, and there have been only three colder Aprils. In London the mean temperature for the period was only 42°·4, and there has been no similarly low mean for the corresponding period since 1854-5, which will be remembered as the time of the Crimean War, and only three equally cold periods during the last fifty years. The temperature of the soil at Greenwich at 3 ft. below the surface was below the average in each month from October to April; in October and April the temperature at this depth was the coldest on record, observations being available for the last forty-two years, and in November it was the coldest for thirty-seven years.

3. "Observations on Cloud Movements near the Equator, and on the General Character of the Weather in the 'Doldrums,'" by Hon. R. Abercromby, F.R.Met.Soc. The author gives the results of observations made during four voyages across the equator and the "Doldrums," with special reference to the motion of clouds at various levels. Two voyages were across the Indian Ocean during the season of the North-west Monsoon, and two across the Atlantic in the months of July and December. The nature of the general circulation of the atmosphere near the "Doldrums" is discussed as regards the theory that the Trades, after meeting, rise and fall back on themselves; or, according to the suggestion of Maury, that the Trades interlace and cross the Equator; or as following the analogy of Dr. Vettin's experiment on smoke. It is shown that the materials at present available are insufficient to form a definite conclusion; but details are given of the general character of the weather, and of the squalls in the "Doldrums," with a view of showing what kind of

observations is required to solve this important problem. The old idea of a deep trade—with a high opposite current flowing overhead—is certainly erroneous; for there is always a regular vertical succession of the upper currents as we ascend.

REVIEW.

Meteorological Tables for West Cornwall and the Scilly Islands for 1887, *also additional tables for Falmouth,* 1871–85, with notes by W. L. Fox, F.R. Met.Soc. [Reprint from Rep. Roy. Cornwall Polytechnic Soc.]. Lake and Co., Falmouth, 1888. 8vo, 20 pages, 1 table.

We are sorry to find that Mr. Fox has given up those observations of sea temperature, which used to add largely to the value of his reports. It is rather curious that in a country surrounded by sea, and dependent on that sea for the habitability of its climate, dependent on the sea for much of its political influence, and much of its wealth, the temperature of that sea is terribly neglected. There is our Government meteorological office with its liberal endowment, and its large staff, spending its time and money over harmonic analysers and hundredths of a Fahrenheit degree of air temperature, and not (as far as we can recollect) publishing any continuous records of sea temperature. However, this rests with the council; it is no business of ours.

Mr. Fox gives the place of honour to his note on the sunshine records, and as 1887 was notable for sunshine, he is doubtless right. He shows that the mean yearly total number of hours was—

Years.....	1881	1882	1883	1884	1885	1886	1887
Hours ...	1847	1730	1615	1535	1605	1539	2074

which shows that 1887 had more than 25 per cent. in excess of the average of the six previous years. They must have had some lovely days in June, 1887, for one of them is reported to have had burning sun during 15 hours 12 minutes, as the day there cannot be much more than 16 hours even on June 21st, the sky must have been absolutely cloudless throughout.

A page or two further on are the details of the storm of March 22nd and 23rd, 1887, and this suggests a query based upon the report by Messrs. Whipple and Dines, at a recent meeting of the Roy. Met. Soc. Mr. Fox, following everybody else, gives the maximum velocity as 61 miles—this is the indication of the Beckley Anemometer reduced with the factor 3; but we now know that this is much too large; if we take it at 2·15, which was we think about the value given in the report just mentioned, the 61 miles an hour comes down to about 44!

With respect to rain he gives for the (15 years) 1872–86, the following values:—Mean 51·24, max. (1872) 64·53 min. (1884), and then adds that the 1887 total was only 29·77, this would bring the 16 years mean down to 49·90, of which the max. 1872, would be 29 per cent. in excess, and the min. 1887, 40 per cent. in defect. No wonder that, as he tells us, the drought greatly inconvenienced the residents of this neighbourhood. There was absolutely no rain for 32 consecutive days.

The pamphlet closes with an interesting and useful series of tables.

BRONTOLOGY.

FIRST REPORT OF THE THUNDERSTORM COMMITTEE.

THE Thunderstorm Committee of the Royal Meteorological Society has issued its first report, and with a promptitude worthy of imitation, has copies ready for sale. As they cost only 1s., and contain four exquisite autotype reproductions of photographs of lightning flashes, we give merely the following epitome of the report and advise those of our readers who are not Fellows of the Society to apply for copies before they are all distributed. The Fellows will eventually get a copy in the *Quarterly Journal*.

This report deals with the photographs of lightning flashes—some sixty in number—which have been received by the Society. From the evidence now obtained, it appears that lightning assumes various typical forms under conditions which are at present unknown. The Committee consider that the lightning flashes may be arranged under the following types:—(1) Stream; (2) sinuous; (3) ramified; (4) meandering; (5) beaded or chapleted; and (6) ribbon lightning. In one of the photographs there is a *dark* flash of the same character as the bright flashes; but the Committee defer offering any explanation of the same until they get further examples of dark flashes.

The Committee appeal strongly for additional photographs to explain how easily they may be obtained.

ELECTRICITY IN A LIGHTNING FLASH.

W. Kohlrausch (*Electrotechnische Zeitschrift*, March, 1888) has estimated the current and quantity of electricity in a lightning flash. He calculated that it will take 9,200 ampères to melt a copper rod of 2·5 centimètres diameter. Preece's constant (*Proc. R.S.*, March, 1888) makes it 10,244. Such a current concentrated in a flash would contain from 52 to 270 coulombs, which would decompose from 5 to 25 milligrammes of water, and generate from 9 to 47 cubic centimètres of explosive gas ($H_2 + O$). If this energy were stored up and distributed for electric lighting, it would require from 7 to 35 such flashes to keep one glow-lamp alight for an hour.

THE JUNE THUNDERSTORMS.

We do not know precisely how the Thunderstorm Committee of the Royal Meteorological Society intend to tabulate and publish the information they collect in response to their circular and appeals. We, however, feel so strongly that concentration of energy is imperative, that although we have been favoured with exceptionally full and interesting details of the damage produced by the June thunderstorms, we have sent the whole on to the Committee. It seems to us waste of strength and resources to print it here, and then for the Royal Meteorological Society to reprint it—and it seems better for it to be all in one place, than part here and part in their report. We hope that those who have so kindly forwarded to us valuable information, will approve of the course we have adopted.

THE HAILSTORMS OF JUNE 25TH.

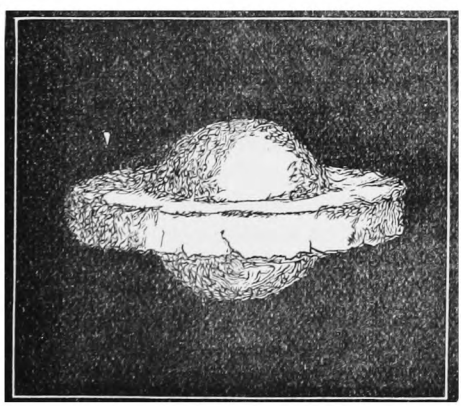
As explained under the article BRONTOLOGY, we omit here all details of the heavy thunderstorms of June, hoping that they will eventually be published by the Royal Meteorologieal Society.

That, however, in no way precludes our reporting upon the remarkable hail which fell, and the damage done by it.

We give first two letters, one from the vicinity of Guildford, and one from near Buckingham, and subsequently some shorter notes in illustration and confirmation thereof.

To the Editor of the Meteorological Magazine.

SIR,—I have only time to send you the enclosed rough sketch of *Ice Stones* which fell here yesterday afternoon, during one of the heaviest thunderstorms we have had for many years. The sketch



is not an exaggerated one, but for your information. My coachman and gardener went out and gathered up some, and five filled the

gardener's hands. The hail stones were very large and my garden was soon white. The fall of water (rain) was ·94 in. in about two hours. There appeared three storms going on at the same time, and we were in the centre. The flashes were most peculiar, two following each other quickly and the thunder at once. The report was like the breaking of a lot of heavy sticks. Damage around, I hear, was great.—Yours sincerely,

E. W. MATHEW.

Wern, Guildford, 26th June, 1888.

To the Editor of the Meteorological Magazine.

SIR,—Late at night though it is, I must tell you what a very destructive hail storm has passed over North Bucks, but which fortunately did not touch us at all. The day has been extremely hot (max. 82°). It began to thunder between one and two o'clock. When standing in the park just after two o'clock, I heard a wonderful and continuous rushing sound to the north, passing from east to west, the clouds of an inky blackness. I observed to those near me that there must be a heavy hail storm passing in that direction. The sound lasted for a quarter of an hour or twenty minutes and then died away; we had not a drop of rain nor any hail. This evening I took a walk into the course of the storm, and I never saw such complete destruction of crops. The village of Adstock, about a mile north of us, suffered a little, a few squares of glass being broken, but every step I took going north, evidence of the storm increased, the road being covered with leaves and twigs of trees. About a mile from that village I came upon many large elm and ash trees rooted up, some broken in two and large limbs carried 50 and 60 yards into the fields. Beans, potatoes, and wheat utterly ruined by the hail, which I found run into great heaps. I could have collected bushels of the hailstones as large as blackbird's eggs, and that at half-past eight in the evening. I was told by those on the spot that the hailstones were the size of guinea fowls' eggs, and I could well believe it. One farm house I called at, had almost every square of glass broken and everything in the garden utterly wrecked. I did not go so far as the village of Thornborough, which is three miles from here, but I am told it has suffered even to a greater extent than what I have seen, and so has Padbury, all places near to us. I fancy your station, Adstock Fields, must have had a good share of it.

I have not had time nor opportunity to get information as to damage done, but what I saw this evening is enough to stamp it as the most destructive storm that has visited this part. The storm we had on the 10th of May, 1867, did more damage to property, but not to growing crops, for they were not so far advanced. No doubt you will get full accounts of this storm from other sources. I

may add that I carried home some hailstones in my pocket handkerchief, and found them three-quarters of an inch in diameter seven hours after they fell.—I am Sir, yours truly,

JOHN MATHISON.

Addington, Winslow June 25th.

Guilford.—At Box Grove House, Clandon, about 800 square feet of glass were broken. At the lodge to the Earl of Onslow's at Merrow nearly every pane was broken. At Glebe House, Box Grove, much glass was broken. At Warplesdon and Sutton an exceptional storm. Hailstones larger than pennies, of irregular shapes, some quite flat. Mangolds were washed completely out of the soil. Trees were entirely stripped of their foliage, and even branches lopped off by the violence and weight of the hail. The country roads in places impassable from the rain and washed-up soil.

Box Hill.—Hail very large.

Farnham.—Hail large, especially at Tongham, and much flooding.

Woking.—Hail as large as ordinary lumps of sugar.

Haslemere.—Water in the streets 3ft. deep; a drain opposite the "White Lion" burst from internal pressure.

Leatherhead.—At East Horsely the storm was exceptionally heavy, and the hail as large as hazel nuts.

St. Albans (*The Grange*).—Very heavy rain, especially about 7.40 p.m., on 26th. Total between 7 p.m., and 4 a.m. (27th), 2·40 in. At Rothamstead the 5 in. gauge collected 3·25 in.; the other gauges were allowed to run over!

Gloucestershire.—At Coleford the rainfall was so heavy that at the Lindars the flood ran through the house some feet deep. At Tintern also, on the other side of the Wye, some houses are stated to have had in them from 6ft. to 8ft. of water.

HEAVY SNOWSTORM IN CORNWALL.

The *Daily News* of June 14th gave the following paragraph:—"A snowstorm in Cornwall in the middle of June is almost unprecedented, but yesterday some parts of the county were visited by a fall of snow and hail which covered the ground for a considerable distance to a depth of about an inch. The morning was beautifully fine and warm, but towards noon heavy clouds covered the sky, and these were followed by pelting showers of rain, accompanied by loud peals of thunder and vivid flashes of lightning. The atmosphere suddenly became bitterly cold as if it were midwinter, and the rain was succeeded by hail and snow, which fell uninterruptedly for more than an hour. In the neighbourhood of Callington the hailstones were so large, and fell with such force, that twigs were cut clean off the trees. Fortunately, no hail fell in the fruit-growing districts, and the fruit crops have escaped injury."

A FURTHER CORRECTION FROM MR. VELSCHOW.

To the Editor of the Meteorological Magazine.

SIR,—In your issue for June, my diagram has been made somewhat unintelligible by having got the peculiar heading "Inches of Mercury." On the corrected proof, these two words are placed alongside of the figures at the top of the diagram, and a star is attached to indicate that they refer to the column in my table from Langley, with the heading, "Weight of vapour in inches of mercury."

Also in the table you have reprinted from Williamson, is a grave error. The bottom figures in the 7th column from the left should be ·255, ·236; instead of ·236, ·160.

Yours &c.,

F. A. VELSCHOW.

53, *Parliament Street, S. W., London, July 7th*, 1888.

[Mr. Velschow might have added that the table is reprinted verbatim from Williamson, with whom, and not with us, the misprint lies; and as regards the heading to the diagram, Mr. Velschow himself on the proof erased the very words he now uses. ED.].

ERRATA IN *METEOROLOGICAL MAGAZINE*, 1887.

REGULAR TABLE.

Hunton Court	Dec.	*should be*	1·83 in.	Haverfordwest	Jan.	*should be*	5·79 in.
Leicester.....	Mar.	,,	1·78 ,,	Braemar	Sept.	,,	2·98 ,,
Ardwick	Feb.	,,	·79 ,,				

Wolstaston	*difference from average*			Dec.	*should be*	+	·14
Orleton	,,	,,	,,	,,	,,	—	·08
Ribston	,,	,,	,,	Mar.	,,	—	·66

SUPPLEMENTARY TABLE.

Bloxham	Oct.	*should be*	2·42 in.	NewcastleWest	Mar.	*should be*	·63 in.
Stowell Rec....	Sept.	,,	2·44 ,,	Currygrane ...	April	,,	1·55 ,,
Lydeard House	May	,,	2·74 ,,	,,	Sept.	,,	3·09 ,,
Lancaster	Nov.	,,	2·76 ,,	Cushendun.....	Feb.	,,	2·19 ,,
Glenlee	Jan.	,,	6·88 ,,				
,,	Oct.	,,	2·50 ,,				

We are sorry for the length of the above list; 18 errors in 1,680 entries, or 1 entry wrong in 94, is too bad—and for only three out of the eighteen can we plead guilty. We hope that all our correspondents (to whom we are greatly indebted) will strive to avoid appearing in this list next year.

SUPPLEMENTARY TABLE OF RAINFALL, JUNE, 1888.

[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	3·55	XI.	Castle Malgwyn	3·26
,,	Margate, Birchington...	1·55	,,	Rhayader, Nantgwillt..	3·29
,,	Littlehampton	2·82	,,	Carno, Tybrith	3·10
,,	Hailsham	2·71	,,	Corwen, Rhug	2·65
,,	Ryde, Thornbrough	3·05	,,	Port Madoc	3·82
,,	Alton, Ashdell.....	2·22	,,	I. of Man, Douglas	2·33
III.	Oxford, Magdalen Col...	3·19	XII.	Stoneykirk, Ardwell Ho.	3·07
,,	Banbury, Bloxham	2·42	,,	New Galloway, Glenlee	4·10
,,	Northampton	1·47	,,	Melrose, Abbey Gate...	2·71
,,	Cambridge, Beech Ho...	1·64	XIII.	N. Esk Res. [Penicuick]	2·05
,,	Wisbech, Bank House..	1·35	XIV.	Ballantrae, Glendrishaig	3·21
IV.	Southend	2·28	,,	Glasgow, Queen's Park.	2·03
,,	Harlow, Sheering	3·00	XV.	Islay, Gruinart School..	2·98
,,	Rendlesham Hall	1·46	XVI.	St. Andrews, Pilmour Cot	2·22
,,	Diss	2·09	,,	Balquhidder, Stronvar..	4·32
,,	Swaffham	1·02	,,	Dunkeld, Inver Braan..	3·49
V.	Salisbury, Alderbury...	2·33	,,	Dalnaspidal H.R.S. ...	3·52
,,	Warminster	3·15	XVII.	Keith H.R.S.	2·65
,,	Bishop's Cannings	4·60	,,	Forres H.R.S.	1·27
,,	Ashburton, Holne Vic....	4·11	XVIII.	Strome Ferry H.R.S....	1·64
,,	Hatherleigh, Winsford.	3·43	,,	Fearn, Lower Pitkerrie.	2·31
,,	Lynmouth, Glenthorne.	2·47	,,	Loch Shiel, Glenaladale	4·05
,,	Probus, Lamellyn	3·24	,,	S. Uist. Ardkenneth ...	1·80
,,	Launceston, S. Petherwin	3·38	,,	Invergarry	1·24
,,	Wincanton, Stowell Rec.	3·17	XIX.	Lairg H.R.S.	...
,,	Taunton, Lydeard Ho...	2·80	,,	Forsinard H.R.S.	2·35
,,	Wells, Westbury.....	3·01	,,	Watten H.R.S.	1·73
VI.	Bristol, Clifton	4·00	XX.	Dunmanway, Coolkelure	5·55
,,	Ross	2·72	,,	Fermoy, Gas Works ...	3·95
,,	Wem, Clive Vicarage ...	2·27	,,	Tipperary, Henry Street	3·18
,,	Cheadle, The Heath Ho.	3·26	,,	Limerick, Kilcornan ...	3·67
,,	Worcester, Diglis Lock	2·36	,,	Miltown Malbay.....	4·20
,,	Coventry, Coundon	1·89	XXI.	Gorey, Courtown House	4·50
VII.	Melton, Coston	2·43	,,	Navan, Balrath	3·90
,,	Ketton Hall [Stamford]	1·55	,,	Mullingar, Belvedere ...	4·48
,,	Horncastle, Bucknall ...	1·68	,,	Athlone, Twyford	4·51
,,	Mansfield, St. John's St.	2·49	,,	Longford, Currygrane...	5·01
VIII.	Knutsford, Heathside ...	2·19	XXII.	Galway, Queen's Coll...	4·67
,,	Walton-on-the-Hill.....	2·12	,,	Clifden, Kylemore	4·46
,,	Lancaster, South Road.	1·90	,,	Crossmolina, Enniscoe..	5·14
,,	Broughton-in-Furness ..	1·86	,,	Collooney, Markree Obs.	5·49
IX.	Shipley, Esholt Vic. ..	2·64	XXIII.	Rockcorry.....	3·77
,,	Ripon, Mickley	2·53	,,	Warrenpoint	3·40
,,	Scarborough, West Bank	2·54	,,	Seaforde	5·11
,,	East Layton [Darlington]	2·10	,,	Belfast, New Barnsley .	4·65
,,	Middleton, Mickleton ..	1·98	,,	Cushendun	3·15
X.	Haltwhistle, Unthank..	3·32	,,	Bushmills	2·61
,,	Shap, Copy Hill	1·50	,,	Stewartstown	5·38
XI.	Llanfrechfa Grange	3·82	,,	Buncrana	4·67
,,	Llandovery	4·29			

JUNE, 1888.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1870–9	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) ...	2·31	— ·36	·60	26	20	84·7	25	43·9	18	0	0
II.		Maidstone (Hunton Court)...	2·77	+ ·70	·46	13	17	...	...	...	...	...	...
,,		Strathfield Turgiss	2·47	+ ·37	·43	21	17	80·3	3	36·8	18	0	1
III.		Hitchin	1·98	— ·15	·75	26	18	78·0	25	44·0	30	0	...
,,		Winslow (Addington)	1·92	— ·59	·43	27	17	82·0	25	35·0	18	0	0
IV.		Bury St. Edmunds (Culford)	1·59	— ·68	·35	27	12	86·0	25*b*	36·0	1	0	...
,,		Norwich (Cossey)	1·31	— ·91	·42	21	13	85·0	4	38·0	14	0	...
V.		Weymouth(LangtonHerring)	3·15	...	·81	5	16	72·0	25	44·0	18	0	...
,,		Barnstaple.....	2·79	+ ·07	·59	5	15	78·0	26	39·5	14	0	...
,,		Bodmin	3·72	+ ·51	·81	7	18	74·0	25	41·0	14	0	0
VI.		Stroud (Upfield)	3·27	+ ·89	·79	21	14	80·0	25	41·0	18	0	...
,,		ChurchStretton(Woolstaston)	2·08	— ·79	·42	27	17	72·0	27	40·0	20	0	0
,,		Tenbury (Orleton)	3·21	+ ·47	·57	27	16	79·5	25	37·2	13	0	0
VII.		Leicester (Barkby)	1·79	— ·72	·55	20	15	84·0	26	34·0	13*d*	0	4
,,		Boston	1·33	— ·92	·35	8	11	90·0	26	42·0	18	0	...
,,		Hesley Hall [Tickhill].....	2·25	...	·72	9	16	82·0	26	38·0	18	0	...
VIII.		Manchester (Ardwick).....	3·13	— ·03	·84	27	15	82·0	26	43·0	6	0	...
IX.		Wetherby (Ribston Hall) ...	1·71	— 1·16	·34	3	9	...	...	...	...	...	...
,,		Skipton (Arncliffe)	3·89	+ ·07	1·38	9	15	88·0	27	34·0	14	0	...
,,		Hull (People's Park)	1·81	— ·46	·48	2	17	...	...	...	...	...	...
X.		North Shields	1·92	— ·11	·54	2	15	70·5	11	37·2	5	0	0
,,		Borrowdale (Seathwaite).....	2·35	— 5·46	·65	12	11	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	3·60	+ ·54	·70	21	18	...	...	...	...	...	...
,,		Haverfordwest	3·53	+ ·50	·95	5	20	79·0	25	37·0	13	0	2
,,		Plinlimmon (Cwmsymlog) ...	4·16	...	1·00	27	18	...	...	...	...	...	...
,,		Llandudno.....	2·51	+ ·51	·79	27	18	76·8	25	43·0	14	0	...
XII.	SCOTLAND.	Cargen [Dumfries]	1·60	— 1·57	·47	2	12	85·0	26	35·8	5	0	...
,,		Jedburgh (Sunnyside).....	2·65	+ ·25	·87	28	12	76·0	26	33·0	5	0	...
XIV.		Old Cumnock	1·77	— 1·15	·36	2	12	86·8	25	30·0	29	2	...
XV.		Lochgilphead (Kilmory).....	4·34	+ ·50	2·05	11	13	...	...	...	...	...	...
,,		Oban (Craigvarren)	3·85	...	1·11	2*a*	11	82·1	25	37·0	5	0	...
,,		Mull (Quinish).....	3·55	...	1·47	11	9	...	...	...	...	...	...
XVI.		Loch Leven Sluices	2·50	— ·27	1·00	3	8	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	2·30	— ·36	·95	2	8	76·2	26	34·6	5	0	...
XVII.		Braemar	2·75	— ·34	·71	3	10	77·0	25	26·3	6	3	12
,,		Aberdeen	2·57	...	1·01	3	10	70·0	26	30·0	4	1	...
XVIII		Lochbroom	1·33	...	·30	10	10	...	...	...	...	...	...
,,		Culloden	1·32	— ·93	...	...	...	78·0	26	32·0	6	1	8
XIX.		Dunrobin	2·40	...	·88	3	9	68·0	26	34·0	2, 5	...	...
,,		Kirkwall (Swanbister).....	...	...	...	...	...	...	...	...	...	...	...
XX.	IRELAND.	Cork (Blackrock).....	4·80	+ 1·25	1·61	11	17	76·0	18*c*	38·0	13	0	..
,,		Dromore Castle	3·41	...	1·45	11	19	78·0	24	43·0	9	0	...
,,		Waterford (Brook Lodge) ...	4·61	...	1·60	5	16	72·5	18	38·0	14	0	...
,,		O'Briensbridge (Ross)	4·57	...	1·73	5	19	78·0	25	42·0	14	0	...
XXI.		Carlow (Browne's Hill)	3·72	+ 1·06	·98	5	18	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	3·04	+ ·84	·95	27	18	72·4	26	43·2	14	0	0
XXII.		Ballinasloe	4·55	+ 1·36	1·58	5	18	70·0	25	40·0	10	0	...
XXIII		Waringstown	4·15	+ 1·49	1·50	27	15	84·0	26	39·0	13	...	...
,,		Londonderry (Creggan Res.).	3·65	...	·93	11	17	...	...	...	...	...	...
,,		Omagh (Edenfel).....	5·34	+ 2·29	1·40	27	15	79·0	25	42·0	17*e*	0	...

a And 10. *b* And 26. *c* And 23, 24. *d* And 17, 20. *e* And 30.
+ Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON JUNE, 1888.

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.—Crops about a fortnight late. The colour of the wheat was excellent. Hay was light and the making was much interfered with by R. Severe TS on the 25th, many trees were destroyed and a cow was killed at Rotherwick; T on five other days and L on two. Butterflies and caterpillars were abundant.

ADDINGTON.—A good deal of cold, unsettled weather was experienced. The much needed R rapidly improved all kinds of crops, which were not looking well at the end of May. The destructive H storm on the 25th, which we just escaped, did much damage in the neighbourhood. All kinds of crops in the track of the storm were completely destroyed, numbers of large trees were uprooted and many were broken in two, the tops being carried some distance. The centre of the storm seemed to be about two miles N. of this station. Dense fog at night on 6th; heavy T with H and R on 14th; T on 21st and 28th also. Hay was cut on 22nd.

CULFORD.—T was frequent and much dull weather prevailed.

LANGTON HERRING.—R 1·14 in. above the average of 13 years and a striking contrast to that of June, 1887. Mean temp. at 9 a.m. 1°·9 below the average of 16 years, the tenth month in succession with temp. below the average. The rains in the early part of the month produced an unusually rapid growth of grass, and there was a heavy hay crop, but the weather was variable for carrying it. On many days there were fogs. T and L on 24th.

BODMIN.—A cold month with much R. Mean temp. 59°.

WOOLSTASTON.—A cold, cheerless, and very backward month, with constant E. winds. Mean temp. 55°·5.

ORLETON.—With the exception of a few days in the first week the weather was generally cloudy, showery, and cold, with winds from N. or E. till the 25th, when it suddenly became warm and continued so for several days, with distant T and much R. The mean temp. till the 25th was lower than that of any June for 30 years, and the mean of the month was 3° below the average of 27 years. Pressure was low throughout, but not subject to rapid changes. T on 13th, 14th, 21st, and 25th; L on 2nd and 21st; solar halo on 19th; dense fog on 30th.

BARKBY.—The direction of the wind for the first few days was W. or S.W., then for nearly three weeks it was N.E. We just missed two heavy H storms. The weather was generally cold and there was a scarcity of water. Vegetation generally was rather backward, and there was some blight. Hay harvest commenced during the last week. T on 6 days.

MANCHESTER.—The month opened with a fall of much needed R. The water supply had got very low, and in some places in Lancashire much inconvenience was felt, but the R in the early part of the month and at its close brought relief to a certain extent. Temperature was very low, except for a few days towards the close. The total R for the six months was only about two-thirds of the average for Manchester. TS on 13th.

HULL.—The weather was remarkable for the prevalence of cloud, with frequent, though generally slight showers, and often with cold winds.

WALES.

HAVERFORDWEST.—A sudden change succeeded the fine summer weather of the last week of May, and unsettled and cold wet weather prevailed throughout the month, the only exception being the very hot, fine days from 23rd to 29th; hay was abundant, but difficult to save; corn crops were luxuriant. No TS occurred.

SCOTLAND.

CARGEN.—The most striking characteristics of the month were the unusual prevalence of easterly winds (22 days), the low mean temperature, and a deficiency again in the R. E. winds prevailed continuously for the last 15 days, accompanied by an unusually low night temperature. The mean temp. was 2°·4 below the average, and, but for a few exceptionally hot days at the close, would have been considerably lower. The max. temp. (85°) has been exceeded only six times during 28 years. The average R for the first six months of the year is 19·72 in., and this year the fall has been only 12·26 in. T and L on 9th and 14th.

JEDBURGH.—Very cold, wind mostly E., N.E., or N., but vegetation well forward. The E. winds affected the turnip crop considerably, but the R at the close did much good. Tree fruit blossom was slightly affected. The corncrake was not heard during the month. T heard on 9th; white butterfly and wasp seen on 9th.

OBAN.—The early part of the month was very cold and unseasonable, with much R and broken weather, but from the 15th to the close there was constant sunshine, giving on the 25th the highest temperature known here for 30 years. All grass was sunburnt and for six days a constant E. wind blew, sometimes in heavy hot squalls, a phenomenon quite unusual in this district.

QUINISH —From 1st to 14th very cold and stormy; from 14th to the end very dry with great heat.

LOCHBROOM.—The month began with heavy S on the heights on 2nd and 3rd; it then improved until the 12th, which was a boisterous day. From 15th to the close it was cloudless and rainless, with great heat by day and cold frosty air at night. Grass was nearly burnt up and grain and crops were making no progress for want of R at the close, and in many places a scarcity of water was experienced.

CULLODEN.—Most of the month was exceedingly dry, with strong, cold E. winds, frosty air at night, and no T.

IRELAND.

BLACKROCK.—Showery and cold to the 16th, with mean temp. 56°·5; then fine and mostly bright to the 20th, after which there were frequent showers, and it was at times gloomy and misty. Vegetation was very luxuriant. Mean temp. 58°·4. T on 2nd.

DROMORE.—Very fine. All sorts of crops were in a flourishing condition at the close.

WATERFORD.—Mean temp. 54°·8. R 2·05 in. above the average; T on 2nd and 21st; thick fog on 25th.

O'BRIENSBRIDGE.—Very heavy R in the first fortnight was followed by fine summer weather. The air seemed in a highly electrical condition on 24th, 25th, and 26th, but there was little T or L. Very heavy R fell one mile to the north of this station on 29th, but there was none here.

DUBLIN.—A marked contrast to June, 1887, which will be long remembered as one of the driest and warmest months on record in Dublin. The only meteorological factor which corresponded in the two Junes was the direction of the wind, there being a singular preponderance of polar winds in each. But for a bright period in the third week the month would have been a singularly cheerless one. Mean temp (56°·2) 1°·6 below the average. The coldest Junes in 23 preceding years were in 1882 and in 1879, with mean temp. 55°·8. Temp. reached 70° on only one day. Luminous cirri were seen on the northern horizon on the 15th and 26th. Fog on 2nd; TS on 2nd; solar halo on 20th; high winds on five days. Mean humidity 81; mean amount of cloud 6·6.

EDENFEL.—The month was somewhat remarkable. By the 14th the average R had been reached; then followed 12 clear, warm, rainless days, succeeded by a fall of 2·28 in. of R in 36 hours on 27th and 28th. Vegetation of all kinds was unusually luxuriant at the close.

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RAINFALL OF SPAIN AND PORTUGAL.

(Continued from page 84.*)*

BEFORE proceeding with our notes on Dr. Hellmann's memoir, we have the pleasure of inserting the following letter from Señor Capello respecting the extraordinarily large rainfall reported from Serra da Estrella. It is one of the most curious coincidences which has occurred in meteorology that just when it has been proved that Coimbra, which used to be quoted as having 119 or 224 inches per annum has really only 35 inches, another station, not 50 miles from it, is found with a rainfall of nearly 150 inches, or between two and three times as much as anywhere else in Spain or Portugal. We hope that our Portuguese friends, now that they have proved the existence of one spot beating our English Seathwaite and running even the Stye very close, will take the matter seriously in hand, and do as we have done, establish daily gauges in the surrounding villages, and monthly ones on the mountains, and give to the world full details of the rainfall of this exceptional district.

To the Editor of the Meteorological Magazine.

SIR,—I have just seen (in the notice of Dr. Gustav Hellmann's magnificent treatise on the "Rainfall of the Peninsula,") in your monthly *Meteorological Magazine*, that you have some doubts as to the accuracy of the returns from Serra da Estrella. I hasten to forward you the following values:—

	Total yearly fall. in.		Max. fall and date. in.
1882	165·67*	.....	7·99 October 27th
1883	120·81	.....	4·88 April 26th
1884	108·60	.....	10·79 January 28th
1885	170·48	.....	6·57 November 25th
1886	184·29	.....	11·50 March 4th

You will see that the fall in 1885 and 1886 was even greater than in the earlier years, and that in a single day at Serra da Estrella

* 11 months, February to December.

more rain falls than at some stations in the interior of Spain during a whole year.

The rain gauge is one of Babinet's, of the usual pattern, 8·89 in. in diameter, corresponding to an area of four decimetres. The measuring glass holds a litre, corresponding, therefore, to 25 millimetres (say one inch).

We were at first afraid that there must be some error in the observations, but all was cleared up some time since. We placed two similar gauges about two miles apart, and they were read every third day, and the quantities were practically identical at the two stations.

I can, therefore, assure you that however excessive the above figures may appear, they are accurate.—Yours truly,

J. CAPELLO.

Observatoire de Don Luiz, Lisbon, July 24th.

We pass over Dr. Hellmann's remarks on the distribution of rain during the 24 hours, because of the shortness of the period on which he has had to rely and of the paucity of the stations, only three in the whole Peninsula.

The author then proceeds to give valuable data for thirty of the longest-established stations, namely, the greatest and least monthly, and greatest and least yearly, totals at each. The monthly minimum is *nil* at almost every station; the monthly maxima are always, in the winter half-year, generally in December or January, and range from 6 in. to 25 in. (25·20 in. at Granada in November, 1858).

After giving the actual values of the wettest and driest year at each station, Dr. Hellmann gives the same values expressed as ratios of the yearly mean at each station. He does not seem to have discussed these results very fully, and his remarks are chiefly directed to the inconvenience to agriculture arising from a rainfall which at one station was, in one year, five and a half times greater than in another. This *per se* is certainly a very alarming figure; the actual values are—

	Max.			Min		Ratios.		M
	Amount.	Year.	Mean.	Amount.	Year.	Max.	min.	m
Sevilla	34·65	1881	16·14	6·30	1874	2·15	·39	5·5

But this is the only case exceeding five times; there are (counting the above) three exceeding four times, and nine exceeding three times—which is about the greatest ever found in the British Isles. Finally we offer the following conclusions which may be acceptable as approximations to the truth :—

(1). The rainfall in the wettest year is generally 60 per cent. above the mean, but may be only 14 per cent. above it, or may be 119 per cent. above it, *i.e.*, may be more than twice the mean amount.

(2). The rainfall in the driest year is generally 44 per cent. below the mean, but may be only 24 per cent. below it, or may be 64 per cent. below it, *i.e.*, may be little more than one-third of the mean amount.

(3). Generally the widest extremes are at the dry stations.

Dr. Hellmann has done all that is possible towards ascertaining the nature and amount of secular change in the rainfall of the Peninsula, but he has not data enough; there are but four stations available, and of these the longest is but for 35 years, and one is only for 25 years.

Droughts.—Of course they get some terrible droughts in Spain and Portugal, and the author gives valuable tables of droughts of 15 days and upwards at San Fernando and at Madrid.

Max. falls in 24 hours.—This subject is treated by the author as fully as the others, but we are not certain that the data are in all cases absolutely indisputable. There are, we believe, few countries where the observers are more careful than they are in the British Isles, yet we constantly detect them in entering as the fall on one day the accumulation of two or three during which they have been absent. This makes grand values for max. fall in 24 hours, but of course the record, while quite right as part of the total for the year, is worse than useless—deceptive for a max. in 24 hours. However this may be, the values are not often remarkable; there are only six stations at which the max. exceed 5 inches, viz.:—

Vizeu,	February 2, 1880, 5·08 in.	Tarifa, January 28, 1881, 6·42 in.	
Carcagente,	November 17, 1855, 5·43 in.	Granada,	(?) 1858, 7·91 in.
Salamanca,	September 7, 1882, 5·79* in.	Serra da Estrella	Oct. 27, 1882, 7·99 in.

As regards heavy falls in short periods, Dr. Hellmann finding himself confronted with the remarkable record of 33 in. in 26 hours at Gibraltar in November 1826, has not confined his table to Spain and Portugal, but has given all the most noteworthy reports for South Western Europe. We do not recollect ever seeing such a collection, and have not only converted the values as given in his table, but have also re-arranged the entries so that they may be readily compared with the data given annually under the heading of "Heavy rains in short periods" in *British Rainfall*. This is essential if the facts are to be thoroughly grasped, because the importance of a rainfall does not depend alone on either duration, or rate per hour—let us take two imaginary cases,

Rain, 9 a.m. to noon ...	3·20 in.,	rate per hour, 1·06 in.
,, 9 a.m. to 6 p.m. ...	7·32 in.,	,, ,, ,, ·81 in.

the former gives the higher rate, but the latter is the more remarkable fall, because a high rate was kept up for a long period.

* More than in the whole year 1875, which gave only 4·88 in. Moreover, this 5·79 in. was 41 per cent. of the total for 1882.

Heavy falls of rain in less than 48 hours in South Western Europe.

Station and Country.	Date.	Duration	Total.	Rate per Hour.
		H. M.	in.	in.
Lagarde, Vaucluse, France	4 July, 1876	10	1·18	7·09
Savoillans, Vaucluse, France	10 July, 1884	15	1·69	6·77
Marseilles, France	21 Sep., 1839	25	1·60	3·82
Perpignan, Pyrenees O., France	21 May, 1859	45	2·21	2·95
Bollène, Vaucluse, France	8 Sep., 1879	1 0	4·53	4·53
Avignon, France	3 Sep., 1884	1 0	3·01	3·01
Molitg, Prades, Pyrenees O., France	20 May, 1868	1 30	12·32	8·22
Perpignan, Pyrenees O., France	29 Aug., 1855	1 30	5·32	3·54
Perpignan, Pyrenees O., France	18 Oct., 1876	1 30	4·57	3·04
Montpellier, France	26 Nov., 1868	1 30	2·56	1·70
Orange, Vaucluse, France	20 July, 1883	2 0	5·81	2·91
Montpellier, France	11 Oct., 1861	2 0	3·74	1·87
Orange, Vaucluse, France	8 Aug., 1877	4 0	4·49	1·13
Montpellier, France	26 Sep., 1857	6 0	5·12	·85
Montpellier, France	11 Oct., 1862	7 0	9·17	1·31
Reggio, Calabria, Italy	20 Oct., 1880	7 30	8·08	1·08
Malaga, Spain	17 Dec., 1876	10 0	5·28	·53
Viviers, Ardèche, France	26 Sep., 1801	18 0	13·57	·78
Joyeuse, Ardèche, France	9 Oct., 1827	22 0	31·18	1·42
Genoa, Italy	25 Oct., 1822	24 0	31·97	1·33
Le Bleymard, Lozère, France	13 Sep., 1885	(24)	15·75	·66
St. Gervais, Hérault, France	17 Oct., 1874	(24)	9·84	·41
Pont-de-Monvert, Lozère, France	13 Sep., 1885	(24)	9·45	·39
Notre Dame des Neiges, Lozère, France	8 Oct., 1878	(24)	9·13	·38
Gette, Hérault, France	13 Sep., 1885	(24)	9·06	·38
Vialas, Lozère, France	8 Oct., 1878	(24)	8·70	·36
Villefort, Lozère France	8 Oct., 1878	(24)	8·66	·36
Granada, Spain	1858	(24)	7·88	·33
Gibraltar, Spain	25 Nov., 1826	26 0	33·00	1·27
Carcagente, Valencia, Spain	21 Oct.. 1843	30 0	15·75	·52
Carcagente, Valencia, Spain	4 Nov., 1864	33 0	11·89	·36
Carcagente, Valencia, Spain	7 Dec., 1853	42 0	19·69	·47

It would be too discursive to make this table the base of a thorough consideration of the probable maximum fall of rain to be expected in extra tropical countries; but looking at the havoc constantly wrought by the so-called "bursting of a waterspout," "breaking of a cloud," &c., we see no reason why if a rain gauge were precisely at the site of greatest fall 24 to 36 in. should not be measured.

It is unfortunately very rare for engineers or surveyors to investigate these cases, in fact the only one that we remember was on Black Hambledon, in Yorkshire (*British Rainfall*, 1870); and when a surveyor does examine a case he can give us only the total fall over certain areas, not the amount at individual spots in those areas.

We hear often of holes being torn in the ground, even on the flat 10 ft. diameter, and 4 ft. or 5 ft. deep. It would require a good many inches of rain to do that. While, therefore, we are always on the look out for mistakes of decimal points, for leaks into gauges, and for other sources of error, we hesitate to refuse credence to amounts which most persons would laugh at. Perhaps we are the more ready to believe these amounts because we have ourselves measured in London the following values :—

Time	1 Min.	5 Min.	15 Min.	30 Min.
	in.	in.	in.	in.
Amount ...	0·17	0·56	1·43	2·32
Rate per hour ...	10·20	6·72	5·72	4·64
Rate per day *...	244·80	161·28	137·28	111·36

However, we must pass to Dr. Hellmann's cases. The highest rate is that reported from Molitg. We have had the pleasure of visiting that little paradise, nestled amid the mountains of the Eastern Pyrenees, and conversing with Dr. Massia, the son of the observer who measured this fall in 1868, and are sure that the observation may be accepted as perfectly correct.

We feel much more hesitation over the enormous *daily* totals in the preceding list, but it is difficult to show that any one is improbable. If we doubt Viviers, there is Bleymard to exceed it, and Bleymard itself is supported by Cette and Pont-de-Monvert. And if we say that we will accept 15 in. in a day as the maximum for Europe, how are we to upset the three accordant values from Joyeuse, Genoa, and Gibraltar.

The work concludes with tables giving the whole of the monthly values *in extenso* for 67 stations, and the best map yet prepared of the mean rainfall of Spain and Portugal.

EXCEPTIONAL PHENOMENA IN JULY 1888.

CAMDEN SQUARE, LONDON.—The loss and discomfort which have resulted from our having had in London only 11 days without rain since June 4th will probably render an authoritative statement of the facts generally acceptable. I purpose in this letter dealing with the facts at this station only, reserving comments upon what has occurred over the country generally until I possess fuller information. One reason why such exceptional notice has been taken of this wet summer is its contrast to that of 1887. From June 4th to July 31st, 1887, rain fell on 10 days; during the corresponding period this year it has fallen on 46 days. In 1887 the total depth during that period was 1·12 in.; this year it has been 7·22 in, so that rain has been nearly five times as frequent and nearly seven times as heavy. No wonder that such a contrast attracts attention. My record now goes

* Of course we do not suggest that it is possible for rain to continue to fall so heavily for so long a period as 24 hours.

back here for 30 years, and there is only one July wetter than the one just passed—viz., July, 1880. Then the fall was 5·11 in., against 4·91 in. in this year. It may be well to give a list of summer months in which the fall has been greater than in the past July; they are as follows:—1860, June, 5·47 in.; 1878, June, 6·71 in.; 1878, August, 6·72 in.; 1879, August, 5·11 in.; 1880, July, 5·11 in. This shows that a fall of 4·91 in., though unusual, and about double the average, is by no means unprecedented. We must look into details if we wish to know why it has been so uncomfortable. Much depends upon how the rain falls, whether in continuous drizzle or in torrential rains. Now, though we have had several short torrential storm rains, we have not once had an inch in 24 hours, but it has fallen day after day, so that in July it rained on 26 out of the 31 days.

Another and very important consideration is the temperature, and this has been far more remarkable for lowness than the rain for excess of quantity. There are five different features with respect to temperature, and I will briefly compare each with the records kept by myself since 1857, with verified instruments, similarly mounted throughout.

Mean temperature at 9 *a.m.*—Mean for 30 years, 64°·5; 1888, 59°·2; in 1879 the value was also 59°·2; in 1860 it was 59°·9, and in every other year above 60°.

Absolute maximum *temperature during the month.*—Mean for 30 years, 86°·0; in 1888, 75°·9; in 1860 also the *maximum* was 75°·9, and there is no other year with so low a *maximum.*

Average maximum *for the month.*—Mean for 30 years, 74°·7; in 1888, 67°·3. There is no other so low, the only three below 70° being—1860, 69°·9; 1875, 69°·8; and 1879, 67°·7.

Average minimum *for the month.*—Mean for 30 years, 54°·0. The lowest was 50°·2 in 1863, and there are nine instances lower than 1888, which was 52°·3.

Absolute minimum *for the month.*—Mean for 30 years, 45°·2; the lowest, 40°·3 in 1863, and there are five instances lower than 1888, which was 42°·8.

Hence we see that although the *minima* have not been excessively low, the *maxima* have been low beyond all precedent for 30 years, and it is to that, coupled with continuous and heavy, though not unprecedented, rain, that all the discomfort and loss is due.—G. J. SYMONS.

ROYAL OBSERVATORY, GREENWICH.—Violent rain in afternoon and evening of 30th, more especially during the thunderstorm between 5 p.m. and 7 p.m. Hail also fell at times; total fall, 2·49 in.—W. H. M. CHRISTIE.

FORDINGBRIDGE, HANTS.—This has been a very exceptional month—wet sunless, cold, and cheerless. Rain fell on a greater

number of days (22) than ever recorded here but once, viz., September, 1885, when it fell on 24 days. Only one day is entered 'fine sunshine.' The total fall for the month has been 3·93 inches. This, however, has been exceeded on four occasions in the 13 previous years, viz., 4·33 in 1875; 4·03 in 1877; 5·38 in 1879; and 4·83 in 1880. The fall in July varies very much, and 0·63, 0·17, and 0·54 are entered during the same period. 0·17 inches is the least in any one month for the 13 years. The average of the last 10 years for July is 2·39 inches. The quantity of rain since January 1st has been 15·86, and the average of the same period 16·59 inches, so that we are still slightly in arrear. This is chiefly caused by the very dry February in this year, which was only 0·73, while the average is 3·19 in. The barometer has been low, above 30 inches on only nine days; the variation has been only from 30·19 to 29·46 inches. The thermometer has been very low for July, and twice registered 40° at night; it was 40°, 42°, and 44° on three nights in January. During the day the highest was 72° on the 6th, and it was 70° and above on four days only, and once only 58°. The rain has been a great boon to the water supply of the country, the deficiency of which was becoming very serious; also has been highly advantageous to the grass and root crops, and the straw of corn crops; but the hay has been sadly spoiled, and much injury done to heavy crops of wheat and barley from laying. A fine August and September would tend much, however, to put matters straight, and is devoutly to be desired.—T. WESTLAKE.

ABINGDON, BERKS, *Monday, July 30th.*—I emptied the gauge at 9 a.m. The weather looked heavy all the morning until about noon, when for an hour or so there was sunshine, but with heavy, dark clouds towards the east, and constant distant thunder. About 2.30 there was a short, heavy shower for about ten minutes; at three a sudden downpour began, and the old people in this village say that they never witnessed such rain. The road is completely washed, and is nothing but bare stone. This continued till a little after 5 p.m., about two hours and twenty minutes. I then emptied the rain gauge, and found it contained 2·95 in. The storm appeared to come from the east. Just above the Rectory is a field of potatoes on the slope, and about an acre is completely washed away, right over a clover field for about 150 yards, and against the hedge at the bottom are at least 50 cart loads of earth and stones. I witnessed nine labourers who had been all day gathering up the potatoes washed away. The storm seems to have gone due west, and I fancy was very heavy towards Didcot and on towards Swindon.—PERCY BURD, *The Rectory, Little Wittenham, Abingdon, July 31st*, 1888.

AYLSHAM NORFOLK.—On the evening of the 30th I measured an extraordinary fall, which reached 3·09 inches between 5.20 p.m. and

7 p.m. My pond, which measures 2¼ acres, and in which the water was eight inches below the bank, overflowed in less than an hour.—R. J. PURDY.

BABBACOMBE, TORQUAY.—Yesterday the heaviest storm of rain, hail, thunder and lightning ever known here passed over us, the storm clouds coming from W.N.W. and going off to E. It began at 1.4 p.m., was very severe from 1.30 to 2.15 p.m., and ceased at 4.10 p.m., though showers fell till 8.15 p.m., accompanied by thunder from 6.1 to 6.3 p.m. The total rainfall was 1·98 inches; 1·47 inches of which fell in the 30 minutes from 1.30 to 2 p.m. Great damage was done to vegetation and glass, and chicken were killed by the tremendous hail which fell from 1.33 to 1.58 p.m., many of the stones measuring ¾ in. by ½ in. in diameter. The ground was covered an inch deep with them for about an hour, and they were still lying several inches deep in the drifts this afternoon. Numerous houses were flooded by rain rushing through them from the higher grounds. The lightning and thunder were simultaneous at 2.6 p.m. The surface wind varied from a light S.E. breeze at 1.15 p.m. to N.N.E. in a squall at 1.49 p.m., then to a light breeze from N.N.W. at 2 p.m. (when the barometer, at 32° and the sea level read 29·748, and the dry bulb thermometer 51°·8, and wet ditto 50°·9); and was generally light from N.N.E. to E. till 4.15 p.m. The barometer rose slowly, with a few slight retrogressions, during the storm. The temperature fell from its maximum (for the day) of 66°·4 before 1 p.m. to its minimum 51°·7 at 2.15 p.m., but rose again to 57°·4 at 5 p.m. The rainfall in Torquay was much less than here, the following amounts having been registered there (for the 6th): viz., at Lamorna, 0·82 in.; Strand, 0·61 in.; Grey's Lodge, 0·56 in.; Castle College, 0·48 in.; and Devon Rosary, 0·37 in. At Livermead (1 mile S.W. of Torquay) no rain fell up to 6 p.m. My observations here quite confirm the partiality of the storm over this peninsula, as I saw blue sky from S.W. to S.E. from 1 to 3.30 p.m., and also in the N.E. quarter from 1 to 2.30 p.m. The day's rainfall (1·98 in.) has been only twice exceeded since observations were commenced here in August, 1876; viz., on October 4th, 1880, when 2·44 in. fell; and on December 26th, 1886, when 2·57 in. fell.—EDWIN E. GLYDE, F.R.Met.Soc., *Kirkham, Babbacombe, Torquay, July 7th*, 1888.

STREET, SOMERSET.—The accompanying returns were collected to show how peculiarly *local* many of the heavy rains were in Somerset, specially round Street in the early part of July. Thunderstorms occurred in the district every day from the 1st to 8th, often two or three; they were frequent all through the month. July 3rd to 5th I was at Bridport, Dorset, and little rain fell, hay being carried by the sea on the 5th, much hurt by previous rain. It was pretty constantly clear at and off the coast; cloudy, with slight showers at Bridport, two miles inland; heavy showers three or four miles in-

land. July 4th, most of the rain fell in an hour, about 2 p.m., at Street—three chief storms. July 8th, the falls at Street (9.45 to 10.45), Langport district and Mendip district (both about 1 p.m.), were separate thunderstorms. At Langport occurred a terrific, but very local, hail fall. Messrs. Kelway's extensive gardens, to the E.N.E., escaped; Mr. Vincent Stuckey's grounds, to the E.S.E. and barely half-a-mile off, were ruined; "our flower-garden destroyed, peas and beans looked as if a gun had been shot down their ranks." The hail lay 3 to 4 inches deep, lasting in places till next noon. The hail barely extended beyond the small town itself. July 16th, waterspout broke near North Petherton. Rain fell in sheets, washing away soil and all in a turnip-field on the west side of the Quantocks, at Colthurst. Being near Edington, S. and D.R., 10 miles or so away, I noticed from the train, about 11.20 a.m., a peculiar cloud, and suggested that there must be a waterspout in that direction. July 30th, at Baltonsborough, three miles E.S.E. of Street, terrific TS, 2 inches of rain; great floods; horses swimming on the high road; only slight rain at Street; still less near King Weston; 2½ miles S.S.W. of Baltonsborough, which had only the "fringe" of the storm.—J. E. CLARK.

[The table would require a whole page, we must, therefore, epitomize the facts in a few lines. Mr. Clark has obtained records from 15 out of the 44 stations quoted in *Brit. Rain.*, 1887, and from one of which we were not previously aware. The results are shortly as follows:—1st. Rain general—between 0·17 and 0·46 at all stations except Willett Ho., where none was recorded. 2nd. Variable from none at S. Petherton to 0·98 at Chewton Mendip. 3rd. Variable and small except at Glastonbury, 0·58. 4th. Very variable; only 0·11 at Weston-super-Mare, more than an inch at most eastern stations, and 1·75 in. at Street. 5th. Small generally. 6th. Gradually increasing W. to E.; 0·01 at Exford, 0·93 at Chewton Mendip. 7th. Generally small; max. 0·56 at Yeovil. 8th. Inappreciable in the W. but 1·16 in. at Langport. From 9th to 15th there is nothing noteworthy. On 16th there was a heavy local fall in the vicinity of Taunton and Bridgewater; 1·60 fell at Lydeard House between 1 and 2.30 p.m., and smaller amounts at surrounding stations.—Ed. *Met. Mag.*]

THE GRAIG, ROSS.—The rainfall for last month at this station corresponds very closely with that of July, 1880.

	Total amount.	No. days.		TEMPERATURE. Mean max.	Mean min.	Absolute max.	Absolute Min.	Cloud.
July 1880	5·96	24	...	69·8	50·5	75·0	45·8	7·9
,, 1888	6·06	27	...	65·4	53·7	74·9	39·5	8·5
56 days ending July 31, 1880	8·78	43	...					
,, ,, ,, ,, 29, 1888	8·77	45	...					
Lowest max., or coldest day	1880	62·0	...	Highest min., or warmest night		1880	59·0	
Ditto.....	1888	56·8	...	Ditto		1888	57·0	

The amount and continuity of rain has, therefore, been equally great in both years, but 1888 has had a much greater number of cold days, for whereas in 1880 the lowest maximum was 62°·0, in 1888 there were no less than seven days when it was below 60°. The mean maximum (65°·4) is the lowest I have recorded in July; 1879, 1883, and 1875 coming next with 65°·6, 67°·2, and 67°·5 respectively. The number of rainy days also beats record, 1882 with 25 days being the next below. The total amount has been twice exceeded in my 30 years' observations, viz., in 1872, 7·54 in.; 1875, 6·76 in.; but in each of these years there were very heavy falls—in 1872 the following was registered: July 6—7, 2·77 in; 24—25, 1·09 in.; 29—30, 2·29 in., or a total of 6·15 in. in three storms. In 1875 rain commenced at 7 a.m. on July 14th, and in 36 hours 3·63 in. fell. In 1888 the most in any two consecutive days was 1·08 in. Rain fell every day from the 14th to the 30th inclusive, 4·85 in. in 17 days. This year there have been scarcely any fine intervals for the haymakers. Let us hope that the next five weeks may be as fine and dry as they were in 1880.—Yours, &c., H. SOUTHALL, *August 2nd*, 1888.

N.W. YORKSHIRE.—ON the night of July 25th, one of the most destructive summer floods ever known swept down Swaledale. Hundreds of people went round the Castle walks anxious to witness the numerous articles of furniture, huge trees, and sheep and pigs floating down the rapid stream. In Upper Swaledale considerable destruction has been wrought. Gunnerside Bridge was swept down, and other bridges were seriously damaged. Most of the walls on the flatts were forced down, and great injury was done to the meadows which were completely under water. Whaw Bridge in Arkengarthdale has been nearly totally washed away, its foundations having been very dangerously undermined. The wooden bridges at Punchard, Seel Houses, and Escliffe were also washed away. The houses at the low end of Reeth were flooded, the wall at the high side of Reeth Bridge was washed down, and the great concrete wall at the low side of Fremington Mill and used as a backwater, was also washed down. At Hawes Junction the very large amount of 3·18 in. of rain was measured.

WIND VELOCITY.

IT may be an old story, but everybody does not at all times recollect how little anemometers tell us of the real motion of air currents. No one would think of quoting, as the velocity of a river, measurement of its motion within 4 or 6 inches of its bottom, where, of course, it is greatly retarded by friction against the river bed. So with anemometers, their records (even putting aside the question of whether the observations are reduced on the scale of 3 to 1 or of 2·2 to 1) are largely influenced by the friction of the air against the

earth's surface. Here are two facts which, for convenience, we put in parallel column.

BALLOON ASCENT.

The first of a series of balloon ascents was made from the Anglo-Danish Exhibition on Saturday afternoon, by Mr. Simmons, who descended at Ingatestone, near Chelmsford, a distance of 26 miles from London, just half-an-hour after leaving the Exhibition, *i.e.*, travelled 52 miles in an hour.

ROYAL OBSERVATORY, GREENWICH.

"The total horizontal motion of the wind on July 14th was 126 miles, the max. pressure 0·9 lb." The former gives a mean velocity of 5 miles an hour, the latter shows that not even for an instant did the velocity exceed 14 miles an hour.

THE CLIMATE OF THE BRITISH EMPIRE DURING 1887.

The Climatological Summary for 1887 shows the same general characteristics as those for former years, the stations which record the extremes—enviable or otherwise—set out in the summary being much the same as usual.

Comparing with the summary for 1886, Stanley, Falkland Isles takes the place of London as the dampest station, and of Auckland as the most cloudy station. At Adelaide, 1887 was exceptionally wet, and Malta reappears with the smallest rainfall.

The Australian stations again outdo the East Indian with their extremely high maximum shade temperatures, though the average maxima at the latter far exceed those of Australia, and the Canadian stations of course maintain their—we had almost said—pre-eminence at the bottom of the temperature scale, and perhaps the word is justified by the fact that the readings would be high but for *the minus* sign in front of them.

SUMMARY.

Highest temperature in shade: 111°·2 at Adelaide, on January 9th.
Lowest temperature in shade: —42°·7 at Winnipeg, on January 7th.
Greatest range in year: 135°·9 at Winnipeg.
Least range in year: 22°·0 at Barbados.
Greatest mean daily range: 24°·5 at Winnipeg.
Least mean daily range: 9°·6 at Barbados.
Highest mean daily temperature: 80°·2 at Colombo, Ceylon.
Lowest mean daily temperature: 31°·0 at Winnipeg.
Driest station: Adelaide, mean humidity, 60.
Dampest station: Stanley, Falkland Isles, mean humidity, 86.
Highest temperature in sun: 164°·0 at Adelaide.
Lowest temperature on grass: —21°·0 at Toronto.*
Greatest rainfall: 94·95 inches at Bombay.
Least rainfall: 17·23 inches at Malta.
Most cloudy station: Stanley, Falkland Isles, average amount 7·0.
Least cloudy station: Malta, average amount 3·7.

* There being no grass mim. thermometer at any other Canadian station.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE FOR 1887.

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. Mean.	Average. Dew Point.	Average. Humidity	Absolute. Max. in Sun.	Absolute. Min. on grass.	Total Rain. Depth.	Total Rain. Days.	Average Cloud
	°		°		°	°	°	°		°	°	°	in.	0—10
England, London	88·8	July 3	14·5	January 2	56·5	41·0	48·8	41·0	79	133·4	11·0	19·21	140	6·1
Malta	100·2	July 24	43·0	January 11	73·3	59·7	66·5	56·6	75	158·4	36·0	17·23	82	3·7
Mauritius	85·0	January 11	54·6	August 18	77·7	67·9	72·8	63·7	75	138·7	42·1	46·64	209	5·7
Calcutta	102·0	April 21, 22	47·1	January 24	85·5	70·1	77·8	68·3	70	159·5	35·4	58·07	116	4·3
Bombay	93·5	April 14	55·9	February 9	84·9	74·0	79·5	70·9	76	149·2	41·9	94·95	112	4·1
Ceylon, Colombo	94·2	February 19	66·8	February 1	86·2	74·2	80·2	70·0	74	151·2	56·0	84·15	182	6·0
Melbourne	104·9	January 10	33·0	June 27	66·4	50·1	58·3	49·3	74	154·2	26·7	32·39	153	6·0
Adelaide	111·2	January 9	36·5	July 12	71·7	53·4	62·6	47·9	60	164·0	29·9	25·69	164	4·8
Wellington	83·0	January 26	31·0	August 25	61·6	48·4	55·0	48·3	80	150·0	23·0	55·97	175	4·2
Auckland	81·5	January 17	35·0	August 13	65·9	53·3	59·6	52·8	78	147·0	26·0	37·71	181	6·7
Falkland Isles, Stanley		...	17·0	June 7	..	36·6	...	39·4	86	133·0	17·5	28·04	234	7·0
Jamaica, Kingston	93·3	July 21	56·7	December 4	88·3	69·3	78·8	69·8	75	...	...	37·60		...
Barbados	88·0	October 10	66·0	Feb. 13,15,21 / Mar. 3, 4, 8	80·8	71·2	76·0	70·0	79	...	...	73·59	181	6·1
Toronto	97·2	July 16	—16·6	January 3	52·5	35·4	44·0	37·5	75	...	—21·0	25·72	160	6·3
New Brunswick, **Fredericton**	91·7	June 30 / July 2	—34·1	January 9	49·2	29·3	39·3	33·7	73	...	...	45·31	168	5·5
Manitoba, Winnipeg	93·2	July 6	—42·7	January 7	43·2	18·7	31·0	27·2	79	...	...	17·98	137	4·9
British Columbia, Victoria	86·0	June 21	6·0	February 2, 5	55·3	39·5	47·4	...	...	...	...	39·06	127	...

SUPPLEMENTARY TABLE OF RAINFALL, JULY, 1888.

[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	5·33	XI.	Castle Malgwyn	6·45
,,	Margate, Birchington...	3·58	,,	Rhayader, Nantgwillt..	8·78
,,	Littlehampton	5·45	,,	Carno, Tybrith	7·95
,,	Hailsham	4·82	,,	Corwen, Rhug	6·18
,,	Ryde, Thornbrough	5·79	,,	Port Madoc	7·21
,,	Alton, Ashdell.....	4·85	,,	I. of Man, Douglas	6·53
III.	Oxford, Magdalen Col...	4·44	XII.	Stoneykirk, Ardwell Ho.	4·17
,,	Banbury, Bloxham	5·81	,,	New Galloway, Glenlee	5·69
,,	Northampton	4·20	,,	Melrose, Abbey Gate...	4·54
,,	Cambridge, Beech Ho...	3·45	XIII.	N. Esk Res. [Penicuick]	6·25
,,	Wisbech, Bank House..	3·73	XIV.	Ballantrae, Glendrishaig	4·58
IV.	Southend	4·56	,,	Glasgow, Queen's Park.	4·52
,,	Harlow, Sheering	3·61	XV.	Islay, Gruinart School..	3·09
,,	Rendlesham Hall	4·82	XVI.	St. Andrews, Pilmour Cot	5·55
,,	Diss	5·85	,,	Balquhidder, Stronvar..	6·77
,,	Swaffham	4·32	,,	Dunkeld, Inver Braan..	5·46
V.	Salisbury, Alderbury...	5·45	,,	Dalnaspidal H.R.S. ...	6·66
,,	Warminster	5·48	XVII.	Keith H.R.S.	3·66
,,	Bishop's Cannings	4·72	,,	Forres H.R.S.	3·06
,,	Ashburton, Holne Vic....	9·44	XVIII.	Strome Ferry H.R.S....	3·37
,,	Hatherleigh, Winsford.	5·11	,,	Fearn, Lower Pitkerrie.	3·38
,,	Lynmouth, Glenthorne.	6·22	,,	Loch Shiel, Glenaladale	5·52
,,	Probus, Lamellyn	9·13	,,	S. Uist. Ardkenneth ...	2·92
,,	Launceston, S. Petherwin	7·74	,,	Invergarry	5·04
,,	Wincanton, Stowell Rec.	6·68	XIX.	Lairg H.R.S.	...
,,	Taunton, Lydeard Ho...	6·28	,,	Forsinard H.R.S.	1·78
,,	Wells, Westbury.....	8·76	,,	Watten H.R.S.	2·02
VI.	Bristol, Clifton	6·22	XX.	Dunmanway, Coolkelure	5·87
,,	Ross	6·06	,,	Fermoy, Gas Works ...	5·68
,,	Wem, Clive Vicarage ...	5·55	,,	Tipperary, Henry Street	4·75
,,	Cheadle, The Heath Ho.	5·28	,,	Limerick, Kilcornan ...	3·07
,,	Worcester, Diglis Lock	5·44	,,	Miltown Malbay.....	4·50
,,	Coventry, Coundon	6·66	XXI.	Gorey, Courtown House	6·82
VII.	Melton, Coston	5·19	,,	Navan, Balrath	5·25
,,	Ketton Hall [Stamford]	4·14	,,	Mullingar, Belvedere...	5·94
,,	Horncastle, Bucknall ...	4·75	,,	Athlone, Twyford	5·14
,,	Mansfield, St. John's St.	5·50	,,	Longford, Currygrane...	4·99
VIII.	Knutsford, Heathside ...	4·92	XXII.	Galway, Queen's Coll...	4·03
,,	Walton-on-the-Hill.....	5·09	,,	Clifden, Kylemore	5·42
,,	Lancaster, South Road.	6·72	,,	Crossmolina, Enniscoe..	4·82
,,	Broughton-in-Furness ..	8·87	,,	Collooney, Markree Obs.	4·68
IX.	Shipley, Esholt Vic. ..	4·37	XXIII.	Rockcorry.....	3·54
,,	Ripon, Mickley	4·16	,,	Warrenpoint	4·64
,,	Scarborough, West Bank	6·50	,,	Seaforde	6·63
,,	East Layton [Darlington]	4·46	,,	Belfast, New Barnsley .	6·02
,,	Middleton, Mickleton ..	5·18	,,	Cushendun	8·06
X.	Haltwhistle, Unthank..	4·77	,,	Bushmills	6·08
,,	Shap, Copy Hill	6·60	,,	Stewartstown	5·50
XI.	Llanfrechfa Grange	7·62	,,	Buncrana	7·53
,,	Llandovery	6·26			

JULY, 1888.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1870–9	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) ...	4·91	+ 2·44	·90	17	26	75·9	1	55·7	11	0	0
II.		Maidstone (Hunton Court)...	5·26	+ 3·22	·99	31	23	...	...	...	...	...	...
,,		Strathfield Turgiss	5·23	+ 2·93	·89	5	23	72·6	19	40·6	11	0	1
III.		Hitchin	2·92	+ ·22	·44	2 *e*	25	71·0	22	44·0	10	0	...
,,		Winslow (Addington)	4·57	+ 1·97	·82	2	23	70·0	17 *b*	39·0	1 *f*	0	...
IV.		Bury St. Edmunds (Culford)	4·49	+ 1·52	·54	16	19	68·0	17 *c*	33·0	13	0	...
,,		Norwich (Cossey)	3·78	+ 1·03	·70	27	18	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	3·23	...	·85	2	22	71·0	19	43·0	11	0	...
,,		Barnstaple	3·94	+ ·39	·53	1	22	69·0	15	41·0	1	0	...
,,		Bodmin	10·16	+ 6·72	2·88	30	26	67·0	20	53·0	28	0	0
VI.		Stroud (Upfield)	5·91	+ 3·07	·71	14 *a*	27	75·0	13	44·0	12	0	...
,,		ChurchStretton(Woolstaston)	4·75	+ 1·72	·69	15	27	72·0	19	38·0	11	0	0
,,		Tenbury (Orleton)	5·44	+ 2·53	·71	27	28	73·0	19	36·7	13	0	0
VII.		Leicester (Barkby)	5·59	+ 2·85	·92	15	23	78·0	17	38·0	10	0	...
,,		Boston	4·77	+ 2·24	·78	4	22	80·0	19	41·0	12	0	...
,,		Hesley Hall [Tickhill].....	5·04	...	·62	17	24	75·0	19	39·0	1	0	...
VIII.		Manchester (Ardwick).....	6·25	+ 2·44	1·80	2	20	71·0	24	41·0	2	0	0
IX.		Wetherby (Ribston Hall) ...	5·56	+ 2·95	·84	18	16	...	...	...	...	...	...
,,		Skipton (Arncliffe)	5·51	+ ·56	·59	14	24	72·0	26	37·0	31	0	...
,,		Hull (People's Park)	5·75	+ 2·93	·90	15	23	...	...	...	...	...	...
X.		North Shields	5·45	+ 2·90	1·44	25	20	71·0	21 *d*	40·0	7	0	0
,,		Borrowdale (Seathwaite).....	11·21	+ 2·44	1·32	22	21	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	7·52	+ 3·70	1·50	7	27	...	...	...	...	...	...
,,		Haverfordwest	7·78	+ 3·85	1·30	1	26	70·5	19	41·5	12	0	...
,,		Plinlimmon (Cwmsymlog) ...	7·72	...	·95	1	20	...	...	...	...	...	...
,,		Llandudno.....	4·60	+ 1·89	·70	2	24	67·0	21	42·0	11	0	...
XII.	SCOTLAND.	Cargen [Dumfries]	4·82	+ 1·69	1·28	22	21	73·8	19	36·8	1	0	...
,,		Jedburgh (Sunnyside).....	4·83	+ 1·90	·80	16	25	73·0	20	37·0	1	0	...
XIV.		Old Cumnock	4·31	+ 1·21	·66	2	23	80·0	19	32·0	7 *g*	3	...
XV.		Lochgilphead (Kilmory)	5·94	+ 1·40	1·57	2	20	...	...	...	...	...	...
,,		Oban (Craigvarren)	6·21	...	1·27	2	25	69·3	19	43·6	10	0	...
,,		Mull (Quinish).....	3·93	...	·72	20	19	...	...	...	...	...	...
XVI.		Loch Leven Sluices	3·70	+ ·65	·90	23	13	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	5·30	+ 2·51	1·00	16	17	75·4	19	37·8	1	0	...
XVII.		Braemar	5·64	+ 2·78	2·00	2	23	71·3	20	36·8	8	0	3
,,		Aberdeen	4·59	...	1·37	3	17	71·0	20	41·0	7	0	...
XVIII		Lochbroom	2·04	...	·45	9	13	...	...	...	...	...	...
,,		Culloden	3·56	+ ·78	...	...	...	74·0	19	39·0	7	0	0
XIX.		Dunrobin	2·65	...	·65	2	13	66·5	19	39·0	7	0	...
,,		Kirkwall (Swanbister)..... ..	...	...	...	...	...	...	...	...	...	...	...
XX.	IRELAND.	Cork (Blackrock)	6·31	+ 3·47	1·02	31	19	72·0	6 *e*	42·0	10	0	..
,,		Dromore Castle	5·63	...	·77	1	21	72·0	16	40·0	19	0	...
,,		Waterford (Brook Lodge) ...	5·24	...	1·04	1	19	70·0	19	41·0	1	0	...
,,		O'Briensbridge (Ross)	3·26	...	·54	2	21	74·0	20	47·0	2 *h*	0	...
XXI.		Carlow (Browne's Hill)	5·57	+ 3·01	1·07	27	22	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	3·88	+ 1·46	·51	27	22	68·7	21	42·9	11	0	0
XXII.		Ballinasloe	4·91	+ 2·03	·95	23	20	70·0	13	40·0	27	0	...
XXIII		Waringstown	5·21	+ 1·63	1·15	27	23	76·0	19	36·0	31	0	...
,,		Londonderry (Creggan Res.).	6·25	...	1·66	27	27	...	...	...	...	...	...
,,		Omagh (Edenfel)	5·02	+ 1·77	1·55	27	23	71·0	19	40·0	10 *i*	0	...

a And 16. *b* And 19, 23. *c* And 26, 29. *d* And 23. *e* And 15. *f* And 13. *g* And 30, 31. *h* And 13. *i* And 31.

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

METEOROLOGICAL NOTES ON JULY, 1888.

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 wettest July recorded in nearly 30 years. "July sloppy, August croppy," says the old adage. The sloppy part of the programme has been fully carried out. Vegetation suffered from a deficiency of accumulated heat; hot brilliant weather was much wanted to save the hay and to mature the corn crops. The month came to an end with continued R and local TSS; the temp. being quite autumnal. TSS on 5th and 30th; T on 4th, 17th, and 23rd; fog on 14th.

ADDINGTON.—A remarkably cold and wet July; R falling on so many days damaged some of the crops very much, particularly hay. The total R has been exceeded only three times, viz., 1871, 4·65 in.; 1875, 4·72 in.; 1880, 8·24 in. T on 4th, 5th, 18th, 26th, and 27th.

CULFORD.—Unusually wet all through the month, with much T.

LANGTON HERRING.—An abnormally cold month. R 1·02 in. above the average, the fall from Jan. 1st still showing a deficiency of 1·93 in. Mean temp. at 9 a.m. (60°·2), 3°·1 below the average. There was a remarkable absence of sunshine, and the corn fields were quite green at the close. Some hay was spoilt by the continuous wet. Pressure low.

BODMIN.—A cold ungenial month, with the heaviest R recorded for many years on 30th. Mean temp. 59°·8.

STROUD.—S fell at Birdlip, between Stroud and Cheltenham, on 11th; ·28 in. of R fell in half an hour on 20th. T and L on 23rd.

WOOLSTASTON.—The coldest and most cheerless July remembered, with only four rainless days, and an almost entire absence of sunshine. Mean temp. 55°·8. Strong gale on 2nd. Most of the hay crop ruined.

ORLETON.—A very cold, wet, and cloudy month. Mean temp. nearly 10° below that of 1887, and 5°·5 below the average of 27 years; the mean of the first 15 days was about 7° below the average, and the lowest for 60 years; the max. reached 70° on only six days, and was below 60° on six days. Distant T was frequent, but no storm came near, and there was no heavy R. Heavier rainfall occurred in July 1834, 1855, 1861, and 1875. Pressure generally low and steady, with little high wind.

BARKBY.—A very wet, cold and cloudy month. Very trying for haymaking; crops mostly injured; scarcely 30 consecutive hours without R. T on six days, and a church and tall chimney struck by L at Leicester. S on 11th between Barkby and Leicester.

BOSTON.—Mean temp. 3°·6 below the average. T and L on 5 days.

MANCHESTER.—Abnormally wet and cold for July.

HULL.—Generally wet and cold.

NORTH SHIELDS.—S on 10th; TSS on 25th.

WALES.

HAVERFORDWEST.—One of the most disastrously wet Julys for many years, and cold withal, the temp. reaching 70° on only one day. On the evening of the 1st misty R commenced falling, and from 4 a.m. on the 2nd till 2.30 p.m. it fell in torrents, the total being 1·94 in. From the 14th to the end of the month, there was not a single dry day, and vast quantities of hay were damaged, and the corn was beaten down in many places.

LLANDUDNO.—TS on 2nd, 11th

SCOTLAND.

CARGEN.—The coldest July recorded during the 28 years observed, the mean

temp being 4°·5 below the average. Duration of sunshine 133 hours, 110 hours less than the average, which, combined with the very low temp., greatly retarded vegetation. Easterly winds on 17 days; T and L on 26th; T on 24th and 31st.

JEDBURGH.—The month was abnormally cold and ungenial, with almost daily rain. Cereal crops fairly good but very late; roots very fair; hay not much damaged.

OBAN.—A cool month with excessive rainfall.

LOCHBROOM.—On the whole a fine month, dry and cold, but with at times scorching sunshine. Vegetation made little progress, and was very stunted at the close. H storm and S on hills on 9th.

CULLODEN.—Cold throughout with little sunshine; very unsettled after the 20th with frequent R and much T. Crops look well.

DUNROBIN.—A cold and sunless month.

IRELAND.

CORK.—Unusually cold and wet with T on 3 days. The wettest July during 23 years.

DROMORE.—Rather too much R.

WATERFORD.—Rainfall 2·24 in. above the average, the latter half being very wet and bad for haymaking. Mean temp. 57°·0. T on 2nd and 7th.

O'BRIENSBRIDGE.—An unsatisfactory month for haymaking; temp. low and many wet days; T and L frequent.

DUBLIN.—A wet, cloudy, cold month, almost as wet and cold as July, 1879, with which month it had many features in common. Mean temp. 57°·3, being the lowest in 23 years, with the exception of 1879 (57°·2). Mean humidity 85; amount of cloud 7·4; L on two days; T on two days.

BALLINASLOE.—TS on 31st; T on 21st, 22nd, and 23rd; ·25 in. of R fell in 10 minutes on 22nd, and ·38 in. in 30 minutes on 29th.

EDENFEL.—A month of low temp. and almost constant R, culminating in a fall of 1·55 in. on 27th; worse for haymaking than even 1879. On the 10th and 31st potato tops were blackened by frost in low-lying damp situations.

GREAT RAIN STORMS ON AUGUST 1ST.

WE purpose dealing with these in our next number, and shall be obliged by any observers, who measured upwards of 2 inches for that day, sending particulars. We know of one station at which more than 4½ inches fell.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCLXXII.] SEPTEMBER, 1888. [PRICE FOURPENCE, or 5s. per ann. post free.

ON JULY, 1888, IN NORWAY, AND ON WEATHER ZONES IN NORTHERN EUROPE.

In several stray notes in *British Rainfall*, and in this magazine, we have called attention to the fact that, not infrequently, extremes of rainfall of opposite kinds occur simultaneously in the N.W. of Scotland, and in the S.E. of England. That is to say, that if a season be exceptionally wet in the S.E. of England, it will very possibly be a dry one in the Hebrides, or *vice versa*.

As the weather of any given spot is the product of the cyclonic or anti-cyclonic systems which have passed over it, we see at once that such facts as we have mentioned might be expected to result from the cyclonic systems following an unusual trajectory. We have not yet had time to ascertain whether the great atmospheric movements during July did, or did not, follow their usual path. Probably many of our readers will think that they did not; some persons have asked us where the summer of 1888 has gone to. The following letters from the Earl of Ducie and Mr. Kettlewell answer the question by showing how dry and fine was the weather in Norway this last July, and both writers carry it further, by pointing out that July, 1887, was extremely wet there, thus making another contrast with south British weather.

Those who are in the habit of reading the *Daily Weather Reports* are familiar with the name of Haparanda, a little fishing town near the top of the Gulf of Bothnia, as the station which most frequently has the lowest temperature (often many degrees below Zero) of any station whence returns are received. And it is quite reasonable that this should be the case, for its latitude is no less than 65° 52′ N. The table, which follows the letters above mentioned, shows the remarkable, if not unprecedented, fact that in July, 1888, the average daily maxima were 1°·8 higher, and the 8 a.m. temperatures 0°·7 higher at Haparanda than in London. The values for Christiansund, which is about 200 miles further from the North Pole than Haparanda, are not so remarkable; but both records confirm and illustrate the exceptional facts reported by our correspondents.

To the Editor of the Meteorological Magazine.

SIR,—I venture to call your attention to the weather which has prevailed on this coast up to the present date, from about June 10th. The contrast with the weather in England is remarkable. Were it confined to this season only, one would scarcely notice it; but, for the last three years, in the month of July and into August, it has been exactly the converse of English weather. In 1886 and 1887 the summer was so wet here that the hay was saved with difficulty, and the oats did not ripen.

I have been on this coast, and within 30 miles of Florö, since July, 4th, and during that time I have met with only one day on which there has been rain, and then only local, under a high mountain, and for a few hours.

July 10th to 20th we have had great heat, 70° to 80° Fahr., and all other days, except July 8th and 9th (when there was a strong Polar wind with scud), have been bright and fine. Every day the bar., which has been at about 29·70 in. has fallen 5 to 7 100ths during the day, rising again at night. As I write, there is no sign of change. The greatest heat has been with calms or light S.E. airs.

The country is dried up; hay crop very small; oats and barley are withering, and will have to be cut and dried for winter forage. Many deciduous trees are withered, and the leaves fly about as in the autumn.

The birch and mountain-ash seedlings, which grow on the turf-covered roofs of sheds, boat-houses, and the poorer sort of houses, are dead and dried up.

All this is in a district where the average annual rainfall is 75 inches, and where in 1886 and 1887 a day without rain was noted as an exceptional occurrence.

The peasants say that for 30 years such a drought has not been known.

I send these details merely to call your attention to the contrast with English weather which occasionally occurs here.

Can it be that zones of moisture of some hundreds of miles in width cross the Atlantic with a varying range N. or S.?

Your obedient servant, DUCIE.

Yacht Monarch, R. Y. S., July 22nd, 1888.

Florö, Norway { 61° 36′ 0″ N. lat.; 5° 2′ 0″ E long.

SIR,—I have just returned from Norway, where I have, as usual, been staying at a place about 60 miles S.W. from Throndhjem. I have again been much struck with the contrast between the weather there and here. I arrived there on July 1st. I was told that for three weeks or more the weather had been very dry and generally hot. This statement was borne out by the condition of the ferns, mosses, &c., which were withering from want of moisture. I left on the 1st of August, and, during my stay, there was very little rain,

although the weather was sometimes cold and cloudy. From the 13th to 19th, both inclusive, it was very hot, one day as high as 86° in the shade. We had a shower on the 2nd, a thunderstorm on the 6th; on the 7th and 11th a little rain; a shower on the 15th; rain on the 25th and 27th, and a little on the 31st. Altogether the rainfall for the month cannot have exceeded 2½ inches. I hear that a rain gauge which was kept by an Englishman about 35 miles from where I stay, showed over 12 inches of rain for the month of July last year. I hope to be able to get some particulars from him both of this year and last, if you would like to have them. Our rainfall here for the month of July just past was 8·79 in.!

I am, yours faithfully, W. W. KETTLEWELL.

Harptree Court, East Harptree, Bristol, Aug. 10th.

Date.	8 A.M.				MAX.			MIN.			
	Yacht R.Y.S. Monarch.	Haparanda.	Christiansund.	London.	Haparanda.	Christiansund.	London.	Haparanda.	Christiansund.	London.	YACHT MONARCH R.Y.S. 61° 36′ N. Lat. 5° 2′ E. Long.
1	55	54	49	53	63	50	66	32	45	45	Mean 8a.m. 58°·8
2	54	57	47	57	66	52	59	43	43	51	
3	56	50	51	59	59	55	68	46	43	54	
4	62	55	53	59	62	61	66	46	46	52	
5	58	62	50	59	72	52	66	46	48	53	HAPARANDA,
6	57	62	49	56	77	52	62	45	46	52	N. end of gulf
7	51	59	48	53	61	48	57	55	45	51	of Bothnia.
8	53	50	47	56	52	54	67	48	43	51	65° 52′ N. Lat.
9	53	48	49	60	59	55	67	45	43	50	24° 3′ E. Long.
10	59	53	51	53	...	59	62	43	46	49	Mean Max. 67°·3
11	59	57	48	44	68	54	54	46	46	44	,, Min. 47°·9
12	57	60	51	50	66	54	55	48	46	43	,, 57°·6
13	57	61	50	55	75	55	71	52	46	45	,, 8a.m. 58°·5
14	60	67	52	62	75	57	71	52	45	55	
15	58	64	56	58	72	66	61	59	48	55	
16	62	64	61	61	73	68	66	54	52	55	CHRISTIANSUND.
17	65	62	65	57	72	73	68	50	57	50	N.W. Coast of
18	65	67	67	62	73	77	71	50	61	56	Norway.
19	67	69	62	59	77	64	70	50	57	56	63° 7′ N. Lat.
20	67	64	53	61	73	57	65	52	50	57	7° 46′ E. Long.
21	59	54	51	60	75	55	66	54	46	55	Mean Max. 57°·5
22	57	59	51	64	64	54	72	52	46	56	,, Min. 47°·3
23	58	54	50	62	66	57	69	46	45	56	,, 52°·4
24	62	59	53	62	63	...	69	50?	48	55	,, 8a.m. 52°·4
25	58	57	...	60	64	59	62	48	...	57	
26	59	57	50	60	63	55	70	46	46	54	
27	60	59	49	59	64	49?	69	46	48	52	LONDON.
28	57	56	47	61	63	52	65	45	43	57	51° 32′ N. Lat.
29	58	54	48	57	63	55	68	46	41	53	0° 5′ W. Long
30	62	57	55	59	72	66	71	45	46	54	Mean Max. 65°·5
31	58	61	60	53	66	61	58	45	55	51	,, Min. 52°·4
											,, 59°·0
Mean	58·8	58·5	52·4	57·8	67·3	57·5	65·5	47·9	47·3	52·4	,, 8a.m. 57°·8

THE RAIN AND THUNDER STORMS OF JULY AND AUGUST, 1888.

THE rains which accompanied the thunderstorms of the closing days of July and the commencement of August, were of such exceptional magnitude in the S.E. of England, that we have collected special returns from a large number of stations in Sussex, Surrey, Kent and Essex, and have compiled a brief account of the most remarkable.

With the electrical phenomena—which, by the way, were apparently not so exceptional as the pluvial—we do not purpose dealing, adhering to the plan adopted with regard to the June thunderstorms, of leaving that branch of the subject in the able hands of the Thunderstorm Committee of the Royal Meteorological Society.

We give in tabular form the more important records from stations in the south eastern counties on July 30th, 31st, and August 1st, A few extracts from the numerous letters with which we have been favoured by our regular correspondents, apologising and regretting that we are unable to print them *in extenso*, and conclude with extracts from the public press, giving details of the floods on August 2nd.

Beginning in the south, we have the 31st of July with several falls exceeding three inches in the neighbourhood of Hastings, and these are good evidence in support of our oft-repeated statement that there is no part of the British Isles where a fall of four inches in less than 24 hours may not be expected. A feature of this storm, perhaps as important as the quantity of rain, is its intensely local character, which the following letter from Mr. Wood, who as a resident is more familiar with the neighbourhood than we are ourselves, clearly describes :—

"DEAR SIR,—I beg to hand you return as requested. The August 1st measurement (entered to July 31st) was a most extraordinary rainfall with respect to its partiality in this district. Mine, as you see, was ·70 in. ; Buckshole, to the west of me and a greater distance from the shore, 3·40 in. ; The Grove, also westward and inland, 3·40 in. ; London Road, between Buckshole and The Grove, but *nearer the shore*, 2·31 in. ; Bexhill, situated similar to London Road, 1·50 in. It seems, therefore, that the great fall (which was from 1 to 5 a.m. on August 1st) was heaviest about two miles from the shore, and lightest as the shore was approached ; The Grove and Buckshole being the farthest from the shore, were the heaviest. London Road, which is nearer, was lighter ; and mine, being nearest, the lightest of all. I was driving round the country, about three miles from the shore, on the next day, and between Buckshole and The Grove, where the fall was heaviest, old solid coach roads were completely torn up and at places gullied out to a most

marked extent. The fall was quite unprecedented in this district. —Faithfully yours, A. H. WOOD. *The Hollies, Hastings.*"

This storm, or an almost simultaneous one, was producing a fall of even greater intensity at a station 10 miles due N., Sandhurst Rectory, just on the boundary of Kent and Sussex. The Rev. G. Ridout, the rector, writes:—At 2 a.m. on August 1st there was a smart shower, followed soon after 5 a.m. by a heavy fall of rain, which became quite tropical in its character from 5.30 to 7.30 a.m., in which period the rainfall was three inches. The readings of the two gauges at 9 a.m. were 3·46 in. and 3·50 in., and at 9.30, ·50 in. more was recorded. More than double the amount recorded in any 24 hours during the preceding 11 years." This fall also was very local, for of the half-dozen stations within six miles, none recorded two inches, and at the nearest station, Benenden, not four miles distant, less than one inch fell.

Travelling northward, we come to the storm of July 30th, and the table exhibits nearly all the remarkable features; two falls exceeding two inches, and one exceeding three inches. Floods were produced in the lower parts of the east end of London, more especially in the Isle of Dogs and the neighbourhood of the docks. These are the usual accompaniments of a heavy rain over east London, and though we would not underrate the vast amount of suffering caused to great numbers of the poorer sections of the community, we must accept them as the natural result of building habitations on reclaimed marshes, where nature never intended man to dwell. The results were aggravated by the frequent rains which had marked the earlier part of July, and were repeated by the great rain of August 1st, the description of which will conclude our article.

SHOOTER'S HILL.—"July 30th, heavy thunderstorm from 3 to 7.30 p.m., passing backwards and forwards, very near sometimes, and rain tropical in intensity occasionally. August 1st, rain from about 8 p.m. to 6.30 a.m. on 2nd."

The storm rain of August 1st was one of the summer rains of exceptional magnitude. In Essex, more than two inches fell over an area of 700 square miles, roughly bounded by London, Shoeburyness, Chelmsford, and Harlow; and more than one inch fell over the greater part of Middlesex and Kent, and a considerable area in Surrey; four stations recorded upwards of three inches, and at North Ockendon and Upminster Hall, both near Romford, the gauges overflowed, after catching 4·56 in. and 4·50 in. respectively. Such a vast volume of water necessarily produced great floods, especially as the ground was thoroughly saturated, more than an inch having fallen over a great part of the district only two days before. The Cann, Roding, Bourn brook or Rom, and the Ingerburn being the chief natural drains of the district were the streams on which most flooding occurred.

Rainfall in S.E. England, July 30—August 1.

County.	Station.	July 30th.	July 31st.	August 1st.	Total, 3 days.
		in.	in.	in.	in.
Sussex ...	St. Leonard's (London Road)		2·31	·46	...
	,, ,, (The Grove)	·02	3·40	·03	3·45
	Hastings (The Hollies)	·04	·70	·19	·93
	,, (Buckshole).....	·02	3·40	...	3·42
	,, (High Beach, Hollington) ...	·03	3·25	·01	3·29
	Battle (Whatlington).....	·03	1·31	·04	1·38
Kent	Hawkhurst (Sandhurst Rectory)	·16	3·50	·55	4·21
	Cranbrook (Hartley)	·13	1·90	·65	2·68
	Bickley (Highfield)	1·63	·70	1·12	3·45
	,, Park	1·54	·78	1·17	3·49
	Forest Hill (Newfield House)	1·18	·35	·73	2·26
Surrey ...	,, ,, (Border Lodge)	1·59	·33	1·17	3·09
	West Norwood	1·61	·38	1·43	3·42
Kent	Eltham.....	1·16	·56	1·21	2·93
	Shooters Hill	1·28	·52	1·25	3·05
	Greenwich (Royal Observatory).....	2·49	·33	1·44	4·26
	Deptford (Kent W. W.)	2·54	·29		...
	,, (Pumping Station)	3·17	...	1·77	...
	Erith (Crossness)	·31	2·13	...	2·44
	Gravesend (Park Place)	·19	·49	1·80	2·48
Essex	Southend (Avenue Road)	·30	·41	2·83	3·54
	Romford (North Ockendon Rectory)...	1·01	·26	+4·56	+5·83
	,, (Upminster Hall)	1·62	·17	+4·50	+6·29
	Ilford (Little)	1·92	·30	1·80	4·02
	,, (Great Gearies)	1·35	·24	2·14	3·73
	Woodford (The Harts)	·27	·28	2·10	2·65
	,, (Hagger Lane)	·41	·17	2·16	2·74
	Brentwood (Sawyer's Hall Farm)	1·50	·50	3·00	5·00
	,, (Dudbrook House)	1·70	·21	2·72	4·63
	Ingatestone (Margaretting)	1·79	·27	3·20	5·26
	Epping (The Hemnalls)	·15	2·43	...	2·58
	Chelmsford (Writtle)	1·06	·24	2·07	3·37
	,, (High Street)	1·45	·27	2·21	3·93
	,, (Roxwell)	1·33	·20	2·02	3·55
	,, (Broomfield)	*1·26	·24	1·88	3·38
	Harlow (Sheering)	·51	·14	1·99	2·64
	Dunmow (High Roding)	1·23	·18	1·32	2·73

* 29th and 30th.

With the amount of loss occasioned we have no concern, but we have extracted rather largely from the public press, to preserve as far as possible a record of the limits of the flood, and we would express the earnest hope that the authorities of Chelmsford will permanently mark on their new bridge the height of the flood which destroyed its predecessor, after it had stood for about fifty years.

North Ockendon.—"August 1st, very little rain had fallen in the day, but at 7 p.m. the storm began without thunder; by 7.30 there was thunder, which continued till 0.30 a.m. on 2nd; by

8.15 p.m. 1·61 in. of rain had fallen; a fresh receptacle was then put under the rain gauge, which on the morning of the 2nd I found to be brim full, and evidently had run over; this receptacle contained 2·95 in., so that I registered 4·56 in., and in all probability a great deal more rain fell."

UPMINSTER HALL.—"From various reasons I believe the fall to have been considerably over four-and-a-half inches. It began to rain hard between 7 and 8 p.m. on 1st, and at 9 it was coming down in sluices: this continued until 2 a.m., when it occasionally eased into hard rain. At 4·15 a.m. I went to the gauge, and found it had overflowed; the quantity it contained, making the total up to that time 4·43 in.; after that ·07 in. more fell. At 2 a.m. a mile from here the water was roaring over the bridges and roads a hundred yards wide, and nearly six feet deep, and all the hollows or dips in the roads were filled with water. The peculiar thing about the storm was the constant and very vivid lightning, and the way the water came down, as if a large tub had suddenly been emptied on one spot. At 9.30 a.m. on 2nd, the Cranham Road, about half a mile from here, was 4 ft. deep in water. On July 30th, 1·07 in. of rain fell in half an hour."

LITTLE ILFORD.—"July 30th, between 4 and 7 p.m., 1·85 in. fell with thunder. August 2nd, the River Roding burst its embankments."

INGATESTONE, MARGARETTING.—"From 8 p.m. on August 1st, to 2 a.m. on August 2nd, a terrible thunderstorm raged. The rain which fell during the actual thunderstorm was not much heavier than that which fell during the day, but was very heavy throughout. There was no hail."

BRENTWOOD, DUDBROOK HOUSE.—"Commenced raining early on morning of 1st, and never ceased till after 5 a.m. on 2nd."

THE FLOODS OF AUGUST 2ND.

At Erith, the sewers were unable to carry off the water, and it washed away a portion of the road and carried about 100 tons of earth on to the South Eastern Railway, which was soon flooded to the depth of several feet. The 10·30 a.m. down train, after leaving Erith Station, ran off the rails where the accumulation of earth and water blocked the line.

Owing to the immense amount of rain, the Ravensbourne and Quaggy are overflowing at New Cross, Deptford and Lewisham, and many houses are flooded in their basements. In the Isle of Dogs, one of the large open fields at the back of the West Ferry-road is a veritable lake, with four feet of water at one end and two at the other. In the lane leading from the Midland Railway dock to Manchester-road, the water rushed over the pavement into the front areas of the houses with such force that the gardens were swept down into the front rooms.

Plaistow and Stratford are in much the same condition. A house in Grafton-road, Plaistow, had six feet of water in the cellars. The fields abutting on the Great Eastern from Bow to Stratford are more or less under water, and so are many portions of Epping Forest. Across Hackney Marshes and round about Temple Mills, all the houses in the hollows are flooded, and the same applies to the lower parts of Tottenham and Clapton. The condition of the poor people living around Victoria Dock is deplorable, many streets being

impassable; the basements of the houses in Barking-road and several adjoining streets are inundated, and the West Ham fire engines and gangs of men are employed pumping the water out.

The heavy rain has been attended with serious results on the Great Eastern Railway. In the early hours of the morning the water rushed down the hill sides abutting on Epping Forest, and the main line of the Great Eastern Railway between Ilford and Chadwell Heath was, by 5 o'clock, completely submerged. In some parts the water is reported to have risen to a height of four feet over the rails. The through traffic with the east coast was absolutely stopped, and the trains had to be worked by way of Bishop Stortford. In the course of the morning the water rapidly subsided, and about 2 p.m. the main line traffic was resumed.

A portion of the London and Tilbury Railway near Plaistow Station was flooded, traffic to London being suspended early in the morning.

At Ilford, a substantial wooden bridge leading to the volunteer butts, close to the railway line, was washed away. At Ilford Bridge the water on each side flooded the neighbourhood, and in some parts of the town cut off the occupants of cottages, who had to get to their business or home again by the use of rafts or boats, the water being up to the window sills of the downstairs rooms. On the London side of the road the water rushed down a builder's yard and gained access to the backyards of about 150 houses, flooding also the front of about 20 in the roadway as well. Farther down the main road was flooded, and 40 or 50 market waggons were stopped. St. Mary's Churchyard was flooded, while at the brickfields and at the paper mills there was about eight feet of water, Railway traffic was impeded till past 9 o'clock, while between Ilford Station and Chadwell Heath the water was so deep that the fires of the engines were extinguished.

The river Rom* overflowed, flooding Romford. The water came down from the uplands on the north and the railway formed a prolific conduit on the east. High-street, North-street, South-street, and the London-road as far as the "Slater's Arms" inn, quickly became powerful streams, and the flood extended into the market place beyond the police-station, while for miles the course of the river Rom was marked by a broad expanse of water. From the railway a large stream flowed into the Junction and Eastern-roads, flooding gardens and houses and adding to the volume in the lower part of the town. In the district many cattle, horses and pigs, were drowned, haystacks demolished, and farm crops destroyed. At Messrs. Ind, Coope and Co's brewery the water was 3ft. deep at the highest point in the yard, and 5ft. to 6ft. in the lower parts. About 4,000 barrels, both full and empty, were washed out of their premises and covered a vast stretch of water. The loss of one life is reported. that of a man who was on a raft which upset. About 6 a.m. the flood began to subside, but at 10 a.m. the main street was still under water. In South-street the water stood at a height of 3ft. in the post office and the shops, and in North-street it reached a higher level. According to the *Stratford Express*, the highest flood hitherto known in Romford occurred in 1841, when the water mark was from 12in. to 15in. below that attained by this latest visitation. Railway traffic was much interrupted, no train being able to pass Chadwell Heath on the down line and Haroldwood on the up line after 2 a.m. At Squirrels Heath the railway track was covered with 5ft. of earth and sand. A single line was opened at 10 a.m.

The Ingatestone Gas Works were so flooded that all the fires were put out, and on Wednesday night no gas could be got.

At Chelmsford, about 3 a.m., people living in the lower part of the High-street, Moulsham and London-roads, and, later on, in Springfield-road, the Friars, Baddow-road, and the Barrack-square, were aroused by the floods rushing into their basements.

* All the maps to which we can readily refer call this the Bourne Brook.—ED.

The river, overflowing at the back of the new London-road, came sweeping up through Dr. Bodkin's house and orchard, poured across the London-road, and submerged the Friars-place, the basements of the houses there being several feet deep in water.

After passing the iron bridge the swollen Cann* tore down the garden hedges and palings, flooding, as we have said, the houses in the High-street. On the other side it poured into the congregational chapel, filling the school-room below; it then carried away about 40 yards of the wall on the right hand side and threw an immense volume of water into Barrack-square.

Coming again to the High-street, a swift stream came up through the Queen's Head gateway, soon covering the road many feet deep. Another stream came up Vickridges-square, and, converging with the first, rushed down the Springfield-road as far as Chelmer Bridge. French's-square was covered several feet deep and the houses suffered. The houses in Museum terrace suffered badly, their gardens were swamped and destroyed and the water flooded the basements quite up to the ceilings. At the club the basements and kitchens were entirely filled, and in the billiard-room the water almost came up to the top of the billiard tables.

Naturally the attention of the authorities was directed to the bridges, and they were anxiously watched. The iron bridge in the New London-road, which was built about 1840, was early doubted. The stream was rushing through within six inches of the footway, shaking the bridge a good deal. Soon after seven o'clock the current, which had done great damage in Dr. Down's garden, tore down the wall, which sent the stream across to the large willow which stood on the Institute side. The current undermined the tree, and in a few minutes it was torn up and dashed against the bridge and then dropped sideways. The effect of this was disastrous, as it diverted the full force of the water to the buttress, where it speedily made a breach, and the whole mass of iron and roadway fell into the stream. On the other side of the High-street the water penetrated as far as Mr. Hicks's shop. Along the Springfield-road as far as Mr. Munnion's the houses were deeply flooded. The gardens of Western-terrace, New London-road, were submerged and the basements flooded. In the Baptist chapel, New London-road, a high water mark is left on the seats. In Wolsley-road, New Writtle-road, the water rose above the mantle-pieces on the ground floor. Van Dieman's Land was flooded deeply, and the lane leading thence to Mildmay-road was like a river up to the Board of Health gates. The Baddow-road was submerged several feet deep nearly up to the Army and Navy Inn; even the high path was covered. The fields stretching down to the navigation looked like an immense lake. The flood extended up Moulsham-street as far as Mr. Remington's house. In the Friars the current carried away the wall of the Bristol School and some of the back gates of Western-terrace.

The floods at Barnes Mill and Sandford Mill were a foot deeper than has been known for 20 years.

ARE THUNDERSTORMS MORE FREQUENT IN TOWNS THAN IN THE OPEN COUNTRY?

When Snow Harris was planning his system of lightning conductors for the then new Houses of Parliament, he deemed it necessary strongly to protect the ventilating shaft of the House of Commons. A coke fire is usually kept burning in this shaft during the session,

* The southern branch of the Chelmer, which joins that river at Chelmsford.

for the purpose of maintaining a ventilating force, so that the column of hot rarefied air ascending from this shaft to a considerable height would be likely to act as a line of least resistance, and so determine the course of a lightning stroke. A case of this kind occurred in August, 1887, at Birmingham, where a chimney shaft, 140 feet high, was discharging a hot current into the air. During a storm, two men sought refuge in a hut at the base of the shaft which was not furnished with a conductor. The lightning struck the chimney, passed through the hut, and killed the men.

So also, when a flock of sheep or other animals are huddled together during a storm, a similar column of warm, rarefied air is produced and this accounts for the frequency with which animals are struck. M. D'Abbadie gives a case which occurred in Ethiopia, n which 2,000 sheep were killed by a flash of lightning. In August, 1858, a flock of 140 sheep was struck by lightning at Salceo in Italy and 120 were killed. The shepherd wasnot touched, and the shepherd boy escaped, but a kid which he held in his arms was killed. Hence arises the curious question whether human beings are less liable to be struck than the so-called lower animals? The latter would send up a more heated steamy current of warm air than the former; but still, it is difficult to account for the death of the kid in the boy's arms while the boy escaped. A case more easy of solution was related to me by Mr. P. Dudgeon, of Cargen, Dumfries. On the 19th May last a man was leading home two horses just taken from the plough. The horses were struck and killed, the man was not injured by the lightning, but was hurt by one of the horses falling on him. He was leading the horses on the near side of the pair. In this case the day was hot and oppressive (79° F. in the shade), so that the horses must have been very warm, and sent up with the heated air from their bodies a considerable column of moisture. The man probably did not share in this rarefied air, and so escaped from the lightning only to be injured by the fall of the horse.

Bearing in mind the above details, the questions that I wish to submit to your readers are (1) whether London has nc t a larger share of thunderstorms than the surrounding country? (2) whether such storms are not of longer continuance, recharging like the residual charge in a Leyden jar, so that the storm is more prolonged than in the country? (3) Whether large towns generally are not more liable to thunderstorms than the simple country, from the fact of their throwing up heated columns of vitiated air? (4) Are there any statistics to show the frequency of storms of lightning at different stations in Great Britain?

C. TOMLINSON, F.R.S., &c.

Highgate, N., 21st August, 1888.

THE EARTHQUAKE IN DUMFRIESSHIRE ON JULY 19TH.

SIR,—You may have noticed in the papers that the shock of an earthquake was felt in many parts of Dumfrieshire on the morning of the 19th inst. It appears that it was also felt across the water-shed at the head of Eskdalemoor, a range 1,500 to 2,000 feet high. Plotting on a map all the places from which the shock is reported gives a roughly oval area about 35 miles by 15 miles, its major axis lying nearly N.E. and S.W. between Hawick and Dumfries. The shock, as far as I can make out (for the time people gave me differed a little), occurred very nearly at 4 a.m. The wave apparrently crossed the country very nearly from E. to W. or from W. to E., it is impossible to say which. A great number of people from all parts of the country were assembled at Dumfries on the 20th to attend a presentation of Colours to the Militia Regiment, so I had a good opportunity of making personal enquiries about the earthquake, and give below what I ascertained. I asked many of my friends to make enquiries in their respective neighbourhoods, if they could hear of any pendulum clocks having been stopped by the shock, and at the same time to ascertain, if they met with such a case, in what direction the pendulum swung. If I can get any information on this point I will communicate with you after.—I remain, yours truly,

PAT. DUDGEON.

21*st July*, 1888, *Cargen, Dumfries.*

Gribton.—Sleepers awakened by bed shaking.

Blackwood.—Shock distinctly felt, but slight (the present occupier familiar with earthquake shocks, having resided for some time in India, where he had experience of them).

Isle.—Sleepers awakened by bed-shaking.

Jardine Hall.—Room shaken and noise distinctly heard.

Fourmerkland (near above).—Bed very distinctly shaken.

Kirkmichael.—Sleepers awakened by bed-shaking.

Dormont.—Rumbling noise awoke sleeper, shock immediately followed; doors and windows shaken, crackling sound heard after shock was over as if walls were settling. Dormont is a large and substantial house, and the gentleman at present occupying it has had large experience of earthquake shocks in Japan and China, and immediately recognised it as one.

Burnfoot.—Sleepers awakened, a sound heard as if a number of cattle were running past the house.

All the above places are substantial houses, the residences of country gentlemen, and what I have noted is as nearly as possible what was told me by the occupiers.

For other details I enclose some slips of local papers.

EARTHQUAKE IN DUMFRIESSHIRE.—On Thursday morning, shortly before four o'clock, what is believed to have been an earthquake

shock was distinctly felt over most of Annandale and Eskdale. A rumbling noise roused many sleepers, who felt their beds gently oscillating. At Mr. Patterson's, Dalmakethar, Applegarth, a portion of the ceiling of one room fell, while the oscillation was very distinct. At the house of Mrs. Todd, Underwood House, Tundergarth, the family and servants were awakened by hearing the sounds of unusual movements amongst quantities of china. The shock was also distinctly felt at Scroggs, in the same parish, and at Blackford House, St. Mungo. At Wamphraygate Farm, Wamphray, Mr. Mackie and his household were alarmed by the loud noise and jingling of utensils, and leaped out of bed. The shock and reverberating sound only lasted a few seconds. Reports have been received from the upland districts of Annandale indicating that the earthquake was more severely felt there than in the lower localities. At Hazelbank the noise was very loud. Mr. Hay, Boreland, Hutton, who has had experience of earthquake shocks in New Zealand, says the shock lasted about a minute. His house distinctly vibrated, and the crockery rattled. At Johnstone and other places in Eskdalemuir the shock created much alarm.—Our Langholm correspondent writes: There was considerable gossip on Thursday morning in the town about a shock of earthquake having been felt early that morning, point being given to the stories by a statement that some houses had fallen in the parish of Westerkirk. This statement failed to receive confirmation, but accounts from both town and country go to show that there was a slight shock felt about a quarter to four in the morning.—The shock was also slightly felt in various parts of Nithsdale. At Auldgirth, Mr. Fergusson, teacher, both heard a peculiar noise and felt the oscillation; and several persons in the immediate neighbourhood of Dumfries make a similiar report.

THE EARTHQUAKE IN THE SOUTH OF SCOTLAND.—Dr. Brydon, Hawick, referring to the earthquake shock experienced in Lockerbie, says:—It will be interesting to know that it was also felt in upper Teviotdale about the same time. At half-past three the shepherd of Rashiegrain, the highest-up house in Teviotdale, the farm on which is the classic Teviot stone, was awakened by the rattling of the plates on his dresser, the howling of his dogs, and the lowing of the cattle about the place. His first impression was that it was thunder, but on looking out there were no thunder-clouds, nor anything to indicate this. It was a calm, still night, with a little haze along the valleys. The valley of the Borthwick lies some six or seven miles northward, and there, at Howpasley, and other homesteads, similar manifestations were experienced. Eskdalemuir in Dumfries, and Teviotdale in Roxburgh, are separated from each other by a high range of hills, running north and south; and on either side for a long distance the rock formation belongs to the Lower Silurian.

SUPPLEMENTARY TABLE OF RAINFALL, AUGUST, 1888.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	2·22	XI.	Castle Malgwyn	4·52
,,	Margate, Birchington...	...	,,	Rhayader, Nantgwillt..	6·71
,,	Littlehampton	2·56	,,	Carno, Tybrith	4·27
,,	Hailsham	1·74	,,	Corwen, Rhug	2·91
,,	Ryde, Thornbrough	2·06	,,	Port Madoc	6·21
,,	Alton, Ashdell.....	2·36	,,	I. of Man, Douglas	2·89
III.	Oxford, Magdalen Col...	1·97	XII.	Stoneykirk, Ardwell Ho.	3·50
,,	Banbury, Bloxham	2·28	,,	New Galloway, Glenlee	4·72
,,	Northampton	1·87	,,	Melrose, Abbey Gate...	2·83
,,	Cambridge, Beech Ho...	2·09	XIII.	N. Esk Res. [Penicuick]	3·05
,,	Wisbech, Bank House..	2·52	XIV.	Ballantrae, Glendrishaig	4·75
IV.	Southend	4·25	,,	Glasgow, Queen's Park.	2·17
,,	Harlow, Sheering	4·13	XV.	Islay, Gruinart School..	3·59
,,	Rendlesham Hall	1·53	XVI.	St. Andrews, Pilmour Cot	1·76
,,	Diss	2·42	,,	Balquhidder, Stronvar..	5·11
,,	Swaffham	3·50	,,	Dunkeld, Inver Braan..	2·49
V.	Salisbury, Alderbury...	1·40	,,	Dalnaspidal H.R.S. ...	3·39
,,	Warminster	1·61	XVII.	Keith H.R.S.	2·49
,,	Bishop's Cannings	1·95	,,	Forres H.R.S.	1·35
,,	Ashburton, Holne Vic....	3·64	XVIII.	Strome Ferry H.R.S....	5·06
,,	Hatherleigh, Winsford.	3·69	,,	Fearn, Lower Pitkerrie.	2·22
,,	Lynmouth, Glenthorne.	3·60	,,	Loch Shiel, Glenaladale	11·28
,,	Probus, Lamellyn	3·67	,,	S. Uist. Ardkenneth ...	3·00
,,	Launceston, S. Petherwin	3·83	,,	Invergarry	4·73
,,	Wincanton, Stowell Rec.	1·59	XIX.	Lairg H.R.S.	...
,,	Taunton, Lydeard Ho...	2·22	,,	Forsinard H.R.S.	2·52
,,	Wells, Westbury.....	2·36	,,	Watten H.R.S.	3·67
VI.	Bristol, Clifton	2·55	XX.	Dunmanway, Coolkelure	6·36
,,	Ross	2·40	,,	Fermoy, Gas Works ...	2·92
,,	Wem, Clive Vicarage ...	3·95	,,	Tipperary, Henry Street	2·97
,,	Cheadle, The Heath Ho.	3·41	,,	Limerick, Kilcornan ...	2·41
,,	Worcester, Diglis Lock	1·87	,,	Miltown Malbay.....	4·17
,,	Coventry, Coundon	2·45	XXI.	Gorey, Courtown House	2·50
VII.	Melton, Coston	2·26	,,	Navan, Balrath	2·62
,,	Ketton Hall [Stamford]	2·19	,,	Mullingar, Belvedere ...	2·46
,,	Horncastle, Bucknall ...	2·06	,,	Athlone, Twyford	2·14
,,	Mansfield, St. John's St.	2·52	,,	Longford, Currygrane...	3·89
VIII.	Knutsford, Heathside ...	3·54	XXII.	Galway, Queen's Coll...	2·57
,,	Walton-on-the-Hill.....	3·10	,,	Clifden, Kylemore	8·72
,,	Lancaster, South Road.	3·32	,,	Crossmolina, Enniscoe..	5·08
,,	Broughton-in-Furness ..	4·95	,,	Collooney, Markree Obs.	4·30
IX.	Shipley, Esholt Vic. ..	...	XXIII.	Rockcorry.....	4·16
,,	Ripon, Mickley	3·05	,,	Warrenpoint	2·75
,,	Scarborough, West Bank	2·91	,,	Seaforde	2·86
,,	East Layton [Darlington]	1·48	,,	Belfast, New Barnsley .	4·17
,,	Middleton, Mickleton ..	1·82	,,	Cushendun	6·39
X.	Haltwhistle, Unthank..	2·76	,,	Bushmills	5·17
,,	Shap, Copy Hill	3·08	,,	Stewartstown	3·81
XI.	Llanfrechfa Grange ...	2·93	,,	Buncrana	4·18
,,	Llandovery	6·64			

AUGUST, 1888.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1870–9	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) ...	3·61	+ ·87	1·39	1	14	84·6	10	43·9	19	0	0
II.		Maidstone (Hunton Court)...	2·19	— ·05	·74	1	12	...	...	...	...	...	...
,,		Strathfield Turgiss	1·75	— ·67	·59	1	15	80·4	10	40·8	19	0	0
III.		Hitchin	2·30	+ ·02	·58	28	13	80·0	10	42·0	31	0	...
,,		Winslow (Addington)	1·97	— ·98	·48	20*f*	13	8 4·0	10	40·0	14*d*	0	...
IV.		Bury St. Edmunds (Culford)	2·62	+ ·45	·60	21	14	90·0	10	36·0	15	0	...
,,		Norwich (Cossey)	2·00	— ·62	·59	28	13	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	1·79	...	·56	20	16	72·0	9	44·0	18	0	...
,,		Barnstaple.....	4·58	+ ·48	·94	28	15	74·0	10	41·0	18	0	...
,,		Bodmin	2·82	— 2·02	·51	28	20	68·0	7	46·0	1,2	0	0
VI.		Stroud (Upfield)	1·82	— 1·35	·57	28	13	83·0	9	45·0	18	0	...
,,		ChurchStretton(Woolstaston)	4·68	+ ·60	1·34	28	16	78·5	9	43·0	17*e*	0	0
,,		Tenbury (Orleton)	2·81	— ·91	·88	28	16	81·3	10	37·3	14	0	0
VII.		Leicester (Barkby)	2·38	— ·17	·91	28	15	86·0	9	35·0	14	0	0
,,		Boston	2·25	— ·36	·62	28	14	85·0	9	36·0	19	0	...
,,		Hesley Hall [Tickhill].....	1·95	...	1·06	28	16	82·0	9	38·0	15	0	...
VIII.		Manchester (Ardwick).....	2·20	— 1·72	·93	28	16	74·0	9, 10	46·0	1*g*	0	...
IX.		Wetherby (Ribston Hall) ...	1·92	— ·71	1·04	29	9	...	...	...	...	...	...
,,		Skipton (Arncliffe)	5·76	— ·04	1·10	4	22	73·0	9	39·0	18	0	...
,,		Hull (People's Park)	2·41	— ·61	·92	28	19	...	...	...	...	...	...
X.		North Shields	2·03	— 1·06	·71	4	14	71·0	8	40·5	1	0	0
,,		Borrowdale (Seathwaite).....	9·30	— 1·74	1·83	4	20	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	4·26	— 1·07	1·00	28*a*	16	...	...	...	...	...	...
,,		Haverfordwest	4·82	— ·15	1·38	28	19	67·5	3, 7*c*	37·0	17	0	1
,,		Plinlimmon (Cwmsymlog) ...	6·45	...	1·20	28	18	...	...	...	...	...	...
,,		Llandudno.....	2·94	— ·25	·57	28	18	69·8	7	43·5	2	0	...
XII.		Cargen [Dumfries]	3·08	— 1·19	·68	4	18	69·0	22	37·0	1	0	...
,,		Jedburgh (Sunnyside).....	1·90	— 1·47	·46	26	16	68·0	25	37·0	19	0	...
XIV.		Old Cumnock	3·59	— ·55	·67	12	22	72·0	25	34·0	30	0	...
XV.		Lochgilphead (Kilmory).....	4·24	— ·98	·74	3	18	...	...	...	...	...	...
,,		Oban (Craigvarren)	...	...	...	...	...	...	...	...	...	...	...
,,		Mull (Quinish).....	5·69	...	·83	31	20	...	...	...	...	...	...
XVI.	SCOTLAND.	Loch Leven Sluices	2·20	— 1·88	·50	13	9	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	1·80	— 1·47	·45	20	14	74·4	25	40·2	19	0	...
XVII.		Braemar	1·97	— 2·46	·42	1	25	66·4	25	33·0	16	0	8
,,		Aberdeen	2·05	...	·35	22	19	69·0	25	35·0	19	0	...
XVIII		Lochbroom	2·93	...	·70	13	24	...	...	...	...	...	...
,,		Culloden	1·56	— 1·44	...	...	...	70·0	25	40·0	3	0	2
XIX.		Dunrobin	2·09	...	·25	23*h*	13	67·0	22	40·5	1	0	...
,,		Kirkwall (Swanbister)..... ..	...	...	...	...	...	...	...	...	...	...	...
XX.	IRELAND.	Cork (Blackrock)	3·62	— ·21	1·15	19	20	73·0	15	41·0	13	0	...
,,		Dromore Castle	5·19	...	·96	23	18	75·0	15	42·0	1	0	...
,,		Waterford (Brook Lodge) ...	3·12	...	·97	19	18	74·0	6	36·0	18	0	...
,,		O'Briensbridge (Ross)	2·92	...	·88	19	20	72·0	...	41·0	19	0	...
XXI.		Carlow (Browne's Hill)	3·01	— ·72	·63	19	20	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	1·27	— 1·91	·23	19*b*	12	71·4	7	42·0	18	0	0
XXII.		Ballinasloe	2·81	— 1·22	·65	1	23	71·0	9	36·0	18	0	...
XXIII		Waringstown	3·16	— ·28	1·00	26	19	73·0	11	39·0	1	0	...
,,		Londonderry (Creggan Res.).	5·00	...	1·62	12	25	...	...	...	...	...	...
,,		Omagh (Edenfel)	4·18	+ ·53	·58	11	22	67·0	21	43·0	1, 13	0	0

a And 29. *b* And 21. *c* And 10. *d* And 15, 16, 19. *e* And 18. *f* And 28. *g* And 16, 18. *h* And 31.

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

METEOROLOGICAL NOTES ON AUGUST, 1888.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermoneter; 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 wet, cold, and cloudy month. Very trying for haymakers, some hay not carried at the close; crops mostly injured, chiefly by lack of sun. Gale on 28th.

ADDINGTON.—The early part of the month was an improvement on the weather of July, and a good deal of hay was secured in moderate condition; but the latter part was very unsettled, and some hay remained out at the close. The cutting of wheat and oats began in the last week.

LANGTON HERRING.—Although R fell on 19 days the total was ·40 in. below the average of 13 years. It was the coldest August in 17 years—the mean temp. being 2°·9 below the average—and the twelfth successive cold month. Slight TSS occurred on the 2nd and 9th, but we escaped the heavy rains which fell in some parts. Great want of sunshine prevented fruits ripening.

BODMIN.—Another cold, dull month; mean temp. 59°·8.

STROUD UPFIELD.—Very little sun; heavy electrical clouds about, all the month, and L at night.

WOOLSTASTON.—An ungenial month, with no sunshine; most unfavourable for harvest operations.

ORLETON.—A cloudy, gloomy, wet and cold month, with the exception of the 7th to 10th, 14th and 31st, which were beautiful days. The mean temp. was nearly 3° below the average of 27 years, and was lower only in 1885. The sky was generally overcast and gloomy, with frequent small R, and occasional heavy showers. T was heard on 5 days, and TSS, with heavy R, occurred on 21st and 28th, that of the latter date causing a flood on the river Teme. Pressure was below the average, and the wind was frequently rough.

BARKBY.—A very cloudy month, with low temp. Oats cut on 13th; wheat on 18th; winter beans on 25th. In some cases winter beans, oats and wheat will be got before the first crop of hay, showing the extraordinary character of the year. Much T.

ARNCLIFFE.—Very wet, dark and cold.

HULL.—From the 1st to the 20th the weather was generally cloudy, with occasional showers, but during the remainder of the month, R fell almost daily. T on 3 days.

WALES.

HAVERFORDWEST.—R fell frequently in small quantities during the first 12 days; it was then very fine, though cold, to the 18th; and the remainder of the month was very wet, and at times stormy. A heavy storm of R and wind occurred from 27th to 29th, causing heavy floods and doing considerable damage to the corn, but though the heavy crops were beaten down in many places, owing to the low temp., no sprouting occurred. The coldest August registered mean temp. 57°·5. Much hay still out.

SCOTLAND.

CARGEN.—Another cold, gloomy month, the mean temp. being 3°·4 below the average; every month since January has had a temp. below the average, and the total duration of sunshine shows a deficiency of 264 hours. T on 4 days.

JEDBURGH.—Ungenial throughout, with many wet days, and a marked absence of sunshine. Corn crops very good, but late; root crops healthy and good.

LOCHBROOM.—Though R fell on 24 days, the total is small, and it was a good growing month, but crops are meagre and very late.

CULLODEN.—Temp. below the average, and R at long intervals. Harvest late, but crops looking well.

IRELAND.

CORK.—Excepting four fine days, from 13th–17th, the weather was showery and often cold. T on 9th and 21st.

DROMORE.—A very wet month, hay and oats damaged.

WATERFORD.—The weather of the month was very broken, though the total R was half-an-inch below the average, mean temp., 57°·3. T and L on 1st and 21st.

O'BRIENSBRIDGE.—Six successive bright days about the middle of the month were of incalculable value in repairing previous damage to hay crop and enabling farmers to secure a large quantity in fair condition; the remainder of the month was nearly as bad as in 1879.

DUBLIN.—Rather cool, very breezy and showery. Mean temp., 58°·2, decidedly below the average; mean humidity 84; mean amount of cloud 5·4.

WARINGSTOWN.—On the 26th, 1·00 in. of R fell in three showers, not in all lasting over two hours.

EDENFEL.—With the exception of a short spell in the beginning of the third week, the month was gloomy, wet and sunless, rendering hay-saving even more difficult than in 1879, and retarding the maturing of all cereals to a serious extent.

COLD NIGHTS IN AUGUST, 1888.

To the Editor of the Meteorological Magazine.

SIR,—I have to report a rather low night temperature, at this station for August, 1888, and especially so during four nights in the middle of the month, namely:—

		Min. in Shade.		Min. on Grass.
August 15	... ..	45°·0	.....	37°·2
,, 17	.....	47 ·0	.....	42 ·2
,, 18	.....	45 ·2	.....	37 ·0
,, 19	.....	40 ·4	.....	36 ·3
	Mean	44 ·4		38 ·2

For 18 nights the minimum readings were below the *mean*, as compared with the average for August for 10 years, 1879-88. I find, however, two *single* nights in the 10 years as low:—In August, 1885 and 1887 thus—14th of August, 1885, 39°·5 and 36°·8; and 15th August, 1887, 42°·0 and 36°·0, but not three or four nights in succession.

The mean of August *min.* for 10 years is 52°·9 in shade, and 49°·3 on grass. This past August the means were 51°·6 and 47°·7 respectively, showing a defect of 1°·3 in shade, 1°·6 on grass.

SAM. H. MILLER.

Lowestoft, Sept. 1, 1888.

ERRATUM IN *MET. MAG.*, AUGUST.

Table of Rainfall and Temperature, July, p. 110—London, Camden-square, max. temp., 72°·7 on 19th, min. temp., 42°·8 on 11th; *not* 75°·9 and 55°·7 as printed.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCLXXIII.] OCTOBER, 1888. [PRICE FOURPENCE, or 5s. per ann. post free.

THE BRITISH ASSOCIATION AT BATH.

WE cannot spare space to describe as fully as we have sometimes done the work of the British Association meeting. Moreover, the discussion upon Lightning Conductors occupied more than three hours, hence even a very condensed report of it will unavoidably occupy much space, and the subject is of too great importance to be slighted. We shall therefore give a list of the reports and papers which bore upon meteorology, and, where practicable, state the leading *feature* of each in a few words.

Report of the Committee on Meteoric Dust.—Prof. Schuster, F.R.S., has all along been the chief worker in this committee; he has been seriously ill, and therefore only an interim report was presented. When a meteor comes within our atmosphere, it is rendered incandescent by friction against the air, it is rapidly oxidized, and particles of oxide, &c., fall away, forming for a few seconds the "tail" of the meteor. These particles fall very slowly to the earth, and the committee was appointed to collect dust from snow-covered mountain tops and from arctic wastes, far away from centres of population, and ascertain its constituents.

Report of the Earth Tremor Committee.—The North of England Institute of Mining Engineers began a few years since the automatic registration of some slight tremors (hardly strong enough to be called earth-quakes). which were found to be somewhat frequent on the coast of Durham. The subject was brought before the British Association in 1887 by Prof. Lebour, F.R.S., and a rather strong committee was appointed to consider the subject. The present is their first report, and it deals with the various instruments suggested and tried, and points out the difficulty of finding sites free from disturbing causes such as sea waves, strong winds, railways, carriages, &c. The committee, while very desirous that similar observations should be made in other parts of the country, point out that the first essential is agreement as to form of instrument and mode of erection. We desire to mention in connection with the above that Vol. XXXVII. of the "Proceedings" of the North of England Insti-

tute of Mining Engineers contains two most valuable papers on seismometers, amply illustrated, the first being the report of its own committee, and the second a paper by Prof. A. S. Herschel, F.R.S.

Report of the Committee on Solar Radiation.—This committee was appointed several years since in order to ascertain whether it was possible to determine precisely the amount of heat received on the surface of the earth. The committee have had a beautiful instrument constructed by Mr. Casella, from designs furnished (jointly we believe) by Prof. Stokes, F.R.S., and the late Prof. Balfour Stewart, F.R.S.; the latter had been throughout secretary to the committee, and was on the point of testing the instrument when he was taken from us. The committee has been re-appointed, with the addition of Mr. Whipple, of Kew Observatory, and it is to be hoped that the instrument will soon be on trial.

Report of the Committee on the Ben Nevis Meteorological Observatory.—The committee report that the work done at the observatory has been mostly directed towards obtaining a wider knowledge of halos, of clouds, St. Elmo's fires, and other natural phenomena. It is found that the St. Elmo's fire is observed at definite phases of the weather. The usual difference in temperature between the summit and bottom of Ben Nevis is about 16° F., but in the driest season of the year it became as small as 7° F. With reference to electrical phenomena, the report states that, when a cloud rests on the mountain, the telegraphic wire which makes communication between the base and summit has an earth current passing through it in one direction, and after the cloud blows over, the direction of the earth current changes. Some work has been done with a view to ascertaining, in conjunction with other observatories, the earliest time at which a storm can be predicted which is travelling from the Atlantic over the British Isles to the European Continent, and by observing the prevailing cyclones and anticyclones the observers think it possible to find out whether a storm reaching the British Isles will travel northward or southward. The committee strongly advocate the erection of a low level station at or near Fort William. We understand that the Meteorological Council have granted for this low level station some, or all, of the instruments formerly at their station at Armagh.

Report of the Committee on the Surface Temperature of Rivers, Lakes, and Estuaries.

This committee was appointed to investigate the seasonable variations of temperature in lakes, rivers, and estuaries in different parts of the United Kingdom, in co-operation with the local societies represented on the Association. The work of the committee has been confined to testing the methods for carrying on a series of systematic general observations. To be satisfactory, such observations must be conducted simultaneously for a period of several years, in as many parts of the country as possible. Volunteer observers will be necessary, and for this purpose it seems to the committee eminently desirable

to obtain the co-operation of local societies, the members of which might feel disposed to take up the work for a definite time. During the present year a commencement has been made in Scotland. There were 20 observers at work for the committee, supplied with thermometers of a uniform pattern. After giving details, the committee recommend that they be re-appointed, with a grant to be expended in clerical assistance, observation books and circulars, thermometers, and postage. The actual arrangements have been mainly carried out by Dr. H. R. Mill, assisted by Mr. John Gunn, of the *Challenger* office. The committee was re-appointed, with a grant of £30.

HON. R. ABERCROMBY.—*Modern Views about Hurricanes as compared with Older Theories.*

The author said that the old conception of the hurricane was that the wind blew in circles; but modern research showed that a hurricane was really an oval eddy, and that the vortex, or centre, of the wind rotation was not in the geometrical centre of the oval, but usually nearer one edge or other of the depression. A hurricane was always changing its shape, so that the oval was sometimes lying in one way and sometimes quite in a different direction; while sometimes the vortex was displaced towards one side of the oval one day and towards quite another side on the next. The vortex swayed about and sometimes even described a loop. For several reasons no rule was possible for determining absolutely the bearing of the vortex by observations on board a single ship; whereas it used to be stated positively that facing the wind the vortex bore eight points—at right angles—to the right in the Northern, and to the left in the Southern Hemisphere. Modern research has proved that a hurricane was usually embedded in some prevailing trade wind or monsoon, and that there was therefore a belt of intensified trade wind outside the true storm field. This belt was always on the side of the hurricane furthest from the equator. The old rules for finding which semicircle of a hurricane a ship might be in, and the old rules for heaving-to in either hemisphere, were all proved to be both true and valuable by modern research. The speaker said that it was much to be regretted that the examination papers of the Board of Trade for masters and mates were painfully behind the modern standards of knowledge, and in these matters the Germans and other nations were now ahead of England. The whole knowledge expected from merchant captains was contained in six questions, and the candidate was expected to say that the centre bore eight points, or perhaps a little more, from the direction of the wind, while no notice was taken either of the small incurvature in front or of the great incurvature in rear, or of the belt of intensified trade where the usual indications of being exactly in front of the vortex failed. No one should blame the master of a ship for not following the established rules without the closest investigation, for, as Piddington says, "absolute rules are all nonsense," and much depends on the capabilities of a ship and on the ever-varying conditions of a heavy cross sea.

Prof. Douglas Archibald felt that many vessels had been lost through following strictly the antiquated rules. Seamen were rather conservative, and liked to stick to their own rules; but he was of opinion the sooner the results of modern research were adopted the better it would be all round.

Dr. W. H. Russell asked whether anyone could throw any light upon the reasons why winds were so frequently rotatory.

Mr. W. H. Shaw gave an explanation upon rotatory winds, and illustrated his remarks by several diagrams. His arguments tended to show that rotatory wind was caused by rushes of hot air from one quarter meeting rushes of cold air coming in an opposite direction, which caused the rotatory motion.

CAPTAIN ABNEY, F.R.S.—*On Transparency of the Atmosphere.*

E. A. COWPER.—*An improved Seismograph.*

Mr. Cowper is a member of the Earth Tremors Committee already mentioned, and this was a description of an instrument which he had been led to design for the work of the Committee.

PROFESSOR G. H. DARWIN, F.R.S.—*On the Mechanical Conditions of a Swarm of Meteorites, and on Theories of Cosmogony.*

This and the subsequent paper by Mr. Norman Lockyer himself, bear on his remarkable hypothesis of the formation of the Solar System.

J. JOLY.—*On reading electrically Meteorological Instruments distant from the Observer.*

The method consists in lowering, by an escapement arrangement worked by an electro-magnet, a platinum wire into the tube of the barometer or thermometer whose height is to be read off. The initial height of the end of the wire is known, and every time a current is sent through the electro-magnet, the wire is lowered by the one-hundredth part of an inch. The total distance by which the wire is lowered is therefore known from the number of contacts. When the mercury and the platinum wire touch, a current passes, which gives a signal by an electric bell.

This reads like a very crude form of the Meteorograph invented many years since by Van Rysselbergh, which has long been in operation at Brussels, and which, during the Paris Electrical Exhibition, engraved in Paris the complete meteorological elements as they were occurring at Brussels.

PROF. J. NORMAN LOCKYER, F.R.S.—*The Spectra of Meteorites compared with the Solar Spectrum.*

See *ante.*

E. J. LOWE.—*On the Effects of the Weather of* 1888 *on the Animal and Vegetable Kingdoms.*

DR. H. R. MILL.—*On the Temperature of some Scottish Rivers.*

W. N. SHAW.—*On some Charts of Kew Corrections for Mercury Thermometers.*

W. N. SHAW.—*On an Apparatus for Determining the Temperature by the Variation of Electrical Resistance.*

We have no abstracts of these papers and were unable to be present when they were read. The title of the last one indicates a probable relation to the long-distance-reading-thermometer invented by Sir W. Siemens, and which the Royal Meteorological Society has at work on the tower of Lincoln Cathedral.

THE DISCUSSION ON LIGHTNING CONDUCTORS.

The discussion between the Mathematical and Physical Science and the Mechanical Sections on lightning conductors was as brilliant a passage of arms as any of the memorable encounters which have taken place in former meetings

of the Association. Some years ago a conference of eminent philosophers considered closely the whole subject, and drew up a report, with rules and regulations for their use and application, which report is widely known, and almost universally acted upon. The use of copper was preferred to iron; perfect connection with damp earth was to be secured by plates, and the point of the conductor was to be blunt, to prevent fusion if struck; whilst all round its upper part there was to be a ring of projecting points to attract the electricity from the atmosphere, and so continuously draw the potent force harmlessly away. People have trusted to their lightning conductors; and they have paid for copper, at a heavy price, to ensure their effectiveness. But a short time ago the late Dr. Mann's widow founded in his memory a small lectureship, with the result that Professor Oliver Lodge has, during the present year, delivered two lectures, in which information of such novelty and importance, based upon scientifically conceived experiments, has been produced as to cause extreme excitement.

The first experiment was very simple. It consisted in giving the imitation lightning discharge an alternative path, or, in other words, the choice between a certain conductor and a certain length of air. From a Holtz or Wimshurst electrical machine two Leyden jars were charged, the spark flying off between the two terminals of the machine. But the outer coats of the jars were led to a second discharger, the air-space in which could be varied. To the rods of this second discharger a circuit of fine iron wire was attached, and the electrical current, or flash, had before it the choice of conduct by the wire, or of bridging by spark through the air, the hiatus between the poles of the discharger. In its first condition the only discharge obtained between the first set of terminals was a feeble and intermittent, but frequent, sparking, very different from the loud report heard when the second set of knobs was brought within striking distance of each other. These second knobs may be at double the distance apart of the first knobs, and yet the discharge will be complete and noisy. The two sparks occur together; the first one precipitating the second. But the reverse will not take place. The experiments have been varied in different ways. Whenever the second spark was allowed to occur, the first spark was very loud; but as soon as the discharge was compelled to traverse the alternative conductor by putting the knobs too far apart for the current to bridge the gap, the noise of the discharge was much diminished, not merely because there was only one spark instead of two, but because, for some reason, the discharge meets with such obstruction in the wire that its duration is lengthened. In the first experiments the length of the first spark was maintained at one inch; the length of the second spark was varied until it sometimes passed and sometimes missed. The alternative path was forty feet of stout (No. 1 Birmingham wire gauge) copper rod, with a resistance to ordinary electric currents of 0·025 ohm. Nevertheless, the discharge refused to take this apparently easy path, and persisted in jumping the air, although the gap measured 1·43 inch. This is the critical distance; for if the knobs are removed further apart the discharge goes by the thick copper wire, and the noise and suddenness of the discharge are less. But if for the thick copper rod a similar length of fine iron wire is employed (No. 27 Birmingham wire gauge), the resistance of which to ordinary currents is 33·3 ohms, or 1,300 times as much as the other, the discharge distinctly prefers the iron wire; for if the knobs remain at the same distance apart as before, no sparks are given off, although the critical spark is increased to 1·03 in. The inference from these experiments is that the lightning conductors would be best constructed of barbed wire, the wire not being so thin as to be deflagrated by the lightning flash.

The case for the existing system was defended by Mr. Preece, who has under his charge 500,000 lightning conductors, and 30,000 or 40,000 lightning protectors in use by the Post Office for the protection of the telegraph offices. He credited Professor Lodge with having made experiments of great value; but he differed in the conclusion drawn from them. He felt convinced that the result of that discussion would be to establish the truth of the position taken

up by the Lightning Rod Conference, and would bring to the front what they were all anxious to see, the true theory of electricity shadowed forth by Professor Fitzgerald in his opening address, and that would make this meeting an epoch in the history of electricity.

PROFESSOR OLIVER J. LODGE said he had no lightning conductors under his supervision and all his conclusions were formed from experiments, and if they were correct very few buildings were effectively and thoroughly protected at the present time; and, further, if his views were correct, lightning rods would in the future cost very much less than now. Mr. Preece said that no properly constructed rod ever failed, but in the report to the conference there were a number of entire failures named.* He had made some very careful experiments in which he provided alternative courses for an electric current, and he found that it required less electro-motive force to send the current along a thin iron wire than along a thick copper one. According to Mr. Preece the object of the conductor was to prevent a flash of lightning, but conductors were struck and melted. The conductor had two functions to perform—to act as a point and prevent a flash if it could, and to carry off a flash when it could not help receiving one. The electricity above had some energy, and they could not hocus pocus it out of existence. It might be better to let it dribble away slowly down a bad conductor than to let it rush headlong down a good one. (Hear, hear). The length of flash was a question for the consideration of meteorologists, and the duration of flashes was a subject on which the same gentlemen might do good work. He had seen flashes which appearsd to last two or three seconds, but he thought they must have been a succession of flashes. The fact that flashes deflected the compass needle did not prove that they were not oscillatory nor did it prove anything as to their duration. A short powerful flash might produce the same effects. There was the question of a flash magnetizing a bar of steel. With regard to the areas of protection, the area which Mr. Preece admitted he protected was so small that they might give it him without discussion. There was, however, in his opinion no sure area of protection. Mr. Preece might have pressed him hard on the question of the conditions of a flash. He (the speaker) had assumed that the flash behaved as electricity did in an experiment. The cloud, however, was not like the tinfoil of a Leyden jar; it was made up of atoms with spaces between them, and a discharge might be more like that of a spangle jar, or might be dribbled away a bit at a time and not by great rushes. But they could not assume that it would always do so, and must prepare for the occurrence of a great rush. The true character of lightning must be discovered by observing lightning, and not by experiments in a laboratory.

THE HON. RALPH ABERCROMBY showed a number of photographs of lightning flashes, and said that there was no absolute evidence in photographs of flashes of lightning following each other rapidly on exactly the same path. There was, however, distinct evidence of the tendency of lightning flashes to occur parallel to each other. There seemed to be a tendency in lightning flashes to be ramified, to give off threads all round the main flash. Photography gave conclusive evidence that flashes were not so instantaneous as was generally supposed. It showed that the flash did not jump from a cloud straight to the earth, but went meandering through the air and tying itself into knots, so that it could not be so instantaneous as was imagined. He was of opinion that lightning clouds were generally more than 5,000ft. high, but there was no evidence of one of more than 7,000ft. high.

LORD RAYLEIGH said that although he had no special knowledge of lightning conductors, from his general acquaintance with electricity he should say that Professor Lodge's experiments would have a most important practical application to lightning conductors in the future. Mr. Preece spoke of the development

* Certainly, and in, we believe, every instance the cause of failure is pointed out—they were *not* "properly constructed."—ED.

of energy by the condensation of vapour into water, but the question was to find how some of that energy came to take the electrical form. They could come to one conclusion from what they heard—namely, that houses made of sheet iron would be the safest possible places in a thunderstorm. With reference to the reports as to the occurrence of globular lightning, he believed them to be much exaggerated, and expressed an opinion that the whole effect might be a physiological optical delusion. The most efficient protection for gunpowder against lightning would be, he thought, to put it in a house whose exterior was entirely of iron and to put no lightning rod on it.

PROFESSOR ROWLAND observed that the conditions of Professor Lodge's experiments were scarcely the same as those of actual lightning, and he pointed out that the length of the spark was no measure of the resistance of the conductor. Further, he showed some effects in Mr. Abercromby's photographs which were probably due to astigmatism in the lens of the camera.

M. DE FONVIELLE, who spoke in French, said he, with Mr. Preece, was a supporter of the old lightning conductor theory, and he was partly led to that state of mind by the fact that there were large numbers of conductors in Paris, and there was very seldom an accident caused by lightning. The large numbers of lightning rods in a city could not fail to protect the city generally from the effects of lightning and to help in discharging a thundercloud passing over it.

PROFESSOR GEORGE FORBES said that Professor Lodge had come to say that if iron was not better than copper, it was at least as good; but they could not be quite prepared to accept that, because the experiments might be tried in instances more nearly approaching the natural conditions, and in that case he believed copper would be found to be the best.

SIR J. DOUGLASS said that his experience of lighthouses protected by lightning rods covered a space of 40 years and was comforting to the members of the Lightning Rod Conference. He never knew a rod fulfilling the conditions they prescribed to fail in protecting the lighthouse.

PROFESSOR CRUM BROWN suggested the use of a revolving camera in taking photographs, in order to separate flashes, and thus see if each is single or not.

MR. SYDNEY WALKER said that anything which would cheapen lightning conductors would be gladly welcomed. In the cases where damage had occurred, he believed that the result was due to a defect in the conductor. He pointed out that iron would not stand the weather so well as copper, and that, besides, it would be affected by the gases at the top of a factory chimney or similar places.

MR. G. J. SYMONS said he had investigated many accidents by lightning and had so got valuable experience. The conclusion left on his mind was that if people would erect conductors precisely in accordance with the rules laid down by the conference and fulfilling all the conditions, they would be absolutely safe. Where accideuts occurred to buildings with conductors, there wa a reasonable explanation to be found. Professor Lodge's experiments were laboratory experiments, and to get the real facts they must have something on a much larger scale, perhaps by a series of interrupted conductors on poles on the tops of some of those high hills where storms frequently occurred. With regard to protected areas, there were only two cases on record, and those doubtful, of anything being struck within the protected area as defined by the conference.

DR. WALKER said he saw an obelisk on the top of a hill struck. The top was knocked off and the fluid came from the steps of the monument at 14 different points, ploughing up the ground and breaking rock at 100ft. distance.

Mr. WOOD thought the black flash shown in one of the photographs was due to the reflection of one of the other flashes.

LORD RAYLEIGH said that Prof. Stokes attributed it to the combination of gases in the path of the flash, causing an opaque stratum.

PROFESSOR LODGE said he could not understand why a conductor should have such a good earth. Why did not three points do at the bottom as well

as at the top? If properly-constructed conductors never failed, how was it that the hotel at Brussels was burnt, for that was considered protected in the most orthodox way?* He would not say that conductors were of no use; they were of great use, but not absolutely certain, In his experiment he was bound to adopt the plan he did, because the experiment could not be done in any other way. It was only the outer surface of the conductor which conducted, and he did not know that there was any good in the centre of a rod. A tube would do as well, and would be all the better if opened out into a flat bar, and yet, better than that would be a strand of wires. Iron buildings to be safe, must have perfect connections, for the smallest gap might give off a spark. That was the danger in houses supplied with gas; if the fluid travelled along the pipes and came to a gap a spark and explosion might result.

Mr. PREECE said the points between Professor Lodge and himself were reduced to a very small compass indeed. He himself had always been a great advocate of iron on account of its cheapness. The use of copper caused needless expense in the erection of lightning conductors. He believed every private house could be protected in accordance with the recommendations of the conference for £1, if people would buy a coil of stranded iron wire, a quarter of an inch in diameter with the finial points, and have that put up.

The President summed up the discussion, and said the principal thing for them to pay attention to was that prevention was better than cure. (Hear, hear.) There could be very little doubt that the presence of a considerable number of conductors afforded a great deal of protection to the area in which it existed, as was shown in the instance of Paris. It was desirable, if possible, that the whole country should be covered with conductors to prevent the discharge of flashes. There was no doubt that, though there might be room for improvement in the conductors, they had on the whole been right. (Cheers.)

REVIEWS.

Instructions for Observing Clouds on Land and Sea, with photographs and engravings. By the Hon. RALPH ABERCROMBY, F.R.Met.Soc. 8vo., 22 pages, 10 photos.—London: Edward Stanford, 1888.

THIS little manual has many claims upon the attention of all meteorologists. It is written by one of the most experienced observers of clouds—one who has studied them in nearly all latitudes—and it has at any rate the indirect, if not the actual support of another of the highest authorities, for we learn from the preface that Prof. Hildebrandsson, of Upsala, as well as Capt. Toynbee, has read the proof sheets and made several valuable suggestions. The frontispiece contains ten photo reproductions reduced from photographs taken by Mr. Abercromby in various parts of the world, and are by far the best series we have seen. The marvellous sharpness of the reproduction is well shown in Fig. 8, a cumulo nimbus photographed off Rio de Janeiro, wherein a building on the sea shore, although less than one-tenth of an inch in length by about one-hundredth in height, will, under adequate power, be seen to contain a door and 25 windows,

* The Hotel de Ville at Brussels was *not* protected in accordance with the report of the Lightning Rod Conference, but with thin iron rods, just such as Prof. Lodge seems to think desirable.—Compare "Melsen L. F. H. Des paratonneres à pointes, à conducteurs, et à raccordements multiples. Brussels: 1877," and "Report of Lightning Rod Conference. London: Spon., 1882."—ED.

every one perfectly sharp, though only a few thousandths of an inch in height or breadth. Having spoken thus highly of the excellence of the reproduction, we are glad to say that the photographs are worthy of the care bestowed upon them. There are very great difficulties in obtaining an accurate and uniformly printed series of cloud pictures. These are the best we have seen, but they vary much in the printing.* Mr. Abercromby is such an authority that one is almost afraid to criticise, but it seems rather strange that the name of cumulus is correctly applied both to the grand mountain-like masses in No. 1, and to the woolly tufts in No. 7.

The pamphlet is divided into three portions—

I.—Instructions for observing clouds on land and sea.

II.—The directions in which cloud stripes lie.

III.—The direction of cloud motion.

The whole work has been carefully thought out, and must be studied attentively, diagrams being freely used in illustration of Sections II. and III. Doubtless the author had good reason for omitting all reference to cloud mirrors, but if, in his opinion, they are bad, we wish that he had pointed out their defects; if they are good, we do not understand why they are ignored.

Even those who do not contemplate making systematic observations of clouds and their motions may be advised to secure a copy of this pamphlet and its beautiful frontispiece while it is to be had.

Der Wolkenbruch am 2-3 August, 1888, im Gebiete des oberen Queis und Bober—[The torrential rains of August 2nd-3rd, 1888, in the Water-sheds of the Upper Queis and Bober]. By Dr. G. HELLMAN, Excerpt from Centralblatt der Bauverwaltung. 4to., 1888.

GERMANY is rapidly being provided with an efficient system of rain-fall registration. Therefore, when the great rain of August 2nd-3rd occurred, there was a satisfactory network of stations in operation, at 50 of which more than 2·00 in. was measured. Dr. Hellman having very kindly procured for us an electro from the block used to illustrate his paper, we are able to put the whole subject before our readers in a very short and clear way.

Locality.—The greatest fall (over 200 mm., *i.e.*, over 7·87 in.) indicated on the map by the darkest shading, is over an area of nearly 35 square miles on the N.E. side of the mountain range, and at the head of two affluents (the Upper Queis and the Bober) of the Oder; and over a tract of country about 30 miles by 50 miles the fall exceeded 4 in., while nearly all the rest of Silesia had from 1 to 4 in. The well known mountain station on the Schneekoppe was just to the S.E. of the heaviest fall, and had only 4·29 in.

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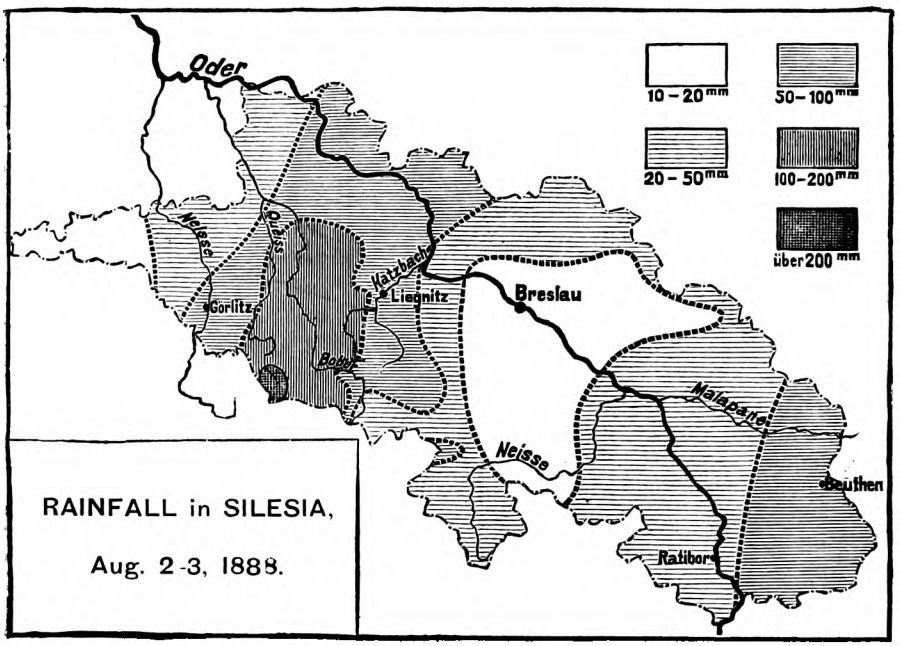
* So that some of the fine weather clouds appear as the darkest of the series.

Those who are not familiar with the smaller rivers will at once recognize the locality of greatest fall, both from the above references to the Schneekoppe, and if we mention that it is just half way between Dresden and Breslau.



ENGLISH EQUIVALENTS.

10–20^{mm} = 0·4 in. to 0·8 in. ..... 50–100^{mm} = 2 in. to 4 in.

20–50^{mm} = 0·8 in. to 2 in. ..... 100–200^{mm} = 4 in. to 8 in.

über 200^{mm} = over 8 in.

Conditions of the Fall.—In the afternoon of August 2nd, there was a gentle N.W. wind and decreasing temperature, which first overclouded the sky, and then produced towards evening a thick mist, which later turned to gentle rain: but the barometer continued to fall, the wind to rise, and the rain to increase, so that about 10 and 11 p.m. it was unusually heavy. The storm and rainfall seem to have been heaviest about 2 to 3 a.m., but both continued with varying intensity until about 4 p.m. on the 3rd of August. The rain, therefore, all fell in about 18 hours, although it fell in parts of two days.

Total fall of Rain.—Dr. Hellman has received returns from 225 stations, and it is upon this splendid series that the map is based. It would, of course, be unwise for us to print any but the mos important values. We have therefore selected all that exceed *five*

inches. The initial letters preceding each name refer to the watershed in which each station is situated. **B**—Bober; **K**—Katzbach; **Q**—Queis.

	in.		in.
Q Flinsberg	8·47	**B** Schreiberhau	5·43
Q Gross Iser	8·03	**Q** Beerberg	5·39
B Agnetendorf	6·81	**B** Seifershau	5·28
B Ludwigsdorf	6·61	**K** Probsthain	5·24
K Falkenhain	5·98	**B** Neue Schlesische Baude	5·20
B Giersdorf	5·63	**K** Schönau	5·08
K Willenberg	5·63	**B** Alt-Kemnitz	5·04
Q Grenzdorf	5·55		
		B Schneekoppe (5246 ft.)	4·29

HEAVY SNOWSTORMS.

To the Editor of the Meteorological Magazine.

SIR,—I am writing a line to say we have a heavy fall of snow here this morning, after a lovely September. Everything is covered, and it must be deep on the hills. Of course it is melting fast, but we had ice and the thermometer at 30° this morning. I don't remember so much at so early a date since I kept a record.—Yours truly,

A. RAWSON.

Fallbarrow, Bowness, Windermere, October 1st, 1888.

To the Editor of the Meteorological Magazine.

SIR,—This very unusual season has now presented us with another phenomenon. Last night (1st to 2nd) we had a *heavy snow storm*, commencing at 10 p.m, without wind, falling level as near as possible, four inches deep at 7 a.m., and I have recorded ·31 inch, carefully melted and measured in the gauge. The storm has been succeeded by the most lovely bright sunshine this morning, but now (at 11 a.m.) the snow is only partially melted.

Yours very truly,

G. F. PEARSON.

Downton, Kington, Herefordshire, October 2nd, 1888.

THE DROUGHT OF 1887 IN IRELAND.

To the Editor of the Meteorological Magazine.

SIR,—As various inquiries have reached me as to where my paper "On the drought of 1887 and some of its effects on Irish agriculture" can be obtained, will you give me space to say that I have a few spare copies left, and will forward one to any applicant until all are gone.—Yours very truly,

RICHARD M. BARRINGTON.

Fassaroe, Bray, Co. Wicklow, Aug. 31, 1888.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JAN., 1888.

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	51·8	8	23·1	1	42·7	33·2	35·6	91	78·3	19·0	·90	9	7·0
Malta	64·8	31	40·7	21	57·5	48·7	44·8	76	114·2	34·3	2·39	10	5·3
Cape of Good Hope.	99·2	28	51·5	12	85·6	59·1	...	...	...	...	·27	2	3·1
Mauritius	84·3	31	72·1	14*b*	82·0	74·3	70·1	78	138·1	65·0	8·86	20	6·3
Calcutta	77·8	5	48·3	31	74·0	55·1	49·8	55	133·1	36·4	·92	5	2·9
Bombay	86·0	7	64·2	29	81·0	68·8	65·1	72	134·6	54·4	1·85	4	1·6
Ceylon, Colombo	90·5	8	66·1	19	87·9	70·0	67·9	73	146·6	58·0	·02	1	0·9
Melbourne	104·0	15	48·8	25	73·6	56·8	55·0	71	155·8	40·7	2·58	12	5·4
Adelaide	106·8	15	50·9	31	86·9	62·6	51·9	45	160·6	40·3	·37	7	4·1
Wellington	...	...	...	...	...		...	...	...	...	...	...	...
Auckland	78·0	16	54·5	9	72·2	58·4	54·6	69	153·0	40·0	1·34	12	6·0
Falkland Isles	...	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston	91·0	14	59·6	5	88·3	64·2	65·8	74	...	...	·09	...	...
Barbados	80·0	1	67·0	3, 17*c*	78·0	70·0	68·1	79	...	...	10·33	20	6·0
Toronto	41·1	13	—11·9	22	22·6	6·9	13·0	82	...	—20·5	1·93	17	6·7
New Brunswick, Fredericton	42·9	2	—22·0	28	16·3	— 4·1	4·0	76	...	...	3·40	14	4·2
Manitoba, Winnipeg	28·0	29*a*	—45·6	11	—4·8	— 23·4	—7·0	96	...	...	·79	8	4·0
British Columbia, Victoria	54·0	27	8·0	13	37·0	27·5	...	...	...	...	5·02	15	

a And 31. *b* And 20. *c* And 18.

REMARKS, JANUARY, 1888.

MALTA.—Mean temp. 52°·9; mean hourly velocity of wind 11·9 miles. Sea temp. fell from 59°·0 to 57°·8 rising again to 58°·6. L on 11th, 17th, and 31st. J. SCOLES.

Mauritius.—Mean temp. of air 0°·4 below, of dew point 0°·5 above, and rainfall 2·57 in. above average. Pressure (29·951 in.) ·007 in. below average. Mean hourly velocity of wind 12·2 miles, 0·8 mile above average; extremes 41·1 miles on 5th and 0·0 mile on 9th. Prevailing direction E.S.E. T on 6 days, L on 7 days.
C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 1°·3 below average. Mean temp. of dew point 2°·3, humidity 7, mean amount of cloud 0·3, rainfall ·80 in., and pressure slightly above average. Prevailing wind S.; strong on 5 days. Hot wind and dust storms on 15th; fog on 14th; T and L on 2nd; L on 12th; aurora on 8th. Heavy dew on 3 days. R. L. J. ELLERY, F.R.S.

Adelaide.—Mean pressure (29·931 in.) and temperature about the average. Rainfall about half the average. C. TODD.

Auckland.—A cool, dry month. Mean temp. 2° below the average. Rainfall not half the average. Pressure close to the average. T. F. CHEESEMAN.

BARBADOS.—Pressure pretty steady. Mean temp. (73°·8) the same as the 30 years' average. Wind high and gusty and 20 per. cent. above average. Rainfall 61 per cent. above average. R. ROWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL, SEPTEMBER, 1888.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	1·16	XI.	Castle Malgwyn	·60
,,	Margate, Birchington...	·77	,,	Rhayader, Nantgwillt..	·84
,,	Littlehampton	1·17	,,	Carno, Tybrith	·57
,,	Hailsham	...	,,	Corwen, Rhug	·80
,,	Ryde, Thornbrough	·88	,,	Port Madoc	3·00
,,	Alton, Ashdell.....	1·76	,,	I. of Man, Douglas	1·04
III.	Oxford, Magdalen Col...	1·13	XII.	Stoneykirk, Ardwell Ho.	1·50
,,	Banbury, Bloxham	·91	,,	New Galloway, Glenlee	1·64
,,	Northampton	1·10	,,	Melrose, Abbey Gate ...	·94
,,	Cambridge, Beech Ho...	·88	XIII.	N. Esk Res. [Penicuick]	1·15
,,	Wisbech, Bank House..	1·23	XIV.	Ballantrae, Glendrishaig	1·88
IV.	Southend	1·25	,,	Glasgow, Queen's Park.	1·42
,,	Harlow, Sheering	·91	XV.	Islay, Gruinart School..	1·94
,,	Rendlesham Hall	2·55	XVI.	St. Andrews, Pilmour Cot	·42
,,	Diss	·96	,,	Balquhidder, Stronvar..	1·06
,,	Swaffham	1·21	,,	Dunkeld, Inver Braan..	·24
V.	Salisbury, Alderbury...	1·69	,,	Dalnaspidal H.R.S. ...	1·56
,,	Warminster	1·50	XVII.	Keith H.R.S.	1·20
,,	Bishop's Cannings	1·94	,,	Forres H.R.S.	1·28
,,	Ashburton, Holne Vic....	1·18	XVIII.	Strome Ferry H.R.S....	3·19
,,	Hatherleigh, Winsford.	·79	,,	Fearn, Lower Pitkerrie.	·76
,,	Lynmouth, Glenthorne.	1·06	,,	Loch Shiel, Glenaladale	4·16
,,	Probus, Lamellyn	1·36	,,	S. Uist. Ardkenneth ...	2·79
,,	Launceston, S. Petherwin	1·09	,,	Invergarry	1·93
,,	Wincanton, Stowell Rec.	1·38	XIX.	Lairg H.R.S.	...
,,	Taunton, Lydeard Ho...	1·02	,,	Forsinard H.R.S.	2·08
,,	Wells, Westbury.....	1·22	,,	Watten H.R.S.	1·46
VI.	Bristol, Clifton	1·28	XX.	Dunmanway, Coolkelure	1·52
,,	Ross	·79	,,	Fermoy, Gas Works ...	·70
,,	Wem, Clive Vicarage ...	·92	,,	Tipperary, Henry Street	·82
,,	Cheadle, The Heath Ho.	·90	,,	Limerick, Kilcornan ...	1·19
,,	Worcester, Diglis Lock	·91	,,	Miltown Malbay.....	1·41
,,	Coventry, Coundon	1·21	XXI.	Gorey, Courtown House	·60
VII.	Melton, Coston	1·09	,,	Navan, Balrath	·73
,,	Ketton Hall [Stamford]	1·89	,,	Mullingar, Belvedere...	·95
,,	Horncastle, Bucknall...	1·65	,,	Athlone, Twyford	·79
,,	Mansfield, St. John's St.	·71	,,	Longford, Currygrane...	1·39
VIII.	Knutsford, Heathside ...	1·26	XXII.	Galway, Queen's Coll...	1·12
,,	Walton-on-the-Hill.....	·94	,,	Clifden, Kylemore	3·14
,,	Lancaster, South Road.	2·04	,,	Crossmolina, Enniscoe..	1 45
,,	Broughton-in-Furness ..	2·50	,,	Collooney, Markree Obs.	1·85
IX.	Shipley, Esholt Vic. ..	...	XXIII.	Rockcorry.....	...
,,	Ripon, Mickley	·89	,,	Warrenpoint	1·63
,,	Scarborough, West Bank	2·35	,,	Seaforde	1·22
,,	East Layton [Darlington]	1·31	,,	Belfast, New Barnsley .	1·93
,,	Middleton, Mickleton..	1·04	,,	Cushendun	1·70
X.	Haltwhistle, Unthank..	1·16	,,	Bushmills	1·56
,,	Shap, Copy Hill	·69	,,	Stewartstown	1 24
XI.	Llanfrechfa Grange	1·21	,,	Buncrana	1·70
,,	Llandovery	1·83			

SEPTEMBER, 1888.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1870–9	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) ...	1·43	— 1·08	·37	25	14	72·7	15	42·4	1	0	0
II.		Maidstone (Hunton Court)...	·74	— 1·57	·38	28	4	...	...	...	...	...	...
,,		Strathfield Turgiss	1·45	— ·85	·41	29	13	74·2	15	36·9	12	0	0
III.		Hitchin	1·31	— 1·17	·68	9	12	68·0	3	38·0	30	0	0
,,		Winslow (Addington)	1·24	— 1·24	·59	9	12	70·0	3, 14	37·0	1, 12	0	0
IV.		Bury St. Edmunds (Culford)	1·02	— 1·76	·22	8	11	70·0	20*a*	32·0	2	1	...
,,		Norwich (Cossey)	1·69	— 1·39	·55	24	12	71·0	16	37·0	1	0	2
V.		Weymouth(LangtonHerring)	1·16	...	·33	27	10	70·0	24	41·0	9, 12	0	0
,,		Barnstaple.....	1·26	— 3·02	·47	1	6	69·0	21	38·0	10*e*	0	0
,,		Bodmin	1·86	— 3·38	·48	27	11	68·0	15	42·0	12	0	0
VI.		Stroud (Upfield)	·76	— 2·49	·21	23	9	71·0	15	38·0	30	0	0
,,		ChurchStretton(Woolstaston)	·57	— 2·90	·15	4	11	68·5	2	38·0	30	0	0
,,		Tenbury (Orleton)	·63	— 2·72	·23	5	10	71·2	2	34·0	12	0	...
VII.		Leicester (Barkby)	1·30	— 1·40	·57	24	15	72·0	15	30·0	30	1	3
,,		Boston	1·39	— 1·22	·30	2, 4	9	78·0	25	39·0	30	0	0
,,		Hesley Hall [Tickhill].....	1·01	...	·39	24	13	72·0	14*b*	35·0	27	0	...
VIII.		Manchester (Ardwick).....	1·69	— 2·08	·46	5	9	64·0	14	39·0	26	0	0
IX.		Wetherby (Ribston Hall) ...	·69	— 2·39	·23	2	6	...	...	...	...	...	...
,,		Skipton (Arncliffe)	1·90	— 3·68	1·13	1	11	70·0	17	34·0	21	0	...
,,		Hull (People's Park)	1·59	— 1·40	·58	10	13	...	...	...	...	...	...
X.		North Shields	1·40	— 0·92	·44	1	12	68·0	5	37·0	30	0	0
,,		Borrowdale (Seathwaite).....	5·77	— 7·45	2·55	1	11	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	1·12	— 3·68	·36	27	8	...	...	...	...	...	...
,,		Haverfordwest	1·45	— 3·60	·47	27	10	66·8	15	35·7	22	0	3
,,		Plinlimmon (Cwmsymlog) ...	2·90	...	·80	5	10	...	...	...	...	...	...
,,		Llandudno.....	1·01	— 2·74	·29	1	12	70·0	13	41·0	26	0	0
XII.	SCOTLAND.	Cargen [Dumfries]	1·08	— 3·33	·44	1	8	69·6	21	35·0	30	0	...
,,		Jedburgh (Sunnyside).....	1·12	— 1·47	·36	1	8	68·0	22	37·0	18*f*	0	...
XIV.		Old Cumnock	2·57	— 1·92	1·12	1	13	68·0	19	26·0	29	2	...
XV.		Lochgilphead (Kilmory).....	2·61	— 3·15	1·15	1	12	...	...	31·0	30	1	...
,,		Oban (Craigvarren)	2·77	...	·64	1	14	61·2	17	43·4	30	0	0
,,		Mull (Quinish).....	2·81	...	·35	3, 5	15	...	...	...	...	...	...
XVI.		Loch Leven Sluices	·40	— 2·83	·20	1	3	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	·40	— 2·54	·20	15	5	71·9	18	34·1	30	0	...
XVII.		Braemar	1·04	— 2·90	·32	6	10	71·0	23	30·0	10	2	11
,,		Aberdeen	1·85	...	·42	1	13	66·0	12*c*	37·0	9	0	0
XVIII		Lochbroom	1·42	...	·21	6	15	...	...	...	...	...	...
,,		Culloden	·91	— 1·99	...	...	...	68·0	14	31·0	26	1	7
XIX.		Dunrobin	1·66	...	·34	2	9	68·0	21	33·0	26	0	...
,,		Kirkwall (Swanbister)..... ..	...	...	...	...	...	...	...	...	...	...	...
XX.	IRELAND.	Cork (Blackrock)	1·19	— 2·96	·88	27	9	73·0	20	36·0	7, 30	0	...
,,		Dromore Castle	1·75	...	·71	28	12	0·0	25	34·0	30	0	...
,,		Waterford (Brook Lodge) ...	·75	...	·60	27	5	69·0	28	36·0	17	0	...
,,		O'Briensbridge (Ross)	·94	...	·29	1	10	68·0	14	42·0	19*g*	0	0
XXI.		Carlow (Browne's Hill)	·61	— 2·65	·21	27	8	...	...	...	..	...	...
,,		Dublin (FitzWilliam Square)	·73	— 1·68	·23	6	10	65·5	5	39·2	30	0	0
XXII.		Ballinasloe	·83	— 3·13	·24	27	8	64·0	4	36·0	30	0	...
XXIII		Waringstown	1·17	— 2·18	·24	2	11	70·0	18	35·0	9	0	0
,,		Londonderry (Creggan Res.).	1·75	...	·35	6	15	...	...	...	...	...	...
,,		Omagh (Edenfel)	1·06	— 2·98	·31	1	11	65·0	14*d*	38·0	30	0	0

a And 21. *b* And 20. *c* And 22. *d* And 16. *e* And 13. *f* And 27, 30. *g* And 20 and 22.
+ Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON SEPTEMBER, 1888.

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 first ten days were showery, but warm. The middle fortnight gloriously fine, quite an Indian summer, bright and hot in the middle of the day. The close of the month was showery, warm, and close. TS on 7th, T and L on 9th.

HITCHEN.—Streams lower than ever before known.

ADDINGTON.—Generally fine, with a small rainfall and a good deal of bright sunshine, which helped harvesting greatly. Dense fog on 15th and 28th. L on 8th.

LANGTON HERRING.—A beautiful month. R 1·73 in. below the average of 18 years. The weather was very fine from 9th to 23rd, with frequent heavy dews. Prevailing wind N.E.; pressure high and steady; Fog on 28th and 29th.

BODMIN.—A most genial month, remarkable for the number of days without R. Mean temp. 55°·9.

WOOLSTASTON.—A beautiful month for harvest, which, contrary to expectation, has been secured in excellent condition. Mean temp. 53°·4.

ORLETON.—A fine, pleasant month, with a larger proportion of sunlight than usual, although there were many cloudy and gloomy days. Slight frost occurred on 12th and 13th and fogs were frequent; the barometer was generally high and steady; there were no violent gales, and the rainfall was the smallest in September during 57 years, with the exception of September, 1832 and 1865. Mean temp. 1°·8 below the average; distant T on 7th.

BARKBY.—The second, third, and last weeks were fine for harvest, the crops being above the average of late years. Remarkably heavy dews throughout. In many places the corn harvest was finished before the hay.

BOSTON.—Harvest not completed at the end of the month, the latest recorded for 50 years. The fine weather of the last three weeks enabled the farmers to get the corn in fairly good condition.

HULL.—The weather of the first ten days was showery, that of the remainder of the month fine, but with frequent fogs or mists.

WALES.

HAVERFORDWEST.—One of the driest, finest, and at the same time coldest Septembers in 40 years' records. From 5th to 27th only ·02 in. of R fell, bright sunshine prevailed, the wind blew principally from N.E. and E.S.E., and the nights were remarkably cold. Perhaps the finest month of the year. Mean temp. low (51°·9). Dense fogs in the third week.

SCOTLAND.

CARGEN.—Mean temp. (51°·8) 2°·8 below the average, mainly owing to the unusually low minima. Sunshine 28 hours above the average. Mean pressure the highest recorded in any month since July, 1885. Thick fog on 22nd, 23rd, and 24th. Sleet fell late on 30th and on October 1st the hills were covered with S.

JEDBURGH.—The weather was cold and ungenial, with prevailing N. and N.E. winds, and fogs were prevalent.

OBAN.—The first half of the month was like August, showery and cold, but the latter half was very fine, with calm though cool weather. Crops, though light, were good, potatoes and turnips being specially well saved.

LOCHBROOM.—A beautiful harvest month, but a sudden change took place on 29th, when it became cold and wintry, and the high hills were deeply covered with the S on 30th.

CULLODEN.—The weather during the greater part of the month was exceed-

ingly fine, warm, and sunny—beautiful harvest weather. Crops very heavy and promising all over the north. Severe frost in the last week did considerable damage to vegetation.

IRELAND.

CORK, BLACKROCK.—On the whole a fine genial month, very favourable for harvesting, but at times hazy with a few cold nights; only ·21 in. of R fell during the first 24 days.

WATERFORD.—The driest September since 1865 and one of the best harvest seasons for some years. A good deal of fog.

ROSS.—An exceptionally fine month, the driest for 40 years; there were many successive bright days with some dull, foggy weather at the close.

DUBLIN.—A fine month with very high barometric pressure, variable light winds, a scanty rainfall, low temp. and frequent fogs. Mean temp. 54°·4; prevailing winds N., N.W., and W.; mean humidity 87; amount of cloud 6·1.

WARINGSTOWN.—A splendid harvest month.

A WHIRLWIND AT WEST HADDON, NEAR DAVENTRY, NORTHAMPTONSHIRE.

On Thursday, August 2nd, about four o'clock, in Mr. W. W. Slye's hay field, as the labourers were at work collecting and carting the hay, a whirlwind was formed near them; first of small circular dimensions, but quickly increasing in size, it eventually took up a quantity of hay to a considerable height in the air. One man, it is said, feeling the effects of the current, held tightly to the animal in his charge, and so was enabled to keep on *terra firma*. The hay thus hoisted, we learn, was floated along, first in a south-easterly direction, passing over the Crick-road, then taking a more southerly direction by the alms-houses, and along the field adjoining. It was next seen crossing the bottom end of the first Buttock's field, then taking second Buttock's in its erratic course, and was finally lost to view, veering toward the west near a spinney on Mr. Gilbert's farm (not far from the Watford road), and some three-quarters of a mile or more from the starting point. Portions of the hay, like ballast thrown from a balloon, were found in several places along the path the whirlwind took. At three o'clock the same day a smaller quantity of hay in the same field was similarly lifted and wafted along, but in a more westerly direction.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

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AN IMPROVEMENT IN ANEMOMETERS.

ONE of the most interesting and practically important questions in relation to wind is, what is its maximum velocity or pressure? I say velocity *or* pressure, because the one depends upon the other.

I need hardly state that many attempts have been made to devise instruments capable of answering this question. It has been generally admitted that existing anemometers using Robinson's Cups are unequal to the task, because a gust lasts but a few seconds—often not more than 5 or 6—and the recording parts, made to register an hour's work on half-an-inch or one inch of paper, will not show satisfactorily a gust lasting 10 secs., that is, 1-360th part of an hour, or in other words, if one could measure such a gust, it would be 1-360th part of an inch on the paper, and the smallest error in measuring becomes so magnified when the measured velocity in 10 secs. is converted into velocity per hour, that results are rendered very uncertain.

Pressure plates have also been tried in many forms, but the results are not satisfactory, because when a gust of wind coming along at a velocity of, say 50 miles an hour strikes a pressure plate, it sets it into rapid motion, which, by acquired momentum, carries it much farther than it ought to do.

Now, Robinson's Cups are free from this defect, and although not without drawbacks, they are, in my opinion, the best means we have of recording gusts of wind. Of course, the open cup, like the pressure plate, is struck by the advancing gust, but at the same moment the same gust strikes the back of the opposite cup, and resists any tendency to run away.

It seemed to me that what was wanted was a means of recording with all possible accuracy the interval of time which the cups took to run a given number of revolutions; and I have accomplished this by putting in a series of pins in the first wheel, so that they may make an electrical contact on a light gold spring for every ten revolutions of the cups.

So far there is nothing new. Many anemometers have been made to record by electrical contacts. The point which I think is new is,

that these contacts are recorded on either of the astronomical chronographs at pleasure, so that the interval between two contacts can be determined with certainty to within one-tenth of a second, or even less, for the chronograph paper runs nearly an inch (0·8) per second, or 240 feet per hour.

The intention is to use this method only for very strong winds. The Observatory anemometer has an ordinary scale of one inch of paper to the hour, which may be increased to two inches; and this is quite enough for all ordinary winds, and more than it is usual to have in observatories. The new method is one that can at any moment be put into operation by turning an electrical key, and at all other times it is at rest, and costs nothing either in paper or battery force.

H. C. RUSSELL.

September 8th, 1888.

GREAT RAIN AT GENEVA, OCT. 2ND–3RD, 1888.

WE are indebted to Mr. Fordham for copies of the *Journal de Genéve*, and the *Gazette de Lausanne*, containing details of a very heavy rain which fell over some parts of Switzerland, on October 2nd. The accounts are too long and too diffuse for translation; we shall, therefore, state the facts as briefly and clearly as we can:—

How the rain fell.—Rain began Oct. 1st, 8 p.m., and thence till

7 a.m., 2nd, there fell			0·51
7 a.m., 2nd, to 2 p.m., 2nd, showers yielding	6·22 in the 24 hours.	4·89in.	0·08
2 p.m., 2nd, to 10 p.m., 2nd			2·21
10 p.m., 2nd, to 7 a.m., 3rd			2·60
7 a.m., 3rd, to 2 p.m., 3rd			1·41
2 p.m., 3rd, to 6 p.m., 3rd			·41
			7·22

In the rainfall day, which in Switzerland ends at 7 a.m., this Geneva value is 4·89 in., which is far in excess of other stations, where in the same period it was respectively, at Castasegna 3·86 in., at Berne 3·82 in., at Lausanne 3·74 in., St. Gothard 1·54 in., Bâle and Locarno 1·50 in., Coire 1·02, Zurich 0·98 in., and still less at other stations.

A more intense previous fall.—A correspondent of the *Journal de Genéve*, reminds its readers of a rainfall more remarkable than the above, because instead of yielding 6·22 in. in 24 hours, it gave 6·38 in. in three hours; this occurred in the afternoon of May 20th, 1827, and the writer, who was out in it, gives ample details of its effects and of the height at which the water stood in different parts of the town.

Limnimetric observations.—Everybody does not know what a limnimeter is, so we begin by explaining that it is the equivalent of

a tide gauge. But as there are no perceptible tides on European lakes, the instruments which by clock-work record on paper the level of the water in lakes are called limnimeters, and automatically produced records of variations in the level of the lakes are called limnimetric records.

Prof. Forel (at least the article is signed F.A.F., so that there is not much room for doubt) has written an interesting account of the effect of this great rain on the level of Lake Leman (*i.e.*, the Lake of Geneva).

The lake of Geneva is about 46 miles long, by an average breadth of nearly six miles, its total area being 240 square miles. So large a lake requires an enormous volume of water to render any change of level visible—to raise it a single inch, 3,500,000,000 gallons of water must flow in. Remembrance of this fact will explain the importance of some of the values which we are about to quote.

Infinitely more care is taken in other countries than in England, over questions of this kind. Windermere or Haweswater, or Ullswater may rise or fall, but neither John Bull, nor his Government cares—no, nor probably will the new County Councils care—in the least; but it is not so on the Continent. On the shores of the lake of Geneva, there are no fewer than nine regular records kept, several, if not all, with self-recording apparatus which gives a curve showing every change in the level.

The sharpest rise was in the morning of Oct. 3rd, when the lake rose nearly half-an-inch an hour—that is to say, the increase in the volume of the lake was about *thirty million gallons a minute*. Taking a period of 24 hours, the greatest rise was 9·37 inches between 6 p.m. on 2nd, and 6 p.m. on 3rd.

Old Observations.—Floods have previously raised the lake 2½, 3 and even 4 inches; that of March 5th, 1817, is said to have raised it 6·38 in., but there was only one observation taken, and Prof. Forel doubts it. M. Lauterburg, of Berne, speaks of a flood on Nov. 2nd, 1870, raising it 9·49 in., but Prof. Forel states that that was quite erroneous, the true value being about two inches. Since limnimeters have been verified regularly and continuous records obtained, there occurred on May 24th and 25th, 1878, the greatest accurately recorded flood previous to the present, viz., one which raised the lake level 6·10 in. This flood was caused by a warm general rain, producing rapid melting of previous mountain snows, while that of 1888 is due to the single fall. As, however, is pointed out in the following account kindly passed on to us by Miss B. Metcalfe, the change in the lake level cannot be used as a check on the record of the rainfall—(1) because, as most persons are aware, the lake is, like so many others, merely a broadening of a river—the Rhone—and therefore its rise is due merely to the difference between the inflow and the outflow; and (2) because even this outflow can be regulated by sluices, and was so regulated on the occasion under notice; because as the writer at Arzier explains, the Arve was so flooded, that the outflow

was actually not only checked, but the Arve was filling the outflow channel so rapidly, that the Rhone was running backwards into the lake. This is just what we consider from the data before us was probable, but it certainly bears testimony to the nerve and to the judgment of the engineer in charge of the sluices.

The following is the note above mentioned, from Arzier, 18 miles N.N.E. of Geneva :—

"For three days rain fell all about Arzier, with snow above 4,000 ft. up. On the Alps and Jura, the two sides of the lake of Geneva, the snow made a line at the same height, so that on each bank there was fresh bright white above a line, all beneath which was black with rain. The effect as the snow soon melted, was but transient, and soaking wet made all very dull, and so swelled the rivers that houses, land, cattle and people were swept away, holes washed in railroads, and ruin everywhere ; for when the water had subsided such a depth of mud was left, that it will be long before the fields recover their vegetation, houses are clean or re-built, and the roads and bridges can be safely used. From 5 p.m. to 4 a.m., Oct. 2nd-3rd, 1888, was continuous thunder and lightning, which fired some large stores near Geneva, and a house not far distant. The Arve from Chamonix was so high that it drove the Rhone back into the Lake ; the flood sluices had to be shut to keep the Arve coming up from the "junction" into the Lake, instead of being shut occasionally to prevent the Lake getting too low."

RATIONAL TIME COUNTING.

In Mr. Ellis's Presidential Address to the Royal Meteorological Society he joined the minority who have long complained of the absurdity of our present calendar, where we not only have months of every number of days from 28 to 31, but are not even content to halve the year properly, but put 181 or 182 days in the first half and 184 in the second. But it is no use talking about it ; every nation in the world has learned the irregular muddle of 31, 28, 31, 30 and so forth, and we do not believe sufficiently in the progress of common sense to expect to see any change.

And it is just the same with the reckoning of hours. There was just the possibility a year or two since that Englishmen and Americans, and perhaps others, would learn to count beyond 12, even as far as 24. There *was* a chance for the New time, but it suited some people for personal pique to make fun of it ; they succeeded—24 hour clocks and watches were laughed out of court, hundreds and thousands of pounds were expended over scores of patents and over watches and clocks which were made but never sold, and now doubtless it would be urged that the scheme has been tried and failed. It was not tried, and therefore it neither could fail nor did fail. The trial was thwarted, and not even Mr. Ellis's sound arguments coming so long afterwards can galvanize the new time into making a single tick. We regret to believe that we shall have to go on with a.m. and p.m. until for us, all time counting has passed away.

RAIN IN 1888.

To the Editor of the Meteorological Magazine.

SIR,--It may be worth noting that in my register of rainfall, extending over 36 years, the present year stands pre-eminent in the following particulars:—

1. The fall in July (6·225 inches) is the largest recorded in that month.
2. The fall in June and July (10·223 inches) is the largest recorded in those two months.
3. The fall in October (1·063 inches) is the smallest recorded in that month.
4. The fall in September and October (2·347 inches) is the smallest recorded in those two months.
5. The fall in August, September and October (4·894 inches) is the smallest recorded in those three months.

GEORGE F. BURDER, M.D.

Clifton, 5th November, 1888.

[We have often called attention to the contrasts as to rainfall which frequently occur even in the small area of England. From the above letter we find that October at Clifton was drier than for 35 previous years. From the letter reprinted below, we see how great was the fall in the Lake District. We have searched the Wythburn register, which is perfect back to 1867, and there are but three years in which October has equalled or exceeded 1888, viz.:—

	1870	1874	1877	1888
October,	21·75 in.	23·25 in.	17·50 in.	15·14 in.—ED.]

A WET WEEK IN THE ENGLISH LAKES.

To the Editor of the Times.

SIR,—The rainfall in the English Lake District at the end of October was so exceptionally heavy, that I think the following details may be acceptable.

Total Rainfall in each day from October 25th to October 30th.

Station.	25th in.	26th. in.	27th. in.	28th. in.	29th. in.	30th. in.	25th-30th in.
Broughton-in-Furness.....	·43	·54	1·83	·10	·16	·94	4·00
Broughton-in-Furness, Ulpha	·85	·86	2·06	·10	·24	1·45	5·56
Hawkshead, Esthwaite	·93	1·66	2·48	·24	·18	1·10	6·59
Windermere, Bowness	·92	1·68	2·45	·41	15	1·15	6·76
Windermere, Ambleside ...	1·80	2·57	3·63	·41	·20	1·25	9·86
Borrowdale, Seathwaite ...	1·50	3·56	4·57	·24	·29	1·65	11·81
Borrowdale, Vicarage	1·46	3·38	4·80	·40	·18	1·56	11·78
Borrowdale, Grange	1·55	3·15	4·61	·30	·18	1·34	11·13
Thirlemere, Wythburn	1·94	3·78	5·20	·67	—	1·80	13·39
Buttermere, Hassness	1·85	3·21	4·56	·46	·14	1·53	11·75
Ulleswater, Patterdale	1·31	2·30	4·45	1·03	·11	2·07	11·27
Shap	·89	2·39	3·50	1·12	·24	·81	8·95

This shows that at the heads of Windermere, Derwentwater Thirlmere, Buttermere, and Ulleswater the fall on the 26th and

27th exceeded six inches, and at Thirlemere very nearly reached nine inches, and that the fall in those localities during the six days ranged from about 10 to about 13½ inches. When I mention that the total fall here for the whole of October was less than an inch and a quarter, the contrast becomes very striking. So large a fall in so short a time would do mischief almost anywhere, and even in the Lakes such a fall is quite unusual. Many roads became impassable, temporary streams rushed through many houses, at two (if not more) places of worship service was impossible, as the surrounding roads were flooded; gates, fences, and timbers were carried down the streams, as well as numerous fowls and other small animals. One farmer in Borrowdale had 20 sheep washed away. The waters of Lodore could be seen from Keswick coming down the gorge in a foaming torrent, and the roaring was like continuous thunder, but as the road from Keswick to Lodore was under water, few could get a close view.

The total quantity of water deposited is almost incredible; it was certainly 10 inches deep over an area of 400 square miles, and therefore if spread over the area of the City of London would have risen everywhere to about the level of the golden gallery of St. Paul's. Or, to put it in another form, had Messrs. Hemans and Hassard's scheme for supplying London with pure mountain water been carried out, these six days would have provided all that London needs, and waste, for half a year. Or, to put it as weight, it must have exceeded 200 million tons.—I am, sir, your obedient servant,

G. J. SYMONS.

62, *Camden-square, N. W., Nov. 6th.*

REVIEWS.

Annales de l'observatoire Impérial de Rio de Janeiro. Par L. CRULS, Directeur. Tome III. Observation du Passage de Vénus en 1882. Rio de Janeiro, 1887. 4to, xxvi.—687 pages, many photogravures, diagrams and illustrations.

SOME one will probably think—Whatever has the *Meteorological Magazine* to do with the Transit of Venus? He will get the answer before we have finished with this magnificent volume. We purposely refrain from touching upon the astronomical part of the volume except as far as is absolutely necessary in order to explain its origin.

At intervals of alternately 8 and 120 years, Venus passes between the Earth and the Sun, and appears to cross the disc of the latter as a round black spot. By measuring with extreme precision the path across the disc as observed from different parts of the earth's surface, it is possible to calculate with considerable accuracy what is the distance of the sun from the earth. As this is a quantity very necessary to be known, many Government expeditions were

sent to remote parts of the world, so as not only to get pairs of observations in different latitudes, but also to lessen the risk of failure owing to clouds.* The Brazilian Government, while reserving some assistants for the observatory of Rio, decided upon organizing three separate expeditions. The present volume describes these expeditions, and what they accomplished.

Expedition to St. Thomas', West Indies.—The vote for the cost of this expedition seems to have fared in the Brazilian Parliament no better than scientific votes do sometimes in England. It was refused altogether, and some Brazilian capitalists found the money which the nation refused. It seems to us strange that in this record, where every clock, barometer and thermometer taken, is fully recorded, the names of these benefactors do not appear. No passenger vessels run from Rio to St. Thomas's, therefore Baron de Teffé and the staff of this little expedition had to go on an overloaded coffee ship, which at its best, and with a strong current, made twelve miles an hour. The author gives a history of St. Thomas's back to the time of Columbus, but we need not follow him there, but we may quote his opinion of St. Thomas's as a residence. "No one, unless ordered to reside there by superior authority, or tempted by the hope of fabulous profits, would stop on a barren soil, constantly trembling with earthquakes, ravaged by epidemics, and at uncertain intervals swept by terrible cyclones."† Apropos to this comes a chapter (14 pages long) upon Cyclones, largely formed of extracts from Contre-Amiral Bourgois's book,‡ and from Padre Viñes's Memoir, read before the Academy of Sciences of Havana, in 1881. The author gives a map of the Island, and an excellent photograph of the capital, Charlotte-Amélie, which, however, does not look so barren as his description would lead one to expect. The narrative of how the Observatory was built, and the anxiety of all as the time approached when it was a question of cloud or sunshine to crown their efforts with success, or to leave all an utter failure, irremediable until June, 2004, is as interesting as a novel, and it is a good novel, too, for there are no murders in it, and all ends happily—how we are not bound to tell. We cannot speak very highly of the meteorological work of this party. They have not given us a single figure respecting the normal climate of the Island; they do not even give us the result of one quarter of the instruments they took with them; *e.g.*, they tell us that outside the three observatories were the rain gauge and two anemometers, and yet they give us not a single figure

* Aggravating cases of this kind occurred at the Imperial Observatory at Rio de Janiero, where the Emperor of Brazil and the Count and Countess d'Eu waited all through the phenomenon, yet, owing to nearly constant rain, obtained only a momentary glimpse; and to the expedition sent from Denmark to the West Indies and which saw nothing.

† See the Tortola Cyclone, *Met. Mag.*, vol. ii., p. 125.

‡ "Des movements de l'atmosphère."

from any one of the three. Between November 22nd and December 10th the shade temperature apparently (for they do not seem to have used their max. and min. thermometers) ranged between 65° and 84°, and had a mean of about 75°. The means for the observation hours were—

7 a.m.	10 a.m.	1 p.m.	4 p.m.
72·1	75·4	78·6	76·6

Mission to Olinda (Pernambuco).—The chief of this mission, Sig. J. de Oliveira Lacaille, tells nothing of his story, and the whole text of his report occupies less than three pages of Spanish. He had just the same fate as the observers at St. Thomas's, saw two of the contacts, and lost two. He appears to have made use of all his meteorological instruments, and prints the observations in extenso.

Mission to the Straits of Magellan (Tierra del Fuego).—This expedition was under the personal direction of Senor Cruls, and though placed last, the account occupies more than half of this handsome volume. Sig. Cruls implies that a German meteorological station having long been established in the town (Puntas Arenas), near which the observatory was erected, he did not try to make his set perfect; we need not, therefore, do more than convert a few of his values into English measures. The meteorological observations extended from November 15th to December 14th, 1882, and the results were—

Maximum temperature	71·8
Minimum ,,	31·3
Mean humidity ,,	75
Total rainfall	1·87 inches.

In comparison with the above (made, be it remembered, at Midsummer), it may be well to quote some of the results of the observations made in Orange Bay by the French during a whole year—

Absolute maximum	76·1
Mean of the year	41·9
Absolute minimum	18·9

An extremely interesting narrative of the voyage from Rio de Janeiro to Puntas Arenas, and account of that Chilian colony, is given by the captain of the frigate (the Parnahyba) which took out the expedition. Captain Louis Philippe de Saldanha da Gama is evidently well worthy of his position in the Brazilian Navy, and we regret that we cannot quote the many interesting bits in his narrative. We must take one, but where the interest and the importance are equally balanced it is difficult to select. Here is an account of a mirage—the Parnahyba was steaming south a few miles off the east coast of Patagonia in about 50 S. :—

"In the course of the day (November 9th, 1882,) we saw some remarkable effects of atmospheric refraction. After midday the wind fell, and the air became warmer, unusually transparent, and pure. The coast, from which we were not far distant, took the most varied and extraordinary forms, sometimes its height was greatly exaggerated, sometimes the salient points, the hills, appeared

turned upside down, or lost in the space between them and the clouds, like the fantastic visions of a dream. One could not distinguish sea from sky, and the froth on the waves resembled fleecy cirri dotted on a blue sky. At one time the reflected images of the hills looked like a row of ships, and the solar rays crossing in various directions made them look as if they were firing a salute. This, however, soon vanished, but only to give place to still stranger appearances.

"The Parnahyba seemed transported into Fairy land, sometimes she seemed to climb a lofty white mountain, at another to slide down the steep slope of a precipice; no horizon could be seen, and, but that we were certain of our position, prudence would have advised our heaving to.

"The mirage of the African desert never produced stranger phenomena than those seen by the travellers on board the Parnahyba.

"The cool of evening dissipated all these extravagances of a rarefied and heated atmosphere, as vanish the fantasies of an over-excited imagination when the mind resumes its natural calm. A little before sunset the whole phenomenon had ceased; on one hand we had the ill-defined sea horizon, on the other the monotonous outline of the Patagonian coast, nearly lost in the shades of evening."

How the expedition succeeded in Patagonia; how some of the party were nearly lost in the lagunes and bogs in the interior of Tierra del Fuego; how the ship struck on a rock, and another time was left perfectly dry standing on her keel on a sand bank; how she passed safely through all troubles, with all sorts of details as to winds, currents, clouds, barometer and temperature, is told most pleasantly in this volume, which reflects credit on printer (we have never seen better photolithography), author, and on the Brazilian Government.

The Meteorite of the 20th of November, 1887. By H. GEORGE FORDHAM, F.G.S. [Excerpt Trans. Hertfordshire Nat. Hist. Soc.] 8vo. 30 pages; 1 map.

OUR readers may recollect that last year a reported "earthquake" was shown to be more probably due to the bursting of a Meteor or Bolide. This was done in the *Met. Mag.* for December, 1887, and we mentioned that Mr. Fordham was taking up the subject on behalf of the Hertfordshire Natural History Society, and that we hoped that our readers would give to him every help in their power. His report is now before us. The evidence is given fully and clearly, the conclusions are well grounded, the paper is illustrated by an excellent map, and altogether the hypothesis is established as conclusively as if a piece of the meteor had been picked up.

BRONTOLOGY.

WE are very glad to see from the following portion of a letter by Dr. Lodge, that he approves of the suggestion as to interrupted conductors made at Bath. (See *Met. Mag.*, Vol. XXIII., page 135.) The war between Theory and Practice is not yet ended, and the more facts are ascertained the more surely will victory crown truth.

LIGHTNING.

To the Editor of the Electrician.

SIR,—I may take this opportunity of remarking how much work can be done at meteorological stations and observatories in the matter of accurately observing and recording lightning; photographic records, obtained by proper appliances for distinguishing multiple from successive flashes, being, of course, superior to all others.

An experimental lightning conductor on a flagstaff near every meteorological observatory would also be a most desirable addition. It need not be associated with danger; a system of fuses or cut-outs, or an east and west steel bar, might be used to record the passage of a flash, and the rod need not be examined until after the cessation of violent disturbances: By having the conductor of different thickness at different parts one could learn what size is really likely to be melted. One could also arrange so as to gain information about side-flashes.—Yours, &c. OLIVER J. LODGE.

A PUZZLE.

To the Editor of the Meteorological Magazine.

SIR,—I send you an extract from a letter I received yesterday from near Wallingford, as I think it may interest you, and possibly you may be able to give some explanation:—

"Last Saturday (November 3rd) evening, we had a most remarkable thing happen in this neighbourhood. Almost every flock of sheep was driven out, the hurdles broken down, and nearly every lot went out towards the east or south-east. From five miles below Abingdon, to Goring and to Nettlebed, and Watlington, and for several miles each side of the Thames, and from all I can hear, it happened to each flock about a quarter to eight in the evening. It was very still and dark at the time, and from people who were out and about I cannot hear of any lightning, or any meteor of any kind. It could not have been done wilfully, because it would have taken no end of men to work the thing, and had they been let out the hurdles would have been opened, and not the sheep driven over them. At present the matter is quite a mystery."

Yours truly,

RICHARD H. WAKE, M.D.

Wood Cottage, Ballyhooly, Nov. 12th, 1888.

[If any of our readers can suggest the explanation of this we shall be very glad. It is curiously near the locality where the bolide, mentioned on p. 153 of this number, is supposed to have burst.—ED.]

THIRD GENERAL MEETING OF THE ITALIAN METEOROLOGICAL SOCIETY.

[We are indebted to Padre Denza for a MS. account of this meeting, from which we have prepared the following note.—ED.]

The third general meeting of the Italian Meteorological Society was held at Venice, September 14 to 21. The municipality and the inhabitants did everything possible to render the meeting agreeable and successful. The meetings were held in the magnificent rooms of the Istituto Musicale Benedetto Marcello, but the opening and closing ones were held in the Ducal Palace. The number of adherents was 170, of whom 140 were present. Sixty papers were presented for discussion; the most important being as follows:—

(1). *General Meteorology and Climatology.*—Among the most important papers in this section may be noticed Prof. Luigi Palmieri on the origin of atmospheric electricity; The results of magnetic observations at 103 stations in Italy; Summary of results from 8 Italian stations in S. America; Heliophotometric (*i.e.* sunshine) observations made by Professor Craveri, of the observatory at Bra, since 1874 with an instrument of his own invention. [We shall be glad to see a description of it. ED. *M.M.*] Two important memoirs by Prof. Busin, of Rome, one on the distribution of temperature in Italy, the other on high and low pressure areas in the northern hemisphere; and one by Prof. D. Ragona on the daily range of temperature. P. G. Giovannozzi called attention to the relation between telescopic definition and meteorology; Prof. I. Galli spoke on the hourly velocity of wind at Velletri; Prof. I. Golfarelli on lightning conductors; and Prof. G. Roberto on a new hygrometer invented by Prof. A. Pizzarello.

(2). *Agricultural Meteorology.*—P. S. Ferrari read an important paper on the present relation between meteorology and agriculture, and on the steps necessary to be taken to further their mutual progress; Count A. Da Schio reported upon the history and development of phenological observations in Italy.

(3). *Hygienic Meteorology and Hydrology.*—A long and important discussion took place on the arrangements and classification of climatic stations, and it was decided that observations of this class should be established in Naples, Turin, and Padua. Prof. G. Roster read a paper on the results of daily observations on the amount of carbonic acid in the air and soil of Florence during 1886; P. V. Siciliani read a paper on the relation between the level of water in wells and the height of the barometer; and Prof. G. Bellucci one on the presence of sea salt in the rain water collected at Perugia.

Seismology.—The most important were by P. Denza on earthquakes in 1887, and by Prof. G. De Luca on the Solfatara of Pozzuoli.

The members were in all respects most hospitably received. On the 15th there was a grand concert and the Piazza S. Marco was illuminated. On the 18th a Serenade on the Grand Canal and a reception by the Municipality, and on the 21st an excursion to the University and Observatory at Padua.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, FEB., 1888.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute.				Average.				Absolute.		TotalRain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	Cloud.
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	0–100	°	°	inches		0–10
England, London	52·0	6	19·1	2	40·1	31·4	31·7	86	59·3	28·2	·78	14	7·9
Malta	66·0	23	40·4	29	59·6	47·4	44·8	79	122·1	34·0	1·73	11	3·9
Cape of Good Hope.	98·8	13	52·0	18	85·1	60·4	...	...	...	...	·02	2	3·5
Mauritius	85·4	3	70·3	12	82·6	73·7	71·1	81	139·1	62·0	8·76	16	7·0
Calcutta	89·4	27	50·9	1	81·0	59·8	55·0	54	143·5	42·1	1·60	2	1·9
Bombay	86·8	22	65·0	10	83·1	70·1	66·5	71	138·3	53·2	·02	1	0·8
Ceylon, Colombo	93·4	1	66·0	8	88·7	71·5	68·1	71	143·0	57·4	3·27	3	1·9
Melbourne	97·2	12	43·1	15	76·5	54·1	51·7	64	148·0	32·6	·42	6	3·9
Adelaide	100·5	11	47·5	17	83·7	58·4	49·9	47	149·2	38·7	·07	2	2·6
Wellington	...	...	...	...	...	..	...	...	...	...	...	...	...
Auckland	80·5	17	49·0	1	70·9	56·3	52·4	67	145·0	38·0	·79	5	4·0
Falkland Isles	...	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston	88·0	27	60·6	25	86·1	64·6	66·2	73	...	...	·69	...	..
Barbados	80·0	27*a*	66·0	23	77·0	69·0	65·7	74	...	...	4·86	13	6·0
Toronto	43·2	20	—16·1	9	29·0	13·7	19·6	81	...	—23·0	1·68	20	7·4
New Brunswick, Fredericton	45·4	26	—14·2	1	26·6	3·9	12·0	70	...	...	4·07	14	4·8
Manitoba, Winnipeg	37·0	23	—46·4	...	8·5	—14·0	6·3	94	...	...	·31	6	5 5
British Columbia, Victoria	52·0	23	28·0	29	46·0	37·1	...	...	...	...	1·77	11	..

a And 28.

REMARKS, FEBRUARY, 1888.

MALTA.—Mean temp. 52°·6; mean hourly velocity of wind 11·5 miles. Sea temp. ranged between 57°·8 and 59°·5. T8S on 4 days; H on 3 days. Waterspout seen on 29th, about 2 miles off E.N.E. J. SCOLES.

Mauritius.—Mean temp. of air 0°·6 below, of dew point 1°·2 above, and R 3·64 in. above, their respective averages. Mean hourly velocity of wind 7·8 miles, or 3·3 below average; extremes 20·9 (for 1 hour) on 6th and 0·0 on 10th. Prevailing direction E. by N. to N.E. by E. T and L on 8 days, L on 4, T on 2. Floods in different parts of the island on 6th, 7th, 16th, and 18th. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 0°·8 below, of dew point 1°·5 below, amount of cloud 1·4 below, R 1·56 in. below, and pressure and humidity slightly below their respective averages for 30 years. Prevailing winds S. and S.E. Heavy dew on 5 days, T8S on 2 days. R. L. J. ELLERY, F.R.S.

Adelaide.—Unusually cool, especially at night. Mean temp. 2°·9 below average, the max. exceeding 90° on only 7 days. Total R ·60 in. below average. C. TODD.

Auckland.—A fine and dry, but cool month, with an unusual predominance of S.W. winds. Mean temp. nearly 4° below, and R not more than a fifth of the average. T. F. CHEESEMAN.

BARBADOS.—Mean temp. 72°·7, a trifle below the average. Mean hourly velocity of wind 8·8 miles, 25 per cent. below the average. R. BOWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL, OCTOBER, 1888.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	1·66	XI.	Castle Malgwyn	4·03
,,	Margate, Birchington...	1·61	,,	Rhayader, Nantgwillt..	4·49
,,	Littlehampton	2·37	,,	Carno, Tybrith	2·90
,,	Hailsham	3·11	,,	Corwen, Rhug	2·08
,,	Ryde, Thornbrough	2·37	,,	Port Madoc	4·30
,,	Alton, Ashdell.....	1·79	,,	I. of Man, Douglas	3·12
III.	Oxford, Magdalen Col...	·77	XII.	Stoneykirk, Ardwell Ho.	·51
,,	Banbury, Bloxham	·51	,,	New Galloway, Glenlee	3·70
,,	Northampton	·51	,,	Melrose, Abbey Gate...	1·28
,,	Cambridge, Beech Ho...	·80	XIII.	N. Esk Res. [Penicuick]	2·15
,,	Wisbech, Bank House..	·50	XIV.	Ballantrae, Glendrishaig	1·12
IV.	Southend	1·22	,,	Glasgow, Queen's Park.	2·10
,,	Harlow, Sheering	1·08	XV.	Islay, Gruinart School..	3·25
,,	Rendlesham Hall	·78	XVI.	St. Andrews, Pilmour Cot	1·23
,,	Diss	1·47	,,	Balquhidder, Stronvar..	7·85
,,	Swaffham	1·08	,,	Dunkeld, Inver Braan..	3·51
V.	Salisbury, Alderbury...	1·87	,,	Dalnaspidal H.R.S. ...	7·21
,,	Warminster	1·54	XVII.	Keith H.R.S.	2·70
,,	Bishop's Cannings	1·25	,,	Forres H.R.S.	2·98
,,	Ashburton, Holne Vic....	2·70	XVIII.	Strome Ferry H.R.S....	9·53
,,	Hatherleigh, Winsford.	2·66	,,	Fearn, Lower Pitkerrie.	3·17
,,	Lynmouth, Glenthorne.	1·55	,,	Loch Shiel, Glenaladale	10·07
,,	Probus, Lamellyn	2·37	,,	S. Uist. Ardkenneth ...	...
,,	Launceston, S. Petherwin	2·53	,,	Invergarry	6·89
,,	Wincanton, Stowell Rec.	1·67	XIX.	Lairg H.R.S.	...
,,	Taunton, Lydeard Ho...	1·04	,,	Forsinard H.R.S.	...
,,	Wells, Westbury.....	1·55	,,	Watten H.R.S.	3·45
VI.	Bristol, Clifton	1·06	XX.	Dunmanway, Coolkelure	4·79
,,	Ross	·91	,,	Fermoy, Gas Works ...	3·29
,,	Wem, Clive Vicarage ...	·97	,,	Tipperary, Henry Street	1·79
,,	Cheadle, The Heath Ho.	·83	,,	Limerick, Kilcornan ...	1·57
,,	Worcester, Diglis Lock	·74	,,	Miltown Malbay.....	2·33
,,	Coventry, Coundon	·47	XXI.	Gorey, Courtown House	2·40
VII.	Melton, Coston	·50	,,	Navan, Balrath	·82
,,	Ketton Hall [Stamford]	·41	,,	Mullingar, Belvedere...	1·48
,,	Horncastle, Bucknall...	·56	,,	Athlone, Twyford	1·39
,,	Mansfield, St. John's St.	·62	,,	Longford, Currygrane...	1·75
VIII.	Knutsford, Heathside ...	1·20	XXII.	Galway, Queen's Coll...	1·82
,,	Walton-on-the-Hill.....	1·31	,,	Clifden, Kylemore	5·51
,,	Lancaster, South Road.	3·28	,,	Crossmolina, Enniscoe..	5·06
,,	Broughton-in-Furness ..	5·54	,,	Collooney, Markree Obs.	2·95
IX.	Shipley, Esholt Vic. ..	...	XXIII.	Rockcorry.....	...
,,	Ripon, Mickley	·85	,,	Warrenpoint	·88
,,	Scarborough, West Bank	1·23	,,	Seaforde	1·13
,,	East Layton [Darlington]	·54	,,	Belfast, New Barnsley .	1·62
,,	Middleton, Mickleton..	1·66	,,	Cushendun	1·86
X.	Haltwhistle, Unthank..	2·16	,,	Bushmills	2·03
,,	Shap, Copy Hill	9·50	,,	Stewartstown	1·14
XI.	Llanfrechfa Grange	1·71	,,	Buncrana	2·98
,,	Llandovery	3·74			

OCTOBER, 1888.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1870–9	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) ...	1·23	— 1·47	·51	29	7	68·8	27	28·2	8	5	18
II.		Maidstone (Hunton Court)...	1·48	— ·98	·57	29	5	...	...	...	...	...	...
,,		Strathfield Turgiss	1·56	— 1·18	·63	29	12	67·1	28	25·8	15	15	23
III.		Hitchin	·80	— 1·38	·24	28	8	68·0	27	26·0	8, 21	10	...
,,		Winslow (Addington)	·72	— 1·90	·24	28	11	68·0	27	25·0	9	17	18
IV.		Bury St. Edmunds (Culford)	1·08	— 1·09	·32	29	5	63·0	27	23·0	23	24	...
,,		Norwich (Cossey)	2·36	+ ·03	·68	2	10	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	2·39	...	·81	29	11	63·0	28	32·0	7	1	...
,,		Barnstaple.....	2·15	— 3·30	·39	2	14	64·0	29	29·0	15	...	...
,,		Bodmin	2·43	— 3·84	·49	28	19	60·0	27	35·0	15	0	...
VI.		Stroud (Upfield)	·80	— 2·21	·15	29	10	70·0	27	27·0	7	6	...
,,		ChurchStretton(Woolstaston)	1·27	— 3·33	·41	28	13	61·5	27	30·0	2	3	15
,,		Tenbury (Orleton)	·68	— 2·56	·23	28	9	65·2	27	26·0	7, 24	13	16
VII.		Leicester (Barkby)	·52	— 1·83	·12	28	11	68·0	27	22·0	13*d*	19	23
,,		Boston	·48	— 1·55	·15	4	7	70·0	27	25·0	21	13	...
,,		Hesley Hall [Tickhill].....	·54	...	·25	1	9	65·0	27	24·0	23	11	...
VIII.		Manchester (Ardwick).....	1·67	— 2·76	·40	28	9	63·0	27	29·0	2, 7	9	...
IX.		Wetherby (Ribston Hall) ...	·58	— 2·78	·18	29	4	...	...	...	...	...	...
,,		Skipton (Arncliffe)	2·45	— 4·81	·42	30	13	60·0	26	32·0	19	1	...
,,		Hull (People's Park)	·99	— 1·81	·22	4	10	...	...	...	...	...	...
X.		North Shields	·83	— 1·68	·28	30	9	66·5	27	27·5	2	4	9
,,		Borrowdale (Seathwaite).....	14·51	— 2·04	4·57	27	15	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	1·92	— 3·31	·50	28*f*	9	...	...	...	...	...	...
,,		Haverfordwest	2·63	— 3·82	·55	28	20	60·8	26	29·8	14	4	13
,,		Plinlimmon (Cwmsymlog) ...	4·53	...	1·04	28	15	...	...	...	...	...	...
,,		Llandudno.....	1·94	— 2·65	·30	27	16	66·3	28	33·4	2	0	...
XII.	SCOTLAND.	Cargen [Dumfries]	3·02	— 2·69	·94	27	8	58·6	27	25·4	2	8	...
,,		Jedburgh (Sunnyside).....	1·69	— ·98	·33	28*a*	14	60·0	26*b*	28·0	2	4	...
XIV.		Old Cumnock	2·33	— 2·83	·41	26	16	62·0	27	22·0	1, 13	10	...
XV.		Lochgilphead (Kilmory)	4·22	— 4·10	·75	30	17	...	...	29·0	4, 21	5	...
,,		Oban (Craigvarren)	4·80	...	1·45	30	20	64·8	12	34·3	5	0	...
,,		Mull (Quinish).....	4·69	...	·77	30	21	...	...	...	...	...	...
XVI.		Loch Leven Sluices	2·10	— 2·21	·50	31	8	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	1·45	— 1·72	·20	2	16	61·9	12	31·9	4	1	...
XVII.		Braemar	3·02	— 1·46	·95	28	23	60·5	27*c*	29·0	5	3	11
,,		Aberdeen	...	...	...	...	...	...	...	...	...	...	..
XVIII		Lochbroom	6·67	...	1·15	27	25	...	...	...	...	...	...
,,		Culloden	2·31	+ ·02	...	...	...	63·0	27	34·0	3, 5*g*	0	11
XIX.		Dunrobin	5·34	...	1·04	4	19	64·0	27	32·0	4	1	...
,,		Kirkwall (Swanbister)..... ..	...	...	...	...	...	...	...	...	...	...	...
XX.		Cork (Blackrock)	3·12	— 1·62	1·16	27	19	62·0	27	29·0	14	5	...
,,		Dromore Castle	2·99	...	·61	31	16	63·0	1	33·0	1	0	...
,,		Waterford (Brook Lodge) ...	2·43	...	1·20	27	13	59·0	...	27·0	15	4	...
,,		O'Briensbridge (Ross)	2·04	...	·52	31	17	61·0	27*c*	30·0	22*e*	...	...
XXI.		Carlow (Browne's Hill)	2·30	— 1·81	·76	27	12	...	...	...	..	...	...
,,		Dublin (FitzWilliam Square)	1·23	— 2·19	·33	27	16	66·6	27	32·9	2	0	10
XXII.	IRELAND.	Ballinasloe	1·10	— 3·35	·25	27	15	60·0	26*b*	27·0	15	8	...
XXIII		Waringstown	1·15	— 2·46	·25	2	15	70·0	28	28·0	1	3	11
,,		Londonderry (Creggan Res.).	2·79	...	·41	30	21	...	...	...	...	...	...
,,		Omagh (Edenfel).....	1·35	— 2·97	·23	27	15	63·0	27	34·0	3, 13	0	4

a And 30. *b* And 27. *c* And 28. *d* And 20. *e* And 23. *f* And 31. *g* And 14.
+ Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON OCTOBER, 1888.

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.—Up to the 24th, the weather was unusually severe for the season; frosts in the morning were followed by much fog and an absence of wind. The end of the month was warm and close, warmer than in July and August.

HITCHEN.—On the 27th the mean temp. was 63°, the highest recorded so late in October, higher than that of June 28th. Extraordinary darkness on 10th. S on 2nd.

ADDINGTON.—Perhaps one of the most remarkable Octobers on record for number of frosty nights (17), and small rainfall, none falling in the 17 days ending 23rd. There were many very fine days, and a few dense fogs after the 16th. The min. temperatures were exceptionally low for the first three weeks, and as remarkably high during the remainder of the month.

CULFORD.—Very fine weather the whole month.

LANGTON HERRING.—On the whole, a very fine month, R having fallen on only 11 days. From 7th to 24th the weather was very fine, though on some days the mornings were foggy. It was the fourteenth consecutive month with low temp., the mean at 9 a.m. being 2°·7 below the average, though from 24th to 28th it was unusually warm.

BODMIN.—A remarkably fine month. Mean temp. 49°.

WOOLSTASTON.—An extremely dry month. The first week was very cold—S falling on 1st—the temp. then rose, but it became very cold again for some days after the 20th, and then very warm for the last week. Mean temp. 47°·2.

ORLETON.—On the night of the 1st R set in, which changed to S and covered the land two inches deep next morning, not clearing off the hills till after mid-day. The weather afterwards was remarkably dry and fine, with frequent frosty nights and clear days till 24th, no measurable R falling in 17 days ending on that date. The mean temp. of the first 24 days was lower than that of any October for 30 years, and the wind was generally between N.E. and N.W. At 9 a.m. on the 24th the temp. in shade was 33°, at night the wind changed to S.E., and at 9 a.m. on 25th it was 56°. This was followed by rough S.E. wind, and four warm days and nights, and the last four days were cloudy, with frequent small R. Fogs were frequent from 16th to 24th.

BARKBY.—A fine dry month, so that leaves remained on the trees ten days after keen frosts. The last week very warm. Strong winds on 25th and 26th. Mean temp. 43°·7. T on 26th and 27th.

MANCHESTER.—October began with a wintry aspect, and there were several frosty nights, and some slight falls of S, but taken altogether, it was a fine month, but cold.

HULL.—With the exception of the first week, the weather was fine, mild, and calm, sometimes with fogs or mists.

SEATHWAITE.—Very wet in the last week, 12·03 in. of R falling after the 24th, and 9·63 in. in the three days ending 27th.

WALES.

HAVERFORDWEST.—The first and last weeks were very stormy and wet, the first extremly cold. Mean temp. of first six days, 42°·4; of last eight, 54°·5; and of the month, 47°·7. From 9th to 23rd, the weather was splendid, plenty of bright sunshine, with cold nights, heavy fogs at times, wind generally from N. or E., and a plentiful harvest well gathered, if deficient in quality. Aurora on 31st.

SCOTLAND.

CARGEN.—The first three weeks were unusually cold, and almost without R, while the last week was unusually warm and wet. The mean temp. of the first week was 40°·7 ; of the last week, 52°·7, only 2°·3 below that of July. Mean temp. of the month (46°·5) 1°·7 below the average. The R, with the exception of ·16 in., all fell in the last week. S on 1st and 4th ; L on 29th.

JEDBURGH.—The temp. was variable, but lower than the average, the dry, cold weather of the middle of the month being valuable for securing cereal crops.

OBAN.—The 1st showed S on the hills—a very early date ; this lasted till 7th, and there were several light falls of S ; a cold period prevailed till the middle ; then followed a short summer, and the month closed with gales, R, and high temp. T and L on 30th and 31st.

BRAEMAR.—A month of unsettled weather. Crops still unsecured, and in bad condition.

LOCHBROOM.—Except for a few days about the middle, the month was one continued storm of R and wind.

DUNROBIN.—Wet and sunless. A good deal of grain still in the fields.

IRELAND.

CORK.—Except a few slight showers, fine autumn weather with frosts to the 19th, thence dull and often misty, with more or less R every day.

DROMORE.—Very fine, with the exception of two or three rather stormy days at the end.

O'BRIEN'S BRIDGE.—Some of the most beautiful days of the whole season were those from 9th to 23rd. R was wanted for wells and streams, and sufficient fell in the latter days of the month.

DUBLIN.—A generally favourable month, with much quiet weather, except at the beginning and end. The first week was very cold and showery, with fresh northerly winds. Anticyclonic weather followed, dry, but foggy or cloudy. The last seven days were remarkably warm, with strong S.W. winds or gales, and frequent showers.

WARINGSTOWN.—A wonderfully fine month, which enabled the late harvest to be well secured ; the last ten days unusually warm.

EDENFEL.—With the exception of some days at the beginning and end of the month, the weather was uniformly fine, calm and generally clear. The polar winds, which prevailed without intermission to the 16th, reduced the temp. much below the average, but there was a rebound during the last fortnight, culminating in a mean temp. of 60°·5 on the 27th. At the close, the springs were lower than during any period of 1887.

GREAT OCEAN DEPTHS.—Her Majesty's surveying ship, Egeria, under the command of Captain P. Aldrich, R.N., has, during a recent sounding cruise and search for reported banks to the south of the Friendly Islands, obtained two very deep soundings of 4,295 fathoms and 4,430 fathoms, equal to five English miles, respectively, the latter in latitude 24° 37′ S., longitude 175° 8′ W., the other about 12 miles to the southward. These depths are more than 1,000 fathoms greater than any before obtained in the Southern Hemisphere, and are only surpassed, as far as is yet known, in three spots in the world—one of 4,655 fathoms off the north-east coast of Japan, found by the United States steamship Tuscarora ; one of 4,475 fathoms south of Ladrone Islands, by the Challenger ; and one of 4,561 fathoms north of Porto Rico, by the United States ship Blake. Captain Aldrich's soundings were obtained with a Lucas sounding machine and galvanized wire. The deeper one occupied three hours, and was obtained in a considerably confused sea, a specimen of the bottom being successfully recovered. Temperature of the bottom, 33°·7 deg. Fahr.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCLXXV.] DECEMBER, 1888. [PRICE FOURPENCE, or 5s. per ann. post free.

THE STAMPEDE OF SHEEP ON NOV. 3RD.

In addition to the letter on the above subject, which we inserted in our last issue, a similar statement appeared in *Nature*, *The Times*, and many other journals. Having invited communications, procured copies of the local newspapers circulating in the district, and applied individually to those whose names were given in the public press as the authorities for the statements, we obtained a very considerable mass of materials, a selection from which follows.

It may be well, in the first place, to state what occurred, and secondly, to discuss the information and theories as to the cause.

On the night of Nov. 3rd, over an area about 25 miles long by from 6 to 8 miles wide, in the Valley of the Thames—stretching from Abingdon to Maidenhead—about four out of every five flocks of sheep broke down the hurdles in which they were penned, and ran about wildly, evidently in a state of intense alarm.

All accounts which state the direction in which the sheep fled give it as E.N.E. or S.E., which is quite as close an agreement as could be expected, and clearly proves that the general direction was easterly.

The time at which this stampede occurred is invariably stated at about 8 o'clock, or a quarter bofore ; and, although we have seen no evidence in support of the statemeut, we have no reason for doubting it. It is stated also that it was intensely dark at this time, probably from high fog.

The suggested causes are :—

1st. A mad or wild dog.
2nd. A practical joke.
3rd. Lightning.
4th. An earthquake.

The first two theories are, we think, readily disposed of by the fact, that the area over which the stampede extended is much too large for one or even many men or dogs to have dealt with.

The third suggestion, Lightning, is unsatisfactory in many particulars. Although lightning is referred to as the canse in several accounts, there are definite statements that no lightning was seen at the time, though it was observed about 2 a.m., long after the occur-

rence. Again, if lightning were the cause, surely such stampedes would be of comparatively frequent occurrence, which certainly is not the case; and finally, if we grant an exceptionally vivid flash, surely the sheep would have fled from it in all directions, N., S., E. and W.

Unless further evidence is forthcoming, we are prepared to accept the earthquake theory as the true one, and chiefly on the following grounds

The fact that animals are undoubtedly remarkably sensitive to slight earth tremors.

The statement of the shepherd (made before the sheep were known to have broken out) that he felt a slight tremor at an earlier hour of the evening.

The fall of the portions of the wall at Frilford.

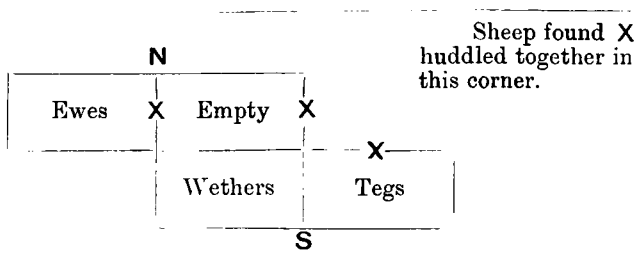
The terror exhibited by a dog at Wargrave without apparent cause.

The fact that all the flocks fled practically in one direction.

On reading all the accounts carefully, there are considerable indications of the cause of alarm being repeated once or twice at short intervals.

On Sunday morning the shepherds employed by various farmers in the parishes of Benson, Brightwell, Hagbourne, Moreton, Stoke, Sotwell, Warborough and other places in this neighbourhood, on visiting the flocks, found that in many cases the sheep had escaped from their folds during the night, and were discovered wandering about the adjoining fields. In many cases the hurdles were found lying flat on the ground, and in others the state of the hurdles showed that the sheep had used their utmost endeavours to escape, but had been unable to do so.

HALL PLACE, MAIDENHEAD.—The panic in the sheep folds on the night of Saturday, Nov. 3rd, extended over a larger tract of country than has been mentioned in the press. On that night I had 570 sheep penned in three folds on a field a good 5 miles nearer London than Twyford, and 3 nearer than Henley. The field is situated on the high land bordering the valley of the Thames, and to the S. of it. The sheep were penned thus :—



The ranks of hurdles marked with a cross were knocked flat down, and the ewes and tegs found mixed up together in a corner of the field. The wethers did not break out. The land at that time was comparatively dry, so it must have taken considerable force to knock down two ranks of hurdles as the ewes did. In the valley of the Thames, about 1 mile away, the sheep belonging to a tenant of mine broke down the hurdles the same night. The shepherd in

this case noticed the places where the sheep must have laid down directly afterwards, though they were not found there. The sheep belonging to a farmer, Mr. Weall, within a mile and a half of Maidenhead, also broke out. I have since heard that all the sheep broke out towards the N.E. on that night.—GILBERT A. CLAYTON EAST, Bart.

GOULD'S GROVE, BENSON, OXON.—On Saturday evening last, a little before eight o'clock, almost every flock of sheep for a distance of nearly twenty miles in length and seven or eight in width all along the valley of the Thames, viz., from five miles below Abingdon nearly to Goring, was driven out and the hurdles smashed and some of those in the meadows were driven over or through the hedges, and as far as I can ascertain almost all went towards the east or south-east. All who can fix the time agree that it happened a little before eight. The evening was very dark and still, and from no one can I hear of any lightning or any meteor (as of course there were many people about at the time) which could have frightened the animals; neither could they have been let out by any preconcerted action of any number of persons, as I do not believe a thousand men could have accomplished the work, added to which had such been the case the hurdles would have been opened and not smashed down. —WILLIAM NEWTON.

SOTWELL HILL, WALLINGFORD.—I cannot arrive at any satisfactory conclusions myself, the evidence is so conflicting, or rather the effect on different flocks of sheep in close proximity is so contrary. In my own case out of five flocks of sheep situated from half a mile to a mile apart four flocks were disturbed; the fifth was quiet. On making inquiries on Monday morning of the two shepherds who had charge of a neighbour's flock, they reported that their sheep were quite undisturbed that night, but one of the men said to me, "I noticed just as the Wallingford clock struck five (Saturday evening) the ground seemed to shake under my feet." The other shepherd said he did not notice anything unusual, but he remembered his mate remarking this to him at the time. This man had not at that time heard of any general or wide-spread disturbance of sheep. Curiously enough, this particular flock was quite quiet on the memorable night. One suggested explanation is that a pitch darkness came over this particular district at eight o'clock, so dark that men accustomed to dark evening walks could not see their hands before their faces. This can be authenticated. The dark cloud lifted after a few minutes; there was then nothing to be seen of lightning or meteor. It is supposed that the timid sheep were frightened by the black darkness, which made each sheep think he or she was separated and left alone. There was lightning seen about two o'clock in the morning of Sunday, but nothing unusual. On Jubilee night last year the firing of our signal rockets from Brightwell Hill so frightened my sheep, who were half a mile distant, that they rushed at the hurdles, and two so injured themselves that they had to be sent to the butcher's. On this night, November 3rd, those flocks which were frightened (about three out of four within a radius of five miles or more) had the appearance of having been hunted almost out of their lives. Flocks were found cut into two or three parts, hurdles broken down in various directions (perhaps less broken on the north side), troughs almost all turned over. The sheep, many of them, had been rolled in the mud, and one of mine had its leg broken.—ALFRED D. WELLS.

FRILFORD, ABINGDON.—In reply to your letter of the 10th inst., my ewes broke out of their fold in several places, and were found mostly near the

hurdles on the outside of the fold on the morning of Nov. 4th. From the footprints, it appeared that some of them ran several chains down the field south of the fold and back again; they probably ran backwards and forwards through the fold several times, as the hurdles were knocked about in all directions. I have several stone walls around my fields, one about half-a-mile long running from east to west, having the highway on the south, and an arable field on the north, about 4½ feet high, partly mortared, the ground, on the north side being about six inches lower than that on the south, fell in three places some time between the 3rd and 4th Nov.; that is to say, about the top half of the wall fell towards the north in the first gap about 3 yards wide, in the second gap at about 8 yards distance from the first 3 yards wide, and the third gap 12 yards distant from the second 6 yards wide. It is not unusual for the walls to fall in a similar way in very wet weather, but there appeared to be little or no rain on the night in question, although it was very dark. There have been no gaps in the wall in question for several months previous to the 3rd Nov., nor have any fallen since. I hear of lightning having been seen on that night, and of a whirring sound having been heard in the air, but cannot hear of anyone who perceived an earthquake.—THOS. FLOYD.

1, CEDARS ROAD, BECKENHAM.—SIR,—As a practical farmer and sheep owner of many years' experience, the stampede of sheep you mention in your letter to the *Times* seems to me a simple matter. It was a densly dark night—what we call a ground darkness, which is, like a black fog, comparatively rare, and I have often known sheep break fold then. The least noise or an extra push, or, as in this case, a flash of lightning, startles them, and they make a rush, seeing nothing. If the hurdles give way, that frightens them still more, and there is no stopping them in their panic; and the sound of a flock rushing by in the mysterious darkness would infallibly startle another.—ARTHUR STONE.

GRASMERE, BUDHURST ROAD, CROYDON.—About ten or twelve years ago my flock and some of the neighbouring flocks broke out of their folds one night. My shepherd attributed it to ground lightning [An upstroke.—ED.]—M. A. SADLER.

7, LISBURN CRESCENT, TORQUAY.—It is possible that the panic amongst the sheep was caused in this instance by an earthquake. It does not appear invariably to alarm them, as I had myself a flock of sheep in North Devon at the time of a rather severe shock some years ago, accompanied by a loud rumble, and on that occasion neither my sheep nor those of any of the farmers in the neighbourhood, as far as I know took any notice of it.—J. J. PHILLIPPS. (Late Capt. 6th Rifles, J.P.)

ATHENÆUM CLUB, PALL MALL.—SIR,—I see that you are asking for information about a panic and a rush of sheep in Berkshire and Oxfordshire. Of the facts in that case I know nothing, but I remember a similar catastrophe, which astonished flock owners in a part of Australia in which I was riding at the time, and of which I was, therefore, a casual witness. A storm of wind and rain was the occasion of the scattering of the sheep in the case in question, and the sheep literally fled before the wind like the light drift of clouds. They went absolutely in line with the wind. I have no doubt (in those days 1849 hurdles were commonly used to fold the sheep in at night) that some sheep-pens were blown down by the wind, and that the scatterred sheep merely fled before the wind, but the belief among many of the neighbours was that the rush and pressure of the sheep in most cases carried away the side of the folds in the first instance.—G. W. RUSDEN.

ROYAL METEOROLOGICAL SOCIETY.

The first monthly meeting of this Society for the present session was held on Wednesday evening, the 21st instant, at the Institution of Civil Engineers, 25, Great George Street, Westminster, Dr. W. Marcet, F.R.S., president, in the chair.

Señor A. Arcimis, Mr. J. W. H. Gray, Dr. J. L. Green, Mr. R. T. Morgan, Mr. C. E. Mumford, Mr. E. L. Oxenham, F.R.G.S., Dr. A. M. Robertson, Dr. E. Seaton, Mr. J. N. Sidebotham, and Dr. T. C. Squance were elected Fellows of the Society.

The following papers were read :—

1. "Results of an Investigation of the Phenomena of English Thunderstorms during the years 1857—59," by Mr. G. J. Symons, F.R.S. This paper was written nearly 30 years ago; it has now been communicated to the Society at the request of the Thunderstorm Committee. The paper contains a summary, chiefly in statistical form, of some of the results of an investigation into English thunderstorms and the accidents produced by lightning during the years 1857—59. The author found that in sheet lightning the most prevalent colour is white, then yellow, blue, and red; in forked lightning the order is nearly reversed, blue being more than twice as frequent as any other colour, then red, white, and most rarely yellow. Sheet lightning was seen about twice as often as forked.

2. "Notes on the Meeting of the International Meteorological Committee at Zurich in September, 1888," by Mr. R. H. Scott, F.R.S. The Committee recommended certain rules for the publication of data by travellers, &c., so as to insure their being useful for the advancement of sound climatological knowledge. The proposals for an international cloud nomenclature, as recommended by Mr. Abercromby and Prof. Hildebrandsson, did not commend themselves to the Committee, who suggested that the subject should be further studied. At the conclusion of the meeting the Committee was dissolved.

3. "On a Method of Photographing Cirrus Clouds," by Dr. A. Riggenbach. The author exhibited some photographs of cirrus and other fine clouds, which had been obtained by using the surface of a lake as a polarising mirror.

Mr. A. C. Stratten exhibited some models of very large hailstones—of irregular shape, but about 2½ inches in diameter—which fell at Montereau, about 40 miles south-east of Paris, on August 15th, 1888.

LIGHTNING AND ITS EFFECTS.

SIR,—The value of the paper on thunderstorms read at the late meeting of the Royal Meteorological Society, has not been in any way lessened by its being thirty years old, for there is now a slight revival of the study of static electricity, held in abeyance for more than this

time, by that of the more profitable dynamic system. This revival is partly attributable to the action of the "Lightning Rod" and now to that of the "Thunderstorms" Committees of the Society. Dr. Lodge has also given a valuable series of papers in *Nature* as well as in the *English Mechanic*, and other parties have sent communications to several scientific serials. There are, however, two points I should like to see more fully dealt with than has been the case, and which I think go a long way towards explaining results which are of so varied and mysterious a character—these points being (1) the upward current from the earth to the cloud; and (2) the great heat which accompanies the "lightning stroke."

In the first case, it is of course well known that in thunderstorms the earth, by induction from the cloud, is in an opposite state of electricity, and that an interchange of electric states (positive and negative) occurs between the clouds and the earth; therefore, there is as much cause for believing that a current proceeds as well in one direction as in another, yet in accounts of storms, the general inference is that the objects have been struck by the flash of lightning descending from the cloud, and hence the difficulty of explaining the results. If we take a few examples. In your September number, Mr. Tomlinson states that 120 sheep out of a flock of 140 were "struck by lightning" in Italy and killed. Is it not most probable that this flock with "its ascending column" of warm and damp air, formed the most convenient conductor at this place for the current from the earth, the catastrophe, of course, occurring with the lightning flash, or the commingling of the two electricities. We do not know how the boy with the kid was circumstanced, but probably sitting down with the kid in his lap, his clothes not of the cleanest, forming a better conductor than his body. The two horses also. Their iron shoes, accompanied by the column of moist air from their bodies, formed a better conductor, and from a larger space of ground than the man occupied. Again, when a tree is "struck," the roots, extending over a large area of ground, are the conductors for the electricity towards the trunk, and so the current passing through the branches to the extreme twigs and leaves forms attraction for the cloud to transmit its electricity to the earth, and thus a person standing beneath the tree forms a portion of the upward conductor, and so shares the result. I fancy, however, that if the person had gutta-percha soled boots, and stood on dry ground, the danger would be very much lessened, if not entirely removed. In many cases of buildings being struck, there is strong evidence of an upward current, and a gentleman told me recently that he was one evening watching a display of lightning among mountains on the coast of Africa, and saw many of the flashes ascending from the earth.

The other point on which I wish to remark is that of the heat, instantaneously developed by the current passing through bad or insufficient conductors, or, to speak in electrical language, "conduc

tors having considerable resistance." I conceive that we have very little idea of the intensity of this heat. We know that copper wires are not only fused, but deflagrated, and you cite cases of the effect on bodies of persons killed—one where it was burnt to a cinder, and two others nearly as bad. The disruptive effects must be in proportion to the amount of resistance to the current. Where this is great, the intense heat decomposes the constituent bodies, causing explosions of great force—*e.g.*, the sap in trees, the resin in pine-wood, carbon in the shape of soot, metals in various forms, the lime and moisture of mortar, and many other substances—so that the disruptions appear to me to be much more of a mechanical effect than of anything electrical, wrapped up, as it generally is, in so much mystery. Looking at some examples. The catastrophe at Crak Scar, Durham, as described by Sir W. W. Smyth (Quarterly Journal of the Royal Meteorological Society, July, 1888), is such as can be accounted for by this intense heat, causing the decomposition and explosion of the carbon (soot) and other substances in the chimney, as well as the mercury and tin on the mirror. The smoking chimney, well coated with carbon was a very tempting conductor for the exit of the upward current, as well as an attraction for the descending one; both of these must, in this case, have been of immense volume. In the case of an elm tree struck near Waterford in August, 1887, the bark was torn off from the root to the fork—20 ft. by 18 in. wide—and scattered about the field for over 50 yards. There were two deep pits blown up at the base, the whole evidently caused by the explosion of the sap. I could cite many other cases, but these are sufficient for my purpose. I think the cause of fulgurites is quite explicable by what I have herein stated.

In conclusion, I would ask, "What is a flash of lightning?" I take it that the flash, *per se*, is an *effect*, not a *cause*, and proceeds from the same cause as I have before stated, viz., the current, or currents, passing through our atmosphere, a medium of considerable electrical resistance, thereby developing heat sufficient to decompose on its path, the air and its contents, causing a vacuum, the collapse of which results in thunder.—Yours faithfully,

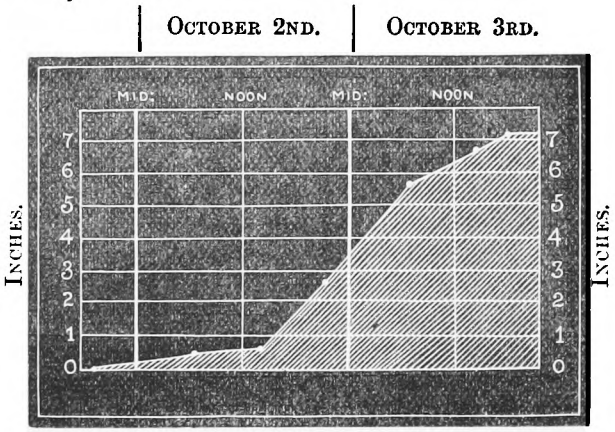
ROBT. J. LECKY.

3, *Lorton-terrace, December* 3, 1888.

GREAT RAIN AT GENEVA.

AN engraving will frequently convey to the mind a clearer conception of facts than can be obtained from numerical statements. The following little diagram is merely the graphic representation of the figures given on p. 146 of our last number, and yet we are sure that it will convey to all a more vivid idea of the persistent intensity of the rain than they previously had. It shows clearly that from the time (2 p.m. October 2nd) when the rain began in earnest, until the

same hour on the 3rd, soon after which it ceased, the fall must have been nearly uniform and at the rate of 1 inch in each four hours. This of course is far below the intensity usual in a severe English thunderstorm, when it sometimes rains ten or twenty times as heavily, but then it rarely lasts more than an hour or two. In the Geneva case it went on for 24 hours, and we should have great difficulty in finding a British record which would surpass it if duration and intensity are taken together.



THE BOLIDE OF NOVEMBER, 1887.

To the Editor of the Meteorological Magazine.

SIR,—Last January you were good enough to admit some observations, on the evidence then at hand of the phenomena attending the passage of this meteorite, which I submitted, with a view of shewing that the sound was due, not, necessarily at least, to explosion, but might be due to vibration only.

We have now had the advantage, thanks to Mr. Fordham's paper mentioned in this month's *Met. Mag.*, of seeing all the evidence that has since been so carefully collected and digested by him. He has undoubtedly made out a strong case in favour of the explosion theory—but I must say that, especially if we eliminate the cases where the sound is said to have been accompanied by distinct motion or earth tremor, the fact remains to which I adverted before, that the sound continued throughout a long line, but extended laterally over but a narrow belt; and that the area affected in the in the immediate neighbourhood of the supposed final explosion is really smaller than that 50 miles to the eastward—nor do I see any explanation suggested why if the final explosion took place, as Mr. Fordham thinks, in the Abingdon-Wantage district, the sound of it should have extended not more than ten miles westward, or why in that case the observer at Lambourn heard it in the N.W.

If any of your readers desire to pursue this subject, I would refer them to a valuable paper by M. Durand-Greville, in the *Revue Scientifique* of 21st April, of this year, on "Le bruit des projectiles à grande vitesse." The writer deals successively with the cases of a projectile whose speed in less than, equal to, and greater than, the speed of a sound-wave in the atmosphere—with the observer placed, first, approximately in the path of the projectile, and secondly at a distance therefrom. He demonstrates how in each case, though with variations proper to each, the simple result of the successive vibrations produced by the continuous whiz or rumbling of the projectile is, at any particular point, what he terms "une pseudo-explosion tout à fait violente et instantanée." He then discusses the case of a "bolide," which he assumes to have a speed greater than that of sound, and concludes that its sound whenever it reaches our ears does not produce on us the effect of a continuous noise, as it is in reality, but one "pseudo-explosion," apparently occurring at a point on the trajectory of the meteorite determinable and variable (according to rules which he explains) relatively to the distance of the observer from the trajectory and to the speed of the meteorite. "This does not mean," he goes on to explain, "that no bolide has ever exploded in our atmosphere; but observers have no doubt for the most part attributed to bolides an explosion which existed only in their imagination."

Mr. Fordham (p. 58) is inclined to minimise the evidence of tremor of the earth and of buildings, and to refer it to nervous excitement or imperfect observation. But I submit that the evidence on this point is too circumstantial to be thus rejected; and it seems to me that to admit it, does not at all displace his main conclusion. If it be true, as some have thought, that some seismic effects, when not attributable to volcanic causes, may be due to a temporary disturbance of magnetic equilibrium affecting the action of gravity upon the earth's crust,may it not be that the passage of a foreign body at a high speed, comparatively near the earth, and in a line almost exactly normal to the magnetic meridian should produce some such effect?

However this may be, the position of the places at which Mr. Fordham reports these effects to have been principally noticed is remarkable. These are Barrington, at the junction of the upper greensand with a chalk outlier; Ampthill (where doors are said to have jammed) on the lower greensand; Silsoe (two shocks) at the junction of the gault and lower greensand; Baldock, just on the edge of the chalk; Heyford, at the junction of the oolite and lias; Garsington (where clocks stopped), on the junction of the Kimmeridge and Oxford clays; and the far outlying Cubbington in Warwickshire, on the new red marl. On the contrary, places where it is expressly said that no tremor was felt were generally on the chalk, and at some distance from its escarpment. The sound heard so peculiarly at Welwyn Viaduct, may be due to the piers conducting the sound from the chalk beds deep below the surface.

These considerations will be appreciated by those who studied the "Report on the East Anglian Earthquake," in which the effect of geological structure on the transmission of a seismic wave is dealt with.

My view is that the phenomena of that morning were not limited to the passage of one meteorite, or even of two, of which also there is evidence.

One word more. Is it not possible that the incandescence of meteorites is to *some* extent referable to their sudden retardation by the earth's attraction when passing tangentially, the loss of motion being productive of heat?—Your obedient servant,

JAMES G. WOOD, M.A., F.G.S.

8, *Lansdowne Crescent, W., Nov*, 22, 1888.

Mr. W. White has kindly disinterred the following note from *British Rainfall*, 1868, where it has been buried for nearly 20 years. What with the meteor at Wantage, April 9th, 1628*, the undermentioned one November 3rd, 1868, the one November 20th, 1887, reported upon by Mr. Fordham, and the sheep panic November 3rd, 1888, it really seems as if residents in that district in November have exceptional opportunities for meteorological research.—ED.

"*November* 3, 1868.—At 3.20 p.m., during bright sunshine, a meteor of considerable brilliancy was seen from London, Rugby, Birmingham, Chipping Norton, and Northampton. The following note from Col. Ward is of high interest in connection therewith:—'I was at Great Marlow that day. It was clear sunshine, with very heavy squalls of wind and rain at times. I was standing at a window of a friend's house, when I, with my friend and many others, heard a noise something between the report of a gun and the falling of some heavy substance on the roof. I said to my friend, 'Something has happened to the roof of your servants' apartments.' He went to see and came back shortly, saying that all was right. My carriage was at the door at the time, and both the coachman and footman looked up at the moment of the explosion and they remember the noise, but thought as I did, that something had fallen on the roof. The wind was apparently E.N.E. from where I stood, and it was exactly at 3.20 p.m. by my chronometer. Two days afterwards I was at a friend s near Gerrard's Cross, about ten miles N.E. of Marlow and not very far from Chalfont St. Giles, and he asked me if I had 'heard the earthquake' two days before. He said it was the general subject of conversation that day at the meet of the old Berkeley hounds close by, as everyone seemed to have heard it. I conclude this must have been the explosion of the meteor, visible in sunshine that day, and which was supposed to have burst over Banbury."—[From *British Rainfall*, 1868; pp. 65-6.]

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* See *Met. Mag.*, vol. xxii. (1887) p. 169.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, MARCH, 1888.

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	55·4	10	24·7	2	45·0	33·7	33·9	84	92·8	17·7	3·34	20	8 5
Malta	81·6	27	42·1	1	64·4	50·4	48·5	77	132·3	36·5	·79	7	3·9
Cape of Good Hope.	97·2	13	51·9	...	79·4	59·2	...	...	...	...	·71	5	3·5
Mauritius	82·4	10	67·2	16	80·6	72·1	68·6	79	139·6	55·5	9·83	19	6·7
Calcutta	98·9	24	59·1	1	91·4	70·3	68·0	61	151·9	48·1	2·37	2	2·2
Bombay	95·6	21	71·8	8	86·8	75·0	71·5	74	145·0	60·2	·10	1	1·4
Ceylon, Colombo	92·2	23	72·6	3	89·5	74·6	71·4	73	145·0	65·7	1·65	13	3·1
Melbourne	94·0	28	42·0	22	69·2	51·7	50·4	71	139·8	33·1	2·16	11	6·5
Adelaide	96·8	28	46·5	19	77·9	57·5	48·9	50	146·7	36·1	·21	9	5·0
Wellington	...	...	...	...	...	...	...	...	...	...	...	...	...
Auckland	76·0	2	44·0	29	69·2	57·5	52·1	67	146·0	35·0	5·09	11	7·0
Falkland Isles	...	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston	89·8	10	61·1	6	86·7	66·5	67·4	70	...	...	0·28	...	..
Barbados	82·0	15	68·0	26	80·0	70·0	68·8	77	...	...	2·10	10	6·0
Toronto	48·3	20	— 1·2	5	29·5	15·1	19·6	88	...	—10·6	2·80	18	5·0
New Brunswick, Fredericton	48·8	22	2·0	2	35·4	19·7	23·5	71	...	...	2·60	18	6·9
Manitoba, Winnipeg	40·0	18	—25·9	22	17·8	— 6·5	5·5	88	...	...	1·09	15	5·0
British Columbia, Victoria	58·0	26	20·0	9	48·3	35·2	...	...	...	...	3·53	11	..

REMARKS, MARCH, 1888.

MALTA.—Mean temp. 56°·4; mean hourly velocity of wind 10·3 miles. Sea temp. rose from 57°·5 to 62°·5. TS on 6th; H on 6th and 8th. Waterspout seen over the land on the 9th. J. SCOLES.

Mauritius.—Mean temp. of air 1°·9 below, of dew point 1°·0 below, and R 2·17 in. above, their respective averages. Mean hourly velocity of wind 10·3 miles, or 0·2 mile above average; extremes 25·5 miles on 14th and 30th, and 1·7 miles on 4th. Prevailing direction E.S.E. L on 8th and 9th. Signs of a cyclone having passed about 700 miles to E. on 27th. C. MELDRUM, F.R.S.

COLOMBO.—TSS occurred on 5 days, and L was seen on 9 other days.
J. C. H. CLARKE, Lt.-Col. R.A.

Melbourne.—Mean temp. of air 3°·7, and of dew point 1°·7 below average; humidity 3, amount of cloud 1·0, and R ·05 in. above average. Prevailing winds W., S.W., and S., strong on 7 days. Heavy dews on 8 days. T and L on 4th. T on 15th.
R. L. J. ELLERY, F.R.S.

Adelaide.—Weather unusually mild. Mean temp. 2°·8 below the average of 31 years, only 4 days above 90°, and very few sudden changes. C. TODD.

Auckland.—Early part of month fine, middle and close wet and stormy, and unusually cold. Mean temp. nearly 3° below the average; R double the average.
T. F. CHEESEMAN.

BARBADOS.—The mean temp. (74°·3), was the same as the average of 30 years. The wind averaged 10·2 miles per hour, being the same as the 15 years' average. The R was 10 per cent. above the 25 years' average. Nine days were more or less cloudy. R. BOWIE WALCOTT.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, APRIL, 1888.

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	64·8	30	27·7	6	52·4	37·1	37·0	78	111·1	20·1	2·37	13	7·0
Malta	82·9	7	49·9	15	70·0	55·7	51·7	71	131·4	42·1	·09	2	4·0
Cape of Good Hope	94·4	11	45·2	28	69·2	53·2	...		...	...	3·63	12	5·2
Mauritius	81·3	26	66·7	7	79·3	70·0	66·3	77	131·7	56·7	1·84	16	5·0
Calcutta	102·3	15	66·4	26	94·6	76·0	73·5	63	156·4	63·7	3·91	5	3·3
Bombay	91·4	13	75·0	1	88·9	78·2	74·0	74	145·2	64·8	·00	...	1·3
Ceylon, Colombo	91·6	1	72·0	23	88·5	75·8	73·6	79	147·5	69·6	28·78	21	5·5
Melbourne	88·9	6	34·8	24	70·1	47·4	46·3	66	136·5	28·4	·83	8	4·7
Adelaide	94·2	5	45·4	24	77·5	55·0	45·6	47	139·5	33·7	·09	5	2·3
Wellington	...	...	..	.	...	...	...	..	...	...	...	...	..
Auckland	73·0	13	43·0	26	65·3	52·2	50·3	74	130·0	36·0	·98	9	5·0
Falkland Isles	...	...	...	...	...	...	...	...	...	...	...	...	..
Jamaica, Kingston	93·0	5	62·6	7*b*	88·4	68·4	68·6	66	...	...	·86	...	...
Barbados	83·0	19*a*	69·0	1	81·0	72·0	71 9	79	...	...	6·46	15	7·0
Toronto	76·3	28	21·2	8	47·5	30·9	28·4	64	...	12·2	1·37	11	5·6
New Brunswick, Fredericton	71·8	28	9·7	8	46·2	26·1	24·8	59	...	...	·75	11	6 6
Manitoba, Winnipeg	73·0	25	– 0·7	6	43·4	21·6	25·8	72	...	...	1·30	10	5·6
British Columbia, Victoria	65·0	22	31·0	22	56·2	40·4	...	...	...	...	2·26	17	...

a And 20, 21. *b* And 8.

REMARKS, APRIL, 1888.

MALTA.—Mean temp. 61°·6; mean hourly velocity of wind 12·8 miles. Sea temp. ranged from 61°·3 to 63°·0. L on 15th. Temp. above 70°·0 on 14 days. J. SCOLES.

Mauritius.—Mean temp. of air 2°·0, of dew point 1°·6, and rainfall 2·88 in. below their respective averages. Mean hourly velocity of wind 11·8 miles, or 1·2 above average; extremes 24·8 on 11th and 1·9 on 30th; prevailing direction S.E. by E. to E.S.E. T on 19th. TL on 20th. C. MELDRUM, F.R.S.

Melbourne.—Mean temp, of air 0°·6, mean temp. of dew point 3°·2, humidity 7, mean amount of cloud 1·2, and R 1·44 in. below average; pressure ·149 in. above average. Prevailing wind N. Heavy dew on 12 days. Fog on 5 days. TS on 6th. L on 8th and 9th. R. L. J. ELLERY, F.R.S.

Adelaide.—Mean pressure (30·256 in.) more than ·100 in. above the average of 31 years, and the highest recorded. Mean daily range of temp. (22°·5) considerably in excess of the average, and the greatest since 1859. Mean amount of cloud and total R the lowest on record. Total R since Jan. 1, ·734 in., far less than any previously recorded for the same period. C. TODD.

Auckland.—A fine and dry, but cool month. Mean temp. 3° below the average; R hardly more than a quarter of the average. T. F. CHEESEMAN.

BARBADOS.—Mean temp. 75°·8, same as 30 years' average; mean hourly velocity of wind 9·9 miles, same as 15 years' average; R 62 per cent. above the 25 years' average; 6 days more or less clouded. R. BOWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL, NOVEMBER, 1888.

[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	4·74	XI.	Castle Malgwyn	8·27
,,	Margate, Birchington...	3·55	,,	Rhayader, Nantgwillt..	11·01
,,	Littlehampton	4·14	,,	Carno, Tybrith	7·46
,,	Hailsham	4·27	,,	Corwen, Rhug	5·17
,,	Ryde, Thornbrough	5·01	,,	Port Madoc	5·10
,,	Alton, Ashdell.....	6·06	,,	I. of Man, Douglas	6·11
III.	Oxford, Magdalen Col...	4·13	XII.	Stoneykirk, Ardwell Ho.	3·67
,,	Banbury, Bloxham	5·17	,,	New Galloway, Glenlee	10·19
,,	Northampton	3·20	,,	Melrose, Abbey Gate ...	6·10
,,	Cambridge, Beech Ho...	3·11	XIII.	N. Esk Res. [Penicuick]	8·60
,,	Wisbech, Bank House..	2·73	XIV.	Ballantrae, Glendrishaig	5·08
IV.	Southend	4·23	,,	Glasgow, Queen's Park.	5·70
,,	Harlow, Sheering	4·65	XV.	Islay, Gruinart School..	4·37
,,	Rendlesham Hall	3·65	XVI.	St. Andrews, Pilmour Cot	4·85
,,	Diss	2·33	,,	Balquhidder, Stronvar..	13·88
,,	Swaffham	2·75	,,	Dunkeld, Inver Braan..	8·30
V.	Salisbury, Alderbury ...	5·11	,,	Dalnaspidal H.R.S. ...	10·12
,,	Warminster	6·20	XVII.	Keith H.R.S.	3·43
,,	Bishop's Cannings	5·16	,,	Forres H.R.S.	2·85
,,	Ashburton, Holne Vic....	14·74	XVIII.	Strome Ferry H.R.S....	7·07
,,	Hatherleigh, Winsford.	5·63	,,	Fearn, Lower Pitkerrie.	2·64
,,	Lynmouth, Glenthorne.	8·79	,,	Loch Shiel, Glenaladale	12·78
,,	Probus, Lamellyn	8·18	,,	S. Uist. Ardkenneth ...	...
,,	Launceston, S. Petherwin	7·00	,,	Invergarry	9·37
,,	Wincanton, Stowell Rec.	7·54	XIX.	Lairg H.R.S.	...
,,	Taunton, Lydeard Ho...	7·22	,,	Forsinard H.R.S.	...
,,	Wells, Westbury.....	6·25	,,	Watten H.R.S.	2·23
VI.	Bristol, Clifton	6·53	XX.	Dunmanway, Coolkelure	8·86
,,	Ross	8·17	,,	Fermoy, Gas Works ...	5·36
,,	Wem, Clive Vicarage ...	4·29	,,	Tipperary, Henry Street	5·60
,,	Cheadle, The Heath Ho.	5·36	,,	Limerick, Kilcornan ...	2·57
,,	Worcester, Diglis Lock	5·64	,,	Miltown Malbay.....	4·78
,,	Coventry, Coundon	4·54	XXI.	Gorey, Courtown House	4·63
VII.	Melton, Coston	3·14	,,	Navan, Balrath	4·83
,,	Ketton Hall [Stamford]	3·24	,,	Mullingar, Belvedere ...	3·59
,,	Horncastle, Bucknall ...	2·60	,,	Athlone, Twyford	2·91
,,	Mansfield, St. John's St.	4·29	,,	Longford, Currygrane...	3·47
VIII.	Knutsford, Heathside ...	4·45	XXII.	Galway, Queen's Coll...	2·62
,,	Walton-on-the-Hill... .	4·57	,,	Clifden, Kylemore	5·49
,,	Lancaster, South Road.	4·97	,,	Crossmolina, Enniscoe..	4·64
,,	Broughton-in-Furness ..	7·64	,,	Collooney, Markree Obs.	3·32
IX.	Shipley, Esholt Vic. ..	...	XXIII.	Rockcorry.....	...
,,	Ripon, Mickley	5·95	,,	Warrenpoint	5·02
,,	Scarborough, West Bank	3·53	,,	Seaforde	5·96
,,	East Layton [Darlington]	5·90	,,	Belfast, New Barnsley .	6·72
,,	Middleton, Mickleton ..	9·01	,,	Cushendun	8·22
X.	Haltwhistle, Unthank..	6·10	,,	Bushmills	5·41
,,	Shap, Copy Hill	8·27	,,	Stewartstown	3·33
XI.	Llanfrechfa Grange	8·75	,,	Buncrana	3·70
,,	Llandovery	8·02			

NOVEMBER, 1888.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1870–9	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) ...	4·38	+ 1·94	·91	2	20	59·9	16	34·6	28	0	3
II.		Maidstone (Hunton Court)...	4·12	+ 1·22	·85	2	19	...	...	...	...	...	...
,,		Strathfield Turgiss	4·20	+ 1·45	·59	12	22	58·3	16	32·4	28	0	7
III.		Hitchin	3·82	+ 1·21	·78	2	20	60·0	16	34·0	27	0	...
,,		Winslow (Addington)	4·79	+ 2·29	1·11	2	21	60·0	16	32·0	7, 28	2	5
IV.		Bury St. Edmunds (Culford)	2·81	— ·02	·48	26	14	...	...	...	...	...	...
,,		Norwich (Cossey)	2·50	— ·81	·50	1	19	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	7·99	...	1·88	12	25	58·0	16	34·0	7	0	...
,,		Barnstaple.....	5·63	+ 1·48	·93	29	20	59·0	16*e*	36·0	28	0	...
,,		Bodmin	9·21	+ 3·89	1·56	12	30	56·0	15	36·0	7	0	2
VI.		Stroud (Upfield)	6·84	+ 3·90	1·35	12	23	58·0	15*b*	33·0	27	0	...
,,		ChurchStretton(Woolstaston)	6·43	+ 2·99	1·18	12	27	57·0	15	30·5	7	3	5
,,		Tenbury (Orleton)	6·48	+ 3·62	1·35	12	24	60·2	16	29·0	28	1	4
VII.		Leicester (Barkby)	3·28	+ ·95	·42	2	23	61·0	16	29·0	27	1	5
,,		Boston	2·15	— ·22	·52	1	16	60·0	16	30·0	28	1	...
,,		Hesley Hall [Tickhill].....	3·67	...	·56	2	23	61·0	16	32·0	28	...	...
VIII.		Manchester (Ardwick).....	4·73	+ 1·76	·68	23	23	56·0	15	35·0	8, 29	0	...
IX.		Wetherby (Ribston Hall) ...	3·65	+ ·89	·78	13	12	...	...	...	...	...	...
,,		Skipton (Arncliffe)	11·05	+ 5·30	1·57	2	25	53·0	1	32·0	27	2	...
,,		Hull (People's Park)	2·81	— ·36	·52	27	21	...	...	...	...	...	...
X.		North Shields	3·01	— ·44	·83	12	19	60·5	16	32·5	28	0	3
,,		Borrowdale (Seathwaite).....	22·87	+11·65	3·57	23	24	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	7·83	+ 3·63	1·14	12	27	...	...	...	...	...	...
,,		Haverfordwest	9·53	+ 4·19	1·37	12	23	56·4	15	27·0	30	2	5
,,		Plinlimmon (Cwmsymlog) ...	6·13	...	·75	12	22	...	...	...	...	...	...
,,		Llandudno.....	4·65	·74	·66	2	25	62·0	16	35·0	28	0	...
XII.	SCOTLAND.	Cargen [Dumfries]	6·91	3·00	·86	12	18	55·0	15	27·6	29	4	...
,,		Jedburgh (Sunnyside).....	4·26	+ 1·25	·73	27	21	57·0	14	28·0	28	6	...
XIV.		Old Cumnock	7·27	+ 3·80	·95	23	20	55·0	15	25·0	28	5	...
XV.		Lochgilphead (Kilmory)	7·84	+ 2·48	1·26	21	18	...	...	29·0	26	4	...
,,		Oban (Craigvarren)	7·37	...	1·34	21	19	59·8	10	33 3	27	0	...
,,		Mull (Quinish)	5·33	...	·76	21	15	...	...	...	...	...	...
XVI.		Loch Leven Sluices	7·70	+ 4·15	1·20	24	21	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	5·75	+ 2·62	1·00	12*a*	22	56·5	16	28·6	27	1	...
XVII.		Braemar	6·45	+ 2·68	·86	21	25	53·0	16	20·8	27	5	14
,,		Aberdeen	...	...	...	...	...	...	...	...	...	...	..
XVIII		Lochbroom	7·64	...	2·09	21	14	...	...	...	...	...	...
,,		Culloden	3·73	+ 1·03	·91	22	9	57·0	16	24·0	27	8	19
XIX.		Dunrobin	4·41	...	·54	22	17	58·0	14	27·0	27	4	...
,,		Kirkwall (Swanbister)..... ..	...	...	...	...	...	...	...	...	...	...	..
XX.	IRELAND.	Cork (Blackrock)	7·81	+ 3·20	1·15	29	23	58·0	13*c*	27·0	30	...	...
,,		Dromore Castle	4·26	...	·90	9	17	55·0	4	33·0	26	0	...
,,		Waterford (Brook Lodge) ...	5·32	...	·84	28	22	58·0	19	30·0	28	2	...
,,		O'Briensbridge (Ross)	2·68	...	·43	10	20	56·0	11	31·0	30	...	...
XXI.		Carlow (Browne's Hill)	3·83	+ ·91	·57	28	25	...	...	...	..	...	...
,,		Dublin (FitzWilliam Square)	6·55	+ 4·27	1·52	28	26	59·5	16	30·8	28	1	5
XXII.		Ballinasloe	3·23	+ ·23	·37	10	27	52·0	15*d*	24·0	28	6	...
XXIII		Waringstown	3·99	+ 1·28	·64	12	20	60·0	15	29·0	27	3	9
,,		Londonderry (Creggan Res.).	3·99	...	·68	23	22	...	...	...	...	...	...
,,		Omagh (Edenfel)	3·75	+ ·70	·85	10	26	55·0	23*d*	30·0	27	2	5

a And 13. *b* And 16. *c* And 15, 20. *d* And 24. *e* And 17.

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

METEOROLOGICAL NOTES ON NOVEMBER, 1888.

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 month opened mild and rainy, with local fogs and with very welcome rain. In the middle the weather was very changeable, with low temperature and strong gales. At the close it was unseasonably mild with very considerable rainfall, so that low lands and the valley of the Loddon were in full flood. Primroses, daisies, and furze in flower and buttercups abundant.

HITCHEN.—The highest mean temp ever recorded in November (46°·3), and the first November in our record without a frost. Averaged temp. of November for 40 years, 37°·5.

ADDINGTON.—The month was mild, wet, and windy, and very free from fogs. More rain fell, and there was less frost than in any November during the preceding 18 years. The temp. in shade did not fall below 32°·0, and frosts on grass occurred only five times.

LANGTON HERRING.—The wettest month since November, 1877, when the rainfall was 8·02 in. The mean temp. was 48°·0, or 4°·1 above the average of November for 16 years, and excepting 1881, when it was 49°·7, was the highest for 17 years. A heavy TS occurred about 5 p.m. on the 26th.

BODMIN.—A most genial month and the mildest November recorded. Mean temp. 47°·7.

WOOLSTASTON.—A wild, wet, and stormy month, only three days on which no rain fell. Dense fogs with E. wind prevailed from 6th to 13th, and on the latter day the darkness at mid-day was intense. The latter part of the month was marked by a succession of gales and high winds. S fell on the 20th. Mean temp. 43°·7.

ORLETON.—A very cloudy, warm, and rainy month, with a few bright days. R only once exceeded in November during 57 years, viz. in 1852, and mean temp. 5° higher than the average of 27 years. On the evening of the 12th R set in and continued about 27 hours, when 1·81 in. had fallen, producing great floods on the rivers Teme and Severn. After this the temp. was high for several days, the min. on 16th being 54°·5, which was only equalled on five nights in July last. The wind was very rough at intervals and the weather very unsettled with a low bar. At 3 p.m. on the 23rd there was a well defined rainbow against a clear sky, with the exception of a few cirrus clouds.

BARKBY.—A mild month on the whole, with strong winds almost every day. Peas, violets, primroses, wallflowers, &c. in flower at end of the month. Mean temp. 45°·0.

MANCHESTER.—A wet month; from 18th to 25th stormy and rough. On the 20th there was a severe TS and in the evening hail, wind and vivid lightning. Temp. unusually high; a little frost on ground on the 7th, 8th, 28th and 29th.

HULL.—The weather during the month was generally wet and mild, with a great amount of cloud and frequent strong winds.

SEATHWAITE.—Eleven days with more than an inch of R, and in the six days ending 24th 12·11 in.

WALES.

HAVERFORDWEST.—A stormy, very mild, and very wet month; the wettest November since 1852, when 10·36 in. of R was registered; only 7 days on which no R fell; only two frosty nights; the rest of the month remarkable for its high temperature. A sudden change of temp. occurred on 30th, when the thermometer in shade fell to 27°.

SCOTLAND.

CARGEN.—An unusually stormy month. An almost continuous succcssion of gales of wind, accompanied by heavy R, prevailed from 12th to 27th, the fall in that period being 6·50 in. Mean temp. 43°·4, 2°·1 above the average. Only 35 hours of sunshine occurred against 87, the mean for the month.

JEDBURGH.—The early part of the month was still and the corn and potatoe crops, though late, were well secured. There were many windy days, and the storm on the 16th was considered little less severe than the Tay Bridge storm ; not much damage occurred, except upsetting of stacks and breaking of trees.

OBAN.—One-third of the month at the commencement was very fine, the remainder was remarkable for violent gales and heavy rain, that of the 20th being quite a hurricane. The temp. was high throughout.

LOCHBROOM.—There was no rain until the 13th, then for 14 days it rained incessantly, with high winds at times of hurricane force. The R of the 21st produced one of the highest floods remembered.

IRELAND.

CORK.—With the exception of a few fine days, it was very wet, damp, and raw, with two stormy nights.

DROMORE.—The month was rather wild and stormy, but not at all cold.

DUBLIN.—This was the wettest and most stormy November for 25 years. There was scarcely any frost and severe TS occurred on two occasions. Anti-cyclonic weather prevailed until 15th, but strong S.E. and S.W. winds and gales occurred in the latter half. Mean temp. 3° above the average.

EDENFEL.—A month of almost continuous gales and rains, with high mean temp.

AN IMPROVEMENT IN ANEMOMETERS.

To the Editor of the Meteorological Magazine.

SIR,—We have just read the letter upon the above subject in your last number. Mr. Russell's improvement appears to consist in multiplying the contacts so as to diminish the time between each, and in employing an astronomical chronograph to record the rapid succession thus established.

We have already constructed some anemometers on this principle, in which the contacts were so placed that a contact was made for each metre of wind that passed, and even some with one contact for each half metre. These are so combined with a system which divides the number of contacts by the time in which they are recorded, that the trace on the paper shows *the true speed of the wind during each second.*

The motive power is not obtained from Robinson's cups, but from a windmill fan made of aluminium, so as to have the minimum of momentum and friction, and it will turn with 0·20 metre per second (less than half a mile an hour), which Robinson's cups cannot do. But Robinson's cups could easily be attached in place of our fans if it is desired, to determine the correction requiring to be applied to them on account of their inertia.—Your obedient servants,

RICHARD FRÈRES.

Impasse Fessard, 8, Paris, November 20th.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCLXXVI.] JANUARY, 1889. [PRICE FOURPENCE, or 5s. per ann. post free.

MR. ABERCROMBY'S TRAVELS.*

A METEOROLOGIST might do far worse than present himself with a copy of the Hon. Ralph Abercromby's last book as a Christmas-box. It has appeared just at the right time; it is a book entirely *sui generis*, and though there are bits in it on an endless variety of subjects (from politics to the growth of one's beard), still the object of his recent voyages and the object of the book are the same—the study of "Seas and Skies in many Latitudes." The author might have added "and Longitudes," for the track chart shows at least two journeys round the world. In fact, excepting the West Indies and the West Coast of America, there are few important ocean tracks along which he has not been.

In this volume the author deals not merely with cloudland, but with weather and weather forecasting as actually practised at most of the extra European establishments. Himself a careful observer and thinker, it has been no slight advantage to personally visit the chiefs of the meteorological services of the United States, of India, New South Wales, and other countries. Then Mr. Abercromby seems to always have his camera ready, whether it be to take the midnight sun from the North Cape, or clouds in the Himalayas, or the entrance to edible bird's nest caves in Borneo, or——— Well, we will let Mr. Abercromby tell the tale; he was between New Zealand and Cape Horn.

"A top-sail had been split by a squall; the weather was very cold, with snow or hail showers; the sea rather high, and the ship rolling a good deal. With the assistance of a friend, who held the legs of the camera while the plate was being exposed, I succeeded in getting a good picture of a cumulus cloud, with a foreground of 21 men on the top-sail yard. They had a long job, shifting and replacing the

* "Seas and Skies in many Latitudes, or Wanderings in search of Weather," by the HON. RALPH ABERCROMBY, F.R.Met.Soc., &c. London, Stanford, 1888. 8vo., xvi.-448 pages. Nine photographs and numerous maps and engravings.

split canvas by a new top-sail, and when they came down some one remarked that a passenger had been photographing them. 'Well,' said an old sailor, 'if he could have photographed our language, he would have made a very pretty picture.'"

It is quite impossible for us to do more than indicate the character of the book. It is a book of travel, in which the ordinary-beaten tracks receive no notice unless some exceptional meteorological phenomenon occurs; but directly that the author leaves the usual routes, we have full and life-like descriptions, whether it be of a state *ve bose* in Fiji, of the climb to Sandakphu (11,930 ft.) in the Himalayas, the tobacco plantations of Sooloo, the temples in Japan, or the observatory on Pike's Peak, Colorado (14,150 ft).

As regards meteorology, we do not think that there is a chapter in the book which does not contain useful information, and perhaps to some it will be satisfactory to be assured that there is not a single equation, or a single table of figures from one end of the book to the other.

We think that Mr. Abercromby has carried the suppression of personal statements just a shade too far. It is all very well for him to assert in the preface, "Of adventure there is nothing in this book; there is no more adventure now in an ordinary voyage round the world than in travelling from London to Edinburgh." Without hunting up the dictionary definition of adventure, we may roughly regard this paragraph as putting coasting about among the mangrove swamps of Borneo as parallel to dining in a Great Northern Express between London and Grantham. Is that so? When a book of travels is well written, the reader becomes interested in the writer, and one wonders whether it is possible for anyone to stand the vicissitudes of climate, and of diet, and of atmospheric pressure without fever or other discomfort. But only once is the slightest hint dropped on this subject, viz., as to nausea at 14.150 ft. on Pike's Peak.

The photographic, and most of the other illustrations, are excellent, and the work is remarkably free from errors, as we have noticed only two, "Mr. Meldrum" for "Dr. Meldrum," and on p. 367 "within 85 per cent." should be either "within 15 per cent" or "85 per cent." Those who have ever seen a volume of 450 pages through the press, will understand from the above how carefully "Seas and Skies" has been printed and read. It is not every one who has Mr. Abercromby's opportunities; it is not one in ten thousand who could and would make such good use of them.

ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this Society was held at the Institution of Civil Engineers, 25, Great George Street, on Dec. 19th, Dr. W. Marcet, F.R.S., president, in the chair.

Dr. G. Adkins, Mr. T. M. Blake, Mr. C. J. Bromhead, Dr. A. Newsholme, Dr. E. P. Thurstan, Rev. Dr. T. T. Wilkinson, and Dr. F. M. Williams were elected Fellows of the Society.

The following papers were read :—

1, "On the Prolonged Spell of Cold Weather from September, 1887, to October, 1888," by Mr. C. Harding, F.R.Met.Soc. During the fifty-nine weeks, ending with the third week in October, there were but four warm weeks in the north-west of England, and only five warm weeks in the south-west of England, whilst in the latter district there was not a single warm week between March 12th and October 22nd. The mean temperature of the whole period was dealt with for the twelve districts into which the Meteorological Office divides the whole area of the United Kingdom, and with the single exception of the north of Scotland the weather for the period ending in October this year was the coldest of any during the past ten years. At Greenwich the temperature during the fourteen months was below the average on 312 days out of 427, or 73 per cent., and in July there was not a single warm day, the temperature being continuously below the average from June 27th to August 6th. The means for July 11th and 12th were colder by several degrees than those for March 9th and 10th.

2, "Report on the Phenological Observations for 1888," by the Rev. T. A. Preston, M.A., F.R.Met.Soc. Vegetation was generally backward throughout the season. In the south-west of England and south of Ireland plants were earlier than usual, but not elsewhere. In February they were from one to four weeks later, and gradually gained ground till June. In the south of Ireland they were slightly in advance of the average in June and July. In the south-west of England they just reached the average in July; whilst in Guernsey they were a fortnight later. Fruits generally were a failure, very few really ripened, and from want of sun all were deficent in flavour. Haymaking was unusually, as much as five weeks, late; it began in July or August, and was not entirely finished till late in September. Much hay was spoilt or secured in bad condition. Straw was plentiful, and though the corn was not an average crop, the fine October enabled farmers to secure a better one than could have been expected. Roots were in many places a failure, and potatoes were very much diseased.

3, "A Winter's Weather in Massowah," by Capt. D. Wilson Barker, F.R.Met.Soc. This gives the results of four-hourly observations during December, 1887, to February, 1888. The highest shade temperature was 95°, and the lowest 68°.

ELECTRIFYING A LONDON FOG.

SINCE Dr. Oliver Lodge made his remarkable discovery of the influence of the static discharge upon the dissipation of vapour, it has often been suggested that experiments should be made upon a large scale to see whether by this means a fog could be locally alleviated—or may we say—dislodged. The atmospheric conditions now existing in London are of the most favourable character, and our own experience would suggest that the neighbourhood of Fleet-street offers the best attainable conditions for an *experimentum crucis*. The *Liverpool Mercury* thinks that the experiment would be worth trying on the River Mersey "at any expense," and that, if successful, "the saving of life and property would be enormous." It also suggests that "the best way to try it would be to have a large balloon sent up some foggy day, and having it connected with a dynamo." If we may presume to offer an opinion of our own, we think a better way would be to get a good sized Wimshurst machine, mount it under shelter on the roof of a factory, or other building (where it could be geared on to some convenient shafting) and provide suitable discharging points. The whole thing could probably be done for £10. Why does not the Smoke Abatement Society take it up?—*The Electrician, December 28th.* 1888.

[If the experiment can be tried for so small a sum we wonder that our contemporary was not patriotic enough to make the attempt at its own cost. Perhaps the County Council will try what can be done.—ED. *M.M.*]

THE WEATHER AT CAMBRIDGE IN 1886, 1887, AND 1888.

	1886.	1887.	1888.
Mean Temperature	46°·4	45°·6	45°·6
Hottest by Day	July 4 & 21. 80°	July 3. 82°	Aug. 10. 80°
Coldest by Day	Dec. 21. 29°	Jan. 1. 21°	Feb. 24, 27°
Hottest by Night	Aug. 29. 64°	July 8 & 26. 62°	Aug. 9. 60°
Coldest by Night	Dec. 31. 16°	Jan 1. 15°	Feb. 1. 18°
No. of Days on which the maximum was at or under 32°	13	9	13
No. of Nights on which the minimum was at or under 32°	97	106	104
Mean of Barometer	29·82	29·94	29·88
Barometer Highest	Feb, 8. 30·60	Feb. 7. 30·62	Jan. 10. 30·61
Barometer Lowest	Dec. 8. 28·10	Jan. 5. 28·79	Mar. 11. 28·60
Rainfall	inches. 23·43	inches. 15·35	inches. 18·85
No. of Rainy Days	168	162	180

Beech House. J. NUTTER.

EXCESSIVE RIME.

To the Editor of the Meteorological Magazine.

SIR,– For the last two or three days we have had the heaviest hoar frost I ever saw, and such is every one's remark. On Saturday, 5th, and Sunday, 6th, the trees were so thickly covered with rime, that you could no more see through the branches than you could when covered with leaves in summer. The rime stood out from the branches from 1 inch to 1½ inches, longest on the side facing the wind, which has been S.W. for some days. A constant and dense fog prevailed from the 3rd until to-day, when the sun got out for an hour or two, and it brought a good deal of the rime off the trees, covering the ground under large trees to a depth of from three to four inches. The frost during these days has been very keen. The min. shade temp. on 4th, 5th, 6th and 7th was 18°, 20°, 16° and 21°, and the max. on the same days was 29°, 24°, 25° and 31°. It has been perfectly calm during those days.

I am, Sir, yours faithfully,

JOHN MATHISON.

Addington, Winslow, Bucks, 7th January, 1889.

SNOWDON RAIN GAUGES.

To the Editor of the Meteorological Magazine.

SIR,—I think that a word of warning to those who use Snowdon gauges, at least of recent construction, may be useful. I have lately got one, which has a receiving can holding no less than 9 inches of rain. This is a good thing in itself, but I find, by comparison with my old gauge, that very small quantities of rain are rather apt to get lost in this vast receptacle, *i.e.*, out of a fall of rain which ought to measure 0·01 inch, so much adheres to the bottom and side in pouring out, that only a non-measurable quantity comes out, and so a "day with rain" may be missed. An easy remedy for this is to place inside the can a small bottle or jar, which will hold all ordinary rains, leaving the big can itself for exceptional rains, when the small bottle will overflow into it.—Yours faithfully,

G. VON U. SEARLE.

30, *Edith Road, West Kensington.*

[Mr. Searle is quite right, but the original design of the Snowdon gauge included a bottle as well as a can; we never before heard of a gauge which had been supplied without both; we hope that the omission was purely accidental, and if it was not, Mr. Searle's letter and this note will probably be useful.—ED.]

LIGHTNING AND ITS EFFECTS.

To the Editor of the Meteorological Magazine.

SIR,—Will you kindly allow me to add a short postscript to my letter of last month; it is as to the sound of thunder. I attributed it to the collapse of the vacuum caused by the flash. I think that it may perhaps as well arise from the concussion of the air in its sudden expansion, as in the firing of a gun.

It also occurs to me that the sand storms in the desert, a good illustration of which is given in "Atkinson's Tour to the Upper Amoor," also the action of the sea in water-spouts, are good examples of the effects of upward currents.

ROBERT J. LECKY.

3, *Lorton Terrace, 1st January*, 1889.

"THE SPECTRE OF THE BROCKEN" IN SOUTH SHROPSHIRE.

(Reprinted from *The Hereford Times.*)

SIR,—Being at the summit of the Titterstone Clee Hill, between 11 a.m. and noon on Wednesday, December 26th, I witnessed a curious phenomenon. There were a few white clouds scudding just across the top, and the sun was shining through them, and the wind was fresh from S., though the direction of all the other clouds, except these few, was westerly. When I stood on the top, the sun threw my shadow some hundred yards or so over the valley into the fog; at about an equal distance of four yards from my image in the fog was a perfect rainbow, and within, again, all round the image of my head, was a perfect halo. As my image was in the centre of the bow, I moved some distance, and the bow also moved, with the halo round my head (or rather the image of my head), so that I was always in its centre. Gradually the fog cleared, and the whole "spectre" also vanished. Soon after there was a snowstorm, with the temperature 34°.

R. P. DANSEY.

The Sheet, Ludlow, December 27th, 1888.

THE NOISE OF METEORITES.

The sounds which these bodies occasionally produce has been hitherto (*Humboldt*) ascribed to explosion. Daubrée calls this in question on account of the great rarity of such sounds and their peculiar character, which resembled rather the discharge of small arms, the rolling of a train, or the tearing of linen. Hirn shows that it is merely an intensification of the whistling of a bullet. The meteorite moves from 80 to 120 times as rapidly as a bullet, and makes consequently a louder sound.—*Public Opinion.*

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, MAY, 1888.

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	77·2	19	35·3	11	64·0	44·1	42·4	68	125·3	29·3	1·18	7	5·0
Malta	80·1	12	52·4	1	72·3	59·3	57·1	76	140·2	45·3	1·57	5	4·5
Cape of Good Hope	75·5	3	45·2	23	63·3	53·2	...	...	...	...	8·55	18	7·5
Mauritius	80·2	8	63·0	23	78·5	68·0	65·1	78	129·7	51·1	·99	14	4·8
Calcutta	100·4	16	70·8	29	93·9	77·7	75·9	67	159·8	68·4	3·77	10	4·9
Bombay	...	...	...	...	...	...	...	...	...	...	...	...	...
Ceylon, Colombo	90·4	3, 5	74·0	11	87·1	77·6	73·3	78	148·0	71·0	16·05	22	6·8
Melbourne	78·1	2	40·0	17	61·2	46·9	47·3	80	125·2	35·3	3·77	15	6·4
Adelaide	84·0	1	39·8	6	65·8	50·3	46·8	66	132·7	29·9	2·12	10	5·4
Wellington	...	...	...	...	...	...	...	...	...	...	...	...	...
Auckland	66·5	7*a*	40·0	30*c*	61·7	51·6	50·1	80	125·0	31·0	5·69	20	6·6
Falkland Isles	...	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston	92·2	6	68·7	21	86·1	71·8	71·8	78	...	...	22·13	...	...
Barbados	83·0	7*b*	70·0	10*d*	82·0	72·0	72·6	82	...	...	5·99	15	7·0
Toronto	74·1	11	32·9	2	59·5	42·4	41·4	68	...	24·2	·85	17	6·5
New Brunswick, Fredericton	77·2	25	27·0	1, 2*e*	59·4	38·6	37·8	60	...	...	4·46	16	6·1
Manitoba, Winnipeg	78·0	8	15·3	14	59·9	30·2	31·3	59	...	...	·17	9	5·2
British Columbia, Victoria	78·0	17	34·0	5	65·4	42·9	...	...	...	...	·19	4	...

a And 15. *b* And 24, 25, 26, 27, 31. *c* And 31. *d* And 11, 28. *e* And 5.

REMARKS, MAY, 1888.

MALTA.—Mean temp. 64°·5; mean hourly velocity of wind 10·0 miles. Sea temp. rose from 63°·0 to 69°·4. TS8 on 17th and 27th. L on 26th. Rain and amount of cloud greatly in excess of the average. J. SCOLES.

Cape of Good Hope.—Rainfall 4·90 in. above the average; mean pressure 0°·1 below, mean max. temp. 1°·7 below, mean min. 2°·3 above average. W. ELLERTON FRY.

Mauritius.—Mean temp. 0°·1 below, mean dew point 0°·8, above, and rainfall 3·52 in. below average. Mean hourly velocity of wind 8·3 miles, or 1·9 below average; extremes 21·1 on 28th and 1·9 on 29th; prevailing direction E.S.E. C. MELDRUM, F.R.S.

Melbourne.—Mean temp, of air 0°·5, of dew point 1°·3, humidity 2, rainfall 1·69 in., and pressure ·102 in. above their respective averages. Amount of cloud ·2 below average. Prevailing winds N. and W.; strong on six days; greatest hourly velocity 23 miles on 3rd from N. Heavy dews on 3 days. Dense fog on 5 days. H on 3rd and 5th; L on 15th. R. L. J. ELLERY, F.R.S.

Adelaide.—Mean pressure (30·204 in.) ·079 in. above average of 31 years. Temp. slightly above and rainfall an inch below the average. Total rainfall from Jan. 1st to May 31st less than in any previous year since 1839. C. TODD.

Auckland.—A wet and stormy month, rainfall 1·75 in. above the average; mean temp. slightly below the average; mean pressure somewhat above. T. F. CHEESEMAN.

BARBADOS.—Mean temp. (75°·0) 1°·2 below the 30 years' average; wind averaged 10·5 miles per hour, same as the 15 years' average; rainfall was 30 per cent. above the 25 years' average. Evaporation 13 per cent. below the average. 7 days were cloudy. R. BOWIE WALCOTT.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JUNE, 1888.

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.	TotalRain. Depth.	Days.	Aver. Cloud.
	°		°		°	°	°	0–100	°	°	inches		0–10
England, London	84·7	25	43·9	18	68·1	50·8	49·9	76	127·6	36·7	2·31	20	6·9
Malta	92·1	9	60·2	1	84·1	67·1	63·5	70	146·5	53·3	...	...	1·8
Cape of Good Hope	76·0	2	43·5	22	62·0	52·4	...	...	...	...	9·75	16	6·8
Mauritius	78·7	6	59·3	16	75·9	65·1	61·4	75	123·2	47·8	1·64	16	4·9
Calcutta	106·6	14	72·9	3	96·5	79·9	77·1	67	165·4	70·8	3·26	7	5·5
Bombay	93·0	3	74·0	8	87·4	79·7	77·5	83	149·0	71·8	15·76	21	6·4
Ceylon, Colombo	86·7	4, 6	73·5	7	85·1	76·8	72·7	80	144·2	69·5	9·06	26	7·8
Melbourne	66·9	29	36·2	27	58·2	46·2	44·6	76	116·4	28·8	1·19	13	6·3
Adelaide	68·2	8	39·3	4	61·1	48·9	46·8	74	123·1	29·5	2·84	18	6·1
Wellington	...	...	...	...	...		...	...	...	...	...	...	...
Auckland	63·0	23	37·0	9	57·9	46·3	45·4	78	118·0	30·0	4·13	20	6·0
Falkland Isles	...	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston	93·6	28	70·1	16	89·0	73·2	73·2	73	...	...	2·76	...	...
Barbados	84·0	4, 6*a*	71·0	22, 23*b*	83·0	73·0	73·3	80	...	...	4·98	12	6·0
Toronto	92 0	22	40·5	4	75·5	53·4	53·8	70	...	33·5	3·99	11	5·2
New Brunswick, Fredericton	87·7	23	37·5	8	72·8	48·8	51·2	68	...	...	1·47	11	6·0
Manitoba, Winnipeg	96·0	18	21·0	1	74·5	48·7	54·0	72	...	...	3·10	17	5 3
British Columbia, Victoria	72·0	22	40·0	21, 22	66·4	48·4	...	...	...	...	2·23	10	..

a And 7, 9, 11, 12, 13, 14, 15, 16, 17. *b* And 24.

REMARKS, JUNE, 1888.

MALTA.—Mean temp. 74·5; mean hourly velocity of wind 7·4 miles. Sea temp ranged from 69°·4 to 77°·0. Slight earthquake shocks on 22nd. Temp. well above the average. J. SCOLES.

Cape of Good Hope.—Unusually wet. R 5·10 in. above the average. Mean max. temp. 1°·1 below average, mean min. 4°·1 above average. W. ELLERTON FRY.

Mauritius.—Mean temp. of air 0°·1 below, of dew point 0°·9 above, and R ·34 in. below, average. Mean hourly velocity of wind 9·3 miles, 2·1 miles below average; extremes 26·6 miles, and 0·0 miles. Prevailing direction E.S.E. to S.E.
C. MELDRUM, F.R.S.

COLOMBO.—TSS occurred on the 2nd and 28th; L was seen on 13 days.
J. C. H. CLARKE, Lt.-Col. R.A.

Melbourne.—Mean temp. of air 2°·6, and of dew point 1°·2 above average; humidity 4, mean amount of cloud 0·3, pressure ·007 in., and R ·79 in. below average. Prevailing wind N. Heavy dew on 7 days. Hoar frost on 4 days. Dense fog on 6th and 7th. L on 18th and 19th. R. L. J. ELLERY, F.R.S.

Adelaide.—Mean pressure (30·157 in.) ·027 above the average of 31 years. Mean temp. 1°·5 above average. Rainfall slightly above average. C. TODD.

Auckland.—A showery month, remarkable for the small amount of wind. Total rainfall ·75 in. below the average. Mean temp. 2° below average; pressure slightly above. T. F. CHEESEMAN.

BARBADOS.—Mean temp. (77°·2), 0°·5 below the 30 years' average. Mean hourly velocity of wind 9·2 miles, 3 miles below the 15 years' average. Rainfall 12 per cent. below the 25 years' average. Evaporation 8 per cent. above the average.
R. BOWIE WALCOTT

SUPPLEMENTARY TABLE OF RAINFALL, DECEMBER, 1888.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	2·18	XI.	Castle Malgwyn	7·73
,,	Margate, Birchington...	1·59	,,	Rhayader, Nantgwillt..	8·22
,,	Littlehampton	1·42	,,	Carno, Tybrith	3·74
,,	Hailsham	1·74	,,	Corwen, Rhug	2·37
,,	Ryde, Thornbrough	1·97	,,	Port Madoc	4·51
,,	Alton, Ashdell.....	2·45	,,	I. of Man, Douglas	5·11
III.	Oxford, Magdalen Col...	1·97	XII.	Stoneykirk, Ardwell Ho.	2·87
,,	Banbury, Bloxham	2·98	,,	New Galloway, Glenlee	8·74
,,	Northampton	1·73	,,	Melrose, Abbey Gate ...	2·31
,,	Cambridge, Beech Ho...	·96	XIII.	N. Esk Res. [Penicuick]	2·00
,,	Wisbech, Bank House..	1·42	XIV.	Ballantrae, Glendrishaig	4·68
IV.	Southend	·87	,,	Glasgow, Queen's Park.	3·95
,,	Harlow, Sheering	·83	XV.	Islay, Gruinart School..	6·38
,,	Rendlesham Hall	·81	XVI.	St. Andrews, Pilmour Cot	2·12
,,	Diss	1·58	,,	Balquhidder, Stronvar..	8·32
,,	Swaffham	1·16	,,	Dunkeld, Inver Braan..	4·04
V.	Salisbury, Alderbury ...	2·45	,,	Dalnaspidal H.R.S. ...	4·88
,,	Warminster	3·71	XVII.	Keith H.R.S.	1·20
,,	Bishop's Cannings	3·13	,,	Forres H.R.S.	·82
,,	Ashburton, Holne Vic....	8·98	XVIII.	Strome Ferry H.R.S....	6·58
,,	Hatherleigh, Winsford.	5·60	,,	Fearn, Lower Pitkerrie.	·79
,,	Lynmouth, Glenthorne.	5·25	,,	Loch Shiel, Glenaladale	10·51
,,	Probus, Lamellyn	4·82	,,	S. Uist. Ardkenneth ...	...
,,	Launceston, S. Petherwin	3·70	,,	Invergarry	3·95
,,	Wincanton, Stowell Rec.	3·17	XIX.	Lairg H.R.S.	...
,,	Taunton, Lydeard Ho...	2·66	,,	Forsinard H.R.S.	...
,,	Wells, Westbury.....	3·25	,,	Watten H.R.S.	1·59
VI.	Bristol, Clifton	3·29	XX.	Dunmanway, Coolkelure	11·86
,,	Ross	3·29	,,	Fermoy, Gas Works ...	5·16
,,	Wem, Clive Vicarage ...	2·00	,,	Tipperary, Henry Street	4·96
,,	Cheadle, The Heath Ho.	2·41	,,	Limerick, Kilcornan ...	4·16
,,	Worcester, Diglis Lock	1·67	,,	Miltown Malbay.....	6·50
,,	Coventry, Coundon	2·53	XXI.	Gorey, Courtown House	4·44
VII.	Melton, Coston	1·43	,,	Navan, Balrath	2·90
,,	Ketton Hall [Stamford]	1·52	,,	Mullingar, Belvedere ...	3·87
,,	Horncastle, Bucknall ...	1·34	,,	Athlone, Twyford	3·76
,,	Mansfield, St. John's St.	2·82	,,	Longford, Currygrane...	4·27
VIII.	Knutsford, Heathside ...	2·03	XXII.	Galway, Queen's Coll...	4·17
,,	Walton-on-the-Hill.....	1·61	,,	Clifden, Kylemore	11·57
,,	Lancaster, South Road.	3·56	,,	Crossmolina, Enniscoe..	7·20
,,	Broughton-in-Furness ..	5·37	,,	Collooney, Markree Obs.	4·87
IX.	Shipley, Esholt Vic. ..	...	XXIII.	Rockcorry.....	...
,,	Ripon, Mickley	2 11	,,	Warrenpoint	5·27
,,	Scarborough, West Bank	1·46	,,	Seaforde	3·44
,,	East Layton [Darlington]	1·41	,,	Belfast, New Barnsley..	3·17
,,	Middleton, Mickleton ..	1·48	,,	Cushendun	4·07
X.	Haltwhistle, Unthank..	1·16	,,	Bushmills	3·18
,,	Shap, Copy Hill	8·12	,,	Stewartstown	3·18
XI.	Llanfrechfa Grange	5·46	,,	Buncrana	3·73
,,	Llandovery	7·06			

DECEMBER, 1888.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1870–9	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) ...	1·29	— ·88	·43	24	9	58·9	5	25·9	31	11	16
II.		Maidstone (Hunton Court)...	1·47	— ·93	·40	25	10	...	...	...	...	...	...
,,		Strathfield Turgiss	1·64	— ·38	·42	25	14	57·4	5	23·1	13	15	20
III.		Hitchin	1·26	— ·79	·25	8	13	56·0	5	23·0	31	14	...
,,		Winslow (Addington)	2·00	— ·11	·68	8	16	59·0	4	19·0	11*a*	14	19
IV.		Bury St. Edmunds (Culford)	1·53	— ·62	·56	25	...	52·0	1	18·0	31	16	...
,,		Norwich (Cossey)	1·25	— 1·07	·50	24	11	...	...	...	...	...	...
V.		Weymouth (Langton Herring)	1·93	...	·30	8	15	56·0	4	30·0	30*a*	7	...
,,		Barnstaple	3·82	+ ·06	·83	24	16	59·0	5, 7	26·0	10*a*	...	...
,,		Bodmin	4·98	— ·47	·55	3	20	54·0	3	27·0	31	4	14
VI.		Stroud (Upfield)	3·42	+ ·99	·71	27	18	56·0	5, 6	23·0	30	15	...
,,		Church Stretton (Woolstaston)	2·96	+ ·17	1·53	27	18	54·5	5	27·0	18*b*	12	18
,,		Tenbury (Orleton)	2·84	+ ·33	1·31	27	18	57·7	5	20·0	31	14	19
VII.		Leicester (Barkby)	1·71	— ·21	·51	27	19	58·0	6	17·0	30	19	22
,,		Boston	1·38	— ·69	·51	8	11	59·0	6	23·0	31	16	...
,,		Hesley Hall [Tickhill].....	1·79	...	1·15	27	12	58·0	4	19·0	18	16	...
VIII.		Manchester (Ardwick).....	2·26	— ·27	1·19	27	13	56·0	22	28·0	14*b*	7	...
IX.		Wetherby (Ribston Hall) ..	1·91	— ·30	·81	28	10	...	...	...	...	...	...
,,		Skipton (Arncliffe)	5·94	+ ·66	·88	27	18	55·0	5	23·0	31	...	...
,,		Hull (People's Park)	1·61	— ·91	·77	27	15	...	...	...	...	...	...
X.		North Shields	·69	— 2·40	·14	25	11	58·0	3, 5	23·5	31	16	17
,,		Borrowdale (Seathwaite).....	17·45	+ 3·72	3·55	2	19	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	4·18	+ ·27	1·16	27	20	...	...	...	...	...	...
,,		Haverfordwest	6·41	+ 1·28	1·05	27	21	55·0	3, 5	24·6	30	15	17
,,		Plinlimmon (Cwmsymlog) ...	4·30	...	1·27	27	18	...	...	...	...	...	...
,,		Llandudno.....	1·73	— 1·12	·33	27	18	60·0	3	30·0	31	3	...
XII.	SCOTLAND.	Cargen [Dumfries]	4·59	+ ·06	·94	3	15	54·6	5	21·0	30	11	...
,,		Jedburgh (Sunnyside).....	1·59	— ·86	·39	25	13	54·0	3, 5	19·0	30	17	...
XIV.		Old Cumnock	3·78	— ·10	·67	19	19	54·0	3	16·0	29	12	...
XV.		Lochgilphead (Kilmory)	5·66	— ·52	·97	2	23	...	...	21·0	28	10	...
,,		Oban (Craigvarren)	5·99	...	·80	31	24	55·3	3	26·4	30	2	...
,,		Mull (Quinish).....	...	...	...	...	..	...	...	...	...	...	...
XVI.		Loch Leven Sluices	2·60	— 1·06	·90	3	13	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	1·85	— 1·42	·60	2	12	55·2	3	21·8	30	11	...
XVII.		Braemar	2·95	— ·48	·78	21	18	53·8	3	16·0	30	12	21
,,		Aberdeen	...	...	...	...	...	...	...	...	...	...	
XVIII		Lochbroom	3·21	...	·39	25	21	...	...	...	...	...	...
,,		Culloden	·48	— 1·36	...	...	...	55·0	4, 7	27·0	11*b*	8	21
XIX.		Dunrobin	1·20	...	·24	27	8	55·5	3	25·0	30	10	...
,,		Kirkwall (Swanbister)..... ..	...	...	...	...	...	...	...	...	...	...	...
XX.	IRELAND.	Cork (Blackrock)	8·41	+ 3·65	2·59	21	20	56·0	2	26·0	29	12	...
,,		Dromore Castle	9·23	...	1·50	6	17	50·0	3	27·0	29	...	...
,,		Waterford (Brook Lodge) ...	5·91	...	1·10	19	21	55·0	2, 3	25·0	31	11	...
,,		O'Briensbridge (Ross)	4·26	...	·48	31	19	56·0	6	24·0	30	...	...
XXI.		Carlow (Browne's Hill)	4·75	+ 1·24	·93	19	20	...	...	...	...	...	...
,,		Dublin (Fitz William Square)	2·91	+ ·33	·68	19	17	59·6	3, 5	26·4	30	5	20
XXII.		Ballinasloe	4·33	+ ·85	·52	6	23	53·0	3, 6	22·0	30	20	...
XXIII		Waringstown	3·03	+ ·07	·43	2	17	57·0	3	21·0	29	15	20
,,		Londonderry (Creggan Res.).	3·61	...	·67	2	24	...	...	...	...	...	...
,,		Omagh (Edenfel)	3·47	+ ·07	·32	31	21	55·0	3	25·0	28	15	...

a And 31. *b* And 30.

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

METEOROLOGICAL NOTES ON DECEMBER, 1888.

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 temp. at the beginning of the month was extremely high, higher than in Italy or Spain, the climatic conditions being entirely abnormal and not conducive to health. The end of the month was cold, raw and foggy. Peacock butterfly seen on the wing on the 6th. The general aspect of the country from an agricultural point of view was highly satisfactory.

HITCHEN.—There have been only five milder Decembers in 40 years.

WINSLOW, ADDINGTON.—From 1st to 9th, very mild; max. temp. on 4th and 5th, 59°·0 and 58°·0. A heavy R on the 8th caused the brooks to overflow, covering the meadows with water. A sharp frost on 10th was followed by a dense fog lasting all day, on the 11th the trees being covered with rime. The 14th, 15th, 16th and 17th were foggy. Sharp frost on 31st.

WEYMOUTH, LANGTON HERRING.—R 1·22 in. below the average of nine years. Mean temp. at 9 a.m. (42°·6) 2°·8 above the average of 16 years. Fog on 6th, 16th, 18th and 20th, and storms on 21st and 22nd.

BODMIN.—A remarkably mild December. Mean temp. 42°·6.

WOOLSTASTON.—A seasonable month. S fell on 27th. Mean temp. 40°·0.

ORLETON.—From the 1st to the 8th, the weather was cloudy and very warm, with a little R at intervals. On the 5th the thermometer registered 57°·7. From the 9th to 18th it was cold and dry, with severe frost, and frequent fog. From 18th to the 25th, it was warm and very rainy. The remainder of the month was cold and foggy. The mean temp. was about a degree above the average of 27 years. The R was above the average; 2·29 in. falling in the eight days, from 20th to 28th. On the evening and night of the 27th, a great local fall took place, which produced on the 28th, a greater flood on the River Teme and its tributaries than that of the 13th November last, causing the loss of a great number of sheep. Fogs occurred on nine days. L was seen on 24th, 25th and 26th. The wind was very often high and gusty between 19th and 27th.

MANCHESTER.—December was an unseasonable month, with very little frost and frequent fogs. The temp. was rather high. Fog on eight days.

HULL.—The weather during the month was generally mild and calm, frequently with mist, fog or drizzle; often cloudless at night.

SEATHWAITE.—On 2nd and 3rd, 6·76 in. of R fell, and in the first five days 11·04 in.

WALES.

HAVERFORDWEST.—Frost on the 1st was succeeded by very wet, mild weather to the 7th; the weather then changed to fine bright skies, N.E. wind, and sharp night frost, with some fog. A change to milder weather, with S.W. winds, and large quantities of R, occurred on the 21st; this R and dampness, with unusual mildness continued to the end of the month, and the fogs were very dense during the last week. The temp. of the month was about the average owing to the min. readings being generally low. L on 21st and 22nd.

LLANDUDNO.—A fine, mild month, with occasional high winds.

SCOTLAND.

CARGEN.—The mean temp. of the month (40°·2) was 1°·6 above the average. Sharp frosts occurred on the 10th and 11th, and on 30th and 31st. The meteorological conditions of the month presented a remarkable similarity to those of December 1887, with the exception of the R, which was 1·15 in. less. Sunshine 20 hours below the average.

JEDBURGH.—The earlier days were marked by fine fresh weather, which brought the primrose into full bloom, but towards the end of the month the temp. was very variable. All kinds of out-door work proceeded without interruption.

OBAN, CRAIGVARREN.—A warm and open month; roses and wall flowers in bloom, daisies visible, and grass in growth throughout. T and L on 27th.

BRAEMAR.—A month of very dark, but soft and genial weather.

LOCHBROOM.—To the 23rd, finer weather was never seen at the time of year, and though there was a rough spell at the end, it was nothing but good natured weather.

INVERNESS, CULLODEN.—The rainfall during the month was very small, and the weather was generally fine, some days warm and sunny; very favourable for labour of all kinds.

IRELAND.

CORK.—A raw, cold and wet month, with an unusual fall of 2·59 in. of R on the 21st. There have been only three wetter Decembers during 23 years.

DROMORE.—The weather was very open except during the last two or three days, when rather hard frost prevailed. There were some very heavy gales during the month.

ROSS.—An ordinary winter month, no snow, some heavy gales of short duration, much fog, and slight frosts in the last week.

DUBLIN.—A mild changeable month, setting in with a period of warmth which was remarkable for the time of year, the mean temp. during the first week being 51°·8. Southerly winds (S.E. through S. and S.W. to W.) vastly preponderated. Fogs were prevalent in an anti-cyclonic period from the 9th to the 18th. A very sharp frost occurred on the 30th, the max. temp. being only 30°·7. There were only three gales, and neither sleet nor S was observed. On eight days the sky was overcast, on four it was clear. The mean temp. 43° 6 was, as in November, above the average (41°·1). Mean humidity 88. Mean amount of cloud 5·8. L on 27th. H on 11th.

EDENFEL.—A mild and wet month. The night frosts, although somewhat frequent were not severe, and there was no snow whatever.

END OF VOL. XXIII.