SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

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THE BRITISH ASSOCIATION AT BELFAST.

WE are not aware of any meteorological feature for which the above meeting will be memorable. The attendance of meteorologists and observers was (as will be seen from the following list) rather above the average, and the papers were quite up to the usual standard, perhaps above it, but not remarkable.

Adams, Prof. J. C. F.R.S. .. Cambridge.
Andrews, Dr., F.R.S. ... Belfast.
*Ashe, J., M.B. ..... Londonderry.
Balfour, Prof. J. H. ... Edinburgh.
Barrington, E. ..... Bray.
Barrington, R. M. ..... Bray.
Belcher, R. B. ..... Blockley.
Boyd, J. K. ..... Belfast.
Brenan, Rev. S. A. ..... Pomeroy.
*Brooke, C., F.R.S. ..... London.
Campbell, Major, R.E. . Athlone.
Curley, T., C.E. ... . Hereford.
Curtis, Prof. A. H. ..... Galway.
Deacon, G. F. ..... Liverpool.
Dyer, Prof. W. T. ..... Kew.
Elliot, Sir Walter..... Wolfelee.
Enniskillen, Earl of, F.R.S. Florence Court.
Everett, Prof. J. D. ..... Belfast.
*Field, Rogers, C.E. ... London.
Glaisher, J., F.R.S. ..... Blackheath.
Gott, C., C.E. .... Bradford.
Graves, Rev. J. .... Stoneyford.
Healey, G. .... Windermere.
Hennessey, H., F.R.S. .. Dublin.
Herschel, Prof. A. . Newcastle-on-Tyne
Hooker, J. D., P.R.S. .... Kew.
Hotchkiss, Major..... Virginia, U.S.
*Howlett, Rev. F. .... East Tisted.
*Hudson, H., M.D. ..... Fermoy.
Lindsay, C. .... Lanark.
Lund, C. .... Bradford.
Mahony, J. A. .... Ramelton.
M'Kay, R. ..... New Galloway
Moffat, Dr. .... Hawarden.
*Muirhead, H. ..... Lanark.
*Mylne, R., C.E., F.R.S. London.
*Negretti, H. .... London.
Pengelly, W., F.R.S. ... Torquay.
Rosse, Earl of, F.R.S. .... Birr Castle.
*Scott, Prof. A. W. ..... Lampeter.
Scott, R. H., F.R.S. ... London.
*Smyth, J., jun., C.E. .... Banbridge.
Strange, Col., F.R.S. ... London.
*Symons, G. J. ..... London.
*Talmage, C. G. ..... Leyton.
*Woodward, C. J. ..... Birmingham.

Mr. Smyth, by reading a good paper on the Meteorology of Banbridge and the Rainfall of Ulster, vindicated the province from the complaint urged against Bradford last year. As to other papers, the abstracts must speak for themselves.

THE METEOROLOGICAL BREAKFAST.

As already indicated in these pages, a "first attempt" at carrying the above idea into practice was made at Belfast. Of the result it would perhaps hardly be proper for us to speak fully, and we therefore confine ourselves to mentioning that the party mustered 15 or 16, and (as will be seen above, the asterisks marking those present at the

breakfast) included a majority of the most able meteorologists at the meeting, while nearly all the absentees stated that they were so unwillingly. In several cases it was due to the arrangements made for the local "Post Office" in the Reception Room, which were unprecedentedly defective. As it was a purely friendly meeting, there was no chairman, and there were no set speeches, but there was much pleasant and profitable conversation. No definite resolution was submitted, but it appeared to be the general wish that a similar gathering should be held annually in future. In that case we hope that the local arrangements may always be in the hands of gentlemen as efficient in every way as Mr. Smyth. We shall be glad even thus early to have an offer of assistance from some one in, or acquainted with, Bristol.

SPECIMEN AND APPARATUS ROOM.

This was a new idea, successfully carried out under the supervision of Mr. Ray Lankester. It has often been felt that a more leisurely examination of apparatus and specimens than is possible in the Sections is desirable. To afford this, a temporary museum was created by the deposit of all models, apparatus, and specimens during the whole week, save only such time as they are actually required in the various Sections.—The exhibits were, as might be expected, extremely various, ranging from Skulls to Patent Safety Cheques, and from Algæ to Railway Signals.

PAPERS ON METEOROLOGICAL SUBJECTS.

The following is a complete list of the papers read :—

ASHE, ISAAC.—"On the cause of the progressive motion of Cyclones, and of the seasonal variations in their paths."

BALFOUR, PROF.—Report "On the influence of forests on rainfall."

BELCHER, R. B.—"On the artificial disturbance of the weather."

BLANDFORD, H. F.—"On certain protracted irregularities of atmospheric pressure in the Indian Monsoon region, and their relation to variations of the local rainfall."

EVERETT, PROF. J. D.—Report "On underground temperatures."

GLAISHER, J., F.R.S.—Report "On luminous meteors."

MOFFAT, T., M.D.—"On the apparent connexion between sun-spots and atmospheric ozone."

MELDRUM, C.—"On the Cyclones of the Mauritius."

NEGRETTI, H.—"On a new Deep Sea and Recording Thermometer."

PASTORELLI, F.—To exhibit a gymbal-swung rain gauge.

SCOTT, R. H., F.R.S.—"On the importance of improved methods of registration of winds on the coast, with a notice of an Anemometer designed by Mr. W. De la Rue, to furnish telegraphic information of the occurrence of strong winds."

SMYTH, J. jun.—"On the meteorology of Banbridge for ten years, and on the rainfall of Ulster."

STOW, REV. F. W.—"On the absorption of the sun's heat rays by the vapour of the atmosphere."

STRANGE, LT.-COL., F.R.S.—"On the necessity for placing physical meteorology on a rational basis."

SYMONS, G. J.—"Report of rainfall committee."

SYMONS, G. J.—To exhibit a set of thermometers prepared to test relative sensitiveness.

SYMONS, G. J.—"On a new and greatly improved form of storm rain gauge."

ON THE ABSORPTION OF THE SUN'S HEAT-RAYS BY THE VAPOUR OF THE ATMOSPHERE.

By the Rev. Fenwick W. Stow, M.A., F.M.S.

The observations of Solar Radiation, which are relied on in this paper, are taken with "blackened-bulb thermometers in vacuo" suspended 4 feet above the ground, the indications of which, when compared with those of the ordinary shade thermometers, give a measure of the intensity of the solar rays.

The absorption of the direct solar heat-rays by the vapour of the atmosphere is proved in several distinct ways :—

1. It is found that the elastic force of vapour is less on the ten days in each month on which radiation is most powerful than on an average of the whole month. This is proved by five years' daily observations at Strathfield Turgiss, Hants, 1869-74 ; two years' at Hawsker, near Whitby, Yorkshire, (1869-71) ; and one year's observations in 1872, at Harpenden, Herts.

2. It was also found by the above observations that N. and N.W. winds, which contain little moisture, are very favourable to solar radiation, whereas S. and S.E. winds are usually accompanied by much less powerful sunshine. The N.E. winds of spring, which are excessively dry, are also accompanied by intensely powerful solar radiation.

3. By frequent observations during cloudless weather, with nearly constant vapour-tension, curves are obtained representing the daily variations in solar radiation produced by the changes in the sun's altitude and consequent alteration of the length of the path which the beams pursue through the atmosphere. From these the per-centage of the sun's heat-rays, which would be absorbed by the atmosphere if the sun were vertical, can be approximately determined, assuming that the tension of vapour remained as it was on the day or days of observation. It is then possible to calculate the amount of radiation due to the altitude of the sun at noon in the middle of each month for a constant vapour-tension, and to compare this with the amount actually observed in each month on cloudless days. In this way it is found that when the tension of vapour falls below the amount on the day which furnishes the data for calculation, the radiation rises above the calculated amount, and *vice versa*. In fact, the sun's rays are more intense in winter than in summer, when the difference of altitude at noon is allowed for, because the absolute amount of vapour in winter is so much less. About ten or twelve per cent. is the minimum of absorption of the sun's heat rays, while the maximum equals or even exceeds 20 per cent.

The paper concludes with a few observations on the increase of solar radiation with elevation above the sea level, from which the difference would appear to have amounted, between the heights of 470 to 1800 feet, to about 5 per cent. of the amount observed at the lower station when the sun's altitude was 20°, and to above 3 per cent. when the altitude was 26°.

THE RAINFALL OF AUGUST 13, 1874, AT DUBLIN.

To the Editor of the Meteorological Magazine.

Sir,—The exceptional character of the rainfall attending the bourrasque of the 12th, 13th, and 14th of August last in this neighbourhood, seems to me worthy of being placed on record in your *Magazine*. I shall therefore briefly describe the conditions preceding and accompanying that rainfall, and give you such information respecting the amount of rain registered in and around Dublin as I have been able to gather from my fellow-observers here.

Early on the morning of the 12th August, the barometer, which until then had been recovering from a depression which travelled

slowly to the eastward across Scotland, again began to fall. A few hours later clouds increased, and the wind backed to S.W., ultimately falling calm. From 8 p.m. the weather was rainy, and at 11 p.m. a very light easterly air was felt in Dublin. By 9 a.m. on the 13th, ·100 of an inch of rain was registered. The barometer had by this time fallen to 29·336 in.; the sky was overcast, with a damp atmosphere, and a light breeze from E.N.E. The centre of a rather serious depression was clearly passing N. Eastward, a little to the S. of Dublin. The weather remained fine, but overcast and gloomy until 2.30 p.m., when rain began to fall heavily, with a sudden shift of wind to N. From 3 p.m. rain fell in torrents, and at 4.30 p.m. thunder was heard to S.E. (Kingstown and Dalkey). By 6 p.m. the barometer had reached its minimal reading—29·266 in. The wind now backed still further to N.N.W., and freshened somewhat. At 9 p.m. I emptied the rain gauge, which yielded, as the result of 6½ hours fall, 2·124 in. After about four hours' additional fall (0·358 in.) the rain ceased, the wind meanwhile rising to a fresh breeze from N.W. At 9 a.m. on the 14th the rainfall proved to be 2·482 in., all of which fell in some 10½ or 11 hours. The total fall during the passage of the bourrasque was therefore 2·582 in., or 20·6 per cent. of the total rainfall here from January 1st to August 12th, 1874.

I now give you the returns from other observatories near Dublin, roughly specifying their relative position to my gauge, as regards bearing and distance.

To the S. or S.E. :—

Fassaroe (12 miles)	2·250 in.
Kingstown (6 miles)	2·380 in.
Monkstown (Easton Lodge,) (5 miles)	2·355 in.
,, (Dean's Grange,) (6 miles)	2·290 in.
Sandford (1 mile)	2·070 in.

To the W.N.W. :—

Ordnance Survey Office, Phœnix Park (4 miles)	1·710 in.

To the N. or N.N.W. :—

Grafton Street (Mr. Yeates, ¾ mile)	1·450 in.
Dame Street (Commercial Buildings, ⅞ mile)	1·450 in.
Eccles Street (1½ miles)	1·670 in.
Botanic Gardens, Glasnevin (2½ miles)	1·620 in.

Mr. Yeates' gauge and that at the Commercial Buildings are both about 70 feet above the ground, and within a furlong of each other, The similarity of the amounts registered by them affords, therefore. satisfactory evidence of their accuracy. In consequence of their elevation, however, their readings lose much of their value in the present inquiry.

It appears from the whole series of observations that the line of heaviest rainfall crossed the south side of Dublin, and reached to Monkstown, Kingstown, and Fassaroe, on the S. and S.E. of the city. To the W. and N. of the city the fall was much less, in no instance exceeding 1¾ inches. Probably the heaviest down-pour occurred at

Dalkey, two miles S.E. of Kingstown, for the thunder and lightning were close to that place at 4.30 p.m. So far as I know there is no rain gauge at Dalkey.

A cause for the heavier fall along the S.W. coast of Dublin Bay, and over the S. of Dublin, is not far to seek, when we remember that the rain came with a N. and N.W. wind, which was blowing *towards* a chain of mountains 2000 feet high, and situated a few miles S. of the city, and that, owing to the very high humidity (mean for the 13th, 91·7 per cent.), the rain-laden clouds were so low as to impinge directly on even the lower slopes of those mountains. The country to the N. of Dublin being at a greater distance from the mountains would almost escape whatever portion of the rainfall was due to this local influence. —I am, Sir, yours truly,

J. W. MOORE, M.D.

40, *Fitz William Square West, Dublin, Sept. 2nd*, 1874.

To the Editor of the Meteorological Magazine.

SIR,—I have much pleasure in complying with your request for some particulars as to the fall of rain which occurred here on Thursday, the 13th inst., by far the greatest I have registered since I commenced about 35 years ago.

For some days previous the weather was very unsettled, the barometer alternating rapidly between 30·00 and 29·50; wind also very variable. At 8 a.m., on the 12th, the barometer stood at 29·77, at 8 p.m. at 29·65. It then commenced to fall rapidly, and at 8 a.m., on the 13th, it stood at 29·40, falling to 29·34 in the afternoon, when it commenced to rise.

The morning of the 13th was very dark, with heavy clouds in all directions; wind about south, moderate, gradually backing to N.E., at which it stood from 11 a.m.

Every appearance indicating an unusually heavy fall of rain, I took the precaution of emptying the gauge, which had about 1·50 in it, fearing it might overflow before I returned home from Dublin. It was fortunate I did so. The fall of rain commenced about 2 p.m., moderate at first, at 3 o'clock it was heavy, and at 4 the downfall was excessive, streets flooded, &c. I returned home in the 4.30 train from Westland Row Station. On arriving at Black Rock at 4.45, I found the line and rails covered, and a regular torrent running along it. We could only cross the line on planks. I arrived home at 5 o'clock, and immediately examined the gauge, and found about what I expected—1·20 in it. From 5 to 6 I watched the rain with great interest; there was an amazingly heavy downfall, with very little wind. At the latter hour one of my sons came home, and immediately called my attention to the gauge, which was just about to overflow! Thus, from 5 to 6 o'clock, 0.80 fell. We immediately emptied it, drawing off 2 inches. For some time longer the rain continued to fall heavily, but diminished rapidly after sunset, and ceased at 10 o'clock, at which time there was 1·14 in the gauge, thus making the total fall 3·14 in 8 hours.

I never registered anything like this before the nearest approach to it was on February 25th-26th last, when I registered 2·54 in 17 hours. As to the recent fall, a friend of mine, about half a mile distant, recorded 3·04; and I have heard of others in this district who measured between 2·50 and 3·00. I cannot find that the great fall extended over a large area. At Wexford, 70 miles south, the day was very fine, and to the northward, a friend of mine coming up from Belfast told me the day was fine until within 20 or 30 miles of Dublin. Eastward, the mail packet from Holyhead had a fine passage till within an hour of Kingstown, when she encountered a violent storm, with R T and L. I have not heard anything definite from the westward. From 4 to 6 there was here a great deal of T and L, which seemed to me to be *above* the clouds. I was unable to percieve it had any effect on the fall of rain, which appeared uniformly steady throughout the greater part of the time it continued.

If I can give you any further information, I shall most gladly do so.

I am, yours very truly,

THOS. BEWLEY.

Rockville, Black Rock, near Dublin, Aug. 20, 1874.

REVIEW.

Horizontal Wells.—A new application of geological principles to effect the solution of the problem of supplying London with pure water. By J. Lucas, F.G.S., of the Geological Survey of England. 4to., viii–86 pages, 3 plates. Stanford.

ENGLISH science owes much to the staff of H. M. Geological Survey, and in the present work Mr. Lucas proves himself a worthy member of that body of clear thinking and very hard working men.

The conciseness and good arrangement of the work may be imagined from the terseness of the following—

SYNOPSIS.

The materials made use of in the following paper will be arranged in chapters, under certain headings, viz:—

1.—To show need of a fresh supply of drinking water to London.

2.—Sketch of Geological Principles on which the proposition contained in this paper is based.

3.—The Principles applied to the case of London. Account of Geological Formations from which supplies may be drawn.

4.—Account of the excellent quality of their waters.

5.—Statement of the main Proposition—How to obtain the largest possible proportion of quantity of Rain falling upon them.

6.—Positions and heights above sea level of Galleries.

7.—Calculations as to probable quantities to be collected by them.

All details will be found to fall under one or another of these heads.

An Appendix, embodying the result of such observations as I have been able to make, has been added since the writing of the paper.

There is one special merit in this work, viz., that the author has spared no trouble in collecting facts, and, as far as we have examined,

does not advance opinions without evidence to support them. We do not share his preference for water from the chalk (even when softened by Dr. Clark's process) but on the contrary believe the water of Loch Katrine, Ullswater, Bala, and kindred districts best suited for all the wants of mankind, but we nevertheless share his objection to the Thames water in its recent or present condition, and are not prepared to deny that softened chalk water would be better than the present supply from the Thames. Mr. Lucas has devoted much care to contouring the water level of the chalk, and gives a map of a portion of Surrey, epitomizing his results, which is extremely interesting. One of the special features of his book, in fact that which gives rise to its short title, is a suggestion which we think may be briefly described as for constructing underground galleries crossing the subterranean chalk streams at their point of maximum yield. This is obviously a good plan, far better than either sinking a well hap-hazard, as is generally done, or than merely supplementing such a vertical shaft by an adit run at any imaginable angle to the probable direction of the subterranean stream. It appears to us that the author has not rendered his proposal complete, inasmuch as though he suggests where these galleries are to be run, he says nothing as to storage reservoirs, and leaves it uncertain whether reliance is to be placed on the natural storage power of the chalk, or upon reservoirs constructed in the usual manner. If the former, we believe that unless the galleries are of enormous size, much water must be allowed to run to waste, and from the rapidity with which water percolates chalk (see *Meteorological Magazine*, vol. i, diagram p. 28) the summer yield might fall short. If, on the other hand, storage be adopted, the argument as to temperature on page 24 must be abandoned—in fact, in any case, Mr. Lucas would have done well not to have quoted an argument which derives all the little weight it possesses from having been printed in an appendix to a blue book. The idea of engineers like Mr. Bateman, or Messrs. Hemans and Hassard, laying the water mains for the supply of London so near the surface that the water would by freezing burst the pipes, is almost worthy of our contemporary *Punch;* however, the onus of publication rests with those who admitted such rubbish into the Appendix to the Report of the Royal Commission, rather than with Mr. Lucas, who has merely reproduced what appeared in good company, and under high auspices.

Although Mr. Lucas speaks in the most humble manner of the "few observations" he has made, several of his tables show that the term *few* has a very different meaning in his work to that which it has in those of most other people. We wish therefore that he had been able to recommend some easier mode of measurement than that which he has suggested, for if, with his large experience, he cannot do so, we fear matters are not very promising for the *Dii minores.* After remarking that "A lead or iron clock weight, not too heavy to carry comfortably, is indispensable" for the accurate measurement of the depth from surface to top of water, he proceeds on the next page as follows :

"An ordinary tape line is practically useless for measuring wells on the chalk.

Very few are so shallow as 66 ft., and a large number run above 300 ft. I therefor had a line made by the Messrs. Stanley, of Great Turnstile, 400 ft. long.

Its weight, 22½ lbs., is unfortunately so great as to make it impossible to carry it for any distance."

He then proceeds to explain certain alterations, whereby

"This would make the weight 16 lbs., below which I do not see that it could be reduced. This however is quite a portable weight."

Perhaps so, but 16 lbs. + the clock weight + sundry necessary little addenda, are more comfortably carried 5 miles than 15, and Mr. Lucas may rest assured that the number of observations made will increase with every reduction in the weight of the apparatus, and with every facility offered for the conduct of such observations.

During the last eight or ten years we have frequently urged the benefits derivable from observations such as are given in this work; we join Mr. Lucas in hoping that they will become much more numerous, but our experience of government work does not lead us to concur in his hope that "a series of such observations may be authorized by Government, and an observatory for the purpose, established on the lower greensands of Surrey." We would far rather see such observations inaugurated and carried out by private enterprise. For so desirable an object, we are sure that if the proper course were pursued, there would not be the least difficulty in obtaining any necessary amount of moral or material support.

We greatly regret that this very suggestive and useful work is marred by one error, which runs through all the calculations as to the volume of subterranean water, or at any rate through all that we have tested. It would not be fair to make such a statement without proof; we therefore take as an instance the first clearly-expressed quantity which we have noticed—viz., on p. 42, where the following paragraph occurs:

"The amount of percolation or absorption corresponding with this rainfall is 12·16 inches, which is equal to 89,229,388,800 gallons, on 51¼ square miles, or an average flow of 244,464,078 gallons daily for one year."

As we cannot tell in what stage of the calculation Mr. Lucas has been mistaken, we must start from the fundamental facts that there are 144 square inches in one square foot, and 43,560 square feet in an acre, and therefore—

$$43{,}560 \times 144 = 6{,}272{,}640 \text{ square inches in one acre.}$$

Secondly, it was settled by Act of Parliament, June 17th, 1824, that the imperial gallon should contain 277·274 cubic inches, and therefore—

$$6{,}272{,}640 \div 277{\cdot}274 = 22{,}623 \text{ gallons per acre} = 1{\cdot}00 \text{ in. of rain.}$$

This is the value given in *British Rainfall*, 1865, Appendix p. vi., and in various other works, but under the circumstances we have thought it better to show how this value of 22,623 gallons per acre is obtained.

As there are 640 acres in one square mile, we have next—

$$22{,}623 \times 640 = 14{,}478{,}720 \text{ gallons per square mile} = 1{\cdot}00 \text{ in of rain.}$$

Then it only remains to introduce from the paragraph quoted above the depth (12·16 in.), and area (51¼ square miles), and we have

14,478,720 × 12·16 × 51·25 = 9,023,138,294 gallons per annum.

while the author gives 89,229,388,800 „ „

or (within a trifle) ten times the real quantity.

That there may be no doubt about the matter, we will work out the *daily* supply in an entirely different way, viz., by the rule given by Prof. Galbraith.*

"If the drainage area is measured in square miles (M), and the annual available rainfall in inches (i), then the daily supply will be found by—

40,000 M i = gallons in daily supply.

(This is in excess by only 8 per mille, which in practice is negligible.)"

Substituting the values of M and i, we have

40,000 × 51·25 × 12·16 = 24,806,400 gallons per day,

while the author gives 244,464,078 „ „

We need hardly say that this serious error destroys the arguments founded on the assumed large quantity of water penetrating the chalk, beyond that discharged by the springs and streams. But it still leaves the work one which must find a place on the shelves of all who are interested in the great question of subterranean water supply, for it still remains sole repository of many useful data, and of several good suggestions.

SUPPLEMENTARY TABLE OF MONTHLY RAINFALL, AUGUST, 1874.

Div.	County.	Station.	Total Fall.
			in.
II.	Kent	Acol	1·17
„	Sussex	Hailsham	—
„	Hampshire	Strathfield Turgiss	1·24
„	Oxford	Magdalen College	1·53
„	Essex	Harlow (Sheering Rectory)	1·17
„	Cambridge	Cambridge (Merton Villa)	1·25
IV.	Norfolk	Swaffham	1·66
V.	Devon	Teignmouth (Brookbank)	2·40
„	„	Torrington (Langtree)	5·30
„	Somerset	Taunton (The Castle)	1·99
VII.	Lincoln	Horncastle (Bucknall)	1·83
VIII.	Lancashire	Liverpool (Walton-on-the-Hill)	3·26
IX.	York	Wakefield (Stanley Vicarage)	1·50
X.	Durham	Gainford	3·16
„	Westmoreland	Shap	—
XVII.	Banff	Keith	6·58
XVIII.	West Ross	Strathconan	5·91
XX.	Cork	Fermoy (Glenville)	3·68
XXI.	Westmeath	Athlone (Twyford)	4·60
XXII.	Galway	Ballinasloe	5·15

* *British Rainfall*, 1865, Appendix p. xv.

THE THUNDERSTORM OF JULY 11TH.

To the Editor of the Meteorological Magazine.

SIR,—After reading the account of the thunderstorm on July 11th, in the *Meteorological Magazine* for this month, I am induced to send you a report of our experiences in this place, which far exceed anything you have described. The rain began to fall about 6 p.m. I mark the hour by the arrival of the London train due at Welwyn station at 5.50; some friends of mine travelled by it, and had time to get into an open carriage before the storm began; they were, however, induced by the threatening look of the clouds to wait in a shed at the station till it was over, and arrived at my house, about one mile off, before 7 o'clock, having waited for the heaviest rain to cease, and driving home without inconvenience: this marks the limits of the duration of heavy fall. My gauge was emptied that evening, the receiver had overflowed; we got what we could out of the body of the gauge itself with a sponge, and 2·50 was the result,—how much more should be allowed for leakage and splashing I don't know. The effects of the storm were very inconvenient if not actually dangerous, scarcely a house in the village but was more or less flooded; wherever there was a back yard or other ground at all higher than the door the rain-fall, which could not escape through ordinary drains, poured through the houses, even of the better sorts; roof-pipes and gutters were quite inadequate to carry off the mass of water which fell on the roofs. The roads, some of which are hollow between banks and hills, were turned into water courses, and were left like the beds of torrents, the fine silt and binding being washed away, leaving the large foundation stones exposed; large portions of fences were carried away, and the top soil, with roots growing in it, swept from several hilly fields. The thunder and lightning, I am told, were very alarming (I was not at home at the time), but the attention of all seems to have been chiefly concentrated on the rain. I may add that another gauge about two miles off corroborated mine, showing 2·90. The storm appears to have moved in a line, the width of area of greatest fall being very limited.

On the evening of July 10th there was also a heavy storm, when a neighbouring church was struck and burnt, my gauge giving ·86.

I remain, your obedient servant,

C. L. WINGFIELD.

The Rectory, Welwyn, Herts.

COLOURING DEGREE MARKS UPON THERMOMETER TUBES AND SCALES.

To the Editor of the Meteorological Magazine.

SIR,—For some time past I have been in the habit of rendering graduations on glass more distinct by filling them with a silicious pigment, which is white or black, according to the purpose for which the scale is to be employed. The processes are as follow:—

White Pigment. — The scale is thoroughly cleaned by scrubbing with a hard brush dipped in a mixture of strong aqueous caustic soda,

with methylated spirit in equal volumes; it is then well rinsed with water, and lightly dried. Equal weights of precipitated baric sulphate (sulphate of baryta) and precipitated zinc oxide are next placed in a mortar, and stirred with enough syrupy sodic silicate to form a somewhat thick paste. A little of this paste is placed on the finger, and rubbed into the divisions without delay; in a few minutes it will begin to harden, and the excess must be instantly removed with the edge of a piece of brown millboard. This pigment is decidedly brilliant.

Black Pigment.—The process is carried out exactly as above; but the sodic silicate is mixed with precipitated manganic dioxide (which alone gives a dark brown), to which a little lampblack has been added.

The scales may be exposed to the weather in about a week's time. Both pigments are very permanent; and, in the long run, they become so thoroughly incorporated with the glass itself, that they cannot be wholly detached, unless by the file. The black one is materially improved by tinting when a week old with aniline black, which is sold at the druggists as "jetoline."

All the materials are cheap, and the process is very easy.

I am, Sir, your obedient servant,

EDMUND J. MILLS.

"POCKY CLOUDS" *alias* "INVERTED CUMULI."

To the Editor of the Meteorological Magazine.

SIR,—A correspondent in the July magazine, asks if it is too late to object to the above name, and many of your readers will endorse your own editorial comment that the expression is "infelicitous."

If I understand correctly the kind of cloud intended, it is one which my late brother and myself were accustomed, as very young observers, to call "tucked-up" clouds, and to which more recently (although still many years ago) my brother applied the term "inverted cumulus." By this name I have always since described it in my own notes, and in the absence of any better suggestion I venture to propose the name for adoption. It has at least the advantage of indicating the real analogies of the cloud, which appears to be closely allied to the ordinary cumulus. The typical cumulus is essentially a thunder-cloud, and so is its "inverted" variety; and whatever kind of force it may be that moulds the form in the one case, giving rise to those magnificent masses of sharply cut, white or copper-coloured cloud that we see in thunderstorms, there can be little doubt that the same force operates in the other case, producing the sharp definition and the rounded "tucked-up" contour of the "inverted cumulus." In all probability the same cloud which is "pocky" below is cumulus above, an identical formative influence being at work on both the upper and lower surfaces.

According to my own observation, the "inverted cumulus" never occurs in a marked degree except in the near neighbourhood of a thunderstorm.

GEORGE F. BURDER, M.D.

Clifton, 8th Sept. 1874.

BOOKS RECEIVED.

DENMARK.

Bulletin Météorologique du Nord, publié par les Instituts Météorologiques de Norvége, de Danemark et de Suéde. April—July, 1874. Oblong 4to.

Hoffmeyer, Capt.—Specimen Meteorological Charts of Europe and North Atlantic. December 1–6, 1873. Single sheets, folio.

FRANCE.

Belgrand, M. E., and Lemoine, M.G.—Abaissement probable du débit des eaux courantes du bassin de la Seine dans l'été et l'automne du 1874. 4 to.

Raulin, Prof.—Sur les Observations Pluviométriques faits dans le sud-ouest de la France, 1861–70. 8vo. Bordeaux, 1874.

GREAT BRITAIN.

Airy, Sir G. B.—Report to the Board of Visitors of the Royal Observatory, Greenwich. 4to. 1874.

Lucas, J., F.G.S.—Horizontal Wells: a Solution of the Problem of Supplying London with Water. 4to. 1874.

Main, Rev. R., M.A.—Results of Meteorological Observations made at the Radcliffe Observatory, 1871. 8vo. Parker, Oxford, 1874.

Meteorological Committee.—Report for the year ending December 31st, 1873. 8vo. Spottiswoode, 1874.

Meteorological Committee.—Quarterly Weather Report of the Meteorological Office, April—June, 1873. 4to. 1874.

Miller, S. H.—Fenland Meteorological Circular, Nos. III.—VI. 4to. Leach and Son, Wisbech.

Pastorelli's Wind and Weather Indicator.

Perry, Rev. S. J., F.R.S.—Results of Meteorological and Magnetical Observations at Stonyhurst College Observatory, 1873. Post 8vo. Robinson, Preston, 1874.

Scott, R. H., F.R.S.—Report on Weather Telegraphy, presented at Vienna by the Committee appointed at Leipzig. Published by authority of the Meteorological Committee. 8vo. Stanford, 1874.

Waterhouse, J., F.R.S.—Eight years' Meteorology of Halifax. 4to. 1874.

INDIA.

Chambers, F.—On the Diurnal Variations of the Wind and Barometric Pressure at Bombay. 4to.

PRUSSIA.

Karsten, G.—Ergebnisse der Beobachtungsstationen an den deutschen Küsten über die physikalischen Eigenschaften der Ostsee und Nordsee und die Fischerei. March—October, 1873. Oblong 4to. Berlin, 1874.

RUSSIA.

Wild, H.—Annalen des Physikalischen Central Observatoriums, Jahrgang, 1872. St. Petersburgh. 4to. 1874.

Wild, H.—Repertorium für Meteorolgie, Band III. St. Petersburgh, 1874. 4to.

UNITED STATES.

Abbe, Cleveland A. M.—Historical Notes on the Systems of Weather Telegraphy. 8vo.

Abbe, Cleveland A. M.—Observations on the Total Eclipse of the Sun in 1869. 8vo.

Abbe, Cleveland A. M.—Annual Report of the Director of the Cincinnati Observatory, 1870. 8vo.

Loomis, Prof. Elias.—Results of an Examination of the United States War Maps for 1872 and 1873. 8vo.

Journal of the Telegraph, Nos. 156, 157, and 159.

AUGUST, 1874.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	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.	Camden Town	1·32	— 1·32	·28	4	16	84·0	23	45·5	23	0	0
II.		Maidstone (Linton Park)	2·07	— ·64	·44	10	15	81·0	20	40·0	24	0	...
,,		Selborne (The Wakes)	3·07	— ·11	·51	13	14	76·0	22	41·6	22	0	0
III.		Hitchen	1·11	— 1·24	·22	29	17	74·0	2†	40·0	22	0	1
,,		Banbury	2·09	— ·04	·45	7	17	79·0	20	41·0	5	0	...
IV.		Bury St. Edmunds (Culford)	1·18	— 1·26	·47	10	12	79·0	2	37·0	25	0	0
V.		Bridport	2·39	— ·20	·44	11	13	77·0	19†	43·0	17	0	...
,,		Barnstaple	5·65	+ 1·46	1·68	12	21	83·0	21	48·5	10	0	...
,,		Bodmin	4·79	+ ·93	1·18	31	22	76·0	19	48·0	17	0	0
VI.		Cirencester	3·18	+ ·34	·94	7	19	...	...	...	...	...	..
,,		Shifnal (Haughton Hall)	2·62	— ·25	·40	12	17	74·0	19	42·0	12	0	...
,,		Tenbury (Orleton)	2·64	— ·24	·41	31	18	83·8	20	41·5	17	0	0
VII.		Leicester (Wigston)	2·55	+ ·36	·39	27	19	85·0	20	39·0	21	0	...
,,		Boston	1·97	— ·32	·31	27	16	81·0	20	42·0	24	0	...
,,		Grimsby (Killingholme)	2·11	...	·33	7	18	76·0	19	44·0	4, 22	0	...
,,		Derby	2·54	— ·06	·48	16	17	81·0	20	45·0	22	0	0
VIII.		Manchester	4·35	+ ·85	·49	8	20	77·8	20	43·0	5	0	0
IX.		York	2·34	— ·37	...	...	...	77·0	19	42·0	24	0	...
,,		Skipton (Arncliffe)	9·52	+ 3·58	1·20	30	23	80·0	19	35·0	4	0	..
X.		North Shields	1·55	— 1·30	·28	30	18	74·3	19	43·0	30	0	0
,,		Borrowdale (Seathwaite)	18·60	+ 4·52	2·46	30	23	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	6·11	+ 1·23	1·15	31	16	76·8	20	43·5	22§	...	..
,,		Rhayader (Cefnfaes)	5·50	+ ·84	·90	28	16	79·0	...	44·0	...	...	...
,,		Llandudno	2·81	— 1·01	·44	13	17	77·9	19	49·3	29	...	...
XII.	SCOTLAND.	Dumfries	6·25	+ 2·38	1·75	30	22	74·5	20	39·0	5	...	...
,,		Hawick (Silverbut Hall)	5·03	...	1·00	30	20	...	...	...	...	...	...
XIV.		Kilmarnock (Annanhill)	5·55	...	1·02	6	23	73·8	24	43·0	13	0	0
XV.		Castle Toward	4·49	— 1·81	·72	7	22	75·0	22	...	...	...	...
XVI.		Leven (Nookton)	3·97	+ ·98	·80	30	19	80·0	22	37·0	28‖	0	1
,,		Stirling (Deanston)	...	...	...	...	...	...	...	...	...	...	...
,,		Logierait	3·06	...	·43	6	19	...	...	..	...	...	..
XVII.		Braemar	6·79	+ 2·95	2·67	13	21	75·3	22	40·2	22	0	1
,,		Aberdeen	6·72	...	1·78	10	24	74·9	19	38·6	24	0	0
XVIII		Loch Broom	4·15	...	·56	8	26	...	...	...	...	...	..
,,		Portree	7·31	— ·14	·69	6	26	...	...	...	...	...	...
,,		Inverness (Culloden)	6·40	+ 3·15	1·27	14	15	72·8	22	37·0	24	0	1
XIX.		Helmsdale	3·91	...	...	...	...	...	...	...	...	...	...
,,		Sandwick	5·00	+ 1·29	·55	5	23	62·8	28	40·8	24	0	0
XX.	IRELAND.	Caherciveen Darrynane Abbey	4·41	...	·61	31	16	...	...	...	...	...	..
,,		Cork	1·66	...	·30	13*	14	...	...	...	...	...	...
,,		Waterford	3·08	— ·87	·59	27	18	76·0	18	46·0	12	0	...
,,		Killaloe	7·83	+ 2·90	1·01	30	24	83·0	19‡	42·0	12	0	...
XXI.		Portarlington	4·19	— ·31	·83	14	25	78·0	19	44·5	11	0	0
,,		Monkstown, Dublin	4·38	— 1·17	2·36	13	17	...	...	...	...	...	...
XXII.		Galway	3·65	...	·46	27	20	82·0	24	46·0	3, 13	0	...
,,		Ballyshannon	5·51	...	·68	6	23	...	...	...	...	...	...
XXIII		Waringstown	4·72	...	·99	13	21	83·0	23	44·0	28	0	0
,,		Edenfell (Omagh)	3·26	...	·53	29	23	76·0	23	41·9	29	...	...

* And 26. † 20. ‡ 22. § 27. ‖ 30.

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

METEOROLOGICAL NOTES ON AUGUST.

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.

Linton Park.—Brisk winds on 4th, 5th, 8th, 10th, 11th, 13th and 15th, with T on 10th and 25th. Fine and warm from 19th to 28th, in fact the month as a whole may be considered a fine one, but the lack of R is felt in many ways.

Selborne.—T, L and H on 10th from 2.30 to 4 p.m.; TS on 29th at 2 p.m.; violent wind from S.W.; T in the night of 31st; dense fogs on 19th, 20th and 21st, and very dense early on 25th. Fine harvest weather after the middle of the month till the 27th; wheat a good crop, and mostly well got in; hops extremely bad all round here.

Banbury.—T, L and H on the 10th.

Culford.—The mean temp. of the month was 57°·5, and westerly winds prevailed on 28 days. T, L and H on 10th; TS also on 29th.

Bridport.—Gales on 12th, 13th, 30th and 31st, principally from S.W.

Haughton Hall, Shiffnal.—R fell daily with one exception (6th) from the 3rd to 16th inclusive, sufficiently to refresh the burnt up pasture without materially injuring the grain, but too late to save most of the turnips, of which on some farms there was almost a total failure, while on the next there were good crops, those on the light soils better in general than on the strong. From the 16th no R fell till the 27th, when a good supply came till the close of the month. Heavy storms with gales from the W. on 11th and 12th. The max. ther. never exceeded 74°, and averaged 62°·5; the min., although as low as 42° and 44° on two nights, averaged 51°. Mushrooms sprang in great abundance, and wasps increased so as to be very destructive.

Orleton.—The first two days were fine and hot; from the 3rd till the 16th R fell each day, but generally in small quantities, which renewed the greenness of the pastures, but did not penetrate far into the dry earth. From the 16th to the 26th another warm period occurred, with many bright and cloudless days, and no R. Much R fell in the remaining five days, which moistened the earth and appears to have broken up the long drought; T was heard on the 4th, 10th and 29th, but was never loud or near. The temp. of the month was about the average. Nearly all the grain crops have been harvested in fine condition.

Wigston.—The fine showers have improved the appearance of the pastures, and also the root crops. The corn harvest may be said to be finished, and, taken altogether, it has been secured in good condition.

Boston.—Almost continuous high winds for the first fortnight, interfering very much with the harvest operations, which commenced generally in this neighbourhood about the 3rd, and finished about the 31st. The first new corn was delivered at market on the 12th, nine days earlier than the average of the last 17 years; crops generally very good, and the yield of wheat above the average.

Grimsby.—Wheat cutting became general about the 6th. T and L on 7th and 10th, and T on the 29th. The showers in the former half of the month refreshed the pastures, but did nothing towards filling the ponds; the fine weather of the latter half enabled the farmers to secure their harvest in excellent condition. Gossamer and garden spider webs, an almost infallible sign of fine weather for a few days at this season, on 22nd.—[*Erratum.* The hygrometrical values for July 3rd should have been, dry 73°, wet 59°, humidity 42.]

Manchester.—T and L on 7th, 8th and 10th, and T on 13th.

North Shields.—T S on 10th and 13th.

Seathwaite.—L on 2nd, T on 9th and 13th, T S with H on 29th. 2·00 of R fell on the 6th, and 2·46 on the 30th; the total fall being 18·60, or 4·52 above the average, though no rain fell between the 18th and 27th.

WALES.

HAVERFORDWEST.—The first half of the month very wet, close and sultry at times. Very stormy about the 12th; a fine, warm, dry week from 15th to 23rd; the last week stormy, with T L and R.

CEFNFAES.—Violent storms of R and H, with heavy gales during the month, but nine days without R; T early in the morning of the 29th.

LLANDUDNO—Wheat cut on 1st, oats on 3rd, and barley on 6th. No R between the 15th and 27th, but frequent haze during that time.

SCOTLAND.

DUMFRIES.—The month just closed has been the wettest (6·25) August since 1861, when 7·55 fell; up to the 15th there was R every day, R also on 17th, then fine weather to the 27th, after which heavy R to the close of the month. The violent T S on 13th came from the south-east about 9 p.m.; the L was very vivid, and occasionally it assumed the form of a ball of fire, with diverging rays; the T was very loud, and accompanied by heavy R. By 10 o'clock the storm had in a great measure abated. At Tinwald Shaws 30 sheep, or rather 29 ewes and a lamb were killed—the sheep were all lying close to a stone dyke which faced the east, there was a slight hollow in the hill-side where the sheep had gone for shelter; several of the carcases had a narrow mark of singeing from the loin on the left side towards the neck, and others on the back; but none of the carcases were injured. The carcases were all lying within a distance of twenty yards in clumps of six and seven carcases. No trees were growing within a quarter of a mile of the spot where the animals were killed; none of the other sheep were injured. At Riddingwood, Kirkmahoe, the electric fluid struck a large spruce fir, about 30 feet from the ground, and split it, breaking the trunk across at 10 feet from the ground, and splitting to the base; a small plane tree was also struck and split to the ground. The trees were growing on the east side of a considerable wood, chiefly spruce fir. The fir struck would be about 55 feet in height, and near the base of the trunk was 4 feet 6 inches in girth. On 30th very extraordinary heavy R, 1·75. Nothwithstanding the frequent showers, harvest work well forward before the 27th.

SILVERBUT HALL.—Rainy month, with cold blustering winds; T and much L on the 13th; potatoes not much affected with disease, but showing a little in the surrounding districts; turnips are now looking very promising.

ANNANHILL.—Wind generally S.W. and W., light to fresh; month cloudy and unsettled. Several T SS, some of them doing much damage, being accompanied by heavy R, which, in some places, submerged the crops; pastures and foliage of all kinds luxuriant. Great growth of mushrooms during the month. Ozone well developed, marking 10 on 6 days. Oat harvest well advanced on 12th; harvest operations in full vigour on 23rd; grain nearly all reaped, and potatoes lifted.

CASTLE TOWARD.—There having been rain on 22 days has rather interfered with the harvest, but a good breadth has been cut down with the reaping machines since the 22nd. Potato crops look bad, and disease has set in within the last fortnight, and to all appearances it is general. The carrots are this year a complete failure, all other vegetables are abundant, and of good quality. Winds during the month principally W. and S.W.; loud T on the 28th.

NOOKTON.—T from 6 to 7 p.m. on 8th.

BRAEMAR.—A month of fine growing weather, crops looking well. T on 12th, and flooded rivers on the 13th from a fall of 2·67.

ABERDEEN.—A month of average temperature, with heavy R and much T and L. Heavy floods in the rivers on the 14th. The fall of R, 6·72, is 3·63 above the average (18 years) and exceeded only once (1868) in the 18 years.

LOCHBROOM.—A boisterous month; the first 20 days were rainy without an exception; the rest of the month sunshine and showers alternately, but there was a genial warmth throughout the whole which ripened the grain and made reaping universal. The potato disease made its appearance very suddenly about the 25th or 26th; no sooner in the shaw than in the root, but its progress seems arrested in the meantime, and, if stopped, there need be no general clamour about its extent.

PORTREE.—A wet, dark, and gloomy month; distant T on 31st; gale on 5th from S.W. to W. No corn cut as yet; it will take three weeks before harvest can be general here. Potatoes free from disease, in fact all kinds of crops look well, and cattle are thriving well on pastures, and free from disease. The prospects of the farmer never promised better in this island than at present.

CULLODEN.—The rainfall during the week ending with the 15th (4·82 in.) was unusually heavy, and although greater falls have occurred within 24 hours than on this occasion, there are few instances in the past 34 years when such a quantity of rain has fallen in succession on the same number of days. The total rainfall for this month (6·40 in.) is greater than in any August since 1868, when it was 6·62, and in the same month in 1863, 6·67.

SANDWICK.—A heavy shower at 6 p.m. on 9th, when ·41 fell in about 40 minutes; a shower of sleet on the 1st, T and L on 29th. August has been much wetter than the mean, indeed there have been only two Augusts since the commencement of the observations, 34 years ago, in which more rain fell. Aurora on 23rd.

IRELAND.

DARRYNANE.—Prevalent winds N.W., 19th to 26th very hot and oppressive. Heavy showers with T and L on night of 28th.

MONKSTOWN.—The beginning of the month was very showery and cold, the middle and end fine and warm. The fall on the 13th (2·36) the heaviest fall in 24 hours registered here since 1864; wind N.N.E. to N.W.; at Blackrock 3·14 was registered. L and T on 15th.

BALLYSHANNON.—The first half of the month was unusually wet, but the temperature was higher than at any other period of the year. The latter half was fine and favourable for the harvest, which, generally speaking, promises to be a plentiful one. Gale from the S.W. on 2nd, from the W. on 8th and 9th, and from S.W. on 10th.

OMAGH.—First half of the month unsettled and boisterous, with occasional heavy rain; from 16th to 26th fine and dry, and on several days very hot; remainder of the month rainy and unsettled. As far as the harvest has proceeded all crops promise great abundance.

THE DROUGHT.

To the Editor of the Meteorological Magazine.

SIR,—It is singular that whilst we observe the effect of the drought this year in the shortness of water in the river and the general fading of trees and grass, more than I ever remember, we have had a slightly *greater* amount of rainfall *here* than in 1870. This year, to August 1st, we have had 6·29 inches—in 1870, to August 1st, we had 6·28 inches; but I can partly account for its greater effect this year by referring to the rainfall in December, 1869, when we had 3·85 inches, while last December we only had 0·45 inches, showing how much more influence on vegetation rain falling in the Winter has, than occasional rain in the Summer.—Yours truly,

JAMES NUTTER.

Cambridge, Aug. 24th, 1874.