

EXPERIMENTAL GAUGES AT HAWSKER, NEAR WHITBY (FROM SOUTH-WEST).

BRITISH RAINFALL, 1870.

ON

THE DISTRIBUTION OF RAIN

OVER THE

BRITISH ISLES,

DURING THE YEAR

1870,

AS OBSERVED AT ABOUT 1500 STATIONS IN GREAT BRITAIN
AND IRELAND,

WITH REMARKS ON VARIOUS EXPERIMENTS,
MAPS, AND NUMEROUS ILLUSTRATIONS,
AND AN APPENDIX ON EVAPORATION.

COMPILED BY

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ERRATA IN BRITISH RAINFALL, 1869.

- Page 118.—Line 13 from top, Hemerdon—strike out the dagger.
- „ 125.—Lines 4 and 3 from bottom—Bashall Lodge and Knowlmere Manor are on the east side of the county boundary, and therefore in Yorkshire.
- „ 133.—Line 23—Llannerch is in Denbighshire, *not* Flint.
- „ 137.— „ 28, Eaglesham—Height above ground 0 ft. 4 in., *not* 4 ft. 0 in.
- „ 142.— „ 17, Auskerry—for 27·60, *read* 26·60.

BRITISH RAINFALL, 1870.

SORELY against my inclination, this publication is six days later than on any previous occasion ; but there are limits to human endurance, and, much as I regret delay, it is better than interrupted or imperfect work. That the figures in these volumes are carefully checked is again proved by the list of errata on the opposite page, showing one figure incorrect and one transposed, out of I know not how many thousands. There can be no doubt as to the desirability of maintaining the highest possible pitch of accuracy, and as the progress of rainfall research leads onward to more and more complex work, and the returns also increase in number, it is evident that the date of publication is liable to become yearly a trifle later.

G. J. SYMONS.

March 16th, 1871.

REPORT.

THE preparation of my last annual volume for the press occupied an unprecedentedly long time, in consequence of the heavy nature of several of the calculations which it contained, and of my determination, *so far as lies in my power*, to print nothing but what is strictly correct. The waste of time and worry produced by the returns of about a dozen observers, who seem unable to cast a single column of figures, and whose returns are consequently continually travelling backwards and forwards, is so great that I have resolved henceforth to exclude the returns of all those persons who, in three consecutive years, send in returns cast up incorrectly. I hope that the number who will thus be excluded will be very small (judging from past experience *not 1 per cent.*), and I am confident that the general body of observers will approve of the regulation. Every one is liable to trip if they only add a column once, but Rule X. says, "All columns should be cast up *twice*." Even then some may go astray, therefore I purpose to wait for three consecutive repetitions before excluding the returns. While, upon the subject of bad casting, it is only fair to mention that the proportion of records returned for such errors is now extremely small; mistakes generally arise from indistinct figures, or neglect of that portion of Rule X. which refers to the placing of cyphers.

Examination of Rain Gauges.—During the year 1870 the number of gauges examined has only been thirty-eight, viz. :—

Cheshire.....	2	Kent.....	7	Radnor.....	2
Derbyshire	9	Montgomery ...	7	Suffolk	6
Hampshire.....	1	Norfolk.....	2	Surrey	2

This is not one-third the number examined in 1869, and I extremely regret this curtailment of a most important branch of the work for the sake of a small pecuniary saving,* but my own suggestion and the unanimous recommendation of the Rainfall Committee of the British Asso-

* This work has of late years been carried on at the cost of the British Association.

ciation that it should be continued, were overruled by other bodies in the Association ; and with this explanation of the cause of the interruption, I turn to more agreeable topics.

Improved Geographical Distribution of Stations.—In this respect steady progress is maintained, as is abundantly proved by the numerous additions to the general tables, and also with respect to Derbyshire especially, in the article on a subsequent page, “On the Rainfall of certain districts.” The localities now most requiring additional observers are—

ENGLAND.

CORNWALL—Northern part.
 CUMBERLAND—Kirkoswald.
 DEVON—Hartland, Exmoor.
 DORSET—Bere Regis, Stalbridge.
 LINCOLN—Kirtton, Wragby.
 SUFFOLK—Mildenhall, Halesworth.
 WESTMORELAND—Ravenstonedale.
 YORKSHIRE—Bridlington.

WALES.

CARDIGAN—Aberaeron.
 CARNARVON—Pentrevoelas, Bettws-y-coed.
 MERIONETH—Barmouth, Harlech.
 MONTGOMERY—Montgomery, Welshpool.
 PEMBROKE—Fishguard.
 RADNOR—Builth, Hay.

SCOTLAND.

ABERDEEN—North-west of.
 ARGYLL—Cantire, Ben Cruachan.
 CAITHNESS—Any place inland.
 FORFAR—West of.
 INVERNESS—Lochaber.
 KIRCUDBRIGHT—West of.
 PEEBLES—Biggar.
 WIGTOWN—North of.

IRELAND.

All parts of the Western counties.

A separate article on a subsequent page is devoted to the subject of “Altitude above Sea Level,” and therefore further reference to it is here unnecessary.

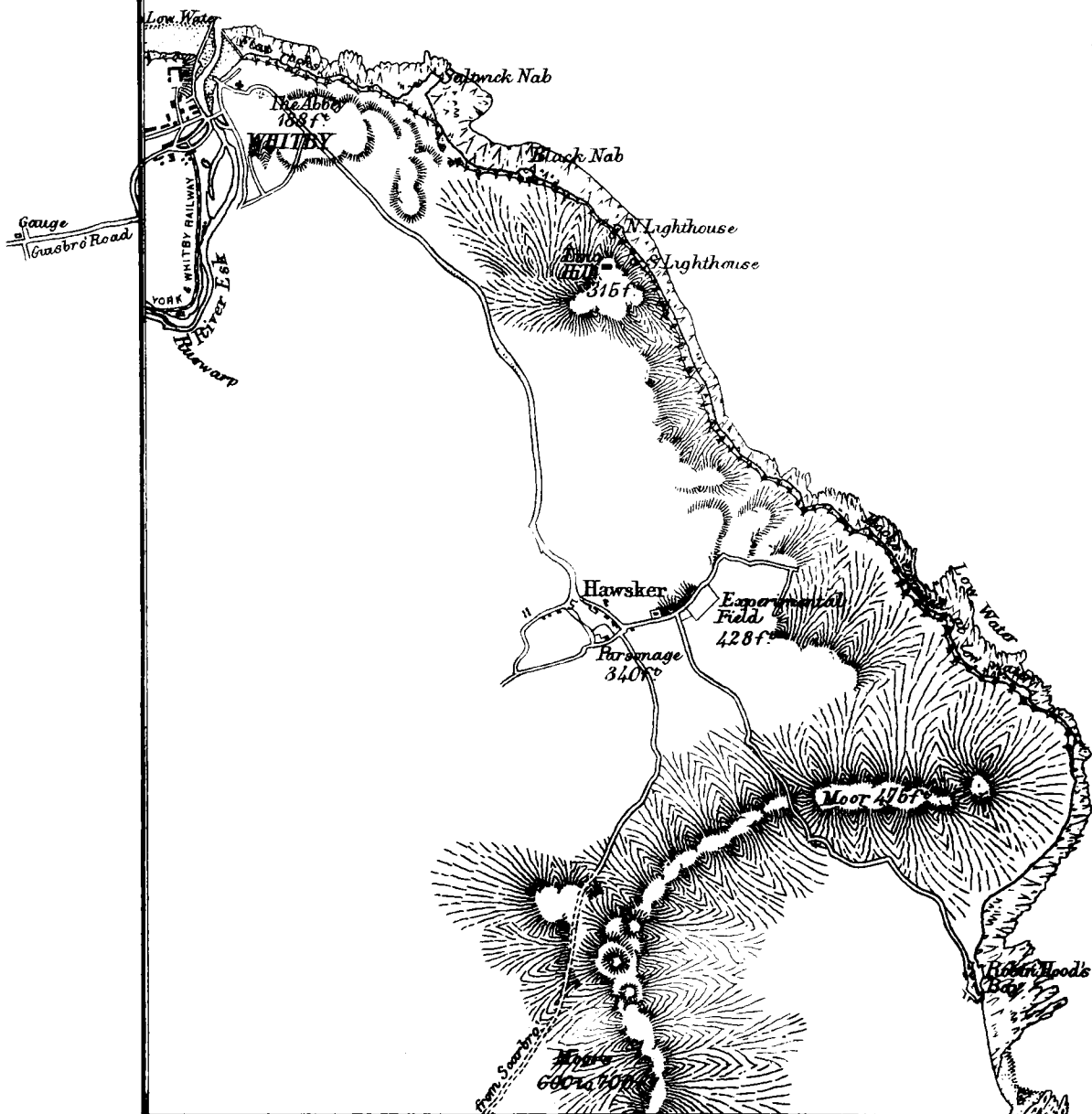
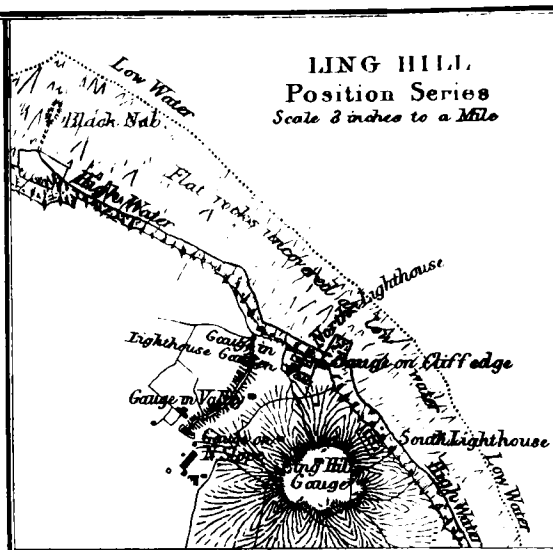
Completion of the Decennial Period, 1860-69.—The computation of the averages for this decade was commenced immediately after the publi-

cation of *British Rainfall*, 1869, and completed early in the summer. The perfect records numbered 333, thus distributed—England, 221; Wales and the Isles, 10; Scotland, 92; and Ireland, 10. The mean values obtained have already proved most useful; they form the basis of a subsequent paper upon “The Secular Variation of the Rainfall in England,” and are also incorporated in that “On the Geographical Distribution of Rain during 1870.” I hope that before long they will also be discussed with reference to the seasonal distribution of rain, in continuation of the papers “On the Monthly per-centage of Mean Annual Rainfall,” with which we have been favoured by Mr. Gaster.

Evaporation.—In my last annual volume I gave, in an appendix, a *résumé* of the principal experiments previously made upon the evaporation from a surface of water, and explained that it had been a joint investigation by Mr. Rogers Field, C.E., and myself. This year I also place the subject in an appendix at the end of the work, and I only mention it here because (although the lion’s share of the computation has fallen to Mr. Field) a small portion of my own time has been occupied in co-operating with him and with Mr. Griffith in perfecting the various arrangements.

Foreign and Colonial Returns.—It is extremely gratifying to receive from all parts of the globe evidences of the rapid awakening to the practical utility of rainfall registration which is taking place. The rules drawn up for British observers have been, with such modifications as the localities require, repeatedly reprinted in both hemispheres. I am continually in receipt of most valuable tables from our colonies and other parts, and my only difficulty is how best to enable my correspondents to share the information thus obtained. In one respect England stands alone—it is the only country which does not defray the cost of the work, but leaves it entirely to private enterprise.

Scale 1 inch to a Mile



RAIN GAUGE EXPERIMENTS AT HAWSKER, NEAR WHITBY, YORKSHIRE.

Lat., 54° 27' N. ; Long., 0° 34' W. ; Height above Sea, 428 ft.

BY THE REV. F. W. STOW, M.A., F.M.S.

It was mentioned in last year's *British Rainfall*, that a number of gauges were sent to me from Strathfield Turgiss, in order to see whether similar results would be obtained in a windy locality as in comparatively sheltered places. When they arrived the roads were blocked by snow, but I was able to get some fixed by New Year's-day, 1870. A considerable number, however, had to have an outer strip of metal added, in order to prevent the funnels from being tilted or blown away by the wind. During the first quarter they were placed on Ling Hill, an eminence rising about 100 ft. above the cliff edge on which the lighthouses stand, and 315 ft. in all above the sea-level. My "Position series" is the only set of gauges there now, under the charge of one of the lightkeepers, whose carefulness may be depended on. The rest I removed to a field about 1,000 yards from my house, 428 feet above the sea, almost level, but completely open and exposed on all sides (*see* Frontispiece and Ground Plan): an admirable place for the purpose, but one where you want warm clothing when measuring the rain.

TABLE I.—*Material Series.*

In paddock adjoining Parsonage till end of April, then in experimental field.
All 5 inches diameter and 1 ft. above ground.

Material.	Copper.	Zinc.	Japanned Tin.	Glass.	Earthen- ware.
Reference Numbers.	XIII.	XIV.	XV.	XVI.	XVII.
February (from 20th)..	0·380	0·375	0·365	0·360	0·320
March	1·625	1·626	1·611	1·642	1·325
April	0·370	0·377	0·345	0·330	0·265
June.....	2·650	2·622	2·608	2·600	2·260
July.....	0·920	0·948	0·925	0·893	0·740
August ...	1·887	1·893	1·822	1·840	1·675
September	0·845	0·893	0·825	0·863	0·758
October	5·000	4·999	4·925	4·883	5·020
November	3·043	3·017	3·012	2·995	3·135
Total	16·720	16·750	16·438	16·406	15·498

I shall begin my report with the "Material series" (see Table I.) This series was at first placed in a paddock adjoining my house, but from the end of April they were placed with the rest. The effect of the material of which a gauge is made on the amount measured has been so well determined, that I should not have thought of making any further experiments, had not zinc been omitted from the list of materials tried. I therefore added a zinc gauge of my own to the series, and also one of Casella's japanned tin gauges, not being able to recognise the one of this material sent. Both these were similar to the other gauges of the series. The result was that the zinc and copper gauges ran a neck and neck race, the zinc winning by 0.030 in. over a course of nearly 17 inches. Next came the japanned tin and glass, pretty close to one another, and the earthenware brought up the rear. This latter gauge lost something, I fancy, from out-splashing—at any rate it did much better after the funnel had been sunk further below the rim, which in fact made its shape better than that of the others. This was done in July. It is satisfactory to find that zinc gives very good results, as it is a cheap and convenient material, and does not perish like tin from rust. There can be no doubt that the only cause of difference is the evaporation from the wetted surface. Any surface which permits the drops to hang on it must be bad for rain gauges. In autumn and winter, however, owing to the greatly diminished evaporation, the difference is immaterial. I think it would contribute to the accuracy of rainfall registers, if the authorities would recommend gauges to be made of either copper or zinc. The latter is, I believe, as cheap as japanned tin. When tin funnels get rusty, it would be well to have a zinc funnel put in instead. Ebonite, however good a material, is not, I suppose, easily procured everywhere, nor likely to come into general use.

I now come to the "Magnitude series" (see Table II.) I scraped off these all the paint which had been put on, exposing a beautifully smooth surface of copper or (in the two largest) zinc. It is a pity that the upright rims were made neither uniform in height, nor proportional to the diameter of the mouth. A uniform height would have made them catch the same quantity of snow: a height proportional to the diameter, together with the same slope of funnel, would have prevented the large gauges from catching more dew than the little ones. Nevertheless, the amounts caught are pretty equal, with the exception of those in the 24-in. and 2 and 1-in. gauges. The excess of the 24-in. was caused by snow in December. The 2-inch gauge had too narrow an opening into the pipe, and retained the last few drops there to be evaporated.

TABLE II.—*Magnitude Series.*TABLE III.—*Form Series.*

Diameters of Gauges.	24-in.	12-in.	8-in.	6-in.	5-in.	4-in.	3-in.	2-in.	1-in.	8-in. flange.	5-in. flange.	5-in. 2½-in. upright rim.	5-in. ordinary rim copper gauge.
Reference Numbers.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
January.. { February { March.... } April June July August September October November December Ditto, omitting snow and rain { measured with it	1·565 1·850 1·097 0·390 2·630 0·977 1·891 0·926 4·985 3·206 6·612 2·849	1·560 1·902 1·081 0·370 2·655 0·933 1·884 0·870 5·045 3·126 5·610 2·870	... 1·900 1·060 0·360 2·630 0·929 1·910 0·894 5·070 3·188 5·390 2·880	... ... ... 0·357 2·697 0·957 1·893 0·892 5·030 3·058 5·216 2·836	1·580 1·982 1·065 0·365 2·672 0·923 1·875 0·848 5·085 3·088 5·812 2·822	... ... 1·018 0·363 2·635 0·885 1·888 0·830 5·054 3·100 5·043 2·823	1·620 2·022 1·015 0·340 2·653 0·940 1·882 0·885 5·032 3·080 5·532 2·807	... 1·857 0·988 0·290 2·632 0·860 1·767 0·759 4·980 3·123 5·615 2·905	1·420 1·785 0·845 0·240 2·622 0·800 1·800 0·740 4·805 3·022 5·658 3·008	... 1·975 1·120 0·366 2·680 0·932 1·875 0·856 5·010 3·262 5·911 2·901	... ... ... 0·345 2·658 0·889 1·858 0·835 5·085 3·188 6·083 2·853	... ... ... 0·370 2·713 0·921 1·908 0·852 5·133 3·142 6·323 2·878	1·610 1·995 1·052 0·360 2·650 0·920 1·887 0·845 5·000 3·043 5·230 2·820
Total for year (except May) ... Do., February to December ... Do., April to Dec. (<i>rain only</i>)..	26·129 24·564 17·854	25·036 23·476 17·753	... 23·331 17·861	... ... 17·720	25·295 23·715 17·678	... ... 17·578	25·001 23·381 17·619	... 22·871 17·316	23·737 22·317 17·037	... 23·981 +S. 20·886 -S. 17·876	... ... 20·941 17·711	... ... 21·362 17·917	24·602 22·992 19·935 17·535
Per-centage for each gauge, { 12-in. = 100, Feb. to Dec.... }	104	100	100	...	101	...	100	97	95	102	...	...	...
Ditto April to Dec. (<i>rain only</i>)	100	100	100	100	100	99	99	98	96	-S. 101 +S. 102	100 102	101 104	99 97
Year	104	100	..	...	101	...	100	...	95	...	...	...	...

I enlarged the opening, and it has done better since. The 1-inch has also a narrow pipe, and in so very small a gauge the drops which adhere to the bottle cause a loss of about 0.01 inch each time of measuring in summer. I think no gauge should have a pipe less than a quarter of an inch in diameter. After all, if two measurements involving snow be omitted, the rain caught in the gauges of this series, from the time when all of them were in operation, is within 2 per cent. of the same amount for all sizes from 24 to 3 inches inclusive. This result agrees with that obtained by Mr. Griffith—a satisfactory circumstance, considering the very different climate. My own preference is for moderately large gauges, there being less risk of error from inaccuracy of make; but there can be no doubt that any size above 2 inches answers equally well, when correctly made and carefully observed.

The next is what I have called the "Form series" (Table III.) This includes the 8-inch and 5-inch flanged gauges, and a gauge with a high upright rim, which have to be compared with an ordinary gauge, *e g.* XIII.; and Crallan's disc gauge, which, being on the ground, should be compared with a 5-inch gauge "in pit." I see flanged gauges have been condemned, because some rain splashes or blows off the flange into the gauge. It is certain they catch more than ordinary gauges, but the gauge with a high rim has caught more than either of the flanged gauges, which shows that the amount of insplashing has been exaggerated; or it may be that the shape of the flanged edge inclines the drops which strike upon it to run down outside rather than inside, and thus the excess is counterbalanced. On the other hand, ordinary gauges, without either flange or upright rim, lose something from out-splashing when heavy rain is driven by a high wind, and still more when hail falls; while in time of snow they are soon filled, and the rest is blown away. Clearly there is nothing like a high upright rim for catching snow; there is something unsatisfactory in all other modes of measuring it. The gauges of this kind which I have had made have rims from $2\frac{1}{2}$ to 4 inches in height; for mountain gauges there can be nothing better than Major Mathew's Welsh gauges, which have a rim 6 inches high. I believe that Mr. Fletcher's gauges at the Lakes—at least the more elevated of them—would catch some 10 per cent. more if they had a high rim added. I should think a 3-inch gauge with high rim would be a very convenient and satisfactory mountain gauge.

The weak point of Crallan's disc gauge (Table IV.) is that, if the surface inside the rim is perfectly flat, the water does not run down readily, and some evaporates; if, on the other hand, this surface is inclined, as it was when it came to me, the theory of the gauge is not

TABLE IV.

In paddock to end of March, then in experimental field.

	Crallan's disc gauge.	5-in. in pit, to compare with Crallan's.
	in.	in.
February	2·050	2·405
March	1·382	1·512
April	0·290	0·390
June.....	2·230	2·705
July	0 873	0·977
August	1·890	1·908
September	0·687	0·934
October	4·945	5·053
Total for 8 months	14·347	15·884

carried out. On this ground I fear this ingenious invention must be set aside. I know nothing about the laws which regulate the splashing of rain-drops, but I should think many things would have to be considered, of which Mr. Griffith's demonstration of last year takes no account. Certainly the effect of the rim, however small it be, must not be neglected.

TABLE VI.—*Miscellaneous Gauges in Garden.*

340 ft. above sea. 1 ft. above ground. Read Monthly.

	Square.		Float. Fleming's.	Steven- son's gauge on ground.	Jagga Rao's.	5-in. circular. (daily)
	10 in.	5-in.				
	in.	in.	in.	in.	in.	in.
February.....	1·870	2·170	1·94	...	...	2·670
March	1·590	1·575	1·43	1·60	...	1·560
April	0·200	0·230	0·20	0·25	0·37	0·375
May	1·100	1·230	1·25	1·45	1·42	1·490
June	3·010	3·020	3·00	3·10	2·80	3·210
July	0·250	0·400	0·35	0·55	0·49	0·500
August	1·870	1·910	1·75	2·30	1·93	1·980
September ...	0·620	0·700	0·65	0·80	0·78	0·820
October	5·160	5·120	5·13	4·50	4·95	5·240
November ...	3·570	3·490	3·10	2·90	3·33	3·470
Total ...	19·240	19·845	18·80	...	...	21·315

I have tried some others of the uncommon gauges (Table VI.) in my garden. Mr. Griffith has pointed out the faulty construction of the square guages. If the funnel were deeper, and fastened to the upper part of the gauge, they would, no doubt, agree with the circular ones. I like the shape of the mouth of Stevenson's gauge ; but it is a roughly made instrument, and seems to give irregular results. Fleming's float

gauge is better in some respects, and if the rod were tied down, it might do for registering heavy rainfalls where minute accuracy was unnecessary. But it would be better on a larger scale, like Mr. Symons' lake gauges. After all, when the ordinary gauges, with funnel, bottle, and measuring glass, are so good, it seems a pity to waste good copper in making eccentricities—not that I have never done so myself.

I now come to what I consider a most interesting investigation—the determination of the cause of diminution of rainfall in elevated gauges. I have not attempted to go over again the ground which others have so well covered. The diminution of the amount caught in a gauge elevated above the ground has long been observed, the amount of diminution in certain places and at certain times determined, and the cause at last hit upon. Considered merely as an elevation series, my series of that name is decidedly meagre. In fact, the only unusual thing about it is, that I have reproduced an idea of Col. Ward's, of isolating gauges with their rims level with the ground, by placing them in pits of a sufficient width to prevent any insplashing. A gauge so placed in an exposed position catches considerably more than one at 1 foot, and it is a little curious that these "isolated level" gauges in the experimental field catch very nearly the same amount as a gauge at 1 foot in my garden, which is a much more sheltered position. I send for the satisfaction of the curious a view of one of the pits used (fig. 1). The chief

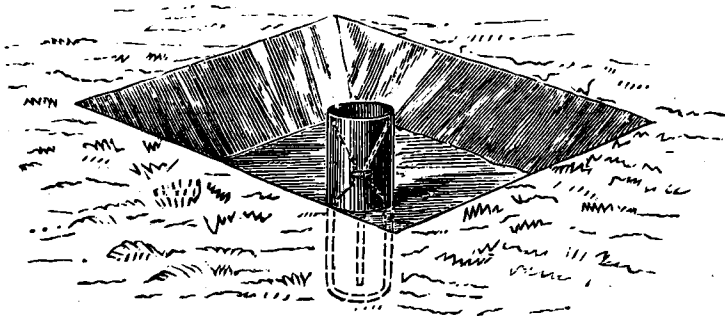
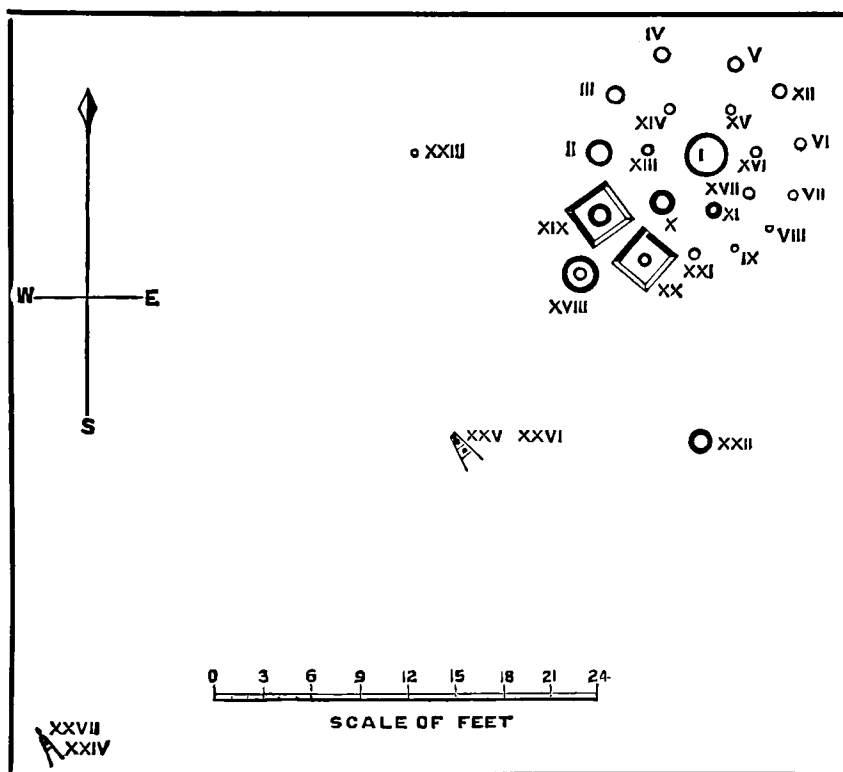


Fig. 1.

objection to placing gauges thus is, that in time of snow they are sure to be full if there is ever so little wind—in fact, it is rather a chance how much snow they catch. In excessively wet weather there is also some danger of their swimming, if not very firmly fixed. There seems to be less difference between gauges at 6 inches and 1 foot than I expected. I think it is wise to recommend 1 foot for general adoption, but as most gauges are only a foot long, it would be far better to sink them 4 or 5 inches into the ground, than have them unsteady and tilted by every wind, though the rim be at the regu-

EXPERIMENTAL GAUGES AT HAWSKER, NEAR WHITBY.



Number.	Diameter of rim.	Character of rim.	Material of funnel.	Height of rim above ground.	Griffith's Nos.
I.	in. 24	Upright	Zinc	1 foot.	1
II.	12	"	"	"	2
III.	8	"	Copper	"	4
IV.	6	"	"	"	3
V.	5	"	"	"	14
VI.	4	"	"	"	8
VII.	3	"	"	"	13
VIII.	2	"	"	"	11
IX.	1	"	"	"	10
X.	8	Flange	Zinc	"	6
XI.	5	"	Copper	"	12
XII.	5	2½ in. upright	Zinc	"	F.W.S.
XIII.	5	Common	Copper	"	VIII.
XIV.	5	"	Zinc	"	F.W.S.
XV.	5	"	Japanned tin..	"	F.W.S.
XVI.	5	"	Glass.....	"	XIV.
XVII.	5	"	Earthenware..	"	III.
XVIII.	5	Crallan's disc.	Zinc	Level.	XV.
XIX.	8	Flange	Tin, painted...	"	18
XX.	5	Common	Zinc	"	V.
XXI.	5	"	Copper	6 inch.	VII.
XXII.	12	Upright	Zinc	5 feet.	F.W.S.
XXIII.	3	"	Copper	5 "	F.W.S.
XXIV.	3	"	"	10 "	F.W.S.
XXV.	3	Verticalmouth	"	1 "	F.W.S.
XXVI.	3	"	"	5 "	F.W.S.
XXVII.	3	"	"	10 "	F.W.S.

* Revolving.

The numbers in the first column are those quoted in the above plan, on the frontispiece, and throughout Mr. Stow's communication. Mr. Griffith's numbers are given in the last column, for the convenience of identification.

All the gauges are provided with bottles, except Nos. I., II., X., XIX. (and III., previously to July 12th), which have cans, and also Nos. XXIV. and XXVII. A pipe was fitted to XXI.

lation height above the ground. I have never detected insplashing in a gauge placed 6 inches above *grass*, and consider that height better than 1 foot *for exposed situations*.

It was not to the amount but to the cause of the diminution of rainfall with height that I directed my attention. My impression of the present state of this investigation is as follows:—Mr. Chrimes' observations have shown that there is some relation between the angle at which the rain falls and the diminution with height above ground, and that both these are somehow related to the velocity of the wind. He has not disproved other supposed causes, such as the condensation of additional vapour by the cold rain-drops in their fall, or by "the coldness of the lower stratum of air with which a wind from a warmer region is brought into contact;" nor a third ingenious notion, viz. the coalescence of particles of vapour into rain-drops, owing to their becoming "electrically polarized" near the ground. But while these have not been disproved, it was shown to be at least highly probable that the force of the wind is the chief cause of this diminution. Accepting this result of Mr. Chrimes' admirable observations, I began to doubt whether there was actually less *rain* at a height above the ground, though there was doubtless less *rainfall* upon a horizontal surface. I had erected, in February, a gauge (fig. 2), with vertical and horizontal mouths to determine the angle of rainfall, and had it placed 10 ft. above

SECTIONAL VIEW OF VERTICAL AND HORIZONTAL GAUGE AT 10 FT.

- a* Post.
- b* Spindle.
- c* Copper tube fastened to frame of gauges.
- d d* Copper bands fastening the two gauges together.
- e* Vane (double) of galvanized iron.
- f* Horizontal gauge of copper, with high brass rim.
- g* Vertical gauge of copper with brass rim.
- h h* Taps by which gauges are emptied.

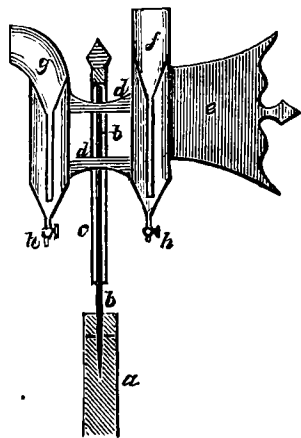
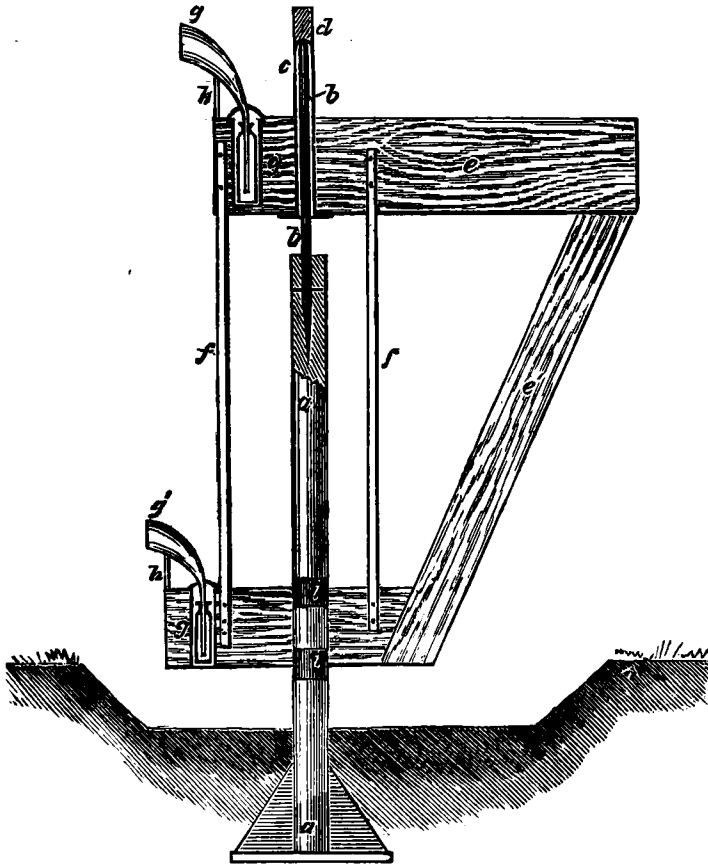


Fig. 2.

the ground. I therefore added two more 3-inch gauges with vertical mouths 5 ft. and 1 ft. respectively above ground, both gauges being kept to the wind by the same vane (fig. 3), and a fixed horizontal gauge of the same size of aperture at 5 ft. There was already a fixed horizontal 3-inch gauge at 1 ft. in the magnitude series. Thus I had both

a horizontal and a vertical gauge at each of the three heights of 1 ft., 5 ft., and 10 ft. above the ground.

SECTIONAL VIEW OF REVOLVING STAND FOR VERTICAL GAUGES AT 1 FT. & 5 FT.



- a Post.
- b Spindle.
- c Brass tube fastened to revolving stand.
- d Steel plug, with socket for spindle.
- e e' Boards forming vane. The vane is double, but only one side is shown.
- f f' Connecting rods, e' also answers this purpose.
- g g Gauges with copper funnels, 3 inches in diameter. The rain is received in bottles.
- h h Props to keep mouth of gauge perfectly steady.
- i i Zinc collars to diminish friction.

Fig. 3.

If any of the hypotheses alluded to were true, it is evident that there would be an actual decrease of rain with elevation above the ground, affecting both horizontal and vertical gauges *in the same way*. The vertical gauge at 10 ft. would therefore regularly catch less than the corresponding gauge at 1 ft. The observations showed that the contrary is invariably the case (see Table V.) The vertical gauge at 10 ft. invariably catches more than that at 1 ft.; and the increase is, so far as the observations yet go, nearly in the same proportion as the decrease in the horizontal gauges. The gauges at 5 ft. are, as might be expected, between these two in their indications, but approach more nearly to those at 10 ft. than to those at 1 ft. I submit that these results show beyond all dispute that the causes assumed by the former hypotheses are either non-existent, or, at any rate, without appreciable effect upon the gauges.

TABLE V.—*Elevation Series.*

[illegible]

TABLE V.—*Elevation Series (continued).*

	Means of			
	Wind at time.		Wind for 24 hours on days of rain, by anemometer.	
	Estimated force 0–12.	Deduced velocity miles per hour.	Miles per hour.	Total motion.
January	4·2	20·5	24·0	576·9
February	6·6	34·0	30·9	741·0
March	4·4	21·3	21·9	528·3
April	3·7	16·3	29·1	698·0
June.....	2·7	13·0	20·8	500·0
July.....	2·8	13·1	14·8	356·3
August	5·5	28·0	30·8	740·0
September	5·2	26·9	23·2	557·3
October	6·4	33·0	25·0	598·7
November	3·8	18·1	21·7	522·0
December	5·5	27·6	...	..
Mean	4·2	21·0	22·0	528·9
Mean, Sept. to Dec..	5·2	26·4	...	...

It will be seen, from what has been said, that if the angle of falling rain be computed from each pair of gauges at these three heights by the formula $\tan \theta = \frac{V}{H}$ (θ being the angle with the vertical, V the amount caught in the vertical, and H that in the horizontal mouth), it will appear that the angle with the vertical increases with elevation; and this *difference of the angle at which the rain falls is the real cause of the decrease of rainfall upon a horizontal surface with elevation.* This decrease does not depend upon the angle at which rain falls, but upon the *difference* of that angle at different heights; nor is it proportional to the force of the wind alone, but depends both on the increase of that force with elevation and on the weight of the rain-drops. Thus, although the force of wind accompanying the rain in October was greater than in September, both according to the anemometer and to estimation, the per-centage of decrease with elevation up to 10 ft. was less by 12, because the rains in September were light and those in October remarkably heavy. If a rain-drop be considered as a projectile, its weight and resistance to the air cannot be left out of calculation, and therefore an attempt to show that the angle of falling rain varies as the force of the wind must necessarily fail. It would be interesting to investigate both theoretically and from experiment the path of the rain-drops. But I may already say with confidence, that elevated gauges catch less than those near the ground, simply because the rain strikes them at a smaller angle with the horizon.

Vertical and Horizontal Gauges during November, 1870.

When measured.		Horizontal.			Vertical.			Angle of falling rain with Vertical.				Wind.			REMARKS.
Day.	Hour.	At 1 ft.	At 5 ft.	At 10 ft.	At 1 ft.	At 5 ft.	At 10 ft.	At time of rain.			At time of rain.		Mean hourly velocity of rain, by anemo- meter.		
		VII.	XXII.	XXIV.	XXV.	XXVI.	XXVII.	Direction.	Esti- mated force 0—12.	Deducted velocity per hour.	miles.				
												miles.			
12	3 p.m.	1.250	1.060	1.030	3.020	3.425	3.460	67°31'	72°48'	73°53'	N.N.W.	6	31	30.3	{ R, H and S from 4 p.m., 9th, to 1 a.m. 12th.
14	11 a.m.	0.615	0.600	0.568	1.065	1.185	1.220	60 0	63 9	65 2	W.N.W.	4	18	26.1	{ Heavy R, 6 p.m. 12th, to 10 a.m. 13th.
17	noon	0.175	0.160	0.150	0.250	0.280	0.320	55 0	60 15	64 53	W.	3	13	20.8	R on night of 15th.
21	10 a.m.	0.125	0.110	0.110	0.260	0.275	0.290	64 19	68 12	69 14	S.S.E.	5	25	19.6	R on night of 19th.
23	10 "	0.220	0.210	0.210	0.130	0.150	0.150	30 35	35 32	35 32	S.S.E.	1	5	12.3	R, 4 p.m. to 10 p.m. 22nd.
24	4 p.m.	0.440	0.420	0.430	0.750	0.840	0.890	59 36	63 0	64 13	S.	4	18	27.5	R, 6 a.m. to 3 p.m. 24th.
25	11 a.m.	0.185	0.165	0.160	0.415	0.440	0.458	65 58	69 27	70 45	S.S.W.	5	25	27.5	R, previous night.
Dec. 1	10 a.m.	0.070	0.063	0.055	0.052	0.068	0.070	36 36	47 11	51 51	E.	2	10	10.0	{ Smart showers on mornings 30th and 1st December. Very high barometer.
Total ...		3.080	2.788	2.713	5.942	6.663	6.858	62°36'	67°22'	68°25'		Mean 3.8	Mean 18.1	Mean 21.7	

N.B.—The angles for the month are calculated from the totals of rain.

TABLE VII.—*Position Series. At Ling Hill.*

All common 5-inch gauges, 8 in. above ground (except gauge in Lighthouse Garden, which is 1 ft.)

	Top of Hill, 315 ft.	On North slope, 285 ft.	In Light-house garden, 198 ft.	Hollow or "Valley" 205 ft.	Cliff edge, 195 ft.
	in.	in.	in.	in.	in.
January	1·610	...	1·590	...	...
February	1·995	1·587	1·970	...	...
March	1·052	1·000	1·390	...	...
April	0·395	0·470	0·515	...	..
May	1·097	1·452	1·140	...	..
June	2·182	2·270	2·440	...	...
July	0·875	0·855	1·040	...	...
August	1·660	1·580	1·930	...	...
September ...	0·770	0·820	0·890	...	...
October	4·265	4·755	4·310	4·480	2·600
November ...	2·735	2·452	3·335	3·120	2·125
December ...	5·310	5·550	6·080	6·290	3·070?
Total ...	23·946	...	26·630	..	...

TABLE VIII.—*Analysis of ditto. October, November, and December.*

	N. winds.	S. winds.	Top of hill=100, ratios are	
			N. winds.	S. winds.
	in.	in.		
Top	4·00	4·04	100	100
N. slope	2·92	5·18	73	128
L. Ho. garden	4·72	4·21	118	104
Hollow	4·27	4·53	107	112
Cliff-edge ...	2·50	3·68	62	91

TABLE IX.—*At Hawsker.*

5-inch gauges, 1 ft. above ground. Gauge in garden read daily, the other at intervals of a few days.

	Exposed field. 428 ft.	Garden. 340 ft.
	in.	in.
January	1·690	1·760
February	2·057	2·670
March	1·431	1·560
April	0·365	0·375
May	1·350	1·490
June	3·149	3·210
July	0·448	0·500
August	1·875	1·980
September	0·848	0·820
October	5·085	5·240
November	3·088	3·470
December	5·812	7·020
Total	27·198	30·095

I have added to the tables of monthly results a table containing the readings of the six vertical and horizontal gauges in detail for the month of November. I have selected November because, unlike October and December, it was, in most respects, a fair average month, and at the same time presented considerable variety. There was a fair but not excessive amount of rain, and the velocity of the wind on days of rain did not exceed the average for the year. Sometimes the rain fell heavily and sometimes lightly, sometimes with light breezes and sometimes with rough winds, while there was almost every possible variety in the direction of the wind. Yet the increase of the angle with elevation will be seen to have been invariable.

My last series is what I have called the Position series (Table VII.) Believing in the great influence of the wind upon the amount caught in a gauge, I thought it might be interesting to test on a small scale, and within a space which scarcely admitted of a difference in the amount of vapour precipitated, the effect which difference of position, involving upward or downward, stronger or more feeble wind-currents, exercises upon mountain or coast gauges. From the beginning of October, I had five gauges at work on or about Ling Hill. One was placed on the top of the hill ; another on its north slope ; another in a hollow or miniature valley running down from S.W. to N.E. ; a fourth in the garden of the lighthouse, which is enclosed by low walls, 50 yards or less from the cliff edge, but with the lighthouse and buildings adjacent between it and the cliff ; the fifth is not five yards from the edge of the cliff, which is precipitous. The figures (Tables VII. and VIII.) show that—(1) The gauge on the top of the hill catches much less than that in the “valley,” or that in the garden ; (2) The gauge on the N. slope of the hill catches a great deal with S. winds, but very little with N. winds ; (3) The gauges sheltered in the “valley” and garden catch considerable and pretty equal amounts ; (4) The gauge on the cliff edge catches not much with land winds, and next to nothing in gales from the sea.

I suppose that the explanation is something of this kind. The greater force of the wind on the top of the hill causes the rain to fly at a greater angle with the vertical than elsewhere, and therefore diminishes the amount which falls upon a horizontal surface ; it sweeps down the steep slope and brings the rain more directly into the mouth of a gauge on the hill-side, or up the slope with a contrary effect. It rushes down, but with diminished force, into valleys and hollows, and its downward blast brings the rain, or its diminished force suffers it to fall at a smaller angle with the vertical into the mouth of a gauge,

which therefore catches a larger amount. Lastly, the wind-swept cliff edge is a place where the rain can scarcely ever fall at any angle at all approaching the vertical ; while, when the wind is from the sea, the up-draught caused by the wind impinging upon the perpendicular rock lifts the rain altogether over the gauge. I need hardly point out the bearing of these results on the returns from mountain and coast gauges. A gauge, if carefully fixed and correctly observed, shows accurately the rain that falls on a horizontal surface in the particular spot where the gauge is. But many returns from lighthouses can only give a tolerable per-centage of the rain which falls in a more sheltered spot in the same locality. It is evident, also, that the wind alone is sufficient to cause very little rain to be registered on the mountain tops, and to account for a very large per-centage of the excessive falls registered in valleys down which the rain-bearing winds sweep. Hence we might expect to find the heaviest rainfalls in valleys on the N. or N.E. side of mountains where the S. and S.W. winds are the most rainy, provided that the distance from the mountain tops which condense the moist vapours is not too great. It might be interesting to apply this rule to the returns from Wales, Scotland, or the Lakes. I will only say that I fancy the small rainfall on Scawfell Pikes, compared with that at the Styne, may not indicate any smaller precipitation of vapour at the former station, but be due solely to the different angular direction of the rain.

RAIN GAUGE EXPERIMENTS AT STRATHFIELD TURGISS, READING.

Lat. $51^{\circ} 20' 23''$ N. ; Lon. $1^{\circ} 2' 30''$ W. ; Height above Sea, 200 feet.

BY THE REV. C. H. GRIFFITH, F.M.S., &c.

IN resigning my stewardship of the experimental rain gauges at Strathfield Turgiss, perhaps a few last words may not be out of place. There is, however, but very little to add to what has been already said in former years. Indeed, but a glance at the tables will be sufficient to show that the difference of amount of rain collected at different heights varies according to a regular and consistent law. I use the term regular and consistent law, advisedly, because to my mind the consistency in the results obtained during three successive years is very remarkable. Of all the gauges the same remark is not true, but to these gauges have been assigned positions, known beforehand to be bad from their liability to influence from causes detailed in the Annual for 1868, p. 23. These, therefore, I remove from the list, in order to give force to these observations, and taking those only which are fairly situated and secure from any influence except that due to elevation, the ratio of the per-centages is very consistent and close during all the three years.

	1868.		1869.		1870.
Bracket, 39 feet.....	75·7	...	72·9	...	73·8
Barn top, 23 feet.....	80·8	...	75·9	...	75·6
Poles, 20 feet.....	92·1	...	92·4	..	93·9
Apps', 3 feet	96·1	...	95·8	...	95·4
D on ground	100·0	...	100·0	...	100·0

The cause of this decline of amount, with increase of height, is doubtless to be found in the angle at which the rain-drops fall, as the elaborate experiments of Mr. Chrimes, at Rotherham, so admirably show. This result, after all, is but due to wind influence, as no doubt, all other conditions being equal, the rain-drops would fall in a straight, or at least very nearly straight line, were there no wind moving at the time of fall. As a curious illustration of this, I select the falls for June, 1870, in which month the 8 in. ground gauge collected

·549 in. and the 20 ft. gauge ·541 in., or the same amount within 8-1000ths of an inch. On turning to my daily journal, I find that only 74 miles were run by the anemometer on that day, giving an average of 3·1 miles per hour ; or, according to Col. Sir Henry James' comparative pressure table, equal to a pressure of 0·75 oz. per square foot, or very little more than an almost insensible movement of the air ; whereas on stormy days, with violent squalls of wind, as great a difference appears in the daily entries of gauges at different elevations as between ·874 in. and ·465 in., or a difference of nearly 50 per cent.

Another point, too, most evident from a consideration of the table, is, that the same comparative difference, whether in diminution or excess, has consistently obtained throughout the whole of the three years' experiments, showing that it is not due to any accidental state of things, but arises from a regular and permanent law.

The experimental elevation series of rain gauges may now be said to be laid up in ordinary, their work done, as I hope, satisfactorily. They have not, however, been removed from their positions, so that, in the event of the occurrence of any remarkable storm, with or without an accompanying gale, the comparative amount of fall at different heights may still be secured.

RAIN GAUGE EXPERIMENTS AT STRATHFIELD TURGISS, READING.

ELEVATION SERIES.

Lat. 51° 20' 23" N.; Lon. 1° 2' 30" W.; Altitude, 200 feet.

Height above ground	Ground.		House.		Barn.			Post Gauges.			X.	V.	VI.
	D. 8 inch. 4 inches.	in.	Bracket. 39 feet.	Centre. 29 feet.	N.W. side. 11 feet.	Top. 23 feet.	S.E. side. 16 feet.	8 inch. 20 feet.	5 inch. 20 feet.	Apps' 5 in. 3 feet.	Ebonite. 1 foot.	5 inch. 1 foot.	5 inch. 1 ft. dup.
1870.													
January	1·181	in.	·660	·689	1·074	·712	1·018	1·012	·933	1·199	in.	in.	1·170
February	1·716		1·160	·976	1·512	1·033	1·377	1·749	1·688	1·769	1·600	1·667	1·672
March	1·708		1·157	1·257	1·617	1·150	1·541	1·563	1·412	1·541	1·552	1·518	1·535
April ...	·290		·204	·207	·301	·208	·269	·258	·214	·271	·351	·286	·289
May.....	1·856		1·612	·908	1·736	1·544	1·707	1·807	1·710	1·779	1·856	1·803	1·703
June.....	·549		·505	·427	·571	·536	·563	·541	·500	·521	·546	·536	·488
July.....	·543		·434	·546	·501	·455	·507	·496	·402	·499	·561	·522	·530
August	1·679		1·507	1·549	1·672	1·512	1·714	1·653	1·598	1·644	1·666	1·674	1·637
September	1·683		1·297	1·469	1·661	1·398	1·567	1·642	1·562	1·518	1·694	1·672	1·666
October	3·543		2·368	2·754	3·418	2·613	3·553	3·267	3·085	3·410	3·490	3·414	3·521
November	1·697		1·126	1·360	1·596	1·226	1·632	1·483	1·395	1·553	1·539	1·558	1·537
December	2·458		1·941	2·142	2·278	1·912	2·378	2·304	2·231	2·335	2·380	2·376	2·342
Totals, 1870	18·903		13·971	14·284	17·937	14·299	17·826	17·775	16·730	18·039	18·423	18·201	18·090
" 1869	26·689		19·419	19·598	26·004	20·221	24·303	24·620	23·377	25·556	...	...	...
" 1868	22·868		17·304	18·315	21·864	18·445	20·249	21·059	20·454	21·957	...	...	...
Ratios, 1870	100·0		73·8	75·4	94·8	75·6	94·2	93·9	88·4	95·4	...	...	...
" 1869	100·0		72·9	73·5	97·5	75·9	91·5	92·4	87·7	95·8	...	...	...
" 1868	100·0		75·7	80·2	95·6	80·8	88·6	92·1	89·5	96·1	...	...	...

C. H. GRIFFITH, Observer.

RAIN GAUGE EXPERIMENTS, BOSTON RESERVOIR, ROTHERHAM.

Lat. 53° 25' N., Long. 1° 20' W. 381 ft. above the Sea Level.

FOR THE YEAR 1870.

FIVE MOUTHED GAUGE.

INCLINED ROTATING GAUGES.

Height above ground.	5ft.					5 ft.				
	Facing East.	Facing North.	Facing West.	Facing South.	Horizon Centre.	22½°	45°	67½°	90°	Tipping
Months.										
January	·196	·255	·880	1·307	1·624	2·219	2·605	2·468	1·887	2·471
Feb. ...	1·317	·341	·494	·763	1·389	2·065	2·529	2·742	2·161	2·480
March..	1·397	2·112	·122	·188	1·904	2·907	3·371	3·540	3·010	3·277
April ...	..	·059	·163	·073	·293	·362	·355	·283	·158	·361
May ...	·256	·109	·112	·379	·658	·843	·915	·772	·473	·868
June ...	·056	·282	·116	·246	1·758	1·911	1·736	1·255	·547	1·900
July ...	·004	·026	·032	·132	·493	·535	·450	·296	·105	·522
August.	...	·190	...	·456	·887	1·042	·917	·786	·450	1·017
Sept. ...	·042	·060	·007	·363	·901	1·067	1·026	·797	·429	1·023
October	2·097	1·287	1·563	2·361	6·012	7·544	8·225	6·959	4·920	7·585
Nov. ...	·391	·200	·507	1·108	1·891	2·228	2·346	1·982	1·327	2·127
Dec. *...	1·313	1·124	·389	·920	2·337	3·087	3·657	3·583	2·573	2·957
Totals..	7·069	6·045	4·385	8·296	20·147	25·810	28·132	25·463	18·040	26·588

ELEVATED GAUGES.

Height above ground.....	1 ft.			5 ft.			10 ft.		
	Read Daily.	Read Mnthly.	Diff.	Read Daily.	Read Mnthly.	Diff.	Read Daily.	Read Mnthly.	Diff.
Months.									
January	1·753	1·696	—·057	1·535	1·515	—·020	1·483	1·453	—·030
February.....	1·439	1·464	+·025	1·317	1·297	—·020	1·295	1·287	—·008
March	1·970	2·049	+·079	1·908	1·906	—·002	1·728	1·769	+·041
April	·322	·248	—·074	·298	·283	—·015	·277	·274	—·003
May	·698	·667	—·031	·648	·613	—·035	·631	·612	—·019
June	1·799	1·776	—·023	1·741	1·733	—·008	1·687	1·688	+·001
July..	·518	·355	—·163†	·485	·461	—·024	·480	·455	—·025
August	·915	·861	—·054	·879	·863	—·016	·865	·849	—·016
September ...	·993	·973	—·020	·899	·873	—·026	·839	·814	—·025
October	6·236	6·242	+·006	5·855	5·815	—·040	5·743	5·687	—·056
November ...	1·896	1·876	—·020	1·770	1·719	—·051	1·727	1·691	—·036
December ...	2·382	2·433	+·051	2·335	2·262	—·073	2·050	2·032	—·018
Totals	20·921	20·640	—·281	19·670	19·340	—·330	18·805	18·611	—·194

* All the experiments since the 21st not to be relied on, on account of frost and snow ; they are approximately correct, but not exactly so.

† Apparently great evaporation in this case.

ROTHERHAM EXPERIMENTS—(con.)

ELEVATED GAUGES—(con.)

Height above ground	15 ft.			20 ft.			25 ft.		
Months.	Read Daily.	Read Mnthly.	Diff.	Read Daily.	Read Mnthly.	Diff.	Read Daily.	Read Mnthly.	Diff.
January.....	1·448	1·455	+·007	1·431	1·394	—·037	1·428	1·433	+·005
February	1·265	1·256	—·009	1·281	1·274	—·007	1·314	1·321	+·007
March	1·805	1·814	+·009	1·667	1·733	+·066	1·730	1·742	+·012
April	·264	·293	+·029	·249	·274	+·025	·237	·260	+·023
May	·618	·621	+·003	·617	·615	—·002	·620	·628	+·008
June	1·683	1·699	+·016	1·703	1·712	+·009	1·627	1·640	+·013
July	·458	·465	+·007	·457	·455	—·002	·437	·403	—·034
August	·831	·866	+·035	·829	·841	+·012	·819	·828	+·009
September... ..	·788	·816	+·028	·788	·776	—·012	·736	·707	—·029
October	5·658	5·650	—·008	5·645	5·565	—·080	5·595	5·516	—·079
November	1·709	1·710	+·001	1·712	1·665	—·047	1·698	1·656	—·042
December	2·009	2·004	—·005	1·951	1·938	—·013	1·927	1·913	—·014
Totals	18·536	18·649	+·113	18·330	18·242	—·088	18·168	18·047	—·121

R. CHRIMES.

AN INVESTIGATION OF THE RESULTS FROM EXPERIMENTAL RAIN GAUGES AT ROTHERHAM.

By RICHARD STRACHAN, F.M.S.

It is proposed in this investigation to take into consideration the results of the five-mouth gauge, the rotating inclined gauges, and the tipping gauge; leaving out of view the elevated gauges. But here I find myself supposing the reader familiar with these experimental gauges, and, in case he is not, it is necessary to add that a description of them is given in *British Rainfall*, 1865, p. 13; 1866, p. 30; and in that for 1869, pp. 11 to 15, the last referred to being the most complete. The theoretical principles by which these gauges are related to each other having also been given in *British Rainfall*, 1868, pp. 32 to 34, it does not appear to be necessary to discuss them here. What has been termed the mean azimuth of rainfall is rather the azimuth of most rain, or the direction of the horizon whence the wind brought most rain during the period under examination. It has been computed from the formula, $\text{Cot. azimuth} = \frac{N-S}{E-W}$; where N. S. E. W. stand for the quantities of rain collected by the vertical gauges facing north, south, east, and west respectively.

The quantity due to a vertical gauge, if placed in this azimuth, may also be computed from the formula, $q = N. \cos \text{Az.} \times E. \sin \text{Az.}$

The mean inclination of the rainfall from the vertical has been computed from the formula, $\text{Cot. } \theta = \frac{H}{V}$; where θ is the angle, H and V being the quantities collected by the horizontal gauge and rotating vertical gauge respectively.

The quantity of rain due to a rotating gauge placed at this inclination may be computed from the formula, $R = \sqrt{H^2 \times V^2}$.

The quantity due to a gauge, if placed in the rainy azimuth and at the mean inclination, may be computed from the formula, $Q = q. \text{cosec } \theta$.

Again, that portion of the rain collected by the horizontal gauge, which may be supposed to have come from the azimuth of most rain, may be also computed from the following formula, $h = \sqrt{Q^2 - q^2}$.

Finally, we may deduce the per-centage of the total horizontal quantity, due to the rainy azimuth, from the proportion— $H : h :: 100 : Z$.

Thus, from the indications of the five-mouth gauge, together with those of the rotating vertical gauge, the data represented by Az , q , θ , R , Q , h , and Z may be calculated.

The azimuth deduced as above ought to agree with the mean direction of wind during the same time, and the inclination ought to be in relation to the wind's velocity ; but for such comparison, the record of a self-registering anemometer would be required. However, θ may be compared with the angle of greatest rainfall indicated by the inclined rotating gauges. R may be compared with the quantity collected by the rotating gauge, the inclination of which agrees nearest with θ . These checks serve to confirm the computations, and testify to the consistency of the results q , Q , h , and z , for which there are no independent checks.

The information deducible, therefore, seems to be the azimuth of most rain, the mean inclination of the rainfall, and the per centage of rain from the rainy quarter ; from which we are enabled to conclude the direction, strength and prevalence of the rain-bearing wind.

The above formulæ take for granted that indications of the vertical gauges, inclined gauges, and horizontal gauge are all equally reliable, being equal in size of aperture, and equally well exposed. But this is a very unlikely postulate. The vertical gauges are the least likely to give proper indications, being in the worse position ; for horizontal showers, and those nearly so, which are specially due in the vertical gauges, are the most likely to be partially intercepted by obstacles, whether they be trees, hills, buildings, or other objects near or remote, in the line of the coming rain. The most eligible site for the best results obtainable from vertical gauges would be a tall church spire, overtopping all surrounding objects in a very flat country. Since such is by no means the kind of exposure of the Rotherham gauges, we cannot expect the vertical gauges to give nearly so accurate indications as the inclined and horizontal gauges there. The inference inevitably is, that too much confidence must not be placed upon the calculated azimuth, inclination and quantities arising from the results of the vertical gauges.

Nevertheless, with few exceptions, the inclined rotating gauge at the angle agreeing nearest with the calculated inclination, almost always receives the most rain, but generally rather *more* than the quantity calculated for the inclination. As it should, theoretically, receive *less*, the inference is that the vertical rotating gauge, and there-

fore also the fixed vertical gauges, receive less than the proper quantity, as we have already suggested as probable.

The rotating and tipping gauge, which, theoretically, ought to receive more rain than any other gauge, since it ought always to be directed towards the showers, as a rule gets always less than some one or more of the others; therefore, we must conclude that its indications are altogether defective. The mechanical difficulties to be overcome in perfecting such a gauge as may be acted upon easily by all winds, gentle or strong, are probably too serious to permit of any hope that the tipping gauge will ever give satisfactory results. And here it may be surmised that the fixed vertical gauges, supposing exposure equally good in all cases, are more reliable than the rotating ones, which, by reason of inertia, must always be behind their proper position, which is *in* the direction of the wind. They must be moved by the wind, and at first lag behind until put in motion, when they overreach their proper position; and, in fact, like wind-vanes, they are subject to oscillations which must interfere with the proper collection of rain. No one can imagine that the wind current oscillates as the wind vanes in it do; and no one should imagine that a rotating rain-gauge, kept in motion by the wind, can always be perfectly directed towards the showers.

Assuming the gauges all perfectly similar and accurate in their apertures, the discrepancies between calculated and observed results must, it would seem, be attributable to mechanical difficulties in the case of the tipping gauge entirely, but rather to imperfect exposure in the case of the vertical gauges, while the mode of measuring and errors of reckoning are other causes which prevent practice being so accurate in its results as theory.

It is to be remembered that the question of quantity is alone answered by all these gauges. Time, rate, and periodicity of rainfall can receive no elucidation from them; these questions must be left to the records of self-registering gauges.

If there be any laws of seasonal or annual periodicity regarding the direction of the surface wind bringing the most rain, and the relative strength of the wind, probably it might be discovered by means of these gauges in the course of time. We already learn from them that the S.W. is the rainy quarter during the winter months, October to February; and, contrary to what might have been expected, the N.E. is the quarter of most rain in summer, March to September; that the rain falls nearer the vertical in summer than in winter; and these are encouraging results.

It appears from the foregoing considerations that it cannot be desirable to make computations from the indications of these gauges with refinement. It will answer all purposes very well, so far as I know, if the azimuth and the inclination are computed to the nearest degree. Time spent in obtaining results to minutes would be thrown away. Accordingly, in the subjoined tabulations, the calculated quantities have been obtained by means of the table for the solution of right-angled triangles used in navigation, and known as the Traverse Table.

The "most collected" was greatly in excess of the computed quantity, R, in March and in December, 1867.

The tipping gauge quantity does not agree very well with the computed quantity, R, until May, 1867; in September and in December, 1867; in January and February, 1868; in March and in May, 1869; and in December, 1870, there is disagreement to a great extent; otherwise, the agreement is remarkably close, all things considered. Probably the tipping gauge fails in frosty weather, or does not get the due amount of snow or hail.

RESULTS OF ROTHERHAM EXPERIMENTS, 1866-70.

MONTHS.	Azimuth.	Inclination.		Most collected.		Tipping gauge.
		θ .	R.			
	degrees.	deg.	in.	in.	angle.	in.
1866.						
February.....	S 74 W	...	...	3.88	45	2.57
March	S 25 E	...	...	2.56	45	...
April	N 57 E	55	1.72	1.62	45	1.19
May	N 65 E	51	0.80	0.78	67½	0.62
June	N 47 E	36	4.25	4.12	45	3.62
July	N 21 E	33	4.70	4.73	22½	4.30
August	N 51 W	34	3.20	3.18	45	2.98
September ...	N 86 E	25	4.03	4.11	22½	3.81
October	S 84 E	28	3.46	3.80	45	3.17
November ...	N 69 W	46	2.82	2.93	45	2.40
December ...	S 49 W	43	2.28	2.28	45	1.97
1867.						
January .....	...	...	...	...	...	...
February.....	S 52 W	46	2.46	2.51	45	2.03
March	N 71 E	69	4.70	5.16	67½	1.97
April	S 49 W	41	3.30	3.29	45	2.96
May	N 70 E	40	2.92	2.95	45	2.61
June	N 13 W	29	2.21	2.26	22½	2.10
July	E	27	2.45	2.50	22½	2.37
August	S 9 W	18	3.30	3.31	22½	3.26
September ...	S 30 E	23	2.14	2.06	22½	1.77
October	S 35 W	30	2.28	2.31	22½	2.11
November ...	N 4 E	32	0.82	0.83	45	0.73
December ...	N 59 W	60	2.74	3.03	67½	1.99

MONTHS.	Azimuth.	Inclination.		Most collected.		Tipping gauge.
		O.	R.			
1868.	degrees.	deg.	in.	in.	angle.	in.
January	S 16 W	59	3.20	3.19	67½	2.10
February	S 78 W	54	3.20	3.22	45	2.61
March	S 70 W	50	2.03	2.12	45	...
April	N 30 E	51	2.65	2.72	45	2.79
May	S 9 E	15	0.69	0.73	22½	0.75
June	S 10 W	7	0.33	0.34	22½	0.34
July	N 15 W	15	0.22	0.24	22½	0.22
August	S 72 E	26	2.02	2.13	22½	2.16
September ...	N 69 E	49	4.17	4.12	45	4.10
October	S 62 W	35	2.90	2.99	34	3.06
November ...	N 88 W	52	1.68	1.88	67½	1.58
December ...	S 11 W	44	9.10	9.32	45	8.95
1869.						
January	S 14 W	43	3.55	3.69	45	3.38
February	S 86 W	53	2.48	2.52	45	2.58
March	N 18 E	72	4.10	4.15	67½	2.83
April	N 62 W	38	1.91	1.91	45	1.88
May	N 46 E	52	8.48	8.08	45	7.27
June	N 48 W	33	0.98	1.00	45	1.04
July	S 37 W	19	0.09	0.10	22½	0.10
August	S 59 W	20	1.81	1.92	22½	1.84
September ...	S 35 W	27	4.04	4.01	22½	4.12
October	N 86 E	29	1.34	1.39	22½	1.43
November ...	S 72 W	42	2.33	2.25	45	2.38
December ...	S 13 W	52	4.90	4.91	67½	4.47
1870.						
January ...	S 33 W	49	2.50	2.61	45	2.47
February	S 63 E	57	2.58	2.74	67½	2.48
March	N 33 E	58	3.57	3.54	67½	3.28
April	S 85 W	28	0.33	0.36	22½	0.36
May	S 28 E	36	0.81	0.91	45	0.87
June	N 59 W	17	1.84	1.91	22½	1.90
July	S 15 W	12	0.50	0.53	22½	0.52
August	N	27	1.00	1.04	22½	1.02
September ...	S 7 E	25	1.00	1.07	22½	1.02
October	S 27 E	39	7.80	8.22	45	7.59
November ...	S 7 W	35	2.31	2.34	45	2.13
December ...	N 78 E	48	3.50	3.66	45	2.96

MONTHS.	No. of Years.	Observed Quantities.					
		E.	N.	W.	S.	H.	V.
		in.	in.	in.	in.	in.	in.
January.....	3	1·285	1·397	2·558	4·785	5·884	7·012
February	4	1·883	1·912	5·182	3·770	6·416	8·495
March	4	4·936	6·868	2·219	2·118	6·118	12·854
April	5	2·635	3·113	2·300	2·111	6·922	6·970
May	5	5·835	4·924	0·505	1·192	9·249	9·839
June	5	1·646	3·030	1·036	0·885	8·275	4·707
July	5	1·974	1·944	0·926	0·777	6·941	3·865
August	5	1·144	2·410	2·146	2·433	10·182	4·761
September	5	3·745	2·353	1·501	3·249	12·805	7·918
October	5	3·645	2·899	3·791	5·032	14·580	10·025
November	5	1·208	2·507	2·990	3·103	7·322	6·694
December	5	4·672	5·755	5·848	6·937	14·860	16·624
56 months...	...	34·608	39·112	31·002	36·392	109·554	99·764

MONTHS.	No. of Years.	Computed.			Most collected.		Tipping gauge	Computed.	
		Azimuth.	O	R	amount.	angle		h.	z.
			deg.	in.	in.	deg.	in.	in.	
January ..	3	S. 21 W.	50	9·20	9·39	56	7·95	4·52	77
February...	4	S. 61 W.	53	10·60	10·99	50	9·70	4·87	76
March	4	N. 30 E.	65	14·20	14·98	62	..	3·93	64
April	5	N. 19 E.	45	9·80	9·91	43	9·18	3·79	55
May	5	N. 55 E.	47	13·45	13·45	45	12·12	7·60	82
June	5	N. 16 E.	30	9·55	9·64	32	9·00	5·80	70
July	5	N. 42 E.	29	7·95	8·11	23	7·51	5·00	72
August ...	5	W.	25	11·25	11·58	27	11·26	4·62	46
September	5	S. 68 E.	32	15·10	15·36	27	14·82	7·50	58
October ...	5	S. 4 W.	35	17·80	18·72	36	17·36	7·54	50
November ..	5	S. 71 W.	43	10·00	10·24	51	9·22	4·13	57
December ..	5	S.W.	48	22·30	23·20	54	20·34	8·17	55
56 months	...	N. 53 E.	42	148·17	155·57	42	128·46	56·21	51

It may be useful and interesting to give here, in full, the computations, with the general results for the 56 months, in exemplification of the formulæ given in this investigation.

1st. To find azimuth :—

$$\text{Cot Az.} = \frac{\text{N.} - \text{S.}}{\text{E.} - \text{W.}}$$

$$\begin{aligned} \text{N.} - \text{S.} &= 2·72 = \log. \cdot 434569 \\ \text{E.} - \text{W.} &= 3·606 = \log. \cdot 557026 \end{aligned}$$

$$\text{Cot Az. N. } 52^{\circ} 58' 22'' \text{ E.} = \log. \underline{9·877543}$$

2nd. To find q :—

$$\begin{array}{rcl}
 q & = & N. \cos Az. + E. \sin Az. \\
 N. 39.112 & = & \log. 1.592310 \\
 \cos 52^\circ 58' 22'' & = & \log. 9.779737 \\
 \hline
 23.56 & = & \log. \underline{1.372047} \\
 E. 34.608 & = & \log. 1.539177 \\
 \sin 52^\circ 58' 22'' & = & \log. 9.902193 \\
 \hline
 27.63 & = & \log. \underline{1.441370} \\
 23.56 & & \\
 \hline
 q & = & \underline{51.19}
 \end{array}$$

3rd. To find inclination :—

$$\begin{array}{rcl}
 \cot \theta & = & \frac{H.}{V.} \\
 H. 109.554 & = & \log. 2.039629 \\
 V. 99.764 & = & \log. 1.998974 \\
 \hline
 \cot 42^\circ 19' 20'' & = & \log. \underline{10.040603}
 \end{array}$$

4th. To find R :—

$$\begin{array}{rcl}
 R & = & \sqrt{H^2 + V^2} \\
 H^2 & = & 12002.0789 \\
 V^2 & = & 9952.8557 \\
 \hline
 R^2 & = & 21954.9346 \\
 \hline
 R & = & \underline{148.17}
 \end{array}$$

5th. To find Q :—

$$\begin{array}{rcl}
 Q & = & q. \operatorname{cosec} \theta \\
 q 51.19 & = & \log. 1.709185 \\
 \operatorname{Cosec} 42^\circ 19' 20'' & = & \log. 10.171792 \\
 \hline
 Q 76.03 & = & \log. \underline{1.880977}
 \end{array}$$

6th. To find h :—

$$\begin{array}{rcl}
 h & = & \sqrt{Q^2 - q^2} \\
 Q^2 & = & 5780.5609 \\
 q^2 & = & 2620.4161 \\
 \hline
 h^2 & = & 3160.1448 \\
 \hline
 h & = & \underline{56.21}
 \end{array}$$

7th. To find z :—

$$\begin{array}{rcl}
 z & = & \frac{h \times 100}{H.} \\
 & = & \frac{5621}{109.554} = 51.3
 \end{array}$$

R. STRACHAN.

THE DURATION, HOURLY FREQUENCY AND RATE OF RAINFALL.

By FREDERICK E. SAWYER, F.M.S.

THE first step towards obtaining any information on these important questions was to obtain a correct record of the duration of rain. This was done on sheets ruled for the twenty-four hours, the duration being marked by black lines and added daily, and the total entered side by side with the amount of rain for the day; then, at the end of the month, by glancing down the column for any hour, the exact number of times rain had fallen during that hour, throughout the month, was ascertained.

Hourly Frequency.—Tables I. and II. show the results of observations on this point. At Brighton, the greatest frequency in any hour was nine times from 2 to 3 p.m. in October, and from 5 to 6 p.m. in December. The least frequency was no rain in several hours in the spring and summer months, during the severe drought. The totals of the year show the greatest frequency to have been 38 times from 2 to 3 and 5 to 6 p.m., and the least frequency, from 11 p.m. to midnight, 21 times. At Bogside, Aberdeenshire, the greatest frequency (monthly) in any hour was 12 times, from 3 to 4 p.m. in December. The least frequency was no rain in several months. From the totals of nine months, the greatest frequency was from 3 to 4 p.m. (36 times), and least frequency from midnight to 1 a.m. (7 times), both periods being one hour later than at Brighton. It is interesting to find that at Brighton and Bogside the hourly frequency follows the same rule as at Greenwich; for in the *Proceedings of the Meteorological Society*, January, 1868, page 49, Mr. Glaisher states "That the largest number is between 2 and 3 p.m., implying the hour of most frequent rain during the year;" and also, "The most continuous large numbers are in the five hours following noon, and these are by far the most rainy hours."

Duration.—The monthly total duration of rain at Brighton ranged from $6\frac{1}{4}$ hours in June to 112 hours in December; and at Bogside, from $17\frac{3}{4}$ hours in June to $132\frac{1}{4}$ hours in December. The total duration of rain in the year at Brighton was 593 hours 40 minutes, or 24 days, 17 hours, 40 minutes; and the rainfall of 1870 being below the average, we may roughly, and with very little error, reckon that in an average year rain actually falls for one month out of it.

TABLE II.

Shewing the number of times rain fell during every hour in every month. Observations made at Bogside, Leochel Cushnie, Aberdeenshire, Scotland, by W. BRUCE, Esq.

Lat., 57° 10' 50" N. Lon., 2° 40' 0" W. 882 feet above the sea level.

Months. 1870.	BETWEEN WHAT HOURS.																								Total duration of Rain. hrs. min	Rain. Sum. inches.
	A.M.												P.M.													
	Mid. to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	10 to 11	11 to noon.	noon to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	10 to 11	11 to mid.		
April..	...	...	1	1	3	4	2	1	2	2	1	...	1	...	...	...	2	...	1	...	...	2	2	2	18 0
May...	...	...	...	1	2	2	1	2	2	3	6	1	1	2	5	3	2	3	2	2	2	3	3	...	33 45
June...	...	...	...	1	1	1	...	...	...	2	1	2	5	3	4	4	4	4	1	1	1	3	1	...	17 40
July...	1	2	2	2	1	1	1	...	1	3	...	...	2	2	3	...	...	2	1	...	...	1	1	...	18 30
Aug...	...	...	...	1	2	1	1	...	2	3	3	2	2	4	3	4	2	2	4	2	1	3	1	...	22 45
Sept...	3	5	5	5	3	3	4	4	1	2	3	4	4	1	6	1	7	5	3	3	3	4	3	...	43 15	
Oct...	1	1	5	3	3	3	6	5	2	6	3	4	4	4	2	6	5	6	4	3	5	4	4	...	64 0	
Nov...	...	2	3	1	3	2	2	4	2	4	5	5	2	5	9	12	8	11	6	9	5	4	2	...	46 0	
Dec...	2	...	...	3	2	4	6	4	4	8	8	9	7	8	9	12	8	6	6	9	4	6	2	...	132 15
Total..	7	9	18	18	21	23	18	21	18	31	30	27	28	28	34	36	32	33	28	25	21	20	26	12		

Rate of Rainfall.—By dividing the sum of rainfall by the duration we obtain the rate, and for convenience in comparison, the rate is calculated for one hour, and thus we obtain the hourly rate of rainfall. Now this is of the greatest importance and interest, for besides being of practical use to the engineer, it enables the meteorologist to compare the different showers, and ascertain the influence of the seasons and of the direction and force of the wind on the rate, and also to define what are heavy showers of rain.

There is a tendency in the minds of many people to confuse the rapidity with the amount of a shower. Now the heaviest shower must be that in which the greatest quantity of rain falls in the least period. On 10th of last August, between 3 and 4 p.m., .17 in. fell in 10 minutes, which is at the rate of 1.02 in. per hour; and on October 22-23, 1.275 in. fell in $14\frac{1}{2}$ hours, or only .087 in. per hour. Many observers, looking only at the total, would say 1.275 in. is the heaviest, but it is palpable that in the short shower the rain was heaviest, as it fell most rapidly. This shows the importance of registering the duration.

Table III. gives the hourly rate of rainfall at Brighton for eighteen months and at Bogside for nine months. The greatest rate at Brighton was in September and the least in April. The rate at Bogside was greater in every month (except August) than at Brighton, and in the spring months this difference is most marked.

In Table IV. the average rates for the seasons are given. This table is most interesting, for it shows that the rate in summer is exactly double that of the winter, while that of the autumn is within a fraction double that of the spring; or, to put it more plainly—that rain falls twice as fast in the summer as in the winter, and twice as fast in the autumn as in the spring.

In order to ascertain what caused the great variations in the hourly rates, the daily falls of rain were taken out with the duration and the mean direction and force of the wind during the rain, and the rate of each day's rain calculated. The results are not very successful, but point out generally a tendency of rain to fall most rapidly with N. and N.E. winds, and also S.S.E. and S. winds. The following table shows the mean rate at Brighton for eighteen months:—

Hourly rate in connection with the direction of the wind.

Calm.	N.	NN.E.	N.E.	E.N.E.	E.	E.S.E.	S.E.	SS.E.
.064	.083	.026	.057	none	.041	none	.044	.066
S.	SS.W.	S.W.	W.S.W.	W.	W.N.W.	N.W.	NN.W.	
.087	.034	.051	.035	.055	.042	.021	.040	

The connection between the wind force and the hourly rate is shown in the following table, which is the mean of eighteen months' observation :—

<i>Wind force, sea scale (0 to 12).</i>												
(Calm, 0)	1	2	3	4	5	6	7	8	9	10	11	12
·064	·045	·071	·050	·054	·085	·061	·029	·053	·087	·108	none	·010

In order to compare the most rapid showers, Table V. was formed with the maximum hourly rates of each month. From this we see that the summer and autumn showers are several times more rapid than the winter ones ; the greatest rates of all occurring with thunderstorms. Speaking generally from the results of this table, we may call heavy rain *that which falls at a greater rate than a tenth of an inch in an hour.*

Space forbids any further remarks, but lest any should wish to impugn the observations during the night hours, it may be stated that the duration was carefully ascertained from night policemen and others whose business led them out at early hours ; and also numerous small showers, which could not have been recorded by a self-registering rain-gauge, were registered.

Lastly, my thanks are due to W. Bruce, Esq., Bogside, Scotland, for kindly taking observations at that distant point. I would strongly urge upon all observers to record the duration of heavy showers during the present year, and to send the results to Mr. Symons with their rainfall returns.

TABLE III.

The hourly rate of Rainfall.

	BRIGHTON.				BOGSIDE.
	1869. inches.		1870. inches.		1870. inches.
January .....	...	...	·024	...	...
February .....	...	...	·022	...	...
March . .....	...	...	·034	..	..
April .....	...	...	·014	...	·060
May .....	...	...	·048	...	·067
June .....	...	...	·044	...	·076
July	·056	...	·057	...	·147
August.....	·057	...	·074	...	·061
September	·091	...	·079	...	·084
October	·067	...	·052	...	·058
November	·031	...	·050	...	·077
December	·040	...	·033	...	·045
Mean .....	...	...	·044	...	,

TABLE IV.

The hourly rate of Rainfall.

Seasons.	BRIGHTON.		BOGSIDE.	
	1869. inches.	1870. inches.	1870. inches.	
Winter (December to February)...	...	·029	...	...
Spring (March to May) .....	...	·032	...	...
Summer (June to August) .....	...	·058	...	·095
Autumn (September to November)	·063	·060	...	·073
January to June .....	...	·031	...	...
July to December	·057	·057	...	·078

TABLE V.

The hourly rate of Rainfall.—Maximum rates.

BRIGHTON.					
1869.		1870.			
inches.	Day.	inches.	Day.		
January ... ..	...	·060	...	9th and 14th.	
February ... ..	...	·037	...	6th.	
March ... ..	...	·103	...	13th.	
April ... ..	...	·093	...	9th.	
May ... ..	...	·130*	...	22nd.	
June ... ..	...	·183*	...	17th.	
July	·060	·120*	...	8th.	
August	·250	·272	...	10th.	
September ...	·770*	·150	...	8th.	
October	·120	·224	...	23rd.	
November ...	·067	·110	...	13th.	
December ...	·146	·073	...	14th.	

Average maximum rate of fall for 1870, ·129 of an inch.

* Thundershowers.

F. E. SAWYER, F.M.S.

Brighton, January 25th, 1871.

RAIN GAUGE EXPERIMENTS AT ALDERSHOT CAMP, HAMPSHIRE.

By COLOUR-SERGEANT J. ARNOLD, A.H.C., F.M.S.

Lat. $51^{\circ} 15' 25''$ N. Lon. $0^{\circ} 45' 36''$ W. Height above Sea, 325 ft.
FOR THE YEAR 1870.

Height above ground ...	0 ft. 0 in.	0 ft. 6 in.	3 ft.	6 ft.		12 ft.	25 ft.	30 ft.
Diameter of Funnel ...	8 in.	8 in.	5 in.	5 in.	5 in. tilted at 45°	5 in.	8 in.	5 in. tilted at 45°
January	in. 1·97	in. 1·95	in. 1·86	in. 1·75	in. 3·04	in. 1·59	in. 1·18	in. 3·00
February.....	2·80	2·73	2·67	2·58	4·16	2·42	1·99	4·14
March	3·01	2·93	2·85	3·78	4·74	2·55	1·87	4·72
April	0·38	0·37	0·35	0·34	0·53	0·32	0·27	0·54
May	1·41	1·31	1·28	1·25	1·87	1·17	0·92	1·88
June	0·38	0·37	0·35	0·35	0·58	0·34	0·32	0·58
July	0·57	0·55	0·54	0·53	0·75	0·49	0·43	0·76
August	1·72	1·67	1·63	1·58	2·01	1·50	1·30	2·02
September ...	2·26	2·22	2·21	2·12	2·93	1·99	1·72	2·93
October	4·09	3·99	3·83	3·68	5·14	3·41	2·75	5·08
November ...	2·02	1·96	1·89	1·80	2·67	1·64	1·41	3·66
December ...	3·43	3·38	3·30	3·18	4·63	2·93	2·35	4·64
Totals	24·04	23·43	22·76	22·94	33·05	20·35	16·51	32·95

ROYAL OBSERVATORY, GREENWICH.

Lat. 51° 28' 38" N. Long. 0° 0' 0"

Amount of Rain collected in different gauges in each month of the year 1870.

1870	MONTHLY AMOUNT OF RAIN COLLECTED IN EACH GAUGE.							
	Cylinder partly sunk in the ground read mntly	Cylinder partly sunk in the ground. read daily.	Crosley's.	On the roof of the Photographic thermometer stand.	On the roof of the Library.	On the roof of the Octagon Room.	Second Gauge at Osler's Anemometer.	Self-registering Gauge at Osler's ‡ Anemometer
	in.	in.	in.	in.	in.	in.	in.	in.
Jan. ...	1·58	1·49	1·37	1·36	1·00	1·23	0·83	0·83
Feb. ...	0·60	0·54	0·46	0·38	0·31	0·32	0·27	0·17
March	2·15	2·05	1·98	1·95	1·63	1·33	1·10	1·00
April..	0·24	0·28	0·32	0·30	0·24	0·24	0·09	0·10
May...	0·37	0·47	0·48	0·44	0·21	0·30	0·21	0·25
June...	0·23	0·39	0·42	0·38	0·35	0·32	0·24	0·28
July...	1·93	2·01	1·97	2·04	1·90	1·88	1·68	1·62
Aug...	2·00	2·02	1·78	1·99	1·56	1·72	1·40	1·40
Sept...	1·70	1·63	1·35	1·60	1·34	1·49	1·19	1·20
Oct. ...	3·40	3·34	2·88	3·13	2·15	2·63	1·90	1·88
Nov ...	1·30	1·20	0·97	1·14	0·75	0·96	0·55	0·63
Dec....	3·00	3·13	2·29	3·01	2·74	2·65	2·14	2·01
Sums..	18·50	18·55	16·27	17·72	14·18	15·07	11·60	11·37

The heights of the receiving surfaces are as follows :

	Above the mean level of the Sea.		Above the Ground.	
	ft.	in.	ft.	in.
The two gauges at Osler's Anemometer	205	6	50	8
Gauge on the roof of the Octagon Room	193	2½	38	4½
Gauge on the roof of the Library	177	2	22	4
Gauge on the roof of the Photographic Thermometer Shed	164	10	10	0
Crosley's Gauge	156	6	1	8
The two Cylinder Gauges, partly sunk in the ground	155	3	0	5

JAMES GLAISHER, F.R.S.

‡ Recorded on Osler's sheets.

NOTE ON THE PRECEDING PAPERS.

It has been our custom to add a few words by way of Editorial comment on the papers with which we are favoured by our correspondents. There is this year so close a connection between the articles of Messrs. Stow, Griffith, and Strachan, that we have thought it better to avoid breaking the continuity of their testimony, and merely add a few words separately at the end.

Our remarks are much abbreviated by the clear and complete manner in which the writers have treated the subjects, whereby it only remains for us to point out a few of the connecting links, and supply one or two additional facts and suggestions.

On page 10 Mr. Stow writes in praise of zinc as a material for rain gauges. We think that it will answer capitally at Hawsker, and in any pure atmosphere; all the Eastern Lake gauges are of zinc, and, we believe, are quite satisfactory; but zinc in the manufacturing districts, in populous towns, or in London, would, we fear, soon require renewal. We shall be glad to hear how it continues to behave, and should think it would be well to have it tried in the heart of Manchester, St. Helen's, or London.

There can be no doubt that the present position of the magnitude series of gauges is as exposed as can be desired, therefore few things can be more satisfactory than for Mr. Stow to report:—

“After all, if two measurements involving snow be omitted, the rain caught in the gauges of this series, from the time when all of them were in operation, is within two per cent. of the same amount for all sizes from 24 to 3 inches inclusive. This result agrees with that obtained by Mr. Griffith—a satisfactory circumstance, considering the very different climate.”

From the tenour of Mr. Stow's remarks (page 15) we infer that he had not noticed Mr. Arnold's experiments at Aldershot, and our remarks upon them, in *British Rainfall*, 1869, page 40. This is very fortunate, because it shows that two experimenters, working hundreds of miles apart, and with different instrumental arrangements, have arrived at nearly identical results; and, moreover, these results are consistent with those which we deduced from the Rotherham experiments, and are not contradicted by any others of which we are aware.

Perhaps the following abstract of the Aldershot results will be useful :—

Height above ground	Horizontal		Inclined at 45 deg.	
	6 feet.	25 feet.	6 feet.	30 feet.
	in.	in.	in.	in.
Total rain in 1869	27·22	20·37	41·59	41·55
„ „ 1870	22·94	16·51	33·05	32·95
Ratio of each pair, 1869 ...	100	75	100·0	99·9
„ „ „ 1870	100	72	100·0	99·7

From this it appears that the decrease with elevation above the surface, which universally occurs with ordinary rain gauges the mouths of which are horizontal, is almost annihilated if the funnels are inclined at 45°, and kept face to wind by vanes.

Mr. Stow's instruments (as will be seen from Table V.) tell a very similar tale, and we need only add to that table one detail not therein expressed—viz., that the sum of the amounts collected in each pair of gauges *increases* with elevation; the figures are, 1 ft. 42·566, 5 ft. 44·200, 10 ft. 45·583. In Mr. Strachan's paper (page 29) he points out that vertical gauges will give results more and more nearly approaching the truth in proportion as they are elevated above surrounding objects. This confirms the accuracy of Mr. Stow's measurements, and indicates that probably an additive correction should be applied to the 1 ft. and 5 ft. vertical gauges. If so, then they would all approach more nearly to uniformity, and agree still more closely with Mr. Arnold's observations at Aldershot.

Evidently the problem which has baffled observers for more than a century is either solved, or so nearly so, that its complete solution can only be a question of a few months.

Mr. Griffith's short paper incidentally confirms the others in reference to the dependence of the ratio of decrease upon the velocity of the wind.

We quite agree with Mr. Strachan as to the impossibility of making the tipping gauge work perfectly, and are surprised that it has proved as satisfactory as it has. We have no record of the date at which Mr. Chrimes added the mercurial regulator, described in *British Rainfall*, 1869, p. 14, but should not be surprised to learn that the improvement in the readings of this instrument noticed by Mr. Strachan, was contemporaneous with this addition.

Mr. Strachan is undoubtedly right as to the probable additive cor-

rection to vertical-mouthed gauges, and we shall not be astonished if evidence is produced to show that, instead of rain falling at a mean angle from the vertical of 42° , a less angle, such as 35° or even 30° , is more nearly correct. We think, however, that the deficiency must arise more from the impossibility of constructing gauges which will take up a correct position in azimuth than from the influence of surrounding objects; but Mr. Chrimes' instruments are so well placed that their main shelter must arise from one another, and a singular illustration of this, and proof of the accuracy and consistency of all the observations is afforded by the fact that the computed mean value of θ , and the mean of the angles of the gauge collecting most rain, are shown by Mr. Strachan's table on page 33 to be identical.

We have on previous occasions urged the importance of assisting Mr. Sawyer in his investigations; we venture once more to press it upon our readers. In Scotland it is a regular practice to record the duration of sunshine; surely it would not be much more difficult to record approximately that of rain. We hope that some of our correspondents will communicate with Mr. Sawyer.

ON FLOAT RAIN GAUGES ADAPTED FOR MOUNTAIN DISTRICTS.

THE conditions which have to be fulfilled by gauges on mountain tops, and in uninhabited moorland districts, differ so essentially from those appertaining to the gauges in ordinary use by residents in less wild localities, that it is absolutely impossible to employ identical instruments in all situations.

Having last year pointed out that gauges for mountain use must be "compromises," that a balance of errors is unavoidable, we scarcely think it necessary to discuss that proposition again. But it does seem advisable to say a few words in explanation of the reasons which induce us to advocate for mountain purposes a gauge different, not only in size but in principle, from those which we recommend for ordinary use. Briefly, they are three—

(1). The extreme simplicity of the observation renders it unnecessary to secure educated and skilled observers. With half-an-hour's instruction, any man who can read a foot-rule, enter what he reads, and write his own name, is perfectly competent to discharge the duties of an observer.

(2). There being only one reading to be taken instead of several, as would be the case with all other patterns of gauges, the risk of error in observing and in adding up the entries is greatly reduced.

(3). There is no delicate glass measure to puzzle a rough labourer or shepherd, and to be broken every few months by one accident or another.

Under these circumstances, and for reasons detailed last year, we hold that float gauges are best adapted for rough work, and hence we think it not unprofitable to devote a little time to their consideration.

Let it, however, be clearly understood that we are only advocating their use for one special purpose; they are no more fit for use in the dry midland counties of England than a Howard's tube rain gauge would be on the summit of Ben Nevis.

In *British Rainfall*, 1869, page 36, Mr. Fletcher called attention to certain corrections-applicable to his mountain gauges, and on a later page (49) we pointed out that a similar but probably smaller correction was required for those erected in the Eastern Lake District by Mr. Symons.

In order that the question may be clearly understood, a brief

recapitulation of the facts of the case, and description of the instruments employed, must precede our narrative of the proceedings with reference to the Eastern District Gauges. They have already been figured and fully described in these pages (1867, p. 16); repetition of the engraving and description is therefore unnecessary.

Of these gauges twelve were distributed over the district, and one was placed at Seathwaite, close to the old gauge, erected there in 1845 by Dr. Miller, and to a specimen of the gauges erected in 1864 by Mr. Fletcher. The two sets of instruments were thus brought into strict comparison, and the table printed last year (p. 49) showed that the gauge above engraved collected 4 per cent. more than Mr. Fletcher's, but 8 per cent. less than the old gauge.

Attention was also drawn to the remarkable difference between the results of the two gauges at Sharrow Bay.

Before describing the observations made during 1870, we think it best to point out two modes of constructing float rain gauges, the merits of each, and the bearing of these merits on the case before us.

The accompanying figure shows the form of float gauge most generally known to observers. For many reasons this pattern is quite unsuited for mountain work, but as these objections may not be patent to everybody, we will enumerate some of them.

(1). Their fundamental principle is that the area of the cylinder is so much less than that of the receiving surface, that the actual depth of rain is multiplied 2, 3, 4.....10 times. Now, suppose it to multiply ten times, then if we take an ordinary mountain station with 20 (not to say 30) inches of rain in a wet month, we should have $(20 \times 10) = 200$ inches, or 16 feet 8 inches, as the length of the measuring rod, which, of course, is absurd; and hence reason the first against this form of gauge, and therefore we conclude that the "contracted float" pattern is unsuited for mountain work.

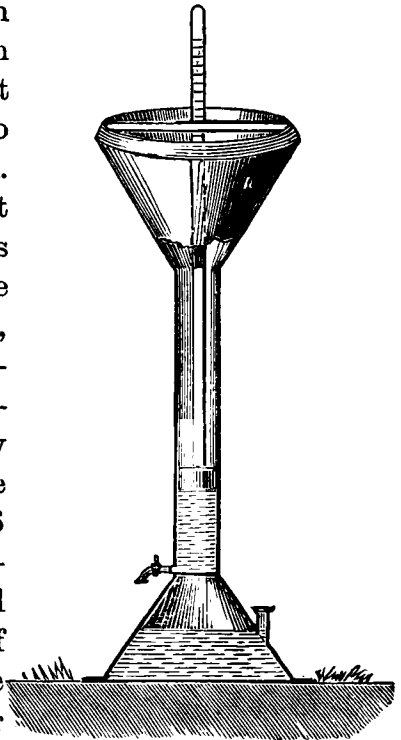


Fig. 4.

But even if we assume that the gauge is a simple cylinder of uniform diameter throughout, as in fig. 5, there are still several objections; we shall therefore proceed to enumerate them.

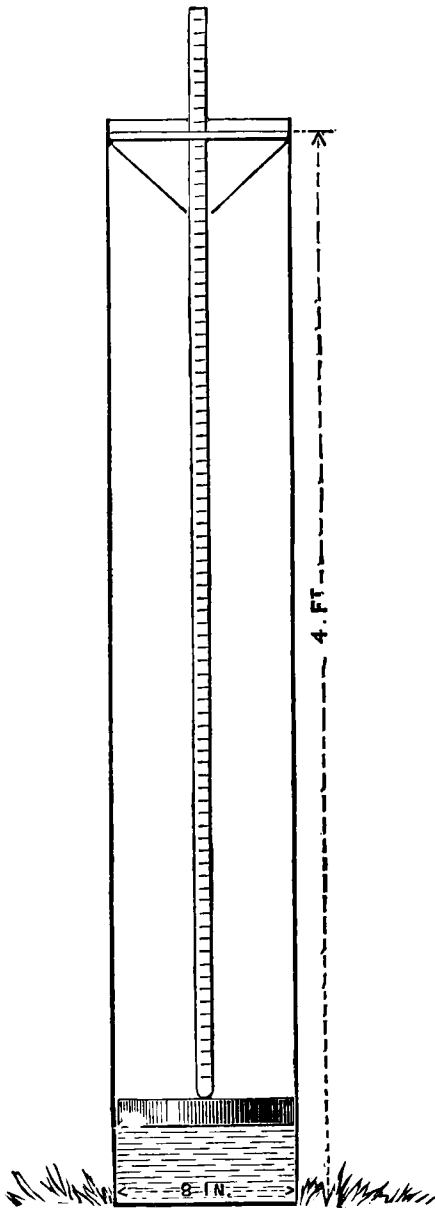


Fig. 5.

(2). Assuming that fig. 5 were substituted for fig. 4, there would still be many difficulties; (a) the gauge would require to be quite 4 feet long, and would therefore stand as a column of that height, certain to attract the attention of unscientific tourists, certain to collect considerably less rain than actually falls, and certain to burst from the exposure of the contained water to the full range of atmospheric temperature. All these evils are either lessened or removed by sinking the cylinder in the earth, and thus we arrive *very nearly* at the adopted Cumberland pattern.

(3). We must now ask our readers to consider the mode of dividing these instruments. When the cylinder is exactly of the same diameter as the receiving surface, it is evident that an inch of rain will raise the float an inch, and in short that the rod must be divided in inches; but where is the zero or 0 to be placed. If it is so placed as to read 0 when the gauge is empty, as would at first sight appear proper, then it will always show less than the true fall, because the weight of the rod and of the float is such as to cause the partial immersion of the float. In

other words, a quantity of water is requisite to ensure the motion of the float, and a slight shower will not cause it to rise. (As the immersion depends upon the weight of the float and rod, it is evident that absorbent floats, *e. g.* those made of cork, are far inferior to metal ones, since in one case the immersion is variable, and in the other constant.)

Now there are two modes of correcting this error—one very old, the other first tried, we believe, by Mr. Symons in 1865; each has some advantages, and is best under some circumstances.

The old plan was to make the gauge rather longer than was actually

required, and to pour water into it until the zero of the rod was raised to its proper position ; and subsequently never to empty the gauge, but only to run off the water until it again showed 0. In dry districts, and where there is every facility for running off the water as in fig. 4, and also for replacing any excess accidentally run off, this is the best plan ; provided always that the observer can be relied upon to make the adjustment carefully, and that there is no fear of his making the fatal error of leaving the tap open, or emptying the gauge instead of running it down to zero. We have, however, already seen (2) that mountain gauges must be buried in the earth ; a very little calculation will show that they and their contents weigh from half to three-quarters of a hundredweight, and great as is the rainfall in those parts, it by no means follows that a supply of water is at hand should the observer empty too much out ; he must, therefore, either be provided with some receptacle for part of the water wherewith to effect the adjustment, or preferentially with a syringe wherewith to finish emptying it. We pity the observer who aimed at accurately recording a gauge of this kind, were it substituted for the present one on Helvellyn ; for we hardly know whether it would be more trying to toil up the mountain side from Wythburn encumbered by the necessary apparatus, or to stand on that bleak spot adjusting the index to zero.

It was to free the observers from these difficulties, and render it impossible for them to go wrong, that Mr. Symons adopted the new plan in 1866. (We shall presently show that we think his gauges are open to one objection, but the fault is one of construction, and now that it has been detected will be easily obviated.)

The depth of immersion for non-absorbent floats being constant, one accurate determination of its amount is sufficient. Now if a quantity of water, exactly equal to (say) 2 inches of rain, be poured into a cylindrical gauge, it is evident that the rod should indicate 2 inches ; we have already shown that in a cylinder of uniform diameter the scale must be divided into inches, hence we have (1) the position of the division indicating 2·00 by direct observation, and (2) we know that a scale of inches has to be laid off from that point in both directions ; and the gauge must always read correctly, *except when there is not enough in it to raise the float*. As less than three-tenths of an inch is sufficient for this purpose, there is not one month in a hundred in which any error will occur in a mountain district, and even then it is limited to that small quantity. By this arrangement, all the trouble of adjustment to zero is shifted from the observer to the maker, and is made, once and for all, not by a shepherd on a snow-covered mountain side,

but amid all the appliances of an optician's workshop. The observer has nothing to do but to note the reading of the gauge, to enter it, to lift the heavy cylinder from its case, and to empty it.

We have now to return to the question why both at Seathwaite and Sharrow Bay these gauges have registered less than those close to them. In the first place, as stated last year, mountain gauges to hold a month's rain must be constructed on a sort of compromise.

"In designing gauges for monthly records, it is only possible to strike a middle path between known sources of error; the larger the inlet pipe to the gauge, the greater the evaporation, *but* the more correctly will you collect snow and hail; the greater the capacity of the gauge, the less correctly will you measure small amounts, *but* the more safe will you be from having your record spoiled by the gauge running over. (In Cumberland you often have more than 30 inches in a month in the winter, and under 2 inches in the spring.)"

In *British Rainfall*, 1865, Mr. Fletcher, when commenting upon a deficiency in his monthly gauge at Seathwaite, wrote as follows:—

"The pipe at the bottom of the funnel is larger than usual, being nearly three-eighths of an inch, in order to lessen the liability to stop up by hailstones, and to prevent overflow during the tremendous downfalls which occasionally occur; and the prevailing wind from the south-west being directed *downwards* from the mountains at the head of the valley into the gauge at an angle of 45°, a small whirlwind is perpetually going on in the receiver; so that I am convinced there is a considerable evaporation in this instance. It is well known that wind is a most powerful incentive to evaporation."

With these two paragraphs before us, and remembering that the aperture of Mr. Symons's gauges is four times as large as Mr. Fletcher's ($\frac{3}{4}$ inch diameter instead of $\frac{3}{8}$), it would seem probable that the deficiency would be greater in Mr. Symons's, but it is not, and the reason probably is the partial covering of the water by the float. In order to ascertain whether the deficiency was due to position or to the "compromise," observations of one of these 8-inch float gauges have been taken for comparison with the daily readings of an ordinary 5-inch gauge, during 1870, at the top of Kirkstone Pass, 1500 feet above the level of the sea. As at Seathwaite, the two gauges were near together, but there all similarity in position ends, as either personal knowledge of the district or a reference to the Ordnance Map will convince any one.

The float gauge was only set to work in May, but the six months records are probably sufficient.

	Ordinary 5-inch gauge.		Float gauge.		Deficiency.		Per cent.
1870. May	9·22	...	8·50	...	0·72	...	7·8
June	4·09	...	3·25	...	0·84	...	20·5
July	1·96	...	1·75	...	0·21	...	10·7
August ...	2·42	...	2·00	...	0·42	...	17·4
September	10·40	...	9·50	...	0·90	...	8·7
October...	10·97	...	10·50	...	0·47	...	4·3
	<hr/> 39·06		<hr/> 35·50		<hr/> 0·59		<hr/> 9·1

From this table the error appears to be nearly constant and quite irrespective of the amount of rain. Therefore (1) it cannot be in the small gauge, either in construction or position ; (2) it cannot be in the position or irregular area of the large gauge, but (3) it may be due to the large aperture at the bottom of the funnel and the extensive internal surface of the gauge (nine square feet), or (4) it may arise from erroneous position of the zero point.

We are of opinion that the principal cause is that stated under (3), but to show the grounds for this opinion, we must turn to some other experiments.

It may be remembered that the float gauge at Sharrow Bay was animadverted upon in our last as probably not suited for so dry a locality ; Mr. Parkin has been kind enough to have both the gauges observed during 1870, and in accordance with our request, from April onwards the monthly gauge was not emptied, but simply recorded at the close of each month.

During 1869 the average difference between the two gauges was 1·60 ; in 1870, prior to the alteration in the mode of measuring, the mean difference was very nearly the same (1·52) ; but, after the alteration, it fell to 0·37. Let us explain the reason for our making the suggestion, and this will lead us to the fault which we previously (p. 49) said we had detected in these gauges.



Fig. 6.



Fig. 7.

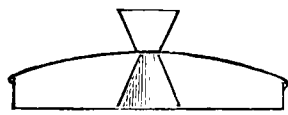


Fig. 8.

When the floats are made their shape is shown by fig. 6. Suppose that, by constantly dropping the measuring rod into the cup, or by a blow they are indented as in fig. 7, the zero will be lowered and a constant error introduced ; so that if the gauge be emptied at the beginning of each month, this error will attach to *each* monthly reading ; but if the gauge is not *emptied* monthly, but simply *read* and the previous reading subtracted, the reading will be correct. And this is exactly what happened : whence we conclude that either the Sharrow Bay float has become flattened, or the zero was not properly placed originally. The possibility of error will in future always be guarded against by inserting a support as in fig. 8.

Although the differences are now reduced to comparatively small amounts, and their causes approximately discovered, we should not conclude without pointing out another element contributing to the

question. The mean amounts are, Kirkstone Pass, 0·59, and Sharrow Bay, 0·37 ; but the small gauge at Kirkstone is emptied daily, while that at Sharrow Bay is only emptied monthly. Therefore, probably under similar conditions, the difference would not exceed 0·10.

After several years' trial, and in spite of the accident to the Sharrow Bay gauge, we doubt if any other pattern will afford a better compromise for the purpose for which they were designed, or yield on the whole more trustworthy results. Undoubtedly the floats must be rendered rigid, but that is a slight matter of detail, and will be easily effected.

ON THE SECULAR VARIATION OF RAINFALL IN ENGLAND SINCE 1725.

ANY variation, and especially any decrease, in the supply of water for motive power, for canals, for agriculture, and, though last not least, for manufacturing and domestic purposes, would be of such great importance to our national position, that we think too much care cannot be devoted to the investigation of the problem.

In the British Association Report for 1866 we gave the detailed calculations, whereby we had arrived at a first approximation to the fluctuation of rain during 140 years, viz. from 1725 to 1865.

The following table shows the results arrived at, in a slightly different arrangement, and continued to the end of the year 1869 :—

*Ratio of the fall of Rain in each year since 1725 to the mean fall of
sixty years, ending with 1869.*

Year.	1720	1730	1740	1750	1760	1770	1780	1790	1800	1810	1820	1830	1840	1850	1860
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
0	...	88	65	61	70	108	75	86	90	100	92	111	89	91	122
1	...	71	58	108	87	70	79	105	96	98	109	108	128	88	92
2	...	83	65	82	71	111	131	117	91	97	100	98	91	138	107
3	...	71	60	87	118	113	93	86	77	92	117	106	110	101	89
4	...	114	89	76	101	129	96	104	85	92	117	90	85	74	73
5	...	102	80	83	82	123	77	84	75	99	96	99	97	88	108
6	109	101	70	100	77	107	107	83	96	107	77	118	108	93	115
7	102	110	95	93	91	89	96	106	94	100	102	87	90	97	103
8	109	70	65	84	128	102	65	88	90	102	120	90	130	80	102
9	97	89	59	81	86	83	116	106	88	99	102	107	98	102	104
Mean	...	89.9	70.6	85.5	91.1	103.5	93.5	96.5	88.2	98.6	103.2	101.4	102.6	95.2	101.5

Perhaps a little explanation of the above table may be desirable. In the first place, to economise space and avoid confusion, the years are only given in the head line, and in front—*e. g.* at the top of the first column stands 1720, which commences the decade contained in the column beneath it; but the first six lines are blank, because these computations could not be carried back to an earlier date than 1726, which, as shown by the table, had a rainfall greater than the mean of the sixty years (1810-69), in the ratio of 109 : 100, *i. e.* 9 per cent. greater. Hence it is obvious, that the departure of the numbers from

100 indicates the per-centage of difference from the mean, whether in excess or defect—all the large numbers being wet years and those less than one hundred, dry ones. The numbers at the foot of each column show the mean ratio for the ten years contained in that column—*e. g.* that under 1750 shows that the mean annual fall of rain, from 1750 to 1759 both inclusive, was (85·5 : 100) 14·5 per cent. below the mean.

We do not intend to discuss at any length the details of this very interesting table, but think it not inexpedient to point out how wet and dry years seem to come in groups ; our readers will see instances as readily as we can point them out.

The remarkably long period of thirteen consecutive dry years (1738 to 1750) is worthy of notice, as unparalleled by any subsequent one, the nearest approach being from 1800 to 1809 ; as compared with both of which, that of 1854 to 1858 is quite unimportant. We can see no reason why such a dry period should not recur ; and if it does, under the modern artificial system of drainage and social economy, it can hardly fail to produce serious commercial and public inconvenience.

In one respect the record of this long dry period is of considerable utility. Ten or twelve years ago, when the short dry period of 1854-58 was closing, considerable discussion was raised as to whether or not the rainfall of the country had commenced to permanently decrease. What would have been the state of opinion on the subject, had the dry period lasted more than twice as long, even to 1866 ? Yet this was what it appears to have done before.

After a short period of medium rain, a rather wet series followed (from 1770), and then, after a few years, we have the following paragraph in a work* written expressly upon the subject :—

“ It has been an opinion universally adopted of late years, that the generality of our summers are more wet, and, consequently, colder, and our winters less frosty and more mild than they formerly were. This remark has been made not only by speculative but practical men ; by those most observant, because most affected by ungenial weather. Persons ignorant of the strong and uniform connection between cause and effect are utterly at a loss to account for it, while they acknowledge the fact ; and the generality of such persons, being addicted to superstition, do not fail on such occasions to cut the knot they cannot untie, and solve every difficulty by having recourse to supernatural means—the malice of our grand enemy, or the judgments of the Almighty. Hence, while this change has been observed, the greater part of the observers have attributed it to that outrageously impious act of our Legislature in the year 1752 ; *for to change the style,*

* *The Climate of Great Britain ; or Remarks on the Change it has undergone, particularly within the last Fifty Years.* By JOHN WILLIAMS. London: 8vo., 1806.

with them, is to alter the seasons. To this has been attributed the cloudy and ungenial weather we have, more or less, experienced ever since, and the years of scarcity we have so frequently felt. This change, it has been peculiarly remarked, has been taking place since about the years 1770 or 1775, and if we apply for information on this subject to people occupied in rural affairs, whose time has been employed in agricultural or horticultural pursuits, whether or not the generality of our summers have been of late years more unfavourable for the production of corn and fruit? the answer is in the affirmative; for the seasons have been invariably more wet and cold than formerly they were."

We may reasonably hope that the author of this lament was cheered by the drier years which accompanied and followed the preparation and publication of his book. Possibly he even flattered himself with the thought that the measures suggested by him had a share in the improvement.

The problem of the secular variation of rainfall may be attacked on a plan entirely different from that adopted in the British Association Report, and in the above table; and the discussion may be based upon the returns of a different group of stations. It is out of the question to give the details of the discussion, as we find it would occupy about 150 pages with tabular matter, but we will give a brief description of the process, and a specimen of part of the work, and then state the results as far as at present ascertained.

We have often explained that all the rain records which we have been able to obtain are copied into register volumes, each (or each set) of which are for one uniform decade of years beginning with 0 and ending with 9—*e. g.*, the returns for 1750 to 1759 inclusive are all in one volume.

For purposes connected with the verification of these records the mean of each completed decade at each station is taken: it is upon a *portion* of these mean values that this second part of our enquiry is based. We have italicized the word *portion*, because considerably more than one-third of the values are (for the present enquiry) useless, as will be evident, on reflecting that the fundamental idea of this enquiry is the comparison of the mean fall of rain in one decade with that in another. Therefore, of course for this special purpose, no record of less than twenty perfect and consecutive years, dating from one of the first uniform decadal years, is of any use. Again, the enquiry is simplified and made more evidently unimpeachable, if it is limited to registers which have one decade in common, and which can therefore be used as a standard of reference. The returns for the last quarter of a century being far more numerous than for earlier periods, we have taken the last completed decade (1860-69) as our standard of

comparison. We proceed to describe how we have used the values, and this will be best illustrated by a specimen :—At Podhole, near Spalding, Lincolnshire, the mean rainfall was,

	inches	
1830 to 1839	=26·80	} And these numbers are to each other in the following ratios:—
1840 to 1849	=27·52	
1850 to 1859	=23·78	
1860 to 1869	=25·34	
		{ 105·8
		{ 108·6
		{ 93·9
		{ 100·0

These ratios were then tabulated, and their means for each decade taken, with the following result :—

Period.....	1800-9	1810-9	1820-9	1830-9	1840-9	1850-9	1860-9
Mean Ratio..	91·0	98·4	103·9	100·5	99·9	92·2	100·0

In this enquiry (as stated above) we have taken as our standard of comparison the rainfall of the period 1860-9 ; in the former investigation we took that of sixty years, ending 1869. For strict comparison of the results of the two different modes of investigation both must be reduced to one standard—let it be that of the sixty years—then, still avoiding the data used in the previous enquiry, we have above—

	inches.		
1810-9	= 98·4	} therefore, it is evident that they must be increased in the ratio of 99·15 : 100·0, and then we have the following values, subject to no further correction.	{ 99·2
1820-9	=103·9		
1830-9	=100·5		
1840-9	= 99·9		
1850-9	= 92·2		
1860-9	=100·0		
Mean..1810 to 1869	= 99·15		{ 100·0

A similar correction is applicable to the period 1800 to 1809, of which the ratio becomes 91·8.

Now let us compare these values with those in that portion of the table on page 53 which is common to both :—

PERIOD.	Secular variation according to	
	British Association Report.	Decennial averages.
1800-09	88·2	91·8
1810-19	98·6	99·2
1820-29	103·2	104·8
1830-39	101·4	101·4
1840-49	102·6	100·7
1850-59	95·2	93·0
1860-69	101·5	100·9
Mean	98·7	98·8

The results of the two modes of investigation are shown in the

following diagram, whence their wonderfully close agreement is sufficiently evident :—

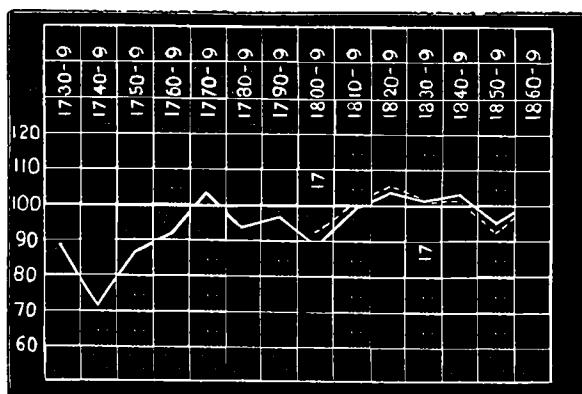


Fig. 9.

If our readers share our satisfaction at this proof of the trustworthiness of old observations, they will probably sympathize with our desire to apply a similar test to the earlier portion of the curve. We venture to suggest that there are few persons who cannot obtain for us copies of some old records which we do not possess. The more complete our collection the more rigorous will be the test, and the sooner we obtain the records the sooner will certainly replace the probable accuracy of the earlier portion of the table, as to the latter seventy years of which we think that no doubt can now remain.

ALTITUDE ABOVE SEA LEVEL.

IN accordance with the suggestion in our last annual, we have devoted considerable attention to the verification and rectification of the altitudes of the whole of the stations whence reports are given in the general tables. As, however, there is much misconception as to what is meant by the Ordnance datum of "Mean Sea Level," we will, in the first place, explain the term.

As illustrations of the prevalent confusion, we may mention that we have had at least twenty notes enquiring whether Ordnance datum was high or low water, spring, or neap tides, &c.; and what is even more remarkable, we have, on two occasions, had returns from engineers giving altitudes above "Trinity Mean Sea Level," a datum which we shall presently show has no existence. The annexed diagram,

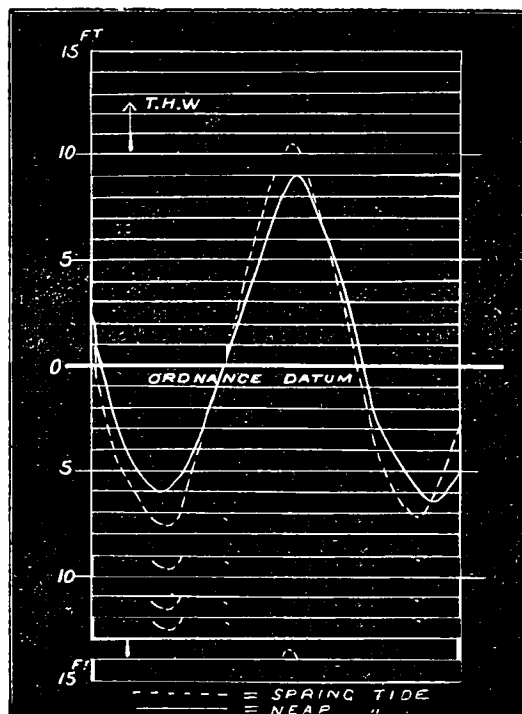


Fig. 10.

showing actual tides in the river Thames, will enable us to clear up all difficulties. Everybody knows that the sole difference between spring tides and neap tides is, that the range of the former is greater than that of the latter—*e. g.*, in the diagram the spring tide rose 1 ft. 6 in. higher than the neap, but as it also fell 1 ft. 6 in. lower, the *mean level* was the same, as can be verified by measuring off the two curves. They will be found to agree in giving the mean level of the Thames as 1 ft. 6 in. above Ordnance datum, which is the *mean level of the sea at Liverpool*.

The present confusion has arisen from two causes—

(1). Before the Ordnance levels were taken, the principal, if not the only datum was that known as Trinity High Water, which consisted of a series of marks along the banks of the Thames, recording the highest points reached by extraordinary tides. They differ considerably among themselves, but may be taken as $12\frac{1}{2}$ ft. above Ordnance datum, and are so represented on the diagram by the arrowhead and letters T H W. From this explanation it will be evident, that the term “Trinity Mean Sea Level” is a jumble of “Trinity High Water” and “Ordnance Mean Sea Level.”

(2). Unfortunately, there is yet another datum, but as it is mainly confined to the Admiralty charts, it does little harm except at stations near the coast. These charts give the height of localities on shore in “feet above high water,” not stating whether spring, ordinary, or neap tides.

Having explained the datum, we proceed to describe the extent to which the levelling has been completed, and to which it is available to the public.

A series of initial levels were run along a network of the principal turnpike roads throughout the country, bench marks ∇ being cut on milestones, gateposts, churches, and other permanent objects along these roads. From these initial lines subsidiary ones and contours have been completed in certain counties, and are in rapid progress in others, so that in the course of a few years there will not be an acre of land in the country, the altitude of which above the one universal datum will be unknown. All Ireland, the northern counties of England and the southern parts of Scotland, are thus favoured; other parts are in progress.

A large and increasing portion of this information is already published in different forms. The heights of all the marks along the initial lines of levelling are published in handsome quarto volumes. In those districts of which maps on the scale of six inches to the mile

are published, the height of each bench mark is given, as well as contour lines; and latterly a considerable number of altitudes are being marked on the ordinary one-inch Ordnance maps.

Lastly, we ought not to pass without thankful recognition, the fact that we never heard of any person who required information on this point, and applied to the Director of the Ordnance Survey (Col. Sir H. James, R.E., F.R.S.), at Southampton, without receiving the best information in the possession of the department.

It has been our duty and pleasure to hunt up for our observers the published information, and where that was insufficient to obtain it from the department; of course, in the case of extensive requirements, paying a small sum for the time occupied in extracting the levels.

There are, however, still many places of which the levels have not been taken; these require far more time to compute, and have seriously interrupted some branches of more strictly rainfall work. But the altitude of the place of observation is as thoroughly an integral part of the measurement of rainfall as the height of the gauge above the ground, and therefore time and care devoted to the subject are wisely appropriated.

From the commencement of our publications we have endeavoured to distinguish estimated altitudes from those accurately determined, by attaching our mark of uncertainty to all those entries which we *knew* to be estimates. We are confident, however, that many returns were only estimates (shall we say guesses) which have not had the query appended.

This year many of our observers have kindly informed us how their altitudes have been determined, and we are therefore able to make some progress with the classification, and to indicate the reliance due to each of those who have given the information for which we asked. In the column of altitudes in the general tables the following marks will be noticed— ∇ , T, L, B, and ?, while some figures have no letter following them; we proceed to explain what is indicated by each symbol.

The ∇ (or Ordnance bench mark) indicates that the height of the mouth of the rain gauge has been ascertained by spirit levelling from the nearest Ordnance mark, and therefore that the altitude is certainly correct within one foot.

The T indicates that the height is that above Ordnance datum, as ascertained from some proximate bench mark or contour line, either by estimate, or by aneroid barometer; the uncertainty in this case is probably very slight, but of course it is not nearly so satisfactory as the preceding.

L (for levelling) indicates that the height has been determined by a spirit level, but not necessarily connected either directly or indirectly with Ordnance datum—*e. g.*, “Levelled from the railway station, the height of which is known.”

B (for barometer) indicates that the altitude has been determined by barometric observations, either (1) at the station and at the sea side ; (2) at the station and some distant Ordnance bench mark ; or (3) in connection with an extensive system of simultaneous observations, such as that carried out during ten days in 1867.

The ? denotes an estimate ; and the absence of any of these symbols that the observer has not stated on what his return is based.

We have indicated our opinion of the relative value of spirit and barometric levelling by placing the former at the head of the list, but for those districts of which the levels are untaken the barometric process is alone available.

An inspection of the general tables will show that there are still a great many stations of which the height is uncertain or unknown. Many new stations have been started since the spring of 1867, and, owing to the increasing desire to possess trustworthy barometers, and to the lower price at which they may be purchased, many stations can now participate in the advantages of the scheme if an opportunity were offered. We think that it would be desirable to repeat the arrangements made in 1867, and though it throws much extra work on our hands, we are quite ready to undertake it, and will do so if not less than fifty observers intimate their intention of co-operating.

In order that our readers may judge of the accuracy, requirements, and trouble involved in participation in this work, we print one of the 1867 returns as a specimen of what we should require in 1871 :—

BAROMETRIC LEVELLING, 1867.

Return from *Bromsgrove*, County of *Worcester*. Nearest Church is (A) *Bromsgrove*, about half a mile. Altitude above sea level (Liverpool) of cistern of barometer, 285 feet, as was determined by (B) *Ordnance survey* to within a short distance thence by a practical surveyor. Barometer is (c) a standard, with brass scale, made by *Negretti and Zambra* in the year 1855; price was; tube is 0·43 inch diameter. Index error as determined by (D) *Mr. Glaisher, Lewisham*, is —·008 in., and capillarity correction + ·006 in., the total correction being —·002 in.

READING OF BAROMETER UNCORRECTED.

	9 a.m.		3 p.m.		9 p.m.	
	Baro- meter.	Att. Ther.	Baro- meter.	Att. Ther.	Baro- meter.	Att. Ther.
1867.	in.	deg.	in.	deg.	in.	deg.
May 24th...	29·944	50	29·906	51	29·904	51
„ 25th...	29·844	50	29·678	52	29·656	52
„ 26th...	29·396	52	29·346	56	29·336	58
„ 27th...	29·296	58	29·360	60	29·408	59
„ 28th...	29·460	59	29·520	60	29·564	60
„ 29th...	29·714	60	29·734	66	29·644	66
„ 30th...	29·756	65	29·826	70	29·850	66
„ 31st...	29·900	63	29·884	67	29·888	66
June 1st...	29·866	64	29·882	65	29·884	66
„ 2nd...	29·810	66	29·748	65	29·762	66
Mean...	29·698	58·7	29·688	61·2	29·689	61·0
Cor. for in- dex error	—·002	...	—·002	...	—·002	...
Correct. for tempt. ...	29·696	...	29·686	...	29·687	...
	—·081	...	—·087	...	—·086	...
Correct. for 285 ft. ...	29·615	...	29·599	...	29·601	...
	+·314	...	+·314	...	+·314	...
	29·929	...	29·913	...	29·915	...

NOTE.—These spaces were not provided on the 1867 returns; for facility of working they will be added to the new ones, but it is not desired that the observers should all work them out.

REMARKS—

(Signed), *Geo. Dipple*.

(A) This distance and bearing of nearest Church, *e.g.*, “Uckfield Church, half mile, N.W.,” may facilitate the determination of true height by Ordnance Levelling.

(B) If altitude is known, state fully how ascertained.

(C) Describe form of barometer, whether scale is entirely of brass or otherwise.

(D) State where error was determined, if at Greenwich, Kew, or where.

It is requested that when filled this form may be sent to G. J. SYMONS, Esq., 62, Camden Square, London, N.W.

In barometric levelling we have mainly to deal with two unknown quantities—(1) that which is the special object of investigation, viz., altitude above mean sea level; (2) the index errors of the various barometers.

Observers who fill up the forms are of two classes—those who (like our excellent correspondent whose return we have printed as a specimen) are already in possession of the altitude and index error of their barometers, and therefore *give* information, and those who *receive* it.

It is evident that those who neither know the altitude nor the error of their barometers, cannot participate in the benefits of the arrangement. If they know *either* the altitude *or* the error, we shall be able to supply whichever is required; if they know both, they will have the satisfactory consciousness that through their instrumentality *alone* can the other observers be benefitted.

One word, in conclusion, to bring this proposal to a definite shape. All who wish to participate in the benefits of this scheme, and those who are willing to assist in its realization, are requested to intimate the same to the Editor as soon as practicable, and not later than April 25th. Provided (as before stated) that not less than fifty such intimations are received, printed forms will be prepared and sent to each observer on or before May 20th; the observations are to be taken from May 24th to June 2nd, and the forms returned on or before June 7th.

ON THE RAINFALL OF CERTAIN DISTRICTS.

DARTMOOR.

SOME years ago a town was to be supplied with water, extensive works were designed, parliamentary powers obtained, the works finished, and when they were to be inaugurated there had been such a drought that there was no water to fill the reservoir or to supply the town. But in spite of this apparent failure, those works after once getting in operation have been quite a success.

Somewhat similar has been our fate as regards Dartmoor; for the first year of our systematic attempt at recording its large rainfall, the drought has been almost unparalleled, the total amount being, we believe, less than two-thirds of the average. We rejoice that it has so happened, since the registration of the minimum is at least equally important with that of the maximum.

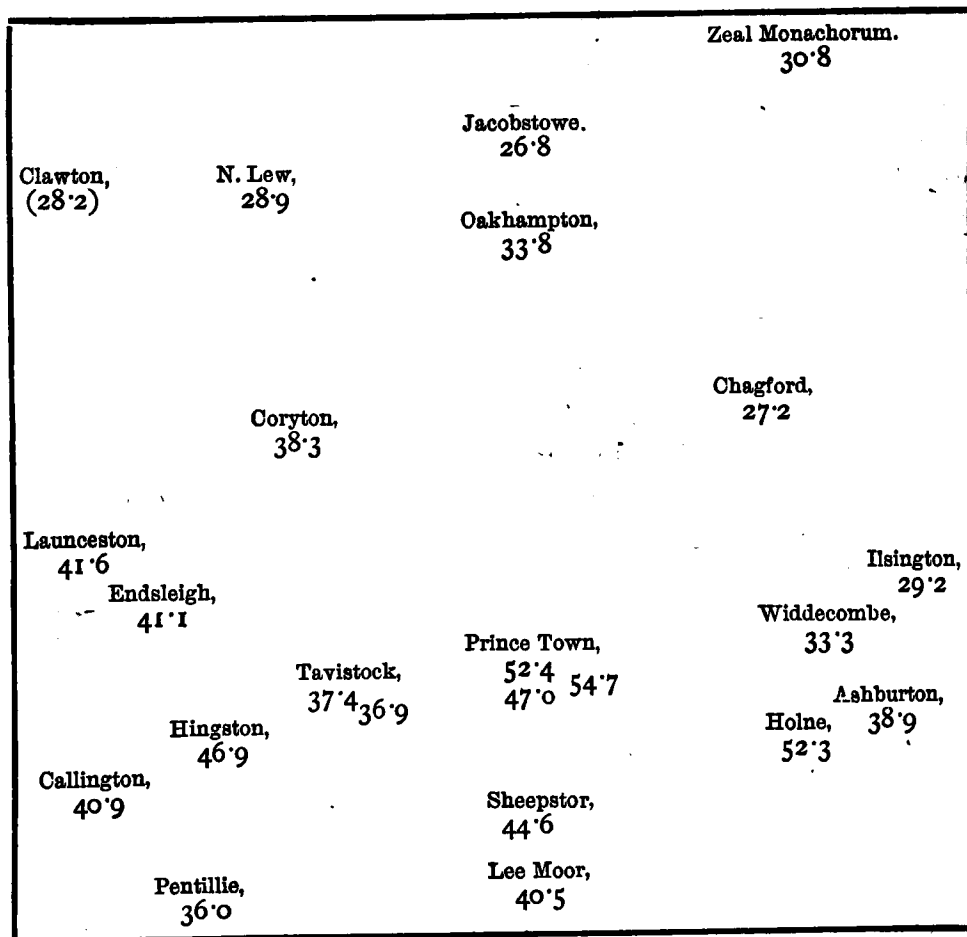
Having already stated the remarkable fact that the fall at the old (and therefore probably at all) stations on the Moor was less than two-thirds of the average, we may supplement it by pointing out that the lowest amount previously recorded by a trustworthy gauge at the Prison Reservoir at Prince Town was 56·26 in 1864, last year it was 46·95, or 9·31 inches below any previous record. As this gauge is becoming rather sheltered by bushes, it *may* read less than formerly, when more exposed, but considering the locality and character of the climate, it does not seem probable. But this will not account for more than an inch or an inch and a half out of 9·31. Therefore, we are quite safe in saying that at Prince Town the fall in 1870 was eight inches below any previous record.

At Lee Moor also, 1864 had the least rainfall of any year on record, viz., 47·22, but in 1870 it was only 40·49, or 6·73 inches below any previous record.

Lastly, if we take the mean rainfall for these two stations as given in our last, we obtain the following results :—

	Prince Town Prison Reservoir.			Lee Moor.		
	Depth	Ratio		Depth.	Ratio.	
Mean	80·18	...	100·0	65·69	..	100·0
1864	56·26	...	70·2	47·22	...	72·1
1865	46·95	...	58·6	40·49	...	61·7

DIAGRAM OF RAINFALL ON DARTMOOR.



The wide difference between adjacent stations, though partly arising from proximate hills, &c., is generally due to their different altitudes, *e.g.*, taking the correction at 4 per cent. per 100 feet—

Callington, 490 feet=40.9 inches.

Hingston, 850 feet=46.9 ,,

then the difference of height, 360 feet, gives a correction of 5.89 in. against 6.00 in., the observed difference.

NOTE.—The amount at Clawton is entered in parenthesis because the gauge was not supplied till after January 1st, and therefore part of the amount has been differentiated from surrounding stations.

The agreement thus shown is very satisfactory ; it would become perfect, if an additive correction (on account of the bushes) of $2\frac{1}{2}$ inches were applied to the Prison Reservoir gauge. But whether this correction be agreed to or not, is immaterial for our present purpose, which is to ascertain approximately the relation of the rainfall of 1870 upon Dartmoor, to the average of a series of years. It is evident that there was a deficiency of nearly, if not quite, 40 per cent. Here, incidentally, we are brought face to face with a problem we have not ourselves yet had time to attack. It has been stated (and as a rule seems generally true) that in England the departure from the mean of a long series of years is limited to one-third, whether in excess or defect, so that the fall in the wettest year is twice that in the driest (mean 100, min. 66, max. 133). If this is the case, what is the explanation of the Dartmoor stations exceeding the ordinary fluctuation in the proportion of 40 to 33? Leaving this question for future examination, we proceed to offer a few remarks on the returns for 1870, which we have tabulated in the annexed diagram.

The first thing which strikes anyone is the blank central tract, in the very midst of which is Cranmere Pool, to which attention was directed last year. Surely the Devonians will contrive to secure observations from near that spot.

The second feature is the extremely small amounts registered on the N. and E. sides of the Moor ; a considerable decrease was to be expected, but scarcely so much as is shown.

It is satisfactory to be able to report that with the exception of the gauge at the Powder Mills (No. 25 on the map), concerning which we can get no information, all our gauges are carefully observed, and one new one has been added at the north-east corner, viz., Zeal Monachorum.

DERBYSHIRE.

From 1866 onwards we have urged again and again the desirability of starting additional gauges in the vicinity of the Peak, but with no result. Through the assistance of Mr. Davis, of Derby, some new gauges were started in what may be called the lowlands of Derbyshire, but, excepting Mr. Sykes, of Buxton, who started a gauge on Axe Edge, in 1868, there was no response to our suggestion of additional gauges in the higher districts. Last autumn we devoted a week or so to the matter ourselves, and through the assistance of Mr. Haslewood, of Castleton, a very satisfactory commencement has been made. One gauge had previously been at work (unknown to us) at Castleton, others have been started at Edale Vicarage, at Bamford, 480 feet above sea, at

Burbage Quarries (near Sheffield), at the Hall, Castleton (600 feet), and one near the summit of Mam Tor (1680 feet), a mile and a half from Castleton, and rather more than a thousand feet above it. This gauge Mr. Haslewood has kindly undertaken personally to observe. It will be useful for comparison with that on Axe Edge.

Another gauge has been started near Buxton by Mr. Sykes, on the northern side of Grin Hill, near the entrance to Poole's Hole. Owing to its position on the lee side of the hill, the amount collected by this gauge will probably considerably exceed that registered at the Devonshire Hospital on the other side of the town.

Having made such considerable progress, we shall not rest until it is completed by four or five more gauges, some to the north and some to the south of the Castleton series. Those to the north should be (1) near the source of the Sett at Kinder Downfall, (2) near the head of Fairbrook or Blackdean brook, (3) at Derwent Chapel. Those to the south at or near (4) Tideswell, (5) Taddington, Moneyash, or Hartington. We hope that the cost and trouble of providing these will not fall to our share, but if so, so let it be.

CUMBERLAND.

The returns from the Eastern Lake District for 1870 are very complete, but Mr. Fletcher's return for the Western District has not yet reached us. At our joint station at Seathwaite, a new observer has been selected instead of Mrs. Dixon, deceased. There seems every reason to hope that the records will be correctly kept. Both the observers have temporarily left Langdale, one in the autumn, the other left Brigg Howes in December; this record has been completed by computation from Grasmere and other stations, and will be found in our new list of completed returns. Wet Sleddale will be seen still to justify its name, the fall being the only English one (except the Seathwaite group) exceeding one hundred inches.

ON THE BORDERS.

Our readers will join us in regretting that, at present, the efforts of the Tyneside Naturalists' Club to secure observations up the North Tyne and on the Cheviots have been unsuccessful; we have not even one new return from them, but, as Mr. Wheeler has now taken it into his own hands, we hope for better things in future. Over the borders the report is the same, with a difference; the observations have been made, but are not to be published without the consent of the Edinburgh Water Trust.

It is not for us to question the wisdom of this decision, but if it were worth while, and we had a few hours' leisure, we should be strongly tempted to compute the fall at the localities of these gauges and publish the results, leaving it to the owners of the gauges to demolish our calculations by their observations if they desired, and were able, to do so.

Of course we should like to have been able to publish the returns, but if our readers will refer to the map of the Border Counties in our last annual (p. 52) they will see that the district in which these new gauges are placed is hemmed in on all sides by stations of which the returns are given in our general tables.

WALES.

We think that the Principality is progressing in rainfall matters. The Cardiff Naturalists' Club are stirring in the south. Two or three important new stations have been started in Central Wales in addition to those the re-erection of which we announced last year, and close to Snowdon two additional returns will be received in future ; one, from Mr. Wyatt, of Bryn Gwynant, Beddgelert, we have the pleasure of inserting this year, the other, from a gauge at Pen-y-gwyrdd, is incomplete for 1870, but as it had 45 inches in three months our readers may anticipate that it will even exceed that from Bryn Gwynant, which is 101·58 for 1870.

On the whole, we believe that the additional stations nearly double the lost ones, which sufficiently indicates progress ; there is, however, one place where observations *must* be resumed, and that is Bettws-y-coed.

ROSS-SHIRE AND SKYE.

Having devoted considerable space to this district last year, there is the less necessity to say more than a few words on the present occasion. All the new gauges announced in our last have been regularly observed, excepting that in Glen Sligachan, which was not in operation until a few days of the year had passed. The proportional quantity due to those days has been computed from various sources, and the yearly return thereby completed.

It is most desirable that a new gauge should be started at Shiel House, Kintail, and any one who can do this will render valuable service.

O B I T U A R Y.

WE have endeavoured to render the following sad list yield even a little more information than in previous years, by adding the symbols **C** and **T** (Commenced and Terminated) to the period of observation in all cases in which we are sure of their correctness.

Although the number of observers is not so great as might have been expected, their loss is, from various reasons, unusually important.

To mention some: the death of Captain Brown, of Hay, and the cessation of his register, leaves a large and important district without an observer. A similar remark applies to Mr. Lamont and to Mr. L'Estrange, of Owendoon. Then Mr. Fox, of Morley, has been cut off before fulfilling his promise of sending copy of his observations prior to 1862. Lastly, we sadly fear that, through the decease of Admiral Wilson, the Troutbeck observations (which have been so regular and so good as to serve as a standard of reference for the Southern Lake District) may be terminated. We are indebted to a member of his family for continuing the record up to the end of 1870, although we are cautioned not to rely upon its permanency. In several other cases we are glad to find that the records will probably be uninterrupted.

	Period of Observation.
Abel, Rev. J., Manse of Forgue, Aberdeen	C 1870 imp
Bigg, E. S., Esq., The Hyde, Crawley, Sussex	C 1856—65 T
Brown, Captain, Pen-y-maes, Hay, Brecon	C 1860—69 T
Bunch, Rev. R. J., Emmanuel Rectory, Loughborough	C 1861—67
Clark, Sir J., Bart., M.D., F.R.S., Bagshot Park, Surrey.....	C 1864—69
Colquhoun, J. C., Esq., Chartwell, Westerham, Surrey.. ..	C 1862—69
Devas, W., Esq., Woodside, Old Windsor	C 1866—69 T
Dixon, Mrs., Seathwaite, Borrowdale, Keswick	C 1845—69
Fox, Rev. S., Morley, Derby	(C 1847—61) 1862—69
Hambly, F. B., Esq., Treharrock House, Wadebridge, Cornwall	C 1853—69
Laidlaw, Mr., Auldearn, Nairn	C 1870 imp T
Lamont, Rev. J., Manse of Waternish, Portree, Skye.....	C 1866—67 T
L'Estrange, G. H., Esq., Owendoon, Bawnboy, Ireland.....	C 1864—69 T
Rippingale, Mr., Hunstanton, Norfolk	C 1856—69
Strangman, T. H., Rathculliheen, Waterford	C 1859—67 T
Voss, W., Esq., West Bucknowle, Corfe Castle, Dorset	C 1848—69
Wilson, Admiral, The Howe, Troutbeck, Westmoreland	C 1842—69

RAINFALL AND METEOROLOGY
OF
1870.

ON THE METEOROLOGY OF 1870,
WITH NOTES OF SOME OF THE PRINCIPAL PHENOMENA.

[These Notes should be read in conjunction with those on Heavy Falls in 1870,
on page 94.]

JANUARY.

2nd.—Aurora seen at Manchester.

3rd.—Fine aurora in the evening seen at most stations.

4th.—Fresh wind in midland counties, with thunder at Chesterfield and thunder, lightning, and hail at Monkmoor, near Shrewsbury, and at Shiffnal and other places in Shropshire, about 2 p.m.

7th.—Thunder in Hampshire and gale in the west of Ireland.

8th.—Heavy S.W. gale in the west of England in the early morning,* extremely violent in Radnorshire between 2 and 5 a.m., passing over the midland counties of England about noon. Hail fell in Hampshire at 3 a.m.

10th.—Heavy hail shower in N. Wales shortly before noon.

11th.—Sheet lightning at Carrickfergus.

12th.—Thunderstorm in Hampshire at 5 a.m.; sheet lightning at Carrickfergus and in Dorset.

19th.—Slight shock of earthquake at Marseilles at 3 a.m.

23rd.—Remarkably fine solar halos in Aberdeenshire.

28th.—Lake Windermere reported to be so frozen over that the steamers were unable to ply. This had not occurred previously since 1854. Rydal Water, Grasmere, and Derwent Water were frozen and afforded excellent skating.

30th.—A heavy cyclonic gale with rain reported from Dublin, commencing at S.S.E. and veering to W. at 8 p.m. on 31st.

FEBRUARY.

1st.—Very fine auroral arch from 7 to 10 p.m. Gale at Sandwick.

6th.—Tremendous gale in Caithness. Part of the breakwater at

* In Carmarthenshire, the greatest force seems to have been from the N.

Wick washed away and damage done to the estimated extent of £10,000. In Dorset, heavy gale with rain for thirty-six hours.

8th.—Frost and heavy snow began in the evening with high wind.

10th.—Pale aurora seen at Cambridge.

11th.—At Maresfield, Sussex, tremendous gale lasting to 15th, and blowing without intermission for 105 hours. Aurora at 7.30 p.m.

13th to 15th.—Bitterly cold N.E. gales, with hard frost and much snow.

26th.—Snowstorm in many parts of Scotland.

28th.—Gales in Dorsetshire and in the North of Ireland.

MARCH.

2nd.—Aurora seen at Winchmore Hill.

3rd.—Very high wind at night, especially on East coast.

9th.—Tremendous storm with excessive rain at Buenos Ayres; damage estimated at £100,000 to £130,000; not less than twenty persons drowned.

12th.—Snow in many parts of England.

13th.—In Sussex about 8 inches of snow fell between 4 and 10 a.m. A deep red aurora was seen in the evening from many stations.

15th.—Snow fell in North Yorkshire to a depth of more than 3 inches in the course of four hours.

18th.—Shock of earthquake at Durban, Natal at 1.40 p.m.

22nd.—At Winchmore Hill aurora very fine, and continued from 9 p.m. to midnight; snow in Nairnshire; in Ballinasloe sudden fall of 10° in temp., from 51° to 41°, between 9 a.m. and 9.30 a.m.

APRIL.

Aurora at Sandwick or other stations on 2nd, 5th, 16th, 18th, 19th, 21st and 28th.

9th.—Thunderstorm in Somersetshire and at Halifax (Yorks.) at 4.30 p.m., doing considerable damage.

10th.—Thunderstorm at Winchmore Hill, with hail and snow at 2 p.m.; thunder at Hillington at 4.50 p.m.

19th to 21st.—A hot period, vegetation advancing rapidly.

22nd.—Gale in Scotland, especially on the West coast.

28th.—Snow at Winchmore Hill.

MAY.

1st.—Dunmow, thunder at 7.15 p.m.; Middlesborough, thunder and lightning; Winchmore Hill, hail; N.E. gale in Scotland, very cold.

2nd.—Winchmore Hill, hail and snow ; Dartmoor, flakes of snow.

11th.—Plymouth, distant thunder all day.

12th.—Bath, violent hailstorm.

21st.—Forest Lodge, temp. in shade varied from $80^{\circ}3$ to $43^{\circ}9$, and the next day stood at $82^{\circ}2$; Winchmore Hill, almost incessant lightning in S. and S.E. from 11 p.m. on 21st to 1 a.m. on 22nd ; East Kent, violent thunderstorm ; a house at Ramsgate seriously injured by lightning.

22nd.—Norwood Cottage, sun's disc visible through a thin covering of cloud ; Ballinasloe, curious appearance of sun through red clouds.

26th.—Druid Ashburton, a very bright light over the sea.

28th.—Bright aurora in early morning.

JUNE.

16th and 17th.—Violent thunderstorms throughout the country.

21st and 22nd.—Very hot days at many stations, the hottest in the year.

JULY.

Frequent thunderstorms during the first week.

7th.—Allithwaite, very slight shower here, but two miles distant very heavy rain, accompanied by a whirlwind or hurricane blowing off the tops of the hayricks and the sand off the shore.

8th.—Ham, thunder ; Druid, thunderstorm at 10.15 p.m.

9th.—Ludlow, the rainfall on this day was the heaviest in twenty-four hours during five years ; from 3.45 to 5.30 p.m. the fall was 2.15 in. Kirkby Stephen, the whole of the rain registered on this day (1.50) fell between 11.30 a.m. and 1 p.m. ; the river Eden rose 3 ft. in twenty minutes, and subsided very rapidly, after doing much damage.

11th.—Wimbledon, violent thunderstorm with very heavy rain ; Dorking (West Street), exactly 1.00 in. fell in an hour and .77 in. in thirty-five minutes ; Blackstock (Midmar), rain to the depth of 1.76 in. fell in about three hours during a thunderstorm ; the rain continued to fall for the time mentioned, but it is my opinion that the greater portion of it fell in twenty or thirty minutes ; the rain came down one of my fields in one continuous sheet of water. Coldstone, thunderstorm with heavy rain ; Allan Vale (Pitmuxton), 1.34 in. fell during a thunderstorm between 2 and 4 p.m.

12th.—Montrose, at noon sky to N. and W. quite black with

thunder cloud ; then vivid flashes of lightning and loud peals of thunder, which continued to 3 p.m.

15th and 16th.—Thunderstorms in many parts of Scotland ; three people killed near Arbroath.

22nd to 31st.—Very hot period, with occasional thunderstorms, during one of which (on 26th) 3·00 in. of rain fell at Lynch, near Midhurst, in Sussex.

AUGUST.

During the first half of the month thunderstorms were very general. We extract only those notes which refer to some special detail.

2nd.—During a storm at Braemar 2·10 in. of rain fell in forty-five minutes.

8th.—At Lynch, Sussex, 2·09 in. fell during a thunderstorm ; and on the same day, about noon, a very local one passed over Salisbury Plain, which only lasted half-an-hour, but was accompanied by a violent N.E. wind, which blew down trees, &c.

10th.—A waterspout passed about ten miles south of Bushy Hill, Cambuslang, Lanarkshire.

11th.—A farmer was killed by lightning at Welton, in Cumberland.

18th.—A farm-house, near Winchester, struck and burnt down.

19th.—About noon a sudden rise of the tide at Ramsgate, causing much inconvenience, and destroying several bathing machines.

20th, 21st and 22nd.—Auroræ seen at various stations.

SEPTEMBER.

1st.—Dublin (Fitzwilliam Square, W.), a cyclone (S.S.W. to N.W.) wind veered rapidly to N.W. at 10.45 p.m., with heavy rain (·72 in. in six hours).

3rd.—Falconhurst (Edenbridge), thunderstorm ; Bushy Hill, aurora ; Camden Town, thunder.

6th.—Aberdeen, thunder.

7th.—East Linton, the heaviest shower of rain fell that has been observed here during fifteen years—1·00 in. having fallen between 2·20 and 2·40 p.m. ; Aberdeen, thunder. Great floods near Tongue.

9th.—Norwood Cottage, heavy S.W. wind, with rain charged with sea-water, which blackened the foliage ; the decay of leaves commenced after this storm. Moneydig, a very heavy gale, quite unusual at this season.

10th.—Dunmow, high S.W. wind ; gale at Camden Town from N.W.

24th and 25th.—Fine auroræ.

OCTOBER.

Frequent auroræ, observed at one or more stations on the 6th, 13th, 14th, 15th, and 20th ; and extremely brilliant on 24th and 25th.

7th and 8th.—Very heavy rains, especially in Lancashire and Yorkshire.

9th.—Snow on Cumberland mountains.

12th.—Violent gale, especially in the Irish Channel.

13th.—Gale continues.

19th.—Violent squall passed across the southern part of England between 9 a.m. and 3 p.m., accompanied by hail, thunder at one or two stations, and very heavy rain.

NOVEMBER.

9th.—Fog in London, aurora at night.

10th.—Thunderstorms with snow at several stations.

22nd.—Thunderstorms very general in the evening, with hail and short heavy rain.

DECEMBER.

18th.—Heavy rains in several parts of Wales.

22nd.—Sharp frost, becoming more severe on 24th ; very low temperatures to the end of the year.

OBSERVERS' NOTES OF THE YEAR 1870.

ENGLAND.

DIVISION I.—MIDDLESEX.

TEDDINGTON.—The greatest fall of the year was of snow on March 12, *i. e.*, if the measurement be correct. I was from home, but am assured by several persons that the average depth was 10 inches. I do not find the formula (2 inches of snow = $\cdot 17$ rain) borne out by measurement and melting. It may be correct as an average, but with a low temperature 2 inches of snow scarcely yielded $\cdot 12$ when melted; the colder the weather the lighter the snow lies, and, of course, the less it yields per inch in melting.

ST. MARY'S ROAD, ISLINGTON.—My return for 1869 was less by about 2 inches than those from Dr. Ballard and Mr. Kesteven. I can only account for it by the growth of trees on the S.W. side of the gauge. I contemplate moving it to a position where it will be more open to the S.W., although more sheltered on the E.

HADHAM HOUSE, UPPER CLAPTON.—On 63 days, in 1870, the rain water manifested an acid reaction.

HAREFIELD PARK, UXBRIDGE.—We had 152 days of E. wind during the year; our temperature for the whole year has been 1° below the average. The highest temperature during the year marked by a Negretti's register thermometer, was 80° on the 25th of July, and the lowest was 10° on the 24th of December.

DIVISION II.—SOUTH EASTERN COUNTIES.

TANFIELD LODGE, CROYDON.—The gauge now stands on the grass, free from any obstruction, having been moved on the 24th of October, 1870, from another part of the garden, where it was thought that a *Wellingtonia* and a walnut tree on the S.W. and S. might interfere with it; the ground in the old position was one or two inches higher than at present.

LINTON PARK, STAPLEHURST.—A fine dry spring after a mild winter; summer dry, but not so hot as 1868; autumn, on the whole, fine; but December a wintry month, the thermometer falling lower than it had done for fifteen years, excepting January, 1867.

BROGDALE.—Required, a better system of taking snow water; after the first fall, should a partial thaw come, and then some more snow, how is this last to be noted?

PARKSIDE, BECKENHAM.—A very dry year and the third dry summer in succession ; no day on which 1 inch fell and only seven on which $\cdot 50$ and upwards fell ; excessively dry from March 26th to July 1st, only $1\cdot 530$ fell on twelve days in that period (96 days) ; a very calm year throughout, only three great gales, viz. 8th January, 13th February, and 12th and 13th of October ; max. pressure on square foot 27 lbs. on 8th of January ; a large proportion of low temperatures, only four months above the average of fifty years, viz. January, April, June, and July ; barometer generally unusually high till 7th of October, when the long-continued drought may be said to have ended : it never reached any extraordinarily high point, but was continually high from 15th of September to 6th of October, and during this time very remarkably steady from the 18th to the 25th of September, the extreme range during these eight days being no more than $\cdot 066$ in.

ELTHAM GREEN.—Total fall from the 27th of March to the 24th of July (120 days) only $2\cdot 05$ inches ; from the 1st of January to the 30th of June, only $5\cdot 30$ inches fell ; and from the 30th of June to the end of the year, 13 inches.

FOREST LODGE, MARESFIELD.—The amount of rain registered is $6\cdot 53$ in. below the average of the preceding fourteen years. April, May, June, and August were notably distinguished for drought, many wells running dry here during the latter part of this period. Several fine displays of the aurora were visible during the year, and I had an admirable view of the zodiacal light on the 3rd of March.

BRIGHTON (BUCKINGHAM PLACE).—The chief feature in the rainfall of 1870 was a greater prevalence of heavy showers. Maximum temperature, $81^{\circ} 3$ on July 24 ; minimum, $18^{\circ} 0$ on December 23, 24, and 30 ; adopted mean temperature, $48^{\circ} 2$; mean daily range, $11^{\circ} 8$; minimum reading of radiation thermometer on grass, $39^{\circ} 5$; minimum reading, $11^{\circ} 3$ on December 27 ; mean proportion of cloud, $5\cdot 6$.

BISHOPS WALTHAM, SWANMORE HOUSE.—This place is on the slope of the Hampshire South Downs ; many of the south-westerly showers and storms come within a mile or two of this high ground, and then stop, go back, or break off right and left.

OTTERBOURNE.—Many wells still dry at the end of the year.

SHERBORNE ST. JOHN.—Five months' drought from the 22nd of March to the 22nd of August, only $3\cdot 35$ in. of rain falling.

BASINGSTOKE, WOTE STREET.—The rainfall is about 11 in. below the average. April was a remarkably dry month, rain only $0\cdot 37$ in. on three days. June and July also very dry, only three days' rain in the former and seven in the latter. On the 16th of June a rapid storm

occurred, .16 in. falling in seven minutes ; and another on July 13th, when 0.23 in. fell in fifteen minutes.

DIVISION III.—SOUTH MIDLAND COUNTIES.

ETON COLLEGE.—Amount of snow during the year = 2.12 in., a large proportion of the whole fall (18.99 in.)

CHOLESBURY RECTORY.—Greatest falls in the year were 1.15 in. on July 31st and 1.23 in. on 1st of August, the former falling in forty minutes and the latter in an hour.

BROUGHTON, NEAR BANBURY.—We have had 6.08 in. less rain than in 1869.

THORPELANDS.—In November the rain had only penetrated a few inches into the soil, and the springs had not increased in volume at the end of the year.

WARESLEY.—Rain has been measured here eight years, during which time the mean annual fall has been 21.735 in., mean number of days 127.33 ; max. daily fall 1.70 in. May 10, 1867 ; max. monthly fall 5.87 in October, 1865.

AMPTHILL.—The first six days of October produced 0.10 in. from the fogs then prevailing.

CARDINGTON.—The following table shows the monthly amount of rain fallen at Cardington in 1870 ; the monthly average fall during twenty-five years ; and the difference of 1870 above or below the average. The sign signifies above and — below the average. Also the number of days in each month on which 0.01 in. or more rain fell in 1870 ; the average during twenty-five years ; and the difference above or below the average :—

	Amount.			Days on which .01 or more fell.		
	1870.	Average of 25 years.	Above or below the average.	1870.	Average of 25 years.	Difference.
	in.	in.	in.			
January	0.640	1.809	—1.169	11	14	— 3
February.....	0.970	1.183	—0.213	12	12	= 0
March	1.520	1.416	+0.104	15	13	+ 2
April	0.450	1.530	—1.080	6	13	— 7
May	0.580	1.815	—1.235	4	12	— 8
June...	0.960	1.906	—0.946	5	12	— 7
July	1.510	2.067	—0.557	6	11	— 5
Aug 1st	1.400	2.322	—0.922	6	13	— 7
September	0.740	1.903	—1.163	8	11	— 3
October	2.430	2.509	—0.079	18	15	+ 3
November	0.910	1.578	—0.668	9	12	— 3
December	2.760	1.546	+1.214	16	14	+ 2
Totals	14.870	21.584	—6.714	116	152	— 36

ABINGTON PIGOTTS.—The deficiency in the rainfall here, for this year, is 5·42 in. The driest period of the year was from the 14th of September to the 3rd of October inclusive, during which time no rain fell, and the wettest time Dec. 8th to 20th. Harvest early and well got in ; great scarcity of hay. Greatest force of wind 12th, 13th and 14th of February ; the pressure for the twenty-four hours, ending at 9 a.m. on 14th, averaging 8 lb. on the square foot.

BEECH HOUSE, CAMBRIDGE.—The rainfall of 1870 was 6·61 in. less than the average of seven years.

DIVISION IV.—EASTERN COUNTIES.

AUDLEY END.—Mean of barometer taken at 9 a.m. and 9 p.m., and reduced, = 29·969. Highest reading, 30·638 on the 1st of December ; lowest ditto, 28·859 on the 24th of October. Highest temp., 86°·8 on 22nd of June ; lowest ditto, 4°·8 on 25th of December. Mean daily temp., 6 in. deep, 48°·59 at 9 a.m. ; 12 in. deep, 50°·53 at 9 p.m.

GRUNDISBURGH.—I, as a tenant farmer, hope that we shall not have such another season for some long time. The total rainfall is not so much less than we have had, but more than half fell in three months (March, October, and December). Our root crops are short. Hay and clover not half a crop, and the pasture produced but very little. The last three years have been very unprofitable to many farmers.

BURY ST. EDMUNDS.—We have had a short supply and but few heavy showers, not one of 1·00 and only five above half an inch.

GELDESTON, NEAR BECCLES.—The number of days of rain corresponds exactly with 1869, when the fall was 8 in. greater.

NORWICH INSTITUTION.—The amount of rain registered this year is the least since 1841, except 1863 (16·18 in.) and 1864 (14·62 in.). Total fall (18·87) is 4·72 in. below the mean of the last thirty years.

DIVISION V.—SOUTH WESTERN COUNTIES.

IMBER.—Many wells in this parish were dry from the end of October to the beginning of 1871.

BRIDPORT.—Rainfall about 12 in. below the average of the previous ten years, only 5·20 in. falling in six months, April to September inclusive.

CHALBURY.—The excessive drought of 1870 is best seen by comparing the rainfall and number of wet days with those of the previous five years :—

1865, 32·86 in., 151 days	|	1868, 38·27 in., 156 days
1866, 35·19 in., 198 days	|	1869, 29·29 in., 163 days
1867, 30·84 in., 163 days	|	1870, 23·85 in., 124 days

—nearly 9·40 in. below the average of them. To the heavy fall on the 11th of May (1·02 in.), under God, we are mainly indebted for what hay crops we had.

BURTON, KINGSBRIDGE.—I think the reason this gauge makes the rainfall nearly 4·00 in. under the one at Bolt Tail is, that this one is placed in a valley, while the other is on a mound very much exposed.

JACOBSTOWE.—The storms that pass over Dartmoor do not reach here to any extent. Snow has fallen (to lie on the ground) only on three days during the year, and that in small quantities. The lowest temperature was on the night of the 22nd of December, 14°; the highest in the shade was on the 24th of July, when it stood at 82°.

DART VIEW, TOTNESS.—The past summer has been the driest ever remembered in Totness; great scarcity of water, the town supply only on an hour or so daily, and to private consumers only twice a week. The springs did not break till the latter part of November.

WIDDICOMBE VICARAGE.—My gauge was originally placed on a wall nearly seven feet high. In February it was broken by the frost, and I continued my observations with the present one. The funnel of the old gauge was allowed to remain in a common wine bottle. The difference between the two gauges was considerable, and apparently governed by no conceivable law. The gauge on the wall always marked less, but sometimes only a few hundredths, at other times several hundredths less; after a fall, nearly the same according to the gauge on ground. Perhaps evaporation was the cause of difference.*

ZEAL MONACHORUM.—We have had frost on 99 mornings during the year at 8.30 a.m. Aurora seen several times, especially on the evenings of the 24th and 25th of October.

CLYST ST. GEORGE.—A very large number of wells in this neighbourhood are still (January) dry. I have deepened three of my own.

EXETER INSTITUTION.—This (21·74 in.) is the smallest amount registered here since this institution has been established, with two exceptions—1854 and 1855, when 18·12 in. and 18·92 in. were registered.

BRAMPFORD SPEKE.—The temperature of the year has been below that of 1869 in every month except June and July. The great drought of the summer has made grass very scarce since April, the plants having been almost killed.

BROADHEMBURY.—The driest year I have ever recorded in my

* Or the funnel was not held steadily by the bottle, and then its indications would vary with the wind.—ED.

register, which commenced in the year 1837. The next driest was 1854, when the fall was 24·92 in. The average (thirty years), 1837 to 1866 both included, is 34·49 in. ; 1870, 22·48 in., being 12·01 in. below it.

GREAT TORRINGTON.—Both the fall of rain, and the number of days on which it fell, were considerably below the average. There were fourteen distinct periods of a week or more in which no rain fell; half of the rainfall belongs to the last quarter. But little thunder again this year; only heard seven times, and then at a distance. The year closed with very severe weather, the coldest days being 22nd and 30th of December, when the thermometer did not rise above 30° and 29° respectively. The lowest night temperature was on the 31st, 19°.

ST. SENNEN.—You will observe that there is a greater difference between the rainfall at the Land's End and Penzance, in October and November, than in the other months. I attribute this to the prevalence of high winds at that season, and the very exposed situation of this place.

DIVISION VI.—WEST MIDLAND COUNTIES.

SAUL LODGE.—With the exception of some heavy gales in the early part of January, and the somewhat wild month of October, the atmospheric condition of the year 1870 has been unusually tranquil, the months of July and August were characterised by a very high temperature. The rainfall (20·30 in.) is less by 4 in. than the average of the last twelve years, and is less than in any year except 1858 (19·94 in.) and 1861 (20·16 in.)

PARK HOUSE, GLOUCESTER.—The top of my gauge is 3 ft. 6 in. above ground. I am open to conviction by facts and arguments, but as yet know no reason for altering it. Ground gauges register condensed dew, which does not appear to me to be rainfall.

THE BOYCE COURT.—I have adopted a 5 in. gauge by Burrow, of Malvern, instead of Negretti and Zambra's 8 in. one, as from the shape of the latter the wind drove some of the rain which fell outside the 8 in., into the funnel. Our rainfall in 1870 was 19·80 in. ; in 1869, it was 31·77 in. ; and the average of 1865 to 1869, inclusive, was 27·10 in.

ARCHENFIELD, ROSS.—The least rainfall of any year from 1859 to 1870 inclusive, except 1864 (19·18 in.), which was just 1 in. less. From February 8th to August 21st, 194 days, rainfall only 5·30 in. The smallest quantity previously recorded in six months was April to September inclusive (1864), 7·06 in. ; in 1852, June to November, was probably more than 26 in. ; so that, in 1870, only about a fifth of the maximum fell. The driest month at Ross for twenty years was

September, 1865, .07 in. on two days. Although the drought was not so continuous as in the summer of 1868, it was more protracted.

STRETTON RECTORY.—This (16.77 in.) has been the smallest rainfall recorded during ten years; the next lowest, 1864 (18.65 in.) The greatest fall was in 1869, 30.48 in. The mean of the ten years is 25.214.

WEST LODGE, LEOMINSTER.—The drought has been more felt about here than I ever remember before. There are scarcely any swedes or other turnips, and the hay crop was, I should think, only about a quarter as much as usual.

OAKLANDS, WOLVERHAMPTON.—Rain above half an inch only three times, viz., on August 1st, .52 in.; 27th, .74 in.; and October 30th, .52 in.

BURTON-ON-TRENT.—The past year has been the driest since I began to observe rainfall.

STAUNTON-ON-WYE.—On October 1st the amount (.02 in.) arose from dew only. From the 28th to the 31st of December, snow $1\frac{1}{2}$ in. deep, estimated in account as .12 in.

TAMWORTH.—From March 5th to June 10th, 97 days, the rainfall was only 2.05 in., which fell on 25 days; from July 14th to August 21st, 38 days, the fall was only .26 in. on six days; from the 14th of September to the 6th of October no rain fell. Commenced cutting wheat on 27th of July, finished August 10th; harvest home on 22nd. Hay crop destroyed by the drought, far more so than in 1868.

STRETTON HOUSE, HINCKLEY.—This year's fall is 5.61 in. below the average of the last five years. The greatest fall was again in August, making four times in five years that I have so recorded it.

DIVISION VII.—NORTH MIDLAND COUNTIES.

LEICESTER.—Very dry year, especially the spring months.

WELBECK.—1870 has been another remarkable year for its long-continued dry spring and summer months, the number of rainy days in March, April, May, June, July, and August being only thirty-three in the six months. The annual average rainfall at Welbeck is nearly 25 in. This year it was only 21.58 in. More rain fell in the last four, than in the other eight months. Owing to the want of moisture in the spring and summer months, there was a great failure in the hay and root crops, as well as in some kinds of spring corn; but the wheat on all well-farmed soils was quite an average. The mean temperature of the air at Welbeck for the year was $49^{\circ}5$, being $1\frac{1}{2}^{\circ}$ above the average. Very severe frost set in on the 22nd of December, which

continued with more or less severity to the end of the year ; the temperature here falling to 13° on the 24th ; the ground being well covered with snow, the wheat may be considered safe.

DIVISION VIII.—NORTH WESTERN COUNTIES.

WIGAN WATER WORKS.—We have not had any very heavy falls in twenty-four hours. The 9.95 in. in October fell on twenty-one days, beginning on the 8th and ending on the 31st.

BOLTON-LE-MOORS.—The rain in 1870 was 5.53 in. less than that of 1869 and 3.79 in. less than the mean of the previous thirty-nine years.

RUFFORD.—The average rainfall from 1847 to 1870 (24 years) is 34.62, so that the fall this year has been 4.78 in. below the average of that period.

SOUTH SHORE, BLACKPOOL.—From March 18th to 31st only .22 in. of rain ; from April 1st to 8th, 0.00 ; from 8th to 22nd, .50 ; from October 1st to 7th, 0.00 ; 7th to 9th, two days, 3.35 in., no thunder, rain from E.S.E. ; 9th to 19th, 2.85 in. ; and 19th to 31st, 3.40 in. ; in the month, 9.60 in., the greatest here in fifteen years ; the average fall in October is 4.10 in., and in the year 30.96 in. : so that we have had 1.45 in. more than our average.

HEST BANK.—The quantity of rain that fell in October is the largest that has fallen in any month since December, 1852, when 9.14 in. was measured ; total rain, 6.31 in. less than last year, but the distribution was so much more equal during the summer that the drought was less felt.

STORR'S HALL, ARKHOLME.—Our position, seven miles from Morecombe Bay, in a valley with a range of hills 500 to 600 feet between us and the sea, accounts partially for our great rainfall as compared with Hest Bank, Silverdale, and other places on the coast near us. The valley is very thickly wooded and surrounded by hills. The summer rains are augmented by thunderstorms, which usually take the course of the river that flows down the valley. March, April, May, June, and July are our driest months ; the autumn and winter generally wet ; our summers are cool, and winters mild ; snow rarely lies here.

ALLITHWAITE.—The least rain I have ever had to register in one year.

ULVERSTONE.—Amongst our heaviest falls I may notice that of the 5th of January, when between midnight and 8.30 next morning we had a fall of .82 in. Again on the 15th and 16th of March, 1.53 in. fell, being considerably more than half the total fall in the month.

As in October we had a heavier month's fall than I ever registered during the last seven years, I thought I might as well send you the amount which fell on six other days, as well as the greatest, *i. e.*, that of the 12th (1·82). On the 7th, ·99 in. ; 8th, 1·79 in. ; 16th, ·90 in. ; 19th, ·91 in. ; 21st, ·75 in. ; and 23rd, ·92 in. From the 22nd of March to the 7th of April (sixteen days) we had no rain, and again from 17th September to 6th October we had another perfectly dry period of nineteen days. With these exceptions, although our rainfall was slight, it was comparatively frequent ; for instance, we had sixteen "wet" days in June, but only ·25 in. was collected on just half of them. The consequence was, that whilst in the greater part of Yorkshire, and I believe in most of the central counties, the crops were literally burnt up, in our vicinity and generally west of the mountain range, grass and most other produce were above the average, the former remarkably so.

BROUGHTON HALL, CARTMEL.—Considerably more than one-fourth of the total rainfall fell in October on twenty-four consecutive days, or about one-sixteenth of the year ; the longest period without rain was nineteen days, from September 18th to October 6th. On seven days in the year upwards of one inch was measured ; four of these days were in one fortnight in October. My observations show that here the heaviest falls are almost always by night, *i. e.*, between 9.30 p.m. and 9.30 a.m. On 21st of October an unusually heavy fall in a given number of hours was noticed, *viz.*, 1·20 in. in 8½ hours by night.

DIVISION IX.—YORKSHIRE.

LEVENTHORPE HALL, LEEDS.—The December rainfall includes ·22 in. of melted snow on the morning of the 1st of January, 1871 ; the gauge registered 21·770 in., but there was snow in the funnel, which only melted on the 5th, and caused the gauge to register 21·990 in.

ALLERTON HILL, LEEDS.—In many parts of Yorkshire the pastures were completely scorched by the excessive drought in June, July, and August, and meadows instead of being mown were pastured.

THORNTON-IN-CRAVEN.—Rainfall 5·34 in. below the average of preceding 7 years.

BEADLAM GRANGE.—The summer drought terminated on the 7th of October, when it rained steadily for fifty-one consecutive hours. On 23rd and 24th of October the bar. registered 28·50, the lowest point observed during upwards of twenty years.

DIVISION X.—NORTHERN COUNTIES.

SOUTHEND, DARLINGTON.—In 1863 we had 19·24 in. ; this year,

17·97 in., the lowest I have recorded since I began in 1858. The almost total absence of thunder-showers and rather dry summer I think will sufficiently account for it.

WEST HENDON HOUSE, SUNDERLAND.—The relative wetness of each of the eight winds (N., N.E., &c.) was, in 1870, much the same as usual; the N.E. was the most rainy, and the S.W. the least so. July, the driest month, except June, 1868, I ever recorded. December, the wettest month since October, 1865. December 22, the thermometer in the shade fluctuated so much from the varying weather, that the influence of the eclipse upon it could not be traced. December 30, thickest covering of snow in 1870—8 inches deep.

WALLSEND.—Snow storm began on 20th of December at night, and the snow continued on the ground at the end of the year, when the gauge was taken into the house, the snow melted, and found to be 1·135 in.

WHITLEY.—February, June, October, and December, above the average; all the other months below it. Deficiency from average, January to July inclusive, —3·17 in. In the dry year (1868) the deficit for the same period was 2·48 in. The rainfall for first seven months in 1870 was thus less than 1868 by 0·69 in. The excess in June is more than accounted for by two heavy thunderstorms on 9th and 26th. The deficiency from the average for the whole year is 3·32 in.

BRAYSTONES.—In 1870 the rainfall was 5·28 in. less than the mean of the previous six years, and 9·60 in. less than in 1869.

WHINFELL HALL.—I have measured my rain to thousandths, reckoning as rainy days those only on which I measured ·010, but on going over the list and counting all from ·005 to ·009 previously omitted as rainy days, I find additional twenty-two days, or about $11\frac{3}{4}$ per cent. more. I am convinced there are nights in September and October when dew alone amounts to ·005; for instance, in September for a week or ten days I neglected to look at the gauge, the weather was so dry, fine, and clear; on the 30th I found an accumulation (in spite of evaporation) amounting to ·036. I then examined daily, as usual, and had October 1st, ·006, foggy morning, all hanging with water, then clear, fine day; 2nd, ·003, clear nearly all day, fine morning; 3rd, ·006, clear fine morning and fine day, some hoar frost; 4th, ·009, no clouds, hoar frost, fine day; then two days ·000. I cannot think that days on which the water is composed of dew only should be called rainy days, the conditions of dew are so different.

SCALEBY HALL.—This year's rainfall much less than the average of past five years.

DIVISION XI.—MONMOUTH, WALES, AND THE ISLES.

TUTSHILL, CHEPSTOW.—The rainfall of 1870 was 4·54 in. below the average —1861 and 1870, inclusive—being the driest year of the decade except 1864. The number of rainy days was twenty-nine below the average of the same period, and the least in the decade; the twelve monthly maxima together amount to 32 per cent. of the yearly fall.

DINGESTOW COURT.—Early winter, variable; great cold 9th to 22nd of February; winter very late, not a leaf or blossom at the end of March; great drought during summer and early part of autumn; springs never before so low, though they have been very low for several years; scarcely any hay or grass in this grazing county.

MERTHYR TYDFIL.—9·25 in. less than the average (five years) and forty-two days less than average for the same period.

LLWYN ONN HALL.—Rainfall this year 8·666 in. less than in 1869. From 4th of May to 11th of July, or sixty-one days, only 1·29 in. of rain fell.

TREVALYN HALL, NEAR WREXHAM.—Rainfall 5·275 in. less than in 1869, and considerably under the probable average of this district; there was only one decidedly wet month (October), a remarkable period of drought from April to August, and very deficient hay crops. Thermometer rose above 80° in shade on two days in June, twelve in July, and seven in August; and fell below 25° on four days in January, four in February, five in March, one in November, and eleven in December.

SCOTLAND.

DIVISION XII.—SOUTHERN COUNTIES.

NORTH BALFERN.—We have experienced a very favourable season for all kinds of crops in Wigtownshire. Though the rainfall has been much less than the average, it was distributed very equally over the summer months, so that the crops seldom needed rain long at once; the deficiency occurred chiefly in the winter months.

MARCH HILL COTTAGE, DUMFRIES.—The rainfall for the year is 4·68 in. below that of 1869 and 6·27 in. below the average of five preceding years. March and April were very dry months, but May and June were showery, and the rain in May came in time to save the crops. Grain crops in this district have seldom been more luxuriant. Harvest early. In August and September the drought was severe, and grass much burned up. On the whole the season has been one of the most productive that is remembered in Dumfriesshire.

WOOP LAW.—Each month this year the rainfall has been below the average (eleven years), excepting February, October, and December.

DIVISION XIII.—SOUTH EASTERN COUNTIES.

EAST LINTON.—Amount of snow dissolved and measured as rain in February, $26\frac{1}{2}$ in., March, $1\frac{1}{2}$ in., and December, $9\frac{1}{4}$ in.

DALKEITH.—Many of the showers we should have been glad of passed on either side of us along the Forth or the ridge of the Pentlands, leaving us burnt up for want of rain.

MEADOWFIELD.—The rainfall of this year (15·10 in.) is the smallest since I began to keep a register in 1853. The supply of water in this district is mostly from wells from 20 to 28 ft. deep. At present some of these are nearly dry, and many of the land drains have not begun to drain. I see this is quoted by the Scottish Meteorological Society as the driest district in Scotland, and they allege that it is on account of the height of my funnel (9 ft. 4 in.), but I am of opinion that the rainfall is less here than in the adjoining station on account of there being no hill near to attract the clouds.

DIVISION XIV.—SOUTH WESTERN COUNTIES.

IRONDALE HOUSE, MUIRKIRK.—The heaviest falls in a short time were ·44 in. (rain and hail mixed) in thirty minutes, at 5.30 to 6 p.m. on 16th of May, and ·40 in. (rain and hail) in fifteen minutes, at 3 to 3.15 p.m. on 2nd of August.

RIDGE PARK, LANARK.—Total in 1869, 30·41 in. ; so 1870 is 7·09 in. below it.

BOTHWELL CASTLE.—The rainfall here has been 7·50 in. below the average, but we had very seasonable showers, and altogether it has been a most favourable season for the crops of every description in this district, and the general pasturage has been very abundant.

DIVISION XV.—WEST MIDLAND COUNTIES.

INVERARY CASTLE.—Taking the year as a whole, it has been a very fruitful one both in the garden and in the field. The limited amount of rain which fell during the ripening of the fruit, roots, and seeds enabled the whole to be secured in good condition. The spring months did not promise well, owing to the cold north wind which prevailed, along with a damp atmosphere, and this was chiefly owing to the high temperature, which burned up every thing in England ; for so long as that lasted, the north wind kept steadily blowing until rain fell in England, when it shifted by day to the south, bringing moisture with

it, and at night returned to the north, which condensed the vapour in the air which fell in fine genial rain, making the crops push on rapidly, which made up for the lateness of the spring, and, as I have said, ended in a remarkably fruitful season in this part of the country.

AIRDS, APPIN.—Rainfall in 1870 much under the average, in fact we have not had so dry a year since 1856, which gave 47·30 in. ; 1870, 55·30 in.

DIVISION XVI.—EAST MIDLAND COUNTIES.

CAMBO HOUSE, ST. ANDREW'S.—This has been the driest year I can remember.

KIPPENROSS, DUNBLANE.—Rainfall in 1870 (23·70 in) very small. The only one approaching it since observations commenced here, in 1852, was 1855, when the fall was 26·30 in.

LENY CALLANDER.—Very late spring vegetation ; snow-drops still in flower on 1st of April ; the 17th and 18th of April singularly warm, as also the last ten days in July ; heliotropes and dahlias in flower on the 1st of November.

TRINITY GASK.—The average rainfall of the thirteen years, ending 1869 inclusive, is 34·43 in. ; 1870 (24·59 in.) is therefore very nearly 10 in. below the average.

DIVISION XVII.—NORTH EASTERN COUNTIES.

BOGSIDE.—The rainfall in 1870 is only ·05 in. greater than in 1869, therefore, the springs were very low and water very scarce during the summer ; many springs were dry during the past summer that were not dry in 1826. On several nights in November and December we had beautiful displays of aurora, so much so that the equals are very rarely seen in this locality ; they extended over the whole heavens, and were of all colours.

DIVISION XVIII.—NORTH WESTERN COUNTIES.

BERNERA COTTAGE, LEWIS.—My gauge was only about 10 ft. above sea level, but our coast is so exposed to the Atlantic, that, fearing the sea spray, with heavy winds, might interfere, I got it placed 90 ft. higher for my observations in 1870. This year has been the best and most plentiful, both for man and beast, during the last fifty years in the island of Lewis.

CORRIMONY.—Snow during February, March, November, and December, 27 in.

DIVISION XIX.—NORTHERN COUNTIES.

PULTENEY HOUSE, WICK.—The average for the four years preceding 1870 was 30·26 in. ; thus it appears that 1870 was 11·38 in. below it.

IRELAND.

DIVISION XX.—MUNSTER.

GLENAM, CLONMEL.—The past year has been remarkably dry here, the total fall of rain (33·25 in.) being 6 in. less than usual and 16 in. less than in 1868.

BRUCE VILLA, CLONMEL.—Heavy falls in short periods were prevalent during the year; ·59 in. fell on the 8th of September in about forty-six minutes; at other times we had ten or fourteen days without rains, so that the number of days on which rain fell is less than in former years. The total fall is also several inches below the average. The three wettest months were January, February, and October, during which nearly half of the rain of the year was registered.

DIVISION XXI.—LEINSTER.

DUBLIN (FITZWILLIAM SQUARE, WEST).—No thunderstorms during the summer.

DIVISION XXII.—CONNAUGHT.

CREGG PARK.—During the summer the falls of rain were very unequal; very heavy showers falling in places, while not a drop fell a mile or two distant.

DIVISION XXIII.—ULSTER.

MOBILE.—Rainfall would have been considerably below the average, if it had not been for the excessive fall in October. On three days in that month more than an inch was registered; on the 12th and 19th, 1·500 in. each day; and on 16th, 1·155 in. The rainfall in October was nearly 2·000 in. more than I have ever registered either here or in Londonderry, commencing in 1865.

FLORENCE COURT.—The first two months were wet and mild, the rest of the spring fine and dry, the summer unusually dry and warm. October was the wettest month recorded here, moderate weather during November, but December very severe, with frost and snow. The total amount of rainfall is about the average, but we have had fewer wet days, and consequently the season has been better than usual.

MONEYDIG.—A very fine seed-time and beautiful summer up to the 22nd of August; from the 15th of July till that time the heat and drought were excessive.

LETTERKENNY.—The amount of rain seems almost equal to the wettest parts of Ireland, but there are no observers in some of the moist spots.

MAXIMUM FALLS IN 1870.

IN this note we intend to confine ourselves to the numerical results deduced from the computations connected with the heaviest falls in the 24 hours forming the rainfall day, as recorded at 687 stations. The whole of the entries have been (as usual with us) tabulated under the respective dates, the per-centage which each max. fall is of the yearly total computed, and the means of the per-centages, and of the max. falls, taken with the result indicated by the last line of the following table.

Year.	Number of Returns.	Mean Per-centage.	Mean Amount.	Mean Total Fall in year.	1867 being assumed =100.	Ratio of Rainfall to the Mean.	Total Fall being assumed =34 in. Mean Max. =
1865	481	5.1	1.70 in.	33 in.	106	102	5.00 percent.
1866	590	3.7	1.48 „	40 „	129	119	4.36 „
1867	584	4.6	1.44 „	31 „	100	100	4.24 „
1868	676	4.3	1.43 „	33 „	106	106	4.21 „
1869	637	4.2	1.42 „	34 „	108	101	4.18 „
1870	687	4.9	1.30 „	27 „	81	82	3.82 „

That line, by the bye, is a good illustration of the unseen work requisite for a publication such as we strive to make this. Before the values it gives can be obtained, about 1,300 returns have to be examined, 687 six-fold entries have to be made, 687 proportional sums to be worked out, then the resultant per-centages and the amounts have to be constituted long (687 entries each) addition sums, and after all this, the result is expressed in five figures, which might be omitted without one person in fifty missing them—but we do not think the time at all mis-spent. In the first place, the correspondence between the values in the sixth and seventh columns is an entirely independent check on the Comparison Table, which we give annually. Secondly, the last column is very suggestive; in it the heavy falls are taken *not* as per-centages of the total fall in the year in which they occur, but as per-centages of an assumed constant quantity; according to this column heavy falls of rain are yearly becoming more rare.

Moreover, from this same collection of data, the following tables are formed, which are not only interesting and useful in themselves, but which have revealed many facts as to the laws regulating heavy rainfalls, which have been quoted in this annual in former years, and confirmed by each successive year.

ABSTRACT OF MAXIMUM FALLS IN 1870.

Largest Falls.

Date.	Div.	Stations.	Depth.	Per cent.	Fall in year
Sept. 7 ...	XIX.	Tongue	6·00in.	17·1	35·10 in.
August 4...	V.	Zeal Monachorum.....	3·60	12·5	30·76 „
October 9 .	VIII.	Entwistle	3·20	5·8	55·40 „
February 6.	XVII.	Ballater	3·15	10·2	30·74 „
October 12.	IX.	Whiteholme	3·06	6·2	48·98 „
August 22..	XI.	Ystalyfera	3·06	5·9	51·67 „
July 26 ...	II.	Lynch	3·00	8·4	35·53 „
Dec. 18 ...	XVIII.	Inverinate House	3·00	6·8	43·95 „
August 4...	V.	Hexworthy	2·99	7·2	41·61 „
February 1.	„	Hingston Down	2·97	6·3	46·91 „
March 16 ..	X.	Windermere, The Howe	2·97	5·2	56·72 „
February 1.	V.	Redstone, Dartmoor.....	2·92	6·5	44·59 „
August 22..	VI.	Berkeley... ..	2·90	5·3	20·94 „
June 11 ...	X.	Keswick.....	2·83	5·1	55·27 „
March 15 ..	„	Loughrigg	2·77	4·1	67·89 „
February 27	XIV.	Glasgow Observatory	2·71	7·7	35·25 „
		Mean	3·20	7·5	43·83 in.

Largest Per-centages.

Date.	Div.	Stations.	Per cent.	Depth.	Fall in year.
Sept. 7 ..	XIX.	Tongue	17·1	6·00in.	35·10 in.
August 4...	V.	Zeal Monachorum	12·5	3·60	30·76 „
June 16 ...	IV.	Hunstanton	11·3	2·08	18·36 „
February 6.	XVII.	Ballater	10·2	3·15	30·74 „
July 9	III.	Stratton Audley Park	10·1	2·01	19·72 „
Sept. 7 ...	II.	Brogdale	9·9	2·03	20·60 „
July 11 ...	„	Wimbledon	9·8	1·78	18·22 „
July 9	VI.	Ludlow	9·5	2·54	26·87 „
Sept. 8 ...	II.	Acol	9·2	1·50	16·38 „
July 11 ...	III.	Stretham	9·1	1·59	17·40 „
October 8...	IX.	Wath-upon-Dearne	8·8	1·71	19·40 „
„ „...	„	Moorgate Grove	8·6	1·87	21·77 „
June 16 ...	III.	Waresley	8·5	1·31	15·47 „
July 26 ...	II.	Lynch	8·4	3·00	35·53 „
October 8...	IX.	Doncaster	8·4	1·62	19·34 „
„ „...	„	Holbeck, Leeds.....	8·3	1·70	20·50 „
		Mean	10·0	2·34	22·89 in.

Largest Falls.

MEAN.					ABSOLUTE.			
Years.	Depth.	Per Cent.	Mean total fall at these stations.		Depth.	Per cent.	Station.	Division.
			Computed.	Observed.				
	in.		in.	in.	in.			
1864 ...	3·47	6·3	55·1	...	6·47	5	Seathwaite	X.
1865 ...	3·67	6·4	57·3	61·8	6·41	5	Seathwaite.....	X.
1866 ...	3·40	4·4	77·3	86·2	6·38	4	Seathwaite.....	X.
1867 ...	3·17	9·0	35·2	42·5	4·78	16	Hartlip	II.
1868 ...	3·32	6·1	54·3	65·9	5·60	5	Camusinas	XV.
1869 ...	3·68	5·0	73·6	77·7	6·70	4	Seathwaite.....	X.
1870 ...	3·20	7·5	42·7	43·8	6·00	17	Tongue	XIX.
Mean ...	3·42	6·4	56·5	63·0	...	...	.....	...

Largest Per-Centages.

MEAN.					ABSOLUTE.			
Years.	Per Cent.	Depth.	Mean total fall at these stations.		Per cent.	Depth.	Station.	Division.
			Computed.	Observed.				
		in.	in.	in.		in.		
1864 ...	9·0	2·48	27·6	...	13·2	3·10	W. Retford ...	VII.
1865 ...	9·9	2·62	26·5	28·4	13·0	4·40	Fleckney	VII.
1866 ...	8·1	2·31	28·5	29·3	10·0	2·48	Burton	VI.
1867 ...	11·0	2·85	25·9	25·3	16·0	4·78	Hartlip	II.
1868 ...	8·6	2·55	29·7	30·1	11·0	4·00	Tongue	XIX.
1869 ...	7·9	2·17	27·5	27·9	10·0	3·40	Tillydesk	XVII.
1870 ..	10·0	2·34	23·4	22·9	17·1	6·00	Tongue	XIX.
Mean...	9·2	2·47	27·0	27·3	...	...	.....	...

It is worthy of note that although as a rule heavy falls seem becoming more rare, yet we have had this year the highest per-centage (17·1) yet recorded. It is also singular that this honour should have *twice* fallen to a station which does not apparently possess any special claims to this distinction.

HEAVY FALLS OF SHORT DURATION.

WE have been requested to supply a table for 1870 analogous to that on page 57 of *British Rainfall*, 1868. We quite concur in the desirability of so doing, and therefore insert the following:—

Date.	Division.	Station.	Duration.		Amount.	Rate per hour.
			hr.	min.	in.	inches.
1870.						
May 16.. ..	XIV.	Irondale House, Muirkirk	...	30	·44	·88
June 16.....	II.	Basingstoke, Wote Street..	...	7	·16	1·37
„ 17..	III.	Granchester	1	30	1·04	·69
„ 17.....	IX.	Malton	4	...	1·35	·34
„ 24.....	IX.	Middlesboro'.....	...	45	·45	·60
July 6.....	XVII.	Bogside	6	..	1·60	·27
„ 9.....	VI.	Ludlow	1	45	2·15	1·23
„ 9.....	X.	Kirkby Stephen ...	1	30	1·80	1·20
„ 11.....	II.	Dorking, West Street.....	...	35	·77	1·32
„ 11.....	XVII.	Allan Vale, Pitmuxton ...	2	...	1·34	·67
„ 11.....	XVII.	Blackstock, Midmar .....	..	30 ?	1·76	3·52
„ 13.....	II.	Basingstoke, Wote Street..	..	15	·23	·92
„ 25.....	IX.	Stonehouse, Dent.....	2	30	2·53	1·01
„ 31.....	III.	Cholesbury .....	...	40	1·15	1·73
Aug. 1.....	III.	Cholesbury	1	0	1·23	1·23
„ 2.....	XIV.	Irondale House.....	0	15	·40	1·60
„ 2.....	XVII.	Braemar	0	45	2·10	2·90
„ 3.....	V.	Zeal Monachorum ...	2	30	3·45	1·38
Sept. 7.....	XIII.	East Linton .....	...	20	1·00	3·00
„ 8.....	XX.	Bruce Villa, Clonmel .....	...	46	·59	0·78
Oct. 19.....	V.	South Molton .....	...	19	·94	2·97

THE PRINCIPAL HEAVY RAINS OF 1870.

JANUARY 30TH.

The maximum fall on any one day in the year occurred on the above date at the majority of stations on the east coast of Ireland. The largest amount (2·05 in.) fell at Fassaroe, but at most stations it was between $1\frac{1}{2}$ and 2 inches.

FEBRUARY 1ST.

At Hingston Downs and Red Stone (Dartmoor) nearly 3 in. of rain fell on this day, and at most stations on Dartmoor the fall was heavy. Was this the east of Ireland rain of January 30th travelling slowly eastward ?



Fig. 11.

FEBRUARY 6TH.

The tract of country over which the fall of rain on this day was greater than on any other day in the year is indicated by fig. 11. The dots show approximately the position of each station at which the fall on this day was the maximum of the year. The actual amounts were generally very small, at many stations not reaching one inch ; so that the fall would possess no claim to notice but for the absence of larger ones, which renders it unduly prominent. The heaviest fall on this day was at a few isolated stations in Aberdeenshire, at one of which (Ballater) upwards of 3 in. of rain fell. The heaviest fall among the south of England group of stations was in East Dorsetshire.

MARCH 1ST.

The fall on this day was also an unimportant one, but, at a few stations on the south coast, it exceeded that of February 6th. At two or three stations on the Devonshire coast it amounted to 6 per cent. of the total yearly fall.

MARCH 3RD.

This was the date of maximum fall for most stations in the metropolitan district, but the amounts and per-centages were very small, being under an inch at every station but one, and in no case reaching 6 per cent. of the total annual fall.

MAY 11TH.

The heavy fall on this day was almost confined to stations on the shores of, or proximate to, the Bristol Channel. At a few stations in South Wales the amount exceeded $1\frac{1}{2}$ in., and at Haverfordwest reached 2·60 in.



Fig. 12.

JUNE 16TH AND 17TH.

I couple these days together, because the rain fell at such time that no other course is practicable. The area (as will be seen from fig. 12) was very limited, comprising merely the vicinity of the Wash, parts of East Yorkshire, and one or two stations inland. The fall was the product of the thunderstorms elsewhere referred to, but it was not large except in North Norfolk, and there it fortunately happened that Mr. Field was staying, so that he has been able to favour us with the following note. The fall was quite local, no other station within fifty miles having more than 1·55 inches :—

HEAVY FALL OF RAIN AT HUNSTANTON.

On the night of the 16th of June there was heavy thunder and lightning, and .96 in. of rain fell at Old Hunstanton between 10 p.m. on the 16th and 1 a.m. on the 17th.

On the 17th of June there was another very violent thunderstorm and a fall of at least 2.08 in. of rain was registered at Old Hunstanton between 12.30 p.m. and 3 p.m.—the rain gauge then overflowing. At New Hunstanton (Hunstanton St. Edmund's) the fall was greater; the rain commenced there about 12.30 p.m. and continued at a moderate rate till 1.30 p.m.; it then began to come down very fast, and gradually increased its rate of fall till 2 p.m., at which time it was coming down in torrents; it continued raining very heavily indeed till 2.45 p.m., then slackened and ceased altogether at 3.4 p.m. I measured the rain-fall roughly at Hunstanton St. Edmund's between 2.4 p.m. and 3.4 p.m. by catching it in glasses, and made the quantity falling during this hour to be just 2 in. During a portion of this time the rain came down more rapidly than I ever remember to have seen rain fall before. Thus, from 2.11 p.m. to 2.16 p.m. (five minutes), .34 of an inch fell, or at the rate of 4.08 in. per hour; and from 2.21 p.m. to 2.22 p.m., .16 of an inch fell, or at the rate of 9.6 in. per hour. I doubt whether even this latter figure represents the maximum rate of fall.

The rain did great damage. The water flowing off from a very small extent of land (some fifteen or twenty acres at the outside) produced a perfect torrent, which flooded the basement of a house to a depth of 5 ft. 8 in., washed down a solid stone wall, and rolled many of the stones (6 in. cube) a distance of 195 yards down the road. The church at Old Hunstanton was also flooded, and very large quantities of soil were washed off the fields.

Thus, the total recorded fall at Old Hunstanton between 10 p.m. on the 16th and 3 p.m. on the 17th was 3.04 in. besides the overflow. At New Hunstanton the fall was considerably greater, and from my measurements I have no doubt that it was at least $3\frac{1}{4}$ inches in the seventeen hours.

Rogers Field, C.E.

6, Cannon Row, Westminster, Feb. 15th, 1871.

JULY 9TH.

This day was that of heaviest rain at less than a dozen stations; at several even of them it was quite unimportant, but at three or four detached spots tremendous falls occurred. At Stratton Audley Park 2.01 in. fell, being more than one-tenth of the entire yearly fall. At Ludlow 2.54 in. fell, being $9\frac{1}{2}$ per cent. of the yearly total. At Stoke-

upon-Trent there was very heavy rain. At Stone House, Dent, Yorkshire 2·53 in. fell in $2\frac{1}{2}$ hours, and a much larger amount two miles up the valley, destroying six small bridges, and damaging one large one.* But the rainfall which will be longest remembered for its destructive effects was that which fell on the hills between Todmorden and Bacup, and which, owing to the steepness of the hill sides, and its extreme amount, swept almost everything before it.

The accompanying skeleton map indicates the locality, the (verified) newspaper extracts describe some of the salient features, and the article by Mr. Greenwood, Surveyor to the Local Board (in whose district the principal damage on the northern side occurred), jointly render it unnecessary for us to offer any remarks upon the subject.

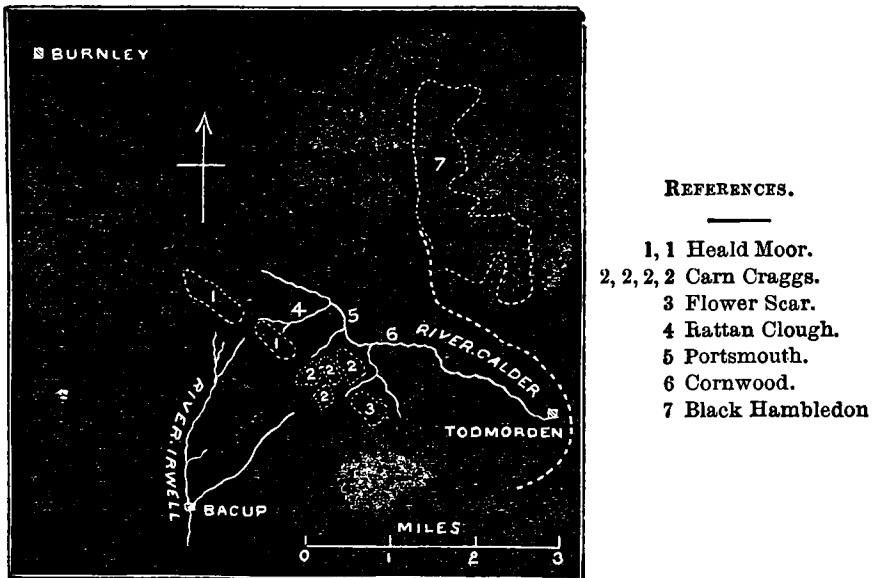


Fig. 13.

One word may, however, be permitted, just to call attention to the very circumscribed area of all these storms, in almost every case perfectly fine weather prevailing all round the storm area.

LOSS OF LIFE AND SERIOUS DESTRUCTION TO PROPERTY.—On Saturday afternoon, the northern and eastern divisions of Lancashire were visited by a most serious thunderstorm, accompanied with an extraordinary fall of rain. In the neighbourhood of Lancaster and Morecambe, the storm was very furious, rain fell in complete torrents, and there was general alarm. But the most serious visitation was in the eastern section of the county, between Haslingden and Burnley. The guard of a train passing through the district when the storm was

* A description of this storm by Professor Sedgwick, F.R.S., is given in *Meteorological Magazine*, vol. v., p. 105.

raging supplies our correspondent with the following particulars: "After leaving Accrington at 2.42 in the afternoon, by the train for Sowerby Bridge, rain began to fall, and came down in torrents till we reached Townley, and on arriving there the road was inundated, the water reaching the footboards of the carriages. Between Townley and Portsmouth the adjoining fields were about two yards deep with water, and nearly every house in the immediate district was flooded. The valley from Portsmouth to Todmorden was inundated, and it is feared that a bridge belonging to the line below the latter station will fall. The line was blocked in several places, and the traffic was suspended for several hours." Great excitement prevails in the district, and it is feared that when a full survey is made the consequences will be more serious than is at present known. Many of the small villages in East Lancashire were flooded, and it is feared that much damage has been done in some of them.

Another correspondent gives the following account of the cause of the flood: "The storm occurred between two and three o'clock, consisting of thunder, lightning, and heavy rain, but the principal cause of the devastation was the tremendous quantity of water which flowed down from the hills. This was caused by the descent of a cloud of water on Flower Scar, a moor overlooking the valleys into which the water rushed in a huge stream, carrying with it every obstacle. Flower Scar is the summit of a range of hills which separate Bacup from Todmorden, and on the Todmorden side slopes down into the two valleys above mentioned. The descent of this cloud of water must have occurred about two o'clock, for soon after that time the inhabitants of Todmorden were alarmed at the sudden rising of the rivers from the two valleys, both of which in a few minutes overflowed their banks, and put the lower part of the town completely under water.

BURNLEY AND ACCRINGTON.—Our correspondent writes: Last Saturday afternoon, a storm passed over these two towns, which, for force and boisterousness, has never been surpassed in the memory of the oldest inhabitant. The rain poured down in perfect torrents, and with unrelenting force, for upwards of two hours. The river Calder, which passes through Burnley, was very much swollen, and rose, in an incredibly short time, something like four feet above its ordinary level. The streets in several parts of the town presented the appearance of an unbroken stream. Men, women, and children could be seen wading through the water knee deep, whilst here and there were to be seen floating on the water stray pieces of furniture. In Fletcher-street, and near the cattle market, were to be seen many cart loads of furniture, which had been hastily recovered from the houses, indiscriminately heaped up, whilst in Cannon-street, and in Wapping, almost every cellar was flooded, and in many instances the houses also. Large quantities of newly-mown hay were either washed away or completely spoiled by the wind and rain. In Manchester-road many tons of the macadam were washed towards the lower parts of the town, and a number of carts were engaged for a good many hours in clearing the streets. The Cross Keys public house, in Newtown, the landlord of which has just recovered from the Burnley Corporation a sum of money for damage sustained in a recent storm, was very considerably damaged, whilst the streets thereabouts were many inches deep in water. At Portsmouth, which is about three miles from Burnley, the line was blocked up for a considerable time by sediment washed from the hills, the water on some parts of the line covering the steps of the carriages. At Todmorden, a few miles further on, considerable damage was done. Several houses, under which was a sewer, fell with a crash during the

afternoon, in consequence of the sewer being blocked up, whilst the water could, in many instances, be seen rushing from the parlour windows. At Accrington considering the violent nature of the storm, the damage done is inconsiderable, chiefly arising from the flooding of some of the cellars in the lower parts of the town.

BACUP.—Our correspondent writes : About one o'clock the sky became so dark that an object at the distance of a few yards was scarcely discernible. The peals of thunder were not very loud, but of a peculiar character, resembling the fall of slates or the noise made by the sails of a vessel during a gale. The flashes of lightning were not particularly vivid, but followed each other in remarkably quick succession. The rain descended in torrents. Several persons concur in saying that it came down literally in volumes, and that waterspouts, similar to what are sometimes seen in tropical latitudes, were at one time distinctly visible. The storm raged for about an hour and a half, and, with but few exceptions, flooded all the streets of the town. Most of the mills are built along the banks of the river Irwell, in some instances over the river, and all of them have sustained more or less damage. At Vale Mill, belonging to Mr. George Maxwell, at Greave, the flood swept down one of the walls of the weaving shed, burst the arch for a distance of several yards, and, in a few minutes, and for several hours afterwards, a perfect torrent of water was dashing through the middle of the building. Several of the looms also fell into the river. At Nut Mill, belonging to Messrs. John Howarth and Sons, the damage is of a precisely similar character, but on a more extended scale. At this place a large wall in the middle of the weaving shed has been washed down, and the roof has also partially fallen in. Here the water entered the weaving shed and destroyed a large quantity of weft and cloth. At Albion Mill, belonging to Mr. George Stewart, the flood entered the weaving shed, and soon all the looms were completely covered. At this place, the shed had just been stocked with 188 entirely new looms, 16 of which had not yet been started. The contents of the carding-room and the warehouse were also completely destroyed. It is estimated that Mr. Stewart's loss will be upwards of £3,000. The mill premises of Messrs. T. and J. Aitken, in Burnley-road, comprise a detached two-storied building, which was used as warehouse, store-room, and mechanics' shop, and this has been completely destroyed, a large portion of the roof being carried down the river for a distance of several hundred yards. At the time, the warehouse was well-stocked with yarn and cloth, the greater portion of which has been carried off by the flood. The flood also entered the weaving room at the mill of Mr. Caleb Shepherd, in the same street, and completely covered the looms. Irwell Mill, belonging to the Rossendale Industrial Company, Limited, is a total wreck. These premises consist of weaving shed and throstle and card rooms, the two latter of which have recently been fitted with new machinery. The flood entered the whole of these rooms, and so seriously damaged the machinery that it is feared it will be totally unfit for further use. The cloth out of the warehouse, and even the books out of the counting-house, were carried off. The flood entered the weaving sheds at both Spring Holme and Throstle Mill, belonging to Messrs. John Mander and Son, Newchurch-road, and also at the India and New Hey Mills, belonging to Mr. Edward Hoyle. At these mills, when our correspondent visited them, workmen were engaged in washing the looms by means of hose pipes. At New Hey Mill the flue of the mill chimney has been torn up for a distance of several yards, and some 400 gallons of oil were

washed out of the store-room and lost. As the result of the damage done, the whole of these mills will have to stop for several weeks. The damage done to house and other property is on a scale of the most frightful magnitude. At one time, in St. James's-street, the water was rushing along at a fearful pace to the depth of 5 feet 9 inches, bearing along on its bosom every conceivable kind of merchandise and of household goods. As an instance of the force of the flood, we may mention that a railway lorry, heavily laden with cloth, and without horses, was carried a distance of 100 yards as though it had been a boat. So suddenly did the flood come that the occupants of the different shops and houses had scarcely time to close their doors, much less to attempt to save any of their property, but were glad to escape to the upper rooms of their premises. Many tradesmen had everything, even until it came to their weights and scales, swept out of their shops, and some, it is feared, will be completely ruined. We have heard of one grocer who estimates his loss at £500, and of a draper who thinks that even £1,000 will not cover his losses. The Bacup Co-operative Store have lost the whole of their stock in the gutta-percha department. In numerous instances houses have been stripped of the whole of their furniture. Notwithstanding the heavy loss of property that the flood has caused, it is satisfactory to learn that not a single life has been sacrificed, but we have heard of several narrow escapes. Had the flood occurred in the night time, the loss of life would have been something terrible to contemplate. An almost similarly destructive flood visited Bacup on the 9th of August, 1849, now nearly 21 years ago.

TODMORDEN. —Our correspondent says : The surrounding district of Todmorden, and some of the low-lying parts of the town, were on Saturday afternoon visited by the most sudden and fearful calamity ever known in the district—a calamity causing damage to property to an incalculable amount, and which we have reason to believe has terminated the lives of at least three persons. At noon, on the day named, the whole of the sky visible was covered with a dark cloud, which rendered the lighting up of the houses necessary. Vivid flashes of lightning and awful peals of thunder continued for about an hour, but to the surprise of the inhabitants very little rain fell in the town, the shower not lasting more than a quarter of an hour. Immediately, and without any warning, the water rushed in great volume down the river, washing away walls, battlements of bridges, and flooding all the tenements of Cobden Shade, &c., to a depth varying from two yards downwards. This was the state of things at Todmorden, but the scene of havoc and desolation was the valley from Todmorden to Portsmouth (Burnley direction). Proceeding up the valley from Todmorden, we first come to the cricket field, in which a match was being played ; here the water forced an entrance, and washed the wall nearly away, and the players had to make a speedy flight. Further on, the bridges (without, I may say, a single exception) were greatly damaged—the water rushing over them, taking away the battlements, flooding the pasture land, and making the road a deep running stream. Cotton mills and dwelling-houses were deluged, and great damage and inconvenience were caused. About a mile and a half up the valley (at Robinwood), the river runs at a somewhat deep level, and here houses were flooded two feet deep, showing the stream to have run at the enormous depth of four or five yards. Here part of the road was swept away, and the bed of the river almost blocked up with *débris*. About 150 or 200 yards farther up is a line of houses known as “Bowed Row.” Two of the houses were completely washed down, and some of the others greatly damaged.

This row of houses is built over the river on an arch. As we proceeded further, the scene became more fearful. Very little of the river wall remained, and the road where the water had ceased to flow was much disturbed. Barewise House, the residence of Mr. Ormerod Barker, manufacturer, was all but undermined, and shows signs of giving way. Now the cause of the mischief, so mysterious to those lower down, explained itself. The cloud which had hung over the sky from some cause had discharged itself in a sheet, as it were, on to the moorland north-east of Todmorden, and had rushed down the steep woodland declivity, bringing with it trees, and all manner of *débris*. At Vale, two and a quarter miles from Todmorden, the road was impassable for hours after the first signal of the disaster. The next scene of catastrophe was at Mount Pleasant, about three miles from Todmorden. Here the sudden deluge was heard or seen by the widow of one William Greenwood. She told her daughter to call in the assistance of a man, but when the daughter returned the end of the house was gone, and nothing could be seen or heard of the woman. About fifty yards further the water entered the loom shed of Mr. Redman, sweeping in the wall on the side near the moor, and almost filling the shed with *débris*, entirely covering much of the machinery and breaking the shafting. The boiler house of this mill was also demolished. At Portsmouth, the weaving shed of the Chirgée Coal Company was destroyed entirely. At last came the most fearful and heart-rending part of this catastrophe. Towards the beginning of the storm a man named William Marshall was crossing a bridge known as Chatham Bridge with two of his children, one in each arm, whom he was endeavouring to rescue from danger. So strong was the current, however, that the two children were washed from his hold, and his own life was much endangered. The hill sides were greatly disfigured and disturbed by the storm; meadows in which was the newly-mown hay were cut up, and scores of beds or cloughs formed. The shower which accompanied the thunderstorm at Portsmouth (three and a quarter miles from Todmorden) lasted about three quarters of an hour, and was unprecedentedly heavy. From the hill opposite to where the water fell, we hear that a waterspout was seen by persons at several points. The telegraph communication, on the Burnley branch at least, was stopped, and the down line of railway at two points was so washed and undermined as to cause the traffic to be carried on only on one line. Live stock, fowls, furniture, food, trees, and things of great variety floated down the river in abundance. The immense volume of water, however, did not all descend into Portsmouth valley, but a great part fell into the narrow vale known as Dulesgate, where, owing to the sharp fall of the vale, and its narrow and confined character, the effect was terrible to the road, especially at Cloughfoot.

ON THE TODMORDEN FLOOD.

HEALD MOOR and Carn Crag, the district where the late storm occurred, is a wild and elevated piece of moorland on the border of Lancashire,* bounded on the north by the Todmorden Valley, and on the south by the ancient Forest of Rossendale; whilst its eastern and western extremities are separated from the other mountain ranges by a small

* Forming a portion of the Pennine chain of mountains which runs through the counties of Derbyshire, Yorkshire, Lancashire, &c., and is generally known as the backbone of England.

mountain torrent a tributary of the Calder, called Black Clough on the west, and by Dulesgate on its eastern side. It might be described as lying in the centre of an isosceles triangle, of which Bacup and Todmorden form the extremities of the base and Burnley its apex—the two first-named places being distant from each other about two miles, the mountain range of Heald Moor and its adjoining slopes only intervening; while they are each about eight miles from Burnley. At the base of these hills, on the N. side, lies the beautiful valley running between Burnley and Todmorden, 900 ft. below the summit of Heald Moor, down which a majority of the water falling on these hills flows. There are some peculiarities connected with the drainage of this moor. The rain falling on its northern slopes empties itself into the river Calder, which separates at a place called Calder Head,*—one part running by Burnley, and forming one of the tributaries of the “Ribble,” finding its way through into the Irish Sea, near Preston; while the other portion flows through Todmorden, thence by Hull, to the German Ocean; then its southern slopes form the source of the Irwell, which flows through Bacup and forward into the Irish Sea, near Liverpool.

So much for the locality. Now, then, for the phenomena.

In the early part of the day the weather was exceedingly sultry and close, and, as it wore on, became rather oppressive. At about half-past one the day became exceedingly dark, and huge black clouds were to be seen flitting about in all directions. There were two dense masses of blackness which had from the first been visible in the east and west, which kept nearing each other; people now began to expect a storm, and it was not long before their anticipations were verified. Vivid flashes of lightning soon began to succeed each other in rapid succession, and were accompanied with heavy peals of thunder. During this period the lightning was observed to come from all sides alternately, and continued under these features for about half-an-hour or more, when there was a slight cessation—many people believing the storm was now over. It was not long, however, before they found themselves grievously disappointed. The dense black masses in the east and west, before spoken of, had now fairly concentrated on the moors above, and it was now that the storm commenced with all its fury. It now became awfully dark, and flashes of lightning succeeded each other in rapid succession; though the thunder was not so heavy, it was exceedingly peculiar, resembling the breaking of slates by loads

* The river Calder takes its rise at Cliviger Dean, in the very gorge of the English Appenines, as Dr. Whittaker, in his “History of Whalley,” describes it.

of stone being poured upon them. I have sometimes attributed this to the extraordinary lowness and density of the clouds. Up to this time the water had not stirred in the Calder the least, but in less than fifteen minutes from this time it was coming down the turnpike road, 30 ft. wide by about 3 ft. deep.

I was in the valley at the time of the flood (near to the confluence of the Tower Clough with the Calder, the place where Mrs. Greenwood was washed away with her house and drowned), but had gone to the back part of some buildings, called Joblin Terrace, to watch the progress of the storm, when a man came to inform me the road was running like a river ; and on going round I found such to be the case. I then went back to the other side again, and scarcely had I done so, before the people living in these houses followed, quite panic stricken, exclaiming : “ What must we do ? Oh, what must we do ? All will be swept away ! ” On going again to learn the cause of their fright, I found the road, which runs in a deep gully here some 30 ft. wide by 5 ft. deep, completely filled with water, which was rushing along at a maddening pace, carrying with it entire trees, &c. Such was the rapid rise of the water, that the carters had to loose their horses from their carts and make for their life, some of the carts being carried away by the flood.

The three mountain tributaries of the “ Calder,” viz., Tower, Green’s Clough, and Rattan Clough, drain the northern side of the moor, while the two tributaries of the Irwell drain its southern side.

As to the quantity of water which fell on those moors, in the absence of a gauge, it is beyond the power of the human intellect to calculate. Some have attempted an approximation, but the data upon which they have based their calculations are, in a great measure, suppositious, and little or no reliance can be placed upon them. I find one man putting the drainage area which concentrated at Cornholme Arch at three square miles, and elaborating a series of calculations to prove a 4 in. rainfall. When, on reference to the Ordnance sheets, I find the real storm area is only about one square mile, which concentrated at this point. I also find the same party who had collected about $3\frac{1}{2}$ inches of rain in a lading can, trying to prove that it did not rain any harder on the hills than it did in the valley below ; and it is amusing to look at these matters, considering the apparent honesty of their supporters, when we look at the facts themselves. At the very top of the hills I find the earth guttered and ploughed up, though not deep ; while, in the valleys, the uncut meadow grass was not laid, though it is common for it to be so in heavy rain. I may just

say further, on this matter, that the lading can about which there has been so much said in our local papers, was placed in such a position as scarcely to be free from the eaves droppings, being on a low wall just in front of the houses.

I think, further, the principle of extending the area to lessen the depth of calculated rainfall is vicious, and in a great measure, destroys the nature of the phenomena, judged in this way.

I have little faith in assuming data for calculations, but as we have no sufficiently known data, it may perhaps be allowable to deal in probabilities, in order to arrive at something like an estimate of the water. Therefore, to take Cornholme Arch as the best place of concentration (another tributary falling in a little below), I find the water here was about 34 ft. wide by 4 ft. 6 in. deep (the watercourse being made up), and supposing the water to travel at the rate of eight miles per hour, which is perhaps no more than it did, about 12,925,440 cubic feet of water would pass this arch in two hours, the length of time which the storm continued. Then taking the drainage area of that part of the storm, as given in the Ordnance Survey, at one square mile, and supposing the rainfall to equal 9 in., about 20,908,800 cubic feet of water would fall over this area—thus leaving nearly 8,000,000 cubic feet to run off in the week following and for absorption, which is scarcely sufficient, considering the spongy nature of the soil, and that the ground was, in some instances, saturated to the depth of 3 feet.

The dotted line on the diagram on p. 97, exhibits pretty clearly the line of rainfall in Yorkshire, there being little or no rain beyond it. At Kebbôtes, about two miles from Heald Moor, people were haymaking, and only became aware of the flood on coming into the valley. At Cross Stone and Hole Bottom, near Todmorden, haymaking was going on. At Todmorden it only rained about fifteen minutes. In Walsden, there was little rain. At Tam O'Shanter, about four miles from Bacup, on the Rochdale Road, the flags were only partially wetted. This is the nearest place to Rochdale where any rain fell. At Bacup it rained pretty freely.

At Rawtenstall the rain was not equal to an ordinary thunderstorm, the same might be said of Crawshawbooth and Sunnyside, and I cannot hear of anything beyond an ordinary rainfall at Burnley, Brierfield, Colne, and forward to Skipton. At Hartley-royd, in Stansfield, about one mile and a half from Carn Craggs, people speak of hearing the falling of the water at the latter place, and the same thing is spoken of by people living at Higher Edge, near Crawshawbooth, who say that it resembled the noise of a railway train in the distance.

As to three waterspouts being seen, I think there must be some misapprehension about it. I cannot learn anything as to when or where they were seen. People who live at a place called Shore, speak not of three only, but of seeing several on various parts of the moor; and this seems more reasonable than three only, judging of the appearance of the moor. A man at Heald describes it as one continuous sheet of water extending all along the hill tops, and so dense that they could not see through it. May be that all are right, as the phenomena might appear different when seen from various stand-points. I should think they are right, as there is nothing more likely than its appearing different to spectators looking in one direction than it does to those looking at it in another.

Without venturing any opinion as to the nature of the phenomena myself, I humbly trust that the little information I am enabled to forward may, perhaps, aid in arriving at a rational conclusion.

Abraham Greenwood.

Cornholme, Todmorden.

JULY 11TH.

The fall on this day was the product of what was known as the "Wimbledon Thunderstorm," from its greatest violence having occurred over the volunteer camp during the annual meeting. The regular gauge at Wimbledon collected 1·78, and, as the total fall in the year was only 18·22, it follows that very nearly one-tenth (9·8) of the whole year's fall came down in the course of the few hours which the storm lasted. The gauge belonging to the National Rifle Association collected 1·38 in., and by another gauge temporarily placed in the camp 1·25 inch was measured in an hour and three-quarters. A storm occurred on the same evening in Cambridgeshire.

JULY 25TH.

Heavy rain in South Essex; at Billericay one-tenth of the whole annual amount fell in a few hours.

JULY 26TH.

The heaviest fall in the year at a few detached stations in Kent, Surrey, and Sussex; at Lynch, in the latter county, three inches of rain fell during a thunderstorm.

AUGUST 4TH.

Excessive rain at two detached stations on opposite sides of Dartmoor, viz., 2·99 at Hexworthy, Launceston, being 7·2 per cent. of the total fall, and 3·60 at Zeal Monachorum, being 12·5 per cent of the total, and the largest per-centage reported this year. It is very singular that with only one exception the stations between the two just mentioned do not appear to have had any rain worth quoting.



Fig. 14.

AUGUST 22ND.

The locality of the stations having their maximum fall on this day is sufficiently shown by the map, fig. 14. The fall was not a heavy one, the only amounts of any importance being at a few stations in Monmouthshire and South Wales, where it amounted to between two and three inches.

AUGUST 27TH.

Another day of such very moderate rainfall that it is quite surprising to find that it was the wettest day in the year at more than 40 places. It may be useful to quote the number of returns and their amounts.

Rainfall not exceeding..	...	·60	...	·70	...	1·00	...	1·50	...	2·00
Number of Stations	...	2	...	8	...	23	...	41	...	46

Thus we have the remarkable fact that at two stations, Englefield, Berks, and Tendring Hall, Suffolk, there was no day in 1870 on which more ·60 inch of rain fell.

SEPTEMBER 7TH.

A fall of about an inch occurred over the south-east of England. The largest fall in that district was at Brogdale, near Faversham, 2·03, and amounted to 9·9 per cent. of the total yearly fall. In the extreme

north of Scotland, a very local and very heavy fall occurred, at Tongue, in Sutherlandshire, as will be readily understood from the following extracts. The rainfall at Tongue House was *six inches*, or 17·1 per cent. of the yearly total, the largest per-centage on record, except Scarborough, in 1857.

DISASTROUS RAIN.—The amount of damage done by the rains of Wednesday last (September 7th) is scarcely imaginable. The whole of the high roads in the Tongue end of the parish are nearly destroyed. The parish manse is also greatly damaged. The burn that flows on its south side overflowed its banks, and demolished all the walks, flower-beds, &c., in front of the manse, leaving in their stead boulders of stone, some of which are said to weigh half a ton. The whole of the furniture in the ground flat of the house is more or less damaged, and the carpets of the rooms are covered with gravel and sand to a height not less than six inches. The churchyard of Tongue is also greatly damaged, more than fifty yards of the wall that enclosed it having been thrown completely off its foundation. On the Melness side the rains have done greater damage, leaving eleven tenants so destitute of corn crops that between them they will scarcely be able to afford winter feeding for one cow. The bridge on the Moin road, above Achvouldrach, is wholly swept away. Though this and far more damage has been done at Tongue and Melness, it is remarkable that very little rain fell east of Farr or south of Ben-Loyal, and we understand nothing worthy of notice has fallen beyond Hope Ferry in the west.—*John O'Groat's Journal*.

FLOODS IN SUTHERLANDSHIRE.—Wick, Wednesday.—Intelligence has just been received of a destructive flood yesterday (September 7th), occasioned by an unprecedented fall of rain on the west coast of Sutherland. In the Strathy district, from which alone details have as yet been received, several bridges have been entirely swept away, destroying all communication. In several cases corn crops are either useless or washed away. At a late hour in the afternoon the church of Strathy was flooded, and water to the depth of several feet threatened the foundations. So far as we have ascertained no lives were lost, but the damage is very great. As communication is stopped it will be probably several days before details can be received from the other districts affected.—*Times*.

Another Account.—From further details which have been obtained of the flood on the west coast of Sutherland it appears that it occurred on Wednesday, September 7th, and was confined to a comparatively narrow spot in the district of Tongue, though very great damage has been done. The manse and glebe of the parish minister have suffered very severely. Miss Logan, his daughter, had to be taken from the window, the lower storey of the manse being flooded. Large numbers of stones are lying in the fields, and the roads are in several places so injured as to be nearly impassable. Several bridges are demolished, and no communication can for some time be carried on by the ordinary route. Some of the cottagers have had their grain crops quite destroyed. The cattle were saved with great difficulty.

*Fig. 15.*

OCTOBER 7TH AND 8TH.

As will be seen from the article on dry periods, the fragmentary drought of 1870 terminated on October 6th or 7th at most stations, and it ended not gently or gradually, but with a week or so of continuous heavy rain. The annexed map shows that the heavy rains of the above date occurred principally in Lancashire, Yorkshire, and Durham, but with outlying stations extending almost to the Bristol Channel. The quantity at the whole of the 68 stations at which this was the heaviest fall of the year averaged an inch and a half, and in South Lancashire and South-west Yorkshire two inches, hence the following extracts from Manchester papers are readily explained.

FLOOD AT PRESTON.—The heavy rains of Saturday, 8th October, caused the river Ribble to overflow its banks in some places in the neighbourhood of Preston, and serious apprehensions of damage from the next tide were entertained. About the time when it flowed, however, 11.20 p.m., there was a rather strong wind from the east, which materially reduced the height of the flood. The Miller Park, at Avenham, was yesterday morning under water in its lowest parts, but this arose from the drains being rendered inoperative by the freshet in the river, which rose considerably above the drainage outlets. Thomas Hesketh, boatman, had two or three boats carried away by the flood. All the low lands east and west of Preston were flooded to some extent, but we have not learned that any serious damage was done. Yesterday morning the carcasses of a cow and some smaller animals, sheep or pigs, floated down the Ribble, past Preston, towards the sea, indicating that the flood must have been serious somewhere further up the river, in East Lancashire or Yorkshire.

HEAVY FLOOD IN THE IRWELL.—Yesterday morning, Manchester and Salford were, for a while, threatened with a repetition of the disastrous floods of 1866, the river Irwell, swelled by some twenty-four hours' heavy rain, rising to an alarming extent, and in many places overflowing its banks. During Friday, continuous showers of rain fell, the effect of which was to create the ordinary freshet,

about four feet above the usual level of the river, but on Saturday evening a perfect downpour, which extended over the upper reaches of the valley, as well as the district immediately around Manchester, speedily caused the water to rise still more, and created general alarm in the low, and, therefore, more readily exposed, portions of Salford and Broughton. There is every reason to believe that but for the sudden cessation of the rain yesterday, the whole of these districts would have been inundated. As it was, large tracts of arable land above Salford, the lower portions of many mills, cellars, and private dwellings were several feet under water. It was about midnight, however, that the alarmingly rapid rise of the stream gave occasion to what might almost be termed a panic in the thickly-populated locality of the Adelphi, where the cellar dwellings are generally the first to experience, either from the backing up of the sewers or immediate inundation, the effects of any flood in the river. Hundreds of interested watchers, therefore, lined the river banks, and, seeing the certainty of an overflow, removed, or assisted to remove, furniture and effects from lower to upper storeys; whilst workmen were similarly engaged in the business houses in transporting goods and perishable articles. The river still continued to rise as the morning advanced, till at a quarter-past eight yesterday morning the official measurements recorded an average of 14 feet above ordinary level. The effect of such a height of water in a confined river like the Irwell is too sufficiently known to require much explanation. From Pendleton to Throstle Nest all the various works and dwellings liable to inundation were simply deluged, and the broad expanse of water at Peel Park, and the fields extending in the direction of a block of cottages known as Wallness, assumed the character of an immense lake, here and there picturesquely studded with trees and foliage. For some hours—from 1 a.m. till 9.30—the flood remained stationary at 14 ft. above the ordinary level. It then slowly decreased till noon, and last evening the official measurements made by Mr. Jones, inspector of the river, showed that it had decreased 9 feet. Such a height of water has not been witnessed since 1866, and perhaps the rapidity with which it ascended never. So heavy was the fall of rain, that shortly before seven o'clock the water rose at the rapid rate of four inches in one hour, and it was evident that at this rate the disasters of 1866 were in a fair way of being renewed. The warehouses along Water Street have not suffered to any appreciable extent. At Mr. J. M. Bennett's timber-yard the water rose to the level of the yard, but receded without doing any mischief. The wharves of the Bridgewater Trustees were also fortunate in escaping injury. Commencing with several acres of land on the farm of Mr. Higson, then overflowing its banks, the river, bringing with it trunks of trees, and other floating materials, stretched away in a splendid sheet of water to Peel Park, as already stated. Here playgrounds, walks, meadows, the carefully-tended flower-beds, shrubberies, and the many floral features of the park were under water, and the high wall at the foot of the Créscent Embankment was covered. In the direction of the Adelphi, Lower Broughton, Springfield Lane, and Greengate Street were under water, cellars and basements inundated, and vast mischief wrought. Nearly all of the works situated on the banks of the river between the Adelphi and Albert Bridge were submerged to a depth of two or three feet. The basement of Messrs. Walker and Norris's Adelphi Dye-works were flooded to a depth of three feet, and their goods and machinery damaged. The adjoining dye premises of Mr. Isaac Bury, Hall and Poole, Adelphi Cotton Mill, Samuel Dewhurst and Co., Renshaw and Co.'s Flax Mill, Mr. Thos. Farmer, Rope and Twine Manufac-

turner (where the depth of water was five feet); Mr. Isaac Slater, Cotton Manufacturer, Hope Field; Leeming and Co.'s Worsted Mill, several cottages in Blackburn Place, the Broughton Copper Company's Works; Haworth and Co.'s Mill, Broughton Bridge; Entwistle and Sons, Spinners, Wheat Mill; a weaving shed, where the warps had to be cut and removed to the upper storeys; Messrs. Brigg's Lower Work, Dickenson Street, Springfield Lane, where the water ran over the embankment; Mr. John King, Jun.'s mill at Springfield; Mr. Goodwin's rope and twine manufactory, at Springfield Lane, washed away in 1866; and Mr. J. Lancaster's dye-works, all suffered. Greengate also experienced its share of the effects of the flood. Numbers of shopkeepers complain of damage done to goods stored in cellars. Messrs. Langworthy Brothers' dye-works, Mr. J. Fletcher and Co.'s machine works, Mr. C. Gibbs's Blackfriars Mill; Messrs. Ellis Brothers, Stanley-street, Messrs. Muir's tool manufactory, Sherbourne-street, the Rock Mill, Strangeways; and Staniar's wireworks were similarly visited. At Sunnyside, Lower Broughton, the river flooded the cellars in Elton-street, and many of them not being provided with soughs, the whole of the water will have to be pumped out. In several dwellings in Strangeways sewers have been backed up. During the day the Mayor (Alderman Davies) and Inspector Jones were occupied in watching the rise of the water, and directing necessary precautions. It would be impossible to give any estimate of the extent of damage caused, but in many instances it must be exceedingly great, and days must elapse before full operations are resumed at some works.

When at its height at Broughton Bridge, the river was six feet below the flood of 1866, and at Albert Bridge three feet eight inches.

The Medlock was also much swollen, the gauge showing yesterday morning a height of about seven feet above the summer level. The cellars along the river-bank were flooded, but no case of serious damage or inconvenience had been reported at the police stations up to last night.



Fig. 16.

OCTOBER 12TH.

The fall on this day was by no means remarkable, except as following several days' heavy rain. It was the wettest day in the year in the North of Ireland, the southern part of the Lake District, and at some Scotch stations, but it was not very heavy anywhere.

OCTOBER 22ND.

Between one inch and one inch and a half of rain fell in Kent and over a large part of Sussex, at most stations in which counties it exceeded the fall on any other day in the year. The fall was local, not extending beyond the boundaries of Division II.

*Fig. 17.*

DECEMBER 19TH.

Another local fall; this time in Division IV., with outlying stations reaching across to Chester. The amounts were not large, ranging from three-quarters of an inch to an inch and a half, but being generally within a few hundredths above or below one inch.

DRY PERIODS IN 1870.

VERY few words of introduction or comment are needed with reference to the following tables, which, at the suggestion of a correspondent, have been drawn up in precisely the same manner as those given for 1868, and are of course intended for comparison therewith. It will be seen at once that the period over which they extend is nearly six months, or about 75 days longer than in 1868; but, on the other hand, the rain which fell during the time was far greater than in 1868, in fact so much so as to render questionable the propriety of applying the term drought to the period. But as we have elsewhere shown that the monthly fall for every month, from March to September inclusive, was below the average, we must admit that it implies a drought; but as six or seven inches of rain fell at most stations during its continuance, it certainly was not an unmitigated one. The longest absolutely rainless period was 23 days from September 13th to October 6th, at Presteign, in Radnorshire, and there were numerous instances of a fortnight or three weeks with less than a tenth of an inch.

Dry Periods in 1870.

Station. County. Total fall in Year.	Duration.		Exceptions.	
	Date.	No. of Days.	Total Depth.	Falls above .10 in.
Camden Town, MIDDLESEX. 21.32 in.	April 11 to 28	17	.12	
	May 2 to July 29...	88	2.45	May 11, .32; 13, .22; June 16, .49; 24, .25; July 5, .16; 11, .24; 25, .31.
	August 2 to 22.....	20	.16	August 7, .11.
	Sept. 10 to Oct. 6	26	.31	September 13, .26.
	April 11 to Oct. 6	179	7.69	Rain on 42 days.
Farnham, SURREY. 19.71 in.	April 10 to May 9	29	.31	April 29, .16.
	May 13 to 29	16	.31	May 15, .29.
	June 2 to 15	13	...	No rain.
	June 18 to Aug. 5	48	.59	June 26, .24.
	August 8 to 25.....	17	.15	August 10, .14.
Acol, Margate, KENT. 16.38 in.	April 13 to 26	13	...	No rain.
	April 29 to May 30	32	1.11	May 13, .18; 21, .39.
	June 2 to 23... ..	21	.25	June 7, .22.
	July 11 to Aug. 27	51	1.05	July 25, .35; 26, .12; August 7, .17;
	Sept. 20 to Oct. 6	16	...	No rain. [22, .33.
	April 13 to Oct. 6	177	7.08	Rain on 39 days.
Sittingbourne, KENT. 17.20 in.	April 11 to July 25	105	2.08	April 30, .12; May 13, .41; June 1,
	July 27 to Aug. 21	25	.56	[.15; 24, .11; July 11, .48.
	Sept. 10 to Oct. 15	35	.41	
	April 11 to Oct. 15	188	6.96	Rain on 32 days.
Englefield, BERKS. 16.85 in.	April 10 to May 11	30	.30	April 30, .22.
	May 17 to July 9...	53	.67	June 17, .29; July 6, .21.
	July 11 to Aug. 22	42	.51	August 1, .21; 9, .16.
	Sept. 11 to Oct. 7	26	.08	
	April 10 to Oct. 7	181	5.71	Rain on 29 days.
Eton College, BUCKS. 18.99 in.	April 10 to May 10	30	.16	
	May 15 to June 23	39	.31	July 16, .27.
	June 25 to July 8	13	.35	July 1, .17; 5, .13.
	July 9 to Aug. 20	42	.87	July 31, .26; August 1, .13.
	Sept. 9 to Oct. 6...	27	.20	September 13, .14.
	April 10 to Oct. 6	180	6.47	Rain on 38 days.
Sheering, Harlow, ESSEX. 18.05 in.	April 12 to 29	17	.12	
	May 16 to June 1	16	...	No rain.
	June 4 to July 3 ...	29	.35	June 16, .16.
	July 7 to 29.....	22	.48	July 15, .15; 25, .22.
	August 2 to 26... ..	24	.71	August 7, .17; 22, .39.
	Sept. 13 to Oct. 6	23	.04	
	April 12 to Oct. 6	178	6.23	Rain on 62 days.
Pickenham, NORFOLK. 21.81 in.	May 17 to June 28	42	.83	June 11, .14; 24, .20; 26, .15.
	July 30 to Aug. 24	25	.81	August 18, .25; 22, .26; 23, .11.
	Sept. 19 to Oct. 6	17	.05	
	May 17 to Oct. 6...	142	7.51	Rain on 45 days.
West Tytherton, WILTS. 18.14 in.	April 11 to 30.....	19	.17	April 29, .16.
	May 18 to June 15	28	.13	

Station. County. Total Fall in Year.	Duration.		Exceptions.	
	Date.	No. of Days.	Total Depth.	Falls above .10 in.
West Tytherton, WILTS. (continued.)	June 19 to July 2	13	.04	No rain.
	July 10 to 29	19	.08	
	August 8 to 21	13	...	
	Sept. 10 to Oct. 6	26	.10	Rain on 57 days.
	April 11 to Oct. 6	179	5.98	
Cricket St. Thomas, SOMERSET. 30.79 in.	April 10 to May 10	30	.32	April 29, .20.
	May 16 to June 15	30	.60	May 30, .14; June 1, .25; 7, .14.
	June 17 to July 31	44	.36	July 9, .30.
	August 10 to 30 ...	20	.78	August 22, .45.
	Sept. 11 to Oct. 4	23	.02	Rain on 36 days.
	April 10 to Oct. 4	178	7.71	
Burnham, SOMERSET. 19.34 in.	April 11 to May 10	29	.25	April 28, .22.
	May 16 to July 2...	47	.45	May 30, .12; June 1, .28.
	July 6 to Aug. 5...	30	.36	August 2, .19.
	Aug. 10 to 22	12	...	No rain.
	Sept. 10 to Oct. 6	26	.05	Rain on 32 days.
	April 11 to Oct. 6	179	6.03	
Arden House, Hedley-in-Arden WARWICK. 19.14 in.	April 13 to 28	15	...	No rain.
	May 14 to June 15	32	.06	No rain.
	June 17 to 30	13	..	
	July 14 to Aug. 21	38	.41	August 7, .29.
	Sept. 14 to Oct. 7	23	...	No rain.
	April 13 to Oct. 7	178	6.60	Rain on 34 days.
Cheswell Grange, SALOP. 21.28 in.	April 15 to 30	15	.07	June 12, .16; 24, .13. August 9, .34.
	May 17 to July 4...	18	.70	
	July 10 to Aug. 21	42	.47	
	Sept. 15 to Oct. 7	22	.06	Rain on 44 days.
	April 15 to Oct. 7	175	6.42	
Owston, LEICESTER. 22.56 in.	April 14 to 27	13	...	No rain.
	May 16 to June 24	39	.44	June 11, .21; 16, .22.
	July 6 to 29	13	.08	Rain on 46 days.
	Sept. 13 to Oct. 6...	23	.02	
	April 14 to Oct. 6	175	5.72	
Boston, LINCOLN. 16.40 in.	April 14 to 28	14	.01	June 11, .12. July 9, .11; August 18, .11.
	May 16 to June 15	30	.12	
	July 15 to Aug. 21	37	.28	
	Sept. 14 to Oct. 6	22	.01	Rain on 41 days.
	April 14 to Oct. 6	175	5.11	
Belmont, LANCASHIRE. 58.87 in.	May 1 to 10	9	.09	Rain on 59 days.
	July 21 to Aug. 20	30	.06	
	Sept. 14 to Oct. 6...	22	.17	
	May 1 to October 6	159	14.49	
Fartown, Hudders- field, YORKSHIRE. 30.45 in.	April 11 to 28	17	.25	April 22, .11.
	July 6 to August 21	46	.23	August 18, .18.
	Sept. 18 to Oct. 6..	18	.04	Rain on 59 days.
	April 11 to Oct. 6	178	7.32	

Station. County. Total Fall in Year.	Duration.		Exceptions.	
	Date.	No. of Days.	Total Depth.	Falls above .10 in.
Allerton, Leeds, YORKSHIRE. 25.03 in.	April 13 to 29	16	.51.	
	May 13 to June 9	27	.14	
	July 3 to Aug. 21	49	.37	August 18, .35
	Sept. 14 to Oct. 6	20	.09	
	April 13 to Oct. 6	176	7.26	Rain on 45 days.
Filey, YORKSHIRE. 22.12 in.	April 12 to 24	12	.02	
	May 1 to June 16	15	.58	May 12, .41.
	July 3 to Aug. 18	46	.31	
	Sept. 16 to Oct. 6	20	...	No rain.
	April 12 to Oct. 6	177	6.06	Rain on 48 days.
Whitby, YORKSHIRE. 26.08 in.	April 11 to 17	6	.07	
	May 15 to 29	14	..	No rain.
	July 3 to 30	27	.26	July 20, .16.
	August 1 to 18 ...	17	.09	
	Sept. 14 to Oct. 6	22	.03	
	April 11 to Oct. 6	178	7.78	Rain on 58 days.
Wallington, NORTHUMBERLAND. 28.83 in.	April 13 to 27	14	.21	April 22, .13.
	July 10 to 29	19	.05	
	August 6 to 26	20	.46	August 18, .23 ; 22, .17.
	Sept. 17 to Oct. 6	19	.04	
	April 13 to Oct. 6	176	8.46	Rain on 74 days.
Tintern Abbey, MONMOUTH. 32.86 in.	April 13 to 28	15	.02	
	May 15 to 29	14	...	No rain.
	June 3 to July 2 ...	29	.45	June 16, .34.
	Sept. 14 to Oct. 6	22	...	No rain.
	April 10 to Oct. 6	179	11.10	Rain on 41 days.
Presteign, RADNOR. 28.94 in.	April 10 to 29	19	.05	
	May 16 to 30	14	...	No rain.
	June 18 to July 2	14	...	No rain.
	July 5 to August 1	27	.19	
	Sept. 13 to Oct. 6	23	...	No rain.
	April 10 to Oct. 6	179	8.18	Rain on 48 days.
SCOTLAND.				
Laggan, INVERNESS. 37.69 in.	July 21 to 31	10	...	No rain.
	August 4 to 19 ..	15	...	No rain.
	Sept. 16 to Oct. 6	20	.30	September 26, .20.
	July 21 to Oct. 6...	78	7.04	Rain on 24 days.
Lochbroom, Ross. 41.82 in.	July 21 to Aug. 16	26	.28	July 23, .16.
	Sept. 16 to Oct. 6	20	.08	
	July 21 to Oct. 6...	78	7.05	Rain on 30 days.
IRELAND.				
Courtown House, WEXFORD. 30.34 in.	April 13 to May 10	27	.26	
	June 16 to Aug. 3	48	.50	
	August 7 to 22... ..	15	...	No rain.
	Sept. 16 to Oct. 6	20	...	No rain.
	April 13 to Oct. 6	176	8.18	Rain on 44 days.
Balbriggan. DUBLIN. 28.92 in.	July 10 to Aug. 2	23	.54	July 16, .28.
	August 8 to 27	19	.33	August 22, .23.
	Sept. 19 to Oct. 6	17	.11	
	July 10 to Oct. 6...	89	4.90	Rain on 31 days.

ON THE FALL OF RAIN IN EACH MONTH OF 1870.

 JANUARY.

The rainfall this month was generally rather below the average. It was most in defect in the west of Scotland, the east of England, and the north of Ireland; it was, on the other hand, above the average in the west of Ireland, and in parts of Lancashire and Yorkshire.

FEBRUARY.

Had it not been for the somewhat irregular distribution of the rain of the 6th, the rainfall this month would have been very uniform and slightly below the average, but the unequal intensity of this storm caused some counties to have more than twice their average (as was the case in Hampshire, in Cornwall, and in the west of Scotland), while others, not catching that storm, were left either with their average amount, or even with a slight deficiency.

MARCH.

A dry month, especially in Scotland.

APRIL.

Another very dry month; scarcely any stations (except in the north-west of Scotland) which had their average amount, and several which had less than 1 per cent. of their yearly total. At the majority of stations the fall was less than 1 inch.

MAY.

A third consecutive dry month at most stations, the only exceptions of any moment being the south-west of Scotland, and some stations across the centre of Ireland.

JUNE.

At the majority of stations this was the fourth consecutive month of deficient rainfall. A few thunder-showers passed about, but from their brevity and the heated condition of the ground, they produced but a very trifling effect on the browned and burnt surface of what should have been verdant lawns, but actually were little better than roadside paths.

JULY.

There were several thunderstorms in this month, and though they were partial and did not yield their ordinary supply of moisture, yet they rendered the total fall in July less deficient than the previous four months. Excepting, however, a few isolated stations, where local heavy rains occurred, the fall was uniformly below the average.

AUGUST.

The sixth consecutive month of which the rainfall of these Islands was below the average; it was not, however, so much so as most of the others, and in a few places (in Northampton, Somerset and Kent) it exceeded it. In the Lake District this usually wet month was remarkably fine.

SEPTEMBER.

The seventh and last of the dry months in England, and some parts of Ireland. In Scotland the fall was very near the average, and in some parts of Ireland there was a considerable excess.

OCTOBER.

Usually (except in Mountain Districts) one of the wettest months of the year, October, 1870, far exceeded its ordinary limits, and bade fair to make up for the deficiencies of the previous months. In the north and north-west, and at one or two stations on the eastern coast of Scotland the fall was below the average; at all others it was above it, and generally, by very large amounts. Reference to the per-centage table on page 121 will show that at several of those stations more than one quarter of the entire year's rain fell in that month.

The following table will, however, be more instructive than any general remarks. It will be seen that the stations are arranged according to the per-centage October bore to the whole year.

Division.	Station.	Yearly Total.	October	
			Depth.	Per cent.
		in.	in.	
IX.	Dunford Bridge	54·44	19·90	36·6
„	Wath-upon-Dearne	19·40	6·47	33·4
XI.	Llanidloes (Dolenog)	38·25	12·67	33·1
„	„ (Ystrad-olwyn-fawr) ..	45·00	14·70	32·7
IX.	Whiteholme, Clitheroe	48·98	15·72	32·2
„	Dunford Bridge Reservoir	44·78	14·39	32·1
X.	Matterdale	63·75	19·75	31·0
XI.	Rhayader (Rhydoldog).....	50·30	14·99	29·8
„	„ (Cefnfaes)	41·35	12·23	29·6
„	Llanwrytydd	47·59	13·26	27·9

It will be seen that the greatest excess occurred on the Yorkshire side of the Pennine chain, and that another district of excess was Central Wales.

The close agreement of many of these values when the actual amounts of rain differ widely, is extremely satisfactory, as evidence of the conformability of rainfall to law and system, and, moreover, it proves the care exercised by the observers, for without it, such results could not be obtained.

NOVEMBER.

The rainfall of this month requires no special note ; it was near the average, but generally below it.

DECEMBER.

A wet month in the Midland and Eastern Counties, and a comparatively dry one in Ireland, Wales, and the West of England.

On the whole we therefore find that the seven months, March to September inclusive, were all below the average ; that the first two months and the last two were not very different from the average, and that October was exceptionally wet.

MONTHLY RAINFALL IN 1870.

ENGLAND

COUNTY ..	Kent.	Sussex.	Berks.	North- ampton. Welling- borough.	Norfolk.	Devon.	Cornwall.	Somerset.	Worcester.
STATION ..	Tunbridge.	Chichester.	Newbury.		Cossey.	Sidmouth.	St. Austell.	Burnham.	Beechwood.
Ft. abv. Sea	71	20	235	...	...	26	300	30	157
January	in. 1·73	in. 1·69	in. 1·36	in. 1·12	in. 1·21	in. 1·54	in. 3·37	in. 2·35	in. 1·74
Feb. ...	1·75	2·48	1·69	1·27	·80	2·17	3·58	1·35	1·75
March..	2·04	1·43	2·34	1 00	1·54	2·10	2·69	1·37	1·32
April ...	— ·38	— ·17	·37	— ·63	·88	— ·35	— ·16	·53	— ·59
May ...	1·04	·90	1·26	·65	— ·61	1·40	2·51	·89	·84
June ...	·51	·24	— ·26	·90	1·12	·65	·29	— ·33	·90
July ...	1·83	1·94	·88	2·17	1·91	·62	2·23	·44	2·20
August.	+4·43	2·13	1·59	2·16	2·18	·78	2·73	2·54	1·48
Sept. ...	2·32	1·61	2·41	·83	1·61	·92	1·97	1·58	·81
October.	4·27	+4·38	+3·99	+3·07	3·85	+3·81	+6·52	+4·96	+3·88
Nov. ...	1·58	1·79	1·62	1·09	1·43	2·45	4·28	1·33	2·67
Dec. ...	3·46	2·61	2·63	2·32	+4·15	3·00	2·93	1·67	1·75
Totals..	25·34	21·37	20·40	17·21	21·29	19·79	33·26	19·34	19·93

ENGLAND—(continued.)

WALES.

COUNTY ..	Lincoln.	Lanca- shire.	York.	York.	Westmore- land.	Pembroke.	Cardigan.	Denbigh.	Merioneth.
STATION ..	Branston.	Lancaster.	Leeds.	Whitby.	Kirkby Stephen.	Kilgerran.	Aberystwith.	Rosset.	Dolgelly.
Ft. abv. Sea	200 ?	118	95	184	574	80	42	58	43
January	in. 1·32	in. 3·62	in. 1·76	in. 1·27	in. 4·09	in. 4·10	in. 2·67	in. 1·94	in. 5·02
Feb. ...	1·96	2·13	1·59	2·27	3·00	4·66	2·48	1·19	6·69
March..	1·69	1·80	1·72	1·38	1·65	2·37	2·36	1·88	4·73
April ...	1·10	—1·35	—·64	·57	—1·18	·80	2·27	1·30	4·67
May ...	—·69	2·05	1·19	1·12	2·24	2·43	1·87	·89	4·23
June ...	1·73	1·91	1·81	3·08	1·52	—·69	—1·52	·70	2·68
July ...	1·01	2·19	·83	—·47	2·46	1·83	3·29	—·52	—2·65
August.	1·75	2·49	1·68	1·76	1·81	2·74	3·42	2·40	3·90
Sept....	1·44	3·05	·83	·95	2·33	2·87	3·32	1·62	3·85
October	+5·20	+8·31	+6·16	4·64	+7·36	+9·43	+11·53	+4·76	+15·04
Nov. ...	1·89	3·04	1·97	2·62	3·26	5·76	6·40	2·68	8·91
Dec. ...	3·27	2·73	2·75	+5·95	2·87	2·56	3·43	2·83	6·15
Totals..	23·05	34·67	22·93	26·08	33·77	40·24	44·56	22·71	68·52

MONTHLY RAINFALL IN 1870—(continued.)

SCOTLAND.

COUNTY....	Kirkcud- bright. Dalbeattie.	Edin- burgh. Cobbin- shaw.	Dumbar- ton. Arddar- och.	Argyll. Airds.	Fife. Cupar.	Aberdeen. New Byth	W. Ross. Duncraig.	E. Ross. Ardross Castle.	Inverness. Farraline.
STATION ..									
Ft. abv. Sea	25 ?	863	80	15	130	391	124	450	700
January	in. 5·12	in. 3·10	in. 7·19	in. 3·20	in. 2·02	in. 1·99	in. 2·49	in. 2·87	in. 2·50
Feb. ...	3·61	1·80	7·51	+11·50	2·59	2·88	2·78	2·06	2·00
March..	2·56	—·80	2·30	—1·40	·85	1·78	—1·13	—·70	—·60
April ...	1·51	1·00	3·06	4·40	—·39	2·38	+5·59	2·34	1·80
May ...	5·22	2·40	6·13	5·30	1·12	2·28	3·10	1·96	1·90
June ...	1·75	2·60	3·07	2·80	1·90	1·63	2·60	·84	1·20
July ...	1·17	1·60	3·14	5·10	1·43	—·70	3·22	1·99	2·40
August.	—·96	—·80	—1·32	2·20	·98	1·68	1·66	2·12	2·40
Sept. ...	4·04	2·40	6·06	5·90	2·91	2·76	4·46	3·37	2·30
October	+6·53	+3·60	+10·38	6·60	3·67	2·94	5·21	3·61	3·00
Nov. ...	3·11	1·70	3·16	1·90	1·62	4·90	3·93	4·12	3·00
Dec. ...	1·99	1·70	5·83	3·00	+4·46	+6·22	4·40	+4·82	+3·20
Totals..	37·57	23·50	59·15	53·30	23·94	32·14	40·57	30·80	26·30

IRELAND.

COUNTY....	Kerry.	Tipperary.	Carlow.	Dublin.	Galway.	Roscom- mon. Holywell.	Cavan.	Antrim	London- derry. Bellarena.
STATION ..	Killarney.	Clonmel.	Carlow.	Skerries.	Cregg Park Gort.		Red Hills.	Antrim.	
Ft. abv. Sea	100	80	291	12	120	...	...	150	20
January	in. 3·37	in. 4·59	in. 3·14	in. 2·05	in. 3·82	in. 3·28	in. 4·19	in. 2·22	in. 1·66
Feb. ...	4·67	4·69	2·42	1·67	2·97	2·74	2·51	1·74	2·15
March..	4·96	2·64	2·41	2·10	1·22	1·58	1·54	·91	1·61
April ...	5·63	1·35	1·08	—·80	1·81	—1·46	—1·16	·86	—1·51
May ...	4·95	2·74	2·75	2·97	3·79	1·68	2·91	2·38	1·84
June ...	—·26	—·89	1·06	1·07	·98	1·81	1·22	1·69	2·33
July ...	·28	1·50	—·74	·88	1·33	2·12	1·65	2·60	1·83
August.	5·51	1·99	1·99	1·86	1·99	2·48	1·24	2·87	1·91
Sept. ...	12·68	2·73	2·65	3·49	3·02	3·32	3·35	2·36	3·26
October	+16·51	+5·16	+5·60	+6·52	+6·09	+5·92	+7·60	+7·60	+7·34
Nov. ...	8·66	2·39	2·21	1·62	—·89	1·93	1·86	—·75	2·20
Dec. ...	1·53	2·58	2·19	2·78	2·10	2·90	3·22	2·56	3·34
Totals..	69·01	33·25	28·24	27·81	30·01	31·22	32·45	28·54	30·98

MONTHLY PER-CENTAGE OF RAIN IN 1870.

ENGLAND.

WALES.

Month.	Tunbridge.	Chichester.	Newbury.	Northampton,	Cossey.	Sidmouth.	St. Austell.	Burnham.	Worcester.	Branston.	Lancaster.	Leeds.	Whitby.	Kirkby Stephen.	Kilgerran.	Aberystwith.	Rosset.	Dolgelly.
Jan...	6.8	7.9	6.7	6.5	5.7	7.8	10.1	12.1	8.7	5.7	10.4	7.7	4.9	12.1	10.2	6.0	8.5	7.3
Feb...	6.9	11.6	8.3	7.4	3.8	11.0	10.8	7.0	8.8	8.5	6.1	6.9	8.7	8.9	11.6	5.6	5.2	9.8
Mar..	8.1	6.7	11.5	5.8	7.2	10.6	8.1	7.1	6.6	7.3	5.2	7.5	5.3	4.9	5.9	5.3	8.3	6.9
April.	1.5	8	1.8	3.7	4.1	1.8	5	2.7	3.0	4.8	3.9	2.8	2.2	3.5	2.0	5.1	5.7	6.8
May..	4.1	4.2	6.2	3.8	2.9	7.1	7.5	4.6	4.2	3.0	5.9	5.2	4.3	6.6	6.1	4.2	3.9	6.2
June.	2.0	1.1	1.3	5.2	5.2	3.3	9	1.7	4.5	7.5	5.5	7.9	11.8	4.5	1.7	3.4	3.1	3.9
July..	7.2	9.1	4.3	12.6	9.0	3.1	6.7	2.3	11.0	4.4	6.3	3.6	1.8	7.3	4.5	7.4	2.3	3.9
Aug..	17.5	10.0	7.8	12.6	10.2	3.9	8.2	13.1	7.4	7.6	7.2	7.3	6.8	5.4	6.8	7.7	10.6	5.7
Sept..	9.2	7.5	11.8	4.8	7.6	4.6	5.9	8.2	4.1	6.2	8.8	3.6	3.6	6.9	7.1	7.4	7.1	5.6
Oct...	16.8	20.5	19.5	17.8	18.1	19.2	19.6	25.7	19.5	22.6	24.0	26.9	17.8	21.8	23.4	25.8	21.0	21.9
Nov..	6.2	8.4	7.9	6.3	6.7	12.4	12.9	6.9	13.4	8.2	8.8	8.6	10.0	9.6	14.3	14.4	11.8	13.0
Dec..	13.7	12.2	12.9	13.5	19.5	15.2	8.8	8.6	8.8	14.2	7.9	12.0	22.8	8.5	6.4	7.7	12.5	9.0

SCOTLAND.

IRELAND.

Month.	Dalbeattie.	Cobbinshaw.	Arddarroch.	Airds.	Cupar.	New Byth.	Duncraig.	Ardross.	Farraline.	Killarney.	Clonmel.	Carlow.	Skerries.	Gort.	Holywell.	Red Hills.	Antrim.	Bellarena.
Jan....	13.6	13.2	12.2	6.0	8.4	6.2	6.1	9.3	9.5	4.9	13.8	11.1	7.4	12.7	10.5	12.9	7.8	5.4
Feb....	9.6	7.7	12.7	21.6	10.8	9.0	6.8	6.7	7.6	6.8	14.1	8.6	6.0	9.9	8.8	7.7	6.1	6.9
Mar...	6.8	3.4	3.9	2.6	3.6	5.5	2.8	2.3	2.3	7.2	7.9	8.5	7.6	4.1	5.1	4.8	3.2	5.2
April.	4.0	4.3	5.2	8.2	1.6	7.4	13.8	7.6	6.8	8.1	4.1	3.8	2.9	6.0	4.7	3.6	3.0	4.9
May..	13.9	10.2	10.4	9.9	4.7	7.1	7.6	6.3	7.2	7.2	8.2	9.8	10.7	12.6	5.4	9.0	8.3	5.9
June..	4.7	11.1	5.2	5.3	7.9	5.1	6.4	2.7	4.6	4	2.7	3.8	3.8	3.3	5.8	3.8	5.9	7.5
July..	3.1	6.8	5.3	9.6	6.0	2.2	7.9	6.5	9.1	4	4.5	2.6	3.2	4.4	6.8	5.1	9.1	5.9
Aug...	2.6	3.4	2.2	4.1	4.1	5.2	4.1	6.9	9.1	8.0	6.0	7.0	6.7	6.6	7.9	3.8	10.1	6.2
Sept..	10.7	10.2	10.2	11.1	12.2	8.6	11.0	10.9	8.9	18.4	8.2	9.4	12.5	10.1	10.6	10.3	8.3	10.5
Oct...	17.4	15.3	17.6	12.4	15.3	9.1	12.9	11.7	11.4	23.9	15.5	19.8	23.4	20.3	18.9	23.4	26.6	23.7
Nov..	8.3	7.2	5.3	3.6	6.8	15.3	9.7	13.4	11.4	12.5	7.2	7.8	5.8	3.0	6.2	5.7	2.6	7.1
Dec...	5.3	7.2	9.8	5.6	18.6	19.3	10.9	15.7	12.2	2.2	7.8	7.8	10.0	7.0	9.3	9.9	9.0	10.8

ON THE GEOGRAPHICAL DISTRIBUTION OF RAIN IN 1870.

THE completion of the decennial period 1860-69, and of the computation of the mean rainfall during that period, already referred to on page 55, together with the calculations on that and subsequent pages, have enabled us to apply a new test to our ordinary comparative tables. Our readers may recollect that when we first adopted the rainfall 1860-65 as our usual standard of comparison, we explained that the values for that period closely approached the mean of a long series of years. Now that the years 1866-9 have rolled away, we are able to apply a searching enquiry into the accuracy of that assumption. The result is, that our original view of the matter is confirmed to a remarkable degree; the error seems to be less than 1 per cent. Perhaps some day we may print the whole of the figures as an illustration of the accuracy with which calculations of this kind may be made. At present we must ask our readers to accept it without actual proof.

The geographical distribution of rain during 1870 was very simple, but very remarkable; simple, because there were only five stations which were above the average—all others were below it. In England and Wales the deficiency has no exceptions but York and Settle; the amount of deficiency varies considerably, ranging from a trifling excess of about an inch, or 4 per cent., at the two stations named to more than 30 per cent. in the southern counties Devon, and Cornwall. At some of the Devonshire stations, 1870 was drier than any other year for more than a quarter of a century; in other parts the years 1854 and 1864 had less rain.

The resemblance between the years 1864 and 1870 is, in many respects, striking. July, 1864, was much drier than July, 1870, otherwise the description of the monthly falls in one year would almost answer for the other. This is notably the case with respect to October; but, in 1864, the drought ended a week later than in 1870, and the excessive rains (and they were even more striking than those of 1870) occurred further north, in the vicinity of the Cheviots, instead of in Wales and along the Pennine chain.

The actual deficiency in England and Wales for 1870 was 17 per cent.

The Scotch returns seem more consistent this year than for some years past, and show that the drought was felt there also, and that the rainfall scarcely exceeded three-quarters of the average.

In Ireland the deficiency, though sensible, was not quite so great.

We therefore obtain (as is fully shown on the two following pages) the following final results :—

	Rainfall in 1870.		
In England and Wales	17	per cent. below average.	
„ Scotland.....	22	„	„
„ Ireland.	14	„	„
	<hr/>		
British Isles ...	18	„	„

COMPARISON OF THE RAINFALL IN 1870 WITH PREVIOUS YEARS.
ENGLAND AND WALES.

Div.	STATION.	COUNTY.	Average			Depth in 1870.	Difference from Average, 1860-5	
			1840-9.	1850-9.	1860-5.		Amount.	Per cent
			in.	in.	in.	in.	in.	
I.	Camden Town	Middlesex ...	...	(24·30)	25·01	21·32	3·69	— 15
II.	Chichester Infirmary.....	Sussex	29·10	26·67	29·01	21·37	7·64	— 26
"	" (Shopwyke) .....	" .....	...	26·25	28·41	24·89	3·52	— 12
"	" (Chilgrove)	"	33·41	32·23	32·77	27·57	5·20	— 16
"	" (W. Dean) .....	" .....	...	35·30	37·02	28·35	8·67	— 23
"	Uckfield Observatory .....	" .....	...	30·03	31·50	24·99	6·51	— 21
"	Ventnor, Isle of Wight...	Hants. ....	...	28·46	29·26	20·60	8·66	— 30
III.	Hemel Hempstead	Herts.	25·86	26·43	25·47	21·64	3·83	— 15
"	Berkhampstead .....	" .....	...	28·05	28·02	25·02	3·00	— 11
"	Hitchin .....	" .....	...	24·72	23·25	17·76	5·49	— 24
"	High Wycombe	Bucks .....	...	23·20	24·29	18·81	5·48	— 23
"	Althorp	Northants ...	...	20·34	21·77	17·21	4·56	— 21
"	Cardington (8 in. gauge)..	Bedford .....	...	21·60	21·87	15·87	6·00	— 27
IV.	Witham	Essex .....	...	20·55	20·73	18·77	1·96	— 9
"	Norwich (Honingham) ...	Norfolk .....	...	25·99	23·28	21·44	1·84	— 8
"	Holkham .....	" .....	...	26·13	23·10	20·74	2·36	— 10
V.	Plymouth (Ham)	Devon .....	...	44·70	42·17	30·27	11·90	— 28
"	Exeter Institution.....	"	29·35	26·91	30·17	21·74	8·43	— 28
"	Honiton (Broadhembury)	"	35·14	32·75	34·28	22·48	11·80	— 34
"	Helston	Cornwall .....	...	36·22	38·05	27·66	10·39	— 27
"	Truro	"	43·81	40·00	42·56	29·77	12·79	— 30
"	Bodmin .....	" .....	...	43·48	46·12	39·73	6·39	— 14
VI.	Cirencester	Gloucester ...	...	29·60	30·87	24·01	6·86	— 22
"	Burford	Shropshire ...	...	25·52	26·25	20·23	6·02	— 23
"	Shiffnal (Haughton Hall)	" .....	...	24·02	23·74	21·48	2·26	— 10
"	Orleton	Worcester ...	28·41	28·82	30·06	24·17	5·89	— 20
VII.	Wigston	Leicester .....	...	26·39	26·49	18·27	8·22	— 31
"	Southwell	Notts .....	...	19·65	19·54	16·33	3·21	— 17
"	Welbeck	"	25·44	23·29	24·02	21·58	2·44	— 10
"	Derby	Derby .....	...	23·98	25·14	18·73	6·41	— 25
VIII.	Bolton (The Folds).....	Lancashire ...	46·46	44·01	48·33	43·47	4·86	— 10
"	" (Belmont) .....	" .....	...	51·19	55·70	52·80	2·90	— 5
"	Preston (Howick) .....	" .....	...	34·28	38·09	34·17	3·92	— 10
"	Ormskirk (Rufford) .....	" .....	...	33·24	34·81	29·84	4·97	— 14
"	Holker .....	" .....	...	39·17	44·98	39·24	5·74	— 13
IX.	Redmires	Yorkshire ...	40·75	37·86	37·89	33·46	4·43	— 12
"	Standedge .....	" .....	...	49·58	52·17	47·75	4·42	— 8
"	Halifax (Well Head).....	"	31·88	30·71	31·09	29·59	1·50	— 5
"	Leeds (Holbeck, M. & Co.)	" .....	...	20·91	21·98	20·50	1·48	— 7
"	York	"	25·42	22·02	23·38	24·37	0·99	+ 4
"	Settle	"	43·41	35·55	39·77	41·33	1·56	+ 4
X.	Seathwaite	Cumberland..	...	126·98	153·47	119·60	33·87	— 22
"	Keswick (Post Office) ...	" .....	...	55·01	60·56	55·27	5·29	— 9
"	Kendal (Kent Terrace)...	Westmorel'nd	51·18	44·91	52·88	43·09	9·79	— 18
"	Windermere (The Howe)	" .....	...	72·13	89·65	56·72	32·93	— 37
XI.	Lampeter	Cardigan.....	...	(43·00)	43·81	39·87	3·94	— 9
"	Holywell (Maes-y-dre) ...	Flint .....	...	24·25	23·58	22·85	0·73	— 3
"	Guernsey	Channel Isds.	...	34·46	37·09	25·05	12·04	— 32

COMPARISON OF THE RAINFALL IN 1870 WITH PREVIOUS YEARS. SCOTLAND.

Div.	STATION.	COUNTY.	Average			Depth in 1870.	Difference from Average, 1860-5	
			1840-9.	1850-9.	1860-65.		Amount.	Per cent
			in.	in.	in.	in.	in.	
XII.	Mull of Galloway	Wigtown.....	20·67	22·52	28·31	21·58	6·73	— 24
„	Little Ross	Kirk'udbright .....	...	25·27	27·35	22·95	4·40	— 16
XIII.	Haddington	Haddington..	23·77	24·35	26·93	19·33	7·60	— 28
„	Cobbinshaw	Edinburgh ...	...	35·65	35·65	23·50	12·15	— 34
„	Glencorse .....	„ .....	...	36·96	36·77	27·70	9·07	— 25
„	Inveresk	„	25·81	24·72	30·05	16·50	13·55	— 45
XIV.	Bothwell Castle	Lanark .....	...	27·76	28·33	21·19	7·14	— 25
„	Largs (Mansfield) ...	Ayr .....	...	43·06	48·63	40·80	7·83	— 16
XV.	Arddaroch	Dumbarton...	...	66·55	75·83	59·15	16·68	— 22
„	Pladda	Bute.....	40·02	35·23	38·12	27·63	10·49	— 27
„	Mull of Cantyre	Argyll	45·76	41·19	44·61	33·16	11·45	— 26
„	Rhynns of Islay	„	33·79	30·58	32·66	25·42	7·24	— 22
„	Castle Toward .....	„ .....	...	47·88	53·80	41·06	12·74	— 24
„	Tyree (Hynish) .....	„ .....	...	73·90	84·77	59·53	25·24	— 30
„	Lismore .....	„ .....	...	38·44	46·95	31·67	15·28	— 32
„	Arduamurchan .....	„ .....	...	38·50	47·94	30·98	16·96	— 35
XVI.	Isle of May	Fife	20·94	15·21	21·08	12·03	9·05	— 43
„	Deanston	Perth	35·74	39·21	42·35	30·22	12·13	— 29
„	Dundee (Hill Head)	Forfar .....	...	31·06	35·59	29·48	6·11	— 17
„	„ (Craigton) .....	„ .....	...	31·87	35·64	29·65	5·99	— 17
„	Arbroath .....	„ .....	...	25·08	29·71	22·40	7·31	— 25
XVII.	Girdleness [Aberdeen] ...	Kincardine ...	23·14	19·71	22·13	19·49	2·64	— 12
„	Kinnairdhead..	Aberdeen.....	22·01	22·05	23·32	30·28	6·96	+ 30
XVIII.	Cromarty	Cromarty ...	...	23·67	27·80	16·28	11·52	— 41
„	Barrahead	Inverness ...	31·60	32·67	32·62	25·62	7·00	— 21
„	Island Glass	„	34·98	31·92	23·86	33·51	9·65	+ 40
„	Cape Wrath	„	38·86	36·94	39·59	29·26	10·33	— 26
„	Noss Head .....	„ .....	...	25·57	23·57	22·06	1·51	— 6
XIX.	Dunnethad	Caithness ...	27·39	22·09	25·93	11·79	14·14	— 56
„	Pentland Skerries ...	„ .....	...	24·12	28·92	19·64	9·28	— 32
„	Sandwick	Orkney .....	...	36·14	36·79	30·72	6·07	— 16
„	Start Point	„	25·05	23·77	24·32	29·76	5·44	+ 22
„	Sumburghhead	Shetland	25·43	25·22	25·52	21·19	4·33	— 17
„	Bressay Manse .....	„ .....	...	36·22	40·40	23·30	17·10	— 42

IRELAND.

XX.	Cork	Cork	41·30	34·23	34·41	28·46	5·95	— 17
„	Killaloe	Clare .....	...	38·33	46·70	40·78	5·92	— 13
„	Tullamore	King's County .....	...	24·37	28·09	24·86	3·23	— 11
XXI.	Black Rock	Dublin	23·20	21·78	25·83	25·02	0·81	— 3
XXIII.	Armagh	Armagh .....	...	(28·20)	32·40	22·29	10·11	— 31
„	Belfast (Linen Hall) ...	Antrim	29·44	30·01	37·12	34·38	2·74	— 7

ABSTRACT.

England .....	...	34·27	36·53	30·04	6·49	— 17
Scotland .....	...	32·80	36·05	27·61	8·44	— 22
Ireland.....	...	29·49	34·09	29·30	4·79	— 14
Mean of the whole .....	...	32·19	35·56	28·98	6·58	— 18

EXTREMES OF RAINFALL IN 1870.

ENGLAND.

GREATEST.		LEAST.	
	in.		in.
Seathwaite.....	119·60	Merton Villa, Cambridge	14·17
Wet Sleddale.....	101·00	Observatory, „	14·25
Wythburn	88·75	Wytham on the Hill	14·40
Easedale.....	88·15	Bedford	14·52
Berkside.....	87·25	White Waltham.....	15·35
Patterdale	85·87	Waresley	15·47

WALES.

GREATEST.		LEAST.	
	in.		in.
Bryn-gwynant, Beddgelert...	101·58	Llwyn Onn, Wrexham	22·56
Rhiwbryfdir	78·71	Trevalyn „	22·71
Glyn Padarn, Llanberis	76·67	Maes y dre, Holywell	22·80
Treherbert, Aberdare	72·61	Hawarden	23·29
Brithdin, Dolgelly	71·72	Brynbella, St. Asaph.....	23·92
Festiniog	70·19	Llanerch „	24·53

SCOTLAND.

GREATEST		LEAST.	
	in.		in.
Lochgoilhead, Upper Glencroe	109·20	Milne Graden	16·10
Bridge of Orchy	94·50	Dalkeith	16·12
Ardlui, Loch Lomond	87·50	Inveresk	16·50
Cairndow	77·33	Fenton Barns, Drem.....	17·00
Firkin	72·30	Smeaton, Haddington ..	17·42
Glengyle	71·30	Fearn, Tain.....	18·48

IRELAND.

GREATEST.		LEAST.	
	in.		in.
Kenmare House, Killarney ...	69·01	Coollattine Park	18·88
Letterkenny, Donegal	49·42	Fitzwilliam Square, Dublin ...	20·86
Bann Reservoir	48·10	Armagh	22·29
Galway.....	44·84	Monkstown	23·56
Florence Court	42·95	Tullamore	24·86
Curraghmore	40·94	Wexford	25·22

GENERAL TABLES
OF
TOTAL RAINFALL IN 1870,
AT ABOUT
1500 STATIONS
IN THE
BRITISH ISLES.

SUGGESTIONS FOR SECURING UNIFORMITY OF PRACTICE AMONG RAINFALL OBSERVERS.*

In order to give the widest possible circulation to these rules, we recently sent a copy to every observer. The result has proved that they are now very generally adopted. Only two of our correspondents have suggested alterations, viz., Mr. Bicknell and Mr. Cator, both of Beckenham. One of Mr. Bicknell's suggestions is a most difficult one, and will probably lead to considerable discussion; his other proposal, also, involves an important point, as will be seen by reference to the *Meteorological Magazine*. Mr. Cator has favoured us with several suggestions, some of which do not involve alterations of principle or practice, and yet are so good that we have added them in brackets to Rules II., III., and X., without waiting for discussion. The others must be submitted for general criticism before adoption, they will therefore accompany Mr. Bicknell's.

I.—SITE.—A rain gauge should not be set on a slope or terrace, but on a level piece of ground, at a distance from shrubs, trees, walls, and buildings—at the very least, as many feet from their base as they are in height. Tall-growing flowers, vegetables, and bushes must be kept away from the gauge. If a thoroughly clear site cannot be obtained, shelter is most endurable from N.W., N., and E., less so from S., S.E., and W., and not at all from S.W. or N.E.

II.—OLD GAUGES.—Old established gauges should not be moved, nor their registration discontinued until, at least, two years after a new one has been in operation, otherwise the continuity of the register will be irreparably destroyed. Both the old and the new ones must be registered at the same time [and the results recorded for comparison].

III.—LEVEL.—The funnel of a rain gauge must be set quite level, and so firmly fixed, that it will remain so in spite of any gale of wind or ordinary circumstance. [Its correctness in this respect should be tested from time to time.]

IV.—HEIGHT.—The funnel of gauges newly placed should be 1 ft. above grass. Information respecting height above sea level may be obtained from the Editor.

V.—RUST.—If the funnel of a japanned gauge becomes so oxidised as to retain the rain in its pores, or threatens to become rusty, it should have a coat of gas tar, or japan black.

VI.—FLOAT GAUGES.—If the measuring rod is detached from the float, it should never be left in the gauge. If it is attached to the

* Our sole object in drawing up these rules has been to ensure uniformity and accuracy. Any observer who objects to, or can suggest improvements in any one of them, will oblige by forwarding the substitute he would prefer, and a short statement of his reasons for so doing. These shall appear in the next issue of the *Meteorological Magazine*, and the rule shall be altered or not, as decided by the observers themselves.

float, it should be pegged or tied down, and only allowed to rise to its proper position at the time of reading. To allow for the weight of the float and rod, these gauges are generally so constructed as to show 0 only when a small amount of water is left in them. Care must always be taken to set the rod to the zero or 0.

VII.—CAN AND BOTTLE GAUGES.—The measuring glass should always be held upright; the reading is to be taken midway between the two apparent surfaces of the water.

VIII.—TIME OF READING.—Nine a.m. daily; if only taken monthly, then 9 a.m. on 1st.

IX.—DATE OF ENTRY.—The amount measured at 9 a.m. on any day is to be set against the previous one; because the amount registered at 9 a.m. of, say, 17th contains the fall during 15 hours of the 16th, and only 9 hours of the 17th. (*This rule has been approved by the Meteorological Societies of England and Scotland, cannot be altered, and is particularly commended to the notice of observers.*)

[Far be it from us to complain of those who by regular and careful observation provide the materials on which this work is founded, but we do wish they would *all* conform to this rule. We believe that some think it is of little consequence, and others are not aware how strongly it has been endorsed by the only meteorological societies in the country. Perhaps the former will take into consideration the fact that besides giving hours of extra work, it seriously impairs the value of their registers. For the information of the latter class of observers, *verbatim* extracts from the reports of the councils of the two societies are annexed.]

“Mr. Buchan stated that the mode of entering the rainfall by the Society's observers was not uniform; some, by far the greater number, entering the rain read off on the 1st of the month as the fall for that day, others entering it as the fall for the last day of the previous month. He recommended, as it is most desirable that one uniform method be adopted, that observers be instructed to read the rain gauge at 9 a.m., and enter that reading for the day previous; and where the readings are not taken daily, that the gauge be always read on the 1st of each month, and the amount then collected be considered as belonging to the previous month, and entered accordingly. The Council agreed to sanction this recommendation, and would strongly urge those observers who have not yet adopted it, to do so without delay.”—*Minute of Council of the Scottish Meteorological Society, April, 1866.*

“The date to which each measurement of rain is to be entered (and which, therefore, involves the termination of the rain month) having been referred to the observers, to ascertain the general practice, it was found that the majority were in favour of 9 a.m., and placing the amount then measured against the day preceding that on which it was measured. This regulation met Mr. Glaisher's approval, and has also received the support of the Council of the Scottish Meteorological Society, who have passed a minute instructing their observers to adopt it. By these means it is hoped that very shortly the practice will be uniform throughout the United Kingdom.”—*Report of the Council of the Meteorological Society, June, 1866.*

X.—MODE OF ENTRY.—If less than one-tenth ($\cdot 10$) has fallen, the cypher must *always* be prefixed; thus, if the measure is full up to the seventh line, it must be entered as $\cdot 07$, that is, no inches, no tenths, and seven hundredths. For the sake of clearness, it has been found necessary to lay down an invariable rule that there shall always be two figures to the right of the decimal point. If there be only one figure, as in the case of one-tenth of an inch (usually written $\cdot 1$) a cypher must be added, making it $\cdot 10$. Neglect of this rule causes much inconvenience. All columns should be cast *twice*—[once up and once down, so as to avoid the same error being made twice]. When there is no rain, a line should be drawn rather than cyphers inserted.

XI.—CAUTION.—The amount should always be written down before the water is thrown away.

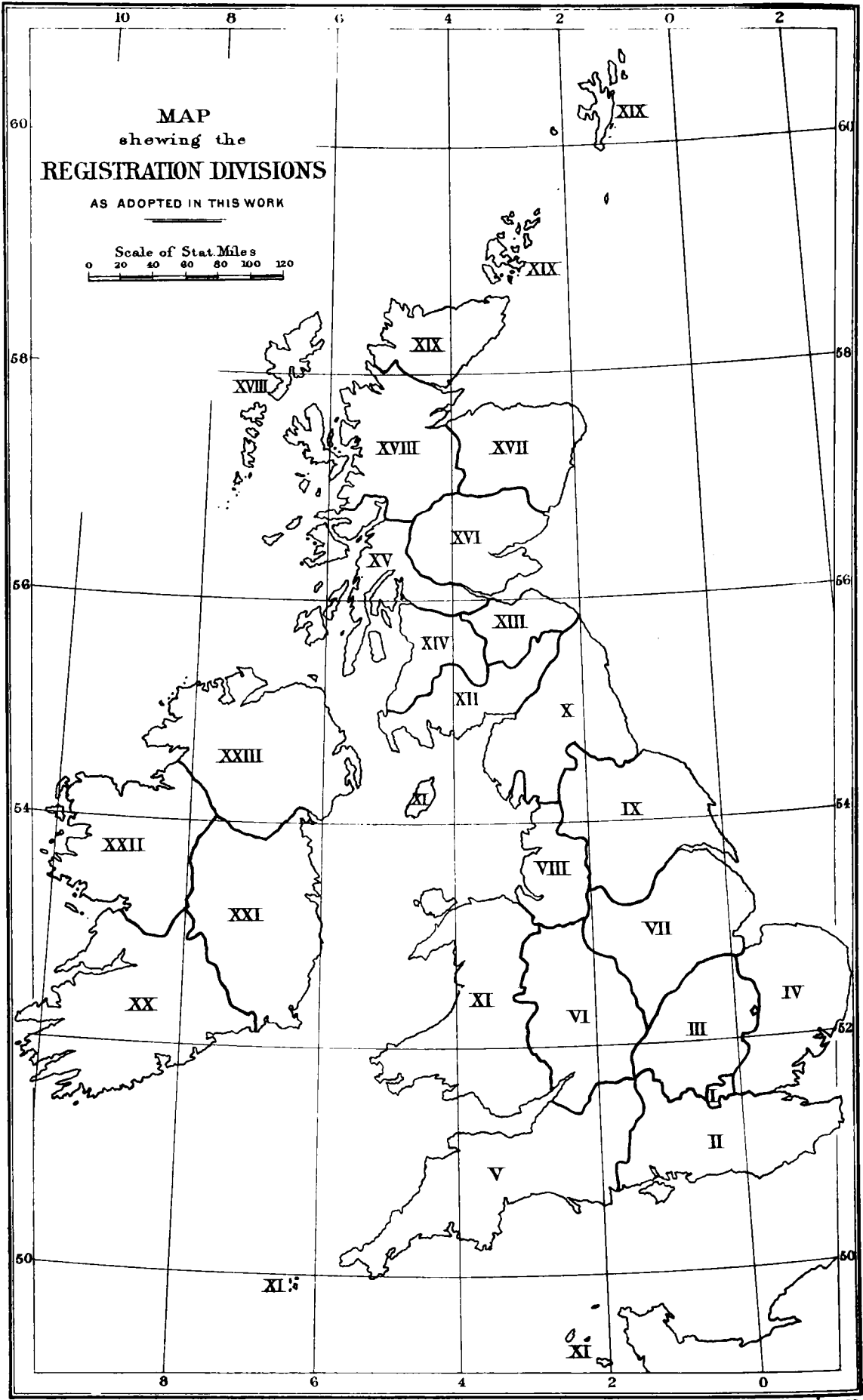
XII.—SMALL QUANTITIES.—The unit of measurement being $\cdot 01$, observers whose gauges are sufficiently delicate to show less than that, are, if the amount is under $\cdot 005$, to throw it away, if it is $\cdot 005$ to $\cdot 010$ inclusive, they are to enter it as $\cdot 01$.

XIII.—ABSENCE.—Every observer should train some one as an assistant; but where this is not possible, instructions should be given that the gauge should be emptied at 9 a.m. on the 1st of the month, and the water bottled, labelled, and tightly corked, to await the observer's return.

XIV.—HEAVY RAINS.—When very heavy rains occur, it is desirable to measure immediately on their termination, and it will be found a safe plan after measuring to return the water to the gauge, so that the morning registration will not be interfered with. Of course if there is the slightest doubt as to the gauge holding all that falls, it must be emptied, the amount being *previously* written down.

XV.—SNOW.—In snow three methods may be adopted—it is well to try them all. (1) Melt what is caught in the funnel, and measure that as rain. (2) Select a place where the snow has not drifted, invert the funnel, and turning it round, lift and melt what is enclosed. (3) Measure with a rule the average depth of snow, and take one-twelfth as the equivalent of water. Some observers use in snowy weather a cylinder of the same diameter as the rain gauge, and of considerable depth. If the wind is at all rough, all the snow is blown out of a flat-funnelled rain gauge.

XVI.—OVERFLOW.—It would seem needless to caution observers on this head, but as a recent foreign table contains *six instances on one day* in which gauges were allowed to run over, it is evidently necessary that British observers should be on the alert.



ARRANGEMENT OF GENERAL TABLES.

The divisions are the same as those adopted by the Registrars General of England and Scotland.

The boundaries of these divisions are shown on the accompanying map.

The counties follow the same order as in the reports of the aforesaid officers.

An alphabetical list of the counties is given with the page or pages on which all returns from each will be found.

The stations in each county are arranged in the order of their latitude from South to North.

In order to facilitate finding the fall in any part of the country, the first name is almost always that of a place given in *Bradshaw*, the *British Postal Guide*, or the *Clergy List*; the second name is added occasionally to fix accurately the site of Observation. In a very few instances, this second name is in [] instead of (); it shows the nearest town, which is then in an adjoining county. For instance, "Lowestoft (Gisleham)" means Gisleham, near Lowestoft, both being in one county, but "Geldeston [Beccles]" means Geldeston, Norfolk, near Beccles, in another county—Suffolk.

The contents of the columns are sufficiently explained by the headings, except that in the column headed "diameter" figures will occasionally be noticed of a different type from the rest of the tables; these figures indicate the length of the sides of rectangular mouthed gauges. These measurements are all in inches.

An asterisk * denotes that the gauge was tested before erection, and a † that it has been visited and examined since. A note of interrogation (?) implies doubt, not necessarily error. ... indicates the absence of information.

BA is employed to indicate gauges originally provided out of the funds of the British Association.

A full explanation of the meaning of the symbols \overline{A} , I, L, B, having been given on pages 60 and 61, it seems unnecessary to repeat it here.

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ENGLAND AND WALES.

DIVISION I.—MIDDLESEX.

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which ·01 or more fell
		Diameter.	Height Above Ground	Height Above Sea Level	1870	
			ft. in.	feet.	inches.	
MIDDLESEX.						
Hampton Wick (The Grove) ...	T. J. Nelson, Esq.	5	1 1	27 ∇	17·81	124
" (Fairlight)	C. Mostyn, Esq.	8	0 5	30 ∇	17·47	121
Teddington (Gomer House)	R. D. Blackmore, Esq. ...	5	0 10	26 ∇	18·35	136
Chiswick (R. H. Soc. Gardens)...	Mr. Smith	12	3 9	14 ∇	17·09	107
Kensington (Holland Road)	H. Doxat, Esq.	5	1 0	..	19·13	136
Ealing (Castlebar Road)	Ealing Local Board ...	5	0 1	120 ∇	17·70	132
Westminster (Spring Grdns), S. W.	JW Bazalgette, Esq. CE	8	6 0	37 ∇	18·76	96
" " "	" " "	12	58 3	95 ∇	17·49	...
" " "	" " "	8	58 6	95 ∇	16·67	...
London (Guildhall), E. C.	W. Haywood, Esq. C.E	8	2 6	49	19·15	122
" " "	" " "	8	51 0	98	18·89	122
" (Chiswell Street), E. C.	A. Slate, Esq.	5	51 0	...	16·85	104
" (Mile End), E.	F. Charrington, Esq. ...	5	10 0	46 ∇	18·98	111
† " (Camden Square), N. W. ...	G. J. Symons, Esq. ...	8	0 6	111 ∇	21·32	139
† " (" Road)	J. Nickolls, Esq.	5	1 0	100 ∇	20·51	...
" Islington (St. Mary's Road), N.	W. T. Reynolds, Esq. ...	5	1 0	117 ∇	19·83	141
" " (Compton Terrace).	Dr. Ballard	8	0 6	122 ∇	20·06	139
* Kentish Town Reservoir Bank ...	G. J. Symons, Esq. ...	5	1 0	200 ∇	20·79	...
* Upper Clapton (Hadham Ho.) ...	J. Parnell, Esq.	5	1 1	91 ∇	19·61	148
Hampstead, N. W. (Roslyn Ho.)	C. H. L. Woodd, Esq. ...	8	1 3	375	19·41	...
† " (Squire's Mount)	Rogers Field, Esq. C.E.	5	1 0	385 ∇	20·12	127
† " (The Grove)	H. Sharpe, Jun., Esq. ...	5	2 0	440 ∇	20·21	134
† " " "	" " "	5	50 0	471 ∇	16·22	124
† Highgate Nurseries	J. Cutbush, Esq.	5	1 0	394 ∇	21·49	114
Harrow-on-the-Hill	T. Hewlett, Esq.	5	1 2	354 ∇	20·19	225
" Station	B. Haughton, Esq., C.E.	5	1 0	188 ∇	20·12	97
" (Northwick House)	H. St. J. Joyner, Esq. ...	5	0 6	200 ∇	20·10	129
Stamford Hill	N. F. Robarts, Esq. ...	5	0 11	110 ∇	20·39	159
† Tottenham (Grove Ho.)	Charles Ashford, Esq. ...	5	1 0	55 ∇	21·94	164
Uxbridge (Harefield Park)	W. F. Vernon, Esq. ...	8	0 8	290	20·27	125

DIVISION I.—MIDDLESEX—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which "01 or more fell.
		Diameter.	Height Above Ground.	Height Above Sea Level		
			ft. in.	feet.	inches.	
MIDDLESEX—(con.)						
Mill Hill (Bittacy House)	J. A. Hadden, Esq. ...	5	1 0	420 ?	19·93	120
Enfield (Nag's Head Lane)	W. C. Mylne, Esq. ...	...	3 0	89	23·11	158
† Winchmore Hill	T. Paulin, Esq.	8	1 0	350 ?	19·96	124
" "	" " "	5	1 0	350 ?	20·08	124
" "	" " "	5	5 6	350 ?	19·65	124

DIVISION II.—SOUTH-EASTERN COUNTIES.

SURREY.

Godalming (Dunsfold)	Mr. T. Underwood ...	5	2 6	166	24·64	...
Weycombe [Haslemere]	G. B. Buckton, Esq. FRS	5	4 0	583 A	28·11	...
Guildford (Cranleigh)	Rev. R. W. Tayler ...	5	0 8	...	23·16	...
Farnham (Culverlands)	Miss Gibson	5	1 1	300 B	19·71	165
Godalming (Elstead)	Capt. James, R.E.	5	1 6	165 A	20·58	...
Guildford (Shalford Common) ...	" " "	10	1 6	115 A	22·03	...
Albury (Potsford)	" " "	5	1 6	200 A	24·48	...
† Guildford (Commercial Road) ...	" " "	10	1 6	120 A	20·52	...
† " (Roy. Grammar Sch.)..	Rev. Dr. Merriman ...	5	1 6	187 A	19·34	...
Dorking (West Street)	Mrs. W. A. Marsh ...	10	35 0	234 T	26·69	130
" (Brookmead)	T. L. M. Winter, Esq. ...	4	0 9	180 A	24·22	...
" (The Shrubbery, Box Hill) ..	E. Boorman, Esq.	8	4 0	500 ?	22·35	...
Red Hill (Earlswood Asylum)...	Dr. Grabham	5	1 2	...	21·07	...
Caterham (Upwood Gorse)	J. Tones, Esq., F.R.S.	5	0 10	715 T	23·66	143
† Cobham (Pyports)	G. Dines, Esq.	8	1 0	65 A	20·44	143
† " "	" " "	5	1 0	65 A	19·41	...
Chobham (Northbourne)	Dr. Ward	8	1 2	93 A	17·57	116
† Weybridge Heath	W. F. Harrison, Esq. ...	8	0 6	150 A	19·55	126
Croydon (South Bridge)	Dr. Westall	5	1 0	152 A	22·27	122
" (Tanfield Lodge)	J. Weston, Esq.	5	0 8	155 T	21·69	...
" (Belfield)	J. Rickett, Esq.	5	7 6	180 T	20·81	139
" (Waldronhurst)	C. W. Johnson, Esq. ...	8	35 0	237 A	19·80	100
Wimbledon	T. Devas, Esq.	12	3 0	160	18·22	116
Upper Tooting	D. A. Freeman, Esq. ...	5	0 6	86	19·42	138
Englefield Green (Parkside)	W. Menzies, Esq. ....	...	6 0	...	22·96	...
* Brixton Hill	Miss E. Sweeting	5	1 0	127 T	19·82	133
Wandsworth (South Fields)	R. Coleman, Esq.	10	1 0	...	20·45	...
† Kew Observatory	Dr. Stewart, F.R.S. ...	10	1 3	19 T	16·64	125
Kennington Road	A. H. Thorns, Esq. ...	8	5 0	19 A	17·86	130

KENT.

† Tenterden (Maytham Hall)	R. Appach, Esq.	8	1 2	120 T	25·34	132
† Hythe	H. B. Mackeson, Esq. ...	8	0 6	12 T	25·50	182
† Dover (Castle Street)	H. J. Poulter, Esq. ...	5	2 2	30	25·24	121
† Cranbrook (Hartley)	G. Pile, Jun. Esq.	5	4 0	407	25·80	192
† " (Tillsden)	T. Pile, Esq. ....	...	0 4	305	28·90	132
Goudhurst Vicarage	Rev. J. S. Clarke	5	1 1	419	23·61	143
† Tunbridge	Dr. Fielding	5	1 0	71 A	25·34	152
Edenbridge (Falconhurst Court) ..	J. G. Talbot, Esq., M.P.	5	1 0	400 L	27·20	139
† Maidstone (Linton Park)	Mr. J. Robson	8	0 6	296 A	21·69	152

DIVISION II.—SOUTH-EASTERN COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which ·01 or more fell.
		Diameter	Height Above Ground.	Height Above Sea Level	1870	
			ft. in.	feet.	inches.	
KENT—(con).						
† Maidstone (East Sutton Park)...	Mr. T. Skinner	8	0 6	387 T	20·88	...
† „ (Hunton Court)	Mr. P. Goddard	8	0 6	80 T	20·49	116
Charing (Otterden)	Rev. W. A. Paxton ...	5	1 0	507	24·78	...
† Faversham (Brogdale)	W. C. Stunt, Esq.	5	0 10	140 T	20·60	144
† Sandwich (Walton House, Eastry)	Colonel Rae	5	1 0	53 T	20·77	...
† Maidstone (Larkfield)	Rev. N. Dimock	5	3 6	95 T	20·75	...
† „ (Somerfield)	F. H. Holmes, Esq. ...	20	1 5	...	19·86	...
„ (Boxley Road)	J. Case, Esq.	5	1 0	170 T	19·56	134
Seven Oaks (River Hill)	J. T. Rogers, Esq.	8	3 6	526 T	24·54	98
„ (Riverhead Vic.) ...	Rev. J. B. Murdoch ...	5	1 0	...	26·32	...
† Westerham (Chartwell)	A. C. Colquhoun, Esq..	5	0 6	500 P	23·37	...
Selling (Harefield)	E. Neame, Esq.	5	2 6	217 T	22·97	152
32† Margate (Acol)	E. S. Lendon, Esq. ...	5	1 0	60 T	16·38	101
„ (Bloxham's Green)	W. Lane Sear, Esq. C.E.	5	6 0	35	19·08	111
Sittingbourne	G. Payne, Junr., Esq..	5	1 1	38	17·20	...
† Bromley Common, S.E.	Rev. A. Rawson	8	1 0	250 T	21·04	136
† Chislehurst (Heathfield Lodge)...	F. Nunes, Esq.	8	1 0	295 T	20·19	152
† „ „ „	„ „ „	5	2 0	296 T	19·39	144
† Foot's Cray (Sidcup)	Miss Berens	5	0 8	231 T	18·63	...
† Beckenham (Parkside)	C. O. F. Cator, Esq. ...	8	0 3	142 T	19·68	143
† „ „ „ monthly	„ „ „	5	0 4	142 T	17·96	...
† „ „ „	„ „ „	5	50 0	200 T	14·35	125
† „ (Foxgrove)	Percy Bicknell, Esq. ...	5	0 5	141 T	19·40	134
† „ „ „	„ „ „	5	4 0	145 T	18·83	131
Dartford (The Downs)	R. F. Jarvis, Esq.	5	2 0	250 T	16·28	115
† Eltham Green	Mr. E. J. C. Smith ...	5	1 0	76 T	18·31	145
Lee (Blessington Road)	J. Grant, Esq., C.E. ...	10	4 9	49	20·22	...
Greenwich (Royal Observatory)..	J. Glaisher, Esq., F.R.S.	8	0 5	155 T	18·55	...
Deptford (Pumping Station)	W. Jeffree, Esq.	10	3 8	18 T	19·82	122
Erith (Crossness)	F. E. Houghton, Esq..	11	0 6	16 T	17·61	146
„ „ „	„ „ „	10	0 6	6 T	20·71	146
„ „ „	„ „ „	11	0 6	24 T	18·35	146
WEST SUSSEX.						
† Bognor (Aldwick)	H. Upton, Esq.	5	1 0	50 T	22·96	...
† Worthing (Bedford Rw.) (monthly)	W. J. Harris, Esq. ...	5	1 0	18 T	21·27	...
„ „ „	„ „ „	8	0 6	17 T	22·03	122
„ (Water Works)	„ „ „	5	0 11	25 T	21·24	111
† Arundel (Yapton)	R. Redford, Esq.	5	1 0	23 T	25·33	132
West Thorney [Emsworth]	F. Padwick, Esq.	5	0 8	10 P	20·58	73
† Chichester (Infirmary = Museum)	W. Hills, Esq.	5	0 6	50 T	21·37	...
† „ (Westgate)	Dr. Tyacke	5	0 6	40 T	21·06	...
† „ (Shopwyke)	Rev. G. H. Woods ...	8	1 2	61 T	24·89	...
† Arundel (Dale Park)	J. C. Fletcher, Esq. ...	11	3 5	316 T	27·40	74
† Steyning	Rev. Hugh Ingram ...	5	1 0	80 T	30·36	...
† Chichester (West Dean)	H. Paxton, Esq.	8	1 6	250 T	28·35	126
† „ (Chilgrove)	John W. Woods, Esq. ...	5	0 6	284 T	27·57	...
† „ (Bepton Hill)	„ „ „	5	0 6	554 T	32·79	...

DIVISION II.—SOUTH-EASTERN COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which ·01 or more fell.
		Diameter.	Height Above Ground.	Height Above Sea Level	1870	
			ft. in.	feet.	inches.	
WEST SUSSEX—(con.)						
+ Petworth Rectory	Rev. C. Holland	5	2 0	190 A	27·81	112
+ Horsham (Leonardslee).....	Mr. Ford.....	5	1 6	273 I	21·95	...
Midhurst (Lynch)	J. Eames, Esq.	6	0 6	160 P	35·53	...
+ Fernhurst [Haslemere]	Miss E. A. Salvin	8	0 10	301	27·58	...
Milland House [Liphook]	Rev. J. M. Heath	18	20 0	372	27·40	...
EAST SUSSEX.						
+ Beachy Head	Miss W. L. Hall	5	1 0	610 I	22·24	...
Eastbourne	" " "	5	4 0	12 L	26·38	127
" (Cemetery).....	" " "	5	4 0	160 P	25·64	121
+ Pevensey	M. Vidler, Esq., C.E...	8	4 0	10 I	19·91	120
Brighton (Cambridge Rd., Hove)	H. B. Peake, Esq. ...	5	1 0	111 A	24·40	114
" (Buckingham Place)...	F. E. Sawyer, Esq. ...	5	0 8	200 A	24·18	134
+ " (St. James' St.).....	E. Rowley, Esq.....	5	1 0	37 I	25·19	...
" (North St.).....	F. E. Sawyer, Esq. ...	10	0 9	110 I	25·54	132
+ " (Eaton Place).....	Dr. Barker.....	8	0 3	98 I	25·23	138
+ " (Water Works)	Brighton Water Co....	5	0 7	90 I	25·42	...
+ Hastings (High Wickham)	E. Field, Esq.	5	2 0	212 B	24·61	...
+ " (Bleak House)	Mr. J. Banks	8	1 3	77 A	23·03	112
+ " (Cemetery)	Mr. Field	5	0 6	500 I	18·18	125
+ " (Hollington)	Capt. Lewis	5	1 0	315 B	24·49	112
+ Lewes (Glynde Place)	Mr. J. McLeod	5	2 9	59 I	27·96	110
+ Battle	F. Webster, Esq.	5	1 3	...	28·45	...
+ Uckfield	C. L. Prince, Esq.....	12	6 0	149 I	24·99	113
+ Newick (Ketches)	Miss I. Shiffner.....	8	0 5	192 I	24·16	117
+ Maresfield (Rectory)	Rev. E. Turner	8	1 3	250	26·89	114
+ " (Forest Lodge).....	Captain W. Noble.....	8	1 2	259 I	24·02	123
+ Hayward's Heath (Asylum).....	Rev. T. E. Crallan ...	5	1 0	250 I	21·80	141
+ Salehurst (Church House)	E. Boorman, Esq.....	5	4 2	75 P	23·92	...
Cuckfield (Balcombe Place)	J. A. Hankey, Esq. ...	8	1 3	300 B	27·55	127
East Grinstead	W.V.K. Stenning, Esq.	5	1 3	400 P	28·90	140
HAMPSHIRE.						
+ Isle of Wight (Niton)	Rev. R. C. Kempe ...	8	0 4	100	22·38	...
+ " " (St. Lawrence) ..	Rev. C. Malden	5	1 0	75 A	21·99	121
+ " " (Ventnor).....	Dr. Martin.....	12	3 0	150 A	20·60	101
+ " " (Newport)	Mr. E. G. Aldridge ...	5	12 9	57 A	24·70	112
+ " " (Ryde).....	R. Taylor, Esq.	12	7 0	20 I	23·13	106
+ " " (Osborne).....	J. R. Mann, Esq.	8	0 8	172 A	21·96	115
Bournemouth (Holmwood).....	Dr. Compton	5	0 6	110 B	23·42	123
Christchurch (Carbery)	F. Moser, Esq.	8	0 8	...	23·75	128
Lymington (Wainsford).....	H. Fawcett, Esq.	5	1 0	58 A	21·60	110
Southampton (Cadland).....	A. H. Hogg, Esq.....	8	5 0	50P	25·50	91
Fareham	H. Sharland, Esq.....	5	0 2	26P	24·52	...
Havant (Bedhampton)	J. N. Hillman, Esq. ...	5	4 0	...	22·79	119
" (Leigh Park)	W.H.Stone,Esq., M.P.	8	0 9	120 I	23·17	91
Southampton, Ordnance Survey }	Col.Sir H.James,R.E. }	5	0 4	74 A	23·43	116
Office	F.R.S.	5	1 0	75 A	23·45	115
" " " "	" " " "	14	18 6	92 A	20·88	117

DIVISION II.—SOUTH-EASTERN COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which ·01 or more fell.
		Diameter.	Height Above Ground		Height Above Sea Level	
			ft.	in.	feet.	inches.
HANTS—(con.)						
Southampton (Eling House).....	W. C. Spooner, Esq....	5	1	0	20	21·60 ...
„ (Shirley Warren)...	R. C. Hankinson, Esq.	5	4	0	106	23·47 137
„ „ „ „ „ „	„ „ „ „ „ „	5	0	6	106	22·95 137
Bishop's Waltham (Swanmore Ho)...	B. P. Shearer, Esq. ...	5	0	4	390 †	25·13 116
Winchester (Otterbourne) <i>daily</i> ..	J. B. Yonge, Esq.	5	1	3	115 †	21·59 98
Petersfield (Liss)	G. E. Coryton, Esq. ...	7	0	7	...	28·05 ...
Alresford (Arle Bury)	F. Marx, Esq.	4	1	6	308 †	26·38 104
Woolmer Forest	Capt. E. James, R.E...	5	1	6	297 †	26·90 ...
Selborne (The Wakes)	T. Bell, Esq.	6	4	0	400 †	26·89 115
Aldershot	Mr. J. Arnold	8	0	6	325	23·43 140
„ „ „ „ „ „	„ „ „ „ „ „	5	3	0	328	22·76 ...
„ „ „ „ „ „	„ „ „ „ „ „	5	6	0	331	22·94 ...
„ „ „ „ „ „	„ „ „ „ „ „	5	12	0	337	20·35 ...
„ „ „ „ „ „	„ „ „ „ „ „	8	25	0	350	16·51 ...
„ (Bourley—2 miles W.)	„ „ „ „ „ „	8	1	0	370	20·69 125
Basingstoke.....	Mr. Pistell	5	1	0	321 †	22·17 ...
† „ (Wote Street)	T. Sweeting, Esq.....	5	1	0	265 †	20·96 117
„ (Chapel Hill).....	G. Stephens, Esq.....	5	1	0	328 †	20·64 141
† „ (Sherborne St. John)	Rev. D. W. Chute ...	5	1	2	276 †	21·08 106
† „ (The Vyne)	W. Wiggett Chute, Esq.	8	1	2	236 †	18·65 106
† „ „ „ „ „ „	„ „ „ „ „ „	3	0	11	236 †	19·49 106
† Strathfield Turgiss.....	Rev. C. H. Griffith ...	5	3	0	200 †	18·04 100
BERKS.						
Sunningdale (Lynwood).....	Admiral Sir F. W. Grey	8	0	9	264	19·84 124
† Reading (Englefield)	E. Robinson, Esq.....	5	1	0	190 †	16·85 99
† „ (Russell Street).....	Dr. Workman	5	2	8	159	16·91 105
Newbury (Greenham).....	Comm. J. Ward, R.N..	5	1	0	235 †	20·40 122
„ (Welford Park).....	Mr. C. Ross	5	0	11	335 †	21·29 132
Maidenhead (White Waltham)...	Mr. J. Silver	8	1	6	...	15·35 ...
„ (Ray Lodge)	W. Lassell, Esq., F.R.S	6	1	0	90 †	18·33 100
Streatley Vicarage	Rev. J. Slatter	10	0	4	150 †	16·78 116
Maidenhead (Cookham Vic.).....	Rev. R. W. Rogers ...	5	1	3	70 †	18·49 138
„ „ (The Halls)	F. W. E. Jowers, Esq.	5	1	6	70 †	19·38 133
Shrivenham (Ashbury Vic.)	Rev. H. Miller	5	1	0	500 †	20·02 133
* Wantage	E. C. Davey, Esq.....	5	12	8	290 †	16·48 118
Wallingford (The Castle)	J. Kirby Hedges, Esq.	5	0	9	175 †	15·48 74
Long Wittenham	Rev. J. C. Clutterbuck	12	1	0	170 †	16·88 98
Abingdon.....	W. Belcher, Esq.	5	1	0	180 †	15·73 116

DIVISION III.—SOUTH MIDLAND COUNTIES.

HERTS.

Watford (Eastbury)	D. Carnegie, Esq.	3	0	4	376	20·23 ...
Hoddesdon (Field's Weir).....	N. Beardmore, Esq. C.E.	24	2	0	82	16·83 115
Bayfordbury	W. C. Baker, Esq.....	8	0	4	250	18·12 116
St. Albans (Gorhambury)	Mr. G. Bogue	6	2	9	...	23·56 124
Hemel Hempstead (Nash Mills)...	J. Dickinson & Co.....	12	3	0	250 †	21·64 139

DIVISION III.—SOUTH MIDLAND COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which 1/2 or more fell.
		Diameter.	Height Above Ground.		Height Above Sea Level	
			ft.	in.	feet.	inches.
HERTS—(con.)						
Berkhampstead	W. Squire, Esq.	8	1	6	370 B	25.02 146
Tring (Cowroast)	H. Thomas, Esq.	10	4	2	395 A	24.40 132
Kensworth [Dunstable]	T. Jones, Esq.	5	1	0	902 A	22.53 ...
Ware (Much Hadham)	Rev. H. S. Mott	5	1	0	222 B	18.68 140
Stevenage	Rev. J. O. Seager	8	4	2	321 L	18.83 148
" (Woodfield)	J. B. Denton, Esq., C.E. ....	...	1	6	300	18.87 100
Hitchin	W. Lucas, Esq.	8	1	4	238 T	17.76 149
Royston	H. Wortham, Esq.	8	0	6	266 A	17.16 133
BUCKINGHAMSHIRE.						
Eton College	Rev. Herbert Snow ...	5	1	0	90 P	18.99 122
High Wycombe	H. S. Wheeler, Esq.	8	0	9	225 T	18.81 ...
Missenden Abbey	J. Begbie, Esq.	6	1	0	...	25.93 ...
Wendover (Cholesbury)	Rev. H. P. Jeston ...	5	4	0	...	22.91 ...
Aylesbury	J. Copcutt, Esq., C.E.	12	1	0	...	19.00 ...
Newport Pagnell	R. Littleboy, Esq.	5	2	0	...	17.94 ...
OXFORD.						
Henley-on-Thames	T. F. A. Byles, Esq.	5	4	0	91 B	19.26 ...
Watlington (Swyncombe House)	Mrs. Ruck Keene ...	5	0	4	750 P	19.23 92
Thame (Aston Rowant)	T. Taylor, Esq.	8	1	0	390 B	16.03 ...
Oxford (Radclyffe Observatory)	Rev. R. Main, F.R.	10	0	8	207 A	17.56 137
" "	" " "	10	22	0	229 A	16.60 138
" "	" " "	12	24	0	231 A	15.24 122
" "	" " "	10	112	0	319 A	10.16 ...
Enstone (Chadlington)	W. Searle, Esq.	4	4	0	550	17.97 77
" (Upper Heyford)	Rev. C. B. Mount	9	1	2	324 T	18.95 120
Bicester (Stratton Audley Pk)	G. Glen, Esq.	5	2	5	295 P	19.72 ...
Chipping Norton (Kingham)	Rev. J. W. Lockwood.	5	3	6	442	20.18 ...
Banbury (Broughton Lodge) ...	E. C. Morrell, Esq. ...	5	2	0	360 P	19.53 142
" (Sibford)	S. Gibbs, Esq.	5	1	0	601	20.25 124
" (High Street)	T. Beesley, Esq.	6	7	0	350	19.93 149
" (Neithrop) ...	F. Francillon, Esq. ...	5	1	0	340	19.06 ...
NORTHAMPTON.						
Potterspury [Stony Stratford] ...	Rev. R. E. Crawley ...	5	0	4	...	18.48 148
Thorpe Mandeville [Banbury] ...	Rev. W. L. Browning ...	5	0	5	580	20.88 142
Weedon Beck Vicarage	Rev. J. S. Winter	8	1	6	280 T	17.83 ...
Northampton	H. Terry, Esq.	5	5	0	...	16.25 144
" (Thorpelands)	H. J. Little, Esq.	8	0	6	280 P	16.46 117
" (Althorp House) ...	Mr. W. F. Jakeman ...	8	3	4	310 A	17.21 123
Wellingborough	E. Sharman, Esq.	5	0	3	...	17.21 143
Kettering	J. Wallis, Esq.	8	1	3	300 B	18.24 167
Rockingham Castle	Mr. J. Brown	5	1	3	300	18.51 ...
Peterborough	Mr. E. Evans	5	1	8	...	16.48 ...
Easton [Stamford]	C. Day, Esq.	5	0	10	220 P	17.18 136

DIVISION III.—SOUTH MIDLAND COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which ·01 or more fell.
		Diameter.	Height Above Ground.	Height Above Sea Level		
			ft. in.	feet.	inches.	
HUNTS.						
St. Neots, (Tetworth Hall).....	Miss Kaye	5	0 6	214 T	15·62	132
„ (Waresley)	Rev. W. M. H. Elwyn	8	1 0	193 T	15·47	119
Kimbolton (Hamerton)	Rev. A. F. Stopford ...	10	5 4	170	16·47	...
*Huntingdon (Wistow)	Rev. T. Woodruff	5	1 2	...	21·20	...
Conington Castle	J. M. Heathcote, Esq..	5	1 0	...	19·07	...
Standground Sluice, [Peterboro']	R. Lunn, Esq. ....	...	...	...	16·35	124
BEDFORD.						
Woburn (Lindon)	Mr. C. R. Clarke	5	2 0	...	20·42	137
Stotfold [Baldock]	W. Denne, Esq.	5	0 9	220	15·88	138
Aspley Guise	Dr. Trew .....	...	...	460?	19·18	...
„ (Hayfield House)	S. Douglas, Esq.	5	1 1	...	16·65	97
Ampthill	W. S. Slinn, Esq.	5	1 1	320	17·23	91
Biggleswade	C. T. Newbery, Esq. ...	5	28 0	...	16·64	...
„ (Sandy Vic.)	Rev. J. Richardson ...	5	0 7	...	15·96	130
Cardington	Mr. J. B. McLaren ...	8	0 0	106	15·87	...
„ (Staff gauge)	„ „ „	12	3 6	109	14·87	116
„	„ „ „	8	36 0	142	12·86	...
Bedford	D. Robie, Esq.	8	1 0	85	14·52	114
CAMBRIDGE.						
Abington Pigotts [Royston].....	G. Pigott, Esq.	8	0 6	130 B	17·01	149
Pampesford Hall	Mr. A. McIntyre	5	1 0	134 T	16·23	138
Granchester Mill	J. Nutter, Esq.	5	4 0	31 T	15·75	150
Cambridge (Beech House).....	„ „ „	8	4 0	40 T	14·71	150
„ (Merton Villa).....	G. Warren, Esq.	5	1 0	40 B	14·17	133
„ (Sidney Street).....	Mr. W. E. Paine	8	51 0	83 T	13·59	122
* „ (Observatory)	Professor Adams, F.R.S.	5	0 9	88 T	14·25	130
Ely (Stretham)	Mr. Edwin Stanley	9	4 9	...	17·40	120
Ely	W. Marshall, Esq.	12	40 0	85 T	11·54	...
Wisbech (Harecroft Ho.)	A. Peckover, Esq.	8	0 8	11 T	20·71	120
„ (Observatory)	S. H. Miller, Esq.	8	0 6	10 T	20·49	136
„ „ (monthly)	„ „ „	5	0 6	10 T	19·45	...
„ „	„ „ „	8	8 0	18 T	19·50	136
„ „	„ „ „	20x10	35 0	45 T	16·28	...

DIVISION IV.—EASTERN COUNTIES.

ESSEX.						
Shoeburyness	Capt. Fairford Ellis, RA	5	4 0	12 P	15·96	122
Rochford (Clement's Hall).....	A. Holt White, Esq.	8	4 0	32 T	17·64	105
Brentwood (Sawyer's Hall Farm)	Rogers Field, Esq., C.E.	5	1 0	250 P	18·24	...
* Billericay	Dr. Carter	5	1 0	...	18·98	...
Waltham Abbey	Captain Smith, R.A. ...	8	4 0	83 P	17·33	88
Epping (The Hemnalls).....	J. Nicholl, Esq.	8	0 8	...	19·82	128
Chelmsford	F. Chancellor, Esq.	8	1 0	...	18·37	...
Harlow (Sheering)	Rev. Edward Hill ...	5	1 0	214 B	18·05	166
„ (Moor Hall)	Mr. Huntley	8	1 6	220 L	15·62	126
Witham (Dorward's Hall).....	H. Dixon, Esq.	6	1 6	20 P	18·77	...

DIVISION IV.—EASTERN COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which "01 or more fell
		Diameter.	Height Above Ground.		Height Above Sea Level	
			ft.	in.	feet.	inches.
ESSEX—(con)						
Dunmow (High Roding)	Rev. E. Maxwell	5	0	8	252 T	16·69 141
"	H. E. Cockayne, Esq... 12	0	0	0	234 A	17·11 122
*Colchester (Birch Hall)	Mr. W. Ingle	5	1	0	80	19·55 123
" (The Camp)	Sergeant Sheehan..... 8	1	0	0	109 A	17·53 121
Braintree (Bocking)	S. Tabor, Esq. 12	3	6	6	200	18·99 116
Harwich (Ramsey)	J. Brampton, Esq. ....	...	...	...	100	17·66 ...
Saffron Waldon (Wimbish)	Mrs. Emson	8	0	6	...	16·97 84
" " (Ashdon)	Rev. J. T. Walker..... 5	1	0	0	300	17·28 ...
" " (Audley End) ..	Mr. J. Bryan	5	1	0	163 A	16·76 137
SUFFOLK.						
Nayland (Tendring Hall)	Mr. G. L. Rushmore... 8	0	8	...	...	18·18 102
Sudbury	J. Alexander, Esq. ... 5	3	10	10	116 B	16·77 ...
Ipswich (St. Peter's)	M. Oliver, Esq. 5	1	2	2	17 A	17·19 127
Hadleigh (Aldham)	T. F. Lloyd, Esq. 5	2	6	6	...	18·14 145
Grundisburgh	P. Harris, Esq. 5	3	6	6	...	17·62 154
Saxmundham (Carlton Hall) ..	Mr. Clark	8	5	0	...	24·57 179
Bury St. Edmunds (Drinkstone Pk)	Mr. Nichol	8	1	2	250	19·06 118
† " " (Abbeygate St.)	T. C. Hinnell, Esq. ... 6	35	0	0	...	15·78 122
Stowmarket (Wetherden Rec.)...	Rev. C. J. Goodhart ... 8	0	6	6	175 T	16·40 162
† Bury St. Edmunds (Beech Hill) ..	H. Turner, Esq. 6	0	9	9	...	20·38 ...
† " " (Westley)	R. Burrell, Esq. 5	1	0	0	...	17·43 ...
† " " (Barton Hall) ..	Mr. W. Allan..... 5	1	0	0	...	17·58 121
† " " (Culford)	Mr. P. Grieve	5	1	2	...	18·94 134
† Ixworth	Rev. W. Steggall	5	1	7	...	20·65 165
† " (Walsham-le-Willows) ..	Miss Martineau..... 5	0	11	11	...	18·88 157
† " (Barningham)	J. Fison, Esq. 8	0	10	10	...	15·70 ...
† Eye (Yaxley)	Rev. W. H. Sewell ... 8	1	0	0	199	19·23 169
† Lowestoft (Gisleham)	Rev. H. Jodrell..... 5	1	2	2	36	21·17 ...
† " (Carlton Colville)	G. Edwards, Esq. C.E. 8	0	9	9	6	21·42 ...
† " (Somerleyton Hall) ..	Mr. Rix	8	3	0	60	18·81 155
† " (" Rectory) ..	Rev. C. J. Steward ... 8	1	0	0	50	19·48 161
NORFOLK.						
† Diss (Dickleburgh)	Francis Dix	8	3	6	120 L	19·35 118
† Geldeston [Beccles]	E. T. Dowson, Esq. ... 5	1	0	0	40 B	19·27 168
† West Tofts [Brandon]	Mr. R. Martin	5	1	0	91 T	16·70 147
Hingham	Rev. J. M. Du Port ...	...	...	...	...	20·67 ...
" (Carleton Forehoe) ..	" " "	...	...	...	...	23·06 ...
" (Hardingham) .....	" " "	...	...	...	...	24·46 ...
Stoke Ferry (Wereham)	Mr F. R. Hawkes-Mason ..	0	5	5	...	18·08 148
Downham Market (Outwell Sluice)	R. Lunn, Esq. ....	...	4	0	16	16·61 111
* " (Bexwell)	Rev. E. J. Howman ... 5	0	11	11	...	17·58 128
" (Fincham)	Rev. W. Blyth	3	4	0	100	20·50 ...
Swaffham (Pickenham Hall)	E. A. Applewhaite, Esq 5	1	0	0	160 ?	21·81 173
Norwich (Postwick)	Rev. J. M. Du Port ...	...	...	...	...	21·62 ...
† " (St. Catherine's Close)	Mrs. Evans	5	2	3	120	20·88 149
" (Literary Institution) ..	The Secretary..... 12	30	0	0	53 T	18·87 122
" (Bethel Street)	C. M. Gibson, Esq. ... 8	0	8	8	103	23·66 122
† " (Thorpe)	W. Birkbeck, Esq..... 5	1	0	0	137 T	22·91 175

DIVISION IV.—EASTERN COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which ·01 or more fell.	
		Diameter.	Height Above Ground.		Height Above Sea Level		1870
			ft.	in.	feet.		inches.
NORFOLK—(cont.)							
Acle (Lingwood).....	Mrs. Burroughes	5	2	6	...	19·80	168
† „ (Rectory)	Rev. R. W. Kennion...	8	0	9	40 ∇	19·61	152
† Filby.....	Mr. Crisp	5	2	4	11	20·46	148
Norwich (Eaton).....	J. Pymar, Esq.	6	1	0	...	21·67	...
„ (Cossey)	H. Culley, Esq.	5	1	0	...	21·29	165
† „ (Honingham Hall)	Lady Bayning	5	0	6	88	21·44	169
„ (Honingham)	Rev. J. M. Du Port ...	...	...	...	90	21·60	...
† Dereham (Mattishall)	„ „ „	8	1	2	165 ∇	22·68	180
† „ (Hockering)	„ „ „	8	1	3	140 ∇	21·66	...
BA *Swaffham (Grammar School)	C. J. Drury, Esq.	5	1	10	239 ∇	19·83	153
† East Dereham.....	G. H. Cooper, Esq.	8	3	0	161 ∇	24·45	...
„ „	Mr. W. T. Gidney.....	9	3	0	190 ∇	23·20	162
Swaffham (Dunham)	Rev. J. M. Du Port ...	...	...	...	...	24·46	...
*Reepham	T. Alderton, Esq.	5	1	0	...	21·72	161
North Walsham (Worstead)	Mrs. Cooke.....	5	...	...	...	21·84	165
Weasenham.....	Rev. J. M. Du Port ...	...	...	...	...	23·09	...
Lynn (Hillington Rectory)	Rev. H. Ffolkes	5	4	0	90 ∇	22·29	140
„ („ Hall)	„ „ „	5	1	0	72	23·23	141
Fakenham (Egmere)	R. Overman, Esq.	4	4	8	150	24·41	135
Burnham (Westgate)	W. H. Spencer, Esq. ...	3	5	10	13	21·15	145
Holkham	J. Davidson, Esq.	8	0	0	39	20·74	...
„	„ „ „	12	4	0	43	20·20	162
Wells	H. R. Rump, Esq.	5	1	0	16 ∇	19·10	192
Hunstanton	Mr. Monument	11	3	8	60 ∇	18·36	...

DIVISION V.—SOUTH-WESTERN COUNTIES.

WILTS.

Landford	J. R. Wigram, Esq. ...	5	1	5	160 ∇	22·14	118
Salisbury (Alderbury)	Rev. R. S. Hutchings..	5	0	8	250 ∇	23·59	130
„ (West Dean)	Rev. W. L. W. Eyre...	5	1	0	139 ∇	22·53	109
„ (Wilton House).....	Mr. Challis.....	8	0	5	150 ∇	25·25	122
„ (Woodford).....	H. Hinxman, Esq.	5	1	2	150 ∇	22·44	...
Salisbury Plain (Chiltern Ho.)...	R. Hayward, jun., Esq	11	4	0	380 ∇	22·59	126
„ „ (Orcheston).....	Rev. J. Wardale	6	0	8	240 ∇	22·18	105
„ „ (Imber)	Rev. W. Slatter	5	4	0	400 ∇	22·07	...
Ludgershall [Andover]	E. G. Fawcett, Esq.	8	1	4	422 ∇	23·17	124
Lavington (John a' Gore)	F. Stratton, Esq.	5	2	6	550	21·40	...
Trowbridge (Sunny Side)	W. J. Mann, Esq.	5	1	1	...	20·49	119
Marlborough (Kingsbury Street)	W. C. Merriman, Esq. 15	4	0	0	500	20·77	120
„ College	Rev. T. A. Preston ...	5	0	0	456 ∇	23·41	123
„ (Mildenhall).....	Rev. C. Soames	5	1	0	502 ∇	20·96	133
Chippenham (Tytherton)	Major Gritton	5	1	2	150 ∇	18·14	157
Swindon (Draycot Folliott)	T. Arkell, Jun., Esq.	5	1	0	...	23·96	120
„ (Penhill)	T. Arkell, Esq.	5	0	10	...	20·10	128
Thames' Head [Cirencester].....	J. H. Taunton, Esq., C.E.	8	4	0	350 ∇	22·20	119

DIVISION V.—SOUTH-WESTERN COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which "01 or more fell.
		Diameter.	Height Above Ground.		Height Above Sea Level	
			ft.	in.	feet	inches.
DORSET.						
Kimmeridge	J. C. Mansel, Esq.....	5	0	4	120 B	23·03 108
Corfe Castle (West Backnowle)..	W. J. Voss, Esq.....	5	4	6	160 L	23·05 71
Weymouth (Osmington)	Captain Hall	5	1	0	150 P	24·15 126
Upwey	J. Miller, Esq.	5	1	0	70	20·55 115
Abbotsbury	Mr. McNeil	5	3	0	150	18·45 78
*Dorchester	J. Jowett, Esq.	5	0	6	250 T	25·66 129
Lyme Regis.....	H. Tucker, Esq.....	5	4	6	146 B	22·79 128
Bridport	A. Stephens, Esq.	8	0	8	60 B	20·32 111
"	"	8	...	...	45 B	19·92 ...
Maiden Newton (Frome Vanchr.)	Rev. P. H. Newnham..	5	0	3	325 B	28·55 145
Blandford (Bingham's Melcombe)	Rev. C. W. Bingham...	5	1	3	300 P	29·08 122
Cerne Abbas (Melbury).....	Mr. T. C. Elliott	12	2	9	...	27·40 ...
*Wimborne Minster (Chalbury)...	Rev. G. H. Billington.	5	2	0	338 T	23·85 124
Blandford.....	W. Shipp, Esq.	5	1	0	...	25·11 ...
" (Longthorns).....	J. C. Mansel, Esq.	5	0	4	340 B	26·92 111
Shaftesbury	T. Ackland, Esq.	5	1	1	416 B	23·77 105
DEVON.						
†Kingsbridge (Bolt Tail) .....(58)	W. Balkwill, Esq.....	5	2	0	297 L	24·75 ...
† " (Burton).....(57)	" " "	5	6	0	200	20·94 ...
† " (Fore St. Hill) (56)	G. Fox, Esq.	5	0	6	68 B	26·04 100
† Plymouth (Old Town St.) ... (52)	A. P. Balkwill, Esq....	5	35	0	150	26·98 ...
† " (Navigation School)...	J. Merrifield, Esq.....	8	26	6	100 T	24·11 118
" (Drake's Reservoir) ...	G. D. Bellamy, Esq....	5	0	6	140	24·70 99
† " (Saltram Gardens) (51)	Mr. J. Snow	5	0	3	96 T	31·31 ...
† " (Ham)	Rev. C. T. C. Trelawny	5	3	0	94 T	30·27 115
† Ivybridge	Dr. Liddell.....	10	3	0	175 B	32·56 ...
† Brixham (Lupton)	Mr. G. Erskine.....	12	3	6	200	30·03 110
† PlymptonStMary(Ridgew'y) (50)	Miss B. T. Phillipps ...	5	0	6	116 T	32·17 152
" " (Hemerdon)...	Rev. G. L. Woolcombe	5	0	6	...	35·99 ...
Totness (Dart View)	E. Windeatt, Esq.....	5	1	0	120	32·97 133
† Torquay (Lamorna)	W. Pengelly, Esq., F.R.S	5	0	9	200 T	25·00 125
† Dartmoor (Lee Moor)	W. L. Martin, Esq. ...	5	0	5	860 T	40·49 ...
† " (Redstone, Sheepstor) (41)	G. D. Bellamy, Esq....	5	1	0	800	44·39 107
" (Holne Vicarage) ... (33)	Rev. J. Gill.....	5	1	0	...	52·3 168
† Ashburton (Druid House) ... (32)	Fabyan Amery, Esq....	5	1	0	570 T	38·89 143
† Dartmoor (Prison Reservoir) (34)	Mr. H. Watts	5	0	2	1400	46·95 186
" " (Garden) ...	" " "	5	1	0	1350 T	54·70 186
" (Rundlestone).....(35)	" " "	5	1	0	1500 P	52·35 186
† Teignmouth (Landscore).....(29)	Mrs. Clark	5	0	3	125 T	21·62 ...
† " (Bishopsteignton) (30)	Rev. S. M. Scroggs ...	5	6	0	120 B	22·13 117
† Ilminster (Middlecott Ho.)... (23)	Alfred Lyon, Esq.....	9	3	6	649 T	29·15 126
† Tavistock (Public Library) (38)	Mr. W. Merrifield.....	8	20	0	283 T	36·89 107
† " (West Street)	T. Windeatt, Esq.....	1	4	6	286 T	37·40 ...
†* " (Mount Tavy).....(37)	H. Clark, Esq.	5	1	0	316 T	31·91 ...
Dartmoor (Widdecombe Vic.) (24)	Rev. J. Williams	5	1	0	700 P	33·26 ...
† Milton Abbot (Endsleigh) ... (26)	Mr. Cornelius.....	5	1	0	180 P	41·06 ...
† Bovey Tracey	J. Divett, Esq.	5	0	6	92 T	30·32 134
† Coryton Lew Down.....(21)	Mr. T. Symons	12	6	0	445	38·26 133

NOTE.—Figures in parentheses on this and following page correspond to those on the Map in our last.

DIVISION V.—SOUTH-WESTERN COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which '01 or more fell.
		Diameter.	Height Above Ground.		Height Above Sea Level	
			ft.	in.	feet.	inches.
DEVON—(con.)						
† Exmouth (Budleigh Salterton)...	R. Walker, Esq.	5	4	0	33	21·29 125
† Chagford (20)	R. L. Berry, Esq.	5	0	7	575 B	27·18 ...
Sidmouth (Belgrave)	Dr. Mackenzie	5	0	6	26 A	19·79 127
"	S. Chick, Esq.	10	25	0	43 A	16·64 112
" (Sidmount).....	Dr. Radford	5	1	0	149 A	19·87 114
"	"	5	8	6	195 A	18·91 114
Cleveland [Lyme Regis]	E. L. Ames, Esq. ....	...	1	6	480 P	22·24 ...
† Topsham (Clyst St. George)	Rev. H. T. Ellacombe.	5	1	3	76 T	19·69 ...
† Exeter (High Street) (17)	W. H. Ellis, Esq.	5	47	11	184 A	20·95 115
† " " "	"	10	44	3	180 A	20·93 114
† " (Devon & Exeter Institution)	Mr. E. Parfitt	6	13	7	155 A	21·74 109
† " (Manston Terrace)... (18)	Miss Dymond.....	5	0	1	165 T	22·58 114
Honiton (Gittisham)	C. Hardy, Esq.	5	1	0	...	28·26 112
Okehampton (Oaklands)..... (19)	W. H. Holley, Esq. ...	5	1	0	500	33·78 163
Hatherleigh (North Lew) ... (15)	Rev. T. England	5	1	10	...	28·89 ...
" (Jacobstowe) ... (14)	Dr. Madden	8	1	2	340	26·80 134
† Exeter (Brampford Speke)... (13)	W. H. Gamlen, Esq....	5	1	0	140 T	22·06 157
† " " " (monthly) (13)	"	8	0	2	140 T	22·29 ...
Zeal Monachorum	Rev. H. J. A. Fothergill	5	0	9	600	30·76 144
Cullompton (Clyst Hydon)	Rev. J. Huyshe.....	...	1	0	200 A	22·98 ...
" (Bradninch)	H. Matthew, Esq.....	12	1	6	234	22·20 ...
† Honiton (Broadhembury)	Rev. W. Heberden ...	5	1	6	400 T	22·48 130
Tiverton (Cove) (9)	W. N. Row, Esq.	11	0	4	450 P	29·89 ...
" (Springfield)	H. Stokes, Esq.	6	0	3	300 P	26·64 156
Chulmleigh (Witheridge)..... (8)	Rev. J. P. Benson.....	...	...	...	...	24·00 114
Great Torrington	Rev. S. Buckland	5	1	1	321 L	30·00 135
S. Molton (Meshaw)	Rev. W. H. Karslake	8	0	6	472 L	28·75 155
" (Rose Ash).....	Captain Davy.....	8	0	6	650	28·82 ...
Bampton (6)	J. Edwards, Esq.	5	1	0	400	32·45 144
South Molton	E. Wales Johnson, Esq.	5	1	0	443 B	32·87 172
* Bideford (Buckish) (7)	Rev. J. H. Kirwan ...	5	1	1	550 B	35·25 160
* " (Northam) (5)	Rev. J. D. Churchward	5	1	0	173	19·12 105
S. Molton (Castle Hill)..... (4)	Mr. J. Baillie.....	12	3	5	200 P	33·12 118
Barnstaple (3)	T. Mackrell, Esq.	8	0	6	43 T	28·79 147
" (Bratton Fleming) ...	Rev. H. S. Pinder.....	5	2	0	700 P	36·32 174
Ilfracombe Hotel.....	Mr. W. Clark.....	12	9	0	25	25·60 117
CORNWALL.						
† Lizard (St. Ruan Rec.)	Rev. F. C. Jackson.....	8	3	0	100 T	26·50 124
† Land's End (St. Sennen)	Rev. G. L. Woolcombe	5	4	10	290	22·79 153
† Helstone	M. P. Moyle, Esq.	5	5	0	116 T	27·66 141
† Penzance	W. H. Richards, Esq.	12	3	0	94 T	31·65 ...
" (Poltair).....	H. R. Trelawny, Esq....	5	1	0	250	32·80 ...
Camborne (Crowan)	Mr. J. T. Bodda.....	8	4	0	530	32·96 ...
"	"	11	1	4	230	35·67 ...
Falmouth (Carelew)	Mr. G. Palmer	5	0	6	...	33·62 129
† Redruth (Tehidy Park)	Mr. Mill	5	0	6	160 T	37·00 ...
† Truro (Royal Institution)	Dr. Barham	10	40	0	56 A	29·77 141
† " " "	"	5	40	0	56 A	29·43 141

DIVISION V.—SOUTH-WESTERN COUNTIES—(continued).

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which ·01 or more fell.
		Diameter.	Height Above Ground.	Height above Sea Level.		
			ft. in.	feet.	inches.	
CORNWALL—(con.)						
† Truro (Penarth)	N. Whitley, Esq.	12	1 0	190 A	28·54	134
† „ (Strangways Terrace)....	Dr. Barham	8	2 6	71 B	29·66	148
† St. Agnes.....	Mr. Opie.....	11	1 8	278 B	32·05	135
† *St. Austell (Trevarna)	W. Coode, Esq.	5	0 6	300 A	33·26	114
„ (Trevarrick)	C. Truscott, Jun., Esq.	5	1 0	169 A	35·31	158
„ (Polcarne)	J. Coode, Esq.	5	1 0	206 T	36·54	135
† Newquay	Mr. W. H. Tregidgo... 6	1 9	90 B	26·03	108	
Saint Columb	Mr. J. Best.....	5	5 0	...	31·48	141
† Liskeard (Dean Terrace).....(47)	S. W. Jenkin, Esq. C.E.	5	1 1	375 A	37·67	158
„ (St. Cleer)	„ „	5	1 1	620 A	39·85	...
† Saltash (Pentillie Castle) ... (46)	Mr. C. Edwards	5	1 3	150 B	36·02	123
† Callington (Hingston Down) (39)	Captain Richards	11	1 0	850 T	46 91	132
† „ (Church Street) ... (40)	Mr. J. Brown, Jun.	5	3 0	490 T	40·89	125
† Bodmin (Castle Street)	Capt. Liddell, R.N.	8	2 6	338 T	39·73	...
† „ „ „	„ „	5	1 0	338 T	41·29	169
† „ „ „ weekly	„ „	5	0 1	338 T	42·89	...
† „ (Fore Street)	A. Hambly, Esq.	8	2 6	336 T	40·13	163
† „ (Warleggan)	Rev. D. Clements	8	2 6	550 B	44·21	175
† Wadebridge.....	Mr. C. Jordan	8	2 6	23 T	29·46	190
† „ (Treglines, St. Minver)	Mr. T. Liddell, Jun.	10	3 0	140 T	25·38	126
† „ (Treharrook House) ...	H. A. Hambly, Esq.	5	2 9	303 T	23·16	147
† St. Endellion (Park Villa).....	Miss Guy	8	3 0	277	23·76	...
† Launceston (Altarnum) .....(28)	C. U. Tripp, Esq.	5	0 7	570 B	47·79	165
† „ (Hexworthy) ... (27)	H. M. Harvey, Esq. ...	5	2 7	411 T	41·61	125
SOMERSET.						
Chard (Cricket St. Thomas)	Viscount Bridport.....	5	1 0	...	30·79	118
Crewkerne (Bincombe House) ...	F. J. Sparkes, Esq. ...	5	1 2	250 ?	27·20	128
Ilminster	J. Knott, Esq.	5	1 0	131 A	27·72	126
„ (South Petherton).....	W. Blake, Esq.	8	0 6	200 ?	21·00	130
Ilebrewers (Walrond Park)	J. Ostler, Jun., Esq.	5	1 0	116 T	19·41	110
Ilchester	J. W. Bourne, Esq. ...	8	2 0	40 ?	21·75	108
*Wellington (Sunnyside).....	W. Elworthy, Esq. ...	5	1 0	...	24·17	122
*Taunton (Fullands School)	W. Reed, Esq.	5	1 6	...	19·43	104
„ (College School)	Rev. W. Tuckwell ...	5	1 0	80 B	19·06	123
„ (The Mount)	H. Alford, Esq.	5	1 1	98	20·02	126
„ (The Castle)	G. Gillett, Esq.	8	1 6	...	19·75	136
Langport (Long Sutton)	R. Palmer, Esq.	5	0 10	50	18·44	106
*Wiveliscombe	B. Boucher, Esq.	5	1 2	...	22·64	138
Taunton (Bishops Lydeard)	Mr. R. King	5	1 2	...	22·44	135
Quantock Hills (Bagborough) ...	Rev. J. B. Riky	9	5 0	1000 ?	21·90	...
Glastonbury (Street)	W. S. Clark, Esq.	8	1 0	60	25·63	125
Wells (Dinder)	Rev. T. J. Bumpsted ..	8	4 0	140 B	29·07	134
Burnham (The Colony)	Captain Estlin	5	1 0	18 A	19·34	102
Frome (Mells Rectory)	Rev. J. H. Horner. ...	5	1 0	342 A	31·62	144
E. Harptree (Sherborne Reservoir)	Bristol Water Works	5	1 0	338	35·35	...
Chew Magna [Bristol]	Bristol Water Works... 5	1 0	160	25·09	...	
West Harptree Vicarage	Rev. Dr. Tyas	8	0 5	268 A	36·76	134

DIVISION V.—SOUTH-WESTERN COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which ·01 or more fell.
		Diameter.	Height Above Ground.		Height Above Sea Level	
			ft.	in.	feet.	inches.
SOMERSET—(con.)						
Bath (Paragon)	Dr. Barter	5	6	0	112 π	22·51 136
" (Gay St.)	" "	5	1	3	145	22·79 135
" (Literary Institute)	C. P. Russell, Esq.	5	8	0	75 π	21·38 113
" (Weston)	"	5	10	0	190 π	21·58 124
" (Batheaston, Bannerdown Ho.)	Colonel Ward	5	1	0	250 π	21·20 118
" " Reservoir	A. Mitchell, Esq.	12	2	0	226	17·85 96
Chelvey [Bristol]	Rev. J. Matthew	5	0	5	37 π	24·20 126
Barrow Gurney Reservoir	Bristol Water Works	5	1	0	320	28·05 ...

DIVISION VI.—WEST MIDLAND COUNTIES.

GLOUCESTER.

Bristol (Small St.)	Bristol Water Works	5	25	0	40	21·41 ...
" (Phil. Inst)	B. Wright, Esq.	12	56	0	...	21·61 ...
Clifton (South Parade)	Dr. G. F. Burder	8	0	6	192 π	23·43 ...
Chipping Sodbury (Badminton)	Mr. McNaughton	5	0	8	...	24·36 98
Fairford (Kempsford)	R. A. Iles, Esq.	5	0	8	...	17·63 91
Nailsworth (Spring Hill)	H. D. Humphries, Esq.	8	2	0	...	27·15 143
Berkeley (Estate Offices)	J. H. Cooke, Esq.	5	8	0	60	20·94 90
Lydney	Rev. W. H. Bathurst..	8	1	0	30	27·96 ...
Cirencester (The Firs)	J. Bravender, Esq.	5	0	8	350	23·33 136
" (Further Barton)	T. C. Brown, Esq.	10	1	2	420	24·01 ...
Stroud (Brimscombe Port)	J. H. Taunton, Esq., C.E.	8	10	0	200 π	24·16 100
" (Brick House)	W. Bishop, Esq.	5	1	0	177 π	25·30 ...
" (Upfield)	Miss Stanton	5	0	11	170 π	22·91 164
" (Castle Villas)	J. Bateman, Esq. ....	...	1	0	240 π	25·10 128
Fairford (Hatherop Rectory) ..	Rev. R. P. Davies	8	1	3	412 π	21·84 112
" (The Dean Hatherop) ..	W. Arkell, Esq.	5	...	...	...	21·83 ...
Frampton-on-Severn (Saul Lodge)	W. B. Clegram, Esq. C.E.	5	3	6	42 π	20·30 118
Northleach (Yanworth)	W. Arkell, Esq.	5	1	0	...	24·72 ...
Cheltenham (Cowley Manor) ..	Mr. J. Sadler	5	1	4	600	26·96 139
Gloucester (Witcomb Court)	A. Bubbs, Esq.	8	2	0	250	18·83 ...
" " " Water Works)	T. Small, Esq.	8	3	0	297 π	20·58 106
" (Quedgeley Ho.)	J. C. Hayward, Esq.	5	0	10	50	19·15 ...
" (Barnwood Ho.)	Dr. A. J. Wood	8	3	6	60 π	19·71 129
" (Park House) monthly..	Alfred Price, Esq.	5	3	6	50 π	17·92 ...
" (Huntley)	Rev. W. L. W. Eyre	5	0	6	200 π	22·54 ...
Cheltenham (Prestbury)	G. Makgill, Esq.	5	0	8	180 π	20·24 112
" (Keynsham Bank) ..	H. D. Humphries, Esq.	8	6	6	232	20·62 119
" (Hatherley Sew. Wks.)	" " "	8	16	6	172	14·19 116
" (Arle=Chelt " ")	" " "	8	16	6	169	13·49 115
Newent (Boyce Court)	General Drummond ..	5	1	0	133	19·80 116
Moreton-in-Marsh (Frogmore) ..	W. Arkell, Jun., Esq. ...	5	0	9	...	19·71 144
HEREFORD.						
Ross (Rocklands)	J. M. Herbert, Esq.	8	1	10	150	26·20 ...
" (Archenfield)	H. Southall, Esq.	5	1	0	250 π	20·18 128
* " (Sellack Vicarage)	Rev. W. C. Ley	5	0	5	...	21·27 126

DIVISION VI.—WEST MIDLAND COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which -01 or more fell.
		Diameter.	Height Above Ground.	Height Above Sea Level.	1870	
			ft. in.	feet.	inches.	
HEREFORD—(con.)						
Hereford (Fownhope Vicarage)	Rev. T. West.....	5	1 1	...	20·26	135
„ (Broomy Hill)	T. Curley, Esq., C.E.	5	0 11	158 ?	18·77	...
„ (The Blue School).....	W. Cooke, Esq.	8	6 0	190	16·61	93
„ (Richmond Place).....	E. J. Isbell, Esq.	8	5 8	188 A	18·63	140
„ (Davison's Nursery) ...	„ „ „	8	1 0	198 T	18·99	...
„ (Hagley Park)	A. Hutchinson. Esq....	5	0 6	284	17·02	...
„ (Tupsley)	P. Ballard, Esq..	5	1 1	...	17·68	...
„ (Stretton)	Rev. H. C. Key	5	1 0	190 T	16·77	83
Bredwardine	Rev. S. Clark	5	1 0	290 ?	23·02	129
Staunton-on-Wye	Rev. H. W. Phillott...	5	1 0	258 B	20·52	139
Kington (Lynhales)	S. Robinson, Esq.....	8	1 0	...	21·89	...
Leominster (West Lodge)	E. P. Southall, Esq. ...	5	1 0	250 T	18·87	136
Kington (Burcher Cottage)	Miss Boddington	12	2 8	...	24·84	108
Leominster (Leysters)	Rev. T. S. Hewitt.....	5	0 4	600 ?	19·31	...
SHROPSHIRE.						
Burford [Tenbury].....	Lord Northwick	5	0 11	100 ?	20·23	...
Ludlow (Knowbury)	Rev. J. B. James	6	0 4	1000 ?	21·91	...
„ (Mill Street)	W. Marston, Esq.	5	1 1	337 T	26·87	160
Craven Arms (Stokesay)	Rev. J. D. La Touche .	5	1 0	...	24·07	123
Bridgenorth (Quatt School)	Mr. L. Roach.....	5	4 2	194 A	21·84	118
„ (Dudmaston Hall)....	Rev. F. H. W. Whitmore	5	1 0	...	23·78	149
Bishop's Castle (More Rectory)....	Rev. A. S. Mall.....	5	1 6	640 T	23·25	131
Church Stretton (Woolstaston)....	Rev. D. Carr	5	1 0	790 B	26·36	165
Shifnal (Badger)	Rev. T. F. Boddington	5	2 10	...	21·93	...
„ (Haughton Hall)	Rev. J. Brooke	5	3 5	355 A	21·48	149
Shrewsbury	Marshall & Co.	10	4 4	192	16·80	...
„ (Monkmoor).....	Miss Lovett	5	1 0	200	18·31	...
„ (Fitz Manor)	R. Middleton, Esq.....	5	2 6	287 B	19·09	...
Newport (Chesswell Grange) ...	T. Radcliffe, Esq. ....	...	1 0	250	21·28	141
Oswestry (Hengoed)	Rev. A. R. Lloyd	5	6 0	470 A	31·26	...
Market Drayton (Nort'n-in-Hales)	Rev. F. Silver	8	1 0	335 B	18·87	96
„ (Adderley)	Rev. Athelstan Corbet	5	0 9	245 ?	22·51	...
33A*Whitchurch	A. B. George, Esq.....	5	3 0	...	26·72	110
STAFFORD.						
Wolverhampton (Oaklands).....	H. Ward, Esq.	5	1 0	525 A	22·14	125
„ (Waterloo Road).....	C. G. DeLessert, Esq..	5	1 1	500	21·09	135
„ (Merridale Road)	John Thrustans, Esq...	5	1 0	426 A	21·35	140
„ (Wrottesley) <i>monthly</i>	Mr. E. Simpson.....	8	0 8	490	21·48	...
Tamworth	W. Arnold, Esq.	5	1 0	160 ?	20·29	124
Weston-under-Lyziard [Shifnal]	Hon. Rev. J. Bridgeman	3	0 10	...	20·75	155
Rugeley (Beau Desert)	Mr. W. R. Robson.....	8	0 4	600	24·05	133
Burton-on-Trent	J. Matthews, Esq.....	5	4 0	152	19·65	125
„ (Horninglow)	R. W. Abbotts, Esq...	5	4 0	150	20·40	155
Stoke (Barlaston)	W. Scott, Esq.	5	0 6	530 T	23·28	136
Oakmoor (Ellaston)	Rev. Sir C. R. Lighton, Bt.	5	3 0	400	26·86	138
Stoke (Stanley Reservoir).....	W. J. Snape, Esq., C.E.	5	3 1	550 T	24·05	110
Leek (Rudyard)	„	5	12 7	500 T	26·45	119
Knypersley [Congleton]	„	5	14 0	500 T	36·83	135

DIVISION VI.—WEST MIDLAND COUNTIES.—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which ·01 or more fell.	
		Diameter.	Height Above Ground.		Height Above Sea Level		1870
WORCESTER.							
Northwick Park.....	Lord Northwick	8	1	6	...	21·76	...
Evesham (Lansdowne)	R. Burlingham, Esq... ..	8	4	6	124 B	15·95	110
Great Malvern	Messrs. W. & J. Burrow..	5	0	10	526	22·00	155
West Malvern	A. H. Hartland, Esq.	8	1	6	850 B	21·40	...
Worcester (Beechwood).....	W. Burgess, Esq.	5	1	0	137	19·93	107
" (Gas Works)	F. N. Gosling, Esq.	10	4	1	...	17·66	...
Tenbury (Orleton)	T. H. Davis, Esq.	5	0	9	200 P	24·17	156
Bromsgrove (The Ford House)...	G. Dipple, Esq.	11	4	4	273 A	20·56	123
Stourbridge (Hagley Rectory) ...	Hon. Mrs. Lyttleton...	8	0	5	636	23·89	141
Selly Hall [Birmingham].....	Rev. E. W. Winter ...	8	3	6	...	24·91	...
Moseley [Birmingham].....	T. L. Plant, Esq.	5	4	0	487 A	25·54	170
WARWICK.							
Alcester (Sambourne).....	A. Winkfield, Esq.	5	1	3	...	22·92	78
" (Studley)	Mr. J. Bourn	5	0	10	350 P	22·03	141
Henley-in-Arden (Arden House)...	G. R. Dartnell, Esq.	5	2	0	400 P	19·14	117
Leamington (Upper Parade).....	S. U. Jones, Esq.	5	0	8	195 A	17·79	129
Coventry	J. Gulson, Esq.	8	1	0	279 A	21·30	148
" (Radford).....	Miss Atkins	8	1	0	305	18·44	133
" (Coundon)	R. Caldicott, Junr., Esq.	5	1	2	350	20·97	118
Pailton House [Lutterworth] ...	Capt. Constable Curtis ...	5	1	0	...	20·54	115
† Birmingham (Edgbaston).....	Miss R. B. Southall ...	8	1	3	510 T	22·81	137
" (Botanic Gardens)...	Mr. Latham	5	5	2	...	20·87	157
† " (Bloomsbury Street).....	D. Smith, Esq.	8	0	10	340 T	23·65	140
Nuneaton (Stretton Ho.)	T. J. Scott, Esq.	5	0	6	...	19·89	145

DIVISION VII.—NORTH MIDLAND COUNTIES.

LEICESTER.						
† Market Harborough (Fleckney)...	J. B. Putt, Esq.	5	0 8	411 T	18·49	...
† Wigston	T. Burgess, Esq.	8	0 6	220 T	18·27	105
Leicester (Belmont Villas).....	H. Billson, Esq.	8	0 6	130 P	20·39	109
† Thornton Reservoir	C. Tebbutt, Esq.	10	2 8	420 P	19·33	113
Appleby Magna	<i>Preston Guardian</i> .....	...	2 0	335	17·15	...
324† Owston [Oakham]	Miss Gilford	5	1 0	580 B	22·56	150
Melton Mowbray (Dalby Hall)...	Mr. G. Jones	8	2 6	480 P	18·60	143
" " (Asfordby)	Rev. C. A. Holmes	5	0 9	212	16·57	127
Loughborough (Cedar Cottage)...	J. Giles, Esq.	5	0 9	400 P	21·67	...
Waltham Rectory	Rev. G. E. Gillett.....	8	1 0	560 B	18·41	140
† Belvoir Castle	W. Ingram, Esq.	8	1 0	237 T	19·28	119
Harston [Grantham]	C. Beasley, Esq. ....	...	...	...	16·43	...
RUTLAND.						
Ryhall	Rev. C. Potchett	5	...	...	16·46	110
LINCOLN.						
Stamford (Barn Hill Ho.)	Dr. Newman	5	1 0	116 T	16·55	...
* Bourne (Wytham-on-the-Hill) ...	A. C. Johnson, Esq.	5	1 3	167 P	14·40	117
Spalding (Pode Hole).....	A. Harrison, Esq.	12	0 0	20 P	16·88	...
Grantham (Denton Hall)	Sir Welby-Gregory, Bt.	8	2 0	200	16·08	...

DIVISION VII.—NORTH MIDLAND COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which "10 or more fell.
		Diameter.	Height Above Ground.		Height Above Sea Level	1870
			ft.	in.	feet.	inches.
LINCOLN—(con.)						
† Grantham.....	J. W. Jeans, Esq.	8	0	6	179 A	17·12 124
Sleaford (Heydour).....	Rev. G. F. Deedes	5	2	0	...	14·84 57
" (Aswarby)	Rev. C. Whichcote ...	5	4	0	...	14·92 ...
Boston (Bargate Lodge)	Dr. Mercer Adam	5	1	0	20 A	18·40 157
" (Grand Sluice)	" " " "	8	6	0	25 A	16·40 143
" (Pen Street)	W. H. Wheeler Esq. C.E	5	4	0	16 A	18·66 156
Stubton [Newark]	G. Nevile, Esq.	5	4	6	...	18·76 119
Lincoln (Navenby).....	Rev. J. Hays	8	0	6	...	18·82 120
Horncastle (Miningsley)	W. H. Wheeler, Esq. C.E	5	0	6	135 A	20·15 143
Spilsby (Welton-le-Marsh)	Rev. A. Wright.....	5	3	6	180 ?	23·24 125
" (Skendleby Hall)	T. Booth, Esq.	6	1	0	...	22·32 145
Lincoln (Branston).....	A. S. Leslie Melville, Esq	5	0	9	200 ?	23·05 142
"	M. S. & L. R. Co † ...	9	3	6	26	16·29 103
Gate Burton.....	" " "	9	3	6	96	19·40 119
Louth	T. W. Wallis, Esq. ...	3	6	0	80 L	26·38 183
Market Rasen	M. S. & L. R. Co.	9	3	6	100	25·26 133
Gainsborough	" " "	9	3	6	76	16·44 125
Stockwith	" " "	9	3	6	21	18·42 102
Brigg	" " "	9	3	6	16	24·06 126
Grimsby	" " "	9	15	0	42	20·10 131
Barnetby	" " "	9	3	6	51	26·90 139
Crowle (Keadby) .....	" " " .....	...	...	...	10	23·98 103
Uleaby (Killingholme)	Rev. J. Byron	5	1	4	60 A	26·81 183
Brigg (Appleby).....	Rev. J. E. Cross	5	0	9	60 L	23·20 ...
" (Ferriby Sluice).....	" " "	5	0	9	10	22·62 ...
New Holland	M. S. & L. R. Co.	9	3	6	18	23·67 152
NOTTS.						
Nottingham (Ruddington Grange)	C. Paget, Esq.	8	1	1	...	17·66 138
" Park	W. Chapman, Esq.	5	1	3	90 L	18·69 ...
" (Arboretum)	M. O. Tarbotton Esq. C.E	8	0	9	238 A	17·93 127
" " " "	" " " "	8	25	6	263 A	16·60 126
" (Gedling) "	Hn & R. O. W. Forrester	6	1	6	130 ?	18·11 126
Southwell (Oxton)	H. Sherbrooke, Esq.	2	2	0	...	20·68 ...
"	W. W. P. Clay, Esq. ...	6	1	0	200 ?	16·33 ...
Welbeck Abbey	Mr. W. Tillery	5	4	0	80 A	21·58 112
Worksop	M. S. & L. R. Co. ...	9	3	6	127	18·08 132
Retford.....	" " "	9	3	6	52	17·02 79
DERBY.						
Sawley	Mr. J. Windle	5	0	9	100	18·41 ...
Trent College	C. U. Tripp, Esq.	5	0	7	150 ?	16·96 134
Derby (Mickleover)	Mr. Ryley	5	17	6	310 B	19·42 ...
"	J. Davis, Esq.	5	6	0	180 A	18·73 146
" (West Hallam)	Rev. C. J. Newdigate	5	2	0	356	21·05 143
" (Duffield).....	W. Bland, Esq.	5	1	0	200 ?	21·99 121
Belper	J. G. Jackson, Esq. ...	5	0	8	240 T	23·42 151

† Kept for the Canals Department of the Manchester, Sheffield, and Lincolnshire Railway Company.
Returns supplied by R. D. Heathcote, Esq.

DIVISION VII.—NORTH-MIDLAND COUNTIES—(continued).

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which ·01 or more fell
		Diameter	Height Above Ground.		Height Above Sea level	
			ft.	in.	ft. in.	inches.
DERBY—(con.)						
† Matlock Bath	R. Chadwick, Esq.	5	1	6	500 T	30·63 ...
Chesterfield (Grassmoor Colliery)	E. Bromley, Esq.	5	9	0	...	20·11 120
"	M. S. & L. R. Co.	9	3	6	248	21·00 103
Brampton (Fairfield)	J. M. Hewitt, Esq. ...	5	6	8	510 B	27·47 163
" (St. Thomas')	Rev. J. M. Mello	5	6	6	324 A	22·73 134
† Chatsworth Gardens	Mr. Speed	12	0	6	404 B	25·74 ...
† Buxton (Axe Edge	E. J. Sykes, Esq.	8	1	0	1620 B	38·78 ...
† " (Devonshire Hospital) ...	" " "	8	5	0	1005 T	45·38 189
† Stony Middleton	Rev. U. Smith	5	4	0	692 B	29·05 111
Kilnarsh (Norwood)	M. S. & L. R. Co. ...	9	3	6	238 T	19·07 128
Comb's Moss	" " "	9	3	6	1669 T	40·24 ...
" Reservoir	" " "	9	3	6	710 T	47·58 176
† Chapel-en-le-Frith	" " "	9	3	6	965 T	37·90 143
† Woodhead	" " "	9	3	6	878 T	42·21 149

DIVISION VIII.—NORTH-WESTERN COUNTIES.

CHESHIRE.

Nantwich (Cholmondeley Cas.) ...	E. L. Williams, Esq. C.E.	8	1	6	42	26·21	149
Chester (Pulford Hall)	R. Massie, Esq.	5	3	0	51 T	22·23	156
Bosley Minns	M. S. & L. R. Co. ...	9	3	6	1210 T	26·49	104
" Reservoir	" " "	9	3	6	590 T	24·33	122
Chester (Crane Street)	F. Hardacre, Esq., C.E.	5	1	6	20 A	20·57	...
" (Newton Nurseries)	J. Dickson & Sons	8	0	6	62 A	21·51	164
" (Hoole Bank)	P. Ewart, Esq.	2	5	6	90 P	17·97	...
Macclesfield	M. S. & L. R. Co.	9	3	6	539 T	23·83	112
" (Park Green)	W. Jeffery, Esq.	8	2	1	450 A	29·01	147
" (Town Yard)	H. S. Aspinwall, Esq.	8	1	11	425	29·76	159
Chelford	Mr. C. Nichols	5	1	6	260 A	25·81	123
Nantwich (Highfield)	E. L. Williams, Esq. C.E.	8	1	6	65	23·35	136
Neston (Hinderton)	Reginald Bushell, Esq.	5	1	0	195 P	22·16	151
Runcorn (Weston Point)	E. L. Williams, Esq. C.E.	8	1	6	15	25·66	158
Bollington (Spond's Hill)	M. S. & L. R. Co.	9	3	6	1279 T	26·80	...
Whaley	" " "	9	3	6	602 T	39·90	175
Altrincham (Barrington House) ..	J. Newton, Esq., C.E.	5	1	0	105	29·15	...
† Birkenhead (Bidstone Obs.)	J. Hartnup, Esq.	8	0	6	182	24·44	154
Marple Aqueduct	M. S. & L. R. Co.	9	3	6	321 T	30·01	140
" Top Lock	" " "	9	3	6	543 T	32·98	139
Godley Reservoir	J. F. Bateman, Esq. FRS	...	...	...	500	30·04	...
Mottram Hill End	M. S. & L. R. Co.	9	3	6	680 T	34·77	159
" Matley's Field	" " "	9	3	6	399 T	32·28	152
Newton	" " "	9	3	6	396 T	30·30	133
Arnfield Reservoir	J. F. Bateman, Esq. FRS	...	...	...	575	34·45	...
Staleybridge (Swineshaw)	Mr. W. Watts	9	3	0	884 T	45·21	158
† Rhodes Wood Reservoir	J. F. Bateman, Esq. FRS	12	1	0	520	39·88	...
† Woodhead	" " "	12	0	10	680	46·62	...
† Torrside	" " "	12	1	6	600	40·16	...
Tintwistle (Featherbed Moss) ...	Mr. W. Watts	8	1	0	...	45·60	...

DIVISION VIII.—NORTH WESTERN COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which -01 or more fell.
		Diameter.	Height Above Ground.		Height Above Sea Level	
			ft	in.	feet.	inches.
LANCASHIRE.						
Warrington (Bewsey Street).....	L. W. Reynolds, Esq. ...	5	1	0	40 T	27·36
West Derby (Sandfield Park) ...	Mr. W. Biggs	8	1	2	147	24·21
Heaton Chapel (Roseleigh)	J. Curtis, Esq.	8	2	3	235 T	27·91
Denton Reservoir	J. F. Bateman, Esq. FRS	...	...	...	324	28·08
Gorton " .....	" " " .....	...	...	...	263	28·93
Prescot (Knowsley)	Mr. J. Freeman	6	10	0	220 T	28·50
† Manchester (Old Trafford)	G. V. Vernon, Esq. ...	8	2	7	106 T	29·55
" (Plymouth Grove).....	J. F. Roberts, Esq.	8	3	9	150 T	30·32
" (Eccles)	T. Mackereth, Esq.	10	3	0	145 T	30·40
" "	" " "	5	34	0	179 T	24·35
Salford (Town Hall)	" " "	5	7	0	115 T	31·09
Manchester (Ardwick)	J. Casartelli, Esq.	9	3	0	154 ?	30·54
† " (Piccadilly)	M. S. & L. R. Co.	9	40	0	194 T	27·67
Fairfield	" " "	9	6	0	312 T	33·44
St. Helen's (Rainford Hall)	G. McKibbin, Esq.	5	0	9	147 ?	29·22
Stoneclough (Outwood).....	W. Horrocks, Esq. ...	12	1	0	295 T	36·00
Wigan (Water Works)	J. L. Hunter, Esq., C.E.	6	1	6	225 T	34·35
Oldham (Waterhouses)	M. S. & L. R. Co.	9	3	6	345 T	33·64
" (Gas Works).....	J. Taylor, Esq.	9	6	0	600 T	32·49
" (Strines Dale)	" " "	10	6	0	800 T	31·35
" (Brushes Clough)	" " "	10	6	0	950 T	37·86
" (Pictborne)	" " "	10	6	0	800 T	31·12
32* " (Royton)	Mr. B. K. Bentley ...	5	1	0	544 T	36·50
Bolton-le-Moors (The Folds).....	H. H. Watson, Esq. ...	10	3	6	283 T	43·47
" (Arkwright St.).....	W. Musgrave, Esq.	9	6	6	352 T	45·69
" (Vale Bank).....	J. Watkins, Esq.	5	3	0	300	41·51
" (Heaton)	H. Baylis, Esq.	10	0	0	500	41·10
" "	J. S. Holdsworth, Esq.	10	3	6	497 T	40·63
" (Belmont)	H. Baylis, Esq.	10	0	0	800	52·80
Entwistle.....	" " " .....	...	0	0	700	55·40
Rochdale (Nagden Dane).....	C. E. Cawley, Esq. M.P.	5	1	6	900	35·18
Ormskirk (Rufford)	J. Porter, Esq.	5	0	8	38 T	29·84
Rawtenstall	E. Barber, Esq.	8	1	0	620 T	58·58
" (Hapton Reservoir)	" " "	8	1	0	900 T	52·58
Accrington (Oswaldtwistle)	<i>The Preston Guardian</i>	...	0	6	635	54·73
Blackburn (W. Works Office).....	J. F. Bateman, Esq. FRS	...	...	...	400	40·68
" (Pickup Reservoir) ...	" " " .....	...	...	...	720	42·00
" (Guide Reservoir) ...	" " " .....	...	...	...	650	39·50
" (Audley Place)	J. Shackleton, Esq. ...	5	0	6	450	49·80
Burnley W. Works (Swindon)...	J. Emmett, Esq. ....	...	18	0	750	26·04
Preston (Howick House) <i>old gauge</i>	T. Norris, Esq.	12	0	6	73 T	34·17
" " <i>(new gauge)</i>	" " "	12	0	6	73 T	34·95
" (Fishwick).....	T. Oddie, Esq.	7	24	0	134 T	29·17
" (Atherton Terrace)	J. Armytage, Esq., C.E.	8	1	2	143 T	40·40
Blackpool (South Shore)	G. Sharples, Esq.	10	1	8	29	31·41
Stonyhurst College	Rev. S. J. Perry	11	0	8	376 T	45·56
" " <i>(monthly)</i> ...	" " "	11	0	8	376 T	44·36

DIVISION VIII.—NORTH-WESTERN COUNTIES—(continued.)

STATIONS.	AUTHORITIES,	Rain Gauge.			Depth of Rain.	Days on which ·01 or more fell.
		Diameter.	Height Above Ground.	Height Above Sea Level.	1870	
			ft. in.	feet.	inches.	
LANCASHIRE—(con.)						
Preston W. Works.						
Alston	J. Armytage, Esq., C.E.	8	1 2	320 ∇	41·16	...
Knowl Green	" "	8	1 2	400 ∇	36·27	...
Jeffrey Hill	" "	8	1 2	900 ∇	43·21	...
Loud-scales	" "	8	1 2	400 ∇	38·25	...
Spade Mill	" "	8	1 2	400 ∇	39·84	...
Clitheroe (Downham Hall)	R. Assheton, Esq. M.P.	10	1 6	464 ∇	38·05	...
Garstang (Vale House)	J. Jackson, Junr., Esq.	6	4 3	455 ∇	40·61	164
" (Grizedale)	J. Bradley, Esq.	8	1 0	480	41·06	...
Lancaster (South Road)	W. Roper, Esq.	12	3 6	118	34·67	154
† " (Caton)	Rev. A. Christopherson	5	1 6	120 ∇	39·67	138
Hest Bank	T. Ransome, Esq.	12	2 2	58	33·34	...
Melling (Hornby Castle)	Mr. Reid	12	3 2	103 ∇	42·21	116
Arkholme (Storr's Hall)	F. F. Pearson, Esq.	5	1 0	220	37·90	...
Yealand Conyers [Milnthorpe]	Rev. T. Birkett	5	3 0	225	33·12	139
Silverdale [Milnthorpe]	Rev. C. C. W. Shephard	5	1 0	56 ∇	34·35	...
† Cartmel (Allithwaite)	Mr. W. R. Nash	5	1 0	88 ∇	34·33	159
† " (Holker)	Mr. Wilson	8	4 8	155 ∇	39·24	163
* Ulverston	J. H. Matthews, Esq.	5	5 6	162 ∇	43·68	166
† Cartmel (Broughton Hall)	Captain Ainsworth	5	2 8	230 ∇	43·27	153
Newby Bridge (Backbarrow)	" " "	12	3 2	70 ∇	38·26	104
† Coniston (Lanehead)	R. J. Bywater, Esq.	5	1 0	287 ∇	64·66	172
† Monk Coniston Park	J. G. Marshall, Esq.	10	4 11	150 ∇	64·40	...
Hawkshead (Belmont)	C. F. Wordsworth, Esq.	5	1 1	316	58·87	157

DIVISION IX.—YORKSHIRE

WEST RIDING.						
Sheffield (Edge)	M. S. & L. R. Co.	9	3 6	336 ∇	27·29	158
" (Broomhall Park)	D. Doncaster, Jun. Esq.	10	2 0	340 ∇	26·01	160
" (High Hazles)	Mrs. Hounsfield	9	3 0	280	21·77	...
† Redmires	J. Gunson, Esq.	10	4 0	1100 ∇	33·46	...
Sheffield (Tinsley Locks)	M. S. & L. R. Co.	...	...	143 ∇	23·03	138
Tickhill	Dr. Dixon	8	2 0	61 ∇	20·68	129
† Rotherham (Moorgate Grove)	R. Chrimes, Esq.	5	1 0	262 ∇	21·77	135
" (Wath-upon-Deerne)	W. M. Burman, Esq.	8	6 6	186 ∇	19·40	128
" (West Melton)	Rev. J. Boyd	6	0 10	172 ∇	21·29	140
Doncaster	M. S. & L. R. Co.	9	...	35 ∇	20·42	146
" (Magdalens)	Mr. J. Howorth	5	5 9	46	19·34	128
† Dunford Bridge	M. S. & L. R. Co.	9	3 6	954 ∇	54·44	172
† " (Reservoir)	Mr. G. Whitfield	12	2 0	1100 ∇	44·78	...
† Penistone	M. S. & L. R. Co.	9	3 6	717 ∇	29·56	142
† Carlcotes	" " "	9	3 6	1075 ∇	50·73	132
Greenfield (Charnel Rocks)	Mr. Watts	8	1 0	...	48·30	...
" (Ashway Hey)	" " "	8	1 0	...	42·00	...
" (Lord's Moor)	" " "	8	1 0	...	40·60	...
Barnsley (Elsecar)	M. S. & L. R. Co.	9	...	175 ∇	23·53	128
" (Worsborough)	" " "	9	...	225 ∇	24·33	151
"	" " "	9	...	175 ∇	24·41	120

DIVISION IX.—YORKSHIRE—(continued).

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain : 1870	Days on which ·01 or more fell.
		Diameter.	Height Above Ground.	Height Above Sea Level		
			ft. in	feet.	inches	
WEST RIDING—(con.)						
Barnsley (Church Street).....	Dr. Sadler	5	3 10	350 T	23·23	160
† Saddleworth (Station)	E. Greenwood, Esq....	10	5 0	640 T	38·11	...
† Standedge	" " "	8	2 0	1150 T	47·75	...
Ackworth School	G. Satterthwaite, Esq..	5	0 3	135	20·83	150
Snaith (Balne Vicarage)	Rev. T. S. Ackland ...	5	1 0	25 A	24·34	124
Goole	T. Kendall, Esq.....	11	3 4	...	23·57	175
† Meltham (Harden Moss)	C. K. Hare, Esq.	8	1 0	1200 T	45·95	...
† " (Grange)	" " "	8	1 0	930 T	33·91	...
Golcar	J. E. Ramsden, Esq....	5	0 8	400 T	39·47	160
† Huddersfield (Longwood)	C. K. Hare, Esq.....	10	4 6	650 T	24·14	145
" (" , Bilberry Edge)	" " "	8	1 0	1100	34·21	...
† " (Fartown).....	Captain Chichester ...	5	1 0	300 T	30·45	170
† " (Dalton).....	J. W. Robson, Esq. ...	8	0 6	350 A	28·66	141
" (Nortonthorpe).....	A. M. Box, Esq.	3	0 3	475 A	24·93	162
Mirfield (Cote Wall)	E. B. W. Balme, Esq...	8	0 9	200	21·27	117
Todmorden (Stansfield Hall).....	J. Fielden, Esq., M.P.	15	7 0	500 P	38·98	138
*Huddersfield (Rastrick).....	A. Clay, Esq.....	5	1 3	410 T	29·24	167
Halifax (Willow Hall Observa.)	Louis J. Crossley, Esq.	8	0 9	630 A	37·65	154
" Warley Moor)	J. F. Bateman, Esq., FRS	...	...	1425	36·10	...
† " (Well Head) <i>monthly</i>	J. Waterhouse, Esq., FRS	12	0 11	487 A	29·59	150
" (") <i>(daily)</i>	" " "	7	1 0	527 A	34·02	150
" (Park Road Obser.)	J. Gledhill, Esq.....	8	0 4	610 A	37·20	160
" (Midgley Moor)	J. F. Bateman, Esq., FRS	...	...	1350	42·30	...
" (Ovenden Moor) .....	" " " .....	...	...	1375	35·30	...
" (Walshaw Dean) .....	" " " .....	...	...	1380	43·70	...
South Milford Rectory	Rev. F. J. Young	5	1 4	60 T	23·57	91
Bradford (Mechanics' Institute)...	C. Lund, Esq.	8	48 0	373 A	28·18	154
" (Hewenden)	C. Gott, Esq., C.E. ...	5	0 9	700	29·88	146
" (Chellow Dean)	" " "	10	5 0	650	30·17	111
" (Doe Park)	" " "	8	0 9	810	38·30	164
" (Queensbury)	W. Foster, Esq.	5	5 4	1050 A	33·67	86
Leeds (Leventhorpe Hall).....	J. T. Leather, Esq. C.E.	10	2 0	90	21·99	...
† " (Holbeck).....	Messrs. Marshall & Co.	10	32 0	127 A	20·50	...
" { ")	" " "	5	1 0	95 A	22·93	141
" { " W. Works Depot)	E. Filliter, Esq., C.E...	8	1 3	95	24·49	142
" (Philos. Hall)	H. Denny, Esq....	10	48 0	137 T	19·45	...
" (Woodhouse Moor).....	E. Filliter, Esq., C.E.	8	0 9	305	24·01	145
" (Weetwood Hall).....	H. C. Marshall, Esq...	5	0 7	400	26·42	147
" (" Reservoir)	E. Filliter, Esq., C.E.	8	0 9	325	25·94	151
" (Allerton Hill)	T. Fenwick, Esq., C.E.	5	0 7	418 A	25·03	145
" (Crag Wood, Horsforth)	James Fox, Esq., C.E.	5	0 10	350 A	27·33	164
" (Eccup).....	E. Filliter, Esq., C.E.	8	0 9	340	26·29	169
Otley	T. E. Thorns Esq. ...	8	0 7	206 A	26·26	120
Harewood (Arthington).....	E. Filliter, Esq., C.E.	8	0 9	140	25·21	133
† York (Bootham)	F. Thorp, Esq.	5	0 6	50 A	24·37	163
† " (Coney Street)	Mr. Sigsworth	5	8 0	40 T	23·50	...
" (Cherry Hill)	H. Richardson, Esq....	5	1 4	50 P	22·97	...
Thornton-in-Craven	T. Wilson, Esq.....	5	5 4	456 A	34·83	184

DIVISION IX.—YORKSHIRE—(continued).

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which ·01 or more fell.
		Diameter	Height Above Ground	Height Above Sea Level		
			ft. in.	feet.	inches	
WEST RIDING—(con.)						
Bashall Lodge [Clitheroe].....	W. Garnett, Esq.	5	1 10	205	49·25	...
Knowlmere Manor „	J. Peel, Esq.	5	1 3	432 ∇	53·69	...
Whiteholme [Clitheroe]	Mrs. Birchall.....	5	1 3	475 ∇	48·98	101
Skipton (Woodlands).....	J. Heelis, Esq.	5	0 8	430	34·80	...
„ (Rockville).....	Rev. H. M. Stallybrass	5	4 9	465 ∇	29·75	147
† Harrogate	J. Coupland, Esq.	8	0 6	380 ∇	28·14	120
Pateley Bridge (Fog Close Ho.)	E. Warburton, Esq. ...	5	2 4	431 ∇	36·81	150
Settle	J. Tatham, Esq.....	12	40 0	498	41·33	...
„ (Langcliffe)	Miss M. I. Sedgwick..	8	1 9	623	39·89	130
33A Malham Tarn	W. Bissett, Esq.....	5	1 1	1250	49·07	...
Arnccliffe	Rev. W. Boyd	8	2 9	750 ∇	50·14	141
Ingleborough	J. Farrer, Esq.	10	6 2	...	38·70	...
Ripon (Littlethorpe).....	Mrs. Swire.....	5	1 0	70 ∇	25·19	121
Wharfedale(OughtershawSchool)	C. H. L. Woodd, Esq.	5	1 3	1225	54·92	...
„ („ „ Hall)	„ „ „	8	3 0	1175	55·40	...
Dent (Stone House)	Mrs. Nixon.....	5	1 1	800	59·97	134
Sedbergh (Thorne)	Miss Elam	5	1 1	400 ∇	46·69	182
EAST RIDING.						
Patrington	W. B. Pugh, Esq.....	5	0 3	10	22·52	193
† Hull (Manor House Street)	W. Lawton, Esq.	5	0 10	14 ∇	24·44	162
† „ (Beverley Rd., York Parade)	J. Smith, Esq.	8	3 10	11 ∇	25·81	172
„ (Baker Street).....	A. Atkinson, Esq. LL.D.	5	1 0	10	24·35	...
„ (People's Park)	Mr. E. Peak	5	0 6	6	25·96	160
† Holme-on-Spalding-Moor	G. Dunn, Esq.	5	6 4	33 ∇	20·72	164
Beverley	T. Dyson, Esq.	12	8 0	57 ∇	25·14	138
Thorganby (Thicket Priory).....	Miss M. C. D. Jefferson	6	1 4	26 ∇	17·90	74
† Beverley (Middleton).....	Rev. H. D. Blanchard..	8	1 6	150 ∇	25·83	146
Pocklington (Warter).....	J. Coxon, Esq.	5	1 10	230 ∇	26·53	174
Little Driffield	W. Lakin, Esq.....	8	1 3	35	27·35	168
Ganton Hall [Scarborough]	Mr. Boulton	5	1 0	250 ?	31·43	156
NORTH RIDING.						
Flaxton Grange	H. Richardson, Esq....	5	0 9	90 ?	24·10	...
† Malton	H. Hurtley, Esq.	10	1 0	75 ∇	26·32	...
33A*Filey Reservoir	Mr. D. Philliskirk ..	5	0 9	183	22·12	132
Thirsk	A. Atkinson, Esq. LL.D.	5	2 6	114	24·53	...
Beadlam Grange.....	J. H. Phillips, Esq. ...	5	0 6	192 ∇	28·45	...
Scarborough	Dr. Cornelius Fox.....	5	1 0	102 ∇	28·40	154
Bedale (Leyburn)	G. W. Wray, Esq.....	7	2 3	650 ∇	30·15	...
33A*Northallerton	Dr. Hodgson	5	1 3	...	23·41	...
Catterick (Tunstall)	H. C. Marshall, Esq....	5	1 0	350	23·98	...
Richmond (Aske)	Mr. J. Miller.....	12	2 8	550	25·95	...
Whitby (Hawsker).....	Rev. F. W. Stow	5	1 0	340 ∇	30·09	155
„ (North Lighthouse).....	„ „ „	5	1 0	198 ∇	26·63	...
„ (Ruswarp)	A. Atkinson, Esq. LL.D.	5	1 6	7	30·06	...
33A*„ (Guisbro' Road)	M. Simpson, Esq.	5	2 0	184 ∇	26·08	176
33A*Port Mulgrave	A. S. Palmer, Esq. ...	5	4 4	350 ∇	23·12	128
Greta Bridge (Thorpe Grange) ...	T. Dodgson, Esq.	5	1 6	431 ∇	25·61	...

DIVISION IX.—YORKSHIRE—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which. '01 or more fell.
		Diameter.	Height Above Ground.	Height Above Sea Level	1870	
			ft. in.	feet.	inches.	
NORTH RIDING—(con.)						
Middlesborough (Marton Hall)...	H. W. Bolekow, Esq. MP	10	1 6	152	22·70	143
Guisborough (Upleatham)	M. Gray, Esq.	4	0 4	330	28·30	...
Middlesborough	W. Fallows, Esq.	8	1 0	21	20·08	121

DIVISION X.—NORTHERN COUNTIES.

DURHAM.						
*Darlington (Dinsdale)	Rev. J. W. Smith	5	2 0	54 T	23·39	146
Eaglescliffe [Yarm]	Rev. J. Hull	5	1 0	80 T	20·89	153
Darlington (Southend)	Mr. J. Richardson ...	5	3 0	140	17·97	...
" " " "	" " " " " " " "	8	0 10	130	21·15	...
" (Brinkburn)	Rev. R. F. Wheeler ...	8	1 0	50	19·65	83
" (Gainford)	A. Atkinson, Esq.	5	1 0	253	21·62	147
Sedgefield	Dr. Smith	5	0 10	360	23·39	151
Hartlepool (The Heugh Lightho.)	Rev. R. F. Wheeler ...	5	0 1	30 T	23·78	174
" (Hurworth Burn)	T. Fenwick, Esq., C.E. ...	...	0 7	360	28·84	...
" (Hart Reservoir) .....	" " " " " " " " .....	...	0 9	164	22·95	144
Wolsingham (St. John's)	U. J. Backhouse, Esq. ...	5	1 1	928 T	29·27	156
" " " " " " " "	A. Mitchell, Esq.	5	1 0	464 T	31·18	168
Stanhope Castle	Mr. T. Surtees	8	3 0	670 T	31·52	...
Durham Observatory	J. J. Plummer, Esq. ...	12	4 6	335 T	24·66	165
" (Claypath)	W. Smurthwaite, Esq. ...	5	1 0	230 B	22·59	168
" (S. Cuthbert's Col. Ushaw)	Rev. Dr. Gillow	5	0 10	600 T	24·86	159
Seaham (Hall)	Mr. R. Draper	5	1 0	80 T	21·63	102
" (Vicarage)	Rev. A. Bethune	5	0 4	80 T	25·40	106
Sunderland (West Hendon)	T. W. Backhouse, Esq. ...	5	1 0	132 T	22·91	...
NORTHUMBERLAND.						
Allenheads	M. Varty, Esq.	8	0 9	1369 T	44·27	199
" " " " " " " "	" " " " " " " "	12	6 9	1375 T	46·52	198
Shotley Hall	Mr. J. Coulson	5	0 3	312 T	25·38	126
Bywell	Mr. J. Dawson	8	0 6	87 T	25·84	195
Wylam Hall	G. C. Atkinson, Esq. ...	10	0 4	96 T	24·43	148
Haltwhistle (Unthank Hall)	Rev. Dixon Brown ...	5	0 9	380	26·90	161
Newcastle (Philos. Soc.)	W. Lyall, Esq.	8	1 5	105 T	23·58	109
" (Town Moor)	Mr. W. Neill	5	0 6	201 T	25·10	180
" (West Parade)	Rev. R. F. Wheeler ...	5	0 10	...	23·95	144
North Shields (Wallsend)	J. W. Dees, Esq.	10	0 6	100 T	23·90	...
† " (Rosella Place) ...	R. Spence, Esq.	8	1 0	124	25·22	172
" (Low Lights)	J. R. Procter, Esq. ...	8	3 1	22 T	23·65	149
" (Tynemouth)	P. J. Messent, Esq. ...	5	1 2	62 T	23·33	173
" (Clementhorpe)	J. R. Procter, Esq. ...	5	1 0	150 T	22·04	152
* " (Whitley)	Rev. R. F. Wheeler ...	5	0 9	83	21·79	115
" (Earsdon)	John Taylor, Esq.	5	2 10	185 T	21·04	118
Stamfordham	Rev. J. F. Bigge	8	1 0	400 T	26·15	...
" (Church Tower) ...	" " " " " " " "	10	42 0	452 T	20·07	...
Hexham (Parkend)	M. A. Ridley, Esq. ...	10	0 4	276	25·16	162
Bellingham (Hesleyside)	W. H. Charlton, Esq. ...	10	3 10	420 P	31·99	74

DIVISION X.—NORTHERN COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which -01 or more fell.	
		Diameter.	Height Above Ground.		Height Above Sea Level		1870
			ft.	in.	feet.	inches.	
NORTHUMBERLAND—(con.)							
Hartburn (Wallington)	H. Laws, Esq.....	5	1	0	398 ∇	28·83	204
Bellingham (Otterburn)	Rev. T. Wearing	10	1	0	500 ∇	26·45	...
Rothbury (Brenckburn Priory)...	C. H. Cadogan, Esq....	5	1	0	300 ∇	29·36	109
Deadwater	Mr. Scott	3	1	6	2000	37·50	...
Rothbury (Cragside)	Rev. R. F. Wheeler ...	8	1	0	400	27·24	67
Rochester (Byrness)	" " "	10	2	0	700	28·12	...
Alnwick (Glanton Pyke)	F. W. Collingwood, Esq	8	4	4	534 ∇	25·38	...
Howick	Earl Grey, K.G.	8	0	10	121 ∇	22·99	120
Lilburn Tower	E. J. Collingwood, Esq	10	6	0	300 ∇	23·27	...
Wooler (Middleton Hall)	J. T. Leather, Esq. C.E.	10	2	0	240	19·21	...
Bamburgh (North Sunderland)...	Rev. F. R. Simpson ...	8	1	2	69 ∇	22·57	179
*Wooler (Milfield)	G. A. Grey, Esq.	5	0	4	200 ∇	23·84	...
CUMBERLAND.							
Bootle (Whitbeck)	Rev. T. Ormandy	2	1	0	...	38·75	128
" (Rectory)	Rev. A. Wilkin.....	8	1	0	87 ∇	37·26	144
Whitehaven (Braystones)	J. D. Watson, Esq ...	10	3	8	36 ∇	31·17	...
† Seathwaite	Mrs. Dixon	8	1	0	422 ∇	113·00	...
† "	I. Fletcher, Esq., M.P.*	5	1	0	422 ∇	119·60	...
St. Bees	W. C. Hughes, Esq....	8	1	6	100 ?	30·05	125
† Wythburn Parsonage	Rev. Basil Lawson ..	8	1	0	574 ∇	88·75	...
† Helvellyn (Birkside) ..	G. J. Symons, Esq....	8	1	0	1800 ∇	87·25	...
† Watendlath	" " "	8	1	0	867 ∇	72·58	...
Keswick (Barrow House).....	S. Z. Langton, Esq ...	8	0	6	282 ∇	66·82	177
Whitehaven (Millgrove)	H. A. Fletcher, Esq....	8	1	6	210 ?	33·14	...
" (The Barracks)	Capt. Morris Fawcett..	5	1	0	21	34·32	157
Loweswater (Waterend)	R. Jackson, Esq.	5	0	8	432 ∇	46·33	154
† Hallsteads.....	A. Marshall, Esq.	10	4	0	490 ∇	50·00	...
† Gowbarrow Fell	G. J. Symons, Esq....	8	1	0	1100 ∇	50·25	...
† " (Watermillock) ...	Mr. W. Rumney	10	3	6	720 ∇	50·70	145
† Matterdale Common	G. J. Symons, Esq.	8	1	0	1400 ∇	63·75	...
Keswick (Deer Close)	H. C. Marshall, Esq....	7	1	9	300 ∇	57·42	157
† " (Crow Park)	" " "	10	4	0	295 ∇	46·40	...
† " (Derwent Island) ...	" " "	5	0	7	280 ∇	53·28	182
† " (Post Office)	Mr. Crosthwaite	8	6	4	270 ∇	55·27	156
BA* " "	" " "	5	1	0	270 ∇	54·43	156
† Skiddaw	Mr. Nixon	8	1	0	1677 ?	45·28	...
Mosser (Beech Hill)	John Alderson, Esq....	5	1	3	550 ∇	48·30	164
† Bassenthwaite (Mirehouse)	Mrs. Spedding	5	0	7	310 ∇	48·97	174
Cockermouth (Whinfell Hall) ...	W. Robinson, Esq.	5	2	0	265 ∇	48·86	187
Workington (Stainburn)	C. Litt, Esq.	8	0	6	101 ∇	34·15	160
" (Park End)	W. Thompson, Esq....	5	1	1	124 ∇	33·58	169
Cockermouth	Dr. Dodgson	8	0	6	158	41·72	165
" (on a post)	" " "	8	6	6	164	39·52	165
" (on Church Tower)...	" " "	8	100	0	258	22·35	...

* The returns from Mr. Fletcher's Mountain Stations not being complete, the publication is deferred for a short time. They will be inserted in the next issue of the *Meteorological Magazine* after their receipt.

NOTE.—The numbers in parentheses on this and two following pages refer to the accompanying Map.

DIVISION X.—NORTHERN COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which '01 or more fell.
		Diameter	Height Above Ground.	Height Above Sea Level		
			ft. in.	feet.	inches.	
CUMBERLAND—(con.)						
Cockermouth (Tarn Bank)	I. Fletcher, Esq., M.P.	10	5 0	230	37·20	139
" "	" "	12	40 0	272	27·94	...
" (Higham)	T. A. Hoskins, Esq.	8	0 6	478 T	40·37	166
Penrith	T. Lester, Esq.	5	0 9	...	28·51	149
Aspatria (Brayton Hall)	Mr. R. Elliot	8	0 5	220	33·12	...
Maryport (Netherhall)	H. P. Senhouse, Esq.	8	0 6	27 T	29·14	...
Silloth (The Rectory)	Rev. F. Redford	8	3 0	28 T	27·18	123
Carlisle (Cemetery)	Mr. J. Cameron, Jun.	8	0 8	114	23·28	...
" (Scaleby Hall)	R. A. Allison, Esq.	5	1 1	100 ?	26·89	143
WESTMORELAND.						
Kirkby Lonsdale (Casterton)	S. Morris, Esq.	8	1 0	305 T	33·94	160
" " (") <i>monthly</i>	" "	8	1 0	305 T	34·46	...
" " (Biggins House)	Miss Tomlinson	12	3 6	400 ?	35·92	...
" " (Whelprigg)	Mrs. Gibson	5	4 6	475	38·08	...
" "	Mr. W. Harrison	5	1 2	209	35·08	...
" " (Vicarage)	Rev. H. Ware	5	1 0	210 T	34·13	...
Crosthwaite (Churchtown)	W. Garnett, Esq.	5	1 3	150 T	46·19	167
Kendal (Kent Terrace)	R. J. Nelson, Esq.	5	1 6	146	43·09	151
" (Highgate)	E. Hayton, Esq.	8	5 0	180 T	41·40	...
" (Underfell)	J. J. Wilson, Esq.	8	4 0	300 T	39·67	145
Stavely (Middle Fairbank)	T. K. Atkinson, Esq.	10	3 0	...	55·22	151
Windermere (Matson's Grounds)	G. Healey, Esq.	12	0 8	405 ?	52·89	148
" (High House)	E. Hayton, Esq.	8	4 0	636 T	47·30	...
" (The Wood)	G. B. Crewdson, Esq.	8	3 2	310	53·92	147
† " (The Howe) ... (35)	Miss C. Wilson	8	1 2	470 T	56·72	129
Ambleside (The Nurseries) ... (D)	Mr. J. Grier	5	1 3	140	63·55	144
" (Low Nook)	Rev. S. Joy	8	3 0	160	66·81	170
" (Lesketh Howe) ... (26)	F. M. T. Jones, Esq.	5	1 6	175 T	66·50	...
Loughrigg Fell ... (24)	E. B. W. Balme, Esq.	8	1 0	1030 T	62·25	...
† Grasmere (High Close)	" " "	8	0 9	553	67·89	180
* Kirkby Stephen	T. Mason, Esq.	5	1 0	574 T	33·77	135
† Kirkstone Pass	G. J. Symons, Esq.	5	1 0	1500 T	82·14	...
† Grasmere (Easedale Tarn) ... (A)	" " "	8	1 0	1175 T	88·50	...
† Shap (Wet Sleddale)	" " "	8	1 0	1500 T	101·00	...
† Haweswater (Mardale Green) (40)	" " "	8	1 0	800 T	81·25	...
† Shap (Crosby Ravensworth) (E)	Rev. G. F. Weston	8	0 5	600 T	46·27	170
Haweswater (Measandbecks) (41)	G. J. Symons, Esq.	8	1 0	1200 T	49·00	...
† Patterdale Hall	Mr. Sinclair	7	2 0	490 T	85·87	144
Appleby	Dr. Armstrong	8	1 0	442 T	27·31	157
† Ullswater (Swarth Fell)	G. J. Symons, Esq.	8	1 0	1000 T	48·25	...
" (Sharro Bay) <i>monthly</i> (38)	A. Parkin, Esq.	5	0 7	500	48·10	...
† Great Strickland [Penrith] (44)	H. Plumer, Esq.	5	1 6	650	35·31	164
† Brougham Hall [Penrith]	Mr. G. Campbell	5	1 0	470 T	33·47	155

DIVISION XI.—MONMOUTH, WALES, AND THE ISLANDS.

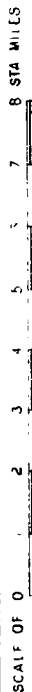
STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which ·01 or more fell.
		Diameter.	Height Above Ground		Height Above Sea Level	
			ft.	in.	feet.	inches
MONMOUTH.						
*Newport(Llanfrehfa Grange) ...	F. J. Mitchell, Esq. ...	5	1	0	360 B	38·79 121
* " (Cwmbrân Parsonage)...	Rev. J. Rees Jenkins..	5	1	0	330	41·55 125
Chepstow (Tutshill)	J. G. Wood, Esq.	8	3	6	200 T	33·29 125
" (The Mount)	H. Clay, Jun., Esq. ...	5	1	6	200 ?	31·12 111
Tintern Abbey.....	Mr. W. Bowen	5	1	0	16	32·86 114
Tredegar (Ebbw Vale)	P. James, Esq.	5	1	0	918	52·97 152
" (Sirhowy)	R. Jordan, Esq.	5	1	0	1055	51·55 152
Monmouth (Dingestow).....	S. R. Bosanquet, Esq.	5	1	0	300 ?	24·77 ...
Abergavenny	Dr. McCullough	5	1	0	220 B	29·90 133
GLAMORGAN.						
*Cowbridge (The Ham)	G. W. Nicholl, Esq. ...	8	1	3	50 ?	26·41 107
Cardiff (Spring Bank)	H. Bowen, Esq.....	10	5	0	35	26·46 ...
" (Ely)	V. G. South, Esq. C.E.	5	3	0	45	35·60 116
" (Tredegaville)	W. Adams, Esq.	5	1	0	44 T	31·75 133
" (Pentyrch)	F. G. Evans, Esq.....	5	1	1	100 T	40·54 149
" (Lisvane)	T. G. South, Esq. C.E.	5	2	0	142	35·24 114
Swansea (South Dock Lock).....	J. W. James, Esq.....	12	14	9	40 T	25·94 118
" (Lliw Reser., Felindre)..	E. Cousins, Esq.	8	3	0	420 T	40·46 110
Aberdare (Treherbert)	W. T. Lewis, Esq. ...	5	1	0	634 T	72·61 155
" (Ty-mawr).....	Evan Jones, Esq.	5	1	6	430	53·05 98
" (Mardy).....	W. T. Lewis, Esq.....	5	1	1	431 T	57·78 141
MerthyrTydfil (Thomas Town)...	T. J. Dyke, Esq.....	5	2	0	550 T	48·73 130
Ystalyfera	Dr. D. Thomas	8	4	4	220 ?	51·67 114
CARMARTHEN.						
Llanelly (West End Terrace) ...	D. M. Llewellyn, Esq.	5	0	10	20 T	36·20 150
"	E. Bagot, Esq., C.E....	5	7	0	20	37·28 120
32A *Carmarthen—(PlasCwrtHyr)	W. E. Gwynn, Esq....	5	3	6	200 ?	40·75 115
" (Gaol)	G. Stephens, Esq.....	8	0	6	92 T	42·63 157
" (Joint Co. Asylum)..	Dr. Hearder	8	0	6	185	41·14 143
32A Llangadock	F. Layard, Esq.....	5	1	0	159 T	39·82 147
Narberth (Tegfynydd)	H. S. Morgan, Esq. ...	5	1	0	158	41·20 80
PEMBROKE.						
Milford (St. Anne's Head).....	T. L. Marriott, Esq....	8	0	8	135	30·80 151
" (St. Anne's)	" " " " " " " "	5	1	0	25 T	33·24 134
*Haverfordwest (High Street).....	E. P. Phillips, Esq. ...	5	1	0	95 T	40·01 98
Kilgerran [Cardigan].....	Rev. D. Evans	5	1	2	30	40·24 ...
CARDIGAN.						
Lampeter	(63) Rev. J. Matthews	8	4	6	420 T	39·87 ...
Aberystwith (Goginan)	(58) H. Trenwith, Esq.....	5	2	6	290	42·02 ...
" (Capel Bangor) (57)	T. Paul, Esq.	5	1	0	42 B	44·56 166
" (The College)	(68) Rev. D. Charles	5	1	3	24	24·80 ...
BRECKNOCK.						
Crickhowell (Glanusk Park).....	Mr. Ireland	8	0	6	300 ?	28·38 ...
Brecknock	J. Kirk, Esq... ..	5	2	0	437	43·57 117
Llanwrtydd	(71) J. Lloyd, Esq.....	...	...	...	...	47·59 ...

NOTE.—The numbers in parentheses on this and the following pages refer to the accompanying Map

DIVISION XI.—MONMOUTH, WALES, AND THE ISLANDS—(continued).

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which ·01 or more fell.
		Diameter	Height Above Ground.		Height Above Sea Level	
			ft.	in.	feet.	inches.
RADNOR.						
Llandrindod (Howey Hall)	P. Lloyd, Esq. ....	...	1	6	...	27·74 ...
*Presteign	Captain Hannam	5	1	0	550	28·94 146
Rhayader (Rhydoldog) .....(70)	R. P. Lloyd, Esq. ....	...	1	0	700 ?	50·30 151
† „ (Cefnfaes) .....(62)	Mrs. Jones	5	2	0	880 A	41·35 135
MONTGOMERY.						
† Llanidloes (Ystrad-olwyn-fawr) (59)	Mr. J. Jones	8	1	0	950 T	45·00 ...
† „ (Dolenog) .....(69)	T. F. Roberts, Esq. ...	5	1	0	550 T	38·25 119
† Dylyve (Head of R. Clwyedog) (55)	Mr. Isaac. Jones	8	1	0	1300 T	68·80 ...
† Carno (Capel) .....(54)	Mr. T. Bound	8	1	0	550 T	44·30 ...
Machynlleth (Plas)	Mr. Johnstone	5	1	0	...	57·56 138
† Garthbibio (Lluest fawr).....(49)	Mr. J. Jones	8	1	0	990 T	57·00 ...
† Llanwddyn .....(47)	Mr. D. Pugh	8	0	7	750 T	56·80 ...
† „ (Head of Vyrnwy) (46)	Mr. J. Gittins.....	8	0	8	1740 T	63·60 ...
FLINT.						
Mold (Bryn Alyn)	Rev. R. B. Cooke	5	1	2	480 T	28·88 ...
† Hawarden [Chester]	Dr. Moffat	8	0	7	270	23·29 ...
Holywell (Maes y dre)	J. Williams, Esq.	10	5	0	400	22·85 ...
St. Asaph (Brynbellia).....(33)	P. P. Pennant, Esq. ...	5	1	0	280 B	23·92 ...
DENBIGH.						
Wrexham (Wynnstay)	Mr. Middleton	12	3	0	486	31·26 174
„ (Llwyn Onn)	F. G. Tippinge, Esq... ..	5	1	0	214 A	22·56 140
„ (Plas Power).....	„ „	5	1	0	472 A	29·39 ...
„ (Brymbo)	C. E. Darby, Esq.....	6	6	3	632 L	26·06 ...
Rosset (Trevalyn Hall)	Capt. Griffith.....	5	1	0	58 A	22·71 157
St. Asaph (Llanerch)	Whitehall Dod, Esq... ..	5	1	1	103 B	24·53 158
† Llandudno (Warwick House) (29)	Dr. Nicol.....	8	0	6	99 A	27·43 140
„ (Great Orme's Head) (64)	R. Price, Esq.	12	6	0	175 ?	18·59 ...
MERIONETH.						
*Dolgelly.....(21)	Major Mathew	5	1	0	43	68·52 149
33A* „ (Brithdin) .....(28)	J. Hill, Esq.	5	1	8	500 ?	71·72 ...
Bala .....(20)	Major Mathew	5	1	0	544	49·13 156
*Festiniog (Blaenyddol) .....(3)	„ „	5	1	0	600	70·19 164
*Rhiw brifdir .....(15)	„ „	5	10	0	1100	78·71 195
Corwen (Rhug) .....(37)	J. Wagstaff, Esq.	8	3	0	500 ?	27·80 ...
CARNARVON.						
Aberdaron (Sarn).....(22)	Mr. W. Jones.....	12	5	0	356 A	41·60 154
*Pwllheli (Bodfaen) .....(17)	Major Mathew	5	4	9	80	40·29 168
*Llanystumdwy (Talarvor) ... (16)	„ „	5	3	0	50	33·11 126
*Llangybi (Cefn) .....(6)	„ „	5	1	1	200	45·92 145
*Port Madoc.....(1)	„ „	5	3	0	10	43·16 154
Beddgelert (Bryn Gwynant) (66)	J. Wyatt, Esq.	9	3	0	264	101·58 161
*Llanllyfni (Cilgwyn) .....(13)	Major Mathew	5	1	0	900	49·99 138
*Llanberis (Dinorwic Quarry) (10)	„ „	5	1	10	850	57·59 177
* „ (Glyn Padarn)(8)	„ „	5	1	0	377	76·67 177
Carnarvon (Cocksidia).....(39)	„ „	5	1	1	120	38·02 162

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DIVISION XI.—MONMOUTH, WALES, AND THE ISLANDS—(continued)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which ·01 or more fell.
		Diameter.	Height Above Ground	Height Above Sea Level	1870	
			ft. in.	feet.	inches.	
CARNARVON—(con.)						
* Carnarvon (Plas Brereton) ... (7)	T. Turner, Esq.	5	1 0	25	36·59	179
* Bethesda (Penrhyn Quarry) ... (11)	Major Mathew	5	5 0	1000	58·70	182
„ (Brynderwen) (12)	R. „ „ „	5	1 0	550	55·84	174
† Llanfairfechan (26)	R. Luck, Esq.	5	0 8	150 B	36·73	133
ANGLESEA						
Menaifron (23)	Rev. W. W. Williams	5	4 9	20 L	34·07	182
Bidorgan (Llangadwaladr) ... (42)	Major Mathew	5	3 6	50	35·55	182
ISLE OF MAN.						
Douglas Head (23)	Bd. of Northern Lights	...	0 6	...	23·64	80
„ (Derby Square) (11)	P. Killey, Esq.	5	1 1	78 L	36·82	160
Point of Ayre (11)	Bd. of Northern Lights	...	3 4	27?	23·89	106
ISLES OF SCILLY.						
St. Mary's (The Parade) (11)	J. G. Moyle, Esq.	5	1 0	20	19·67	129
GUERNSEY.						
Guernsey (11)	Dr. Hoskins, F.R.S. ...	12	12 0	204 B	25·05	123
„ (Grange Road) (11)	Dr. Mansell	5	1 0	174 B	28·83	139
JERSEY.						
Millbrook (11)	P. Langlois, Esq.	5	1 0	50	25·08	139
ALDERNEY.						
Alderney (11)	L.F.V. Harcourt, Esq. ...	12	10 0	48	21·05	...
SARK.						
Sark Parsonage (11)	Rev. T. L. V. Cachemaille	5	1 0	340 L	24·33	116

SCOTLAND.

DIVISION XII.—SOUTHERN COUNTIES.

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which ·01 or more fell.
		Diameter.	Height Above Ground.	Height Above Sea Level	1870	
			ft. in.	feet.	inches.	
WIGTOWN.						
Mull of Galloway	Bd. of Northern Lights ...	...	...	...	21·58	110
32A*Wigton (N. Balforn)	T. MacLelland, Esq....	5	0 11	75 A	34·85	153
Stranraer (South Cairn).....	Mr. J. Kennedy.....	8	1 4	209	62·25	148
Corsewall.....	Bd. of Northern Lights ...	...	3 4	22 ?	32·05	123
KIRKCUDBRIGHT.						
Little Ross	Bd. of Northern Lights ...	...	3 3	130 ?	22·95	118
32A*Dalbeattie	J. Grieve, Esq.	5	0 8	25 ?	37·57	...
Castle Douglas (Slogarie).....	Miss Bruce.....	4	0 6	800 A	48·85	...
" " "	" " " "	8	6 0	300	45·77	...
Cargen [Dumfries].....	P. Dudgeon, Esq.	3	0 4	80 T	39·97	116
New Galloway	R. McKay, Esq.....	8	20 0	200 ?	37·28	151
" (Glenlee).....	Mr. W. Melville	3	1 6	217	40·20	...
32A*Carsphairn.....	J. Hannah, Esq.	5	3 10	574 T	51·33	112
DUMFRIES.						
Annan (Warmanbie)	D. A. Carruthers, Esq.	8	3 0	100	30·12	142
Dumfries (Crichton Asylum).....	Dr. Gilchrist	8	0 6	154 T	34·28	135
" (March Hill Cott.).....	Mr. T. Hogg	5	0 5	70 T	28·32	147
" (Canobie School)	J. Little, Esq.....	3	2 0	140 T	47·05	...
Thornhill (Wallace Hall)	C. T. Ramage, Esq. ...	3	0 10	207 T	31·90	...
Drumlanrig Castle.....	A. Buchan, Esq.	3	0 6	191	38·81	...
Kirkpatrick Juxta (Broomlands)	Mr. Burgess	3	0 2	346	47·27	124
Wanlockhead	Mr. G. Dawson	3	0 4	1330 T	49·31	163
Langholm	J. Little, Esq.	3	2 0	270 T	48·61	...
Westerkirk School.....	" "	4	0 6	420 T	44·30	...
Byerburnfoot	" "	3	2 0	140 T	38·90	...
Ewes School	" "	3	0 6	407 T	42·45	...
Carlesgill.....	" "	10	2 0	370 T	47·68	...
Eskdalemuir School	" "	3	0 6	612 T	48·10	...
Eskdale Pen Top	" "	4	1 0	2268 T	53·00	...
ROXBURGH.						
New Castleton (Kirndeane).....	Miss Elliot	3	0 9	400 T	38·90	...
" " (The Flatt).....	J. Elliot, Esq.....	3	0 9	350 T	41·80	...
Hawick (Borthwickbrae)	A. E. Lockhart, Esq... 8	8	0 2	800 T	29·40	...
" (Langraw)	Mr. W. Oliver	5	0 6	570 A	32·49	...
" (Goldielands)	Dr. Elliot .....	...	0 8	505	24·80	...

DIVISION XII.—SOUTHERN COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which -01 or more fell.
		Diameter.	Height Above Ground.	Height Above Sea Level	1870	
			ft. in.	feet.	inches.	
ROXBURGH—(con.)						
Hawick (Lynnwood)	Dr. Elliot .....	...	0 6?	387	25·50	...
* „ (Silverbut Hall)	Mr. D. Elder	5	4 0	512 ∇	22·99	170
„ (Heron Hill)	G. Wilson, Esq. ....	...	1 0	400	20·72	...
„ (Kirkton)	Mr. J. Welsh .....	...	1 0	...	25·30	...
„ (Wolfelee)	Dr. Elliot .....	...	...	...	33·50	...
*Jedburgh (Sunnyside)	G. Hilson, Jun., Esq. ...	5	10 0	360 ∇	16·94	96
Wooplaw [Galashiels]	J. Murray, Esq.	5	0 9	880 ∇	24·36	186
Melrose (Dingleton Mains)	R. Paulin, Esq.	5	4 0	400 ?	21·99	...
Kelso (Springwood Park)	Sir G. Douglas, Bt ...	10	1 0	130	19·27	164

DIVISION XIII.—SOUTH-EASTERN COUNTIES.

SELKIRK.						
Bowhill	Mr. Mathison	6	11 0	537	25·06	...
Galashiels	Dr. Somerville	5	0 4	416 ∇	25·39	160
PEEBLES.						
Glenrath	Mr. S. Linton	5	1 2	764 ∇	29·81	148
Cairnmuir	A. Buchan, Esq.	12	0 5	1150	30·17	...
Penicuik (N. Esk Reservoir) ...	Mr. J. Garnock	11	0 6	1150 ∇	23·65	112
BERWICK.						
Swinton (Milne Graden)	A. Buchan, Esq.	8	0 8	104	16·10	...
„ Manse	Rev. R. Home	5	0 9	200 ∇	22·21	139
Marchmont	Mr. P. Loney	5	1 0	500	28·56	201
Lauder (Thirlestane Castle)	Mr. J. Whitton	3	0 3	558	22·40	89
Dunse (Mungo's Walls)	Mr. J. Thomson	3	0 6	267	23·85	164
St. Abb's Head	Bd. of Northern Lights ...	...	0 4	211 ?	20·22	86
HADDINGTON.						
Yester	A. Buchan, Esq.	12	1 0	425	22·68	...
Prestonkirk (Smeaton)	„ „	8	13 0	100	17·42	136
Haddington (Millfield)	Mr. T. Dods	6	4 0	140 ∇	19·33	...
Tranent (Tyneholme)	A. Buchan, Esq. ....	...	...	284	17·36	...
Dunbar (Thurston)	„ „	6	4 0	327	22·08	...
East Linton	Mr. J. Storie	3	0 3	90 ∇	19·30	149
Drem (Fenton Barns)	G. Hope, Esq.	3	1 0	103 ∇	17·00	...
North Berwick (Seacliffe)	A. Buchan, Esq. ....	...	...	80	18·60	...
EDINBURGH.						
Moorfoot	A. Buchan, Esq.	12	0 5	...	31·61	...
Cobbinshaw Reservoir	„ „	6	0 7	863	23·50	...
Harlaw	W.H.Cameron Esq.C.E. ...	...	...	...	27·20	...
Glencorse .....	„ „ „ .....	...	0 6	787	27·70	...
Kirknewton Manse	W. Smith, Esq. ....	...	0 10	530	20·91	...
Clubbiedean	W.H.Cameron Esq.C.E. ...	...	...	...	27·60	...
Swanston .....	„ „ „ .....	...	0 6	555	22·56	...
Colinton (Fernielaw)	J. Leslie, Esq., C.E. ...	11	0 6	500	25·20	...
Dalkeith	A. Buchan, Esq.	4	0 4	183	16·12	...
Inveresk	Mr. McAuslane	9	2 0	90	16·50	128
Edinburgh (March Hall)	A. Buchan, Esq.	5	0 3	170	17·90	...

DIVISION XIII.—SOUTH EASTERN COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which of or more fell.
		Diameter.	Height Above Ground.	Height Above Sea Level	1870	
EDINBURGH—(con.)			ft. in.	feet.	inches.	
Edinburgh (Princes St.)	A. Buchan, Esq. ....	...	...	...	17·17	...
„ (Charlotte Square)...	J. Leslie, Esq., C.E. ...	11	0 6	230	22·11	...
Costorphine (Meadowfield)	A. Paterson, Esq.	8	9 4	155	15·10	...
Inchkeith	Bd. of Northern Lights	..	...	...	12·90	...

DIVISION XIV.—SOUTH-WESTERN COUNTIES.

LANARK.

Douglas (Newmains)	Mr. J. Russell	3	0 4	783 T	35·22	136
Uddingston (Meadowbank)	J. Anderson, Esq.	5	15 0	75 T	25·30	...
Lanark (Baronald).....	Captain Thornton	5	1 0	505 T	23·39	185
„ (Sunnyside)	Miss Leishman	5	1 8	384 T	21·06	177
„ (Ridge Park).....	C. Lindsay, Esq.....	5	0 4	630 T	23·32	146
Carnwath	Mr. W. Currie	3	0 1	700 T	23·20	182
Hamilton (Murdostoun Castle)...	Mr. Armour	10	4 0	550 T	17·48	112
„ (Auchinraith)	R. Ker, Esq.	8	4 9	150	21·76	...
„ (Bothwell Castle)	Mr. A. Turnbull	10	18 0	146 T	21·19	131
Cambuslang (Bushy Hill).....	Dr. Muirhead	6	0 10	147	24·99	161
Glasgow (Cessnock Park).....	R. Hart, Esq.....	10	4 4	29	26·62	...
„ (Observatory)	Professor Grant, F.R.S.	5	0 1	180 T	35·25	182
Baillieston	Mr. P. Jarvie.....	6	0 3	230 T	36·17	173
Shotts (Hillend House)	Mr. D. Thompson	10	7 0	620	24·13	173

AYR.

Girvan (Pinmore)	Captain Hamilton	5	1 0	187 T	45·81	174
New Cumnock (Whitehills)	W. Lennox, Esq.	5	1 0	860 T	45·15	169
Ayr (Auchendrane House)	E. Cathcart, Esq.	8	2 3	96 T	33·22	166
„ „ (in a pit)	„ „	5	0 0	94 T	33·63	166
Old Cumnock	J. Ballantine, Esq.	6	1 3	380	33·25	...
34 Muirkirk (Irondale House) ...	J. Wilson, Esq.....	5	1 0	735 T	39·24	181
Kilmarnock (North Craig).....	J. M. Gale, Esq., C.E.	12	0 6	330 ?	33·22	...
Largs (Mansfield)	Dr. Campbell	10	0 6	30	40·80	...
Skelmorlie (Morland).....	A. Buchan, Esq. ....	...	...	100	48·80	...

RENFREW.

Gorbals's District. Ryat Lynn	† Glasgow Water Works	8	0 5	310	33·75	...
Waulk Glen	„ „ „	12	0 5	280	33·35	...
Middleton	„ „ „	12	0 5	550	40·25	...
Mearns (Newton)	P. R. Murdoch, Esq....	5	1 0	350	34·32	...
„ (Netherplace)	W. Mather, Esq.	4	0 6	360	36·69	...
Back Thornleymuir	R. Sharp, Esq.....	11	1 0	647	48·12	...
Muirhead	„ „	11	1 0	482	43·88	...
Springside	„ „	11	1 0	532	48·25	...
Paisley (Ferguslie House).....	A. Buchan, Esq.	3	0 3	88	26·97	...
Shaws W. Works (Loch Thom)...	J. Wilson, Esq.	6	0 9	650 ?	50·80	...
„ „ (Compen. Res.)	„ „ „	6	0 9	560 ?	48·00	...
„ „ (Shiel Hill) ...	„ „ „	6	0 9	800 ?	48·30	...
„ „ (Spango Burn)	„ „ „	6	0 9	540 ?	44·60	...
Greenock (Hamilton Street)	Mr. Anderson	6	0 6	50	47·00	188

† Information supplied by J. M. Gale, Esq., C.E.

DIVISION XV.—WEST MIDLAND COUNTIES.

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870	Days on which -01 or more fell.
		Diameter.	Height Above Ground.		Height Above Sea Level	
			ft.	in.	feet.	inches.
DUMBARTON.						
Cardross (Kilmahew Castle)	J. W. Burns, Esq.	3	0	2	96 7	39·10 113
Dumbarton (Balloch Castle)	A. J. D. Brown, Esq. ...	7	0	4	91 7	40·00 ...
Loch Lomond (Ardlui)	A. McDowall, Esq. ...	3	0	6	50 ?	87·50 ...
" " (Firkin)	" " "	3	0	6	100	72·30 ...
Loch Long (Arddaroch)	J. White, Esq.	5	0	10	80	59·15 141
STIRLING.						
Strathblane (Mugdock Reservoir)	Glasgow Water Works	8	0	6	320	40·70 ...
Falkirk (Kerse)	Earl Zetland, K.T. ...	8	1	0	...	21·50 ...
" (Arnott Hill)	A. Buchan, Esq. ....	...	...	...	135	23·39 ...
Stirling (Polmaise Gardens) ..	Mr. Gorrie	6	0	2	12	26·65 ...
BUTE.						
Pladda	Bd. of Northern Lights	...	3	3	55 ?	27·63 126
ARGYLL—(MAINLAND.)						
Castle Toward	Mr. McIntosh	6	4	0	65	41·06 179
Lochgilphhead (Kilmory) <i>Thom's g.</i>	Sir J. P. Orde, Bart. ...	6	0	4	100	53·70 208
" " (<i>bottle gauge</i>) ..	" " "	5	0	4	100	54·82 208
" (Callton Môr)	Mr. J. Russell	3	4	6	65	50·26 196
Lochgoilhead (Upper Glencroe)	A. McDowall, Esq. ...	3	0	6	520	109·20 ...
Loch Fyne (Cairndow No. I.) ...	" " "	3	0	6	25	77·33 ..
" " (" No. II.) ...	" " "	8	0	6	25	75·86 ...
Inverary Castle	Mr. J. Caie	4	0	1	30	42·00 ...
Dalmally (Bridge of Orchy)	A. McDowall, Esq. ...	3	0	6	600 ?	94·50 ...
Appin (Aird's)	R. Macfie, Esq.	6	0	3	15	53·30 196
Loch Eil (Corran)	Bd. of Northern Lights	...	0	4	14 ?	60·31 130
Ardnamurchan .....	" " " .....	...	3	6	82 ?	30·98 128
" (Camusinas)	J. J. Dalgleish, Esq. ...	5	0	2	6 1	59·11 182
ARGYLL—(INSULAR.)						
Cantire, Mull of	Bd. of Northern Lights	...	...	...	279 ?	33·16 87
" Campbeltown (Devaar) ...	" " " .....	...	3	4	75 ?	38·32 142
Skipness Castle	Mrs. Graham	6	1	0	20 1	42·80 ...
Tarbert (Stonefield)	Colin G. Campbell, Esq.	3	1	3	90	56·90 117
* Islay (Lochindaul)	Bd. of Northern Lights	...	...	...	...	36·97 139
* " (Eallabus)	R. Ballingal, Esq.	5	1	0	67 1	39·80 188
" (Rhinn)	Bd. of Northern Lights	..	3	0	74 ?	25·42 146
" (Mc Arthurshead) .....	" " " .....	..	0	4	106 ?	19·65 130
Jura (Lowlandmansbay) .....	" " " .....	..	...	...	...	44·32 165
" (Fladda) .....	" " " .....	...	...	...	...	25·53 109
Lismore (Mousedale) .....	" " " .....	..	3	4	37 ?	31·67 128
" (Glengorm)	Miss Forsyth	6	0	9	200	39·20 ...
" (Sound of Mull)	Bd. of Northern Lights	...	0	6	12 ?	24·43 176
Tyree (Hynish) .....	" " " .....	...	...	...	...	59·53 129
BA* " (Heynish Farm)	L. Macquarie, Esq. ...	5	0	9	60	31·68 164

DIVISION XVI.—EAST MIDLAND COUNTIES.

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain 1870	Days on which ·01 or more fell.
		Diameter.	Height Above Ground.		Height Above Sea Level	
			ft.	in.	feet.	inches
CLACKMANNAN.						
Dollar	Mr. Westwood	7	0	6	174 π	31·61 93
KINROSS.						
Loch Leven Sluice	Mr. P. Farnie .....	...	0	10	...	21·40 ...
FIFE.						
Burntisland	Rev. G. H. Forbes .....	...	...	...	...	18·23 145
Dunfermline (Craigluscar)	W. Chisholm, Esq.	10	0	10	400	27·10 ...
Balfour	Mr. J. Dewar	3	0	6	127 τ	23·41 122
Leven (Nookton)	W. McG. Miller, Esq. ...	5	0	6	80 π	21·69 158
Isle of May	Bd. of Northern Lights ...	...	2	2	182 ?	12·03 73
St. Andrews (Cambo House)	Sir T. Erskine, Bt.	3	0	8	50 τ	18·62 ...
32 Auchtermuchty	Dr. Troup	5	1	0	179 π	24·77 162
" (Feddinch Mains)	Mr. Muirhead	3	1	0	300 τ	24·79 117
Cupar (Birkhill)	Mrs. Wedderburn	5	0	5	130	23·94 ...
PERTH.						
Culross (West Grange)	J. J. Dalgleish, Esq.	5	0	2	116 π	24·90 91
Menteith (Cardross House)	Mr. Wyber	8	1	0	120 ι	32·40 ...
Aberfoyle	Glasgow Water Works	8	0	6	60	40·60 ...
Dunblane (Kippenross)	J. Stirling, Esq.	6	0	4	100	23·70 ...
Deanston House	J. Finlay, Esq.	6	0	4	130 π	30·22 174
Loch Dhu	Glasgow Water Works	8	0	6	325	57·50 ...
" Drunkie	" " "	8	0	6	420	46·60 ...
" Vennachar	" " "	8	0	6	275	39·10 ...
Lanrick Castle	A. Glover, Esq.	3	0	0	...	28·90 107
Bridge of Turk	Glasgow Water Works	8	0	6	270	46·10 ...
Loch Katrine (Tunnel Hill Top)	" " "	8	0	6	830	57·40 ...
Callander (Leny)	J. B. Hamilton, Esq.	3	0	3	345 π	43·30 ...
Between Glen Finlas & Ben Ledi	Glasgow Water Works	8	0	6	1800	39·70 ...
Glen Gyle .....	" " "	...	...	...	380	71·30 ...
Auchterarder House	Colonel Hunter	8	2	3	162	24·05 ...
Auchterarder (Colquhalzie) ...	J. S. Hepburn, Esq.	8	0	5	150 ?	26·74 ...
" (Trinity Gask)	Mr. R. Wylie	3	0	1	133 π	24·59 116
Loch Earnhead	A. Buchan, Esq.	3	0	4	460	50·50 ...
" (Stronvar)	D. Carnegie, Esq. ....	...	...	...	...	61·33 ...
Perth Academy	Dr. Miller, F.R.S.E.	15	64	5	83 π	15·94 ...
" (Inchbank)	" " "	10	1	6	24 π	20·14 ..
Scone Palace	Mr. J. Halliday	6	2	6	80 ι	21·39 126
Glen Almond (Logie Lodge)	Mr. J. Stewart	2	4	6	1022 π	39·00 ...
Meigle (Belmont Castle)	Mr. J. Davidson	8	37	0	237	20·90 ...
Blairstown (Rosemount)	R. Geekie, Esq.	8	6	1	300 π	22·13 120
Aberfeldy (Bolfracks)	J. F. Wyllie, Esq.	12	0	6	360	31·30 ...
" (Blackhill)	J. S. Hepburn, Esq. ...	3	0	4	820	32·05 ...
32 *Logierait (Strath-tay)	Rev. G. D. R. Munro ..	5	1	0	313 π	27·13 135
FORFAR.						
† Dundee (Hermon Hill)	R. Adamson, Esq.	11	0	9	118 τ	24·09 ...
† " (Westfield Cottage) ...	C. Clark, Esq.	5	5	6	50 τ	22·62 170
† " (Eastern Necropolis) ...	Mr. W. R. McKelvie ...	3	0	5	167 τ	22·15 116
† Barry Village	Mr. J. Proctor	12	0	3	35 τ	24·22 170

DIVISION XVI.—EAST MIDLAND COUNTIES—(continued.)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which ".01 or more fell.	
		Diameter.	Height Above Ground.		Height Above Sea Level		1870
FORFAR—(con.)							
† Craigton	Dundee Water Works	11	0	3	481	29·65	107
† Crombie Reservoir	„ „ „	11	0	3	522 †	27·90	...
Kettins.....	Mr. J. Gibb	4	1	0	218 †	27·11	110
† Hill Head	Dundee Water Works	11	0	3	570 †	29·48	...
Arbroath	A. Brown, Esq., LL.D.	8	2	0	60 †	22·40	120
Montrose (Bridge Street)	D. Scott, Esq.	11	0	3	25 †	24·10	...
„ (High Street)	Mr. W. Leighton	7	6	4	22	21·57	103
„ (Sunnyside)	A. Buchan, Esq. ....	...	...	...	200	31·01	...

DIVISION XVII.—NORTH EASTERN COUNTIES.

KINCARDINE.

Lawrencekirk (Johnstone Lodge)	A. Buchan, Esq.....	5	...	...	382	31·23	...
Brechin (The Burn)	Col. McInroy	6	0	6	235	28·70	...
Fettercairn	A. C. Cameron, Esq....	3	0	3	230 †	32·50	199
" (Arnhall)	J. Vallentine, Esq.....	6	0	2	240	26·70	110
Girdleness [Aberdeen]	Bd. of Northern Lights	...	4	7	86	19·49	90

ABERDEEN.

Braemar	Mr. J. Aitken	8	1	0	1114 †	30·38	149
Ballater	J. W. Paterson, Esq....	5	1	0	656 †	30·74	122
Drumoak (Drum Castle) <i>monthly</i>	Mr. G. Gammie.....	5	1	8	275 †	37·21	...
Cromar (Coldstone)	Rev. J. G. Michie	5	4	0	608 †	24·70	151
Aberdeen (Pitmuir)	Mr. J. Taylor.....	10	1	4	14	24·78	184
† " (Rose Street).....	A. Cruickshank, Esq....	8	0	4	95 †	24·00	...
* " (Grammar School) "	Rev. A. Beverly	5	4	8	99 †	26·59	179
" " " <i>monthly</i>	" " "	5	1	6	96 †	26·81	...
" (" ") "	" " "	5	8	6	103 †	21·25	...
" (" ") "	" " "	5	63	10	161 †	22·57	...
Midmar (Blackstock).....	Mr. J. Barron	5	0	8	500 †	30·16	164
Lumphanan (Corse House)	Mr. J. Hay.....	5	3	0	833 †	27·58	150
33 1/2 * Alford (Bogside, Leochel) ...	W. Bruce, Esq.	5	3	0	882 †	32·31	175
Inverury (Kenmay)	Rev. G. Peter.....	8	0	0	300	34·70	...
" " "	" " "	8	0	7	300	28·25	...
" (Manse)	Rev. J. Davidson	9	0	0	220 †	30·10	...
Ellon (Tillydesk)	Mr. W. Hay	11	0	4	349 †	29·49	...
Old Deer (Manse)	Rev. J. Peter	8	0	6	156	25·20	...
Turriff (New Byth).....	A. Henderson, Esq. ...	5	0	5	391 †	32·14	...
New Pitligo	Mr. D. Sturrock	3	0	3	501 †	29·02	180
Kinnairdhead	Bd. of Northern Lights	...	3	4	64 †	30·28	128

BANFF.

Gordon Castle.....	Mr. Webster	8	1	6	70	23·56	...
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ELGIN OR MORAY.

Grantown	Mr. W. Duncan.....	5	1	1	712	28·26	143
Elgin (Ashgrove)	W. Topp, Esq.	8	0	3	33	20·14	174
" (Institution).....	Mr. J. Martin .....	...	...	...	...	23·35	...
Covesea Skerries.....	Bd. of Northern Lights	14·63	109

NAIRN.

Nairn	1	0	50	18·66	157
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Information supplied by W. Mackison, Esq.

DIVISION XVIII.—NORTH-WESTERN COUNTIES.

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which -01 or more fell.	
		Diameter.	Height Above Ground		Height Above Sea Level		1870
			ft.	in.	feet.	inches.	
WEST ROSS.‡							
*Loch Alsh (Inverinate House) ...	Mrs. Matheson	5	3	0	150	43·95	136
" (Duncraig)	Mr. Graham	5	1	0	124 L	40·57	216
BA Gairloch	Mr. K. Mackenzie.....	5	1	0	...	44·28	...
Loch Vraon	J. W. Baldry, Esq. ...	...	0	5	750	36·17	...
Lochbroom (Loch Drome).....	" " .....	...	0	5	850	41·13	...
Braemore House.....	" " .....	...	0	5	750	34·87	...
" Lodge.....	" " .....	...	0	5	100	41·74	...
BA *Lochbroom.....	Mr. M. Macleay	5	0	8	48	41·82	208
Isle of Lewis (Stornoway)	Bd. of Northern Lights ...	...	3	4	31 P	24·22	125
" (Lewis Castle)	Mr. Smith	5	0	8	60	18·54	219
" (Bernera)	Mr. J. Macdonald	5	0	6	100	37·90	...
" (Butt of Lewis)	Bd. of Northern Lights ...	...	3	6	...	34·50	173
EAST ROSS.‡							
BA *Dingwall Academy	J. Boyd, Esq.	5	1	0	25 T	20·29	112
Cromarty	Bd. of Northern Lights ...	...	3	4	28 P	16·28	109
*Invergordon Castle.....	B. B. Æ. McLeod, Esq. ...	5	2	6	14	20·09	126
Alness (Ardross Castle).....	Mrs. Matheson	5	1	0	450	30·80	141
BA *Tain (Fearn) ...	Mr. M. McLean.....	5	1	3	50 P	18·48	137
" (Springfield)	Mr. McLardy.....	5	1	2	80 T	24·28	156
Tarbetness	Bd. of Northern Lights ...	...	3	4	61 P	14·58	100
WEST INVERNESS.							
Loch Nevis (Inverie)	Mr. N. Macdonald ...	5	2	6	14	60·10	...
Isle of Skye (Oronsay)	Bd. of Northern Lights ...	...	0	6	15 P	34·95	110
" (Kyle Akin).....	" " " .....	...	0	2	3 P	49·07	131
" (Raasay)	Mr. T. Bunning.....	12	1	4	80	55·40	134
BA * " (Portree)	Mr. J. Grant	5	1	8	85	65·46	217
" (Dunvegan)	A. Buchan, Esq.....	3	0	1	16	61·21	197
Barrahead	Bd. of Northern Lights ...	...	3	0	640 P	25·62	108
S. Uist (Ushenish) .....	" " " .....	...	0	4	157 P	42·78	172
N. Uist (Monach) .....	" " " .....	...	...	...	...	40·03	122
Harris (Island Glass).....	" " " .....	...	3	4	50 P	33·51	138
EAST INVERNESS.							
BA *Laggan	Mr. A. McIntosh	5	0	9	821 T	37·69	181
Strath Errick (Farraline House)	Capt. Fraser	3	1	0	700 B	26·30	...
Glen Urquhart (Corrimony)	T. Ogilvy, Esq.	4	0	6	537 T	26·60	152
Glen Strathfarrer	Mr. D. Fraser	5	1	0	461	43·75	207
*Beauley (Beaufort Castle)	Mr. W. Anderson ...	5	1	0	50	20·41	111
Inverness (Culloden House)	A. Forbes, Esq. ....	...	3	0	104	17·91	...
Cawdor [Nairn]	J. Joss, Esq.	5	1	0	...	21·16	174

DIVISION XIX.—NORTHERN COUNTIES.

SUTHERLAND.

BA *Invershin	Mr. G. Young	5	4	0	20	23·07	...
Golspie (Dunrobin Castle)	Mr. J. Mitchell	3	0	3	6 T	26·76	152
BA *Helmsdale	Mr. J. Campbell	5	1	0	34	29·43	...
Scourie	A. Buchan, Esq. ....	...	0	3	26	43·04	...
House of Tongue	J. Crawford, Esq.	4	0	1	33	35·10	222
Cape Wrath	Bd. of Northern Lights ...	...	3	6	355 P	29·26	139

† Including Cromarty.

DIVISION XIX.—NORTHERN COUNTIES—(continued).

STATION.	AUTHORITIES.	Rain Gauge.			Depth of Rain. 1870.	Days on which -01 or more fell.
		Diameter.	Height Above Ground.	Height Above Sea level		
			ft. in.	feet.	inches.	
CAITHNESS.						
Wick (Pulteney House).....	Capt Rutherford, R.N.	5	6 0	76	18·88	127
„ (Nosshead).....	Bd. of Northern Lights	...	3 4	127 ?	22·06	139
Thurso (Holburnhead)	„ „ „	...	0 4	60 ?	21·97	79
Dunnethad.....	„ „ „	...	3 6	300 ?	11·79	72
Pentland Skerries	„ „ „	...	3 3	72 ?	19·64	142
ORKNEY.						
Walls (Melsetter)	Rev. C. Clouston, LL.D.	...	...	...	23·99	...
South Ronaldsay (Roeberry) ...	J. Gray, Esq	5	1 2	150 ?	22·10	210
Hoy (Cantickhead)	Bd. of Northern Lights	...	...	...	20·33	69
„ Graemsay Sound (East).....	„ „ „	...	3 4	27 ?	27·34	136
„ „ (West).....	„ „ „	...	...	37 ?	17·63	84
BA* Pomona (Holm Manse)	Rev. O. Scott.....	5	1 4	30 ?	25·54	...
† „ (Kirkwall)	Mr. J. G. Iverach	3	0 4	8	30·00	196
„ (Tankerness).....	A. Buchan, Esq.....	5	...	...	26·47	...
Shapinsay (Balfour Castle)	D. Balfour, Esq.....	4	0 6	50	29·60	...
+ Pomona (Sandwick)	Rev. C. Clouston, LL.D.	11	2 0	78	30·72	227
Stronsay (Auskerry)	Bd. of Northern Lights	...	...	...	22·32	72
Sanda (Start Point)	„ „ „	11	0 6	29 ?	29·76	92
BA* Papa Westray	Rev. C. Clouston, LL.D.	5	...	80 ?	24·34	...
North Ronaldsay	Bd. of Northern Lights	...	3 4	21 ?	14·40	68
SHETLAND.						
· Sumburghead	Bd. of Northern Lights	...	3 4	265 ?	21·19	168
Bressay Lighthouse	„ „ „	5	0 4	60	24·48	113
„ Manse	Rev. Dr. Hamilton ...	8	1 0	10	23·30	207
BA* East Yell	Mr. A. D. Mathewson	5	1 0	178 l	32·42	276

I R E L A N D.

DIVISION XX.—MUNSTER.

STATION.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which of or more fell.
		Diameter.	Height Above Ground.	Height Above Sea level		
			ft.	in.	feet.		1870. inches.
CORK.						
Cork (Queen's College)	Professor England ...	10	6 0	65	35·61	134
„ (Royal Institution)	Dr. Caulfield	10	50 0	70	28·46	115
Fermoy	A. Campbell, Esq.....	10	4 0	114 ∇	29·09	155
Mallow (Woodfort)	G. S. Ware, Esq.	5	5 6	205 ∇	31·40	172
KERRY.						
Knightstown (Valentia).....	The Knight of Kerry	8	6 0	38	47·10	212
32 * Killarney (Kenmare Gardens)	Mr. Breese	4	4 0	100 ∇	69·01	145
WATERFORD.						
Waterford (Newtown)	Mr. R. J. Greer	10	4 0	60 ∇	33·55	174
„ (Curraghmore)	Mr. J. Anderson, Jun.	5	4 6	...	40·94	167
„ (Portlaw) .....	.....	24	25 0	50	32·40	124
TIPPERARY.						
Carrick-on-Suir (Deer Pk. Lodge)	J. Ernest Grubb, Esq..	5	1 4	140 ∇	30·01	149
Clonmel (Glenam)	Miss Grubb	5	1 10	80 ∇	33·25	172
„ (Bruce Villa)	J. H. Grubb, Esq.....	5	1 6	110 ∇	30·39	167
Tipperary (Ballykisteen)	J. Fewster, Esq.	5	1 1	351 ∇	37·85	169
CLARE.						
Killaloe	Rev. C. Mayne	10	5 0	123 ∇	40·78	178

DIVISION XXI.—LEINSTER.

WEXFORD.						
Wexford (Reclaimed Lands)	C. W. Palliser, Esq.	10	0 2	1 ∇	25·22	124
New Ross (Rosbercon Cas.)	A. E. Graves, Esq.	6	2 6	45 ∇	32·32	105
Enniscorthy (Ballyhyland)	J. Moffat, Esq.	5	1 0	420 ∇	32·60	184
Gorey (Courtown)	Earl of Courtown	5	3 0	80 ∇	30·34	125
KILKENNY.						
New Ross (Tullogher)	D. A. Milward, Esq.	5	1 0	500 ∇	39·55	144
Inistioge (Woodstock) ..	Rt. Hon. W. F. Tighe	5	4 6	400 ∇	38·19	136
32 * Stoneyford (Inisnag)	Rev. J. Graves	5	1 0	200	26·42	176
CARLOW.						
Bagnalstown (Fenagh)	D. W. P. Beresford, Esq.	5	1 5	340	29·07	155
Carlow (Browne's Hill)	R. C. Browne, Jun., Esq.	5	1 0	291 ∇	28·24	187

DIVISION XXI.—LEINSTER—(continued.)

STATION.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which '01 or more fell
		Diameter	Height Above Ground.	Height Above Sea level	1870.	
			ft. in.	feet.			inches.
QUEEN'S COUNTY.						
Durrow	Rev. V. R. Drapes.....	5	1 0	400 ?	28·10	120
Portarlinton	Dr. Hanlon	5	1 2	240 L	26·04	219
KING'S COUNTY.						
Parsonstown (Birr Castle)	Hon. R. Parsons	4	0 3	200 T	28·47	...
Rathangan (Clonbron)	W. Gusson, Esq.....	5	1 3	224 T	28·72	...
Tullamore	H. J. B. Kane, Esq. ...	10	3 0	235	24·86	171
WICKLOW.						
Tinahely (Coollattine Park)	Mr. Byrne	5	1 0	427	18·88	82
Bray (Fassaroe)	E. Barrington, Esq. ...	10	5 0	250	33·14	138
DUBLIN.						
Black Rock (Rockville)	T. Bewley, Esq.....	12	29 0	90 T	25·02	95
Dundrum (Bloomsbury)	J. Wensley Bond, Esq. ...	5	1 0	268 T	25·48	160
Monkstown (Easton Lodge)	Greenwood Pim, Esq. ...	3	0 10	70 ?	23·56	138
Dublin (FitzWilliam Square) ...	Dr. J. W. Moore	5	3 6	57	20·86	145
32A* Skerries	Rev. T. Greene	5	1 0	12	27·81	167
Balbriggan	Rev. S. P. Warren ...	5	1 0	40	28·92	177
WESTMEATH.						
Athlone (Twyford)	J. Wensley Bond, Esq. ...	5	1 0	201	33·73	208

DIVISION XXII.—CONNAUGHT.

GALWAY.						
Gort (Cregg Park)	R. J. Lattey, Esq.....	5	3 0	130 T	30·01	135
Galway (Queen's College)	Prof. Curtis, LL.D. ...	10	6 0	25	44·84	187
Ballinasloe	J. Kempster, Esq.....	5	0 6	150 ?	34·47	174
Tuam (Gardenfield)	H. Kirwan, Esq.	5	6 0	136 T	33·39	...
ROSCOMMON.						
32A* Hollywell	H. Smyth, Esq.	5	5 6	...	31·22	153
SLIGO.						
32A* Buninnadden (Doo Castle)...	Mr. D. O'Dowd.....	5	1 0	...	38·21	...
Collooney (Markree Observatory)	Col. Cooper	24	16 3	145	32·94	184
Sligo (Haslewood)	Owen Wynne, Esq. ...	2	2 4	27	37·30	168
„ (Mount Shannon).....	F. M. Olpherts, Esq...	9	4 5	70	42·21	190

DIVISION XXIII.—ULSTER.

CAVAN.						
*Belturbet (Red Hills).....	Rev. E. Whyte Venables	5	0 9	...	32·45	200
FERMANAGH.						
Enniskillen (Florence Court) ...	Earl of Enniskillen FRS	12	11 0	300	42·95	186
ARMAGH.						
Armagh Observatory	Rev. Dr. Robinson F.R.S	10	1 5	208 T	22·29	125
DOWN.						
Seaforde	Colonel Forde, M.P....	8	0 5	180	37·29	172
Milltown (Bann Res).....	J. Smyth, Esq. C.E. ...	8	1 0	440	48·10	95
Banbridge (Milltown)	„ „ „ ...	8	0 8	200 T	27·68	172

DIVISION XXIII.—ULSTER—(continued).

STATION.	AUTHORITIES.	Rain Gauge.			Depth of Rain.		Days on which "1 or more fell
		Diameter	Height Above Ground.		Height Above Sea level	1870.	
			ft.	in.	feet.	inches.	
DOWN— <i>con.</i>							
Banbridge (Milltown)	J. Smyth, Esq., C.E....	12	40	0	220	23·09	...
Waringstown	Capt. Waring	8	0	4	190 ∇	28·54	173
Sydenham (Alma House)	R. Reade, Esq.	5	1	1	60	35·49	191
ANTRIM.							
Lisburn (Aghalee)	Lancelot Turtle, Esq... 5	5	1	0	105 ∇	28·86	170
" "	" "	9	1	0	105	28·78	...
† Belfast (Queen's College)	Mr. W. Taylor	11	7	4	68 ∇	30·14	160
† " (Linen Hall)	J. Stephens, Esq.	11	4	0	12	34·38	182
" (Old Park)	W. Girdwood, Esq.....	6	4	0	224 ∇	36·99	187
" (Antrim Road)	G. Thompson, Esq.....	2	7	3	144 ∇	28·77	122
37A Carrickfergus	A. Sutherland, Esq. ...	5	1	0	18 ∇	30·70	171
37A* Antrim (The Manse)	Rev. J. H. Orr	5	1	0	150 ∇	28·54	139
Ballymoney	E. H. Knox, Esq.....	5	7	0	170 ∇	32·25	200
Cushendun (Agolah)	Rev. S. A. Brennan.....	10	2	6	100 ∇	33·69	...
LONDONDERRY.							
*Garvagh (Moneydig)	H. R. Morrison, Esq... 5	5	1	0	121 ∇	33·87	173
Londonderry	D. Watt, Esq.	8	0	6	80	37·27	...
Bellarena	Sir F. Heygate, Bt., M.P. 5	5	1	0	12	30·98	169
TYRONE.							
Omagh (Edenfell)	Captain Buchanan..... 8	8	1	0	290 ∇	32·06	198
" "	" "	5	1	2	300 ∇	31·75	...
Strabane (Leckpatrick)	Rev. C. Maxwell	8	0	5	253 ∇	38·59	209
DONEGAL.							
37A* Letterkenny (Glendoen)	Rev. Dr. Kingsmill ... 5	5	1	8	108 ∇	49·42	154
Dunglow (Templecrone)	Rev. A. Delap	8	0	6	10	39·18	201
Moville.....	Rev. F. Smith	12	4	0	100 ∇	39·84	198

G. J. S.

SUPPLEMENTARY TABLE OF IMPERFECT RETURNS, COMPLETED BY DIFFERENTIATION FROM
ADJACENT STATIONS.

	DIV.	COUNTY.	STATION.	OBSERVER.	Rain Gauge.			Depth of Rain.
					Diameter	Height Above Ground.	Height Above Sea level.	
					ft.	in.	feet.	inches.
England ...	II.	Surrey	Gomshall	F. Evershed, Esq.	5	1	270	28.56
"	V.	Devon	33 Tavistock (Kilworthy Hill)	Mr. Merrifield	5	1	434	35.27
"	VII.	"	33 Clawton (Court Barn)	W. W. Melhuish, Esq.	5	1	300	28.16
"	IX.	Nottingham	Mansfield	R. Tyrer, Esq.	5	0	350	23.96
"	X.	York, W. R.	Skipton (Buckden)	Mr. Metcalfe	10	2	800	55.06
"	XI.	Westmoreland	Langdale (Brigg Howes)	Mr. Tucker	5	0	250	85.47
Wales	XI.	Denbigh	Wrexham (Gwersyllt Hall)	W. Lassell, Jun., Esq.	8	2	400	34.72
Isle of Man	"	Isle of Man	33 Kirk Michael	Rev. W. C. Ingram	5	0	70	40.93
Scotland	XIV.	Ayr	33 Patna (Holehouse)	Mr. P. Murdoch	5	1	441	35.99
"	"	Renfrew	Nether Cairn	Glasgow Water Works	...	...	700	39.05
"	XV.	Stirling	Ben Lomond	"	...	...	...	52.20
"	"	Argyle	Loch Fyne (Glen Fyne)	A. M'Dowall, Esq.	6	1	70	79.90
"	XVI.	Perth	33 Ballachulish	Rev. D. Mackenzie	5	1	30	62.88
"	XVII.	Aberdeen	Ledard	Glasgow Water Works	...	...	1500	47.60
"	"	"	Aberdeen (Wallfield)	Rev. A. Beverley	5	3	163	26.55
"	"	Banff	Peterhead (Buchanness)	Board of Northern Lights	...	...	...	18.91
"	"	Nairn	33 Tomintoul (Inchroty)	Mr. Macrae	5	1	0	44.37
"	XVIII.	West Ross	33 Auldearn	Mr. Laidlaw	5	1	0	21.95
"	"	West Inverness	33 Strathconan	"	5	3	4	42.74
"	"	"	33 Isle of Skye (Sligachan)	Mr. McDonald	8	1	0	76.75
"	"	"	Rona	Board of Northern Lights	...	...	...	33.94
Ireland	XX.	Kerry	33 Darrynane Abbey	D. O'Connell, Esq.	5	1	13	48.18

NOTE.—Several of the British Association gauges having been delayed in despatch, and others in erection, the returns for January last were imperfect; it is most undesirable that the record for the decennial period, 1870-9, should be thereby rendered imperfect—hence the compilation of the above Table.

FINANCIAL.

THIS important element of rainfall work is the only one in which I am unable to report any progress; this is very much to be regretted, because it seriously retards many useful enquiries, and leaves me to carry them on single-handed. It is admitted that the work is of national importance; should it not, then, be assisted by national funds? In this, as in previous years, the expenses are met by subscriptions from a portion of the observers, but funds adequate to provide a qualified assistant, or *any* remuneration for the Editor, are not forthcoming. I fear that there will be some difficulty in obtaining a successor to myself on the same terms.

List of all Sums of £1 and upwards, received in payment for Books, Diagrams, &c., or as contributions to the general expenses of Rainfall investigations in 1871.

	£	s.	d.		£	s.	d.
Abbotts, R. W., Esq.	1	10	0	Blake, W., Esq.	1	0	0
Adam, Dr. A. M. (2 years).....	1	1	0	Bolckow, H. W. F., Esq., M.P.	1	5	0
Aire & Calder Navigation Co...	2	7	0	Boorman, D. E., Esq.	1	1	0
Alexander, J., Esq.	1	5	0	Bosanquet, S., Esq.	1	0	0
Appach, R., Esq.	1	0	0	Box, A. M., Esq.	1	5	0
Assheton, R., Esq., M.P.	1	1	0	Bridgeman, Hon. & Rev. J.R.O.	1	1	0
Atkinson, A., Esq.	1	0	0	Brooke, The Rev. J.	1	1	0
Backhouse, C. J., Esq.	1	0	0	Brown, A. J. D., Esq.	1	10	0
Backhouse, T. W., Esq.	1	0	0	Brown, T. C., Esq.	1	0	0
Baker, W. C., Esq.	1	1	0	Brown, Rev. D.	1	0	0
Balme, E. B. W., Esq.	1	6	0	Bumpstead, The Rev. T. J.	1	0	0
Barrington, E., Esq.	1	0	0	Burlingham, R., Esq.	1	11	0
Barnes, R. H., Esq.	1	1	0	Campbell, Colin, Esq.	1	0	0
Bathurst, Rev. W. H.	1	0	0	Carswell, J., Esq.	1	0	0
Baylis, H., Esq.	1	1	0	Casella, L. P., Esq.	1	0	0
Bayning, The Lady	1	1	0	Cator, C. O. F., Esq.	1	10	0
Bell, T., Esq.	1	1	0	Cathcart, E., Esq.	1	0	0
Bellamy, G. D., Esq.	1	0	0	Charrington, F., Esq.	1	0	0
Bicknell, P., Esq.	1	11	0	Chrimes, R., Esq.	10	0	0
Birkbeck, W., Esq.	1	0	0	Clegram, W. B., Esq., C.E. ...	1	1	0

	£	s.	d.		£	s.	d.
Compton, T. A., Esq., M.D. ...	1	0	0	Jones, Mrs.....	1	0	0
Coode, W., Esq.....	1	1	0	Jowers, F. W. E., Esq.	1	6	0
Cooke, The Rev. R. B.....	1	0	0	Karslake, The Rev. W. H.....	1	0	0
Cooke, J. H., Esq.	1	0	0	Ker, R., Esq.....	1	1	0
Courtown, Right Hon. Earl of	1	5	0	Knott, J., Esq.	1	1	0
Darby, C., Esq.....	1	10	0	Knowles, J., Esq.....	1	0	0
Davis, J., Esq.	1	1	0	Lassell, W., Jun., Esq.	1	0	0
Davis, T. H., Esq.....	1	3	0	Leather, J. T., Esq., C.E.	1	11	0
Denne, W., Esq.	1	1	0	Legard, the Hon. Lady	2	0	0
Dines, G., Esq.....	1	0	0	L'Estrange, H. S., Esq.	1	1	0
Dipple, G., Esq.	1	0	0	Lighton, Rev. Sir C. R., Bart..	1	0	0
Divett, J., Esq.....	1	0	0	Lippincott, R. C. C., Esq.	1	0	0
Dod, Whitehall, Esq.	1	13	0	Lockhart, A. E., Esq.....	1	0	0
Douglas, S., Esq.	1	0	0	Lucas, W., Esq.....	1	1	0
Drummond, General.....	1	10	0	Lund, C., Esq.	1	0	0
Duncan, J., Esq. (2 years).....	1	0	0	Mackeson, H. B., Esq.....	1	13	0
Erskine, Sir T., Bart.	1	0	0	Macfie, R., Esq.	1	0	0
Evans, F. G., Esq.	1	6	0	Malden, The Rev. C.	1	5	0
Eyre, Rev. W.	1	1	0	Mansel, J. C., Esq.	1	0	0
Fawcett, H., Esq.....	1	9	6	Marshall, A., Esq.....	3	0	0
Fenwick, T., Esq.....	1	8	0	Marshall, H. C., Esq.	3	3	0
Ffolkes, The Rev. H.	1	0	0	Mathew, Major	2	13	6
Field, Rogers, Esq., C.E.	1	11	0	Matthews, J., Esq.	1	1	0
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Finlay, J., Esq.....	1	10	0	Muirhead, H., Esq., M.D.	1	1	0
Forde, Colonel, M.P.....	2	5	0	Musgrave, W., Esq.....	1	0	0
Fothergill, Rev. H. J. A.....	1	0	0	Newdigate, Rev. C.	1	0	0
Freeman, D. A., Esq.	1	7	6	Nicholl, J., Esq.	1	1	0
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Giles, J., Esq.....	1	0	0	Nunes, F., Esq.....	2	2	0
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Gillow, Rev. Dr.	1	0	0	Ogilvy, T., Esq.	1	1	0
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Harris, W. J., Esq.	2	2	0	Perry, Rev. S. J.	1	5	0
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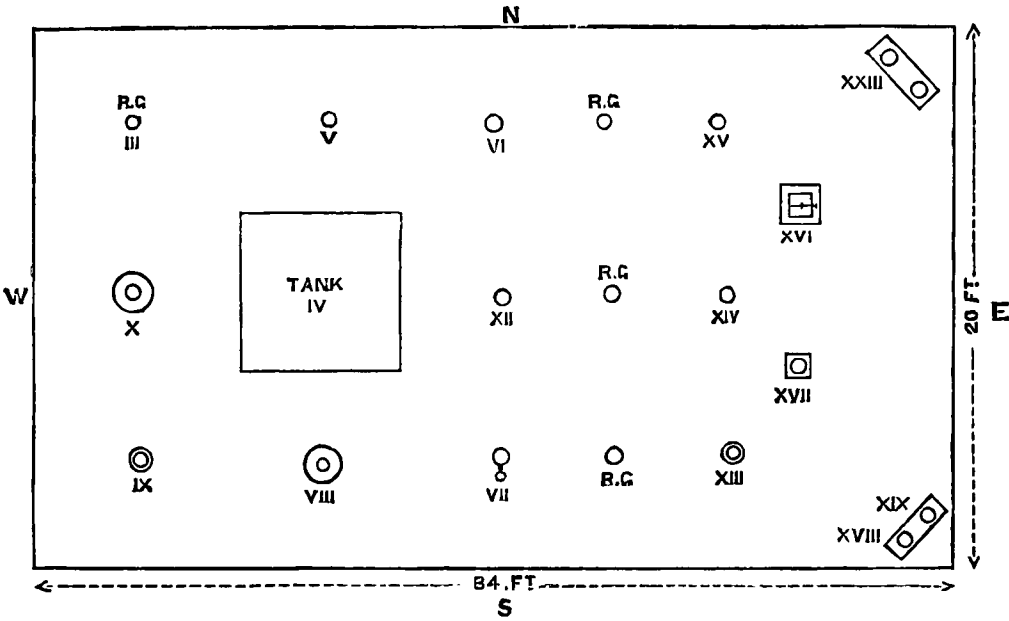
[Subsequent receipts will be acknowledged monthly in the
Meteorological Magazine.]

APPENDIX.



ON EVAPORATION.

GROUND PLAN OF ENCLOSURE FOR EVAPORATION EXPERIMENTS, STRATHFIELD TURGISS, READING.



EXPLANATION.

Number.	Description.	Height of rim above ground.
III.	Rain Gauge.....	4 in.
IV.	Tank.....	3 in.
V.	Earthenware	4 in.
VI.	Japanned tin	4 in.
VII.	„ „ with overflow.....	4 in.
VIII.	Phillips' „ „	4 in.
IX.	Miller's Sand	5 in.
X.	Phillips'	4 in.
R. G.	Rain Gauges	12 in.
XII.	Japanned tin (water salted).....	12 in.
XIII.	„ „ (felt protected) ...	12 in.
XIV.	„ „	12 in.
XV.	Casella's, with overflow.....	12 in.
XVI.	Proctor's	12 in.
XVII.	Sharpe's	12 in.
XVIII. & XIX.	Fletcher's.....	5 ft.
XXIII.	Watson's	3 ft. 6 in.

ON EVAPORATION.

IN my last volume a joint note by Mr. Rogers Field, C.E., and myself, detailed the various forms of apparatus hitherto employed in ascertaining (or, more correctly speaking, in attempting to ascertain) the amount of evaporation from a surface of water. It also gave an abstract of the results obtained previous to that time, and briefly stated that a grant had been obtained from the Royal Society to defray the cost of constructing sundry apparatus, and that our constant helper in these matters, the Rev. C. H. Griffith, had agreed to carry on the experiments at Strathfield Turgiss. These experiments have been in progress during the whole of last year, and the observations, which are very voluminous, are now being reduced and compared by Mr. Field, who will report fully on them to the Royal Society. Till this report is completed, no precise results can of course be given. A brief note, however, on the arrangements adopted will be useful to those who are working at the subject, and I therefore intend, in the following note, to give such a short and simple account as will enable my readers to understand generally what has been done, referring them to Mr. Field's forthcoming paper for the precise results and more complete details.

First, as to the *locus in quo*. Most of the instruments are placed in the enclosure at Strathfield Turgiss, previously occupied by the experimental rain gauges, and now appropriated as shown by the annexed plan.

Secondly, as to the instruments. On reference to the plan, Figs. I. and II. will not be found, because *they* are not in that enclosure. Evaporator No. I. is Luke Howard's, engraved and fully described on page 169 of our last volume. It is placed in the thermometer enclosure, under the Kew thermometer stand.*

Evaporator No. II. is Mr. S. H. Miller's No. II.; it is an 8-inch cylinder, 4 in. deep, placed under Martin's stand,* so as to allow a free current of air, but to exclude all rain and sunshine.

* See *Meteorological Magazine*, Vol. IV., p. 33.

Fig. III. is an 8-inch rain gauge, of which the mouth is 4 in. above the ground, so as to be strictly comparable with evaporators Nos. IV. to X., all of which are placed with their receiving surfaces about 4 in. above the grass.

Evaporator No. IV. is a galvanized iron tank 6 ft. square and 2 ft. deep (therefore holding more than 400 gallons); it is sunk 1 ft. 9 in. into the earth, and filled with water up to the ground level, the surplus (3 in.) being kept to prevent overflow, either from heavy rain or from the wavelets breaking against the sides.

Evaporator No. V. is a white glazed earthenware jar, 5 in. in diameter, 10 in. deep, buried 6 in. in the earth, and with about 8 in. of water in it; so that the rim is 4 in. above the ground and 1 or 2 inches above the water level.

Evaporator No. VI. is similar in general arrangement to No. V., except that it is made of japanned tin.

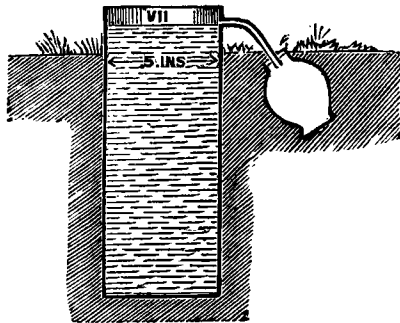


Fig. 18.—TIN, WITH OVERFLOW.

No. VII. only differs from No. VI. in being provided with an overflow pipe (as shown in the annexed sketch, fig. 18,) to prevent interruption of the observations by extremely heavy rain.

No. VIII. is constructed of glass, on the principle adopted by Major Phillips, R.E., namely, a glass cylinder of 5 in. diameter and 10 in. in length, almost entirely immersed in an earthenware pan of water a foot or more in diameter; it is also provided with an overflow pipe.

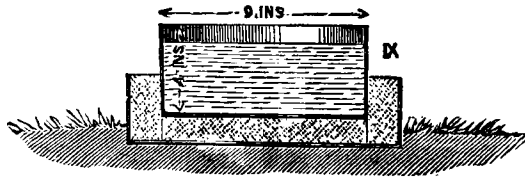


Fig. 19.—MILLER'S SAND.

No. IX. is a zinc vessel 8 in. diameter and about 4 in. deep, immersed

in a larger vessel containing wet sand. Having been described last year by Mr. S. H. Miller, it is for brevity termed "Miller's Sand," and is shown in fig. 19.

No. X. is similar to No. VIII. in every respect, except that it has not the overflow arrangement; it is shown on page 154 of 1869 (fig. 3.)

As already mentioned, evaporators Nos. IV. to X. all have their orifices about 4 in. above the ground.

No. XI. is a rain gauge (there are, in fact three, marked R. G., but only one is used for this enquiry), of which the mouth is 1 ft. above the ground, and it is employed for comparison with evaporators No. XII. to XVII., which are all similarly placed.

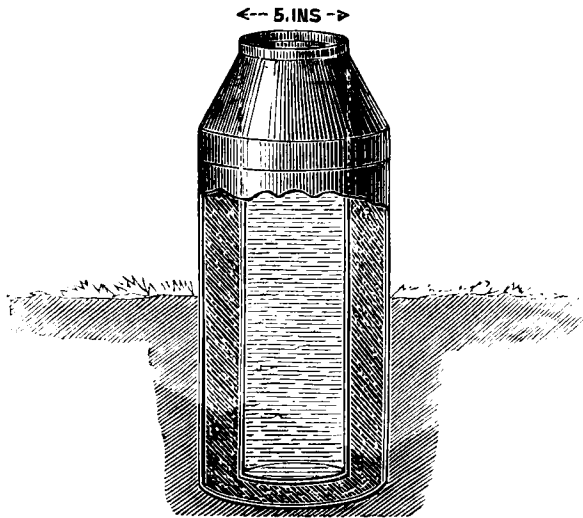


Fig. 20.—FELT PROTECTED.

Nos. XII. to XV. inclusive are all metal cans, 5 inches in diameter, standing on the ground, and with their orifices 1 ft. above the ground, they differ only in the following respects:—In No. XII. a small quantity of salt is, in the winter time, added to the water to prevent its freezing and secure continuity of observation and freedom from bursting. No. XIII. has an outer metal case (shown in fig. 20) and the intervening space filled with hair felt—hence called "Felt protected." No. XIV. has no protection whatever. No. XV. is represented in fig. 1, p. 154, 1869, and, as will be seen, is exposed to atmospheric temperature at the bottom as well as the sides.

Evaporator No. XVI. (Proctor's evaporator) was partly described last year (on p. 172); it will, however, be better understood from the annexed, (fig. 21) than from any description.

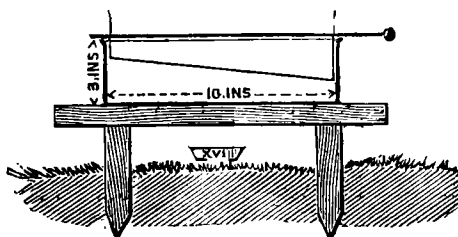


Fig. 21.—PROCTOR'S.

No. XVII. (Sharpe's) is shown in fig. 22 ; its essential principle is the protection of the tin vessel from extremes of temperature by a casing of inch deal boards.

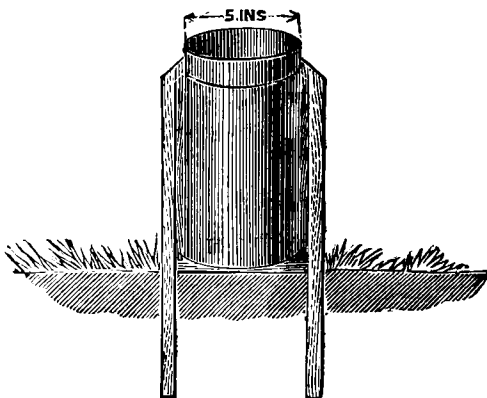


Fig. 22.—SHARPE'S.

Nos. XVIII. and XIX. are Fletcher's evaporator, and the rain gauge for comparison with it, as shown in fig. 23. The mode of using this apparatus was fully described by Mr. Fletcher, M.P., F.R.S., in *British Rainfall*, 1867, p. 43.

Nos. XX. and XXI. (not shown on ground plan) are a rain gauge and an evaporator similar to No. XIV., placed on the roof of the rectory at an elevation of about 30 ft.

Nos. XXII. and XXIII. (recently added) are fac-similes of the gauges approved by Dr. Dalton, and used by Mr. Watson, F.C.S., at Bolton and at Braystones, near Whitehaven ; their general arrangement will be readily understood from the annexed fig. 24 and from the description given on page 174 of our last.

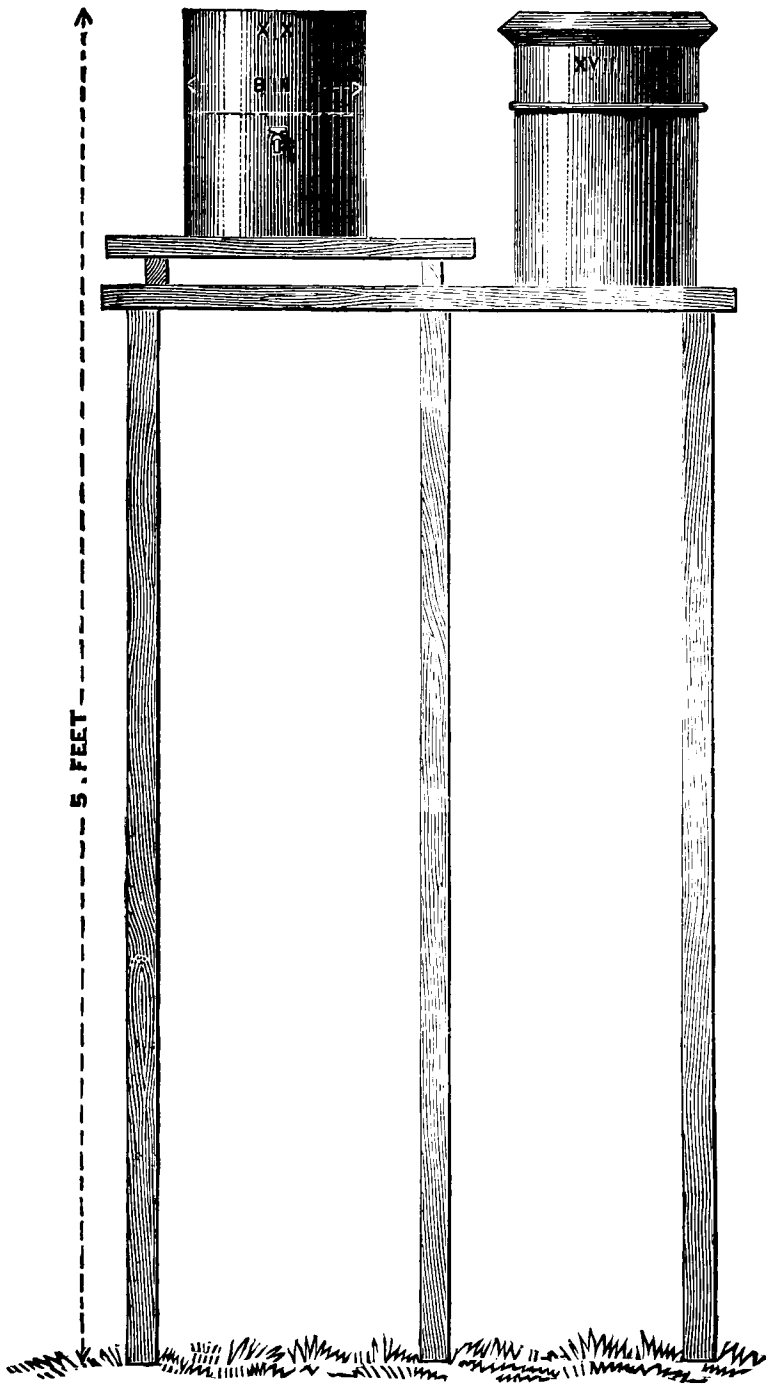


Fig. 23.—FLETCHER'S.

The results quoted in the joint paper by Mr. Field and myself, read before the British Association, and reprinted in *British Rainfall*, 1869, could not fail to convince any one that the key to the whole question was to be found in one item—the temperature of the water ; therefore,

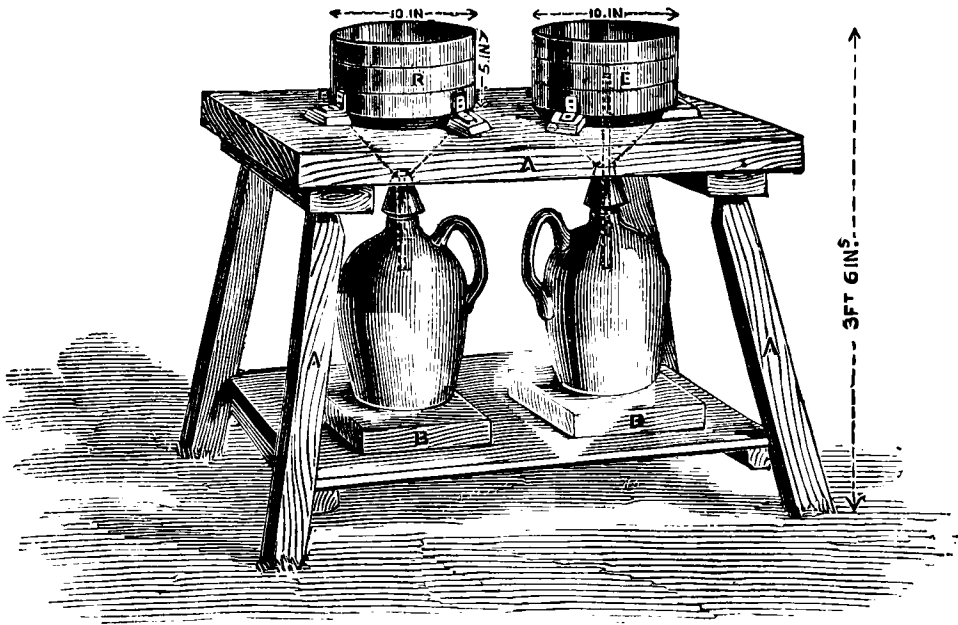


Fig. 24.—WATSON'S.

in the experiments at Strathfield Turgiss this element has been carefully examined.

The several steps towards that end may be mentioned. First, self-registering thermometers are kept in the river Loddon, a quarter of a mile from the rectory, and their records are compared with others kept in the tank (IV.) and with individual readings in all the other evaporators. Secondly, the temperature of the water in the tank is recorded not only at the surface but at various depths. Thirdly, every observation of the amount evaporated by each instrument is accompanied by a note of the temperature of the water at the time. The result has simply been to show that much yet remains to be done in this respect.

These observations have fully confirmed those made at Camdensquare, and quoted last year. The evaporation from some of those vessels which "heat up" most readily, such as Nos. XII. and XIV., being more than 50 inches per annum, while from the tank IV. and Nos. I. and II. it is less than half that amount.

This result is also confirmed by several very delicate experiments by Mr. Dines, which have been published in the *Proceedings of the Meteorological Society*. Mr. Dines has shown that the amount of evaporation *decreases* (in consequence of the diminished effect of wind) with the angular super-elevation of the sides of the vessel; we had already found that small evaporators, by getting too hot, evaporated too much. *Possibly* we may be able to hit upon some depth which will compensate for this heating error, and thus obtain an instrument which though not correct, would, nevertheless, be more so than anything yet available for ordinary observers.

In conclusion, we add a *résumé* of such reports from other stations as have reached us, some of which will be noticed as being four times as large as others. It appears that identical apparatus at Bolton and Braystones gives results which differ by 50 per cent. Surely this must be due to some difference of position or of shelter.

AMOUNT OF EVAPORATION IN 1870.

County ...	Cambridge.				Lancashire.		York.	Cumber- land	Forfar.	Aber- deen.
Station ...	Wisbech.				Bolton. H. H. Watson, Esq.	South Shore. G. Sharples, Esq.	Hawsker, Whitby. Rev. F. W. Stow.	Braystones, Whitehaven. J. D. Watson, Esq.	Barry. Mr. Proctor.	Aberdeen. Rev. A. Beverley.
Observer...	S. H. Miller, Esq.									
Reference	A.	B.	C.	D.	E.	F.	G.	H.	I.	K.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
January..	·24	·32	·51	·25	·25	·70	·10	1·02	1·70	·67
February	·29	·40	·73	·12	·71	1·75	·20	1·45	2·85	1·14
March ...	·66	·54	·74	·49	1·13	2·15	1·30	1·93	2·35	2·17
April ...	1·77	1·29	1·18	1·66	2·27	3·10	3·67	3·00	4·10	4·37
May	2·79	1·50	1·45	2·28	1·98	4·10	3·30	3·33	4·65	4·38
June ...	2·76	1·22	1·28	2·38	3·25	3·65	3·00	3·77	4·40	4·08
July ...	2·22	1·06	·95	2·22	3·39	4·85	2·94	4·72	5·10	4·39
August...	2·28	1·16	1·39	2·06	3·32	4·60	3·19	4·86	3·80	3·22
Sept.....	1·19	·82	·71	1·29	1·76	4·05	1·99	3·40	3·30	1·98
October..	1·25	·46	·74	1·00	·45	4·00	2·10	1·94	2·35	·86
Nov.....	·16	·22	·30	·12	·20	·90	·70	1·05	2·70	·52
Dec. ...	·22	·20	·28	·18	·21	·72	1·73	·38	1·70	·41
Totals.	15·83	9·19	10·26	14·05	18·92	34·57	24·22	30·85	39·00	28·19

Refer- ence.	Diameter.	Height above ground.	REMARKS.	
A. ...	8 in.	0 ft. 4 in.	...	Described and figured on page 178. Consists of a shallow tin vessel of water immersed in a larger one of wet sand.
B. ...	8 in.	6 ft. 0 in.	...	Placed under a stand protected from sun and rain.
C. ...	8 in.	0 ft. 4 in.	...	Similar to A., except that it is protected from sun and rain by a white board on posts.
D. ...	8 in.	0 ft. 0 in.	...	Stands in a large vessel holding 8 gallons of water, which is kept nearly level with that in the inner one.
E. ...	10 in.	3 ft. 6 in.	...	See figure on page 182.
F. ...	...	1 ft. 8 in.	...	In a large tub of earth, partly buried in the ground.—See <i>British Rainfall</i> , 1869, p. 173.
G. ...	12 in.	0 ft. 3 in.	...	Cylinder 15 inches long, sunk in grass plot, water kept level with the ground.
H. ...	10 in.	3 ft. 6 in.	...	Exactly similar to E.
I. ...	10 in. sq.	3 ft. 0 in.	...	A zinc box, about four inches deep, standing on a dwarf stool.—[See figure 21, p. 180.]
K. ...	5 in.	0 ft. 0 in.	...	Zinc cylinder with overflow arrangement.—[See <i>British Rainfall</i> , 1869, p. 163.]

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