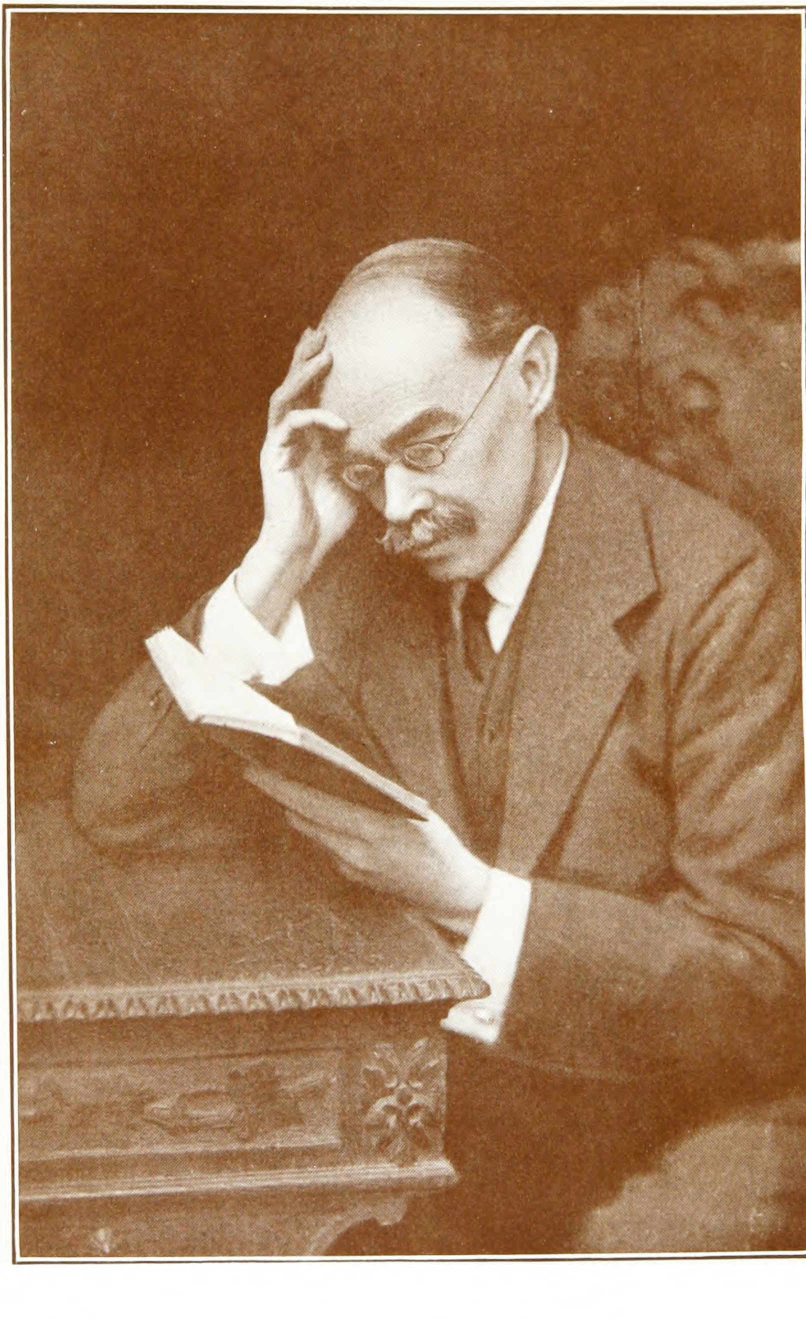

Yours very sincerely
Hugh Robert Mill

Editor, Symons's Meteorological Magazine, 1900-1919.

SYMONS'S

METEOROLOGICAL

MAGAZINE

Edited by HUGH ROBERT MILL, D.Sc., LL.D.

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VOL. LIII. No. 625.

The history of this Magazine as of most lives is one of alternate hope and disappointment, of struggle and slackness. At one time it seemed as if increasing support and encouragement were about to justify a course which might lead direct to popularity with profit, again, and now, the utmost we can hope for for months if not years to come is to weather the storm by shortening sail.

It is worth while to make the effort, for this Magazine possesses some elements of usefulness which ought to be preserved. It has the longest history of any journal devoted to meteorology. It makes a feature of giving expression to all sane views however much these may be at variance from orthodox scientific beliefs or from the opinions of the Editor. This is, we are convinced, the proper attitude of the scientific mind, and for our part we should feel far more ashamed of suppressing an unsuspected truth than of involuntarily giving publicity to an error. But if an error should appear we very cordially welcome its refutation.

In these days when the last word on any subject of difficulty is nationalization and the appointment of a Controller with an unlimited staff, we are conscious of being on the unpopular side in supporting individual effort, voluntary organization and consistent economy. We hold very strongly that public departments should assist such work as ours by recognition and even financial aid in emergencies, but without imposing conditions of official control which tend to stifle initiative and lessen responsibility. Experience has convinced us that work of great value is often done by voluntary Observers working not quite in the best way who would rather cease to observe than come under a rigid system of rules and regulations. We try to guide such Observers by endeavouring to increase their enthusiasm to the point which leads them voluntarily to ask for advice.

In a properly regulated State, such as we may dream of after the war, it should not be found impossible, we believe it would be easy, to unite voluntary enthusiasts in willing co-operation in a national system of rainfall observations (for example) which should be supported by public funds. But pending the dawn of that golden day we shall endeavour to render such services and produce such results as the contributions of the faithful and the restrictions of this time of stress admit.

GUNFIRE IN FRANCE, RAINFALL IN ENGLAND.

By THE EDITOR.

MR. HARRIES raises a very important point in his letter, published on another page, when he questions the validity of the regional averages used by Mr. Brodie in his article in the January number. We have always been at pains to lay the utmost stress on the importance of using the same period for average rainfalls at stations which have to be compared, and on selecting equally spaced stations when the general rainfall over a district has to be dealt with. How far these rules are followed in the official *Weather Reports* we are not aware; but we give herewith a series of values which are free from any errors of this kind. Time could only be found for dealing with two districts, one the South-East of England (comprising divisions I.-IV. of *British Rainfall, i.e.*, the counties to the south-east of a line drawn from the Wash to Portland Bill), the other comprising coastal stations from Sutherland and the Hebrides to the west of Ireland, the one being the nearest, the other the most remote part of the British Isles as viewed from the centre of warlike activity in Flanders. The number of stations differed by one or two in different years; but care was always taken to ensure that the stations employed for any one year gave a true account of the general distribution of rainfall, so that it is quite certain that no one year over-represents the wetter or the drier parts of the district. The average employed in every case was that of the stations used and extended over the 35 years, 1875-1909, except in the case of 1909, when the average was for the 30 years, 1870-1899. The figures for the individual stations are those published annually in Part II. of *British Rainfall* under the title of "Monthly Rainfall . . . the average . . . being taken as 100."

The Tables represent the variations of monthly rainfall from the monthly normals, and they will no doubt be interpreted variously by various theorists. In order to facilitate discussion we group the results in a special form by taking the mean percentage for each month in three three-yearly periods, and a final mean for the whole nine years. While a month cannot have less than no rain, or a deficiency of 100 per cent., it may have as much as four times the normal rainfall or an excess of 300 per cent. at an individual station, and probably an excess of 200 per cent. for a whole region of the size of those dealt with. The limits of annual rainfall, on the other hand, range from a deficiency of about 40 per cent. to an excess of about 50 per cent. at individual stations.

A glance at the Tables shows that for both regions the nine years were as a whole wetter than the average, the south-eastern rather more so than the north-western. This increase of rainfall was not uniform throughout the year. In both regions the summer and early autumn months were considerably drier than the average, the

South Eastern Region. Rainfall as per cent. of Average.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
1909	41	34	189	94	86	174	120	94	110	166	34	168	110
1910	107	162	58	116	144	103	107	90	40	80	134	186	109
1911	73	75	116	76	69	102	13	51	70	96	142	204	91
1912	171	97	175	10	67	143	101	267	108	80	86	123	120
1913	169	49	145	154	101	40	78	58	86	129	102	46	95
1914	63	133	239	58	68	68	90	63	46	75	121	273	107
1915	174	196	70	60	161	54	166	90	99	69	106	231	121
1916	74	233	223	77	103	117	54	142	67	112	144	138	121
1917	91	56	113	84	88	118	142	206	76	120	54	62	104
1909-11	74	90	121	95	100	126	80	78	73	114	103	186	103
1912-14	134	93	186	74	79	84	90	129	80	95	103	147	107
1915-17	113	162	135	74	117	96	121	146	81	100	101	144	115
1909-17	107	115	148	81	100	102	97	118	78	103	102	159	109

North Western Region. Rainfall as per cent. of Average.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
1909	120	80	89	156	116	57	113	80	70	128	81	96	97
1910	132	177	88	139	111	98	105	146	36	50	105	76	103
1911	73	130	69	129	94	89	128	73	78	71	114	134	97
1912	77	103	139	113	89	148	96	111	48	104	116	144	109
1913	110	77	150	148	131	128	40	42	79	87	134	108	101
1914	91	189	134	130	94	63	97	97	84	51	128	131	107
1915	129	147	72	155	44	59	124	69	58	57	75	132	94
1916	138	143	58	162	168	87	70	76	63	176	129	93	114
1917	65	38	75	98	88	94	48	104	91	182	178	72	105
1909-11	108	129	82	141	107	81	115	100	61	83	100	102	99
1912-14	93	123	141	130	105	113	78	83	70	81	126	128	106
1915-17	111	109	68	138	100	80	81	83	71	138	127	99	104
1909-17	104	120	97	137	104	91	91	89	67	101	118	110	103

nine years mean showing no excess but in most cases a marked deficiency of rainfall for June, July, August, September and October, and excesses only for the winter and early spring months November, December, January and February. In the north-west April and May were also wet, and in the south-east March and August. The most conspicuous feature is that in both regions September showed a greater deficiency than any other month. We have shown on a previous occasion that the increasing dryness of September has been a feature of the climatology of the British Isles for the past fifty years. We cannot say why this should be so, but the fact is incontestable and the tables show by the three year averages that although the deficiency was greatest in 1909-1911 the slight decrease in the deficiency occurred more in the pre-war years 1912-14 than in the war years 1915-17. It is surely remarkable that during the war not one of the three Septembers had as much as its average rainfall, and we do not suppose that less explosives were consumed in September than in other months. Again, in the south-eastern region the greatest excesses in the three war years occurred in February, March, August and December. In February and August the war years showed a higher excess than in either of the previous three-yearly periods; but in March, the three-years' period 1912-14, and in December, both the previous three-year periods had greater excesses. Thus if the increase in the wetness of February and August is to be attributed to gun-fire, there must be some other explanation for the reduced wetness of March and December. These are only examples of the arguments which may be drawn from our tables, but they bear very strong evidence to the effect that the abnormalities of the rainfall of the war years are merely the natural development of changes which have certainly been at work for nine years and in one case no less certainly for fifty years.

In the south-eastern region the wettest January, February, July, November and December in the nine years occurred during the war; the wettest of the other seven months before the war. In the north-western region the wettest January, April, May, September, October and November occurred during the war, the other six months before the war. So far as this rough test goes the wettest months during the war were more numerous in the region remoter from the firing.

We may approach the matter also from the point of view of the frequency of wet and dry months in the period of forty-one months commencing in August, 1914, during which the war has been raging, and also in the forty-one months ending in July, 1914, when peace reigned.

Monthly rainfall is so variable that a month which has within 25 per cent. of the average rainfall cannot be treated as significant of either exceptional wetness or dryness, but may be termed *neutral*. A month with from 25 to 50 per cent. below the average may be called *dry*, with more than 50 per cent. below the average, *very dry*; while a month with between 25 and 100 per cent. of excess may be called *wet*, and one with an excess of more than 100 per cent *very wet*. Applying these terms to the two areas we find the following results :—

Number of Months out of 41.

	Very Dry.	Dry.	Neutral.	Wet.	Very Wet.
S.E. before War	5	9	15	9	3
,, during War	1	11	16	8	5
N.W. before War	3	4	20	14	0
,, during War	3	11	12	15	0

A partisan of the belief that gunfire in France influences rainfall in England would, of course, fasten on the fact that immediately before the war there were in the south-east of England 5 very dry months in 41, and during the war only 1; whilst before the war there were only 3 very wet months out of 41, and during the war,5. But in the same period before the war there were 14 dry or very dry months, and 12 wet or very wet months, and during the war 12 dry or very dry and 13 wet or very wet months, so a single month transferred from one category to the other would bring the result to equality or even reversal. In the north-west of the British Isles in the same two periods very dry months were equally numerous, whilst there were no very wet months. Taking dry and very dry months together there were 7 before, and 14 during the war, and of wet months there were 14 before and 15 during the war.

Much stress has been laid on the relative wetness of the years 1915 and 1916 in the south-east of England, but this fact must be considered in connection with the fact that 1917, when the war was at its intensest phase, was a year of nearly normal fall.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

GUNFIRE AND RAINFALL.

In the preparation of the article on pp. 121-126 of the December number the "Iconoclastic Spirit" was too intent upon spectacular effect to be curbed by the cautionary official foot-note as to the considerable effect produced by changes in the distribution of stations. Some years ago a paper, giving the results of 60 years' rainfall on one of our sugar growing islands, was submitted to me. The conclusion arrived at was alarming. The second half of the period showed that the rainfall was double that of the first half! But the earlier records were taken in the relatively dry residential lowlands along the littoral, whereas the later ones were contributed by from two to three times as many observers, most of them in the wet upland regions of the interior. As no attempt was made to weight the records, the annual mean values of the total number of stations, and the diagram representing them, were entirely misleading.

Proverbially, mere figures can be made to prove anything. Mr. Brodie, taking a perspective view, sees only the large foreground figures of 1917, to the exclusion of those at the vanishing point, in 1881. Lieut. Dobson (p. 139), taking a full-face view of the same figures, arrives at conclusions which demolish Mr. Horner's theory. However, the solution of the problem under discussion is not to be determined by pages of vague statements and suggestions about instances of rain falling during or after some cannonading, while completely ignoring the numerous cases of the noisiest actions in the campaign which have been marked by brilliantly fine and dry weather.

What the readers of your Magazine require for their guidance are accounts of actual experiments proving beyond a doubt that under some if not all conditions noise does produce rain. If this cannot be done—all experiments thus far appear to have been hopeless failures —there is no other alternative than to class the theory with that of the angelic origin of rain given at p. 144, which is not only a far simpler, but a much prettier theory.

HY. HARRIES.

January 20th, 1918.

The letters from Mr. D. W. Horner which appeared in the September and November issues of your Magazine (pp. 90, 115), and my article which you were good enough to insert in the December issue, have elicited a volume of criticism, mostly of a decidedly unfavourable character.

(1.) Mr. J. Edmund Clark draws attention to the fact that in the course of the past year heavy falls of rain, causing disastrous floods, were experienced in various parts of the Eastern and Southern Hemispheres, and asks, somewhat triumphantly, whether these occurrences could, with any shadow of reason, be associated with the heavy gunfire in France and in Flanders. The reply is that in our own country the feature in the rainfall has been not so much the occurrence of short lived plumps as an excess of precipitation in what may be described as the Continental regions, extending, with a few notable interruptions, over a period of three years.

(2.) Lieut. Gordon Dobson, after a mild reference to my supposed ignorance of sound statistical methods, produces a table, showing, firstly, the number of quarters in which an excess of rain occurred in England S.E. in war and in peace times; and, secondly, for the same periods, the number of quarters in which there was more rain in the south-eastern than in the north-western district. With the first set of figures little fault can be found. It is true that in the three year period, October, 1909, to September, 1912, the number of wet quarters in England, S.E., was practically as large as in the later period, October, 1914, to September, 1917. But Mr. Dobson loses sight of the fact that in the war period the excess of rain in the east and south-east of England was very much greater than in the peace period. No re-arrangement of the figures is capable of masking this feature, which is, to my mind, of considerable importance. If we assume that Mr. Dobson is dealing simply with the meteorological districts known as England, S.E. and England, N.W., and if we are to understand further that the percentage of the average is the thing to be noted my own results below given differ very materially from those of my critic.

Number of Quarters with more rain in S.E. or N.W. Districts.

	Oct. 1914— March 1916	April 1914— Sept 1917	Total (War)	Oct. 1909— March 1911	April 1911— Sept. 1912	Total (Peace)
Excess in S.E. ...	6	4	10	3	2	5
Excess in N.W. ...	0	1	1	1	3	4
Uncertain ..	0	1	1	2	1	3

(3. Mr. Henry Harries attaches much importance to the fact that although gun practice has been for many years past in frequent progress at Shoeburyness the average rainfall in that locality is smaller than in any other part of the United Kingdom. Does Mr. Harries seriously imagine that, as regards air displacement, any comparison may be fairly drawn between the explosions at Shoeburyness and the heavy firing which is in almost constant operation (even on a fairly quiet day) along the Western Front. In the further communication from Mr. Harries, which appears in this issue of the Magazine reference is made to the possible effect of "noise" as a rain producer. For the expression "noise" I should prefer to substitute "violent concussions, producing air waves of unusual magnitude."

(4.) Mr. W. H. Dines evidently regards the whole question as beneath the notice of any serious meteorologist. His Shakespearian quotation appeals to one's sense of humour, but one cannot help thinking that Mr. Dines could "an he would" afford some real enlightenment on a subject which is scarcely capable of solution in the way suggested by our good friend Hotspur.

(5.) Mr. F. J. Wardale shows that in the distant past when big European wars were happily unknown, it was clearly possible for various sections of the United Kingdom to be affected by an excess of rain extending over a long period. He also draws attention to the fact that for many months together there is often a tendency for incoming barometrical depressions to pursue definite paths, sometimes over one portion and at other times over some other portion of this country. The causes of such tendencies remain a profound mystery, and are a serious stumbling block in the way of those who would venture upon long distance weather forecasting.

The conclusion one forms with regard to the question under issue is that, in the opinions of many of our ablest meteorologists, the impossibility of any connection between gunfire and rainfall is so clearly established that further discussion of the subject would be nothing less than a waste of time. There is, on the other hand, a small but not insignificant minority in whose ranks I prefer, for the moment, to stand, whose minds are still open to conviction on the one side or the other. All doubts upon the matter might, I venture to think, be solved by an enquiry conducted upon the following lines :—

(1.) By procuring from official, or other reliable, sources the dates, upon which the bombardments along the Western Front have been unusually heavy and prolonged.

(2.) By examining carefully the daily weather maps and reports for two or three days prior and for about a week subsequent, to the above dates with a view to discovering :—

(*a.*) Whether the barometrical conditions were distinctly unfavourable to the production of rain, and whether in such cases any material precipitation was reported in our eastern and southern districts.

(*b.*) Whether the conditions were of an indefinite type, whether in such cases any rain fell, and whether it was heavier or more general than might have been expected.

(*c.*) Whether the conditions were of a pronounced rainy type, and whether in such cases the precipitation was heavier than might have been expected.

With regard to (*b.*) and (*c.*) some difficulty would arise owing to the impossibility of estimating correctly the quantity of rain which is likely to occur within any given area under favourable rainfall conditions. Some of our heaviest rains, such for instance as the Norfolk fall of August, 1912, and the Somerset fall of June last, appear to have been wholly unexpected; and in the present state of weather knowledge it seems quite impossible to account satisfactorily either for cloudbursts which are purely local, or for others which cover, as in the cases mentioned, a tolerably wide area.

In spite of such difficulties the enquiry suggested would, in all probability, yield results of a sufficiently decisive character to remove all doubts as to the meteorological effect of gunfire, and in the opinion of many of us such a consummation would fully compensate for the time and trouble involved in the investigation.

FREDK. J. BRODIE.

30 Loxley Road, Wandsworth Common, Feb. 10th, 1918.

COLD OF JANUARY 13th.

On January 13th the thermometer fell to —4° on the low ground near the river. On the lawn 90 feet above it it marked 1°. On April 1st, 1917, it marked —5°, and on the lawn 90 feet higher it was 3°. An interesting point is that an Aucuba bush, about 4 feet high, was badly cut in April. The same bush (what remains of it) is as fresh as can be, which shows the effect when the sap was rising and when the plant was at rest.

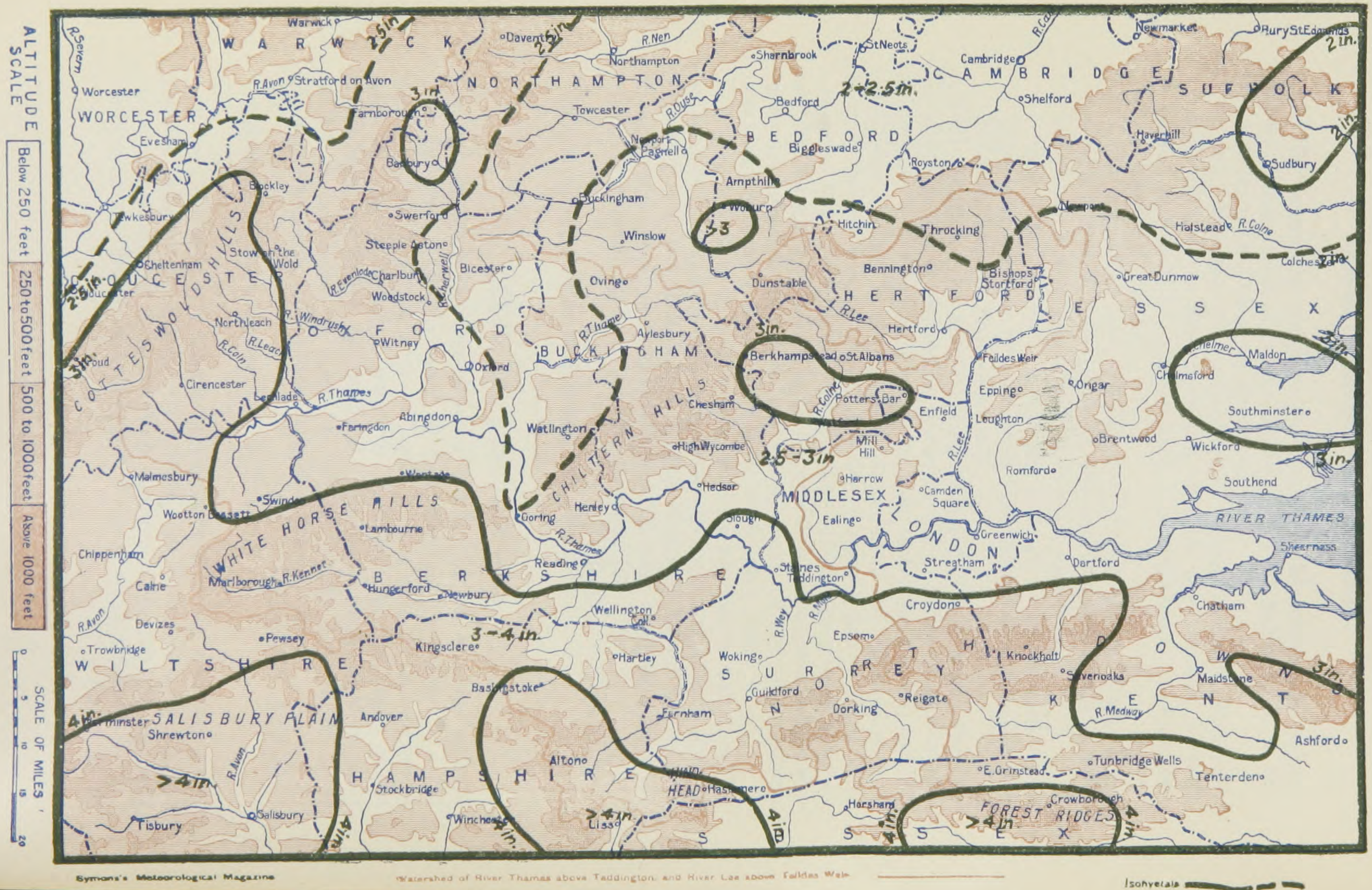
WILLIAM ELLIS.

Bothalhaugh, Morpeth, January 26th, 1918.

Note.—In order to concentrate the interest in the question of the possible influence of gunfire on rainfall, we have left no space this month for a number of interesting matters, including the January meeting of the Royal Meteorological Society, which are held over,

Ed. *S.M.M.*

THAMES VALLEY RAINFALL JANUARY, 1918.



THE WEATHER OF JANUARY.

THE month was cold in its first half, and remarkably mild during the second half. During the cold period comparatively little snow fell. The distribution of barometric pressure about the middle of the month was complex, but during the first ten days pressure was high off the west of Ireland and low over Scandinavia, while in the last ten days of the month the reverse conditions obtained. The mean temperature of the month taking the country as a whole was in close acccordance with the average, but in the north and east of Scotland was a degree and a half under, and in the north-west of England a degree above the average. The lowest temperatures were recorded in Scotland, on the 14th or 15th, the minima in shade falling to —3°, at West Linton, —1° at Eskdalemuir, and 4°, at Balmoral. In England readings under 12° were confined to northern districts; and at Scilly, on the 14th, the lowest was only 39°. The cold in Scotland was quite exceptional, the Dee and the lower reaches of Loch Lomond being frozen for the first time since the memorable frost of 1895. About the 17th a mild south-westerly current spread over the country, and by the 24th or 25th shade maxima exceeding 55° had been recorded at a large number of places, the maximum values being 58°, at London (Westminster), on the 24th, and at Hawarden Bridge on the 25th. As far north as Gordon Castle a value of 56° was reported on the former day.

Bright sunshine was deficient except on the south coast, where there was an average of three hours a day, while the average in the north of Scotland was only half an hour. The south-east of England was relatively sunny with about two hours hours a day. Compared with the average the dullest weather was experienced over Ireland.

The rainfall was in general above the average, the excess being considerable in the south and west parts of the country, Kerry, the Devon-Cornwall peninsula, Kirkcudbright and Wigtown, for example, all having a heavy rainfall. The actual amounts rose to as much as 10 inches at Killarney, 8 inches on Dartmoor, and 11 inches at Shiel, in Kirkcudbright. Slightly larger amounts fell in the normally wet areas where the excess as compared with the average was, however, slight.

The least rainfall, from 1·50 to 2 inches, was recorded in the central Highlands of Scotland, the north Midlands, the Fen district, and in Kings Co. In our map of the Thames Valley the southern portion of a dry area and the northern part of the wet area near the south coast are included. The general fall expressed as a percentage of the average was :—England and Wales, 123 per cent ; Scotland, 104 per cent. ; Ireland, 110 per cent. ; British Isles, 113 per cent.

In London (Camden Square), the mean temperature was 39°·3, or 0·°8, above the average. The duration of bright sunshine was 29·2 hours, and the duration of rainfall, 61·0 hours. Evaporation, ·14 in.

RAINFALL TABLE FOR JANUARY, 1918.

STATION.	COUNTY.	RAINFALL. Aver. 1875—1909. in.	1918. in.	Diff. from Av. in.	Per cent. of Av.	Max. in 24 hours. in.	Date.	No. of Days
Camden Square	*London*	1·83	2·86	+1·03	156	1·23	15	18
Tenterden	*Kent*	2·14	3·21	+1·07	150	1·49	15	19
Arundel (Patching)	*Sussex*	2·59	3·80	+1·21	147	1·58	15	14
Fordingbridge (Oaklands)	*Hampshire*	2·67	4·48	+1·81	168	1·30	15	19
Oxford (Magdalen College)	*Oxfordshire*	1·78	2·74	+ ·96	154	1·26	15	12
Wellingborough (Swanspool)	*Northampn*	1·90	1·62	— ·28	85	·24	14	17
Bury St. Edmunds (Westley)	*Suffolk*	1·70	2·24	+ ·54	132	·95	15	13
Geldeston [Beccles]	*Norfolk*	1·53	2·73	+1·20	179	1·21	15	21
Polapit Tamar [Launceston]	*Devon*	3·59	5·83	+2·24	163	1·51	15	24
Rousdon [Lyme Regis]	,,	2·94	3·92	+ ·98	133	1·57	15	18
Stroud (Field Place)	*Gloucester*	2·33	3·03	+ ·70	130	·75	19	15
Church Stretton	*Shropshire*	...	3·11		..	·51	15	15
Boston	*Lincoln*	1·54	1·68	+ ·14	109	·36	15	19
Worksop (Hodsock Priory)	*Nottingham*	1·70	1·63	— ·07	96	·29	15	15
Mickleover Manor	*Derbyshire*	1·95	2·07	+ ·12	106	·45	19	18
Buxton	,,	4·41	3·91	— ·50	89	·63	9	18
Southport (Hesketh Park)	*Lancashire*	2·55	2·87	+ ·32	113	·79	14	20
Arncliffe Vicarage	*York, W.R.*	6·26	...	...	...	...	...	...
Wetherby (Ribston Hall)	,, ,,	1·89	2·28	+ ·39	121	·62	18	9
Hull (Pearson Park)	,, *E.R.*	1·70	1·82	+ ·12	107	·26	18	17
Newcastle (Town Moor)	*North'land*	1·90	2·73	+ ·83	144	·68	18	16
Borrowdale (Seathwaite)	*Cumberland*	13·44	15·46	+2·02	116	2·95	20	14
Cardiff (Ely)	*Glamorgan*	3·65	4·78	+1·13	131	1·52	18	22
Haverfordwest	*Pembroke*	4·69	4·95	+ ·26	106	·72	17	20
Aberystwyth (Gogerddan)	*Cardigan*	3·91	3·16	— ·75	81	·83	18	16
Llandudno	*Carnarvon*	2·51	2·20	— ·31	88	·71	14	17
Cargen [Dumfries]	*Kirkcudbrt.*	4·10	5·93	+1·83	145	1·50	19	18
Marchmont House	*Berwick*	2·40	2·73	+ ·33	114	·59	19	14
Girvan (Pinmore)	*Ayr*	4·78	5·09	+ ·31	107	·50	9	25
Glasgow (Queen's Park)	*Renfrew*	3·53	4·09	+ ·56	116	1·75	20	15
Islay (Eallabus)	*Argyll*	4·78	4·18	— ·60	88	·49	19	27
Mull (Quinish)	,,	5·55	3·88	—1·67	70	·53	19	25
Balquhidder (Stronvar)	*Perth*	8·74	7·80	— ·94	89	1·87	29	22
Dundee (Eastern Necropolis)	*Forfar*	2·01	2·01	·00	100	·59	19	15
Braemar	*Aberdeen*	2·92	2·02	— ·90	69	·54	22	13
Aberdeen (Cranford)	,,	2·36	2·98	+ ·62	126	·71	22	20
Gordon Castle	*Moray*	1·99	3·21	+1·22	161	·42	22	20
Drumnadrochit	*Inverness*	3·63	3·84	+ ·21	106	·81	21	24
Fort William	,,	9·20	8·55	— ·65	93	2·16	28	26
Loch Torridon (Bendamph)	*Ross*	9·42	11·53	+2·11	122	1·01	28	26
Dunrobin Castle	*Sutherland*	2·75	3·24	+ ·49	118	·70	21	16
Killarney (District Asylum)	*Kerry*	5·94	9·51	+3·57	160	1·47	25	25
Waterford (Brook Lodge)	*Waterford*	3·78	3·87	+ ·09	103	·98	14	17
Nenagh (Castle Lough)	*Tipperary*	3·88	3·39	— ·49	87	·50	18	21
Ennistymon House	*Clare*	4·30	3·26	—1·04	76	·59	25	22
Gorey (Courtown House)	*Wexford*	3·19	4·34	+1·15	136	1·00	14	17
Abbey Leix (Blandsfort)	*Queen's Co.*	3·15	2·68	— ·47	85	·64	14	19
Dublin (FitzWilliam Square)	*Dublin*	2·14	1·60	— ·54	75	·35	18	15
Mullingar (Belvedere)	*Westmeath*	3·10	2·88	— ·22	93	·86	17	15
Crossmolina (Enniscoe)	*Mayo*	5·35	6·10	+ ·75	114	1·03	17	27
Cong (The Glebe)	,,	4·79	5·94	+1·15	124	1·38	17	23
Collooney (Markree Obsy.)	*Sligo*	3·87	4·57	+ ·70	118	1·10	17	26
Seaforde	*Down*	3·41	4·98	+1·57	146	1·05	19	21
Ballymena (Harryville)	*Antrim*	3·73	3·67	— ·06	98	·35	8	25
Omagh (Edenfel)	*Tyrone*	3·46	2·86	— ·60	83	·43	18	24

SUPPLEMENTARY RAINFALL, JANUARY, 1918.

Div.	STATION.	Rain inches.	Div.	STATION.	Rain inches.
II.	Warlingham, Redvers Road	3·62	XI.	Lligwy	3·76
,,	Ramsgate	2·73	,,	Douglas, Isle of Man	.
,,	Hailsham	3·99	XII.	Stoneykirk, Ardwell House	4·07
,,	Totland Bay, Aston House	2·93	,,	Carsphairn, Shiel	11·01
,,	Stockbridge, Ashley	3·75	,,	Langholm, Drove Road	6·81
,,	Grayshott	4·11	XIII.	Selkirk, The Hangingshaw	3·80
III.	Harrow Weald, Hill House	2·56	,,	North Berwick Reservoir	2·11
,,	Pitsford, Sedgebrook	2·36	,,	Edinburgh, Royal Observaty.	2·03
,,	Woburn, Milton Bryant	3·29	XIV.	Biggar	2·37
,,	Chatteris, The Priory	1·84	,,	Maybole, Knockdon Farm	3·77
IV.	Elsenham, Gaunts End	2·91	XV.	Buchlyvie, The Manse	6·20
,,	Shoeburyness	2·74	,,	Ardgour House	12·97
,,	Colchester, Hill Ho., Lexden	2·56	,,	Oban	5·47
,,	Ipswich, Rookwood, Copdock	2·50	,,	Campbeltown, Witchburn	4·75
,,	Aylsham, Rippon Hall	2·02	,,	Holy Loch, Ardnadam	10·10
,,	Swaffham	2·46	,,	Tiree, Cornaigmore	2·53
V.	Bishops Cannings	3·14	XVI.	Glenquey	6·30
,,	Weymouth	3·18	,,	Glenlyon, Meggernie Castle	...
,,	Ashburton, Druid House	6·86	,,	Blair Atholl	1·51
,,	Cullompton	5·44	,,	Coupar Angus	1·90
,,	Lynmouth, Rock House	5·78	,,	Montrose, Sunnyside Asylum.	2·02
,,	Okehampton, Oaklands	6·81	XVII.	Balmoral	3·18
,,	Hartland Abbey	4·85	,,	Fyvie Castle	5·01
,,	St. Austell, Trevarna	4·97	,,	Keith Station	4·29
,,	North Cadbury Rectory	3·30	XVIII.	Rothiemurchus	2·57
VI.	Clifton, Stoke Bishop	3·63	,,	Loch Quoich, Loan	13·30
,,	Ledbury, Underdown	2·42	,,	Skye, Dunvegan	7·20
,,	Shifnal, Hatton Grange	1·77	,,	Fortrose	3·28
,,	Droitwich	2·22	,,	Glencarron Lodge	7·08
,,	Blockley, Upton Wold	3·18	XIX.	Tongue Manse	4·17
VII.	Grantham, Saltersford	1·52	,,	Melvich	3·35
,,	Market Rasen	1·66	,,	Loch More, Achfary	6·95
,,	Bawtry, Hesley Hall	1·22	XX.	Dunmanway, The Rectory	7·76
,,	Whaley Bridge, Mosley Hall	3·16	,,	Glanmire, Lota Lodge	4·70
,,	Derby, Midland Railway	1·70	,,	Mitchelstown Castle	4·33
VIII.	Nantwich, Dorfold Hall	1·86	,,	Darrynane Abbey	6·08
,,	Bolton, Queen's Park	3·72	,,	Clonmel, Bruce Villa	3·66
,,	Lancaster, Strathspey	4·14	,,	Broadford, Hurdlestown	3·62
IX.	Langsett Moor, Up. Midhope	3·11	XXI.	Enniscorthy, Ballyhyland	3·55
,,	Scarborough, Scalby	2·27	,,	Rathnew, Clonmannon	3·73
,,	Ingleby Greenhow	1·89	,,	Ballycumber, Moorock Lodge	2·12
,,	Mickleton	3·90	,,	Balbriggan, Ardgillan	2·65
X.	Bellingham, High Green Manor	4·08	,,	Castle Forbes Gardens	3·38
,,	Ilderton, Lilburn Cottage	2·76	XXII.	Ballynahinch Castle	6·34
,,	Keswick, The Bank	7·05	,,	Woodlawn	2·40
XI.	Llanfrechfa Grange	4·24	,,	Westport, St. Helens	5·05
,,	Treherbert, Tyn-y-waun	8·73	,,	Dugort, Slievemore Hotel	5·13
,,	Carmarthen, The Friary	5·60	XXIII.	Enniskillen, Portora	4·14
,,	Fishguard, Goodwick Station.	4·50	,,	Dartrey [Cootehill]	3·19
,,	Crickhowell, Tal-y-maes	4·50	,,	Warrenpoint, Manor House	3·12
,,	New Radnor, Ednol	2·60	,,	Belfast, Cave Hill Road	4·72
,,	Birmingham WW., Tyrmynydd	6·18	,,	Glenarm Castle	3·85
,,	Lake Vyrnwy	5·28	,,	Londonderry, Creggan Res.	3·19
,,	Llangynhafal, Plas Drâw	1·99	,,	Dunfanaghy, Horn Head	...
,,	Dolgelly, Bryntirion	4·72	,,	Killybegs	4·07
,,	Bettws-y-Coed, Tyn-y-bryn	...			

Climatological Table for the British Empire, August, 1917.

STATIONS. (Those in italics are South of the Equator.)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain Depth.	Total Rain Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	80·5	22	49·6	20	71·4	55·6	55·8	83	131·3	47·6	3·99	23	7·3
Malta	93·6	30	69·5	12	87·0	74·5	...	74	143·0	...	·00	0	0·5
Lagos	89·0	1	70·5	3	82·5	72·9	73·1	86	147·2	69·0	22 77	28	9·0
Cape Town	72.4	18	38·4	26	62·4	46·6	45·9	73	...	...	2·15	13	5·3
Johannesburg	68·5	6	28·6	9	58·7	39·6	36·0	73	...	30·1	2·57	10	3·2
Mauritius	76·3	29	54·0	22	74·0	61·6	58·5	75	...	·96	2·60	24	6·4
Bloemfontein	74·7	4	24·1	3	60·4	34·9	34·7	70	..	...	1·96	10	4·5
Calcutta...	91·7	22	75·6	13	87·8	78·7	77·7	86	...	74·1	14·27	18	8·9
Bombay...	87·7	18	73·4	15	83·6	77·1	76·4	88	133·5	71·1	33·27	28	9·0
Madras	98·3	2	73·7	29	92·1	77·1	74·5	79	161·5	73·1	6·39	18	6·1
Colombo, Ceylon ...	87·8	2	73·7	26	85·4	76·9	73·0	80	153·2	68·0	2·28	14	7·9
Hongkong	90·5	29	74·4	14	87·2	78·3	76·2	83	...	...	11·95	14	5·5
Sydney	70·2	30	40·1	2	62·0	46·8	42·7	69	119·2	29·2	2·04	11	3·2
Melbourne	67·6	28	33·0	5	59·2	44·6	43·3	68	115·6	25·9	2·25	13	5·5
Adelaide	74·3	9, 17	37·7	26	62·0	45·6	44·9	70	127·9	28·1	3·04	14	4·9
Perth	73·6	25	36·3	10	62·3	46·6	45·9	70	131·2	31·4	4·56	14	5·3
Coolgardie	77·2	27	31·8	18	63·0	41·0	35·8	51	135·8	27·0	·63	6	3·6
Hobart, Tasmania ..	64·0	10	35·8	6	56·9	41·9	39·0	64	113·4	29·2	2·30	15	5·5
Wellington ...	60·3	25	34·4	21*	55·4	43·9	43·4	79	122·5	25·0	3·94	15	5·5
Auckland	...	..	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston ..	91·8	25	70·5	25	89·7	73·3	71·2	80	...	...	1·15	6	5·2
Grenada	89·0	30	71·0	5, 24	85·0	75·0	...	78	138·0	...	10·58	23	4·0
Toronto	92·0	1	46·0	31	77·7	57·7	58·7	81	141·8	40·2	4·44	12	5·8
Fredericton	91·0	2	44·0	27	78·1	56·7	61·1	83	...	...	7·20	13	5·7
St. John, N.B. ...	84·0	7	50·0	27	70·5	55·9	58·0	85	141·2	45·9	4·34	16	6·4
Victoria, B.C.	82·0	31	49·0	5, 8	69·2	51·6	52·0	76	134·8	39·0	·19	1	1·9

* And 27.

Johannesburg.—Bright sunshine 258·[illegible] hours.

COLOMBO, CEYLON.—Mean temp. 81°·1, same as average, dew point 0°·6 below, average and R ·40 in. below average. Mean hourly velocity of wind 5·6 miles.

HONGKONG.—Mean temp. 82°·0. Bright sunshine 239·6 hours. Mean hourly velocity of wind 7·4 miles.

Melbourne.—Mean temp. 0°·8 above, and R ·45 in. above, averages. A remarkable meteoric display on the 20th. Fine aurora australis on the 9th at 7 p.m.

Adelaide.—Mean temp. 0°·1 below, and R ·54 in. above, averages.

Coolgardie.—Temp. 1°·7 below average.

Hobart.—Magnificent aurora australis on the 9th.

Wellington.—Mean temp. 1°·2 above and rainfall ·56 in. below averages. Bright sunshine 148·1 hours. Frost on 10 days. Cloudy and showery month.

Symons's Meteorological Magazine.

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THE SHOWER CLOUD BLACK LINES.

By L. C. W. Bonacina.

All who study the clouds from either the artistic or scientific point of view, or from both, as everyone should, must be familiar with the characteristic dark stripes or streaks which appear beneath detached cloud-masses from which rain is falling. To the shepherd on the solitary hills, accustomed to take long-range views, the phenomenon, indeed, must be as familiar as any in the skies ; but it can scarcely be less famliar among the ordinary phenomena of nature to any one who lives in the more open districts of London, and who examines the sky for other sights than air-craft. The appearance is most sharply defined in the case of clouds nearer the horizon than the zenith, and it is essentially characteristic of broken showery conditions of weather. It is not conspicuous against the uniform grey sky of a set-in wet day, for the reason, apparently, that on an overcast day there is not the contrast between light and shadow which is necessary in order that the raindrops may be sharply silhouetted against the background of the sky. But on a showery day with varied skies the drops may be shown up in the manner described either against the background of the cloud from which they are falling, or against clear sky appearing beneath the cloud. It is not a little surprising that a phenomenon so common in this showery climate should be so seldom referred to in literature—the more so on account of its utility as an index of falling rain at a distance.

There are a number of cloudy days in the year when it is very difficult from an inspection of the sky to tell definitely whether the tendency is showery or not. But if in any quarter of the sky you see a cloud from whose base these black lines are pendent you may say at once : "Rain is falling from that cloud"—which means, of course, that showers are about, and that it is highly probable you will experience one locally before the day is over. The association of these black lines with showery conditions is invariable, and that they are falling rain-drops shown up against the background of the sky cannot be doubted.

ROYAL METEOROLOGICAL SOCIETY.

THE annual general meeting of this Society was held on Wednesday, 16th instant, at Caxton Hall, Westminster, Major H. G. Lyons, F.R.S., President, in the Chair.

The Report of the Council for 1917 was read, and the Symons Memorial Medal, which is awarded biennially for distinguished work in connection with Meteorological Science, was presented to Dr. H. R. Mill, Director, British Rainfall Organization. The following officers were elected for the ensuing session :—*President*—Sir Napier Shaw, F.R.S. ; *Vice-Presidents*—Mr. T. W. Backhouse, Major Lyons, F.R.S., Mr. Henry Mellish, C.B., Captain A. J. Walker ; *Treasurer*—Mr. Francis Druce ; *Secretaries*—Mr. W. W. Bryant, Mr. W. Vaux Graham, M.Inst.C.E. ; *Foreign Secretary*—Mr. R. G. K. Lempfert, C.B.E. ; *Councillors*—Mr. C. E. P. Brooks, Prof. C. M. Delgado de Carvalho, Captain C. J. P. Cave, R.E., Mr. J. Edmund Clark, Mr. J. S. Dines, Mr. W. H. Dines, F.R.S., Captain G. M. B. Dobson, Mr. R. H. Hooker, Mr. Carle Salter, Major G. I. Taylor, R.F.C., Prof. H. H. Turner, F.R.S., Mr. F. J. W, Whipple.

Major H. G. Lyons delivered an address on " The Meteorological Resources of the Empire," in the course of which he remarked that in many directions steps are being taken to take stock of the resources of the Empire, and to plan how these may best be utilized in the general reconstruction which must undoubtedly be taken in hand on the cessation of hostilities. In meteorology the same should be done, for within the Empire we may meet every type of climate. The great Oversea Dominions, India, the colonies and especially the oceanic islands, not only afford the means for extending our knowledge of the direction and velocity of the currents of the upper air, to meet the demands of aviation, which will become greater in the near future, but with a very moderate increase in the resources of their existing institutions, and more active co-operation, they may powerfully aid in the solution of many meteorological problems of theoretical and practical importance.

In all countries where there is a meteorological service the network of climatological stations is controlled by one or more First Order Stations, but none as yet exist in the great colonial regions of East Africa, West Africa, or in the West Indian Islands, though there are eighteen institutions of this class in other parts of the Empire.

Nor is the study of a single region sufficient in itself. India, in preparing the Monsoon forecast, draws upon data from Egypt, St. Helena, temperate South America, etc. ; Egypt, in forming each year an estimate of the coming Nile flood utilizes information from India, Uganda, the South Atlantic, and so on. The West India

Islands need warnings of their hurricanes from the more eastward islands of their archipelago, and must utilize all that Asia and Africa can tell them about the development and movement of tropical storms before their precautions can be considered to have exhausted all the means available. All lands which lie near the sub-tropical zones of scanty rainfall are vitally interested in the problems of forecasting the probable sufficiency or failure of their rainy season. Within the limits of the Empire there are already over 1,000 climatological stations, ranging in latitude from 66° N. to 54° S. and embracing all varieties of climate, insular, continental and mountain.

The Address concluded with a plea for the more efficient organization of the available meteorological resources of the Empire, and a hope was expressed that a career might be available for some of the large number of trained meteorologists whom present needs had created.

At the conclusion of the meeting Sir Napier Shaw, F.R.S., took over the duties of President.

The following gentlemen were elected fellows :—Dr. Thomas Agius, Capt. H. Bathurst, Mr. F. L. Bland, Mr. L. C. W. Bonacina, Major J. Shipley Ellis, Rev. W F. A. Ellison, M.A., Mr. F. J. Gurney, Mr. A. J. Kelley, Mr. Elliott Kitchener, Mr. W. D. Lewis, Mr., H. Lowery, Capt. S. W. Price-Williams, Mr. J. Sherwen.

THE usual monthly meeting of this Society was held on February 20th, Sir Napier Shaw, F.R.S., President, in the Chair.

A paper by Mr. F. A. Bellamy, on "The Barometer Record at the Radcliffe Observatory, Oxford, with special reference to Professor Turner's suggested discontinuities," was read. Professor Turner has in several papers to the Royal Meteorological Society claimed that meteorological history is divisible into "chapters" of an average length of six and a half years each, and has assigned the dates at which a new "chapter" opens (when there are abrupt discontinuities in meteorological phenomena) with considerable precision for the last two centuries. The evidence has hitherto been based upon the monthly values of rainfall and temperature, and he has shown that these monthly values differ systematically in the "even" chapters as compared with the "odd." To examine whether such systematic differences extended to periods shorter than one month Mr. Bellamy has analysed a series of 62 years daily barometer records. He collected all those records into daily groups and formed the means of the differences between "even and odd chapters" for corresponding days; these were in many cases quite large, but apparently no larger than similar arbitrary differences for any chance selection of years that was made. Only one such arbitrary selection was used for comparison, but it is probably sufficient to substantiate that statement. Proceeding now to combine two consecutive days together, then three such days and so on in groups of 6 up to 180 days, Mr. Bellamy found that the differences between corresponding groups of even minus odd still remained "accidental" in character until the number of days combined reached about 30; but from this point the even minus odd set began to show an excess which gradually increased until the differences became twice as great. The inference is that for periods from one to six months there is a decided difference in the even and odd chapters for atmospheric pressure, even for one station, as has been shown for rainfall and temperature from many stations, and that the existence of discontinuities is supported.

Dr. C. Chree, F.R.S., read a paper entitled "The Diurnal Variation of Barometric Pressure at Seven British Observatories, 1871–1882." The diurnal variation of atmospheric pressure, as of any other element, can be analysed in Fourier terms or "waves," of periods 24, 12, 8 hours. In the case of the mean diurnal variation from all months of the year combined, the 12-hour wave appears of a very dominant character, the amplitude being nearly the same for all stations in the same latitude, and the phase referred to local mean time being everywhere nearly the same. The 24-hour wave on the other hand is very variable and the 8-hour wave small compared with the 12-hour wave. Taking the seven stations, Valencia, Armagh, Glasgow, Aberdeen, Stonyhurst, Falmouth and Kew, it is pointed out that the comparative unimportance of the 8-hour wave in the mean diurnal inequality for the year arises in great measure from the large difference that presents itself between the phase angles in two different seasons of the year. In individual months the 8-hour wave, though considerably smaller than the 12-hour wave, is far from negligible, and the phenomena presented by the 8-hour wave at the seven British stations exhibit almost as close a similarity as those presented by the 12-hour wave. The paper also considered a theory as to the nature of the 12-hour wave recently advanced by Dr. G. C. Simpson. It discussed the theory from the point of view of the variation in the phenomena throughout the year, and showed how some of Dr. Simpson's mathematical expressions can be put in a simpler form of sufficient accuracy in the case of stations in low or middle latitudes.

The following candidates were elected Fellows of the Society :— Mr. Harry Lander, Mr. Edgar Lyman, Mrs. H. Edith Purchas.

SCOTTISH METEOROLOGICAL SOCIETY.

In a paper on "Some cases of Ground-ice and the meteorological conditions that determined them," read on December 20th, at the Annual General Meeting of the Society, Mr. Watt noted that towards the end of January, 1917, various water-supply systems were seriously affected by the formation of "ground-ice," though interruptions from that cause had not previously been experienced even during longer and more severe spells of cold. Occurrences at some of the Greenock reservoirs and at Lochrutton Loch, near Dumfries, had been especially noteworthy. The weather had been for some three weeks before not only very cold but continously rather stormy, with north-easterly winds, so that there had been an unusually thorough mixing of the waters of lakes and reservoirs, comparable with that obtaining in running waters. In these circumstances there would be a quite unusual cooling of the whole mass of water, whilst waves or wavelets prevented the formation of a protective surface ice-sheet. In comparatively quiet anticyclonic weather, such as characterised a frost such as that of January and February, 1895, "ground-ice" formed only in running streams. The researches some eighty years ago of the Rev. James Farquharson, F.R.S., of Alford, seemed to indicate that radiation from the floor of a stream was the determining factor in the formation of "ground-ice." There was also "Frazil-ice," which appeared in the form of little spicules on the surface of running water.

Dr. John Aitken, F.R.S., in a paper on "Ground-ice," communicated the results of some experiments which showed that "Ground-ice" was really made up of crystals of "Frazil-ice" which had been carried away by the stream and had come in contact with and adhered to the stones and rocks in the bed of the stream. Farquharson's radiation theory could hardly be a sufficient explanation of the formation of "Ground-ice" as water must be cooled some degrees below 32° F. before it can freeze, unless there be ice present, and the bottom of a river was never likely to be cooled much below 32° F. with water flowing over it. Moreover, "Ground-ice" was of a soft and spongy character and not clear and solid as it would have been if formed *in situ*. The spicules of "Frazil-ice" might or might not adhere to obstacles in the stream and the part played by radiation from the river bed seemed to be to help to cool the stones and rocks sufficiently to prevent the spicules slipping when they came in contact with them. If the temperature of the water was rising and the ice beginning to melt, the ice slipped over an obstacle, but with a falling temperature it adhered to it.

NOTE !—Summer Time commences Sunday, 24th March.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

COLD DECEMBER DAYS IN AMERICA.

DECEMBER, 1917, was one of the most remarkable months in meteological records in the eastern section of the United States. During the last three days of the year intensely cold weather prevailed. Subjoined are temperatures for the three days at Philadephia :—

	Max.	Min.	Mean.	Below Normal.
	°	°	°	°
Dec. 29th	10	2	6	27
,, 30th	8	-4	2	31
,, 31st	11	0	5	28

These are from standard thermometers exposed in a weather bureau instrument shelter. The high barometer that dominated the weather was above thirty-one inches over the north-west.

C. DECKER.

2330 S. 21st Street, Philadelphia, U.S.A.

THE RAINFALL OF HAVANA AND ENGLAND, SOUTH-WEST.

THE rainfall data for Havana, Cuba, for the rainy season May-October, 1917, have now been received. The figures show only 57 per cent. of the average fall for these months, and, with one exception, the rainfall at Havana during the wet season has been deficient each year since 1911.

Previous notes have shown the connection between the rainfall at Havana during May-October, and the subsequent amount registered in England, South-west, during January-March following. the correlation co-efficient being —·54 and the probable error ·08

The rainfall of Havana for 1917 being so much below the average suggests copious precipitation in England, South-west, during January-March of the present year, but in 1916 the Havana figures also indicated a similar result and the amount recorded was only 69 per cent. of the average. In view of the complete failure of last year's indication faith in the correlated connection between the two districts is distinctly shaken, and it will be interesting to see if last year was the exception that proves the rule. Perhaps the believers in the rain-producing effect of gun-fire will urge that the heavy precipitation normal to the western districts of this country has been diverted to the eastern counties ?

January 7th, 1918. A. HAMPTON BROWN.

THE SQUALL OF NOVEMBER 25th, 1917.

WHEN I wrote on this subject in the last number I had not examined the instrumental records for the London district, and from casual eye observation was under the impression that the squall took place in a cold N.W. current of more or less uniform temperature. But through the kindness of Mr. Bryant of Greenwich Observatory I have obtained sufficient instrumental information to show that the squall was marked by a sudden shift of wind to a still colder quarter, and that it can, therefore, be easily enough explained in the ordinary way.

There were in fact two squalls that morning. The first passed over Greenwich soon after 4 a.m., with a shift of wind from W.S.W. to W.N.W., and sudden drop of temperature. The second (which caught me whilst out at Hampstead) passed over Greenwich about 11.30 a.m., with wind-shift from W.N.W. to N.N.W. and greater fall in temperature than on the first occasion. Hence there was a succession of cold "douches" from more northerly points of the compass, and I have little doubt that cartographic investigation for the morning in question would confirm the passage across the country of minor line-squalls in connection with the juxta-position of air currents of different temperatures. Out walking I was not sufficiently alert to notice that the wind had shifted a couple of points, and, of course, temperature changes cannot be accurately judged.

L. C. W. BONACINA.

February 3rd, 1918.

WARM FEBRUARY.

DURING my readings of temperature here only four times in the past thirty-two years has the February mean maximum been higher than that of February, 1918. Only once has the mean minimum of February been higher than that of February, 1918, and only twice has the maximum and minimum combined been higher than that of February, 1918. The following table gives the data for the years referred to :—

	Max.	Min.	Mean.
February, 1899	48·4	37·7	43·1
1903	48·1	40·5	44·3
1910	47·8	39·0	43·4
1914	48·6	41·4	45·0
1918	47·4	40·7	44·0

JOHN DOVER.

Totland Bay, Isle of Wight, 1st March, 1918.

EXCEPTIONAL DRYNESS OF NOVEMBER AND DECEMBER—A COMPARISON.

The rainfall for November and December has been so exceptionally small for that period that I think the figures are sufficiently interesting to quote, therefore I give below a table of the rainfall for November and December of each year since 1911 :—

	1911.	No. of Wet days.	1912.	No. of Wet days.	1913.	No. of Wet days.	1914.	No. of Wet days.	1915.	No. of Wet days.	1916.	No. of Wet days.	1917.	No. of Wet days
Nov.	5·05	19	2·37	17	3·38	18	4·60	19	3·59	8	4·50	20	1·00	11
Dec.	8·69	27	4·62	23	2·04	12	10·46	26	9·52	25	4·39	18	1·08	8
	13·74	46	6·99	40	5·42	30	15·06	45	13·11	33	8·89	38	2·08	19

The scanty rainfall during the past two months is undoutbedly due to the prevalence of N.W.-N.E. winds which have been particularly common lately. S. HYLA GREVES.

Rodney House, Bournemouth, January 4th, 1918.

REMARKABLE LOWNESS OF STREAMS IN DEVON.

Although we had anything but a fine summer and have had no absolute or partial droughts, yet streams in this neighbourhood are lower than they have been for years. This substantiates the fact that summer rains do not affect springs as winter rains or snow do, as in this locality, although last winter was severe, there was very little snow, and this winter seems likely to follow suit, the heavy snowfalls in the eastern and midland counties not reaching this part of England. D. W. HORNER, F.R.Met.Soc.

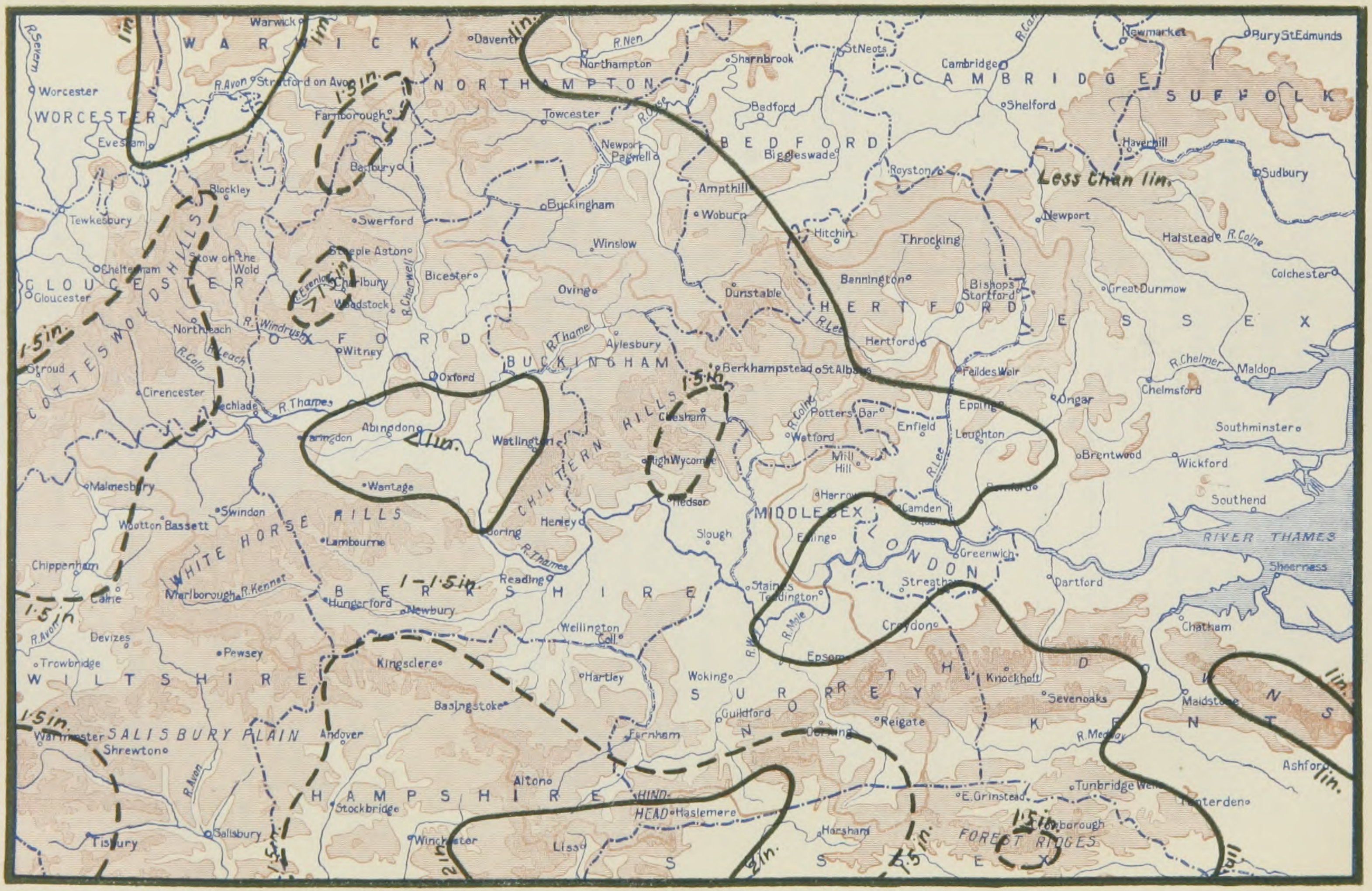
Moretonhampstead, January 4th, 1918.

PROTECTIVE POWER OF SNOW.

The following observation shows the remarkable extent to which a covering of snow protects the ground and plant life from intense cold. About 6 p.m. on the 13th January, a minimum thermometer was placed on the ground in the centre of my lawn here, the temperature then being only a few degrees below freezing. Snow then fell to the depth of one and a half inches. At 11 p.m. the snow had ceased falling and it was a bright starlight night, and very cold. A second minimum thermometer was then placed on the top of the snow. No more snow fell in the night. In the morning the two thermometers recorded the following minimum temperatures :—On the top of the snow, 2° below zero ; under the snow, 24°, or a difference of 26°. A. R. CROSSLEY.

Falling Royd, Hebden Bridge, 2nd February, 1918.

THAMES VALLEY RAINFALL FEBRUARY, 1918.



ALTITUDE SCALE

Below 250 feet	250 to 500 feet	500 to 1000 feet	Above 1000 feet

SCALE OF MILES 0 5 10 15 20

Watershed of River Thames above Teddington, and River Lee above Feildes Weir.

Isohyets

THE WEATHER OF FEBRUARY.

By F. J. Brodie.

Owing to prevalence of wind from south and west the mean temperature was considerably above the average, both in the daytime and at night.

During the first week the British Isles lay between a large anticyclone over central Europe and a series of depressions moving northwards along our Atlantic seaboard. Southerly winds prevailed generally, and the weather was mild and changeable, maximum temperatures slightly above 55° being recorded on the 4th and again on the 7th in several parts of England. After about the 5th the anticyclone drifted slowly southwards to the Mediterranean. This change was accompanied in our islands by a gradual veering of the wind, first to S.W., and afterwards to W., but temperature remained high, the maximum readings of the 10th-12th being again above 55° at many stations in England and Ireland. The Atlantic depressions pursued in the meantime, an easterly course, between Iceland and Scotland, and the wind on our western and northern coasts occasionally rose to the force of a gale. On the 12th and 13th the weather became dull and gloomy and fog prevailed extensively over our eastern districts. After the 13th a new anticyclone extended westward over Great Britain, a light breeze from S. and S.E. set in, and temperature fell decidedly. Between the 14th and 17th sharp night frosts were in fact experienced, the temperature falling to 20° in the east centre and south of England, while the grass temperature reached 9° on the 17th at Wisley, and at Raunds. After the 17th a high-pressure system extended northwards from the Azores region, and between the 20th and 26th, when depressions passed from Greenland to Scandinavia, a mild westerly breeze of increasing strength set in over our islands, and temperature again rose considerably above the average. The warmest weather occurred on the 22nd or 23rd, reaching 60° at Geldeston, and 61° at Aberdeen, the latter a reading exceeded once only at Aberdeen during 50 years, 64° having been observed on the 22nd of the month in 1897.

On the 27th, in the rear of one of the northern disturbances, a secondary depression was developed near the Faeroe, and on the following day, when this system moved southwards over the North Sea, a northerly gale sprang up over nearly the whole of the United Kingdom, and blew with great strength on our north and north-west coats. At Holyhead the wind reached, in gusts, a velocity of 72 miles, and at Aberdeen, 74 miles per hour. Snow fell heavily in the north, and sleet or hail in all other districts. and on the 28th the thermometer in many places failed to reach a maximum of 40°.

Over the United Kingdom as a whole the total duration of bright sunshine in February was below the normal, and in the west little more than one half. In the London district, the average was slightly exceeded. At Kew the duration for December to February was 178 hours, being 37 more than the average.

The only part of the British Isles with appreciably less than the average rainfall was in the south of England, and in the extreme south-east little more than half the average fell, less than 1·00 in. being recorded from Cromer to Beachy Head. The fall increased towards the west, and exceeded 5 inches over all elevated regions, except in Devonshire, and 10 inches over considerable areas in Wales and Scotland. Nearly twice the average fell in the West Highlands and in the north of Ireland. The general rainfall expressed as a percentage of the average, was :—England and Wales, 107, Scotland, 159, Ireland, 166, British Isles, 140 per cent.

In London (Camden Square), the mean temperature was 43°·4, or 3°·7 above the average. The duration of bright sunshine was 38·9 hours, and the duration of rainfall, 25·3 hours. Evaporation, ·27 in.

RAINFALL TABLE FOR FEBRUARY, 1918.

STATION.	COUNTY.	RAINFALL. Aver. 1875—1909. in.	1918. in.	Diff. from Av. in.	Per cent. of Av.	Max. in 24 hours. in.	Date.	No. of Days
Camden Square	*London*	1·66	1·11	— ·55	67	·25	24	16
Tenterden	*Kent*	1·90	·89	—1·01	47	·21	24	14
Arundel (Patching)	*Sussex*	2·17	1·10	—1·07	51	·24	24	11
Fordingbridge (Oaklands)	*Hampshire*	2·34	1·99	— ·35	85	·35	8	18
Oxford (Magdalen College)	*Oxfordshire*	1·62	1·00	— ·62	62	·15	5	12
Wellingborough (Swanspool)	*Northampn*	1·70	1·12	— ·58	66	·18	2,6	15
Bury St. Edmunds (Westley)	*Suffolk*	1·59	·92	— ·67	58	·20	12	11
Geldeston [Beccles]	*Norfolk*	1·41	·75	— ·66	53	·13	24	13
Polapit Tamar [Launceston]	*Devon*	2·95	2·82	— ·13	96	·38	2	19
Rousdon [Lyme Regis]	,,	2·50	1·71	— ·79	68	·36	8	16
Stroud (Field Place)	*Gloucester*	2·12	1·48	— ·64	70	·24	24	16
Church Stretton	*Shropshire*	...	2·33	...	..	·59	9	17
Boston	*Lincoln*	1·53	1·57	+ ·04	103	·47	9	18
Worksop (Hodsock Priory)	*Nottingham*	1·64	1·35	— ·29	82	·30	9	16
Mickleover Manor	*Derbyshire*	1·71	1·98	+ ·27	116	·57	10	17
Buxton	,,	4·01	5·96	+1·95	149	1·24	6	21
Southport (Hesketh Park)	*Lancashire*	2·07	2·89	+ ·82	140	·56	20	18
Arncliffe Vicarage	*York, W.R.*	4·88	6·75	+1·87	138	...	...	...
Wetherby (Ribston Hall)	,, ,,	1·71	2·64	+ ·93	154	·53	9	14
Hull (Pearson Park)	,, *E.R.*	1·78	1·66	— ·12	93	·33	9	17
Newcastle (Town Moor)	*North'land*	1·63	1·26	— ·37	77	·20	20	14
Borrowdale (Seathwaite)	*Cumberland*	10·96	20·56	+9·60	187	4·45	21	25
Cardiff (Ely)	*Glamorgan*	3·07	2·04	—1·03	66	·27	2	22
Haverfordwest	*Pembroke*	3·42	2·98	— ·44	87	·78	6	20
Aberystwyth (Gogerddan)	*Cardigan*	3·09	4·17	+1·08	135	·83	6	21
Llandudno	*Carnarvon*	2·11	2·74	+ ·63	130	·69	6	20
Cargen [Dumfries]	*Kirkcudbrt.*	3·42	5·56	+2·14	163	·73	10	25
Marchmont House	*Berwick*	2·15	2·31	+ ·16	107	·33	28	19
Girvan (Pinmore)	*Ayr*	3·87	6·37	+2·50	165	·98	17	25
Glasgow (Queen's Park)	*Renfrew*	2·70	4·71	+2·01	174	·74	22	24
Islay (Eallabus)	*Argyll*	3·91	6·20	+2·29	159	1·08	18	25
Mull (Quinish)	,,	4·45	9·32	+4·87	209	1·14	17	26
Balquhidder (Stronvar)	*Perth*	6·33	13·13	+6·80	207	1·96	21	25
Dundee (Eastern Necropolis)	*Forfar*	1·91	1·95	+ ·04	102	·35	27	22
Braemar	*Aberdeen*	2·55	4·20	+1·65	165	·80	27	21
Aberdeen (Cranford)	,,	2·36	1·39	— ·97	59	·32	12	13
Gordon Castle	*Moray*	1·95	1·58	— ·37	81	·28	27	14
Drumnadrochit	*Inverness*	2·89	4·22	+1·33	146	·57	21	25
Fort William	,,	6·85	13·14	+6·29	192	1·48	23	26
Loch Torridon (Bendamph)	*Ross*	7·53	14·19	+6·66	188	1·19	17	27
Dunrobin Castle	*Sutherland*	2·58	3·00	+ ·42	116	·57	24	16
Killarney (District Asylum)	*Kerry*	4·99	7·47	+2·48	150	·94	18	26
Waterford (Brook Lodge)	*Waterford*	3·18	3·83	+ ·65	120	·44	1	23
Nenagh (Castle Lough)	*Tipperary*	2·89	5·72	+2·83	198	·95	18	24
Ennistymon House	*Clare*	3·44	4·74	+1·30	138	·58	17	23
Gorey (Courtown House)	*Wexford*	2·75	3·50	+ ·75	127	·63	16	23
Abbey Leix (Blandsfort)	*Queen's Co.*	2·55	4·70	+2·15	184	·74	18	23
Dublin (FitzWilliam Square)	*Dublin*	1·93	1·90	— ·03	98	·29	17	21
Mullingar (Belvedere)	*Westmeath*	2·67	4·04	+1·37	151	·67	11	23
Crossmolina (Enniscoe)	*Mayo*	4·20	7·10	+2·90	169	1·04	17	26
Cong (The Glebe)	,,	3·72	6·74	+3·02	181	1·17	17	25
Collooney (Markree Obsy.)	*Sligo*	3·20	6·17	+2·97	193	·73	17	26
Seaforde	*Down*	2·81	4·49	+1·68	160	·76	18	23
Ballymena (Harryville)	*Antrim*	2·99	5·36	+2·37	179	1·31	18	24
Omagh (Edenfel)	*Tyrone*	2·68	5·13	+2·45	191	·75	18	26

SUPPLEMENTARY RAINFALL, FEBRUARY, 1918.

Div.	STATION.	Rain inches.	Div.	STATION.	Rain inches.
II.	Warlingham, Redvers Road..	1·76	XI.	Lligwy	3·36
,,	Ramsgate	·61	,,	Douglas, Isle of Man	5·12
,,	Hailsham	1·19	XII.	Stoneykirk, Ardwell House...	3·92
,,	Totland Bay, Aston House...	1·17	,,	Carsphairn, Shiel	11·39
,,	Stockbridge, Ashley	1·63	,,	Langholm, Drove Road	6·25
,,	Grayshott	2·21	XIII.	Selkirk, The Hangingshaw..	2·59
III.	Harrow Weald, Hill House...	1·21	,,	North Berwick Reservoir	2·46
,,	Pitsford, Sedgebrook	1·02	,,	Edinburgh, Royal Observaty.	2·47
,,	Woburn, Milton Bryant	·97	XIV.	Biggar	4·62
,,	Chatteris, The Priory	·92	,,	Maybole, Knockdon Farm ...	5·10
IV.	Elsenham, Gaunts End	·82	XV.	Buchlyvie, The Manse	7·46
,,	Shoeburyness	·71	,,	Ardgour House	14·21
,,	Colchester, Hill Ho., Lexden	·52	,,	Oban	6·83
,,	Ipswich, Rookwood, Copdock	·65	,,	Campbeltown, Witchburn ..	6·34
,,	Aylsham, Rippon Hall	1·19	,,	Holy Loch, Ardnadam	13·03
,,	Swaffham	1·08	,,	Tiree, Cornaigmore	...
V.	Bishops Cannings	1·29	XVI.	Glenquey	8·50
,,	Weymouth	1·35	,,	Glenlyon, Meggernie Castle..	...
,,	Ashburton, Druid House.. ...	3·48	,,	Blair Atholl	4·24
,,	Cullompton	1·82	,,	Coupar Angus	2·26
,,	Lynmouth, Rock House	3·15	,,	Montrose, Sunnyside Asylum.	1·75
,,	Okehampton, Oaklands	3·62	XVII.	Balmoral	2·74
,,	Hartland Abbey	2·35	,,	Fyvie Castle	1·16
,,	St. Austell, Trevarna	3·61	,,	Keith Station	1·72
,,	North Cadbury Rectory	1·10	XVIII.	Rothiemurchus	3·32
VI.	Clifton, Stoke Bishop	2·32	,,	Loch Quoich, Loan	31·40
,,	Ledbury, Underdown	·93	,,	Skye, Dunvegan	11·26
,,	Shifnal, Hatton Grange	1·50	,,	Fortrose	2·38
,,	Droitwich	1·35	,,	Glencarron Lodge	11·09
,,	Blockley, Upton Wold	1·57	XIX.	Tongue Manse	2·86
VII.	Grantham, Saltersford	1·58	,,	Melvich	2·94
,,	Market Rasen	1·72	,,	Loch More, Achfary	7·39
,,	Bawtry, Hesley Hall	1·43	XX.	Dunmanway, The Rectory ..	8·79
,,	Whaley Bridge, Mosley Hall	5·48	,,	Glanmire, Lota Lodge	6·55
,,	Derby, Midland Railway	1·99	,,	Mitchelstown Castle	6·04
VIII.	Nantwich, Dorfold Hall	2·39	,,	Darrynane Abbey	5·76
,,	Bolton, Queen's Park	4·71	,,	Clonmel, Bruce Villa	5·31
,,	Lancaster, Strathspey	4·25	,,	Broadford, Hurdlestown	5·22
IX.	Langsett Moor, Up. Midhope	4·64	XXI.	Enniscorthy, Ballyhyland...	4·54
,,	Scarborough, Scalby	2·10	,,	Rathnew, Clonmannon	3·48
,,	Ingleby Greenhow	1·31	,,	Ballycumber, Moorock Lodge	3·58
,,	Mickleton	5·60	,,	Balbriggan, Ardgillan	2·97
X.	Bellingham, High Green Manor	2·69	,,	Castle Forbes Gardens	4·22
,,	Ilderton, Lilburn Cottage ...	1·06	XXII.	Ballynahinch Castle	7·43
,,	Keswick, The Bank	8·30	,,	Woodlawn	3·38
XI.	Llanfrechfa Grange	2·85	,,	Westport, St. Helens	2·99
,,	Treherbert, Tyn-y-waun	9·47	,,	Dugort, Slievemore Hotel ...	8·10
,,	Carmarthen, The Friary	3·48	XXIII.	Enniskillen, Portora	4·86
,,	Fishguard, Goodwick Station.	2·93	,,	Dartrey [Cootehill]	3·84
,,	Crickhowell, Tal-y-maes	2·20	,,	Warrenpoint, Manor House ..	4·53
,,	New Radnor, Ednol	3·69	,,	Belfast, Cave Hill Road	4·94
,,	Birmingham WW., Tyrmynydd	6·21	,,	Glenarm Castle	5·00
,,	Lake Vyrnwy	9·06	,,	Londonderry, Creggan Res...	3·83
,,	Llangynhafal, Plas Drâw	2·91	,,	Dunfanaghy, Horn Head ...	....
,,	Rhwibryfdir	15·15	,,	Killybegs	6·17
,,	Dolgelly, Bryntirion	6·95			

Climatological Table for the British Empire, September, 1917.

STATIONS. (Those in italics are South of the Equator.)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain. Depth.	Total Rain. Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	74·9	5, 8	43·0	30	69·8	51·9	54·5	...	119·9	43·8	2·31	11	6·6
Malta	89·6	2	63·5	30	82·5	72·0	...	76	140·0	...	1·70	1	0·8
Lagos	92·2	12	70·0	13	84·6	73·8	72·2	80	149·2	68·0	9·93	22	8·5
Cape Town	79.2	15	39·1	17	66·8	49·5	50·2	72	...	...	1·72	8	4·5
Johannesburg	76·0	7	38·2	14	67·1	46·3	44·0	75	...	34·0	1·14	8	5·6
Mauritius	78·2	8	55·5	28	75·5	61·5	57·4	69	...	49·6	·91	16	5·5
Bloemfontein	82·1	22	32·4	14	71·8	42·3	41·2	61	..	...	·51	3	3·5
Calcutta...	91·7	5	75·2	18	87·7	78·0	77·0	85	...	73·1	8·09	16	7·6
Bombay...	88·3	24	74·0	3	83·8	77·0	76·1	88	136·0	70·1	19·58	25	8·3
Madras	94·0	4	72·8	30	90·0	76·6	74·6	82	161·0	73·0	5·30	16	6·7
Colombo, Ceylon ...	87·1	15	72·8	25	84·4	75·4	73·6	84	154·8	68·8	12·74	23	8·0
Hongkong	89·9	20	74·3	23	86·6	78·1	74·2	77	...	...	4·88	12	5·0
Sydney	83·8	28	45·5	11	68·3	52·7	48·0	64	131·1	33·0	5·42	10	4·5
Melbourne	72·1	30	36·8	19	62·9	47·1	45·3	64	128·1	27·3	3·42	15	6·1
Adelaide	79·4	11	39·9	25	66·2	47·7	47·4	70	137·6	32·0	3·68	20	5·6
Perth	69.0	23	43·6	13	66·2	50·2	49·1	74	135·2	33·1	6·79	24	7·3
Coolgardie	78·6	30	33·0	4	67·6	43·9	38·7	46	138·4	29·0	·51	5	3·7
Hobart, Tasmania ..	70·3	21	38·0	15	58·6	44·0	41·1	65	132·7	28·1	3·76	19	6·8
Wellington	...	...	...	...	...	...	...	...	...	...	...	...	...
Auckland	...	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston ...	91·2	5	70·3	11	87·4	72·6	72·0	83	...	...	8·00	16	5·8
Grenada	91·0	20	70·0	29	86·0	75·0	...	79	138·0	...	6·89	19	5·0
Toronto	81·0	1	36·0	11	69·3	47·9	50·0	81	131·4	30·7	·65	8	3·4
Fredericton	82·0	19	29·0	23	67·7	40·4	47·6	80	...	...	·90	9	3·8
St. John, N.B. ...	78·0	27	35·0	23	63·2	46·3	47·8	75	135·2	30·5	1·24	9	4·0
Victoria, B.C.	76·0	1	46·0	20	61·8	49·9	50·0	83	131·2	36·5	1·06	15	5·5

Johannesburg.—Bright sunshine 237·°5 hours.

COLOMBO, CEYLON.—Mean temp. 79°·9, or 1°·0 below, dew point equal to the average and R 7·85 in. above average. Mean hourly velocity of wind 5·6 miles.

HONGKONG.—Mean temp. 82°·0. Bright sunshine 266·5 hours. Mean hourly velocity of wind 10·4 miles.

Sydney.—Very severe gales and heavy R on the 19th with much damage to buildings, wires, shipping and trees.

Melbourne.—Temp. 1°·0 above, and R 1·03 in. above, averages. Northern rivers in flood. Crops good, fruit being a record yield.

Adelaide.—Mean temp. equal to the average, R 1·73 in. above, averages.

Perth.—Rainfall 3·53 in. above, average. Gales and high winds.

Coolgardie.—Temp. 2°·9 below, and R slightly below, averages.

KINGSTON, JAMAICA.—A hurricane passed across the island on 23rd, but not much damage was done. R twice the average.

Symons's
Meteorological Magazine.

No. 627. APRIL, 1918. Vol. LIII.

Sec. Lieut. Donald Sowerby Salter, R.G.A.

March 16th, 1890—March 22nd, 1918.

Mr. Donald Salter, cartographer to the British Rainfall Organization, who died on March 22nd from wounds received in action, was born in London and educated at Bancroft's School, Woodford. He was the younger brother of Mr. Carle Salter, Assistant Director of the British Rainfall Organization, and joined the staff of the Organization in 1908. He rapidly became extremely efficient in the intricate mapping work which plays such an important part in rainfall research. In order to improve a natural talent for map drawing he took a special course at the Camden School of Art, and acquired also a thorough professional knowledge of technical methods. His routine work included the plotting and drawing for reproduction of many hundreds of rainfall maps, most of which appeared in *British Rainfall* and *Symons's Meteorological Magazine* between 1908 and 1916, as well as a large number of annual rainfall maps of the British Isles, which are still unpublished. When Dr. H. R. Mill decided in 1910 to regroup the rainfall stations of the British Isles in river-divisions Mr. Donald Salter made a reduction of the watershed lines which he had drawn specially on the half-inch ordnance survey map as a basis for the new work. He also planned and carried out a specially reduced outline map of the British Isles for eventual use as the basis of a Rainfall Atlas, and re-drew the majority of the coloured plates for a new edition of Dr. H. R. Mill's "Realm of Nature." He was elected a fellow of the Royal Meteorological Society in March, 1915.

Mr. Donald Salter joined the Royal Engineers in 1916, under the Derby Scheme, and after being for a short time in the Ordnance Survey Department, Southampton, saw active service in France for some time. He was invalided home in October, 1916, and was granted a commission in the Royal Garrison Artillery in 1917. It was in carrying out the duties of Section Commander by his gun that he was fatally wounded at the outset of the great German offensive

of the past month. His brother officers speak in the highest terms of his gallant behaviour and example.

In spite of a manner extremely modest and retiring, Mr. Donald Salter had already made a large circle of friends, which his artistic and literary tastes constantly augmented. Many of these will value highly the beautifully executed drawings and paintings to which he devoted practically the whole of his leisure. To the Director and Staff of the British Rainfall Organization he proved throughout a devoted and enthusiastic colleague, the memory of whose work will long prove a stimulating tradition at Camden Square.

ROYAL METEOROLOGICAL SOCIETY.

At the meeting of the Royal Meteorological Society held at Caxton Hall, Westminster, on March 20th, Sir Napier Shaw, F.R.S., President, in the Chair, Dr. J. S. Owens, A.M.Inst.C.E., delivered a lecture illustrated by lantern slides on "The Measurement of Atmospheric Pollution."

Dr. Owens dealt with the need for exact measurements of suspended impurities in the air. He explained the work undertaken by the Advisory Committee on Atmospheric Pollution in this connection, and the methods used, and gave some of the results obtained during the last four years. He said that the era when a harmless gas like carbon-dioxide was taken as a measure of impurity was rapidly giving way to a recognition that the really important thing to measure was suspended dust and dirt. It was shown that the latter connoted great waste of human life and also of fuel, light and other important necessities.

As showing the kind of air city dwellers were sometimes forced to breathe he gave figures for deposit from the air for one year, April to March, at the following places :—

Oldham, 1915-16 ..	950	tons per square mile.
Manchester, 1915-16..	635	„ „ „
London, 1915-16 ..	453	„ „ „
Sheffield, 1914-15 ..	395	„ „ „
Malvern Wells, 1915-16	56	„ „ „

He stated that there was evidence of a general reduction of atmospheric impurity during the winter of 1916-17, as compared with the preceding winter, an effect probably due to reduced consumption of raw coal.

An account of the research work of the Advisory Committee, relating to methods of measurement, was also given, with an account of the special apparatus designed for the purpose, the preliminary difficulties encountered and the distribution of observing stations.

In conclusion mention was made of certain problems awaiting solution, such as relation of impurity to wind and distance from source, also to incidence of disease. Does smoke in the air reduce or increase the number of bacteria? What is the vertical distribution of suspended matter? The selective power of rain or snow in bringing down impurity.

The following gentlemen were ballotted for and elected fellows of the Society :—Messrs. R. T. Barratt, B.S., J. W. A. Brown, and A. S. MacDonald, of the U.S. Naval Reserve Flying Corps ; Mr. E. McInnes, Lieut.-Comm. W. L. Marsh, R.N.V.R., and Messrs. W. G. W. Mitchell, B.Sc., C. F. Prance, A. C. Pratt, C.E., H. B. Pratt, and J. A. G. Simpson.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

GUNFIRE AND RAINFALL.

IN Switzerland, during the most intense period of the heat and drought of the memorable summer of 1911, I had the good fortune to witness the remarkable spectacle of an immense colony of ants endeavouring, by means of the ejection of large quantities of formic acid, to extinguish a fire, which for experimental purposes had been introduced into their nest. They were ultimately successful. That night the drought was broken by one of the most violent thunderstorms within my experience.

The excuse for this note is not that I have mistaken your magazine for an entomological journal, but that I could not help wondering, while reading some of the correspondence in recent issues, whether popular opinion amongst the ant-colony attributed the thunderstorm to the prodigious expenditure of formic acid, and, if so, whether the ant-scientists were able to demonstrate that such was not the case.

Do we realize the immensity of Nature's laboratories and the colossal scale upon which her processes are conducted ?

If the Krakatoa eruption, which visibly overcharged the world's atmosphere with volcanic dust for many months and was heard at a distance of 3000 miles, so far from occasioning a second flood, had no noticeable effect on rainfall, how can we, with our puny imitations, audible perhaps at 200 miles, expect to alter the course of Nature, even if all the world were one vast, twentieth-century battlefield ?

E. L. HAWKE.

S. Farnborough, Hants, March 4th, 1918.

UNUSUAL TEMPERATURE RANGE.

YOUR readers may be interested to hear that on March 24th, near Godalming (at an elevation of about 400 feet), the range of temperature in a Stevenson screen was 35°—71°. The fact that this maximum was 5° higher than that recorded at Kensington is not, perhaps, surprising, as it seems that there was considerable mistiness in town. A temperature of 71° in March, and a diurnal range of 36° at any season, must however, be very unusual. I cannot say whether either of these incidents constitutes a record for the district.

G. WESTON.

47, Chester Terrace, S.W. 1, 26th March, 1918.

AN EXCEPTIONAL THERMOGRAPH RECORD.

THE second of the three warm-current assaults (January 15th, 16th and 18th), which finally broke the six weeks' cold spell was possibly unique. At first I feared my Lander and Smith thermograph had gone wrong. The record of 49° at 7.30 a.m. on the 15th, had fallen to 32°·5 by 9 p.m., when the vibrations indicate a half gale until 0.30 a.m. on the 16th, with temperature slightly lower until 1.45 a.m. By 2.50 a.m. it had jumped up 5°, falling back 3° by 3 a.m. Then began an unbroken rise to 49° in two hours, instantly and more rapidly beginning a fall back to 32°·5 by 6.50 a.m. It remained below 34° till the final change supervened at 6 p.m. on the 17th, 49° being reached about noon on the 18th, for the third time in January.

One is familiar with the sudden fall and rise of a summer cold wave thunderstorm, but this inversion is unique among my ten years of records. A rainfall record of 1·32 in. is a natural association for the twenty-four hours in question. J. EDMUND CLARK.

Asgarth, Riddlesdown Road, Purley, February 5th, 1918.

METEOROLOGICAL NEWS AND NOTES.

DR. H. R. MILL met with a serious accident on alighting from an omnibus in Camden Road on March 18th, from the result of which he was unconscious for several hours. He has suffered no permanent injuries, but the shock necessitated his remaining several weeks in hospital, and a prolonged rest has been recommended. The work of the British Rainfall Organization is being carried on meanwhile by Mr. Carle Salter.

MR. CARLE SALTER gave popular lectures on "Weather Maps," before the Hampstead Scientific Society on February 1st, and the Royal Flying Corps, Halton Camp, Wendover, on March 21st.

THE WEATHER OF MARCH, 1918, was exceptional for dryness and warmth in many parts of the country. We regret that pressure on our space prevents us from printing a number of interesting letters on the subject.

BLACK RAIN in the west of Ireland on March 6th is attributed by a local correspondent to the presence of soot carried from English factory chimneys. He adds, "This explanation illustrates vividly one drawback of our connection with England, and I am, therefore, pretty certain that Sinn Feiners will accept it, but I should add that very few people in these parts are satisfied with it. They prefer to call black rain a miracle."

INVERSE WEATHER PHENOMENA.

By L. C. W. Bonacina.

If the physical conditions which attend certain phenomena of the weather are examined, it is sometimes found that a set of conditions which favours the occurrence of one phenomenon may be just that which is essentially unfavourable to the occurrence of another. Two such phenomena may be regarded as inversely related. There is not, perhaps, any better guide to the discovery of such inverse relationships than is afforded by seasonal opposition in weather phenomena. If, for example, summer heat thunderstorms and winter cyclonic gales, or summer thunderstorms and winter land fogs show a complete seasonal antithesis in frequency and intensity there is reason to suspect that thunderstorms and gales on the one hand, or thunderstorms and fogs on the other, are not merely opposite phenomena seasonally, but are also inverse to one another in respect of one or more of the physical processes which underlie them. The term " inverse " will in this article be used to indicate opposition among the underlying factors concerned in producing one of a given pair of phenomena, and not opposition in the phenomena themselves, which may exhibit no physical contrast at all in the sense, for instance, in which windiness and calmness, or cloudiness and sunniness, are necessarily opposite conditions.

In this paper it is intended to consider a few of the more striking phenomena which in this climate exhibit well-marked seasonal opposition, and to point out in what way they may be regarded as inverse. The discussion will for the sake of brevity refer only to the climate of the British Isles ; but what holds for these islands is also true for a great part of the North Temperate zone. The following weather events will be brought under review:—thunderstorms, gales, fogs, rainstorms and snowstorms. If the question were suddenly put to a number of persons, among them meteorologists : What is the inverse seasonal phenomenon of the summer thunderstorm ? it is probable that the majority would immediately answer the winter snowstorm. They would argue that snowstorms require of necessity a certain degree of cold, and thunderstorms, though able to occur with any temperature, are certainly favoured by a certain degree of heat. But a study of the average monthly frequency of snow and thunder does not show complete, but only approximate, seasonal antithesis—a fact which suggests a great deal. The months of greatest thunder frequency coincide with the summer half-year April to September ; but the months of greatest snow frequency are not entirely coincident with the winter half-year October to March, inasmuch as April has a decidedly higher frequency than October. Examination of local climatological records shows this ; but the fact is apparent to casual observation. In other words the snow season overlaps into the thunder season, and this is quite sufficient to suggest that the basal physical conditions which occasion thunderstorms and snowstorms are not essentially inverse as might at first be supposed. On the contrary, it is noteworthy that the broad barometric situation which is conducive to heavy local snowfalls in the cold season is often curiously similar to that which is conducive to heavy local thunderstorms in the warm season, since both commonly occur when the pressure distribution is typically complex and irregular, and both likewise have a peculiar way of developing unexpectedly in what often appears to be settled fine weather with hard frost in the one case and baking drought in the other. This does not necessarily argue a close dynamical analogy between the immediate determining conditions of local snowstorms in winter and of thunderstorms in summer inasmuch as the atmospheric instability which is the essential condition of thunderstorm activity is absent in the case of simple snowfalls ; but it does help one to understand what the lack of full seasonal opposition intimates, namely, that snowstorms and thunderstorms though perhaps the most striking features of the cold and warm months respectively, are not such truly inverse phenomena as certain other pairs of phenomena to be considered. What, then, is the inverse of the thunderstorm among ordinary weather phenomena? In the first place it must be a matter of general experience to all who watch the English climate closely that just as land thunderstorms belong in the main to the summer half of the year, April-September, so do cyclonic gales as well as land (valley or plain) fogs belong to the winter half-year, October to March ; and, further, that the special period for summer thunderstorms is around the solstice, May to August and for both gales and fogs around the other solstice, November to February. It is during the seven or eight weeks on either side of June 21st that the really violent electrical storms burst at intervals over the country, and it is during the dark weeks round Christmas that the most destructive gales rage most frequently, and also, curiously enough, the paralyzing land fogs which need calm conditions are generally bred. But since all meteorologists do not receive general climatic impressions with the same force it is necessary to support these statements with such statistical data on the seasonal variations of thunderstorms, gales and fogs as is readily available. All three phenomena were investigated seasonally some years ago by Mr. F. J. Brodie.* His figures, giving the mean monthly frequency of thunderstorms at a number of stations in

* *See* Q.J.R. Met. Soc., Vol. 28, 1902, for paper on "Gales of British Isles," and Vol. 31, 1905, for paper on "Fogs of London." An unpublished paper on "British Thunderstorm Distribution," was read at a meeting of the Roy. Met. Soc. about 1906, and the data on which it was based are now, by the kindness of Mr. Brodie, in charge of the writer.

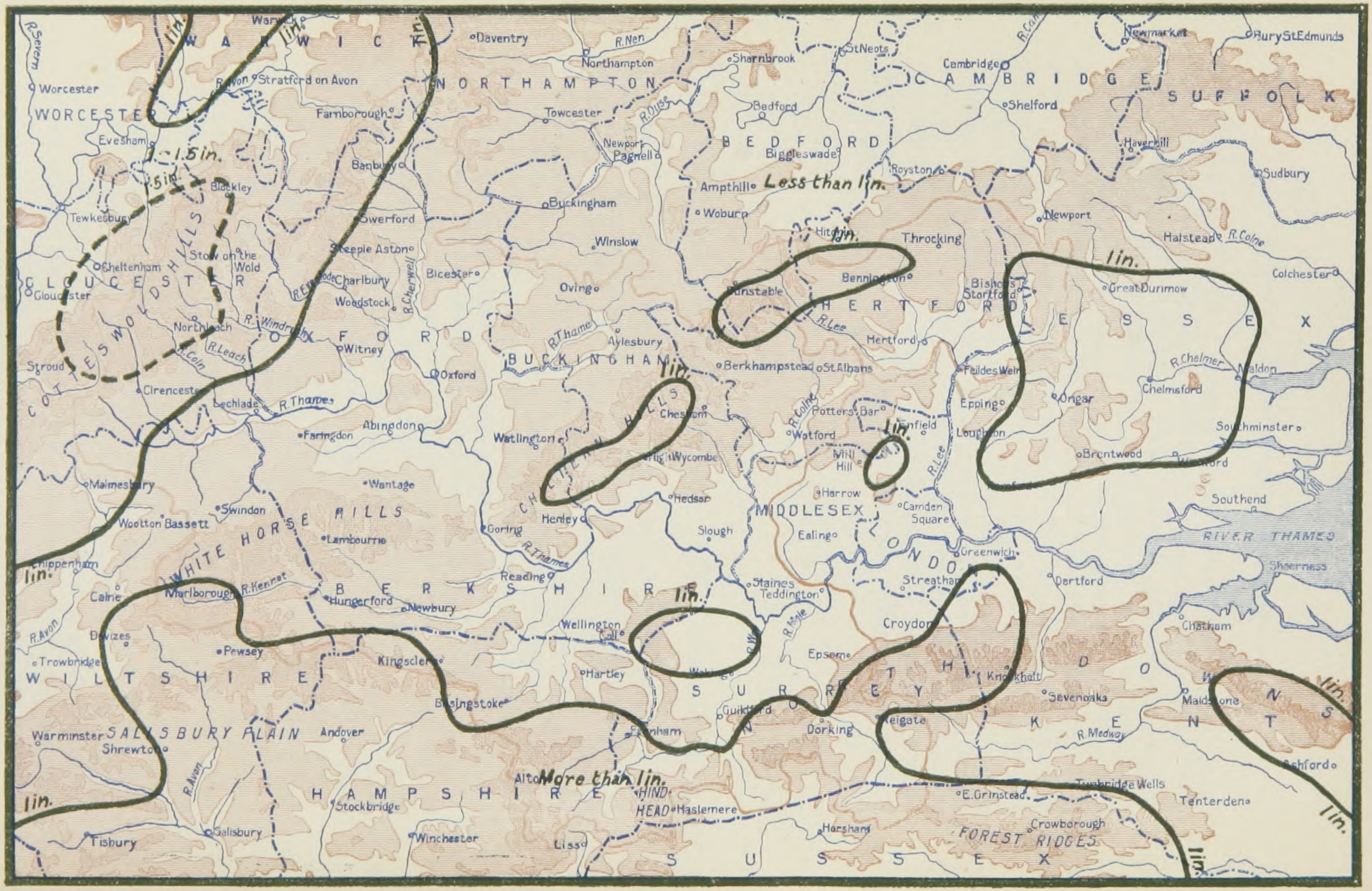
the British Islands for a period of twenty-five years show, taking the country as a whole, a well-marked maximum between May and August in conformity with general experience. Brook's figures for the U.S.A. reveal the same feature, as also Angot's for the Paris district of France. In the Mediterranean, however, the researches of Eredia and others indicate that the maximum, as a result of the special climatic regime of that region, is deferred till the autumnal equinox. With the exception of the stations on the extreme western seaboard of Scotland and Ireland, where the annual number of thunderstorms is small, and where there can hardly be said to exist a definite seasonal range, thunderstorms being as common in winter as in summer, all the rest of the kingdom experiences storms of the summer heat type far more frequently than those of the winter cyclonic type.

(*To be continued.*)

THE GENERAL STRUCTURE OF THE ATMOSPHERE.

At a meeting of the Geophysical Committee of the British Association, held in the rooms of the Royal Astronomical Society on Thursday, December 13th, Prof. Schuster in the Chair, Sir Napier Shaw opened a discussion on "The General Structure of the Atmosphere." The address began with a description of the chemical composition of a quiescent atmosphere as computed from the ascertained composition of the surface layer. The outer layers are composed of hydrogen and helium, with probably a layer of geosoronium still further out. Water vapour loses its importance at 10 kilometres, at 57 kilometres hydrogen begins to displace nitrogen and oxygen, and at 80 kilometres the replacement is complete. Meteorological phenomena take place in a very small portion of the atmosphere about 10 kilometres thick called the troposphere. This region marks the boundary of convection, and it is the stop of convection that determines the boundary of the troposphere. The height of the top of the latter ranges from 10,600 m. in our latitudes to 17,000 m. over the equator. In the stratosphere temperature does not fall off with height. The intermediate layer is known as the tropopause. In the stratosphere the wind when observed with pilot balloons falls off rapidly with height, but the whole subject of wind at great heights is somewhat confused and further data are required. The upper layers are liable to as great variations in winds as the lower layers, which display such a very complex structure. The various thermodynamic conditions and the chemical composition of the surface air were also referred to in the discussion which was illustrated by slides.

THAMES VALLEY RAINFALL. MARCH, 1918.



ALTITUDE SCALE

Below 250 feet	250 to 500 feet	500 to 1000 feet	Above 1000 feet

SCALE OF MILES 0 5 10 15 20

Symons's Meteorological Magazine.

Watershed of River Thames above Teddington, and River Lee above Feildes Weir.

Isohyetals

THE WEATHER OF MARCH.

ALTHOUGH the type of pressure distribution showed considerable variations, there was throughout the whole of March, a marked tendency for the establishment of anticyclonic conditions. The mean barometric pressure of the month was, therefore, high, and was also extremely uniform ; temperature was above the average ; rainfall was slight, and the duration of bright sunshine, though very deficient in north Britain, was slightly in excess of the normal in most other parts of the Kingdom.

The month opened with cold northerly winds, and local falls of snow or sleet, and on the first two nights a keen frost prevailed, the sheltered thermometer falling below 25° in many places, and reaching 17° at West Linton and 9° at Balmoral. Between the 2nd and the 8th the borders of an anticyclone centred over northern Europe, occasionally extended over a large portion of the United Kingdom. In the south the weather was affected adversely by a depression which moved in an unusual course from the Netherlands across the north of France to the Atlantic ; and on the 3rd the easterly wind in the Channel reached the force of a gale. After the 9th a series of disturbances passed in quite a normal track across Iceland and caused unsettled weather on our western and northern coasts. Elsewhere the weather, though subject to local fogs, was mostly fair and dry, and on the 11th and 12th the day temperatures in many parts of England passed beyond 60°. After this a new anticyclone from the Atlantic drifted north-eastwards across the United Kingdom and in the middle of the month the wind was easterly or south-easterly, and the weather rather cold, a sharp frost occurring on the night of the 16th.

The most pronounced anticyclonic spell occurred between the 20th and 26th, when a well-marked system appears to have been developed immediately over England and France. During its prevalence intermittent sea fogs of considerable density prevailed round our western and southern coasts, and caused, in the localities affected, a raw cold air. Elsewhere the weather was fair, sunny and warm in the daytime, but cold at night. On the 23rd and 24th the thermometer in many inland parts of England rose slightly above 70°. During the closing days of the month the weather was affected in all districts by cyclonic areas, which passed eastwards directly across the United Kingdom. The weather, therefore, fell into an unsettled showery state generally ; a thunderstorm occurred on the 29th in London, and also in the south of Ireland (at Cahirciveen), and on the 31st in several isolated parts of England.

Aurora was seen in Scotland on the 1st and 2nd, and at a number of stations situated in the more northern and eastern parts of Great Britain on 7th.

The rainfall for the month was nearly everywhere below the average, less than 1 inch falling over much of the east of England, and less than 2 inches over nearly the whole country. In Wales parts of the mountainous districts had more than 4 inches. The east of Scotland was also dry and the fall in the west Highlands was moderate. The south of Ireland had rather more than 2 inches, whilst the fall in the north was smaller. The general rainfall of the countries expressed as a percentage of the average was :—England and Wales, 62; Scotland, 48; Ireland, 65 ; British Isles, 58.

In London (Camden Square) the mean temperature was 43°·5, or 1°·4 above the average of 50 years. The duration of bright sunshine was 102·4 hours, and the duration of rainfall, 16·1 hours. Evaporation, ·85 in.

RAINFALL TABLE FOR MARCH, 1918.

STATION.	COUNTY.	Aver. 1875—1909. in.	1918. in.	Diff. from Av. in.	Per cent. of Av.	Max. in 24 hours. in.	Max. in 24 hours. Date.	No. of Days
Camden Square	*London*	1·70	1·09	— ·61	64	·51	30	8
Tenterden	*Kent*	1·95	·81	—1·14	42	·34	30	8
Arundel (Patching)	*Sussex*	1·95	1·48	— ·47	76	·64	30	9
Fordingbridge (Oaklands)	*Hampshire*	2·09	1·27	— ·82	61	·47	30	12
Oxford (Magdalen College)	*Oxfordshire*	1·45	·60	— ·85	42	·24	30	12
Wellingborough (Swanspool)	*Northampn*	1·72	·65	—1·07	38	·25	30	10
Bury St. Edmunds (Westley)	*Suffolk*	1·71	·62	—1·09	37	·32	30	6
Geldeston [Beccles]	*Norfolk*	1·57	·78	— ·79	56	·27	30	13
Polapit Tamar [Launceston]	*Devon*	2·74	1·77	— ·97	65	·39	31	11
Rousdon [Lyme Regis]	,,	2·30	1·86	— ·44	82	·58	30	12
Stroud (Field Place)	*Gloucester*	2·01	1·30	— ·71	65	·30	31	10
Church Stretton (Wolstaston)	*Shropshire*	2·19	1·72	— ·47	79	·48	31	10
Boston	*Lincoln*	1·47	·60	— ·87	41	·19	30	10
Worksop (Hodsock Priory)	*Nottingham*	1·70	·85	— ·85	50	·30	30	11
Mickleover Manor	*Derbyshire*	1·69	1·48	— ·21	88	·61	29	8
Buxton	,,	3·99	...	...	...	...	..	...
Southport (Hesketh Park)	*Lancashire*	2·11	1·13	— ·98	54	·25	27	10
Arncliffe Vicarage	*York, W.R.*	5·17	...	...	...	...	...	...
Wetherby (Ribston Hall)	,, ,,	1·92	1·39	— ·53	74	·33	28	8
Hull (Pearson Park)	,, *E.R.*	1·84	·84	—1·00	46	·36	30	13
Newcastle (Town Moor)	*North'land*	2·10	1·17	— ·93	56	·25	5	13
Borrowdale (Seathwaite)	*Cumberland*	10·63	5·65	—4·98	53	1·90	27	11
Cardiff (Ely)	*Glamorgan*	2·89	2·88	— ·01	100	·54	28	15
Haverfordwest	*Pembroke*	3·16	3·06	— ·10	97	·65	27	13
Aberystwyth (Gogerddan)	*Cardigan*	3·04	3·24	+ ·20	107	·96	31	8
Llandudno	*Carnarvon*	2·13	·94	—1·19	44	·30	31	8
Cargen [Dumfries]	*Kirkcudbrt.*	3·33	1·93	—1·40	58	·47	27	10
Marchmont House	*Berwick*	2·64	1·23	—1·41	47	·24	28	14
Girvan (Pinmore)	*Ayr*	3·62	1·38	—2·24	38	·40	28	11
Glasgow (Queen's Park)	*Renfrew*	2·61	1·40	—1·21	54	·67	31	10
Islay (Eallabus)	*Argyll*	3·68	1·99	—1·69	54	·63	27	11
Mull (Quinish)	,,	4·28	2·59	—1·69	61	·55	30	15
Balquhidder (Stronvar)	*Perth*	6·02	2·65	—3·37	44	1·00	28	11
Dundee (Eastern Necropolis)	*Forfar*	2·06	1·09	— ·97	53	·30	30	15
Braemar	*Aberdeen*	2·87	·65	—2·22	28	·15	28, 30	10
Aberdeen (Cranford)	,,	2·65	1·79	— ·86	68	·67	28	16
Gordon Castle	*Moray*	2·36	1·19	—1·17	50	·36	28	14
Drumnadrochit	*Inverness*	3·09	·88	—2·21	29	·28	27	9
Fort William	,,	6·39	2·41	—3·98	38	·47	11	14
Loch Torridon (Bendamph)	*Ross*	7·29	3·94	—3·35	54	·74	27	17
Dunrobin Castle	*Sutherland*	2·64	1·32	—1·32	50	·60	27	7
Killarney (District Asylum)	*Kerry*	4·51	3·11	—1·40	69	·67	28	15
Waterford (Brook Lodge)	*Waterford*	2·64	2·55	— ·09	97	·46	29	15
Nenagh (Castle Lough)	*Tipperary*	2·99	2·51	— ·48	84	·73	29	12
Ennistymon House	*Clare*	3·24	2·55	— ·69	79	·73	29	11
Gorey (Courtown House)	*Wexford*	2·28	1·97	— ·31	87	·43	29	14
Abbey Leix (Blandsfort)	*Queen's Co.*	2·59	2·35	— ·24	91	·45	29	13
Dublin (FitzWilliam Square)	*Dublin*	1·98	1·03	— ·95	53	·18	27	13
Mullingar (Belvedere)	*Westmeath*	2·64	2·51	— ·13	95	·55	31	10
Crossmolina (Enniscoe)	*Mayo*	4·36	1·56	—2·80	36	·44	27	12
Cong (The Glebe)	,,	3·80	2·35	—1·45	62	·76	28	13
Collooney (Markree Obsy.)	*Sligo*	3·33	1·62	—1·71	49	·47	27	11
Seaforde	*Down*	2·84	1·39	—1·45	49	·41	29	10
Ballymena (Harryville)	***Antrim***	3·07	1·35	—1·72	45	·28	29	10
Omagh (Edenfel)	*Tyrone*	2·98	1·51	—1·47	51	·35	11	11

SUPPLEMENTARY RAINFALL, MARCH, 1918.

Div.	STATION.	Rain inches.
II.	Warlingham, Redvers Road..	1·27
,,	Ramsgate	·96
,,	Hailsham	1·16
,,	Totland Bay, Aston House...	1·04
,,	Stockbridge, Ashley..	1·03
,,	Grayshott	1·54
III.	Harrow Weald, Hill House...	·78
,,	Pitsford, Sedgebrook....	·61
,,	Woburn, Milton Bryant	·67
,,	Chatteris, The Priory	·51
IV.	Elsenham, Gaunts End	·99
,,	Shoeburyness	·85
,,	Colchester, Hill Ho., Lexden	·91
,,	Ipswich, Rookwood, Copdock	·83
,,	Aylsham, Rippon Hall	·69
,,	Swaffham	·68
V.	Bishops Cannings	1·08
,,	Weymouth	1·04
,,	Ashburton, Druid House..	2·05
,,	Cullompton	1·82
,,	Lynmouth, Rock House	2·44
,,	Okehampton, Oaklands	1·99
,,	Hartland Abbey	1·36
,,	St. Austell, Trevarna	1·77
,,	North Cadbury Rectory	1·05
VI.	Clifton, Stoke Bishop	1·79
,,	Ledbury, Underdown	1·59
,,	Shifnal, Hatton Grange	1·41
,,	Droitwich	1·06
,,	Blockley, Upton Wold	1·73
VII.	Grantham, Saltersford	·77
,,	Market Rasen	·45
,,	Bawtry, Hesley Hall	·76
,,	Whaley Bridge, Mosley Hall	2·19
,,	Derby, Midland Railway	1·29
VIII.	Nantwich, Dorfold Hall	1·06
,,	Bolton, Queen's Park	2·13
,,	Lancaster, Strathspey	1·66
IX.	Langsett Moor, Up. Midhope	1·36
,,	Scarborough, Scalby	1·12
,,	Ingleby Greenhow	1·33
,,	Mickleton	1·30
X.	Bellingham, High Green Manor	1·22
,,	Ilderton, Lilburn Cottage	·75
,,	Keswick, The Bank	2·11
XI.	Llanfrechfa Grange	2·86
,,	Treherbert, Tyn-y-waun	4·88
,,	Carmarthen, The Friary	2·70
,,	Fishguard, Goodwick Station.	2·64
,,	Crickhowell, Tal-y-maes	6·00
,,	New Radnor, Ednol	2·42
,,	Birmingham WW., Tyrmynydd	3·55
,,	Lake Vyrnwy	2·13
,,	Llangynhafal, Plas Drâw	·69
,,	Rhwibryfdir	6·14
,,	Dolgelly, Bryntirion	4·24
XI.	Lligwy	1·45
,,	Douglas, Isle of Man	2·02
XII.	Stoneykirk, Ardwell House...	1·24
,,	Carsphairn, Shiel	2·84
,,	Langholm, Drove Road	1·75
XIII.	Selkirk, The Hangingshaw..	·45
,,	North Berwick Reservoir	1·04
,,	Edinburgh, Royal Observaty.	·50
XIV.	Biggar	·57
,,	Maybole, Knockdon Farm	1·32
XV.	Buchlyvie, The Manse	1·82
,,	Ardgour House	3·42
,,	Oban	1·99
,,	Campbeltown, Witchburn ..	2·10
,,	Holy Loch, Ardnadam	3·23
,,	Tiree, Cornaigmore	...
XVI.	Glenquey	2·10
,,	Glenlyon, Meggernie Castle..	...
,,	Blair Atholl	1·19
,,	Coupar Angus	·86
,,	Montrose, Sunnyside Asylum.	1·15
XVII.	Balmoral	·96
,,	Fyvie Castle	1·61
,,	Keith Station	2·14
XVIII.	Rothiemurchus	·72
,,	Loch Quoich, Loan	6·80
,,	Skye, Dunvegan	3·32
,,	Fortrose	·83
,,	Glencarron Lodge	2·86
XIX.	Tongue Manse	1·96
,,	Melvich	1·29
,,	Loch More, Achfary	2·79
XX.	Dunmanway, The Rectory ..	3·78
,,	Glanmire, Lota Lodge	3·41
,,	Mitchelstown Castle	2·54
,,	Darrynane Abbey	3·10
,,	Clonmel, Bruce Villa	2·21
,,	Broadford, Hurdlestown	2·62
XXI.	Enniscorthy, Ballyhyland...	2·57
,,	Rathnew, Clonmannon	1·60
,,	Ballycumber, Moorock Lodge	1·99
,,	Balbriggan, Ardgillan	1·26
,,	Castle Forbes Gardens	1·71
XXII.	Ballynahinch Castle	...
,,	Woodlawn	1·76
,,	Westport, St. Helens	2·45
,,	Dugort, Slievemore Hotel	1·89
XXIII.	Enniskillen, Portora	1·13
,,	Dartrey [Cootehill]	1·85
,,	Warrenpoint, Manor House ..	2·05
,,	Belfast, Cave Hill Road	1·18
,,	Glenarm Castle	1·14
,,	Londonderry, Creggan Res...	1·31
,,	Dunfanaghy, Horn Head	...
,,	Killybegs	2·33

Climatological Table for the British Empire, October, 1917.

STATIONS. (Those in italics are South of the Equator.)	Absolute. Maximum. Temp.	Date.	Absolute. Minimum. Temp.	Date.	Average. Max.	Min.	Dew Point.	Humidity.	Absolute. Max. in Sun.	Min. on Grass.	Total Rain Depth.	Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	71·9	2	30·1	28	55·9	40·3	42·4	87	111·7	29·3	3·26	19	7·0
Malta	87·8	12	56·8	23	75·0	65·4	...	88	142·0	...	1·67	7	2·1
Lagos	96·0	3	71·2	1	87·0	74·1	73·7	77	155·3	69·0	4·94	16	7·8
Cape Town	84.0	28	46·0	4	71·7	52·9	52·1	68	...	...	1·10	7	4·9
Johannesburg	84·3	30	38·3	28	75·9	51·5	43·6	55	...	37·5	·65	6	3·3
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	87·2	7	35·4	19	79·8	48·1	43·5	45	..	...	·05	1	4·8
Calcutta...	90·0	20	74·2	9	86·6	76·5	75·7	85	...	68·1	11·31	11	6·0
Bombay...	89·9	21	71·3	31	84·7	76·3	74·1	82	144·1	63·1	16·11	18	6·3
Madras	94·5	9	72·0	2	89·0	75·3	72·7	79	162·4	68·0	16·48	11	5·1
Colombo, Ceylon ...	86·4	12	70·5	31	84·5	75·0	72·3	81	158·8	64·6	4·24	16	6·4
Hongkong	86·8	16	66·9	30	81·3	73·8	67·7	73	...	...	3·47	6	3·8
Sydney	88·8	20	44·9	10	70·4	56·3	52·0	63	135·2	38·2	4·41	16	5·2
Melbourne	79·0	16*	35·1	8	66·6	49·7	46·8	64	142·4	25·3	3·65	17	6·6
Adelaide	87·3	16	37·7	9	69·3	49·9	48·7	66	144·5	31·3	2·09	17	6·1
Perth	85·5	29	40·9	4	68·1	52·2	47·9	62	151·4	30·5	2·89	16	4·8
Coolgardie	89·8	31	38·0	4	73·0	47·4	40·4	41	154·4	34·0	·55	5	2·9
Hobart, Tasmania ..	76·0	13	35·0	11	61·7	45·7	42·8	64	144·6	28·4	2·79	19	6·8
Wellington	65·5	28	37·2	14	60·5	51·3	49·0	77	143·0	27·3	2·51	15	6·7
Jamaica, Kingston ..	90·3	6	68·3	24	87·8	71·7	71·1	84	...	...	2·05	6	5·0
Grenada	89·0	12	72·0	14	85·0	75·0	...	78	139·0	...	7·92	20	3·5
Toronto	62·2	2	29·0	21	52·2	36·9	37·5	83	120·8	22·6	4·78	17	...
Fredericton	65·0	1, 4	27·5	27	54·1	35·6	40·3	88	...	...	7·32	18	5·6
St. John, N.B. ...	62·7	31	33·5	27	52·8	40·1	41·8	81	121·2	27·3	7·91	15	5·8
Victoria, B.C.	69·4	4	36·8*	28	56·7	36·8	46·0	85	119·0	29·0	1·02	9	5·5

* and 19

Johannesburg.—Bright sunshine 331·°2 hours.

COLOMBO, CEYLON.—Mean temp. 79°·8, or 0°·3 below, dew point 1°·4 below, and R 9·04 in. below, averages. Mean hourly velocity of wind 5·1 miles.

HONGKONG.—Mean temp. 77°·0. Bright sunshine 258·8 hours. Mean hourly velocity of wind 14·0 miles.

Melbourne.—Mean temp. 0°·6 above, and R 1·06 in. above, averages.

Adelaide.—Mean temp. 2°·4 below, and R ·37 in. above, averages.

Coolgardie.—Temp. 3°·6 below, and R normal.

Wellington.—Mean temp. 5°·7 above, and rainfall 1·71 in. below, averages. Bright sunshine 155 hours, frosts on three days, cloudy and showery month.

JAMAICA.—Rainfall below average over the whole island.

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INVERSE WEATHER PHENOMENA.

(Continued.)

By L. C. W. Bonacina.

It will be instructive here to quote the mean monthly frequencies for three English stations in Mr. Brodie's list, namely, Oxford, a typical Thames Valley district in the South Midlands, Cambridge, a locality characteristic of the flat Fen Country, in the East Midlands, and Stonyhurst a north country station climatically influenced by the bold relief of the Pennine Chain:—

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Cambridge—	—	0·12	0·32	0·72	*2·32*	*3·32*	*3·40*	*2·56*	1·32	0·52	0·08	—	14·68
Oxford—	0·04	—	0·16	0·60	*1·56*	*2·40*	*2·48*	*1·84*	1·08	0·32	0·04	0·08	10·60
Stonyhurst—	0·24	0·40	0·52	1·12	*2·28*	*2·76*	*3·40*	*3·52*	1·72	1·16	0·52	0·32	17·96

In all three cases the May-August maximum is conspicuously brought out ; and the only anomaly worthy of note is that at Stonyhurst, where winter thunderstorms figure more prominently than in the south and east of England, the frequency shows some disposition to be displaced towards the autumnal side of summer as evidenced by the maximum in August and the slightly higher value for October than for April. The fact that May, with a lower mean temperature of the air than September brings more frequent and severe thunderstorms points indubitably to the importance of direct solar heating in their production. In July the factors of direct sun heat and accumulated warmth apparently combine at most places to cause the highest thunder frequency of the four summer months. It should be remembered, however, that Mr. Brodie's figures do not distinguish different types of thunderstorm, and that many of the passing thunder showers common in the rather wet months of July and August are electrically speaking of a mild character, though the rainfall may be torrential. At all events the writer becomes yearly more convinced that it is the first heat of the summer in May and June that is so prone to breed violent electrical disturbance, and that spells of hot weather later in the summer are on the whole less conducive to sudden local instability, the July and August storms occurring more characteristically in spells of unsettled, broken and relatively cool weather. But such details, though interesting, are incidental, and do not affect the main proposition, namely, that the heat, or land, thunderstorms of the summer season in general are grouped in mean frequency and intensity more or less symmetrically round the high solstice.

Mr. Brodie's figures for gale frequency around the British coasts as a whole, on the basis of 33 years' observations, represent "severe" gales (Beaufort force 10) alone, as well as the total number of gales. The designation of a "gale" is, of course, more or less arbitrary, and such being the case, the seasonal variations of cyclonic storms are, perhaps, as well or better emphasized by studying the figures for the "severe" storms only, which are herewith quoted :—

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Winter Half-Year..	1·2	1·7	2·0	2·2	1·2	1·2
	April	May	June	July	Aug.	Sep.
Summer Half-Year	0·3	0·1	0·1	—	0·2	0·5

The distribution of total number of gales is similar, but the figures are about three times as great for the winter months and about eight times for the summer months. It will be seen that severe gales are virtually relegated to the winter half of the year, with a prominent solstitial maximum, November to January, in exact accordance with ordinary experience. The minimum is diametrically opposite, May to July or August, when thunderstorms are at their maximum. It is, therefore, evident that the equinoxes bound the gale season, and that instead of "equinoctial gales," which, in a seasonal sense, have no existence, we ought correctly to speak of "winter solstitial gales." The minor irregularity which represents February equal to March and October in the number of severe gales instead of greater may possibly be due to the shortness of the month, but even if it is real it does not obscure the broad clear association of gales with the winter six months and very especially with the midwinter or solstitial three months.

Mr. Brodie's figures for the mean fog frequency only refer to London, and consequently hardly have the same significance in this article as those for the gales and thunderstorms. They are based on a 33-year period and are as follows :—

	Oct.	Nov.	Dec.	Jan.	Feb.	March
Winter Half-Year	7·8	8·5	9·5	8·2	6·4	4·8
	April	May	June	July	Aug.	Sept.
Summer Half-Year	2·0	0·8	0·6	0·4	1·2	4·7

Here, again, the winter solstitial maximum, November to January, stands out in company with the gale predominance in the same period, and in opposition likewise to the summer solstitial minimum May to July. A minor anomaly indicates a rather higher frequency in equinoctial October than in February, which is mainly a solstitial month*, but it should be noted that under the term "fog," especially London fog, a variety of dark, misty appearances are liable to be included, and that it is the true land radiation (valley or plain, as distinct from mountain or hill) fogs which are under discussion. Dense surface fog in London as a day phenomenon is practically confined to November, December and January, when the sun is lowest, but by night it is common enough in October and February, and occasionally develops in September and March, or even April. The interesting point, however, to observe is this: that in the London Basin gales and fogs which are irreconcilable phenomena and cannot occur simultaneously, have a seasonal variation which is practically identical, the one or other meteorological event occurring according as the temporary conditions are cyclonic or anticyclonic, etc.

The seasonal opposition between gales and thunderstorms on the one hand and between fogs and thunderstorms on the other, being demonstrated, the question arises whether the facts can be interpreted to a certain extent in the light of physical inversion.

The fog-thunderstorm case had better be considered first as it is the easier to explain, having, indeed, already been discussed by Sir Napier Shaw.† It is a question of stability or instability. Solar radiation at the summer solstice effects a great amount of surface heating, which is conducive at intervals to a condition of atmospheric instability favourable to those convective disturbances of which thunderstorms are the meteorological exponent. Terrestrial radiation at the winter solstice, on the contrary, promotes shallow surface cooling which induces a stable condition of the air strata, one of the essential predisposing causes of dense and occasionally prolonged surface fog. Sir Napier Shaw says: "Hence to a certain extent fogs and thunderstorms may be regarded as inverse phenomena and for a good physical reason. The surface fog is characteristic of stability in the stratification of the atmosphere; the thunderstorm on the contrary of marked instability." This, of course, refers to winter land fogs as opposed to summer land thunderstorms. It may be observed, moreover, that certain physical divisions of the country, *e.g.*, the Thames Valley, which have a somewhat evil notoriety for their fog-breeding capacity in the depth of winter have also a rather sinister reputation for electrical disturbance in the height of summer.

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* The solstitial periods roughly comprise eight months out of the twelve.

† "Forecasting Weather," p. 292.

The cyclonic gale-thunderstorm case is more difficult to expound, and is little understood at the present time. It is not a simple question of stability *versus* instability, but depends upon another relation, namely the dynamical opposition between two essentially different types of circulation. This subject was investigated for the first time by the writer in a paper* on, "The Re-adjustment of Pressure Differences: Two Species of Atmospheric Circulation and their Connection." Cyclonic gales, as has been demonstrated, occur primarily around midwinter, thunderstorms around midsummer, a fact which may be interpreted in the following manner, the physical explanation being sought in the paper above quoted. At the low solstice storm energy takes the form of a fairly uniform diffuse system of horizontal air motion round areas of deep barometric depression. At the high solstice, on the other hand, storm energy is concentrated in local patches of vertical (convective) air motion in such a manner that although the individual thunderstorms so engendered are only local, the total area of disturbed electrical conditions is as great as that which in winter would form the central core of a cyclonic depression commanding a system of wind energy. It is attempted to show elsewhere that the two species of circulation are, as regards a given disturbing force, dynamically inconsistent with one another; and that whilst cyclonic wind energy greatly accentuates in accordance with the effect of the earth's rotation the original difference of pressure which generates it in the first place, the vertical circulation of thunderstorm commotion neutralizes any such disturbing variation of pressure, thus preventing the development of barometric-gradient winds with respect to a cyclonic minimum. It is shown why at the high solstice dynamical conditions do not permit of so much horizontal motion as at the low solstice, and that *ipso facto* instability ensues at the former season with consequent vertical motion instead of the prohibited horizontal. Thunderstorm circulation may, of course, occur locally superimposed upon cyclonic circulation, and such instances are best exemplified in the case of quick-travelling winter thunderstorms which are invariably of the line-squall type, and are more common along the Atlantic seaboard of Scotland and Ireland than elsewhere.

It should be noted, furthermore, that winter gales and fogs, being both in different senses inverse to summer thunderstorms are in one very patent sense inverse to one another in that valley or plain fogs are conditioned by a calm atmosphere. Since both these meteorological events occur at the same time of year, in this case there is no seasonal opposition to hint at their inverse character which, however, is obvious to the senses.

(To be continued.)

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* Q.J.R. Met. Soc., Vol. 42, 1916.

ROYAL METEOROLOGICAL SOCIETY.

A MEETING of this Society was held on April 17th at 70, Victoria Street, S.W., Col. H. Mellish, C.B., Vice-President, in the Chair.

Mr. E. G. Bilham, B.Sc., read a paper entitled, "The Variations of Underground Water Level near a Tidal River." The paper was chiefly devoted to a comparison of records from the Kew Observatory water-level recorder and the Richmond Lock tide-gauge for a period of two years from May, 1914. The seasonal variations, determined from lunar monthly means, are found to be similar, as was to be anticipated on general grounds. A better method of determining the extent to which the variations of sub-soil water-level are directly controlled by the river Thames consists in the analysis of the well records to find tidal oscillations analogous to those which are well marked in the river. The well responds but slightly to the lunar semi-diurnal tide, but the lunar-fortnightly oscillation is well reproduced with a lag of five days and a reduction of amplitude in the ratio of approximately one to fourteen. After allowing for the direct action of the river, the well is found to be very sensitive to local rainfall during winter months. The effects of rainfall upon river-level and underground water-level appear to be in many respects closely similar.

Mr. J. Fairgrieve, M.A., read a paper entitled "Suggestions as to the Conditions precedent to the occurrence of Summer Thunderstorms, with special reference to that of June 14th, 1914." The meteorological phenomena accompanying the rainfall were put on record and the cloud distribution, the barometric pressure, the wind movements and the temperature were specially dealt with. It is evident that the clouds and the rain-fields lie in parallel belts and that the former appear some hours before the rain begins to fall. It was suggested that this belting of wind and rain must be due to rippling on a large scale, the rippling being brought about by the interaction of two currents of different temperatures. If the conditions are unstable and especially if relief also induces disturbance, thunderstorms will develop along lines of rippling and will drift with the wind. Thunderstorms have apparently three movements, a development along a belt, a sideways movement to leeward, and a spread to windward. The first may be due to rippling; the second is a drift; the third may be explained if it is granted that a local ridge of high pressure develops along the axis of the thunderstorm. The storm then breaks up into two belts of which that to leeward soon dies out, owing to the lack of a supply of rising air.

The following gentlemen were balloted for and elected Fellows of the Society:—Mr. H. Aldous, Lieut. D. Brunt, R.E., Lieut. H. Cotton, R.E., Lieut. L. B. Cundall, R.E., and Lieut.-Col. C. E. Dupuis, R.E.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

THE LATE Mr. D. S. SALTER.

MAY I be permitted to express my gratitude to your numerous readers who have written to me on hearing of the death of my brother, since it has been impossible for me to reply to each personally. Their sympathy has made me feel that my own sense of loss is widely shared in that the war has taken toll of another of those promising young lives on which the future of meteorology depended

CARLE SALTER.

62, Camden Square, London, N.W. 1, 4th May. 1918.

BLACK RAIN.

A BLACK RAIN is recorded in the minutes of the Philosophical Club of the Royal Society which I have recently been editing. It was described by Mr. James Rust, Minister of Slains, in Aberdeenshire, and Colonel Sykes, who made the communication, had satisfied himself of his trustworthiness. The rain fell not only at that place but also along the whole eastern coast of the county on January 14th, 1862. The morning, about 8.30 a.m., was clear, then the sky darkened, threatening rain. About an hour later, a "large, dense, black, smoky-looking cloud came driving over the sea from the S.S.E. and discharged a shower of rain, with drops like ink, which blackened all the water collected in cisterns from the roofs of houses and dirtied clothes put out to bleach, so effectively that warm water was needed to wash out the spots." Mr. Rust suggested that a recent eruption of Vesuvius might be the cause ; Sir R. Murchison thought this origin impossible, because of the distance, and that it must be smoke, while Professor Tyndall stated that his own experiments made him doubtful whether a sufficient quantity of soot could have been distributed through the atmosphere to produce the blackness described.

T. G. BONNEY.

9, Scroope Terrace, Cambridge, 25th April, 1918.

VARIATIONS IN SPRING TEMPERATURE.

THE following readings afford another instance of the great and irregular changes to which our climate is subject :—

1918.	Max. temp.	Min. temp.	Range °	Mean °	Difference from average.
March 24 ..	71	36	35	53·5	+11·0
April 16 ..	39	36	3	37·5	— 9·7

Bristol, April 18th, 1918. W. F. DENNING.

USUAL TEMPERATURE RANGE.

THE temperature range of 36°F. recorded by Mr. G. Weston, near Godalming on March 24th, was certainly remarkable, but reference to the Daily Weather Report shows that it was exceeded at both Benson and South Farnborough, as at each of these stations the range amounted to more than 40°. The figures in the Report for March 24th are :—Benson, max. 67°, min. 26° ; South Farnborough, max., 70°, min., 28°. The Benson thermograph record for the week ending on the 25th was of great interest, the regular diurnal wave growing steadily larger in amplitude as the week advanced, culminating in the range of 41° noted above. If the "meteorological day," 7 a.m. to 7 a.m. is disregarded, the range between the min. early on the 24th and the max. on the afternoon of the same day was 1° larger still, *i.e.*, 42° at Benson, and 43° at South Farnborough, and this in a period of about 12 hours, a very unusual phenomenon in this country.

J. S. DINES.

66, Sydney Street, S.W. 3, April 23rd, 1918.

METEOROLOGICAL NEWS AND NOTES.

DR. H. R. MILL is steadily improving in health, after his recent accident, and is now at his home in Surrey. It may still be some time before he is able to resume his work at Camden Square.

CORPORAL H. E. CARTER, Chief Computer to the British Rainfall Organization, who had been for some time employed in the Meteorological Section of the Royal Engineers, felt it to be his duty to take a more active part in the war, and recently obtained a transfer to an infantry regiment, with which he took part in opposing the great German offensive movement of March last. We regret to learn that he was taken prisoner and sent to Germany. All those who know his enthusiastic temperament will have much sympathy with him in the misfortune that has befallen him.

MR. R. C. MOSSMAN, F.R.S.E., has been awarded the Keith Prize (which is a gold medal and a sum of money) by the Royal Society of Edinburgh, "for his work on the Meteorology of the Antarctic Regions, which originated with the important series of observations made by him during the voyage of the *Scotia* (1902-1904), and has continued to the present time. Mr. Mossman's paper 'On a See-Saw of Barometric Pressure, Temperature, and Wind Velocity between the Weddell Sea and the Ross Sea,' published in the *Proceedings* of the Society, falls within the period."

REVIEWS.

Weather Forecasting in the United States. By a Board composed of Alfred J. Henry, *Chairman,* Edward H. Bowie, Henry J. Cox, Harry C. Frankenfield. U.S. Weather Bureau (Charles F. Marvin, Chief). Washington, 1916. Size, $10\frac{1}{4} \times 7$. Pp., 370, many plates.

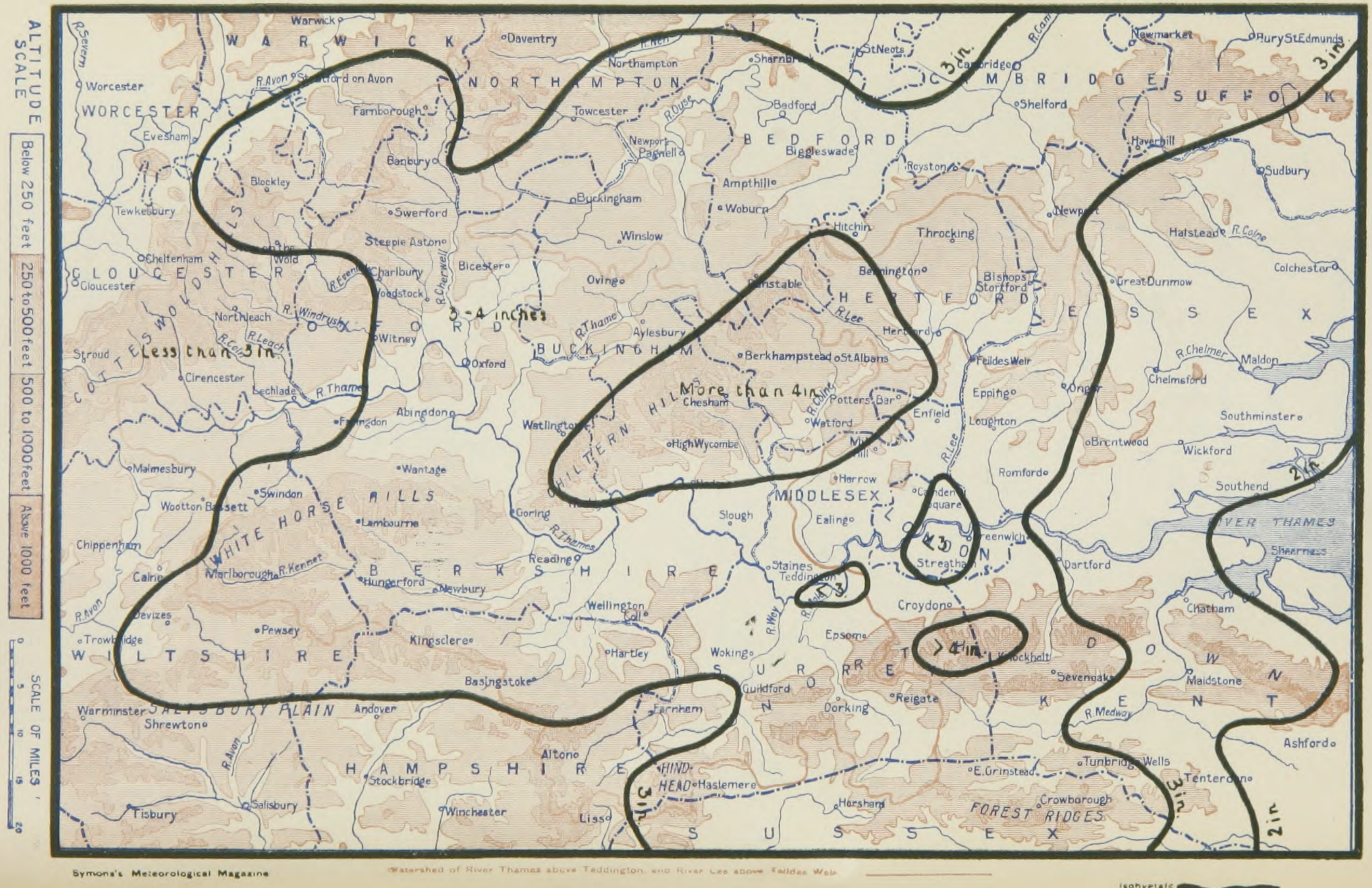
Prof. Marvin, struck by the want of any formal statement of the principles of weather forecasting which could serve as a text book for students of the art, invited the forecasting staff of the United States Weather Bureau, of which he is Chief, to set out in writing the rules on which they worked. As there are six separate forecast regions in the United States each with its own expert and experienced staff, the Board which was set up to examine the essays sent in had a considerable mass of material to deal with. The result is a dozen chapters, the three first dealing with generalities, the remainder with the practical problems of forecasting as practised in America. The work is copiously illustrated by weather charts and diagrams.

Prof. Marvin sums up thus :—" The consensus of opinion seems to be that the only road to successful forecasting lies in the practical and consistent study of the daily weather maps." The value of the book he considers is that it gives the experience of those who have gone before as a guide.

The Combination of Observations. By David Brunt, M.A., B.Sc. Cambridge, University Press. 1917. Size, $9 \times 5\frac{1}{4}$. Pp. x. + 220. Price, 8s. net.

A Difficulty which frequently perplexes students of the actual phenomena of Nature is the apparent indifference of mathematicians to the quality of the Observations on which they exercise their methods. There has grown up a semi-superstitious feeling that mathematical processes have a magical purifying power which can build firm conclusions from shaky data. A useful corrective of this feeling is supplied by Mr. Brunt's valuable little book. The author keeps the limitations of his methods steadily in mind while developing the value of them by carefully worked out practical examples. The aim of the book is to give an account of the method of least squares in applying the law of errors to the treatment of observational data. Special interest attaches to the short chapters on the Weighting of Observations, the Rejection of Observations, and Correlation. An extremely important feature to the student is the bibliography which directs attention to special works dealing with each of the aspects of the subject.

THAMES VALLEY RAINFALL. APRIL, 1918.



THE WEATHER OF APRIL.

In an average April the mean barometric pressure over the United Kingdom is highest over Central and Southern England, and lowest in the north and west of Scotland. In the past month the normal atmospheric conditions were entirely reversed, and, as a result, the arrangement of weather in the various districts was altogether exceptional.

With the existing pressure distribution the predominant winds were naturally from some point between north and east, and over England, where the weather was influenced not infrequently by cyclonic systems which were developed over neighbouring parts of the Continent, they occasionally blew with considerable strength. The polar current would in itself have been sufficient to produce a low mean temperature, but. owing to the disturbing causes just mentioned, it was unfortunately accompanied by much cloud, and, in the eastern and south-eastern districts, by frequent rains, often of great intensity. At nearly all the English stations the total duration of sunshine for the month was below the average, and at Kew it was the smallest registered in April since the record commenced in 1881. The worst weather occurred during the third week, when the aggregate rainfall in England S.E. was equal to nearly four times, and in England E. to nearly eight times, the average. At many places in the same districts the heavy downpours of the 15th-16th, and the 19th-21st, were mingled with snow.

Over Ireland and north Britain the weather was cold and rather changeable in the earlier part of the month, with sharp frost in many places on the nights of the 2nd, 4th, 7th, and the 11th and 12th. Early on the 3rd the sheltered thermometer fell to 26°, at Markree Castle, on the 5th to 24°, at West Linton, and on the 8th to 22°, at Balmoral, and 27° at Gordon Castle. Towards the middle of the month the weather improved, and later on, when the eastern and southern districts were experiencing the worst possible conditions, the west and the north enjoyed more than a fair amount of bright sunshine. For the month as a whole Glasgow recorded a total duration of 170 hours, or 43 more than the average, and Birr Castle 193 hours, or 40 more than the average, and considerably more than twice as much as Kew.

In the closing week, when an anticyclone extended from the northward, fair weather became more general, and, under the influence of genial sunshine, the temperature reached its highest level for the month. In many parts of the United Kingdom the thermometer between the 26th and 28th rose to between 65° and 70°, and at Killarney it touched 73°.

Auroræ were observed in Scotland on the 3rd, 5th, 6th and 11th; on the last mentioned date it was also seen in the north of Ireland.

The rainfall of the month exceeded the average only in the south-east of England, where a well-marked area extending from Salisbury Plain to Norwich had more than 3 inches. More than 4 inches fell over part of the Thames Valley, where about twice the average fell in places. This renders the map of the distribution of rainfall facing this page more than usually interesting. The total fall in other parts of England and over a large part of Scotland hardly anywhere reached 2 inches. Over the greater part of Wales, and even in the wet districts of the West Highlands, not much more than 2 inches fell. In Ireland the rainfall was very uniform at between 1 and 2 inches. The general rainfall of the countries, expressed as a percentage of the average, was :— England and Wales, 106; Scotland, 49; Ireland, 56; British Isles. 74.

In London (Camden Square), the mean temperature was 45°·2, or 2°·9 below the average of 50 years. The duration of bright sunshine was, 75·3 hours, and the duration of rainfall, 72·1 hours. Evaporation, ·89 in.

RAINFALL TABLE FOR APRIL, 1918.

STATION.	COUNTY.	RAINFALL. Aver. 1875—1909. in.	1918. in.	Diff. from Av. in.	Per cent. of Av.	Max. in 24 hours. in.	Date.	No. of Days
Camden Square	*London*	1·74	3·24	+1·50	148	·89	15	20
Tenterden	*Kent*	1·77	1·23	— ·54	70	·20	20	15
Arundel (Patching)	*Sussex*	1·82	2·64	+ ·82	146	·66	20	16
Fordingbridge (Oaklands)	*Hampshire*	1·92	2·29	+ ·37	119	·52	15	14
Oxford (Magdalen College)	*Oxfordshire*	1·67	3·27	+1·66	196	·95	15	18
Wellingborough (Swanspool)	*Northampn*	1·78	2·82	+1·04	159	·56	20	17
Bury St. Edmunds (Westley)	*Suffolk*	1·62	3·70	+2·08	129	1·71	15	17
Geldeston [Beccles]	*Norfolk*	1·55	3·48	+1·93	124	1·85	15	12
Polapit Tamar [Launceston]	*Devon*	2·34	2·53	+ ·19	108	·51	16	15
Rousdon [Lyme Regis]	,,	2·39	1·82	— ·57	76	·33	10	17
Stroud (Field Place)	*Gloucester*	2·09	2·30	+ ·21	111	·60	16	15
Church Stretton (Wolstaston)	*Shropshire*	2·20	1·56	— ·64	71	·30	21	12
Boston	*Lincoln*	1·57	1·74	+ ·17	111	·56	15	21
Worksop (Hodsock Priory)	*Nottingham*	1·62	1·49	— ·13	92	·45	6	16
Mickleover Manor	*Derbyshire*	1·77	1·20	— ·57	68	·26	6	13
Buxton	,,	2·87	2·15	— ·72	75	·59	7	12
Southport (Hesketh Park)	*Lancashire*	1·84	1·04	— ·80	57	·24	6	13
Arncliffe Vicarage	*York, W.R.*	3·73	...	...	...	...	...	...
Wetherby (Ribston Hall)	,, ,,	1·85	1·35	— ·50	73	·35	6	9
Hull (Pearson Park)	,, *E.R.*	1·69	1·44	— ·25	35	·36	6	20
Newcastle (Town Moor)	*North'land*	1·84	1·44	— ·40	78	·35	20	15
Borrowdale (Seathwaite)	*Cumberland*	6·91	...	...	...	...	...	...
Cardiff (Ely)	*Glamorgan*	2·50	2·17	— ·33	87	·50	9	18
Haverfordwest	*Pembroke*	2·82	2·09	— ·73	75	·63	25	13
Aberystwyth (Gogerddan)	*Cardigan*	2·48	1·28	—1·20	52	·44	5	9
Llandudno	*Carnarvon*	1·79	1·06	— ·73	60	·29	6	10
Cargen [Dumfries]	*Kirkcudbrt.*	2·50	·69	—1·81	28	·24	25	4
Marchmont House	*Berwick*	2·28	·93	—1·35	41	·15	2	14
Girvan (Pinmore)	*Ayr*	2·81	·80	—2·01	29	·23	9	10
Glasgow (Queen's Park)	*Renfrew*	1·86	·44	—1·42	24	·15	6	9
Islay (Eallabus)	*Argyll*	2·64	2·27	— ·37	86	·87	8	11
Mull (Quinish)	,,	2·98	2·26	— ·72	76	·84	8	12
Balquhidder (Stronvar)	*Perth*	4·15	...	—	...	...	...	...
Dundee (Eastern Necropolis)	*Forfar*	1·93	·88	—1·05	46	·27	19	8
Braemar	*Aberdeen*	2·30	1·03	—1·27	45	·31	1	8
Aberdeen (Cranford)	,,	2·23	·36	—1·87	16	·14	19	10
Gordon Castle	*Moray*	1·74	1·71	— ·03	99	·59	19	12
Drumnadrochit	*Inverness*	1·85	1·41	— ·44	77	·52	19	11
Fort William	,,	3·65	1·34	—2·31	37	·59	5	9
Loch Torridon (Bendamph)	*Ross*	4·70	2·26	—2·44	48	·55	5	10
Dunrobin Castle	*Sutherland*	2·02	1·04	— ·98	52	·45	8	4
Killarney (District Asylum)	*Kerry*	3·46	1·45	—2·01	42	·27	7, 9	17
Waterford (Brook Lodge)	*Waterford*	2·68	1·70	— ·98	64	·65	8	10
Nenagh (Castle Lough)	*Tipperary*	2·54	·79	—1·75	31	·21	8	8
Ennistymon House	*Clare*	2·81	1·23	—1·58	44	·47	8	11
Gorey (Courtown House)	*Wexford*	2·37	1·83	— ·54	77	·37	9	12
Abbey Leix (Blandsfort)	*Queen's Co.*	2·54	1·52	—1·02	60	·52	8	10
Dublin (FitzWilliam Square)	*Dublin*	2·03	1·87	— ·16	94	·49	9	11
Mullingar (Belvedere)	*Westmeath*	2·37	1·76	— ·61	75	·58	8	9
Crossmolina (Enniscoe)	*Mayo*	3·13	1·47	—1·66	47	·29	8	11
Cong (The Glebe)	,,	2·98	1·01	—1·97	34	·21	5	10
Collooney (Markree Obsy.)	*Sligo*	2·52	1·18	—1·34	47	·33	8	10
Seaforde	*Down*	2·76	1·21	—1·55	44	·47	8	9
Ballymena (Harryville)	*Antrim*	2·57	1·89	— ·68	76	·68	8	10
Omagh (Edenfel)	*Tyrone*	2·50	1·40	—1·10	56	·43	8	9

SUPPLEMENTARY RAINFALL, APRIL, 1918.

Div.	STATION.	Rain inches.	Div.	STATION.	Rain inches.
II.	Warlingham, Redvers Road .	4·84	XI.	Lligwy	1·16
,,	Ramsgate	1·32	,,	Douglas, Isle of Man	1·77
,,	Hailsham	3·31	XII.	Stoneykirk, Ardwell House...	1·08
,,	Totland Bay, Aston House...	1·74	,,	Carsphairn, Shiel	1·88
,,	Stockbridge, Ashley	3·04	,,	Langholm, Drove Road	1·00
,,	Grayshott	3·36	XIII.	Selkirk, The Hangingshaw..	·65
III.	Harrow Weald, Hill House...	3·89	,,	North Berwick Reservoir	·62
,,	Pitsford, Sedgebrook	2·38	,,	Edinburgh, Royal Observaty.	·62
,,	Woburn, Milton Bryant	3·60	XIV.	Biggar	·55
,,	Chatteris, The Priory	2·43	,,	Maybole, Knockdon Farm ...	·48
IV.	Elsenham, Gaunts End	3·03	XV.	Buchlyvie, The Manse	·98
,,	Shoeburyness	1·84	,,	Ardgour House	1·62
,,	Colchester, Hill Ho., Lexden	2·08	,,	Oban	1·52
,,	Ipswich, Rookwood, Copdock	2·47	,,	Campbeltown, Witchburn ..	1·17
,,	Aylsham, Rippon Hall	2·95	,,	Holy Loch, Ardnadam	1·79
,,	Swaffham	2·12	,,	Tiree, Cornaigmore	...
V.	Bishops Cannings	3·76	XVI.	Glenquey	1·60
,,	Weymouth	1·35	,,	Glenlyon, Meggernie Castle..	...
,,	Ashburton, Druid House	2·92	,,	Blair Atholl	·74
,,	Cullompton	2·10	,,	Coupar Angus	·87
,,	Lynmouth, Rock House	2·59	,,	Montrose, Sunnyside Asylum.	·40
,,	Okehampton, Oaklands	2·86	XVII.	Balmoral	·86
,,	Hartland Abbey	1·82	,,	Fyvie Castle	1·00
,,	St. Austell, Trevarna	2·63	,,	Keith Station	2·28
,,	North Cadbury Rectory	1·88	XVIII.	Rothiemurchus	1·63
VI.	Clifton, Stoke Bishop	2·38	,,	Loch Quoich, Loan	4·20
,,	Ledbury, Underdown	2·71	,,	Skye, Dunvegan	2·69
,,	Shifnal, Hatton Grange	2·33	,,	Fortrose	·81
,,	Droitwich	2·56	,,	Glencarron Lodge	2·47
,,	Blockley, Upton Wold	3·68	XIX.	Tongue Manse	2·26
VII.	Grantham, Saltersford	2·05	,,	Melvich	1·30
,,	Market Rasen	...	,,	Loch More, Achfary	3·03
,,	Bawtry, Hesley Hall	1·36	XX.	Dunmanway, The Rectory ..	1·96
,,	Whaley Bridge, Mosley Hall	1·70	,,	Glanmire, Lota Lodge	1·57
,,	Derby, Midland Railway	1·33	,,	Mitchelstown Castle	1·57
VIII.	Nantwich, Dorfold Hall	1·22	,,	Darrynane Abbey	2·37
,,	Bolton, Queen's Park	1·06	,,	Clonmel, Bruce Villa	1·51
,,	Lancaster, Strathspey	1·11	,,	Broadford, Hurdlestown	1·19
IX.	Langsett Moor, Up. Midhope	1·33	XXI.	Enniscorthy, Ballyhyland...	1·87
,,	Scarborough, Scalby	2·06	,,	Rathnew, Clonmannon	1·77
,,	Ingleby Greenhow	1·84	,,	Ballycumber, Moorock Lodge	1·00
,,	Mickleton	·70	,,	Balbriggan, Ardgillan	1·56
X.	Bellingham, High Green Manor	·96	,,	Castle Forbes Gardens	1·22
,,	Ilderton, Lilburn Cottage ...	1·17	XXII.	Ballynahinch Castle	1·28
,,	Keswick, The Bank	1·39	,,	Woodlawn	·98
XI.	Llanfrechfa Grange	2·50	,,	Westport, St. Helens	1·36
,,	Treherbert, Tyn-y-waun	3·27	,,	Dugort, Slievemore Hotel ...	1·12
,,	Carmarthen, The Friary	2·38	XXIII.	Enniskillen, Portora	1·35
,,	Fishguard, Goodwick Station.	1·27	,,	Dartrey [Cootehill]	1·48
,,	Crickhowell, Tal-y-maes	6·50	,,	Warrenpoint, Manor House ..	1·26
,,	New Radnor, Ednol	2·62	,,	Belfast, Cave Hill Road	1·56
,,	Birmingham WW., Tyrmynydd	2·02	,,	Glenarm Castle	1·25
,,	Lake Vyrnwy	2·24	,,	Londonderry, Creggan Res...	2·15
,,	Llangynhafal, Plas Drâw	2·18	,,	Dunfanaghy, Horn Head ...	...
,,	Rhwibryfdir	3·44	,,	Killybegs	1·50
,,	Dolgelly, Bryntirion	2·24			

Climatological Table for the British Empire, November, 1917.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain Depth.	Total Rain Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	58·8	21	30·9	26	52·1	41·8	43·0	88	89·7	26·9	1·82	15	7·5
Malta	72·1	11	52·7	17	64·8	58·0	...	81	119·0	45·0	3·44	16	0·4
Lagos	95.0	18	70·0	15	88·2	84·0	74·8	77	154·4	69·0	2·63	7	7·3
Cape Town	89·4	21	45·1	26	72·6	55·6	52·8	67	...	...	·78	9	4·2
Johannesburg	84·4	1	39·0	20	70·8	51·3	52·1	77	..	37·0	17·76	20	6·1
Mauritius	80·2	17	61·2	1	78·6	66·6	63·1	74	...	57·7	2·97	20	6·2
Bloemfontein	90·2	2	45·3	18	79·8	51·7	49·3	53	..	...	2·82	9	4·2
Calcutta...	86·6	12	58·0	20	82·0	66·4	65·1	75	...	49·0	·40	1	2·2
Bombay...	87·3	29	69·5	12	85·4	72·0	68·0	71	139·5	61·0	·00	0	1·4
Madras	89·5	4	70·2	30	85·0	74·3	72·2	82	159·5	66·6	6·03	17	6·2
Colombo, Ceylon ...	87·9	7	69·6	2, 4	84·8	73·6	71·7	82	158·2	62·0	11·04	19	7·4
Hongkong	82·9	2	57·1	21	72·7	64·7	54·8	60	...	...	·10	1	5·6
Sydney	82·8	15	52·0	19	71·7	58·9	56·1	68	145·7	46·0	8·35	18	7·0
Melbourne	84·5	29	43·3	6	69·6	52·8	50·3	67	147·0	35·4	4·18	16	6·4
Adelaide	89·0	2	43·9	13	75·2	54·1	47·9	55	157·0	35·1	1·15	11	5·1
Perth	96·0	26	48·4	4	75·3	56·6	51·3	58	156·4	38·0	·02	1	2·9
Coolgardie	98·2	2	45·0	6, 16	81·8	54·2	43·3	35	155·0	41·0	1·40	2	2·0
Hobart, Tasmania ...	84·0	4	40·0	6	66·4	49·3	47·5	67	148·3	33·1	2·50	20	6·4
Wellington	70·9	30	45·5	25	64·7	52·0	51·1	77	150·0	30·0	1·79	4	5·3
Jamaica, Kingston ...	89·7	29	68·0	3	85·0	71·2	69·6	82	...	...	·66	9	6·7
Grenada	88·0	9	70·0	1,3,4	84·0	73·1	...	76	139·0	...	6·54	12	4·0
Toronto	54·5	10	10·1	25	41·8	27·1	27·5	80	104·8	6·6	1·27	10	...
Fredericton	50·8	5	—5·0	28	36·3	20·8	23·7	82	...	...	2·33	7	5·8
St. John, N.B. ...	51·3	6	5·5	28	37·0	25·8	25·2	74	111·5	4·2	3·36	11	5·7
Victoria, B.C.	61·2	10	36·6	25	52·3	36·6	44·0	89	117·0	30·8	2·28	19	7·4

Johannesburg.—Bright sunshine 233·°7 hours. Rainfall a record for November.

COLOMBO, CEYLON.—Mean temp. 79°·2, or 0°·3 below, dew point 1°·1 below, and R ·49 in. below, averages. Mean hourly velocity of wind 4·5 miles.

HONGKONG.—Mean temp. 68°·2. Bright sunshine 189·2 hours. Mean hourly velocity of wind 12·5 miles.

Sydney.—A very wet month, R 5·53 in. above average and not surpassed since November, 1873, when 9·45 in. was recorded.

Melbourne.—Mean temp. 0°·1 above, and R 1·94 in. above, averages.

Adelaide.—Mean temp. 2°·3 below, and R ·02 in. below, averages.

Coolgardie.—Mean temp. 2°·9 below, average, and R ·75 above, averages.

Hobart.—Mean temp. slightly above, average, and rainfall normal.

Wellington.—Bright sunshine, 244·4 hours. Mean temp. 1°·4 below.

Symons's Meteorological Magazine.

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THE METEOROLOGICAL OFFICE.

We have received the following intimation from Sir Napier Shaw, under date of May 23rd, 1918 :—

The Lords Commissioners of His Majesty's Treasury have been pleased to approve the proposal of the Meteorological Committee that in view of the variety and importance of the scientific problems upon which the Meteorological Office is required to advise the fighting forces, Sir Napier Shaw, F.R.S., shall, for the period of the war, become scientific adviser to his Majesty's Government in Meteorology, being relieved of the administrative duties of the Meterorlogical Office but retaining the Chairmanship of the Meteorological Committee, Lieut.-Col. H. G. Lyons, R.E., F.R.S., with the sanction of the War Office, being appointed Acting Director of the Meteorological Office for the same period.

ROYAL METEOROLOGICAL SOCIETY.

A meeting of the Society was held on Wednesday, May 15th, at 70, Victoria Street, S.W., Sir Napier Shaw, F.R.S., President, in the Chair.

Mr. C. E. P. Brooks, M.Sc. read a paper, entitled : "Continentality and Temperature, Second Paper." The first part dealt with the variation with latitude of the coefficients which give the influence of land on temperature, land east, land west and ice being considered separately, and it was found that in the tropics the coefficients are uniformly small. In the temperate regions in winter the effect of land to the east is also small, but land to the west has a well-marked effect in lowering temperature ; this effect increases towards the poles. In summer land both east and west increases temperature. In the second part the temperatures of land and water hemispheres were calculated. The distribution of land and sea at the beginning of the Great Ice Age was reconstructed from geological data, and on applying the calculated formulae to this changed distribution it was found that the temperature must have been lower than the present in different districts by various amounts up to 20°C. in January and 15°C. in July. These changes agreed very closely with those required by geologists and palæontologists, and it was further proved that the glacial period was a necessary consequence of the geographical changes. Finally a theory of climatic evolution was outlined in accordance with these ideas, and the theory of isostasy.

The report on Phenological Observations in the British Isles during 1917 was presented by Mr. J. Edmund Clark and Mr. H. B. Adames. The persistent winter, hardly broken over four and a half months from early December, dominated seasonal conditions. The temperature from December to April showed in England, S.W., a deficiency of 4°·8 F., ranging to 1°·2 in Scotland, N. In the southern half of our islands the 125 days to mid-April were cold almost beyond precedent in the previous hundred years, farm and garden prospects being therefore of the gloomiest. By the end of spring there was a complete change. Absence of keen winds and frosts favoured the belated blossoming, and by June flowering dates were normal, although the early spring flowers, anemone and blackthorn, had been twenty and twenty-four days late. From the time of the dog rose, dates were actually early. Finally, the chief practical result of the cold was indirect, the heavy destruction of bird life favouring tree blight and caterpillars, the ova of which had been preserved by the cold. In many parts caterpillars stripped fruit trees and ruined garden greens. The antler caterpillar plague in Derbyshire was ascribed mainly to the scarcity of rooks. On the other hand berries and other fruits suffered little from birds. From late July into September the splendid harvest prospects were much marred by rain, wind and lack of sun. Final results were better than in 1916, although grain crops fell about 5 per cent below the ten-year average in England. As to roots, a warm, dry November more than made up for the cold, wet October, and potatoes gave a record crop with 8,600,000 tons off 1,364,000 acres, compared with 5,468,000 off 1,134,400 in 1916. Tree fruits were excellent, the August gales proving prejudicial to apples only. November gave a splendid send-off for the coming year in the exceptionally favoured winter earring of the grain crops. Table V. of the Report gave the yearly floral means for the five chief districts from 1891. That year alone was later than 1917, namely, 9·6 days against 7·6, after the mean flowering date, May 17·4. Birds and insects, in Table VI., confirmed the lateness of 1917, averaging 6 and 12 days behind, whilst Table VII., of 24 migrants, showed nearly 10 days lag behind a 20-year mean, 1877-1896.

The following candidates were balloted for and elected Fellows of the Society :—Sir J. Benton, K.C.I.E., Mr. J. Fairgrieve, M.A. Capt. E. H. D. Nicholls, Director of Public Works, Cyprus, Mr. W. Norbury, and Ensigns J. D. Anderson, A. B. Leonard and W. P. Prien, of the U.S. Naval Reserve Force.

INVERSE WEATHER PHENOMENA.

(*Concluded.*)

By L. C. W. Bonacina.

There is one more feature to be discussed in this article, namely, the true inverse of snowstorms. It was demonstrated at the beginning that the seasonal antithesis between snowstorms and thunderstoms is less complete than between gales and thunderstorms inasmuch as the highest monthly snowfall frequencies overlap into the thunder season in April and fall short of the commencement of the common gale and fog season in October; and when the physical processes involved are examined, one finds in accordance with the seasonal hint, a correspondingly weaker case of inversion.

But, remembering that the snow season embraces both the winter solstice, November to February, and the spring equinox, March and April, if one looks at the opposite period of the summer solstice, May to August, and the autumnal equinox, September and October, taken together, can any feature of the rainfall of the warmer months be discovered which, on the basis of determining conditions, can be regarded as an inverse weather phenomenon to snowfall? Now precipitation in the colder months is, so far as the temperature effect is concerned, less intense than in the warmer months, and this is the reason why individual summer downpours tend *cæteris paribus* to be heavier than winter rainfalls and, *a fortiori*, snowfalls. In fact as a simple temperature effect it would be true to regard the heavy character of showers and rainstorms in summer and autumn as the inverse climatic feature of snow showers or storms in winter and spring. In this case it is merely the striking physical appearance of the frozen form of precipitation in a land where the liquid form is more prevalent that renders the winter one of the inversely related pair the more conspicuous; but *heavy* rain is as much characteristic of the warmer months of the year as snow is of the colder.

In this connection it is important to guard against a rather prevalent error among meteorologists of confusing heavy summer rainstorms as such with thunderstorms. Probably not more than a quarter of the number of heavy summer downpours are occasioned by thunderstorms in the real sense, and not more than half could be called thunderstorms in even a secondary sense. The true thunder or electrical disturbance is a highly distinctive phenomenon; but many of the heavy rainstorms of summer in association with the passage of small cyclonic depressions are not accompanied by thunder and lightning at all. The great Norwich rainstorm at the end of August, 1912, was in no sense a thunderstorm, and the great rainstorm of the night of June 28th, 1917, was not in a primary sense a thunderstorm, the electrical disturbance being but feeble and occasional. But the great London rainfall of June 16th, 1917, on the contrary, was brought by a thunderstorm in the fullest sense of the term. The importance of distinguishing between summer thunderstorms and rainstorms in regard to the inverse phenomena under discussion is this : thunderstorms are, as has been pointed out, mainly solstitial phenomena (May to August), but showers or rains of a high degree of intensity but without electrical disturbance continue to characterize the period of the autumnal equinox, September and October. The reason is that heavy rain, which indicates high absolute humidity is simply favoured by the high air temperature which exists in autumn in consequence of the atmosphere's accumulated store of warmth ; but thunderstorms, on the other hand, require for their full violence not only a high air temperature but also the direct heating effects of powerful radiation, and this combination can only be had during the solstitial or midsummer period. The contrast in this respect between the month of May with its violent electrical storms generated by the shaft-like force of the sun's rays, and the month of September, with its heavy rain showers, but fewer and less powerful electrical disturbances, is a feature that can hardly fail to have struck the majority of climatic observers. In July thunderstorms and simple rainstorms are both very prominent ; but the super-imposition of the thunderstorms on the more general rainfalls, which are more common than in the drier month of May, seems *ipso facto* to have the effect of often rendering the thunderstorms of the later or hotter part of the season less severe on the *electrical* side than those which mark the earlier and cooler part when thunderstorms are bred with special facility by the first heat of the year.

REVIEW.

Twelfth Annual Report of the Meteorological Committee. For the Year ended March 31st, 1917 (62nd year of the Meteorological Office). Published by H.M. Stationery Office, 1917. Size, 9½ × 6. Pp., 16. Price, 1d.

The twelfth Annual Report of the Meteorological Committee has dwindled to a mere shadow of its predecessors, but bears evidence that the work of the Meteorological Office has increased in an inverse ratio. One of the new activities mentioned consists in the taking over of the responsibility for the Committee on the Investigation of Atmospheric Pollution. A large number of the regular staff of the Office are absent on war duties, many of them being engaged in the Meteorological Section of the Royal Engineers under Major E. Gold, D.S.O. The Meteorological Office has also undertaken the training of a number of outside candidates for this service.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

THE HEAT AND THUNDERSTORMS OF MAY.

THE month of May, 1918, was very true to type, the first half being cool, with an occasional suspicion of sultriness in the afternoons, and the second half full summer. The first advance of the summer in May is always an impressive phase of climate, and this year it took the form between the 15th and 22nd of an unbroken spell of sustained warmth during which the rich tones of the sky and the refulgence of the new foliage in the fierce solar rays were magnificent. As is invariably the case in early summer such conditions meant electrical disturbance, and in the London district violent thunderstorms occurred on the 17th and 22nd. The first indications of the evening storm of the 22nd were apparent on the 21st, and it often happens that heat thunderstorms take a couple of days to develop. Thus thundery-looking cumulus on the afternoon of the 21st died down at dusk, and it only wanted another day's heat for the storms to burst the following evening. In the Hampstead district considerable damage was done both on the 17th and 22nd, and on the latter occasion ball lighting is reported to have been seen. The ordinary flashes on the 22nd were of blinding intensity and were followed on more than one occasion by instantaneous crashes. There was rather more general wind motion during the storm of the 22nd than is usual in heat thunderstorms. The year 1918 serves to confirm my impression that the month of May is the most constant in character, and in some ways the best and most reliable of the summer months. How often does June fall back on May!

L. C. W. BONACINA.

Hampstead, June 4th, 1918.

A VIOLENT thunderstorm was experienced in this district on May 17th. Thunder was first heard about 1.30 p.m.; the storm broke at 3.30 and continued practically without interruption until 7 p.m. Two or three storms seemed to meet in this neighbourhood after working round and round for a considerable time. At one time there was lightning every five seconds and consequently there was a continuous uproar as if there were violent gunfire taking place in the sky. The rainfall may without exaggeration be described as terrific. The ground floors and basements of houses were flooded out, roads torn up and rendered impassable owing to rushing torrents of water. Serious damage was done to the allotments and crops in general. At Steppingley hailstones the size of marbles fell to the depth of three to four inches, unless my informant was exaggerating.

R. A. S. MACKENZIE.

The Hawthorns, Flitwick, Beds., May 25th, 1918.

THE heaviest thunderstorm since August, 1879, broke over this village and district this afternoon. Peals of thunder began about 2 p.m., but there was no rainfall worth mentioning till 4 p.m. Rain then came down in torrents, lightning very vivid and thunder claps deafening. About 4.30 there was much hail, the stones being very large, but this was not so noticeable at my end of the village as near the church; the deluge of rain and hail there must have been much heavier than where I live, as some two hours later the hail stones were lying by the road side several inches thick, and we had none to be seen. At 4.45 there was a slight abatement, but from 5 to 5.30 the rain came down in sheets and the thunder returned and was more terrific than ever. Rain continued till about 6.30. Total fall, 3·07 in., quite a record here, the nearest approach to it for a single storm being ·57 in. in 35 minutes, on July 19th, 1903.

So far as I can gather it was very local, as no rain fell beyond Woburn, two miles north-west, or beyond Harlington, four miles east, and it did not reach Dunstable, which is six miles south-east.

CHARLES J. KILBY.

Milton Bryan, Woburn, Beds., May 17th, 1918.

AN extraordinary hail storm occurred here soon after 3 p.m. on May 17th. The morning had been hot and sunny—maximum, 75°·1. Shortly before 3 p.m, it clouded over and a violent thunderstorm occurred accompanied first by hail, and then by rain. By 4 p,m. it was quite bright again. I have seen larger hailstones on the Himalayas, but never any approaching their size in Great Britain. The stones were literally the size of very large marbles. The hail only fell quite locally, the villages on either side not getting any. The rain measured ·39 in. My solar thermometer was smashed to pieces.

C. J. BROMHEAD.

Plâs Draw, Ruthin, North Wales, May 20th, 1918.

SNOW IN ALGIERS.

I HAVE received a letter from Algiers from Rev. E. Arkwright, whose villa is about 400 ft. above sea level, and three-quarters of a mile, as the crow flies, from the innermost part of the bay of Algiers. The position may be described as a little way up the back of an armchair that is set looking N.E., *i.e.*, with higher ground near by to S.E. and to N.W. and higher still immediately to S.W.

He writes of a snow such as in forty-five years there he never has known. Certainly in my thirteen years there, from 1875 to 1889, there was nothing like it. His letter, of December 28th, 1917, says:

> "Yesterday morning snow lay apparently 12 inches deep over everything, a most lovely soft covering, and on every twig was a load of three or four inches! Our rain is also a record. Since the summer, we have had 21·17 in. It was 17·77 in. in 1916, and 18·60 in. in 1915, and both seemed to beat the record. *P.S.*—29th.—Ice on the ponds."

In my time I saw snow flakes occasionally, and snow lying only once, about an inch deep. I do not think that I ever saw ice on water more than a few inches deep. My friend does not say in what months the rain fell. It is generally almost entirely in October, November and December, especially in December.

H. A. BOYS.

North Cadbury Rectory, Somerset, January 9th, 1918.

MOUNTAIN MISTS AND WATER SUPPLY.

IN the Spanish forestry journal, *Amigos del Arbol,* for January, 1918, Dr. Perez, of Tenerife, discusses the precipitation of water from mountain mists by means of forests. He points out that the mist or cloud collected over Table Mountain, south of Cape Town, which is compared by travellers to a table cloth, forms more abundantly in the summer or rainless months when the south-east wind blows harder. He cites Dr. Marloth's experiments with two rain gauges, one representing the forest by having a series of rods rising from the funnel, the other an ordinary gauge, as described in the *Transactions of the South African Philosophical Society,* vols. 14 and 16. From December, 1902, to February, 1903, nearly 80 inches (2 metres) of water was collected in the rain gauge representing the forest and very little in the other.

In the Canary Islands the north-east Trade winds bring about the formation of a similar belt of clouds between, say, 2,000 and 5,000 feet altitude, where the evergreen forest of the Atlantic Islands grows best, and amongst them a laurel, called *Til,* which was undoubtedly the famous *Garoe* or *Holy Tree* of the Island of Ferro, which actually supplied that fountainless island with drinking water for the inhabitants until a storm blew it down. Anyone who has gone through a forest in the Canaries covered with mist can bear witness as to how much water is condensed by the foliage where trees grow. What creditable historians relate about the holy tree of Ferro is not a miracle but a scientific fact which has been proved at a similar altitude on Table Mountain, near Cape Town, under similar circumstances, and this fact should never be forgotten by those who undertake a campaign in favour of covering arid mountains by forests and thus utilizing the mountain mists in suitable localities.

We may add that the power of trees to cause the small spherules of mist to coalesce into rain-drops and drip in a steady stream to the ground is familiar to everyone who walks through an English wood during a winter mist. We have repeatedly noticed that on a misty day the road running through a forest is dry and even dusty, while the ground under the trees on either side is saturated with water, and the falling drops produce the familiar sound of a steady shower in still weather.

METEOROLOGICAL OBSERVATIONS AT LU-KIA-PANG, CHINA, FOR 1917.

By Rev. J. De Moidrey, S.J.

I.—*Barometric Pressure. Millibars.*

	8 a.m.	2 p.m.	8 p.m.	Daily Mean.
Jan.	1030·3	1028·1	1029·4	1029·4
Feb.	24·7	22·8	23·9	23·9
Mar.	23·7	21·8	22·6	22·7
April	14·2	12·6	13·3	13·3
May	11·3	09·8	10·3	10·4
June	05·8	04·9	05·3	05·2
July	*05·4*	*04·4*	*04·6*	*04·7*
Aug.	05·8	04·5	05·3	05·1
Sept.	12·3	11·0	12·2	11·8
Oct.	19·2	17·1	18·5	18·2
Nov.	30·0	24·1	25·3	25·1
Dec.	26·7	24·6	25·8	25·7
Year	1017·1	1015·5	1016·4	1016·3

IV.—*Mean amount of Cloud.*

Jan.	*3·7*
Feb.	5·5
Mar.	5·9
April	7·4
May	5·9
June	8·3
July	7·8
Aug.	5·7
Sept.	6·6
Oct.	5·9
Nov.	5·3
Dec.	3·9
Year	6·0

V.—*Days with Thunderstorms.*

Jan.	—
Feb.	—
Mar.	—
April	—
May	1*a*
June	4
July	4
Aug.	6
Sept.	1*b*
Oct.	—
Nov.	—
Dec.	—
Year	16

a First, May 3. *b* Last, September 16.

II.—*Temperature. Degrees Centigrade.*

	MEAN DAILY.			MINIMUM.				
	Mean.	Lowest.	Highest.	Mean.	Hour A.M. h.	min.	Lowest.	Highest.
	°	°	°	°			°	°
Jan.	*—0·2*	*—6·8*	+4·2	*—4·1*	5	30	*—10·5*	+3·1
Feb.	+3·4	—2·2	9·2	—0·8	4	45	—6·3	6·5
Mar.	7·1	+1·2	13·7	+2·8	4	35	—3·8	9·2
April	14·4	10·8	18·8	9·7	3	45	+5·7	12·9
May	18·7	11·4	25·6	13·3	4	5	8·6	18·8
June	23·9	18·1	31·2	20·8	3	50	15·7	26·8
July	27·3	21·8	32·1	24·6	4	50	19·3	27·8
Aug.	27·2	24·4	30·9	23·7	3	20	19·9	26·5
Sept.	23·9	19·1	29·2	21·0	4	5	19·1	26·0
Oct.	17·2	11·5	19·7	13·4	4	10	6·1	17·4
Nov.	9·5	4·6	15·1	5·7	5	5	0·6	13·7
Dec.	2·3	—6·0	11·4	—1·0	4	50	—8·8	10·9
Year	14·6	—6·8*c*	32·1*d*	10·8	4	30	—10·5*c*	27·8*e*

Latest frost, March 24th (—0°·2); earliest, December 16th (—0°·8).

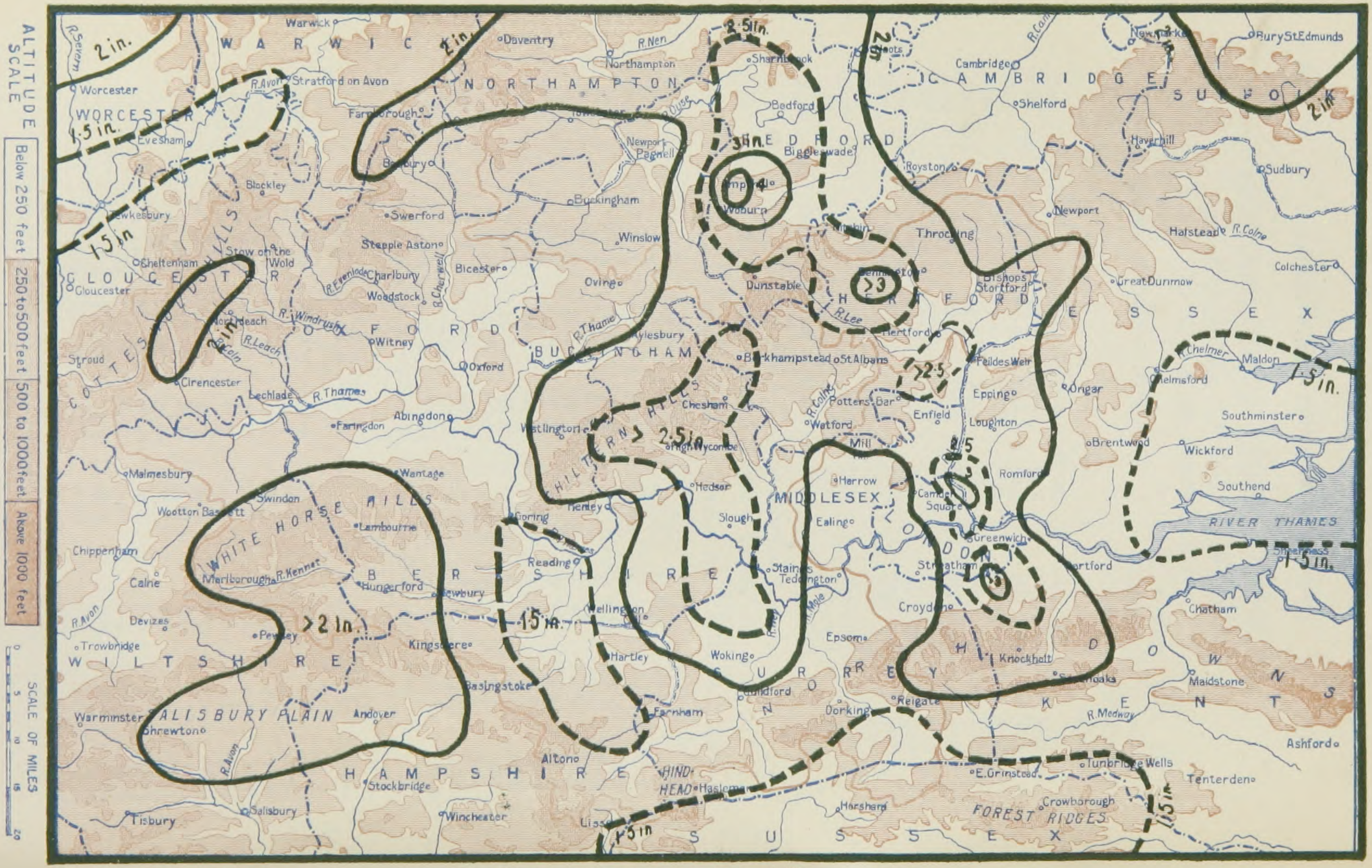
II.—(*con.*)

	MAXIMUM.					RANGE.		
	Mean.	Hour, P.M. h.	m.	Lowest.	Highest.	Mean.	Lowest	Highest.
	°			°	°	°	°	°
Jan.	*+4·9*	13	35	*—3·4*	+11·6	9·0	*1·6*	14·7
Feb.	9·3	13	50	+1·1	19·8	10·1	2·6	19·1
Mar.	12·6	13	45	4·7	23·5	9·8	1·7	18·5
April	20·8	13	50	11·8	29·3	11·4	2·6	19·3
May	25·4	14	5	13·2	34·8	12·2	3·8	20·0
June	28·0	14	5	20·1	36,3	7·2	*1·6*	15·1
July	30·8	13	30	23·8	36·5	*6·3*	2·2	9·8
Aug.	32·3	13	50	26·8	36·8	8·6	2·6	11·3
Sept.	28·6	13	10	23·8	34·2	7·6	2·1	12·4
Oct.	22·9	12	50	15·2	26·8	9·4	2·5	15·2
Nov.	14·8	13	20	9·9	20·2	9·2	2·3	15·0
Dec.	6·9	13	10	—2·7	16·0	7·8	1·8	14·0
Year	19·8	13	35	—3·4*c*	36·8*f*	9·0	1·6*g*	20·0*h*

c Jan. 8. *d* July 3. *e* July 2. *f* Aug. 12. *g* Jan 1; July 15 *h* May 18

(*To be continued*).

THAMES VALLEY RAINFALL. MAY, 1918.



Symons's Meteorological Magazine.

THE WEATHER OF MAY.

MAY opened in a most unseasonable mood. The country was, at the time, under the influence of a cold easterly wind, blowing in the front of a shallow cyclonic system which lay off our south-west coasts; and on the 1st there were few places in which the maximum thermometer touched 50°, and, in the north and east, several places in which it did not reach 45°. On the same night a sharp ground frost occurred in many northern districts, the exposed thermometer falling to 21°, at Blackpool, Aberdeen and Balmoral, and to 23°, at West Linton. Between the 2nd and 6th, the south-western disturbance extended very slowly over nearly the whole kingdom, and the weather became generally unsettled, thunderstorms occurring at some southern stations on the 3rd, and heavy rain in the north-east of Great Britain on the 5th and 6th. The cold easterly wind was, however, soon replaced by more variable breezes, and temperature rose to a fairly seasonable level, the maximum readings on the 4th being in many places quite 15° higher than those of the 1st. With the opening of the second week the conditions, though still changeable, assumed a more normal aspect. For the next few days the weather was influenced by Atlantic depressions which spread in from the westward or north-westward, causing winds from between S. and W., with temperatures differing but little from the average. Between the 9th and 11th, the thermometer rose above 65° in many districts, and touched 71° at Kilmarnock and Waterford.

After the middle of the month anticyclonic conditions were in the ascendant and the weather was, therefore, generally fine. There were, however, two important breaks, one on the 17th, the other on the night of the 22nd or on the 23rd. In each case thunderstorms were very prevalent, those of the latter dates finding their way to almost every corner of Great Britain. In some instances the storms were accompanied by exceedingly heavy falls of rain and hail; on the 17th nearly 3 inches of rain fell at Fulbeck, and on the 23rd nearly 3¼ inches at Beddgelert. Between the 20th and 22nd, temperature rose to an unusually high level for the time of year, readings of 80° and upwards being recorded in nearly all the English districts, and a reading of 84° at Manchester and Clifton (Bristol). Later on the wind, though light, was mainly from some easterly quarter, and the weather was, therefore, much cooler, but at the same time exceedingly fine and bright. In the south-west of England and the south of Ireland the duration of sunshine in the closing week (ended June 1st) amounted to more than 75 per cent., and at Valencia (Cahirciveen) to as much as 88 per cent., of the possible for the season.

The distribution of rainfall during the month was patchy, on account of local thunderstorms. These appear to have been most severe in the south-east Midlands of Englands and particularly in the neighbourhood of Woburn, where very severe flooding and hail occurred on the 17th. The effect of these storms on the rainfall map of the Thames Valley, facing this page, is well marked, and reference is made to their destructive effect in our correspondence pages. Apart from this most of the south of England had less than 2 inches of rain, and the north rather more than 2 inches. Scotland was slightly wetter, but with very moderate falls in the Western Highlands and there, as in Ireland also, the tendency was for the rainfall to be relatively greater in the east than the west. The general rainfall in the countries, expressed as a percentage of the average, was;—England and Wales, 113; Scotland, 94; Ireland, 91; British Isles, 100.

In London (Camden Square), the mean temperature was 57°·7, or 3°·7 above the average of 50 years. The duration of bright sunshine was 185·2 hours, and the duration of rainfall, 28·8 hours. Evaporation, 2·38 in.

RAINFALL TABLE FOR MAY, 1918.

STATION.	COUNTY.	RAINFALL. Aver. 1875—1909. in.	1918. in.	Diff. from Av. in.	Per cent. of Av.	Max. in 24 hours. in.	Date.	No. of Days
Camden Square	*London*	1·75	2·11	+ ·36	121	·49	22	11
Tenterden	*Kent*	1·65	1·76	+ ·11	106	·41	5	12
Arundel (Patching)	*Sussex*	1·80	1·83	+ ·03	102	·71	4	9
Fordingbridge (Oaklands)	*Hampshire*	2·09	1·54	— ·55	74	·46	7	9
Oxford (Magdalen College)	*Oxfordshire*	1·81	1·77	— ·04	98	·36	12	9
Wellingborough (Swanspool)	*Northampn*	1·98	2·32	+ ·34	117	·53	3	10
Bury St. Edmunds (Westley)	*Suffolk*	1·93	2·51	+ ·58	130	1·43	23	10
Geldeston [Beccles]	*Norfolk*	1·78	·93	— ·85	52	·42	12	7
Polapit Tamar [Launceston]	*Devon*	2·08	·82	—1·26	40	·15	25	12
Rousdon [Lyme Regis]	,,	2·02	1·68	— ·34	83	·46	12	11
Stroud (Field Place)	*Gloucester*	2·10	1·72	— ·38	82	·50	17	10
Church Stretton (Wolstaston)	*Shropshire*	2·64	3·54	+ ·90	134	1·38	23	13
Boston	*Lincoln*	1·80	3·59	+1·79	200	1·43	17	9
Worksop (Hodsock Priory)	*Nottingham*	2·08	1·95	— ·13	95	·53	3	9
Mickleover Manor	*Derbyshire*	2·10	2·86	+ ·76	136	·93	23	10
Buxton	,,	3·30	...	...	...	...	...	...
Southport (Hesketh Park)	*Lancashire*	2·13	3·28	+1·15	154	1·07	22	13
Wetherby (Ribston Hall)	*York, W.R.*	2·09	3·92	+1·83	188	·87	21	8
Hull (Pearson Park)	,, *E.R.*	1·98	2·05	+ ·07	103	·45	11	10
Newcastle (Town Moor)	*North'land*	2·04	1·67	– ·37	82	·67	5	11
Borrowdale (Seathwaite)	*Cumberland*	7·50	...	...	...	...	...	...
Cardiff (Ely)	*Glamorgan*	2·56	1·43	—1·13	56	·44	7	14
Haverfordwest	*Pembroke*	2·62	1·62	—1·00	62	·34	12	8
Aberystwyth (Gogerddan)	*Cardigan*	2·63	5·03	+2·40	192	1·68	23	11
Llandudno	*Carnarvon*	1·86	3·70	+1·84	200	·74	23	10
Cargen [Dumfries]	*Kirkcudbrt.*	2·87	2·55	— ·32	89	·40	25	12
Marchmont House	*Berwick*	2·53	2·46	— ·07	97	·74	5	9
Girvan (Pinmore)	*Ayr*	2·98	2·52	— ·46	84	·94	22	17
Glasgow (Queen's Park)	*Renfrew*	2·40	2·15	— ·25	89	·40	5	16
Islay (Eallabus)	*Argyll*	2·58	2·44	— ·14	95	·47	14	16
Mull (Quinish)	,,	2·99	3·49	+ ·50	116	·67	14	20
Balquhidder (Stronvar)	*Perth*	4·10	2·96	—1·14	72	1·48	22	9
Dundee (Eastern Necropolis)	*Forfar*	2·05	3·58	+1·53	175	·85	4	16
Braemar	*Aberdeen*	2·33	2·87	+ ·54	123	·67	22	10
Aberdeen (Cranford)	,,	2·40	1·85	— ·55	77	·73	6	14
Gordon Castle	*Moray*	2·10	1·78	— ·32	85	·45	11	13
Drumnadrochit	*Inverness*	2·33	3·18	+ ·85	136	·94	25	17
Fort William	,,	3·93	3·22	— ·71	82	·66	14	18
Loch Torridon (Bendamph)	*Ross*	4·54	2·85	—1·69	63	·50	9	15
Dunrobin Castle	*Sutherland*	2·19	1·75	— ·44	80	·38	22	11
Glanmire (Lota Lodge)	*Cork*	2·54	2·45	— ·09	96	·82	2	11
Killarney (District Asylum)	*Kerry*	3·05	2·15	— ·90	70	·54	3	15
Waterford (Brook Lodge)	*Waterford*	2·33	2·65	+ ·32	114	·67	3	12
Nenagh (Castle Lough)	*Tipperary*	2·51	2·74	+ ·23	108	·68	3	12
Ennistymon House	*Clare*	2·70	2·06	— ·64	76	·45	6	13
Gorey (Courtown House)	*Wexford*	2·24	2·74	+ ·50	122	·66	23	14
Abbey Leix (Blandsfort)	*Queen's Co.*	2·43	2·60	+ ·17	107	·40	3	14
Dublin (FitzWilliam Square)	*Dublin*	2·07	2·27	+ ·20	110	·42	3	10
Mullingar (Belvedere)	*Westmeath*	2·51	1·93	— ·58	77	·50	3	11
Crossmolina (Enniscoe)	*Mayo*	3·17	2·58	— ·59	82	·44	3	20
Cong (The Glebe)	,,	2·94	2·18	— ·76	74	·53	14	16
Collooney (Markree Obsy.)	*Sligo*	2·80	2·06	— ·74	74	·39	20	16
Seaforde	*Down*	2·72	2·81	+ ·09	104	1·12	3	14
Ballymena (Harryville)	*Antrim*	2·84	2·17	— ·67	77	·33	3	18
Omagh (Edenfel)	*Tyrone*	2·66	2·52	— ·14	95	·60	22	15

SUPPLEMENTARY RAINFALL, MAY, 1918.

Div.	STATION.	Rain inches.	Div.	STATION.	Rain inches.
II.	Warlingham, Redvers Road..	2·21	XI.	Lligwy	2·94
,,	Ramsgate	1·73	,,	Douglas, Isle of Man	2·87
,,	Hailsham	1·77	XII.	Stoneykirk, Ardwell House...	3·55
,,	Totland Bay, Aston House...	1·33	,,	Carsphairn, Shiel	2·54
,,	Stockbridge, Ashley..	1·66	,,	Langholm, Drove Road	2·90
,,	Grayshott	1·59	XIII.	Selkirk, The Hangingshaw..	2·40
III.	Harrow Weald, Hill House...	1·86	,,	North Berwick Reservoir	2·10
,,	Pitsford, Sedgebrook	1·78	,,	Edinburgh, Royal Observaty.	2·93
,,	Woburn, Milton Bryant	4·83	XIV.	Biggar	1·86
,,	Chatteris, The Priory	1·73	,,	Maybole, Knockdon Farm ...	2·44
IV.	Elsenham, Gaunts End	2·05	XV.	Buchlyvie, The Manse	2·74
,,	Shoeburyness	1·35	,,	Ardgour House	4·30
,,	Colchester, Hill Ho., Lexden	1·74	,,	Oban	2·99
,,	Ipswich, Rookwood, Copdock	1·66	,,	Campbeltown, Witchburn ..	4·25
,,	Aylsham, Rippon Hall	1·13	,,	Holy Loch, Ardnadam	4·86
,,	Swaffham	2·93	,,	Tiree, Cornaigmore	...
V.	Bishops Cannings	2·02	XVI.	Glenquey	3·30
,,	Weymouth	1·83	,,	Loch Rannoch Wall	3·71
,,	Ashburton, Druid House..	1·26	,,	Blair Atholl	3·84
,,	Cullompton	1·43	,,	Coupar Angus	3·08
,,	Lynmouth, Rock House	1·27	,,	Montrose, Sunnyside Asylum.	3·33
,,	Okehampton, Oaklands	1·49	XVII.	Balmoral	2·11
,,	Hartland Abbey	1·29	,,	Fyvie Castle	1·90
,,	St. Austell, Trevarna	1·11	,,	Keith Station	1·75
,,	North Cadbury Rectory	1·87	XVIII.	Rothiemurchus	2·19
VI.	Clifton, Stoke Bishop	2·08	,,	Loch Quoich, Loan	4·06
,,	Ledbury, Underdown	1·55	,,	Skye, Dunvegan	3·21
,,	Shifnal, Hatton Grange	3·76	,,	Fortrose	2·90
,,	Droitwich	2·31	,,	Glencarron Lodge	2·11
,,	Blockley, Upton Wold	1·86	XIX.	Tongue Manse	1·75
VII.	Grantham, Saltersford	1·42	,,	Melvich	1·43
,,	Market Rasen	...	,,	Loch More, Achfary	1·84
,,	Bawtry, Hesley Hall	2·21	XX.	Dunmanway, The Rectory ..	2·58
,,	Whaley Bridge, Mosley Hall	3·24	,,	Gap of Dunloe Gearahameen	3·40
,,	Derby, Midland Railway	3·25	,,	Mitchelstown Castle	2·24
VIII.	Nantwich, Dorfold Hall	2·41	,,	Darrynane Abbey	...
,,	Bolton, Queen's Park	3·02	,,	Clonmel, Bruce Villa	2·12
,,	Lancaster, Strathspey	2·19	,,	Broadford, Hurdlestown	2·69
IX.	Langsett Moor, Up. Midhope	2·73	XXI.	Enniscorthy, Ballyhyland...	2·81
,,	Scarborough, Scalby	2·51	,,	Rathnew, Clonmannon	2·40
,,	Ingleby Greenhow	2·14	,,	Ballycumber, Moorock Lodge	1·67
,,	Mickleton	1·70	,,	Balbriggan, Ardgillan	2·52
X.	Bellingham, High Green Manor	1·48	,,	Castle Forbes Gardens	1·72
,,	Ilderton, Lilburn Cottage ...	2·02	XXII.	Ballynahinch Castle	3·23
,,	Keswick, The Bank	1·82	,,	Woodlawn	2·22
XI.	Llanfrechfa Grange	—	,,	Westport, St. Helens	1·79
,,	Treherbert, Tyn-y-waun	2·65	,,	Dugort, Slievemore Hotel ...	1·80
,,	Carmarthen, The Friary	1·70	XXIII.	Enniskillen, Portora	1·99
,,	Fishguard, Goodwick Station.	1·49	,,	Dartrey [Cootehill]	2·09
,,	Crickhowell, Tal-y-maes	...	,,	Warrenpoint, Manor House ..	2·95
,,	New Radnor, Ednol	2·77	,,	Belfast, Cave Hill Road	3·08
,,	Birmingham W W., Tyrmynydd	3·73	,,	Glenarm Castle	3·12
,,	Lake Vyrnwy	4·08	,,	Londonderry, Creggan Res...	2·29
,,	Llangynhafal, Plas Drâw	3·58	,,	Milford, The Manse	2·04
,,	Rhwibryfdir	6·11	,,	Killybegs	2·47
,,	Dolgelly, Bryntirion	5·27			

Climatological Table for the British Empire, December, 1917.

STATIONS.	Absolute.				Average.				Absolute.		Total Rain		Aver.
	Maximum.		Minimum.										
(*Those in italics are South of the Equator.*)	Temp.	Date.	Temp.	Date.	Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	53·8	1	21·6	19	41·1	31·3	32·4	87	82·8	18·9	1·11	14	7·0
Malta	66·2	1	41·2	6	59·1	50·8	...	75	110·0	33·5	2·31	15	2·5
Lagos	89·0	var.	69·0	6	87·9	74·4	74·7	78	147·0	68·3	1·60	6	5·7
Cape Town	94·0	9	53·3	30	78·7	59·0	54·1	60	...	...	·46	3	2·5
Johannesburg	79·5	5	47·2	2	71·4	53·7	54·7	81	...	47·0	7·71	22	7·0
Mauritius	88·9	18	63·7	6	83·8	69·3	64·8	73	...	57·6	1·40	12	5·2
Bloemfontein	88·8	4	50·5	9	84·2	57·6	52·8	55	..	...	2·30	10	4·4
Calcutta...	80·1	10	50·7	24	76·4	55·9	55·0	70	...	43·9	·00	0	1·6
Bombay...	86·3	24	62·7	31	82·8	68·7	65·3	71	137·2	53·9	·00	0	0·5
Madras	86·9	31	63·7	30	82·6	69·0	67·8	78	156·9	59·4	6·06	7	4·9
Colombo, Ceylon ...	86·8	24	64·4	29	84·3	70·9	69·6	80	166·1	55·8	4·30	9	5·3
Hongkong	71·7	1	46·9	31	63·7	55·2	46·6	60	...	...	1·14	3	4·3
Sydney	100·0	23	58·2	11	77·3	63·5	59·8	64	153·0	51·9	1·76	14	5·3
Melbourne	101·0	22	48·7	14	78·1	57·9	52·8	57	153·7	41·4	2·89	6	5·1
Adelaide	104·0	22	47·5	9	85·3	61·5	52·6	44	159·4	39·2	1·02	4	4·1
Perth	95·3	31	51·2	4	77·5	59·3	56·7	66	158·2	44·0	1·96	7	4·5
Coolgardie	105·0	15	52·0	4, 11	86·6	59·8	50·6	42	173·0	45·0	1·02	6	3·2
Hobart, Tasmania ..	87·8	16	42·0	10	70·2	53·5	49·9	64	150·0	35·3	·89	13	6·4
Wellington	76·0	3	45·2	17*b*	67·9	54·4	51·7	71	148·0	34·5	2·86	16	5·8
Jamaica, Kingston ...	87·2	11	63·1	27	83·7	68·0	66·2	79	...	...	1·04	8	2·7
Grenada	86·0	13*a*	70·0	4*c*	88·0	72·0	...	77	138·0	...	7·08	20	5·0
Toronto	41·6	24	—17·0	29	26·7	12·4	13·2	82	78·2	—20·2	2·40	14	...
Fredericton	38·0	9	—25·0	30	21·3	—25·0	5 0	...	...	...	2·15	10	5·6
St. John, N.B. ...	46·5	9	—19·7	30	25·7	8·9	15·8	76	90·0	—20·0	3·04	15	6·2
Victoria, B.C.	56·4	31	27·5	24	45·4	37·3	39·0	90	93·0	22·5	13·02	27	8·8

a—20, 23. *b*—19. *c*—24, 26, 31.

Johannesburg.—Bright sunshine 179·8 hours.

COLOMBO, CEYLON.—Mean temp. 77°·6, or 1°·2 below, dew point 1°·4 below, and R ·01 in. above, averages. Mean hourly velocity of wind 4·6 miles.

HONGKONG.—Mean temp. 59°·2. Bright sunshine 209·0 hours. Mean hourly velocity of wind 11·6 miles.

Melbourne.—Temp. was over 90° for seven consecutive days, an absolute record for early heat in Victoria.

Adelaide.—Mean temp. 2°·3 above, and R ·06 in. above, averages.

Perth.—Rainfall 1·41 in. above average.

Coolgardie.—Temp. 2°·8 below, and R above, averages.

Hobart.—Temp. 1°·5 above, and R 1·10 in. below, averages.

Wellington.—Mean temp. 0°·8 above, and R ·43 in. below, averages. Bright sunshine, 217·4 hours; early part of the month bright and sunny, and latter part cloudy and showery.

Symons's
Meteorological Magazine.

No. 630. JULY, 1918. Vol. LIII.

SIR NAPIER SHAW ON REVOLVING FLUID IN THE ATMOSPHERE.

In a recent memoir communicated to the Royal Society* Sir Napier Shaw gives an extremely interesting and important summary of his views on the subject of "revolving fluid in the atmosphere" following Lord Rayleigh's contribution to the dynamics of this subject based on the paper by Dr. John Aitken, F.R.S. on "The Dynamics of Cyclones and Anticyclones." Lord Rayleigh in the introduction to his paper remarked that "so much of meteorology depends ultimately upon the dynamics of revolving fluid that it is desirable to formulate as clearly as possible such simple conclusions as are within our reach," with the object of finding their application in the phenomena shown by cyclones and anticyclones. At the beginning of the paper Sir Napier Shaw states that in the twenty years during which he has been practically concerned with the progress of dynamical meteorology and the explanation of the observed phenomena of cyclones and anticyclones he has deliberately avoided the discussion of the theory of revolving fluid because he could not find it in the weather maps which form the starting point for such an investigation. In several previous investigations, of which the most exhaustive was the well known memoir dealing with "The Life-History of Surface Air Currents," it was clearly shown that in our latitudes cyclones and anticyclones are not examples of revolving fluid in the special sense referred to, and for that reason cannot be explained on the hypothesis that they are. The situation is summed up by the statement that "if the motion of the air had really been motion of a revolving fluid symmetrical with regard to a vertical axis it would not have appeared in circular form on the map. If it looks circular it is not a case of revolving fluid." This apparent paradox is explained thus, that the rate

* *Royal Soc. Proc.*; A, Vol. 94, pp. 34-52.

at which all the depressions of well marked circular form in our latitudes travel is much the same as that of the wind velocity of which they are composed. Stationary depressions are of irregular form and do not show the characteristic features of strong winds with a definite centre." But when the motion of translation is of the same order of magnitude as the winds the instantaneous motion is round a moving centre, and the actual motion with reference to the centre is the apparent uniform motion round the centre shown on the map combined vectorially with a velocity equal and opposite to that of the translation of the cyclone. Consequently the appearance of uniform and symmetrical instantaneous motion in a cyclone is in itself proof that we have not in that case symmetrical motion, about a centre, of a mass which travels as a whole. In other words the motion of air in cyclones is not the motion of revolving fluid in the special sense referred to." In "The Life History of Surface Air Currents," this conclusion was amply confirmed for all classes and forms of depressions. Cyclonic motion is, therefore, not analogous to that of a vortex ring travelling in air, but on the other hand the trajectories of a moving cyclonic disturbance show that the air flows through the depression. The vortex, therefore, does not actually breathe or pulsate. Visible examples of revolving fluid whose existence cannot be denied are are to be found in the eddy of dry leaves in a gusty wind at a street corner, the "dust-devil" of Eastern deserts, the water spout, the whirlwind, and the tropical cyclone, which is universally treated in text books of meteorology as a gigantic eddy typically analagous to the vortex ring. These, Sir Napier Shaw says, *may* (the italics are ours) be cases of revolving fluid, but they do not correspond with the phenomena of the cyclonic depressions of middle latitudes such as those experienced in the British Isles, where, during the ten years ending with 1916, a new cyclonic depression was shown on the weather maps on the average every third day. It is pointed out that a cyclonic disturbance which began as revolving fluid in the tropics is gradually transposed in higher latitudes into an ordinary cyclonic depression "and yet we have to deny the identity of the two types of phenomenon." Here a short digression containing a mathematical proof is given to show how the revolving tropical cyclone passes into the depression of our own latitudes, and how it is quite possible that in the end "the conditions necessary for maintaining a core of revolving fluid disappear and the whole system degenerates (if that is the correct expression) into cyclonic motion without a core of revolving fluid." There is nothing in the weather maps to contradict such a suggestion, although it is pointed out that owing to the destruction of buildings, instruments and sometimes the human beings who attend to them, the tropical revolving storm is a very unsatisfactory example of revolving fluid for scientific purposes. It is thus impossible to ascertain whether the behaviour of a tropical storm is in harmony with Lord Rayleigh's theory or Dr. Aitken's practical illustrations. Sir Napier Shaw in his investigations starts with the assumption which meteorologists cannot deny that temporary whirls are actually visible, and cites a case described by Mr. R. H. Curtis of a whirl which carried off the sheets of music from an open-air band-stand with a spinning motion to a great height and dropped them some miles away. Here there are obviously two elements, the current which carries the whirl, and the whirl within the current. The supposition is made that we have here a mass of revolving fluid with a discontinuity of velocity at the circle bounding the revolving mass. There may be a relation at the margin of the whirl and the wind in the current which carries it, but as shown by Lord Rayleigh, and Dr. Aitken, the velocity in the whirl at any time depends upon dynamical or physical processes within the whirling mass itself. No general assumption can therefore be made of a relation between the velocity in the whirl and the rate of its translation. The difficulty of investigating small whirls is that they cannot be detected on the working weather map, if under twenty miles in diameter. The vortex that appears on such a map it is shown " must be more like a penny than a pin." A method was devised for the investigation and identification of vortices having a temporary existence in the atmosphere, but not to be found directly on the map. This is described on pp. 40-44 of Sir Napier Shaw's paper, but considerations of space render it impossible to go into the matter here with the fulness necessary for a clear understanding of the procedure. It will be sufficient to say that in addition to a large number of illustrative cases two special cases are cited, *viz.*, the destructive " secondary " depression of March 24th, 1895, which in the eastern counties of England was unattended with any rainfall either before, or during, or after the strong wind. Except for the wind it was a fine afternoon and remained so. The second case is the tornado in Devonshire and South Wales on October 27th, 1913, which did not appear on the working charts at 6 p.m. when the greatest damage was done. The first case may " be cited as a good example of revolving fluid carried along in a main current, the velocity of translation being governed by the spacing of the isobars of the main depression outside the area affected by the local rotation, and, in virtue of this, the air which formed the mass of revolving fluid over the south of Ireland at 8 a.m., was carried along bodily to Denmark by 6 p.m." As a good deal of rain fell in the west its existence is *prima facie* evidence of considerable convection in the atmosphere. It is thus reasonable to suppose that the special conditions involved in the maintenance of a column of revolving fluid are satisfied, namely that the wind velocity in the surrounding medium should be the same at all elevations. The second case cited, *viz.*, the tornado in the Taff Valley, Glamorgan, in which the barograph near the centre showed a sudden fall and recovery of 10 mb. (·30 in.), within less than one minute, and where the localities where damage was done were those of heavy rainfall, was evidently associated with a very definite line of discontinuity marking off the area of rotational velocity from its environment. The destruction in South Wales seems to have been occasioned by the conveyance of the air within the moving column of revolving fluid, forming an excellent example of the progression of revolving fluid, although it was impossible to identify it on a map. Sir Napier Shaw sums up his conclusions in the following words, "We are thus able to draw a definite distinction between the cyclonic or anticyclonic motion as exhibited in the atmosphere and cases of revolving fluid motion. In the latter there is rotation about the vertical axis and the whole mass of revolving fluid is carried along bodily in a current of air which has a velocity corresponding with its position in the main cyclonic system and which can be related to the run and the distance apart of the isobars. There is practical discontinuity of velocity between this current and the rotating mass, and there is no relation between the velocity of wind in the whirl and the velocity of translation in which the whirl travels over the country. In the case of a cyclonic depression the travel over the country is a part of the motion of the wind in the cyclone itself. There is no discontinuity of velocity. The wind so moves that each part of it revolves about a centre which has a motion of translation. The rate of progress of the centre depends upon the curvature of the path of the air in the cyclone, and the motion of the centre is apparently due to the fact that the cyclostrophic component of the pressure is governed by the radius of curvature of the path and not by the radius of the circle of instantaneous motion. The motion in a travelling cyclonic depression is therefore of a different type from that of motion in a circle with a superposed velocity of translation." The memoir concludes with a supplementary note remarking that the terms used by the author are remarkably similar to those employed by Prof. R. de C Ward in his investigation on "Tornadoes in the United States," published last July in the *Quar. Jour. Roy. Met. Soc.* There can be little doubt that these violent manifestations are columns of revolving fluid developed locally in the southern portions of large cyclones and carried along with the ordinary wind of the cyclone in which they are formed.

R. C. M.

ROYAL METEOROLOGICAL SOCIETY.

THE last monthly meeting for the 1917-18 Session was held on June 19th, at 70, Victoria Street, S.W., Sir Napier Shaw, F.R.S., President, in the Chair.

Dr. S. Chapman, F.R.A.S., read a paper entitled "The Lunar Atmospheric Tide at Greenwich, 1851-1917." The tidal forces, due to the moon, affect the aerial as well as the fluid ocean, and the lunar atmospheric tide is manifested by a periodic variation in the height of the barometer having two maxima and two minima (high and low tide) in the course of a lunar day. This variation is much smaller than the solar semi-diurnal barometric variation, which is not a simple solar tidal effect ; the minute lunar variation, however, can be detected with ease in the records of tropical observatories, where the irregular fluctuations of pressure are small. Attempts to determine it in the records of European observatories have been made, but hitherto without success. By treating hourly observations of "quiet" days only, on which the barometric range did not exceed 0·1 in., and by abstracting the solar variation, the lunar atmospheric tide at Greenwich has now been ascertained. Its total amplitude is less than 0·001 in., the harmonic formula being $0{\cdot}00038 \sin (2t + 114°)$ inch, where "t" represents lunar time measured, at the rate of 360° per lunar day, from the epoch of upper transit. A comparison with the variation at Batavia (lat. 6° S.), viz., $0{\cdot}00256 \sin (2t + 65°)$ inch, suggests that the amplitude varies as the fourth power of the cosine of latitude, and that the phase also varies with latitude.

A paper by Mr. Miller Christy was also read, entitled, "The Audibility of Gunfire on the Continent at Chignal St. James, near Chelmsford, during 1917," in which the author continued his series of observations of the sound of gunfire commenced in 1915 and published by the Society in 1916. In the present paper the record is confined entirely to Mr. Christy's observations at Chignal St. James. The most interesting point in connection with the observations is that there is apparently (1) a regular and well-defined season or period during which the gunfire is usually audible with ease, and that this is followed by (2) a longer season or period during which the gunfire is seldom or never heard. The following are the earliest and latest dates of the sound of the gunfire on the Continent as heard at Chignal St. James during the three years 1915-1917 :—

1915—From about	**1st May**	**to about**	**31st August**	**= 17 weeks**	**3 days**
1916— ,, ,,	**1st May**	,,	**15th August**	**= 15** ,,	**1** ,,
1917— ,, ,,	**22nd April**	,,	**6th Sept.**	**= 19** ,,	**4** ,,

Mr. F. J. W. Whipple, F.R.Met.Soc., contributed a paper entitled, "Seasonal Variation in the Audibility of Gunfire." Mr. Christy's observations indicate that in Essex continental gunfire is only heard during the summer months. On the other hand, evidence collected by W. Brand and published in the *Meteorologische Zeitschrift*, in February, 1917, indicates that in Germany at places 100 km. or more from the firing line, such sounds are only heard during the winter. Thus it appears that in summer the outer zone of audibility lies to the west of the source of sound, in winter to the east. No theory hitherto put forward in explanation of the existence of the outer zone of audibility is in accord with this generalization.

The following gentlemen were elected Fellows of the Society :—Messrs. F. G. Bales, J. Hooley, H. E. Richards, F. L. Watkins, Rev. T. E. R. Phillips, Lieut. W. H. Pick, R.E. and Ensigns P. J. Barnes, J. C. Boyd, A. Gardner, H. le G. Goodspeed and W. S. Vanderbilt, of the U.S. Naval Reserve Force.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

DRY AIR AT TOTLAND BAY.

THE mean humidity for the month of June at 9 a.m. (Greenwich time) amounted to only 69·4 per cent. This is the driest June atmosphere during all the thirty-two Junes I have taken readings at Totland Bay. The nearest approach to it was in June, 1911, with a relative humidity of 71·3 per cent. The boundary line of Totland parish measures eight miles; six of these miles are washed by the sea.

An absolute drought of 17 days ended on June 8th, showing a deficiency of 97 tons of rain water to the acre, and a partial drought of 33 days terminated on June 14th, giving a deficiency of 157 tons of water to the acre.

On June 15th, we had the unusual scene for half an hour of fields all white with large hailstones in the late afternoon; distant thunder, but no lightning accompanied the hail.

Many places have had ground frosts this June, but the nearest approach to it here was a temperature of 35·9 F. by the exposed thermometer on the grass on June 26th. JOHN DOVER.

Aston House, Totland Bay, Isle of Wight.

BLACK RAIN.

In case it is of any interest I am reporting to you that in a very heavy rainfall, on Monday afternoon, June 17th, here (about 6 p.m. summer-time) the rain was black as if full of soot, not only close to buildings but in the rain gauge. I was not at home at the time, but my daughter kept the contents. I understand the wind was northerly. Could the storm have brought London smoke in suspension? We are about twenty-nine miles from the City, but it is the only solution I can think of. T. H. W. BUCKLEY.

The Grange, Crawley Down, June 19th, 1918.

WARM MAYS.

During recent years there has been a remarkable predominance of warm Mays According to the Meteorological Office Calendar, the mean temperature for May in the Midlands, as derived from observations made in the period 1881-1905, is 51°·1, F.

This value has been exceeded here in nine out of the past eleven years. The mean temperature of May for the decade 1908-17 was 52°·9, and, according to the law of averages, a cold May was certainly due in 1918. Yet the May just passed was warmer than any in the preceding ten years. The mean temperature was as high as 55°·9, with "summer heat" on six days, and a maximum reading of 84°—the highest temperature recorded here in May during the past quarter century. DAVID HILL OWEN.

Sparkhill, Birmingham, June 7th, 1918.

DIURNAL VARIATION OF PRESSURE AND WIND VELOCITY.

It is well known that at exposed places like the top of Ben Nevis, and probably also at other stormy spots on our western coasts, the barometric pressure is reduced appreciably with winds above a certain force. This effect increases with each augmentation in wind velocity and is due to the suck-out of air from the room in which the barometer is hung. As wind velocity has a well-marked diurnal range, the hourly values of pressure must be modified accordingly, especially at places where the wind velocity is high, and its daily range considerable. Has this factor ever been taken into account in discussing the diurnal range of pressure in exposed situations?

R. C. MOSSMAN.

Edinburgh, June 4th, 1918.

LOCAL WHIRLWIND.

My gardener has told me of a curious little whirlwind he witnessed some days ago. Two men were digging a piece of ground in the middle of the orchard where the apple trees are far apart, sloping towards south-east, they heard a noise like distant thunder ; as it continued they looked up and saw dead leaves being swept up from the ground and whirled to a height of 40 feet. This whirlwind moved in an irregular direction, and when it passed near them seemed to be icy cold. I believe it was a sunny afternoon, with north-east wind.

R. B. ROGERS.

Hexworthy, Launceston, Cornwall, April 26th, 1918.

GOVERNMENT COMMITTEE ON WATER POWER.

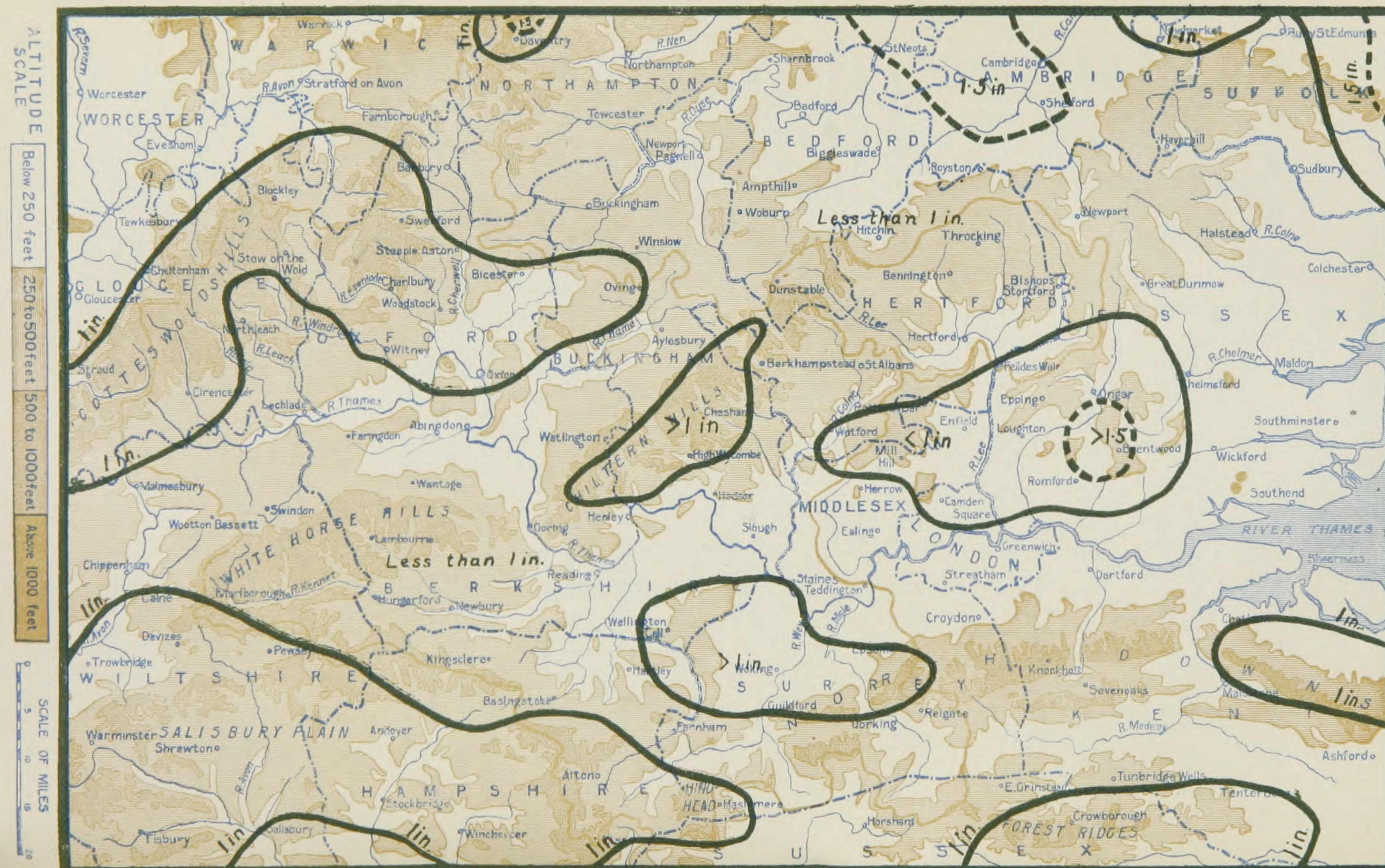
The Board of Trade, with the concurrence of the Ministry of Reconstruction, have appointed a Committee to examine and report upon the Water Power resources of the United Kingdom, and the extent to which they can be made available for industrial purposes. The following are the members of this Committee :—Sir John F. C. Snell, C.E., Chairman ; Mr. G. S. Albright, Mr. H. F. Carlill (Board of Trade), Sir Dugald Clerk, F.R.S., Dr. J. F. Crowley, Mr. Philip Dawson, Professor Gibson of University College, Dundee, Mr. Vernon Hartshorn, Dr. H. R. Mill, Mr. A. Newlands, C.E., Mr. G. C. Vyle (Associated Chambers of Commerce), Mr. A. J. Walter, K.C., Mr. Ralph Walter (Ministry of Reconstruction) and Mr. D. J. Williams. Mr. R. T. G. French is the Secretary of the Committee, the address of which is 10, Princes Street, Westminster, London, S.W. 1.

The Sub-Committee of the Conjoint Board of Scientific Societies for enquiring into the Water Power of the British Empire, under the chairmanship of Sir Dugald Clerk, has, as the result of its investigations drawn up a preliminary report for presentation to the Conjoint Board.

NEW POSTAL RATES.

Rainfall observers who send in monthly postcards (British Rainfall, Form C.) can continue to do so at the ½d. rate of postage, provided that when completed in hand-writing the latter refers solely to the subject matter. This would exclude any remark other than one relating to the weather of the month. Until a new edition of cards can be printed, the words " Post Card " should be struck out and the words " Printed Paper " substituted.

THAMES VALLEY RAINFALL JUNE, 1918



Symons's Meteorological Magazine

Watershed of River Thames above Teddington, and River Lea above Feildes Weir

THE WEATHER OF JUNE.

A SPELL of fine warm weather, which had commenced about the third week in May, continued throughout the early days of June. On the 2nd, which proved by far the hottest day of the month, the thermometer rose slightly above 80° in many parts of England and Ireland, and reached 83° at Camden Square and 84° at Killarney. In the eastern, central and south-eastern districts the nights were, however, cold, and between the 3rd and 5th, a sharp ground frost occurred in many places, the exposed thermometer falling to 19° at Raunds (Northants), 26° at Greenwich, and 27° at Wisley.

Towards the close of the first week an absolute drought (which had, however, only just exceeded the prescribed limits) came to an end, and for more than a fortnight the weather was generally cool and showery. The wind was usually from some point between W. and N., and on the 9th and 10th, when small depressions moved south-eastwards across the country, a gale was experienced in many of the western and northern districts, the velocity of the wind in gusts being as high as 76 miles per hour at Aberdeen. Between the 12th and 15th, a large cyclonic disturbance passed slowly eastwards from Iceland to Scandinavia, while further secondaries moved directly across the United Kingdom. Thunderstorms were experienced in many isolated parts of Great Britain on the 15th, and in the south-east of England on the 16th and 17th, while on the 18th and 19th, when a well marked depression moved eastwards across our southern districts, a heavy fall of rain occurred in some parts of Devonshire and South Wales. The day temperatures recorded about this time were extremely low for the time of year, the thermometer in many places failing to reach 55°, and the nights were also very cold. One of the most striking features in the weather of June was in fact the general prevalence of ground frosts. In addition to the cases already quoted (between the 3rd and 5th) the phenomenon was observed on the nights of the 14th the 16th-17th, and between the 23rd and 25th. At Benson (Oxon.) ground frost occurred during the month on as many as eight nights, three of which were consecutive. Strong N.W. winds, which prevailed on the 22nd, again reached gale force in many places, the gusts blowing with a velocity of 60 miles an hour, at Southport, and 54 miles at Paisley, Eskdalemuir and Holyhead. In the closing week the weather became more settled, and although the nights remained cold the day temperatures gradually rose to a point slightly in excess of the June average.

The total amount of bright sunshine for the month was in excess of the normal. In most districts the departure was slight, but in England S.W. the mean daily duration was an hour and a half more than the average.

The rainfall was practically everywhere below the average, most so in England, where only a few districts had as much as 50 per cent. In the east of Scotland also less than half the average fell. The total fall was less than an inch in the east generally and very few stations in England had as much as 2 inches. In Wales and the west of Scotland considerable areas had more than three inches, but this amount was experienced only very locally in the west of Ireland.

In London (Camden Square), the mean temperature was 59°·3, or 0·8 below the average. The duration of bright sunshine was 188·2 hours, and of rainfall, 18·6 hours. The total evaporation from a free water surface was 3·01 in.

RAINFALL TABLE FOR JUNE, 1918.

STATION.	COUNTY.	RAINFALL. Aver. 1875—1909. in.	1918. in.	Diff. from Av. in.	Per cent. of Av.	Max. in 24 hours. in.	Date.	No. of Days
Camden Square	*London*	2·28	1·30	— ·98	57	·42	14	11
Tenterden	*Kent*	2·03	·96	—1·07	47	·31	19	11
Arundel (Patching)	*Sussex*	2·13	·85	—1·28	40	·40	18	8
Fordingbridge (Oaklands)	*Hampshire*	1·93	·96	— ·97	50	·54	18	7
Oxford (Magdalen College)	*Oxfordshire*	2·27	1·07	—1·20	47	·32	18	13
Wellingborough (Swanspool)	*Northampn*	2·14	·49	—1·65	23	·09	18	14
Bury St. Edmunds (Westley)	*Suffolk*	2·21	·95	—1·26	43	·33	19	10
Geldeston [Beccles]	*Norfolk*	1·77	1·90	+ ·13	108	·88	17	12
Polapit Tamar [Launceston]	*Devon*	2·18	1·93	— ·25	88	·62	18	12
Rousdon [Lyme Regis]	,,	2·18	1·02	—1·16	47	·64	18	8
Stroud (Field Place)	*Gloucester*	2·43	·96	—1·47	40	·45	18	11
Church Stretton (Wolstaston)	*Shropshire*	2·59	1·03	—1·56	40	·26	18	9
Boston	*Lincoln*	1·95	·81	—1·14	42	·35	25	10
Worksop (Hodsock Priory)	*Nottingham*	2·06	·80	—1·26	39	·29	25	9
Mickleover Manor	*Derbyshire*	2·55	·81	—1·74	32	·18	9	11
Congleton (Buglawton Vic.)	*Cheshire*	2·69	1·93	— ·76	72	·39	9	17
Southport (Hesketh Park)	*Lancashire*	2·26	1·66	— ·60	73	·50	6	12
Wetherby (Ribston Hall)	*York, W.R.*	2·17	·72	—1·45	33	·35	16	4
Hull (Pearson Park)	,, *E.R.*	2·09	·40	—1·69	19	·11	6	9
Newcastle (Town Moor)	*North'land*	2·04	·71	—1·33	35	·30	6	7
Borrowdale (Seathwaite)	*Cumberland*	6·94	...	...	...	...	...	...
Cardiff (Ely)	*Glamorgan*	2·55	1·87	— ·68	73	1·01	18	14
Haverfordwest	*Pembroke*	2·74	1·63	—1·11	59	·59	18	9
Aberystwyth (Gogerddan)	*Cardigan*	2·97	2·18	— ·79	73	·67	9	12
Llandudno	*Carnarvon*	1·97	1·26	— ·71	64	·41	9	12
Cargen [Dumfries]	*Kirkcudbrt.*	2·84	1·42	—1·42	50	·33	6	14
Marchmont House	*Berwick*	2·38	·47	—1·91	20	·16	15,20	7
Girvan (Pinmore)	*Ayr*	3·04	2·19	— ·85	72	·44	9	15
Glasgow (Queen's Park)	*Renfrew*	2·41	1·11	—1·30	46	·21	7·22	12
Islay (Eallabus)	*Argyll*	2·80	2·14	— ·66	77	·33	15	21
Mull (Quinish)	,,	3·30	2·96	— ·34	90	·57	6	19
Balquhidder (Stronvar)	*Perth*	4·07	...	...	...	...	...	...
Dundee (Eastern Necropolis)	*Forfar*	2·06	·81	—1·25	39	·33	15	10
Braemar	*Aberdeen*	2·18	·91	—1·27	42	·16	15	11
Aberdeen (Cranford)	,,	2·02	1·57	— ·45	77	·28	20	15
Gordon Castle	*Moray*	2·13	1·89	— ·24	89	·47	15	15
Drumnadrochit	*Inverness*	2·26	2·14	— ·12	95	·50	15	18
Fort William	,,	3·77	3·83	+ ·06	102	1·21	13	16
Loch Torridon (Bendamph)	*Ross*	4·07	4·10	+ ·03	100	·73	6	17
Dunrobin Castle	*Sutherland*	2·10	1·46	— ·64	70	·52	22	10
Glanmire (Lota Lodge)	*Cork*	2·91	·97	—1·94	34	·43	8	9
Killarney (District Asylum)	*Kerry*	2·92	2·54	— ·38	87	·52	8	13
Waterford (Brook Lodge)	*Waterford*	2·79	1·80	— ·99	65	·39	8	10
Nenagh (Castle Lough)	*Tipperary*	2·70	1·69	—1·01	63	·46	8	15
Ennistymon House	*Clare*	3·18	1·77	—1·41	56	·33	8	14
Gorey (Courtown House)	*Wexford*	2·59	1·29	—1·30	50	·29	8	11
Abbey Leix (Blandsfort)	*Queen's Co.*	2·58	1·70	— ·88	66	·43	8	16
Dublin (FitzWilliam Square)	*Dublin*	2·00	·91	—1·09	45	·19	9	13
Mullingar (Belvedere)	*Westmeath*	2·72	1·89	— ·83	69	·38	9	11
Crossmolina (Enniscoe)	*Mayo*	3·17	1·74	—1·43	55	·29	17	14
Cong (The Glebe)	,,	3·18	1·38	—1·80	43	·33	16	13
Collooney (Markree Obsy.)	*Sligo*	3·11	2·79	— ·32	90	·76	8	18
Seaforde	*Down*	2·88	1·43	—1·45	50	·36	18	12
Ballymena (Harryville)	*Antrim*	2·89	2·14	— ·75	74	·37	9	17
Omagh (Edenfel)	*Tyrone*	2·82	1·92	— ·90	68	·60	9	15

SUPPLEMENTARY RAINFALL, JUNE, 1918.

Div.	STATION.	Rain inches.
II.	Warlingham, Redvers Road..	·91
,,	Ramsgate	·87
,,	Hailsham	·99
,,	Totland Bay, Aston House...	1·02
,,	Stockbridge, Ashley..	·99
,,	Grayshott	1·14
III.	Harrow Weald, Hill House...	·97
,,	Pitsford, Sedgebrook...	·48
,,	Woburn, Milton Bryant	·46
,,	Chatteris, The Priory	·25
IV.	Elsenham, Gaunts End	·79
,,	Shoeburyness	·67
,,	Colchester, Hill Ho., Lexden	·58
,,	Ipswich, Rookwood, Copdock	1·54
,,	Aylsham, Rippon Hall	1·43
,,	Swaffham	·55
V.	Bishops Cannings	1·47
,,	Weymouth	·62
,,	Ashburton, Druid House	1·70
,,	Cullompton	1·11
,,	Lynmouth, Rock House	1·49
,,	Okehampton, Oaklands	1·47
,,	Hartland Abbey	1·53
,,	St. Austell, Trevarna	1·46
,,	North Cadbury Rectory	·84
VI.	Clifton, Stoke Bishop	1·21
,,	Ledbury, Underdown	·71
,,	Shifnal, Hatton Grange	1·02
,,	Droitwich	·72
,,	Blockley, Upton Wold	1·27
VII.	Grantham, Saltersford	·16
,,	Louth Westgate	·51
,,	Bawtry, Hesley Hall	·88
,,	Whaley Bridge, Mosley Hall	2·50
,,	Derby, Midland Railway	·56
VIII.	Nantwich, Dorfold Hall	1·16
,,	Bolton, Queen's Park	2·39
,,	Lancaster, Strathspey	2·08
IX.	Langsett Moor, Up. Midhope	1·23
,,	Scarborough, Scalby	·59
,,	Ingleby Greenhow	·82
,,	Mickleton	·60
X.	Bellingham, High Green Manor	·65
,,	Ilderton, Lilburn Cottage	·44
,,	Keswick, The Bank	1·85
XI.	Llanfrechfa Grange	...
,,	Treherbert, Tyn-y-waun	4·09
,,	Carmarthen, The Friary	1·32
,,	Fishguard, Goodwick Station.	1·15
,,	Crickhowell, Tal-y-maes	1·50
,,	Gwernargllwydd	4·50
,,	Birmingham W W., Tyrmynydd	2·55
,,	Lake Vyrnwy	...
,,	Llangynhafal, Plas Drâw	1·72
,,	Rhwibryfdir	4·88
,,	Dolgelly, Bryntirion	4·49

Div.	STATION.	Rain inches.
XI.	Lligwy	1·62
,,	Douglas, Isle of Man	1·90
XII.	Stoneykirk, Ardwell House...	1·95
,,	Carsphairn, Shiel	2·85
,,	Langholm, Drove Road	1·08
XIII.	Selkirk, The Hangingshaw..	·44
,,	North Berwick Reservoir	·14
,,	Edinburgh, Royal Observaty.	·42
XIV.	Biggar	·95
,,	Maybole, Knockdon Farm	1·41
XV.	Buchlyvie, The Manse	1·58
,,	Ardgour House	6·63
,,	Oban	2·59
,,	Campbeltown, Witchburn	...
,,	Holy Loch, Ardnadam	2·49
,,	Tiree, Cornaigmore	...
XVI.	Glenquey	1·70
,,	Loch Rannoch Dall	1·87
,,	Blair Atholl	·64
,,	Coupar Angus	·82
,,	Montrose, Sunnyside Asylum.	1·51
XVII.	Balmoral	1·02
,,	Fyvie Castle	...
,,	Keith Station	2·93
XVIII.	Rothiemurchus	·91
,,	Loch Quoich, Loan	12·20
,,	Skye, Dunvegan	4·16
,,	Fortrose	1·83
,,	Glencarron Lodge	5·29
XIX.	Tongue Manse	3·00
,,	Melvich	2·95
,,	Loch More, Achfary	6·35
XX.	Dunmanway, The Rectory	1·58
,,	Mitchelstown Castle	1·12
,,	Gap of Dunloe Gearahameen	4·20
,,	Darrynane Abbey	1·85
,,	Clonmel, Bruce Villa	1·31
,,	Broadford, Hurdlestown	1·83
XXI.	Enniscorthy, Ballyhyland...	1·63
,,	Rathnew, Clonmannon	1·09
,,	Ballycumber, Moorock Lodge	2·31
,,	Balbriggan, Ardgillan	1·47
,,	Castle Forbes Gardens	1·69
XXII.	Ballynahinch Castle	2·60
,,	Woodlawn	1·16
,,	Westport, St. Helens	1·73
,,	Dugort, Slievemore Hotel	2·14
XXIII.	Enniskillen, Portora	2·09
,,	Dartrey [Cootehill]	2·61
,,	Warrenpoint, Manor House	1·85
,,	Belfast, Cave Hill Road	1·66
,,	Glenarm Castle	2·30
,,	Londonderry, Creggan Res	3·84
,,	Milford, The Manse	2·61
,,	Killybegs	3·49

Climatological Table for the British Empire, January, 1918.

STATIONS. (Those in italics are South of the Equator.)	Absolute. Maximum. Temp.	Date.	Absolute. Minimum. Temp.	Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain. Depth.	Total Rain. Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	54·9	21	16·1	9	44·6	34·2	36·2	88	87·6	16·5	2·86	18	8·2
Malta	64·6	25	40·5	7	59·0	50·9	...	80	117·0	31·6	·44	4	2·3
Lagos	90·2	30*a*	67·2	17	87·7	72·3	69·0	69	145·0	61·0	·00	0	6·5
Cape Town	97·0	27	53·1	26	81·6	60·1	55·0	58	...	...	·05	1	1·8
Johannesburg	84·3	27	42·0	25	72·2	53·0	54·3	83	...	41·5	4·96	18	7·2
Bloemfontein	90·2	28	48·3	5	80·7	57·5	55·2	63	...	...	4·67	11	4·1
Calcutta...	77·8	24	47·8	6	75·6	53·2	50·4	62	...	37·1	·00	0	2·0
Bombay...	86·8	30	62·8	25	83·3	68·2	63·3	67	136·0	54·1	·00	0	1·5
Madras	88·0	26	64·9	6	81·8	69·9	68·5	81	152·6	63·3	8·05	10	5·2
Colombo, Ceylon ...	88·1	28	66·9	19	84·2	70·7	69·0	80	159·0	59·0	4·25	10	6·2
Hongkong	66·7	12	42·1	9	59·2	49·8	33·8	46	...	...	·01	2	3·0
Sydney	81·2	27	59·2	3	76·0	64·7	61·5	70	153·2	55·4	13·18	19	5·8
Melbourne	98·7	25	52·7	2	79·9	60·7	56·7	63	151·0	44·0	2·44	9	4·4
Adelaide	104·6	21	51·7	1, 17	87·9	64·2	55·0	45	161·0	43·8	·38	3	2·3
Perth	107·0	9	52·8	3	89·1	66·7	59·3	55	171·6	47·3	·43	4	2·9
Coolgardie	108·6	25	51·0	14	92·0	63·2	50·5	36	174·2	48·0	·01	1	2·4
Brisbane	94·1	14	61·8	6	82·9	67·0	64·8	73	156·7	55·9	7·70	21	7·2
Hobart, Tasmania ..	95·1	21	46·0	17	70·2	54·2	50·6	65	148·8	39·2	·99	10	6·3
Wellington ...	78·5	17	46·7	30	70·2	58·0	55·2	73	154·0	34·4	1·73	11	5·9
Jamaica, Kingston ...	91·5	26	56·9	2	84·5	67·1	64·4	74	...	...	·58	3	2·8
Grenada	87·0	3	69·0	16	82·0	71·0	...	77	138·0	...	6·16	21	4·0
Toronto	33·1	7	—8·0	27	20·4	6·0	6·6	81	95·5	—10·5	2·30	13	5·6
Fredericton	36·0	7	—28·0	3	18·8	—1·4	4·0	86	...	...	3·11	12	5·0
St. John, N.B. ...	38·0	13	—13·5	3	22·1	6·4	7·3	73	103·5	—13·7	3·71	17	5·4
Victoria, B.C.	56·0	3	23·2	30	45·8	38·3	38·0	86	105·0	16·6	...	...	...

a—31.

Johannesburg.—Bright sunshine 189·9 hours.

COLOMBO, CEYLON.—Mean temp. 77°·5, or 1°·2 below, dew point 0°·4 below, and R 1·06 in. above, averages. Mean hourly velocity of wind 5·0 miles.

HONGKONG.—Mean temp. 54°·0. Bright sunshine 241·9 hours. Mean hourly velocity of wind 10·8 miles.

Sydney.—Very heavy R on the 11th when 6·53 in. fell in 24 hours.

Melbourne.—Mean temp. 2°·9 above, and R ·58 in. above, averages.

Adelaide.—Mean temp. 1°·9 above, and R ·34 in. below, averages.

Perth.—The hottest January since 1896, the temperature on 17 days being over 90°.

Coolgardie.—Rainfall about half an inch below average.

Brisbane.—Mean temp. 2°·7 below average. Rainfall slightly above average.

Wellington.—Bright sunshine, 206·4 hours. Mean temp. 1°·7 above average.

Symons's

Meteorological Magazine.

No. 631. AUGUST, 1918. Vol. LIII.

THE THUNDERSTORMS OF JULY 16th TO 20th, 1918.

THUNDERSTORMS of exceptional severity occurred in the south-eastern and Midland districts of England during this period and we print a few of the accounts which have been sent to us, adding some supplementary notes.

The principal storms appear to have been three in number. (1) The first, in east Surrey, occurred in the early hours of July 16th, and was remarkable for extraordinary hail, which is described by several correspondents. (2) On the evening of the 17th, London, especially the south, experienced exceptionally heavy rain, and a local storm of great severity is reported from Hawkedon, near Bury St. Edmunds, and one of less severity in Sussex. A sharp storm also occurred at at Edinburgh later on the same evening. (3) The storm of July 20th appears to have been most notable in the Midlands, particularly round Worksop and Todmordon. The following correspondence deals with details of these storms.

JULY 16th.

ABOUT 2.15 a.m. on the 16th violent thunder and lightning began with heavy rain evidently accompanied by hail. In a minute violent blows were struck on the south windows by huge hailstones and less than a minute later they fell at such a rate that the deafening sound prevented the thunder from being audible. This continued for about six minutes, without the slightest slackening. When the hailstones struck the windows there was a phosphorescent flash. The lightning showed that the hillsides were white as with snow. In about 9 or 10 minutes from the start the hail had entirely ceased, and in another minute rain also practically ceased. The entire roof of the greenhouse was smashed and round the house hail lay 2 or 3 inches deep, being scattered unevenly about an inch deep on the level. Damage to vegetation was very great. The storm passed off to east by south, having come from west by south, but the wind was south by west. The total rainfall for the day was 1·03 in., of which ·80 in. almost certainly fell in ten minutes.

The hail was of three forms still quite distinct at 6 a.m. The largest had an opaque core about ¼ in. in diameter, and were spherical or "bun-shaped" with jagged protruberances, some nearly an inch long. These were not smaller stones frozen on. Another form was opaque, very hard, and oval to spherical, from ½ to ¾ in. across and looking like big sugar plums. Mixed with these were ordinary opaque hailstones. The rain was quite warm and the fall of temperature during the storm was only from 62·°5 to 59°·5 F.

The track of the storm across the valley was apparently only 300 yards wide in the worst parts, and lay nearly from south-west to north-east, and the greatest damage was almost within a mile east or west, through Walton, Tadworth, Chipstead, Coulsdon and Purley, mainly east of the Brighton Road, and Lower Sanderstead, Ballards on Shirley Hills, to Lower Shirley on the Wickham Road. The final traces of hail were at Bromley. Many windows were broken in Godstone and Little Roke, Kenley, but Kenley proper escaped almost entirely. J. EDMUND CLARK

Asgarth, Purley, July 16th, 1918.

AFTER a thunder and hail storm at Purley, Surrey, this morning, between 3 and 3.30 a.m., I went into the garden and picked up large jagged hailstones. Some were of enormous size and one —a fairly regular oval or lemon shape—was 4½ inches in circumference. They were not several stones stuck together after fall to the ground, but were lying quite distinct on the lawn with appreciable spaces of grass between, and each was complete in itself. They were picked up almost immediately after the fall.

The above measurement was made by myself with a tape measure in the presence of my wife and two other persons. Its accuracy is supported by the fact that as late as 7 a.m. this morning, I found many distinct and separate stones of an inch or more in diameter still lying in sheltered spots. The hail broke windows in the house and completely smashed in the glass roof of a conservatory. Roads were badly torn up and flooded. E. C. RUTHERFORD.

L. B. and S. C. Railway, London Bridge Terminus, S.E., July 16th, 1918.

AN extraordinarily violent hailstorm passed over here this morning at 3.30 a.m. (summer time). I was awoken by distant thunder and lightning about 2.30 and the storm appeared to approach from the direction of Kenley. When the hail fell the stones were apparently large from the first, and by the aid of the lightning I saw large masses of hailstones slide off the roof and crash to the ground. They came down every chimney, and, coated with soot, rolled about the floors in size from that of a pea up to conglomerations of $1\frac{1}{2}$ inch either way and $\frac{3}{4}$ inch thick. Probably larger stones fell. The lawns remained white for half an hour after the fall although a warm, heavy rain continued to fall. Eight hours later there were cluster of hailstones as large as marbles still lying under the yew trees, although the temperature was about 65° F.

The majority of the stones were globular, but many were disc shaped, and the flatter, larger stones showed indications of conglomeration.

The destruction involved all glass of cucumber frames, rhubarb cut in holes and ribbons, early potato haulm flattened into the ground and late potato haulm very much torn, tomato plants, marrows and cucumbers were stripped and apples at least half torn off the trees. All flowers and half the leaves of trees were stripped—even gooseberries and small damsons being torn off.

ALFRED CARPENTER, Capt. R.N.

The Red House, Sanderstead, July 16th, 1918.

I HAVE a note from Mr. W. Clifford Smith, C.E., on the thunderstorm of July 16th at Cane Hill Asylum, the gist of which is as follows :—There was no hail as we ordinarily understand it, but flat, irregularly shaped pieces of ice from one to two inches in length and sometimes more, and about $\frac{3}{4}$ in thick. The fall of this ice began at 3.10 a.m. and lasted from seven to ten minutes, in which time it did damage to glass to the extent of £200, and to crops on the Asylum estate to the value of £1,000. These details you can take as reliable. Mr. Smith says that at 6.30 a.m. there had been collected from the gutters of the Asylum about three cubic yards of these pieces of ice, many of which still retained their flat faces. The ice did not fall until the thunderstorm had been in operation for an hour. He gives the limits of the fall about Cane Hill as the Chipstead Railway and Carshalton Hill on the north, Hollyme Road on the west, and the Valley beyond Farthing Downs on the south.

My rainfall here was only ·07 in., although I noted the storm as a severe one, but early during the night of the 17th -18th we had a wonderful display of lightning, and there appeared to me to be three distinct storms in south-east, south-west, and north-west. At times lightning was literally incessant and it wound up with very heavy rain, 1·02 in. being measured at 9 a.m. R. H. CURTIS.

"St. Budeaux," Warlingham, July 29th, 1918.

JULY 17th.

AT 9 a.m. on the 18th inst. I registered 1·50 in. of rain, of which 1·35 in. fell in thirty minutes, between 6.50 and 7.20 p.m. on the 17th, during a severe thunderstorm, which passed over this district.

F. E. WRIGHT.

Hillsboro', Camborne Road, Sutton, July 19th, 1918.

IN a storm, on July 17th, 1·02 in. of rain fell in forty-two minutes. The total rainfall for the day was 1·14 in. G. E. DACEY.

65, Clarendon Road, Lewisham, S.E.

THE rainfall from 7 p.m to 8 p.m. during last evening's storm was 1·19 in. E. A. MARTIN.

285, Holmesdale Road, South Norwood, S.E., July 18th, 1918.

HEAVY rain fell here from 7.20 p.m. to 8.10 p.m. (summer time), which registered 1·23 in. during the fall. G. B. HAMLIN.

285, The Broadway, Bexley Heath, Kent, July 17th, 1918.

I MEASURED more rain in twenty-four hours on 17th July than I have ever done since keeping a rain gauge, now thirty years. Of the 2·53 in., more than 2 inches fell in the hour from 7 to 8 p.m. (G.M.T.)

The afternoon was very sultry with no wind whatever, and all that one could see was that it was getting darker and darker so that lamps had to be lit by 7 p.m. About 6.45 p.m. tremendous hollow-sounding rumbles began which sounded up above the clouds, and so far no lightning appeared to strike the earth; but almost at 7 p.m. the rain suddenly came down in torrents and the lightning and thunder were terrific. The rain appeared to cease a few minutes after 8 p.m., and only a slight drizzle kept on till about midnight, when all was fairly clear. I did not go out to take the measurement at 8 o'clock but I feel confident that not more than ·25 in. could have fallen after that time.

Three miles from here to the south-east in a direct line a road was blocked up with soil off a hilly field, and on the hill-side it was a yard deep tapering off to a foot on the road till it reached the stream.

There was about 200 yards of the road covered, but the worst part which I have described was about 100 yards. Five men, working with two tumbrels and horses, had been at work clearing away the soil for ten days, and then no waggon could pass, only a light cart which could get on to the grass. This is the heaviest cloudburst I have known round here, and I believe from inquiry that the thunderstorm covered a very wide district. B. P. OAKES.

Hawkedon Rectory, Bury St. Edmunds, August 1st, 1918.

THE Buckland district experienced the heaviest hailstorm known to the oldest inhabitant: the stones were extraordinary for their size, and caused much havoc, not only among the glass in some of the larger grounds, but especially among the flowers and the vegetables. Many of the gardens were completely devastated, the hailstones cutting off the haulms of the potatoes, and damaging dwarf and runner beans and other products as if they had been slashed with a faggot. Tomatoes and cucumbers in the greenhouses were not even immune. The area between the "Red Lion" and Reigate Heath seems to have felt the full fury of the storm. In the Dorking neighbourhood, in many parts, the corn has suffered severely, especially where there was a promise of a heavy crop. In many instances the corn has been beaten down flat.—*Dorking Advertiser. July 20th, 1918.*

RAINFALL OF JULY 17th.

Tilbury	7.30 to 9 p.m. ..	1 hr. 30 min. ..	1·50 in.
Old Ford	6·55 „ 8.45 „ ..	1 „ 50 „ ..	1·53 „
	6.55 „ 7.35 „ ..	40 „ ..	1·34 „
Shad Thames	6.15 „ 8·5 „ ..	1 „ 50 „ ..	2·32 „
	6.20 „ 6.50 „ ..	30 „ ..	2·07 „
Clapton Pond	5.45 „ 7.25 ..	1 „ 40 „ ..	1·48 „
	5.45 „ 6.20 „ ..	35 „ ..	1·35 „
Barnes, Castlenau	Between 5 and 7 p.m...	40 „ ..	·41 „

JULY 20th.

PERHAPS you will like to have some remarks on the severe storm here, on Saturday, the 20th inst. The day was fine, though not settled. Thunder was first heard about 4.20 p.m. (summer time). The main fall of rain was from about 7.2 to 8.30 p.m., when 1·79 in. was measured—also I measured ·21 in. about 10.14 p.m. At 10 a.m. on the 21st, I measured ·08 in., so that the total for the day was 2·08 in. The duration of the heavy fall was one feature; also the thunder, which was heavy and frequent, chiefly between 7.12 and 7.41 p.m. No hail of any importance was observed.

The storm caused flooding and I have heard of a waterspout.

JAS. EDESON.

Clinton Villas, Worksop, 29th July, 1918.

RAINFALL OF JULY 20th.

Worksop (Hodsock Priory)	10 min. ..	·53 in.
„ (Gateford Hill)	4 hours ..	2·50 „

METEOROLOGICAL OBSERVATIONS AT LU-KIA-PANG, CHINA, FOR 1917.

By REV. J. DE MOIDREY, S.J.

(*Continued from page 56*).

III.—*Relative Humidity. Per cent.*

	RELATIVE HUMIDITY.			VAPOUR TENSION.		
	Mean.	Lowest.	Highest.	Mean.	Lowest.	Highest.
Jan.	70	50	92	*3·2*	*1·3*	5·3
Feb..........	68	48	93	4·1	2·2	7·1
Mar.	69	51	96	5·6	3·2	8·8
April	*64*	*36*	97	8·0	4·8	11·2
May	64	39	97	10·8	6·9	15·6
June	83	67	97	18·9	12·4	25·3
July.........	84	67	95	23·1	18·5	27·9
Aug.	81	65	94	22·5	17·1	26·4
Sept.	84	72	95	19·4	11·9	26·0
Oct.	79	58	98	11·9	5·7	15·0
Nov.	76	63	99	7·0	4·3	12·6
Dec.	72	54	96	4·3	1·7	9·7
Year	74	36	99	11·6	1·3	27·9

VI.—*Rainfall.*

	(a.) INTENSITY. Days with								Days with		
	mm. 0·1—0·9	1·0—2·9	3·0—4·9	5·0—9·9	10·0—19·9	20·0—39·9	40·0—59·9	60·0 & over	Rain.	Snow.	Total.
Jan	3	2	—	1	—	—	—	—	*4*	2	6
Feb.......	2	2	—	2	—	—	—	—	*4*	1	5
Mar.	3	2	1	3	1	—	—	—	9	—	9
April	4	2	1	1	1	—	—	—	9	—	9
May......	4	2	2	3	1	—	—	—	11	—	11
June	3	5	—	1	3	1	—	2	15	—	15
July......	—	2	1	3	—	1	1	—	8	—	8
Aug.	4	—	2	2	1	3	—	—	10	—	10
Sept.	7	1	2	3	2	1	—	—	13	—	13
Oct.	5	2	1	—	3	1	—	—	8	—	8
Nov.	5	3	—	—	—	—	1	—	5	—	5
Dec.	2	2	—	—	1	—	—	—	*4*	—	*4*
Year	42	25	10	19	13	7	2	2	100	3	103

VI.—(*con.*)

(*b.*) *Total Rainfall. Millimeters.*

	8 p.m. –8 a.m.	8 a.m. –8 p.m.	Total.
Jan.	*3·1*	*8·6*	*11·7*
Feb. ..	5·9	9·8	15·7
Mar. ...	36·0	12·7	48·7
April ..	16·3	10·7	27·0
May....	24·1	21·9	46·0
June ...	**134·5**	**149·2**	**283·7**
July ..	58·7	63·9	122·6
Aug. ...	48·4	54·0	102·4
Sept. ..	66·9	17·5	84·4
Oct. ...	26·3	8·8	35·1
Nov. ...	19·2	31·0	50·2
Dec. ..	9·6	9·5	19·1
Year ...	449·0	397·6	846·6

(*c.*) *Rainless Periods of 10 days or more, excluding dew.*

Began.	Ended.	Lasted.
Jan. 2	**Jan. 21**	**20 days**
Mar. 19	April 9	22 „
Oct. 5	Oct. 22	18 „
Nov. 8	Nov. 29	22 „
Dec. 2	Dec. 11	10 „
Dec. 15	*	

*The last rainless period was not ended when sending the report, on February 2nd, 1918, 50 days.

VIII.

Mean Duration of Bright Sunshine. Hours.

	Fore-noon.	After-noon.	Total.	Percentage of possible.	Mean amount of Cloud.
Jan. ...	3·3	3·1	6·4	**62**	0·4
Feb. ..	2·9	2·8	5·7	51	0·5
Mar. ...	3·3	3·0	6·3	52	0·5
April ..	3·0	2·8	5·8	44	0·6
May....	3·6	3·4	7·0	51	0·5
June ...	2·2	2·0	4·2	*30*	0·7
July ..	3·5	3·0	6·5	47	0·5
Aug. ...	4·0	3·8	7·8	59	0·4
Sept. ..	3·0	2·6	5·6	45	0·5
Oct. ...	2·4	1·6	4·0	35	0·6
Nov. ...	2·7	2·6	5·3	50	0·5
Dec.* ..	—	—	—	—	—
Year* ..	3·1	2·8	5·9	48	0·9

VII.—*Wind* (*a.*)

Mean Velocity at 8 a.m., 2 p.m. and 8 p.m. Metres per second.

	Mean.	Min.	Max.
Jan. ...	3·8	8·8	7·3
Feb. ...	3·5	0·4	**8·2**
Mar.....	3·4	1·1	5·4
April ...	3·7	1·2	8·1
May ...	3·4	1·3	6·1
June ...	2·9	1·0	4·9
July ...	**4·4**	1·7	7·9
Aug. ..	*2·4*	0·3	6·9
Sept. ...	3·3	0·9	7·9
Oct. ...	*2·4*	0·3	4·0
Nov. ..	2·6	*0·0*	6·1
Dec. ..	3·5	0·7	7·3
Year ..	3·3	0·0	8·2

VII.—*Wind.* (*b.*) *Direction. Percentage Frequency.*

	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.	Variable
Jan.......	13	7	*6*	8	4	6	**13**	**39**	4	*0*
Feb.......	20	15	13	12	5	5	4	15	8	2
Mar.	20	13	11	21	4	6	4	15	5	1
April	6	15	19	24	6	11	3	9	7	1
May	5	13	9	22	15	**16**	10	5	3	1
June	3	13	**24**	28	11	8	2	3	7	*0*
July......	3	6	17	**46**	**18**	6	*1*	*2*	*1*	*0*
Aug.	*2*	13	18	15	10	12	3	9	17	*0*
Sept.	**21**	21	8	20	7	*2*	2	10	6	2
Oct.	19	**24**	15	5	*1*	*2*	7	14	12	*0*
Nov.	20	8	7	3	3	4	7	22	24	*0*
Dec.	13	*4*	9	*2*	4	3	14	40	9	2
Year	12	13	13	17	7	7	6	15	9	1

* Sunshine recorder was under repair. Yearly means are not correct.

ERRATUM.—Vol. 52, p. 68—last line of table VII., Col. 1—*For* 22 *read* 15.

REVIEW.

Observations Météorologiques, 1917. By A. Collenette, Guernsey, 1918. Size, 11 × 8½. Pp. 16. One plate.

MR. COLLENETTE's fifteenth annual report on the climate of Guernsey —a subject which he has made peculiarly his own, is of especial interest as containing a large scale map of the distribution of average rainfall over the island. The method followed is somewhat original, the isopleths representing not the actual rainfall but the percentage of the fall at the standard station at St. Martin's Road, where observations are available for the long period of seventy-five years. This station, with an average annual fall of 36·7 inches, is, it appears, the rainiest spot in the island, and the map shows a fairly uniform falling off in all directions, the rainfall being below 90 per cent. of the standard in the western half of the island, and along the north coast, and less than 80 per cent. in the extreme west. The map is put forward, we gather, only as a first approximation to the true distribution, but Mr. Collenette's intimate knowledge of the climatic conditions of Guernsey, coupled with the care he has lavished on the observing stations, of which a tour, under Mr. Collenette's guidance gave us recent evidence, give great weight to his expression of opinion on the subject. C.S.

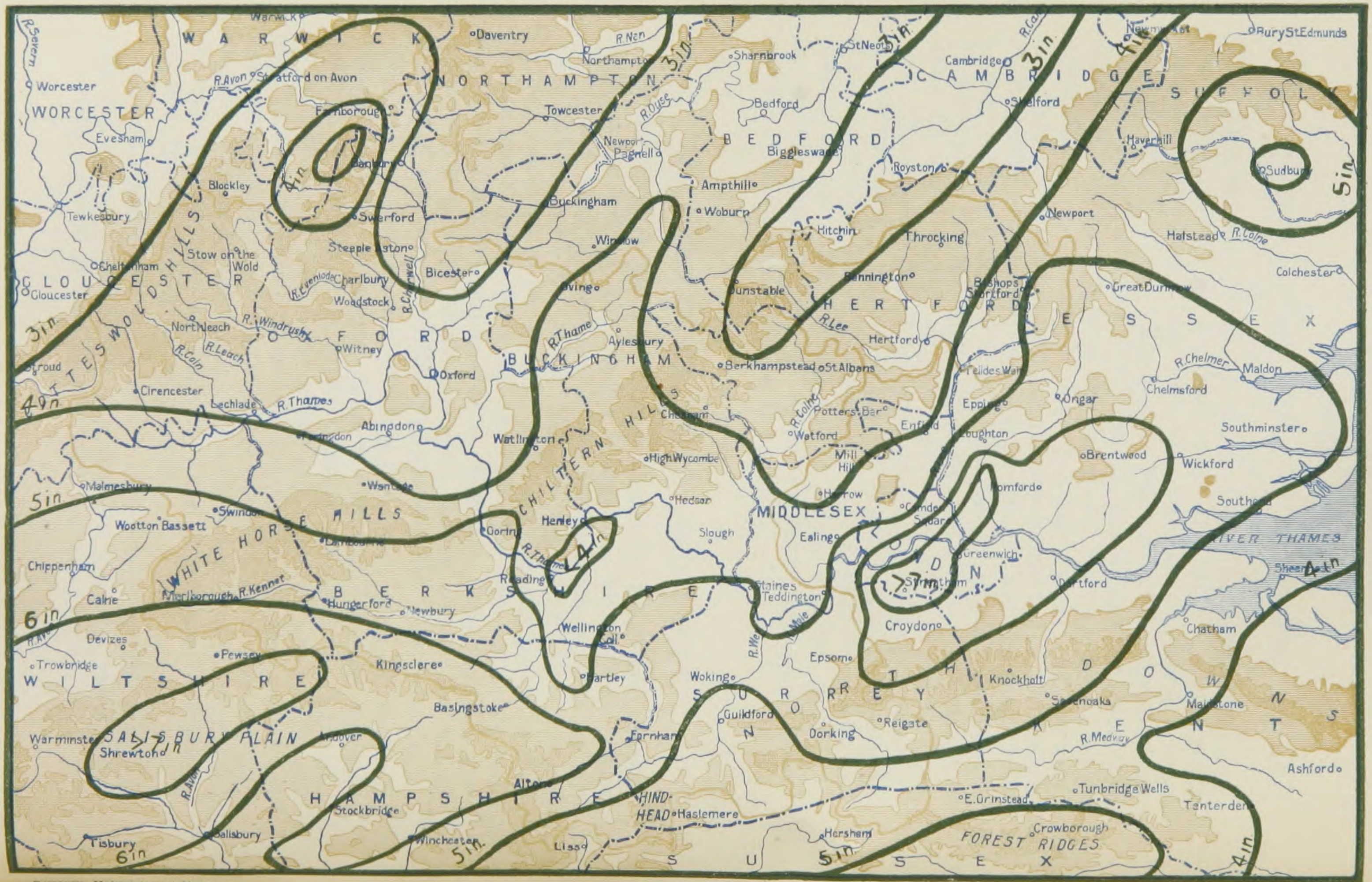
METEOROLOGICAL NEWS AND NOTES.

AT THE ANNUAL MEETING of the Trustees of the British Rainfall Organization, held at 62, Camden Square, on July 31st, Mr. Carle Salter, the Assistant-Director of the Organization, was appointed Joint-Director with Dr. H. R. Mill, for the period during which Dr. Mill continues to be Director, or for such shorter period as may be determined by the Trustees. Mr. Salter has been connected with the British Rainfall Organization as Assistant, Chief Assistant and Assistant-Director for twenty-one years, having joined the Staff in the time of the Founder of the Organization, Mr. G. J. Symons.

MR. A. PEARSE JENKIN, F.R.Met.Soc., read a paper, entitled, "Suggestions for a Rainfall Map of Cornwall," at the Summer meeting of the Royal Cornwall Polytechnic Society at Falmouth, on July 30th. He laid stress on the importance of an exact knowledge of the distribution of average annual rainfall, and pointed out that the preparation of a satisfactory rainfall map of Cornwall was rendered difficult by the existence of wide stretches of country without any observing stations. He urged the importance of establishing new rainfall stations in such areas.

BRITISH RAINFALL, 1917, is now complete, and the MS. is in the printer's hands, but difficulties of production will delay the publication until a period at least as late as it was last year.

THAMES VALLEY RAINFALL. JULY, 1918



ALTITUDE SCALE

Below 250 feet	250 to 500 feet	500 to 1000 feet	Above 1000 feet

SCALE OF MILES 0 5 10 15 20

Symons's Meteorological Magazine

Isohyetals

THE WEATHER OF JULY.

THE month opened with about a week of fine summer weather, and a mean temperature slightly above the average in all but the north-western and extreme northern parts of the United Kingdom. On the 1st, and again on the 7th or 8th, the thermometer rose to between 75° and 80° over the inland portions of England, and on the former date it touched 84° (in the Glaisher screen) at Camden Square.

The distribution of barometric pressure was at the time anticyclonic, but after the 7th a marked change took place, and for about three weeks the weather was influenced by numerous depressions which came in, at first from the northern, and afterwards from the more central portions of the North Atlantic. The accompanying winds were often light and variable, but as a rule blew from some easterly quarter in the north, and from the southerly to westerly quadrant in the south. In Scotland the air was, therefore, cool for the time of the year. Early on the 10th the sheltered thermometer sank to 30° at Balmoral, and 28° at West Linton, the minimum readings on the grass being in each case a couple of degrees lower than those in the screen. Over the major part of England and Ireland the mean temperature agreed pretty closely with the average, an exception occurring on the 16th and 17th, when the thermometer rose to 80° or slightly above it at a few isolated spots in East Anglia. During this long spell of cyclonic weather, rain was frequent and often very heavy, more especially in the southern and south-eastern portions of the London district, where the total fall in eighteen or nineteen days was largely in excess of anything previously recorded in any complete July. An equally striking feature in connection with this long spell of disturbed weather was the abnormal frequency of thunderstorms, accompanied in many instances by torrential falls of rain or hail. At a large number of stations in England thunder occurred on at least seven or eight days, and at Richmond and Yarmouth on nine days, the number recorded at Kew Observatory being greater than in any July since the year 1880, when twelve days were affected.

After about the 27th an anticyclone extended over the United Kingdom from the south-westward and occasioned a decided improvement in the weather and a general increase of temperature. On the 31st the thermometer rose to 80° or slightly above it in several English districts, and touched 82° at Clifton (Bristol) and Jersey.

In spite of so much unfavourable weather the total duration of bright sunshine over the country, as a whole, was in excess of the average, but at a few places in the eastern and south-eastern portions of Great Britain there was a slight deficit.

The total rainfall of the month was in excess of the average in nearly all parts of the British Isles, and was exceptionally large in the south of England and in the east of Scotland, where rather more than double the average fell at one or two stations. As will be clear from the correspondence which we publish this month thunderstorms of a remarkable nature occurred in the south, principally to the south of London, where a number of stations experienced a total rainfall exceeding 7 inches in the month. More than 6 inches fell over a strip of country extending from Devonshire to Essex, a portion of which comes within the scope of the map of the Thames Valley facing this page. Less than 3 inches of rain fell over a part of the English Midlands, but more than 4 inches over the greater part of the country, practically everywhere in Scotland, and over the most of Ireland. The general rainfall of the countries expressed as a percentage of the average was :—England and Wales, 146; Scotland, 141; Ireland, 126; British Isles, 140.

In London (Camden Square) the mean temperature was 63°·0, or 0°·5 below the average. The duration of bright sunshine was 163·2 hours, and of rainfall, 47·2 hours. The total evaporation was 2·59 in.

RAINFALL TABLE FOR JULY, 1918.

STATION.	COUNTY.	RAINFALL. Aver. 1875—1909. in.	1918. in.	Diff. from Av. in.	Per cent. of Av.	Max. in 24 hours. in.	Date.	No. of Days
Camden Square	*London*	2·57	4·74	+2·17	185	·56	26	18
Tenterden	*Kent*	2·21	3·59	+1·38	163	·98	20	15
Arundel (Patching)	*Sussex*	2·46	4·73	+2·27	192	...	...	14
Fordingbridge (Oaklands)	*Hampshire*	2·14	4·68	+2·54	219	·73	17	17
Oxford (Magdalen College)	*Oxfordshire*	2·43	4·12	+1·69	169	·63	17	16
Wellingborough (Swanspool)	*Northampn*	2·54	2·81	+ ·27	111	·67	17	17
Bury St. Edmunds (Westley)	*Suffolk*	2·68	4·24	+1·56	159	1·93	17	16
Geldeston [Beccles]	*Norfolk*	2·37	3·76	+·139	159	·89	17.20	19
Polapit Tamar [Launceston]	*Devon*	2·74	4·12	+1·38	150	·89	22	19
Rousdon [Lyme Regis]	,,	2·68	4·92	+2·24	184	·88	22	19
Stroud (Field Place)	*Gloucester*	2·75	2·95	+ ·20	107	·44	26	19
Church Stretton (Wolstaston)	*Shropshire*	2·58	2·81	+ ·23	109	·68	15	16
Boston	*Lincoln*	2·35	2·86	+ ·51	122	·99	17	18
Worksop (Hodsock Priory)	*Nottingham*	2·35	3·64	+1·29	155	1·09	20	18
Mickleover Manor	*Derbyshire*	2·57	3·23	+ ·66	126	·58	26	18
Congleton (Buglawton Vic.)	*Cheshire*	3·03	3·70	+ ·67	122	·56	20	19
Southport (Hesketh Park)	*Lancashire*	2·92	4·06	+1·14	139	·48	17	16
Wetherby (Ribston Hall)	*York, W.R.*	2·56	3·78	+1·22	148	·63	18	16
Hull (Pearson Park)	,, *E.R.*	2·39	3·31	+ ·92	138	1·07	16	18
Newcastle (Town Moor)	*North'land*	2·90	4·00	+1·10	138	·71	16	18
Borrowdale (Seathwaite)	*Cumberland*	8·91	...	...	...	...	...	...
Cardiff (Ely)	*Glamorgan*	3·26	5·54	+2·28	170	·85	22	19
Haverfordwest	*Pembroke*	3·39	5·19	+1·80	153	1·18	17	17
Aberystwyth (Gogerddan)	*Cardigan*	4·03	4·85	+ ·82	120	·75	15	17
Llandudno	*Carnarvon*	2·52	2·54	+ ·02	101	·51	15	18
Cargen [Dumfries]	*Kirkcudbrt.*	3·20	3·94	+ ·74	123	·81	15	19
Marchmont House	*Berwick*	3·30	3·14	— ·16	95	·85	20	15
Girvan (Pinmore)	*Ayr*	3·73	3·80	+ ·07	102	1·30	20	18
Glasgow (Queen's Park)	*Renfrew*	2·91	3·07	+ ·16	106	·57	23	19
Islay (Eallabus)	*Argyll*	3·41	3·59	+ ·18	105	·49	22	20
Mull (Quinish)	,,	4·12	4·96	+ ·84	120	·76	22	21
Balquhidder (Stronvar)	*Perth*	4·34	3·75	— ·59	86	1·00	22	17
Dundee (Eastern Necropolis)	*Forfar*	2·84	5·54	+2·70	195	1·14	20	18
Braemar	*Aberdeen*	2·65	6·62	+3·97	250	1·65	17	17
Aberdeen (Cranford)	,,	3·00	6·42	+3·42	214	1·40	21	17
Gordon Castle	*Moray*	3·25	5·02	+1·77	154	·97	21	20
Drumnadrochit	*Inverness*	3·37	5·04	+1·67	150	·80	17	18
Fort William	,,	4·92	4·65	— ·27	95	·66	7	20
Loch Torridon (Bendamph)	*Ross*	5·35	8·97	+3·62	168	1·31	12	21
Dunrobin Castle	*Sutherland*	2·91	6·93	+4·02	238	1·48	11	17
Glanmire (Lota Lodge)	*Cork*	2·73	4·68	+1·95	171	·86	21	21
Killarney (District Asylum)	*Kerry*	3·53	4·10	+ ·57	116	·86	31	22
Waterford (Brook Lodge)	*Waterford*	3·13	3·03	— ·10	97	·83	21	19
Nenagh (Castle Lough)	*Tipperary*	3·02	5·09	+2·07	169	·73	13	22
Ennistymon House	*Clare*	3·57	5·94	+2·37	166	·77	31	21
Gorey (Courtown House)	*Wexford*	2·90	2·67	— ·23	92	·62	21	18
Abbey Leix (Blandsfort)	*Queen's Co.*	2·99	3·62	+ ·63	120	·49	14	20
Dublin (FitzWilliam Square)	*Dublin*	2·60	2·76	+ ·16	106	·47	12	18
Mullingar (Belvedere)	*Westmeath*	3·16	4·07	+ ·91	129	·87	14	18
Crossmolina (Enniscoe)	*Mayo*	3·26	4·81	+1·55	148	·69	7	22
Cong (The Glebe)	,,	3·72	4·23	+ ·51	114	·74	31	20
Collooney (Markree Obsy.)	*Sligo*	3·36	3·31	— ·05	99	·53	7	22
Seaforde	*Down*	3·32	4·76	+1·44	143	1·02	17	17
Ballymena (Harryville)	*Antrim*	3·44	4·16	+ ·72	121	·66	22	18
Omagh (Edenfel)	*Tyrone*	3·34	3·48	+ 14	104	·57	25	19

SUPPLEMENTARY RAINFALL, JULY, 1918.

Div.	STATION.	Rain inches.	Div.	STATION.	Rain inches.
II.	Warlingham, Redvers Road..	5·48	XI.	Lligwy	4·17
,,	Ramsgate	3·60	,,	Douglas, Isle of Man	3·21
,,	Hailsham	4·70	XII.	Stoneykirk, Ardwell House...	2·34
,,	Totland Bay, Aston House...	3·28	,,	Carsphairn, Shiel	5·37
,,	Stockbridge, Ashley..	6·19	,,	Langholm, Drove Road	5·99
,,	Grayshott	4·77	XIII.	Selkirk, The Hangingshaw..	4·04
III.	Harrow Weald, Hill House...	3·41	,,	North Berwick Reservoir	3·81
,,	Pitsford, Sedgebrook	2·87	,,	Edinburgh, Royal Observaty.	3·56
,,	Woburn, Milton Bryant	3·72	XIV.	Biggar	3·47
,,	Chatteris, The Priory	2·57	,,	Maybole, Knockdon Farm ...	2·47
IV.	Elsenham, Gaunts End	4·96	XV.	Buchlyvie, The Manse	3·22
,,	Shoeburyness	4·74	,,	Ardgour House	7·40
,,	Colchester, Hill Ho., Lexden	4·67	,,	Oban	3·93
,,	Ipswich, Rookwood, Copdock	3·87	,,	Campbeltown, Witchburn ..	...
,,	Aylsham, Rippon Hall	3·58	,,	Holy Loch, Ardnadam	4·57
,,	Swaffham	3·40	,,	Tiree, Cornaigmore	...
V.	Bishops Cannings	6·27	XVI.	Glenquey	4·90
,,	Weymouth	3·59	,,	Loch Rannoch Dall	4·29
,,	Ashburton, Druid House..	5·33	,,	Blair Atholl	5·49
,,	Cullompton	4·36	,,	Coupar Angus	5·88
,,	Lynmouth, Rock House	4·63	,,	Montrose, Sunnyside Asylum.	4·32
,,	Okehampton, Oaklands	4·37	XVII.	Balmoral	5·52
,,	Hartland Abbey	4·77	,,	Fyvie Castle	7·48
,,	St. Austell, Trevarna	5·10	,,	Keith Station	4·79
,,	North Cadbury Rectory	6·14	XVIII.	Rothiemurchus	4·97
VI.	Clifton, Stoke Bishop	5·54	,,	Loch Quoich, Loan	12·60
,,	Ledbury, Underdown	2·39	,,	Skye, Dunvegan	5·84
,,	Shifnal, Hatton Grange	3·37	,,	Fortrose	2·94
,,	Droitwich	2·44	,,	Glencarron Lodge	6·07
,,	Blockley, Upton Wold	3·26	XIX.	Tongue Manse	5·67
VII.	Grantham, Saltersford	2·62	,,	Melvich	5·93
,,	Louth Westgate	...	,,	Loch More, Achfary	7·94
,,	Bawtry, Hesley Hall	3·71	XX.	Dunmanway, The Rectory ..	5·92
,,	Whaley Bridge, Mosley Hall	4·21	,,	Mitchelstown Castle	3·53
,,	Derby, Midland Railway	2·46	,,	Gap of Dunloe Gearahameen	7·30
VIII.	Nantwich, Dorfold Hall	3·62	,,	Darrynane Abbey	5·35
,,	Bolton, Queen's Park	4·18	,,	Clonmel, Bruce Villa	3·50
,,	Lancaster, Strathspey	4·85	,,	Broadford, Hurdlestown	5·05
IX.	Langsett Moor, Up. Midhope	2·88	XXI.	Enniscorthy, Ballyhyland...	4·31
,,	Scarborough, Scalby	4·68	,,	Rathnew, Clonmannon	2·59
,,	Ingleby Greenhow	4·56	,,	Ballycumber, Moorock Lodge	4·10
,,	Mickleton	4·40	,,	Balbriggan, Ardgillan	3·20
X.	Bellingham, High Green Manor	4·29	,,	Castle Forbes Gardens	2·83
,,	Ilderton, Lilburn Cottage ...	3·59	XXII.	Ballynahinch Castle	6·18
,,	Keswick, The Bank	4·35	,,	Woodlawn	3·77
XI.	Llanfrechfa Grange	...	,,	Westport, St. Helens	2·95
,,	Treherbert, Tyn-y-waun	9·43	,,	Dugort, Slievemore Hotel ...	3·78
,,	Carmarthen, The Friary	5·80	XXIII.	Enniskillen, Portora	...
,,	Fishguard, Goodwick Station.	4·16	,,	Dartrey [Cootehill]	5·29
,,	Crickhowell, Tal-y-maes	4·00	,,	Warrenpoint, Manor House ..	5·11
,,	Gwernargllwydd	2·00	,,	Belfast, Cave Hill Road	4·19
,,	Birmingham WW., Tyrmynydd	5·11	,,	Glenarm Castle	3·36
,,	Lake Vyrnwy	6·19	,,	Londonderry, Creggan Res...	3·57
,,	Llangynhafal, Plas Drâw	3·35	,,	Milford, The Manse	...
,,	Rhwibryfdir	13·53	,,	Killybegs	4·14
,,	Dolgelly, Bryntirion	4·02			

Climatological Table for the British Empire, February, 1918.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain. Depth.	Total Rain. Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	59·2	23	22·9	18	49·2	38·4	...	88	100·5	21·3	1·11	16	7·6
Malta	61·9	25	45·6	18	57·5	50·1	...	78	114·0	31·4	1·08	10	2·6
Lagos	91·0	17	68·5	1	88·6	74·9	72·4	73	145·3	65·0	3·66	2	5·3
Cape Town	99·1	13	54·1	3	82·6	61·8	58·0	62	...	...	4·76	2	2·4
Johannesburg	80·1	16	44·8	11	73·6	55·0	56·9	85	...	44·1	15·06	15	6·4
Mauritius	86·2	14	65·8	18	82·5	71·3	70·2	81	...	61·0	10·60	24	6·4
Bloemfontein	95·7	16	48·9	1	85·2	59·4	56·0	61	..	...	2·94	7	4·6
Calcutta...	92·0	28	49·7	1	85·1	58·8	54·4	57	...	39·1	·00	0	0·5
Madras	94·5	15	60·3	15	85·5	66·3	66·2	75	157·1	56·6	2·18	2	1·8
Colombo, Ceylon ...	90·3	12*a*	63·4	18	86·3	68·3	65·8	73	159·1	53·3	·10	2	2·9
Hongkong	72·2	26	50·0	19	64·5	55·7	50·4	71	...	...	·02	1	5·1
Sydney	92·0	9	56·0	24	76·6	63·6	60·5	69	150·0	52·2	4·88	15	6·0
Melbourne	98·8	11	49·4	27	78·3	58·0	55·1	62	152·3	41·2	1·08	11	4·8
Adelaide	109·2	11	45·5	23	85·8	61·6	52·9	45	162·2	36·7	·19	4	4·3
Perth	93·6	16	55·3	12	83·5	65·8	63·1	66	162·9	47·1	1·21	5	4·6
Coolgardie	102·0	18	47·8	12	86·4	64·1	55·3	50	166·4	46·0	2.43	11	5·8
Brisbane	96·1	4	62·1	16	83·4	67·4	64·4	71	155·3	58·6	2·25	11	5·3
Hobart, Tasmania ..	88·1	12	46·1	26	71·9	54·3	50·3	62	144·6	40·2	1·80	11	5·7
Wellington ...	79·3	6	51·0	20	71·8	59·5	55·6	73	154·0	42·3	5·04	8	6·8
Jamaica, Kingston ..	88·8	28	64·6	21	85·0	67·6	65·3	76	...	...	·52	7	4·0
Grenada	84·0	10, 11	69·0	1, 22	82·0	71·0	..	76	138·0	...	3·35	19	4·0
Toronto	48·8	20	—20·2	5	30·7	11·6	15·5	85	110·2	—26·2	4·05	15	6·0
Fredericton	48·0	20	25·5	22	24·0	—2·2	4·5	83	...	...	3·41	16	5·6
St. John, N.B. ...	48·1	25	—14·0	6	26·6	7·6	10·7	75	104·5	—14·9	4·60	19	5·8
Victoria, B.C.	51·8	3, 5	25·4	18	43·9	35·2	33·0	77	104·0	18·0	3·87	19	7·1
Mauritius (January)	88·0	10	67·7	4	84·8	71·7	68·2	73	...	60·7	5·28	20	5·5

a—17.

Malta.—Crops suffering for want of rain. If drought continues, crops will be damaged, and the storage of water considerably decreased.

Johannesburg.—Bright sunshine 194·5 hours.

COLOMBO, CEYLON.—Mean temp. 77°·3, or 2°·3 below, dew point 4·4 below, and R 1·86 in. below, averages. Mean hourly velocity of wind 5·5 miles.

HONGKONG.—Mean temp. 59·2. Bright sunshine 203·6 hours. Mean hourly velocity of wind 14·4 miles.

Sydney.—Unsettled with rain and cool S. winds. Fine toward the end.

Melbourne.—Temp. 0°·8 above, and R ·62 in. below, averages.

Adelaide.—Mean temp. 0·4 in. below, and R ·44 in. below, averages.

Brisbane.—R 4·32 in. below average.

Wellington.—Mean temp. 3°·3 above, and R 1·77 in. above, average. Bright sunshine, 158·5 hours.

Symons's
Meteorological Magazine.

No. 632. SEPTEMBER, 1918. Vol. LIII.

THE WATER POWER OF THE BRITISH EMPIRE.

Physical geography includes the study of the forms of the land and the circulation of water through the air; rainfall research is concerned with just those portions of physical geography, and the application of rainfall research to practical problems is required in all questions of the utilizations of water for the supply of towns, the production of power, the conservation of rivers, the maintenance of canals, as well as in agriculture and public health. While the observation of rainfall has always been part of the routine of meteorological stations, the main value of rainfall records is in reality less meteorological than geographical. The distinction may, perhaps, best be seen by reflecting that meteorology is concerned mainly with *why* rain falls, geography with *where* it falls and whither it flows.

The use of water in the production of power depends practically less on the amount of water power available than on the cost of it as compared with other sources of power. Hence it may be said that the price of coal and mineral oil regulate the demands on the water power of a country. Where coal is abundant and cheap water power is naturally neglected; but where coal is difficult to obtain and costly the existence of water power becomes very interesting to the industrial world. Hence, at this time when coal-supplies are short everywhere and coal-prices are rising week by week there is a general awakening to the importance of exploring the water-power resources of the world. To the scientific man it often seems that the practical man opens his eyes too late to the importance of unused resources. In the *Geographical Journal* for April, 1896, more than twenty years ago, we elaborated a scheme for the complete geographical description of the British Isles with special reference to the survey of natural resources, and the time estimated for the completion of the work was twenty years. Had the scheme, which perished in a general chorus of praise of its promise, been carried out, the Ministry of Reconstruction would now have before it a mass of elaborated data, the like of which cannot now be obtained in time to guide the after-war development of the country. It is not too much to say that many millions of public money would have been saved during the war in public works begun in panic hurry and abandoned only when failure became the reward of ignorance.

Late though it is, the country seems to have fairly awakened to the importance of water power, and we have before us the Preliminary Report of the Water Power Committee (formerly called Sub-committee) of the Conjoint Board of Scientific Societies, presided over by Sir Dugald Clerk, F.R.S., with Professor A. H. Gibson as Secretary. It consists of 28 pp., and its importance demands a brief summary here.

The Committee was appointed "to report on what is at present being done to ascertain the amount and distribution of water power in the British Empire," but this purpose was interpreted to include the preliminary results as well as the existing agencies for acquiring information, and even to enter into the general question of water power and its utilization.

The Report begins with the consideration of the world's present power demands in steam, gas and water-power, and this is stated as about 120 million horse-power, of which 75 million are required for factories, including the output of electricity, 21 million for railways and 24 million horse-power for the world's shipping. Of the 75 million horse-power required in the world, the United States is responsible for 29 million, the United Kingdom for 13 million, and the rest of the British Empire for 6 million. Of the amount of power utilized in various parts of the world water power amounts to much less than 1 per cent. in the United Kingdom, to 24 per cent. in the United States, 27 per cent. in continental Europe and to 33 per cent. in the British Dominions and dependencies. In Germany the Report states 43·4 per cent. of the industrial horse-power is derived from water.

Having shown the extraordinary backwardness of the United Kingdom in the present use of water power, the Report goes on to consider the probable available water power of the British Empire, though it is acknowledged that the paucity of data, save for two of the Dominions, makes such an estimate "highly speculative." First attention is given to the forms of industrial activity to which water power may be applied effectively, and these are practically all dependent on electricity, the generation of which is the first stage in all modern applications of water power. Electric power may be transmitted to any distance, the only limitation being financial, and at present there are transmission lines of as much as

200 miles in existence. In addition to its use for running machinery, including railways, electricity has a great future in metallurgical and chemical operations, such as the manufacture of aluminium and carbide of calcium, and, perhaps most important of all, the fixation of atmospheric nitrogen for the production of explosives and fertilizers, the paramount essentials for war and peace. In this work at present 400,000 horse-power are being used from water in Norway alone. The demand is enormous and increasing. One very attractive feature of this industry is that the raw material exists everywhere in the air in inexhaustible quantities, and that the product is so valuable in proportion to its bulk that it can afford to pay a considerable amount for transport; hence factories can be erected near the source of power even at considerable distances from centres of population.

In view of the great possibilities presented by the use of water power and the complex questions of law, administration and engineering that are involved, the Report states :—

"In view of the immensity of the interests involved it is urged that nothing short of statutory control of these developments is desirable. The exact method of control is not for the Committee to suggest. So far as is possible private enterprise should be encouraged, but under conditions which would prevent the perpetual rights being lost to the community."

The cost of power is, it is pointed out, a relative matter, and changes of conditions might make possible in the future the development of sources which it would not pay to deal with at present. An examination of 120 European installations shows that where upwards of 10,000 horse-power is developed the cost is on the average in the neighbourhood of £10 10s. per electrical horse-power per annum.

Great stress is laid in the Report on the necessity for preliminary investigations before the development of water power can be taken in hand on a great scale. It is clear that there may be abundant water power in a locality where circumstances make its utilization too costly to be practicable at present, though in future conditions the cost might be justified. While in most cases the usefulness of a water supply depends on maintaining its uniformity over the whole year, there are cases in which supplies that vary with the seasons may be utilized for work that does not need to be continuous. In any case an investigation to be of real service must extend over a number of years. Perhaps the Report may be considered by some physical geographers a little too didactic in the statement "Rainfall records, though forming the basis of any such investigation, are only of partial assistance in dealing with water-power questions. The actual run-off from the catchment area is the all-important factor, and the ratio of run-off to rainfall varies with the physical characteristics of the area, the vegetation, and the climate, so that rainfall gaugings cannot be substituted for the more laborious and costly collection of continuous records of river levels, combined with frequent gaugings of flow." Possibly more general acceptance would be given to the dictum :—" If a reasonably long record of rainfall exists, the determination of the run-off for a few years will serve to give a relation between precipitation and run-off which can be carried back as far as the rainfall records go."

Space does not allow us to give in detail the estimates of water power for the different parts of the British Empire. Suffice it to say that while valuable surveys of water power exist for the Dominions of Canada and New Zealand little in the way of a systematic census of power resources exists in other parts of the Empire, although approximate estimates may be given with a wide margin of error.

The Report proceeds to say, " It is a matter of urgent importance that the preparation of the necessary hydrographic and meteorological data should be undertaken at the earliest possible date in the remaining dominions and dependencies of the Empire.

" In this connection an adequate rainfall map is of great value and importance, and where, as is the case, for example, for the greater part of the British Isles, data for such a map are available, its preparation would appear to be most advisable."

The Report concludes with six recommendations, which may be summarized thus :—That the British Government bring before the other Governments of the Empire the necessity of an exact survey of water powers, ascertain if the respective Governments are prepared to undertake the work. Should they not be so prepared the British Government should place the work on an " Imperial Water Power Board " or " Conservation Commission," to be created including a representative from each Dominion or dependency. This Board should act in an advisory capacity. As it is unlikely that private capital for developing water power will be available for many years, the State should assist or undertake such development.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

ASHDOWN FOREST CLIMATOLOGY.

THE forest ridges of east Sussex probably offer the nearest approach to true mountain scenery of the softer woodland type, that is to be found within 100 miles of London.

During a rainy walk on a July day, from Uckfield to Forest Row, over the Ashdown Forest Ridge and back by another and wilder route, we particularly noted the following climatic features :—

(1.) The transition on both sides of the ridge between the heather and pine forest of the upper slopes and the richly tangled oak forest of the lower is very sharp, an indication, we thought, that the climatic factor in the altitudinal distribution was only secondary to the edaphic or geological.

(2.) Both at Nutley, on the south side of the ridge, and at Forest Row, on the north side, a snow plough was conspicuously set in the village green, a fine indication we observed of bleak country, since snow ploughs are not usually so obtrusive in Thames Valley villages.

(3.) The warm, south-easterly wind rain that had set in before we left Uckfield, at 9 a.m., continued till we reached the summit of the range, but soon afterwards it seemed to degenerate into a true moorland drizzle, all scenery in the higher zone being blotted out by thick hill-mist driving along much as in the high hill regions of the west and north of England. As the day wore on the weather gradually improved in the surrounding lower country, but the Ashdown ridge remained thickly enveloped in mountain mist through which on our return journey an occasional smart spurt of true rain would fall. We came to the conclusion that on this day the orographic factor of condensation was very prominent on Ashdown Forest, and that on a range of only moderate elevation of barely 1,000 feet this factor could only be conspicuous on days of more or less general rainfall. Again we had an example of the observation so often made that hill-mist and true rainfall are only with difficulty associated. The sudden short spurts of true rain, referred to above, we ascribed to the passage of *general* showers produced at a higher level and falling through the hill-born mist. Six days later, on the contrary, during heavy rain of the thunder type, with no wind, there was no mist at all on Ashdown Forest, and from the top of the ridge the outline of the South Downs could be clearly seen through a fairly thick rain-sheet.

L. C. W. BONACINA.
M. A. GIBLETT.

A GREEN FLASH.

On going through my old meteorological record I came across the following note :—

"At sunrise on February 15th, 1906, the sky was clear of clouds with a low temperature, 30° F. below zero, there was a heavy wood smoke drifting from the chimneys, immediately after the limb of the sun appeared above the horizon a cloud of smoke passed between me and the sun, as it did so the small sector of sun that was visible turned a bright green; the smoke rolled away, and when it rolled in front of the sun again there was about one-eighth of sun's diameter visible the green flash did not appear."

The above requires a little explanation. At that time the only fuel used was wood, with temperatures below zero the water vapour in wood smoke on coming into the air condenses and forms a somewhat thick white cloud. The house I was in was at higher elevation than the rest of the village, which stands on rising ground on the west side of Lake Temiskaming, which is five miles wide here, so that I had an uninterrupted view of the eastern horizon across the lake; the smoke clouds were rolling slowly from the south, some of the puffs rising just high enough to cover the horizon so that the place of the rising sun was obscured intermittently. The point to be specially noticed is that the green flash came when only a very *small portion* of the sun was above the horizon, when one-eighth of the sun's diameter was visible no flash appeared.

PAUL A. COBBOLD, F.R.Met.Soc.

Haileybury, Ont., February 18th, 1918.

OUR RAINFALL TABLES.

Six hundred and thirty-one numbers of this Magazine have been issued during the last fifty-two years and never until to-day has the new number failed to contain statistical data of the preceding month. No. 632 appears without the Tables to which our readers are in the habit of turning, but the fault is not ours or our printers. We have striven against difficulties arising from the war for four years, and so far we have striven successfully, carrying out what we know to be a national service of real value. At times the labour and strain have almost proved too much for us; but hitherto each difficulty has been met and surmounted as it occurred. The last difficulty, however, springs from one of those conditions against which "the gods themselves fight in vain" and we have to submit. Time will, no doubt, overcome this difficulty also, and when it does so the Tables and map missing from this number will be forwarded to all subscribers served from this office and supplied to the publishing agents for other purchasers.

VOLUNTARY OBSERVERS AND THE NEW STAR.

A NEW star in the constellation Aquila suddenly blazed up to the first magnitude on June 8th, and, after shining brilliantly for a few nights, gradually faded and has now become inconspicuous. The Astronomer Royal, writing to *The Times* on June 15th, handsomely acknowledges the value of amateur Observers, who, while on the outlook for meteors and variable stars, picked up Nova Aquilae in many cases before it had attained its maximum brilliancy. Our old friend, Mr. Denning, was one of the first to see the new star, but he was anticipated by a schoolboy of astronomical tastes. The value of early notice being given to professional astronomers of such an occurrence as the change in brilliancy of a star lies in the importance of following the changes with the spectroscope, and so ascertaining the true nature of the occurrence. It must, of course, be remembered that the professional astronomer is pinned down to specific duties which may compel him to devote all his attention to a particular quarter of the heavens. The wide-sweeping eye and the passion for finding something new are, perhaps, more common in the amateur, and it is recorded of one professional astronomer that when the new star caught his eye as he was going to his observatory he said to himself that there was something unfamiliar in the stars of that part of the sky, but set himself to his routine duties and forgot to call his chief's attention to the fact.

We have long felt that in many departments of science immense services may be rendered by enthusiastic Observers with no special knowledge but keen interest in phenomena. The professional specialist alone can make full use of the information collected by the army of amateurs, and perhaps he sometimes fails in acknowledging his debt. In meteorology even more than in astronomy the work of the amateur Observer is of the utmost value, and no one has more constant proof of this than the Director of the British Rainfall Organization.

METEOROLOGICAL NEWS AND NOTES.

PROFESSOR FILIPPI EREDIA has, says *Nature*, been awarded the Natural Sciences Gold Medal of the Societa Italiana delle Scienze for his important work in Meteorology, this being the first time that such a distinction has been awarded for meteorology in Italy.

THE METEOROLOGICAL OFFICE announces that the *Daily Weather Report*, the *Weekly Weather Report* and the *Monthly Weather Report* will not be issued to the public henceforth during the continuance of the War. Subscribers to these Reports may, on giving notice to the Director of the Meteorological Office, have their copies kept for them to be delivered at the end of the War.

Climatological Table for the British Empire, March, 1918.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain. Depth.	Total Rain. Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	70·3	23	27·2	9	52·9	35·8	...	84	109·6	24·0	1·09	8	6·1
Malta	66·7	28	48·5	22	59·5	51·6	...	81	121·0	29·0	5·49	12	2·0
Lagos	90·4	2	68·0	18	87·3	75·3	73·3	75	153·4	65·0	7 86	14	7·4
Cape Town	92·1	12	50·8	25	77·3	58·0	56·0	68	...	...	·90	4	2·3
Johannesburg	77·5	10	46·2	23	70·6	54·1	55·4	87	...	47·2	4·73	23	7·9
Mauritius	86·4	10	65·0	4	83·5	70·7	70·4	81	...	14·8	11·43	21	6·0
Bloemfontein	86·6	10	48·9	2	77·1	60·2	68·7	72	..	...	3·28	11	6·2
Calcutta...	98·8	9	60·9	13	93·2	70·8	65·8	62	...	43·3	·82	2	1·8
Madras	91·7	21	66·6	12	87·8	70·6	71·1	78	156·2	62·2	·02	1	1·5
Colombo, Ceylon ...	90·2	17	69·6	2	88·4	73·2	71·3	78	158·5	63·3	1·85	6	4·2
Hongkong	78·2	25	54·1	15	68·6	60·7	58·3	81	...	...	1·11	10	7·7
Sydney	86·4	6	52·7	30	75·6	60·7	60·7	74	144·6	56·4	2·48	15	4·8
Melbourne	87·8	23	40·0	18	73·4	55·0	52·5	64	146·7	31·5	4·46	14	5·7
Adelaide	96·2	23	49·6	26*a*	80·0	57·6	50·6	50	153·0	35·5	·50	4	3·6
Perth	92·3	19	51·0	4	80·2	60·2	55·9	62	167·0	42·3	1·91	6	3·9
Coolgardie	93·8	7	47·8	6	82·3	57·4	49·4	46	153·6	46·0	1·01	6	3·6
Brisbane	84·8	15	58·0	26	79·1	64·0	61·6	72	151·9	52·8	3·05	20	5·6
Hobart, Tasmania ..	87·3	23	40·4	16	68·5	51·9	47·2	60	140·8	34·7	1·38	13	5·8
Wellington ...	76 3	8	43·7	25	66·7	55·1	53·2	76	139·0	31·6	3·50	11	7·2
Jamaica, Kingston ..	87·5	9, 11	65·3	7	85·3	67·6	66·2	79	...	...	1·02	5	3·6
Grenada	85·0	26*a*	69·0	sev.	82·0	71·0	...	71	137·0	...	2·49	17	2·5
Toronto	67·2	20	6·0	11	42·4	24·7	23·2	73	118·0	—1·0	2·08	10	4·1
Fredericton	54·0	21	—27·0	8	33·4	7·9	13 5	75	...	...	3·05	7	4·4
St. John, N.B. ...	54·6	31	—8·0	8	32·2	16·2	16·2	71	130·2	—8·6	2·90	12	5·0
Victoria, B.C.	60·0	28	28·0	5	48·4	37·4	35·0	79	122·0	19·5	2·79	17	7·3

a—27.

Johannesburg.—Bright sunshine 157·6 hours.

COLOMBO, CEYLON.—Mean temp. 80°·8, or 0°·5 below, dew point 1·3 below and R 2·36 in. below averages. Mean hourly velocity of wind 3·6 miles. TS on 5 days.

HONGKONG.—Mean temp. 64·0. Bright sunshine 122·1 hours. Mean hourly velocity of wind 13·6 miles.

Melbourne.—Temp. 0°·3 below, and R 2·30 in. above, averages.

Adelaide.—Mean temp. 1·1 in. below, and R ·56 in. below, averages.

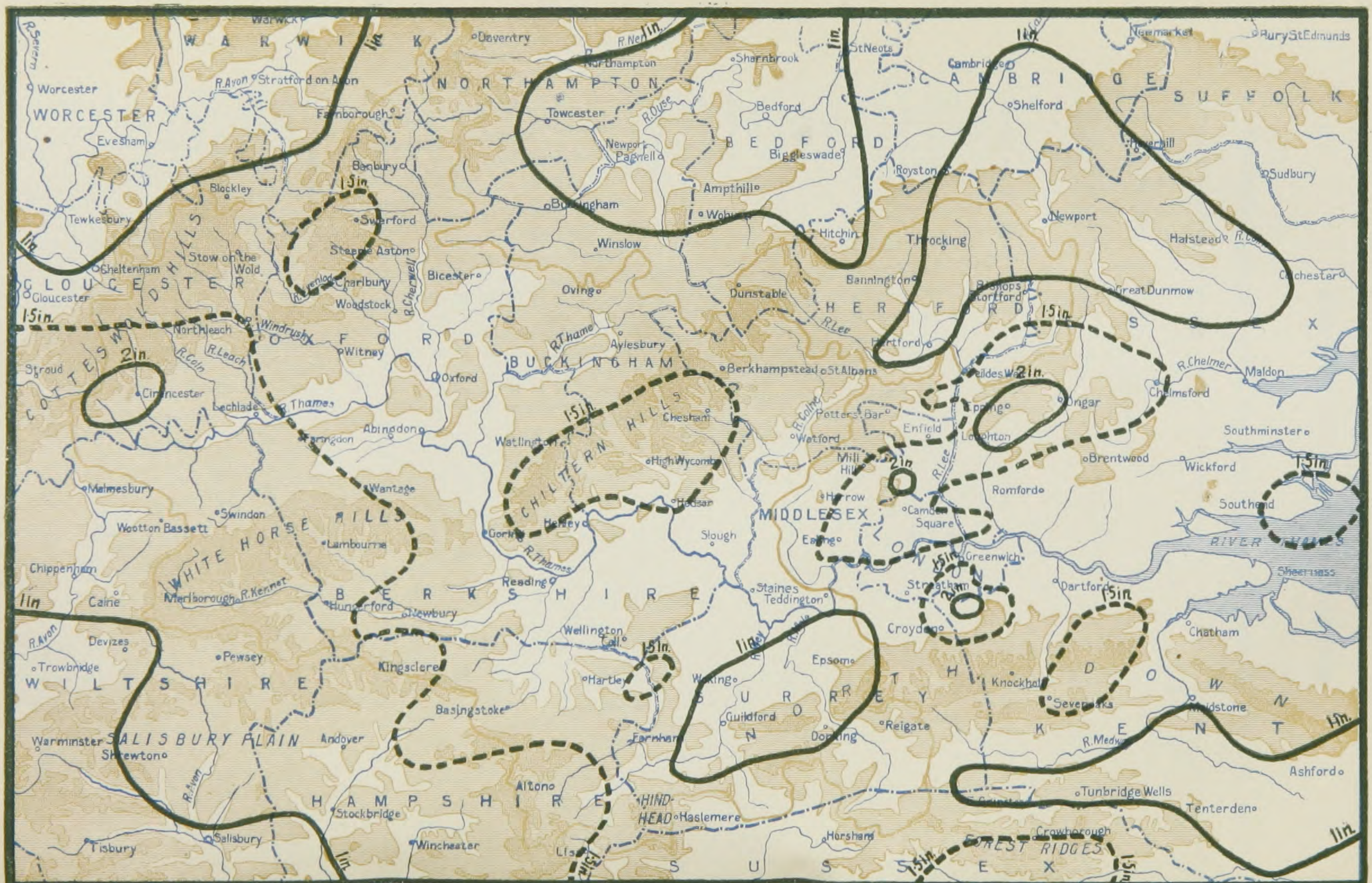
Coolgardie.—Temp. 1·8 in. below, and R slightly above, averages.

Brisbane.—Temp. 3·2 in. below, and R below, averages.

Hobart.—Bright sunshine 167·1 hours.

Wellington.—Mean temp. 0°·4 above, and R ·13 in. above, averages. Bright sunshine, 149·5 hours.

THAMES VALLEY RAINFALL. AUGUST, 1918.



ALTITUDE SCALE

Below 250 feet	250 to 500 feet	500 to 1000 feet	Above 1000 feet

SCALE OF MILES 0 5 10 15 20

Symons's Meteorological Magazine

Watershed of River Thames above Teddington, and River Lee above Feildes Weir.

Isohyetals.

PUBLICATION POSTPONED BY ORDER OF CHIEF CENSOR, ADMIRALTY.

RAINFALL TABLE FOR AUGUST, 1918.

STATION.	COUNTY.	RAINFALL. Aver. 1875—1909. in.	1918. in.	Diff. from Av. in.	Per cent. of Av.	Max. in 24 hours. in.	Date.	Nos. of Day
Camden Square	*London*	2·39	1·78	— ·61	74	·48	2	12
Tenterden	*Kent*	2·42	·94	—1·48	39	·27	2	12
Arundel (Patching)	*Sussex*	2·52	2·22	— ·30	88	·63	2	10
Fordingbridge (Oaklands)	*Hampshire*	2·76	2·91	+ ·15	105	·83	1	13
Oxford (Magdalen College)	*Oxfordshire*	2·44	·99	—1·45	41	·36	25	9
Wellingborough (Swanspool)	*Northampn*	2·36	·71	—1·65	30	·16	25	11
Bury St. Edmunds (Westley)	*Suffolk*	2·52	1·32	—1·20	52	·24	27	12
Geldeston [Beccles]	*Norfolk*	2·22	1·72	— ·50	78	1·15	2	8
Polapit Tamar [Launceston]	*Devon*	3·17	3·29	+ ·12	104	1·00	5	13
Rousdon [Lyme Regis]	,,	2·84	2·30	— ·54	81	·69	1·25	11
Stroud (Field Place)	*Gloucester*	2·90	1·70	—1·20	59	·48	3	9
Church Stretton (Wolstaston)	*Shropshire*	3·43	2·46	— ·97	72	·55	27	14
Boston	*Lincoln*	2·39	1·27	—1·12	53	·34	2	9
Worksop (Hodsock Priory)	*Nottingham*	2·55	1·91	— ·64	75	·62	3	9
Mickleover Manor	*Derbyshire*	2·80	2·97	+ ·17	106	1·23	2	14
Congleton (Buglawton Vic.)	*Cheshire*	3·52	2·90	— ·62	82	·54	2	19
Southport (Hesketh Park)	*Lancashire*	3·73	2·88	— ·85	77	·69	27	12
Wetherby (Ribston Hall)	*York, W.R.*	2·78	2·84	+ ·06	102	·86	4	9
Hull (Pearson Park)	,, *E.R.*	3·05	2·62	— ·43	86	·85	3	12
Newcastle (Town Moor)	*North'land*	3·20	1·58	—1·62	49	·29	25	14
Borrowdale (Seathwaite)	*Cumberland*	11·47	...	...	...	...	...	...
Cardiff (Ely)	*Glamorgan*	4·54	3·61	— ·93	80	1·06	24	17
Haverfordwest	*Pembroke*	4·21	3·15	—1·06	75	·85	1	16
Aberystwyth (Gogerddan)	*Cardigan*	4·88	3·97	— ·91	81	1·02	25	16
Llandudno	*Carnarvon*	3·16	1·57	—1·59	50	·39	25	13
Cargen [Dumfries]	*Kirkcudbrt.*	4·23	6·05	+1·82	143	1·87	25	21
Marchmont House	*Berwick*	3·54	1·81	—1·73	51	·41	27	15
Girvan (Pinmore)	*Ayr*	4·54	5·71	+1·17	126	1·80	26	19
Glasgow (Queen's Park)	*Renfrew*	3·62	2·53	—1·09	70	·46	20	21
Islay (Eallabus)	*Argyll*	4·49	4·39	— ·10	98	·65	11	27
Mull (Quinish)	,,	5·00	5·88	+ ·88	118	·92	22	25
Balquhidder (Stronvar)	*Perth*	6·22	4·20	—2·02	68	1·00	27	22
Dundee (Eastern Necropolis)	*Forfar*	3·34	2·26	—1·08	68	·45	24	19
Braemar	*Aberdeen*	3·63	2·45	—1·18	68	·55	31	16
Aberdeen (Cranford)	,,	3·07	3·50	+ ·43	114	1·25	31	15
Gordon Castle	*Moray*	3·29	3·33	+ ·04	101	...	...	...
Drumnadrochit	*Inverness*	3·11	2·83	— ·28	91	·53	31	20
Fort William	,,	6·15	5·69	— ·46	93	·71	22	25
Loch Torridon (Bendamph)	*Ross*	6·61	9·98	+3·37	151	1·57	31	23
Dunrobin Castle	*Sutherland*	2·71	3·79	+1·08	140	·74	31	17
Glanmire (Lota Lodge)	*Cork*	3·83	2·25	—1·58	59	·99	2	15
Killarney (District Asylum)	*Kerry*	4·57	2·89	—1·68	63	·41	4	21
Waterford (Brook Lodge)	*Waterford*	3·73	3·02	— ·71	81	1·04	1	13
Nenagh (Castle Lough)	*Tipperary*	4·04	4·67	+ ·63	116	1·39	1	22
Ennistymon House	*Clare*	5·01	5·60	+ ·59	112	·97	2	24
Gorey (Courtown House)	*Wexford*	3·31	2·66	— ·65	80	·64	1	12
Abbey Leix (Blandsfort)	*Queen's Co.*	3·94	2·76	—1·18	70	·52	1	16
Dublin (Fitz William Square)	*Dublin*	3·08	2·19	— ·89	71	·60	25	17
Mullingar (Belvedere)	*Westmeath*	4·00	2·32	—1·68	58	·36	26	15
Crossmolina (Enniscoe)	*Mayo*	4·68	4·66	— ·02	100	1·25	5	24
Cong (The Glebe)	,,	4·70	...	...	...	...	...	...
Collooney (Markree Obsy.)	*Sligo*	4·30	2·78	—1·52	65	·51	26	22
Seaforde	*Down*	3·64	3·61	— ·03	99	1·34	5	15
Ballymena (Harryville)	*Antrim*	4·18	4·69	+ ·51	112	1·57	5	22
Omagh (Edenfel)	*Tyrone*	4·22	3·18	—1·04	75	·45	5	24

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SUPPLEMENTARY RAINFALL, AUGUST, 1918.

Div.	STATION.	Rain inches.	Div.	STATION.	Rain inches.
II.	Warlingham, Redvers Road..	1·23	XI.	Lligwy	1·39
,,	Ramsgate	·77	,,	Douglas, Isle of Man	2·16
,,	Hailsham	1·55	XII.	Stoneykirk, Ardwell House...	3·54
,,	Totland Bay, Aston House...	1·81	,,	Carsphairn, Shiel	6·88
,,	Stockbridge, Ashley	1·89	,,	Langholm, Drove Road	5·41
,,	Grayshott	1·18	XIII.	Selkirk, The Hangingshaw..	1·73
III.	Harrow Weald, Hill House...	1·24	,,	North Berwick Reservoir	2·16
,,	Pitsford, Sedgebrook	1·56	,,	Edinburgh, Royal Observaty.	1·57
,,	Woburn, Milton Bryant	·98	XIV.	Biggar	2·00
,,	Chatteris, The Priory	1·02	,,	Maybole, Knockdon Farm ...	3·72
IV.	Elsenham, Gaunts End	·92	XV.	Buchlyvie, The Manse	3·80
,,	Shoeburyness	1·68	,,	Ardgour House	9·56
,,	Colchester, Hill Ho., Lexden	·86	,,	Oban	3·90
,,	Ipswich, Rookwood,Copdock	1·55	,,	Campbeltown, Witchburn ..	...
,,	Aylsham, Rippon Hall	2·65	,,	Holy Loch, Ardnadam	4·82
,,	Swaffham	2·00	,,	Tiree, Cornaigmore	...
V.	Bishops Cannings	2·28	XVI.	Glenquey	4·90
,,	Weymouth	1·54	,,	Loch Rannoch Dall	2·62
,,	Ashburton, Druid House	2·99	,,	Blair Atholl	2·08
,,	Cullompton	3·37	,,	Coupar Angus	3·25
,,	Lynmouth, Rock House	3·23	,,	Montrose, Sunnyside Asylum.	2·32
,,	Okehampton, Oaklands	2·97	XVII.	Balmoral	2·00
,,	Hartland Abbey	2·32	,,	Fyvie Castle	3·10
,,	St. Austell, Trevarna	2·60	,,	Keith Station	1·63
,,	North Cadbury Rectory	3·10	XVIII.	Rothiemurchus	2·33
VI.	Clifton, Stoke Bishop	2·57	,,	Loch Quoich, Loan	20·40
,,	Ledbury, Underdown	1·55	,,	Skye, Dunvegan	11·39
,,	Shifnal, Hatton Grange	1·89	,,	Fortrose	2·56
,,	Droitwich	·92	,,	Glencarron Lodge	9·31
,,	Blockley, Upton Wold	1·26	XIX.	Tongue Manse	5·28
VII.	Grantham, Saltersford	1·55	,,	Melvich	4·39
,,	Louth Westgate	1·97	,,	Loch More, Achfary	9·70
,,	Bawtry, Hesley Hall	1·78	XX.	Dunmanway, The Rectory ..	3·01
,,	Whaley Bridge, Mosley Hall	3·43	,,	Mitchelstown Castle	3·82
,,	Derby, Midland Railway	1·82	,,	Gep of Dunloe Gearahameen	5·00
VIII.	Nantwich, Dorfold Hall	2·75	,,	Darrynane Abbey	4·51
,,	Bolton, Queen's Park	4·17	,,	Clonmel, Bruce Villa	2·44
,,	Lancaster, Strathspey	4·04	,,	Broadford, Hurdlestown	3·67
IX.	Langsett Moor, Up. Midhope	1·08	XXI.	Enniscorthy, Ballyhyland...	2·80
,,	Scarborough, Scalby	2·82	,,	Rathnew, Clonmannon	1·80
,,	Ingleby Greenhow	2·43	,,	Ballycumber, Moorock Lodge	2·46
,,	Mickleton	...	,,	Balbriggan, Ardgillan	2·23
X.	Bellingham, High Green Manor	2·66	,,	Castle Forbes Gardens	2·08
,,	Ilderton, Lilburn Cottage ...	1·19	XXII.	Ballynahinch Castle	6·80
,,	Keswick, The Bank	5·26	,,	Woodlawn	4·00
XI.	Llanfrechfa Grange	3·57	,,	Westport, St. Helens	2·04
,,	Treherbert, Tyn-y-waun	4·70	,,	Dugort, Slievemore Hotel ...	5·56
,,	Carmarthen, The Friary	3·54	XXIII.	Enniskillen, Portora	3·81
,,	Fishguard, Goodwick Station.	3·91	,,	Dartrey [Cootehill]	3·13
,,	Crickhowell, Tal-y-maes	2·70	,,	Warrenpoint, Manor House ..	2·43
,,	Gwernargllwydd	2·00	,,	Belfast, Cave Hill Road	3·86
,,	Birmingham WW., Tyrmynydd	2·45	,,	Glenarm Castle	2·53
,,	Lake Vyrnwy	2·49	,,	Londonderry, Creggan Res...	5·25
,,	Llangynhafal, Plas Drâw	2·20	,,	Milford, The Manse	5·18
,,	Rhwibryfdir	14·99	,,	Killybegs	5·92
,,	Dolgelly, Bryntirion	4·03			

Symons's Meteorological Magazine.

No. 633. OCTOBER, 1918. Vol. LIII.

THE WATER CONTENTS OF THE ATMOSPHERE IN RELATION TO HEAVY RAINFALL.

By W. H. Dines, F.R.S.

The difficulty in this matter is that one must postulate certain wind conditions which may be far from the reality. It is easy to calculate the total amount of water in a column of saturated air obeying the usual law as to decrease of temperature with height and at a given temperature at the bottom, but before the vapour can be extracted all the bottom air must rise, and, of course, that means that fresh air must come in to take its place, and this fresh air hopelessly complicates the matter.

Some time ago the total water contents of the air as recorded by the humidity records of 250 registering balloons were worked up with the following results for England and the Continent :—

In the winter the total equivalent rainfall is about ·40 in., with a range from ·25 in. to ·80 in. ; in summer the mean is about ·80 in., with a range from ·50 in. to 1·50 in. The amount seems to depend chiefly on the temperature and but little on anything else, *i.e.*, if the air is warm there is almost certain to be plenty of moisture and conversely. Practically all the water is contained in the first few kilometres.

The total water contents of a column of the atmosphere expressed as rainfall are given in the following table.

It is assumed that the air is just at the saturation point throughout, and that the fall of temperature is 10° F. per kilometre of height. This is about the average rate in the lower strata, and it is only the lower strata that matter. Water vapour at temperatures below 5° F. are neglected.

	° F.			*in.*
Ground temperature	80	..	Total contents	2·86
,, ,,	70	..	,, ,,	1·90
,, ,,	60	..	,, ,,	1·24
,, ,,	50	..	,, ,,	·84
,, ,,	40	..	,, ,,	·53
,, ,,	30	..	,, ,,	·33
,, ,,	20	..	,, ,,	·18

The values used were interpolated from Davis' Elementary Meteorology. A graphical method has been used but the errors should not exceed 5 per cent.

The amount of water entering per day a given area on certain arbitrary assumptions as to the strength and direction and height of the inflowing winds, may be arrived at by the following method. Consider a circular area of 100 kilometres radius. In general it is found that the wind is parallel to the isobars at a height of half a kilometre. Take, therefore, an inflowing wind of 500 metres (1660 ft.) height, with a component velocity of 10 metres per second (22·5 miles per hour), at right angles to the boundary. The amount of air entering per day in cubic metres is equal to $500 \times 2\pi \times 100000 \times 10 \times 24 \times 60 \times 60$. This is the number of cubic centimetres of water entering if each cubic metre contains one gramme. Assume that all this water vapour is condensed.

Rainfall area $= \pi\,(100000)^2$ square metres.

Average Rainfall (total amount in grammes per square metre)

$$= \frac{\pi \times 24 \times 6 \times 6 \times 10^{11}}{\pi\, 10^{10}} = 24 \times 360 = 8640.$$

8640 grammes per square metre = 8640 cubic centimetres per 10000 square centimetres = a rainfall of ·864 centimetres, or 8·64 millimetres.

From Davis, graphically, we get the approximate values :—

° F.								
At 80	one saturated	cubic	metre	contains		25·2	grammes	of water.
,, 70	,,	,,	,,	,,	,,	18·4	,,	,,
,, 60	,,	,,	,,	,,	,,	13·0	,,	,,
,, 50	,,	,,	,,	,,	,,	9·4	,,	,,
,, 40	,,	,,	,,	,,	,,	6·2	,,	,,
,, 30	,,	,,	,,	,,	,,	4·5	,,	,,

Hence the following values :—

		° F.					*mm.*
Air	entering at	80	should give	a rainfall	of	8·64 × 25·2 =	218
,,	,,	70	,,	,,	,,	,,	159
,,	,,	60	,,	,,	,,	,,	112
,,	,,	50	,,	,,	,,	,,	81
,,	,,	40	,,	,,	,,	,,	54
,,	,,	30	,,	,,	,,	,,	39

On changing to inches :—

At	80°	70°	60°	50°	40°	30° F.
Rainfall .	8·58	6·62	4·42	3·20	2·13	1·53 in.

To change to miles instead of kilometres :—

If the radius of the circular area be doubled the amount of the inflowing wind is doubled, but the rainfall area is increased fourfold, therefore the average rainfall is halved. Hence, for an area of 100 miles radius instead of 100 kilometres, the rainfall must be reduced by 5/8, and taking 10 miles per hour instead of 10 metres per second it must be further reduced by multiplying by 10/22·5.

At	80°	70°	60°	50°	40°	30°
Rainfall ..	2·40	1·84	1·23	·89	·59	·43 in.

If the air entering the area at 80° F. left it at 60° F., the rainfall would be 2·40—1·23, and so on for entering and leaving at other temperatures.

The circle gives the minimum rainfall because it contains the largest area of any figure in the smallest perimeter; for an oval the rainfall would be greater. Also the rainfall is the average over the whole area, in reality it would be concentrated into parts of the area.

In the above remarks it is assumed that all rain is due to dynamic cooling. All heavy rain is certainly so caused. The supposition that the water-bringing winds enter a rainy area from all sides is probably far from the truth, but the figures show that very heavy rainfalls must be due to inflowing winds, for the air over any given area at any time does not contain water enough to produce them.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

WATERSPOUT CLOUD EFFECT.

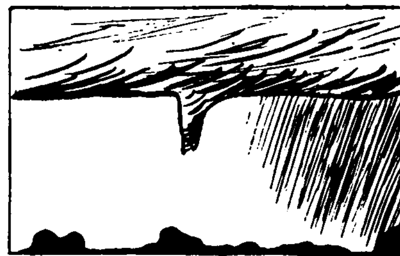
At Northampton, one August day, I witnessed the terrestrial equivalent of a waterspout.

At 3.10 p.m., looking northwards, I noticed a clearly defined slate grey funnel-shaped suspension from the rear and lowest portion of the base of a large, irregularly constructed Nimbo-cumulus, which spread slowly southwards precipitating rain accompanied by thunder and leaving as an aftermath an extensive and dense upper canopy of cloud from which rain continued to fall for two hours at Northampton. Eye-witnesses in the immediate neighbourhood of the phenomenon have described it as resembling a balloon and refer to the swaying motion of the funnel, but I have been unable to acquire any positive information regarding violent wind effects or so-called cloud-bursts.

At 3.14 the funnel diminished considerably in size, but by 3.16 had rapidly revived in a slightly different form only to disintegrate and disappear a minute later within a dense rain curtain which spread from right to left coinciding with the occurrence of the first thunder heard by me. The mass of scud forming the rear limit of the low-hanging base reached my zenith at 3.50 and was obviously in a state of the greatest agitation.

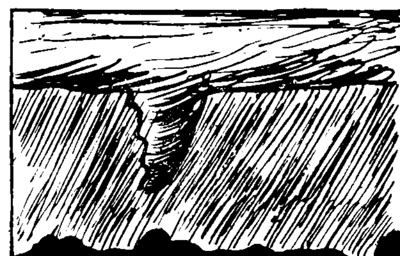
Of rain only a few drops, and these of exceptionally large size, reached earth at this time, but steady rain followed from the upper canopy and continued for two hours. Fitful south-westerly and north-westerly gusts were also noted at this period, but with this exception only very light and variable breezes from the west were experienced before, during and after the storm. The sky gradually cleared during the evening.

3.10 P.M., B.S.T.



3.14 P.M.

3.16 P.M.



3.17 P.M.

I was enabled to get into touch with witnesses through the medium of the respective rectors of the parishes north of Northampton to whom I am very grateful for their help. The complete concordance of descriptions is as satisfactory as unusual, but what is remarkable and not without significance is the fact that, of the crowds of people out-of-doors on a Saturday afternoon in a large town, so very few appear to have noticed what is surely a most unusual spectacle.

Additional facts justifiy the following conclusions :—

Origin :—Its brief existence seems to have begun and ended within the basin of one of the tributaries of the river Nene.

Dimensions :—Its diameter was about 700 feet at the top of the funnel diminishing to, say, 150 feet for the greater part of its length. The base of the cloud from which the funnel was suspended was about 3,000 feet above the ground, and the length of the spout rather more than 2,000 feet.

Speed :—The spout took 7 minutes to travel half a mile and the cloud base of scud referred to, or, perhaps more properly, the process of which the agitated scud was merely the visible sign, would appear to have travelled at the same slow rate. One witness states that it had an anti-clockwise motion and " . . . . it burst and simply drenched us in a moment." A. S. MARTIN-SMITH, Lieut.

71, Wood Street, Barnet, Herts, August 19th, 1918

THE GREEN FLASH.

Mr. Cobbold's note in this month's *Meteorological Magazine*, p. 90, of his observation on February 15th, 1906, was no doubt induced by my notes in last year's volume at p. 100. May I be allowed space to call attention to the fact that what Mr. Cobbold, like many other Observers in the *Meteorological Magazine* of 1905 and 1906, describes as a green "flash" is in fact a change in the apparent colour of a small sector of the sun during an appreciable, though short space of time, and is not really to be defined as a flash. What I, and I think a few other Observers, have described was a ray or rays of light of green colour darting out from the sun's limb at its disappearance. and quite momentary. and so a true flash.

If we are to arrive at a satisfactory explanation, we must carefully distinguish the two phenomena. JAMES G. WOOD.

115, Sutherland Avenue, W. 9, October 6th, 1918.

Mr. Paul Cobbold appears, from his letter published in your last Magazine, to be puzzled that, when a larger portion of the sun's disc appeared above the horizon, the "Green Flash" disappeared, seen when only a small portion of the sun was visible.

Is it not likely that this was owing to the :—

(i.) Stronger light of the sun, or

(ii.) To a difference in the density of the smoke.

Anyone who can remember the autumn of the Krakatoa eruption will recall the unanswered questionings which arose about the marvellous atmospheric effects—green suns, blue moons and gorgeous sunsets, till the startling news of the eruption came to hand, and we learnt that the air was full of volcanic dust.

In a similar way was not smoke capable of changing the light, in the case referred to by Mr. Cobbold ?

ONE WHO SAW THE EFFECTS OF THE KRAKATOA ERUPTION.

September 17th, 1918.

[We agree with the correspondent whose letter is given above that the green colour given to the disc of the sun when seen through a veil of smoke is akin to the Krakatoa phenomena. The subject of the green suns of thirty-five years ago was very fully dealt with by Mr. C. Michie Smith, of Madras. The phenomenon, as Mr. Wood points out, is different altogether from the momentary green rays seen at sunset and sunrise.—Ed. *S.M.M.*]

OUR RAINFALL TABLES.

We regret that the difficulty referred to last month has again prevented the publication of our rainfall tables. We propose, however, to print these and to circulate them to our readers at some future time.

THE WORK OF THE METEOROLOGICAL OFFICE.

We have just received the thirteenth annual report of the Meteorological Committee for the year ended 31st March, 1918 (Cd. 9143, price 2d.), and the special circumstances of the time make it appropriate to refer to it at some length. Our readers include the great majority of those who, before the war, were in the habit of looking forward to the appearance of the daily, weekly, monthly, annual and occasional publications of the Meteorological Office and of utilizing their contents for scientific or economic purposes. The evils of war are brought home very keenly to those loyal and patriotic citizens by such restrictions on liberty as the suppression of the publications of the Meteorological Office. The fact that some of these publications if issued promptly might conceivably be useful to the enemy if conveyed to him only makes the honest patriot suffer the more from the indignity of being treated as a potential traitor to his country. Added to that, as he does not know who is responsible for the restriction, he is apt to be haunted by the fear that the veil of mystery may serve as a screen for departmental inefficiency and the doubt whether the activities he followed with such interest in time of peace may have been slackened or stopped.

If such vain fears have found a place in any reader's mind the relief which the Annual Report affords must be as complete as it is welcome, for it shows that far from being slackened the activities of the Meteorological Office have been greatly stimulated, the volume of its work increased and its usefulness carried into new spheres. The Report does not, of course, refer to the changes announced in our issue for June last, which belong to the present official year. As for 1917-18 the Report says :—

"The most noteworthy feature of the year is the great development of pressing demands for expert meteorological assistance, and the prospect of still larger demands in the future, as regards the Naval, Military and Air Services. The Committee have to note the establishment of a Naval Meteorological Service under a director attached to the Hydrographic Office, a large extension of the Meteorological Section, R.E., various projects in connection with the Royal Flying Corps arranged in conjunction with the Office by Major G. I. Taylor, R.A.F., and the prospect of a large meteorological organization in connection with the Royal Air Force."

Some particulars are given of the development of the Meteorological Section of the Royal Engineers under the charge of Colonel Lyons. In this connection it is noted that a Home Unit has been established "to meet the requirements of a number of military services," with headquarters on Salisbury Plain, under the charge of Captain C. J. P. Cave. The selection of men for this Unit and their training are undertaken at the Meteorological Office.

The Forecast Division has been re-organized to meet a greatly increased demand for forecasts, of course, for military and naval purposes only, and continuous attendance at the Office for this purpose has been introduced.

The Meteorological Office has also taken into its system the Committee on Atmospheric Pollution. All the increased work in every department is, of course, hampered by the difficulty of securing a sufficient staff, and this necessarily falls more heavily on the old essential duties of the Office than on the new departures which are largely under military conditions.

The most interesting thing by far in the Report before us is the indication of future developments given in the following terms :—

" It is obvious that there must be distributing centres in charge of competent meteorologists in various centres as well as London, whether they be under the control of the Meteorological Committee or not. And as the various Dominions beyond the seas will themselves require some provision for compiling and utilising meteorological information some co-operative organisation is called for on the part of the Imperial Government in conjunction with the Local Governments. This wide extension of its outlook which must be faced if the Office is to continue to be the central national and imperial establishment for meteorology has been before the Committee on several occasions, in the first place with reference to the development of the organisation within the Office to meet the increased requirements for information of different kinds; and, secondly, with reference to application for the acceleration of the supply of information in distant parts of the Kingdom, which can only be satisfied by local centres of distribution.

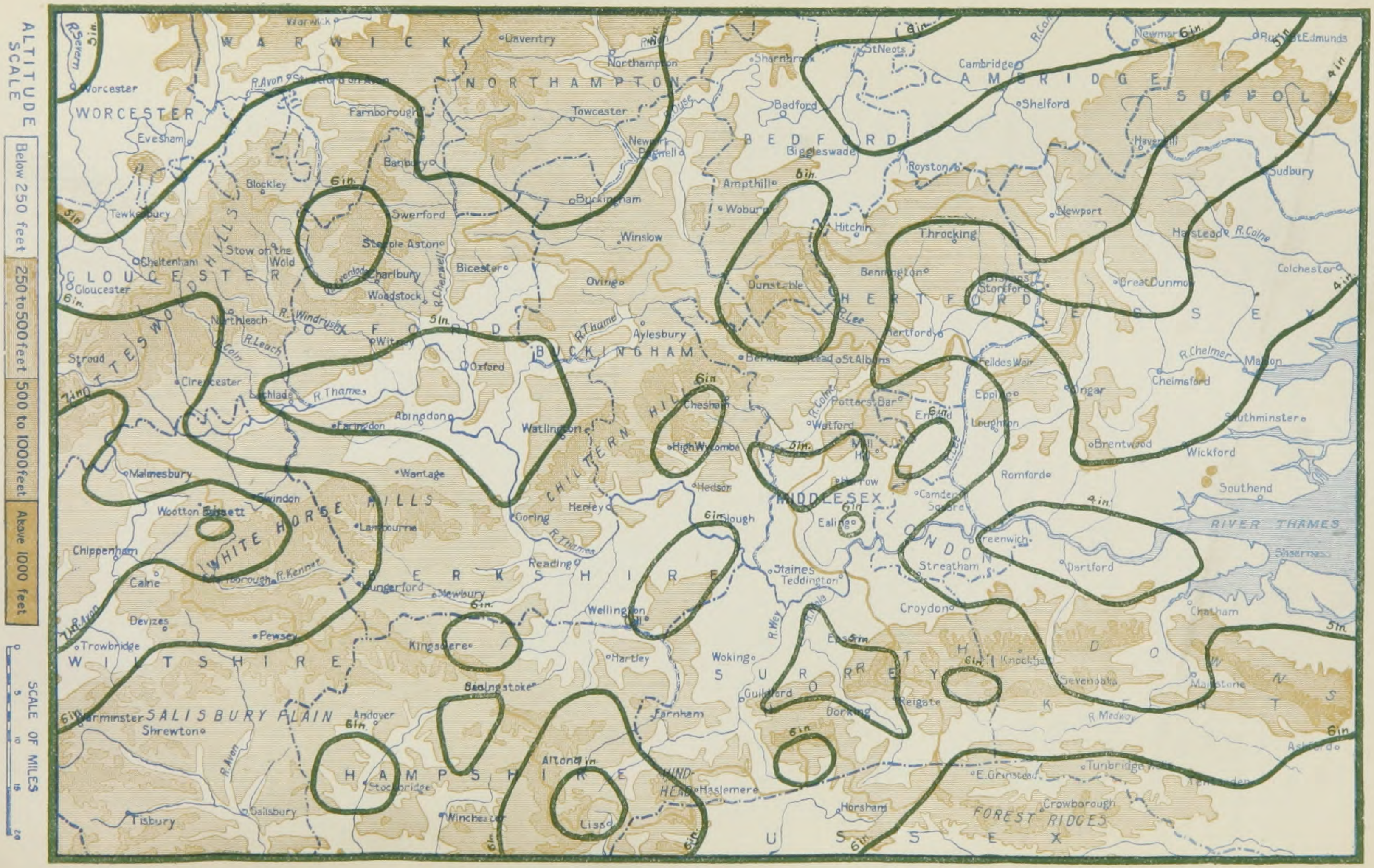
" In response to a request from the Ministry of Reconstruction for a report on the steps taken by the Committee with reference to post-war problems a memorandum was prepared and submitted setting out the peculiarities of the British meteorological services depending upon the history of the development of meteorological work in this Country and the organization necessary for completing the service. It was pointed out that as the work of the Office originated in the study of the meteorology of the sea exclusively, the detailed study of rainfall which is obviously a vital part of general meteorology and which is the fundamental study of practically all national meteorological establishments in the Dominions and in foreign countries, is still in this Country, in accordance with traditions, left in charge of a private organization, and also that the municipal authorities in this Country make no provision as a general rule for recording their experiences of the weather for the guidance of their successors ; thus all the information required for climatological questions to supplement what appears in the Daily Weather Report is left almost exclusively to private effort. Now that the weather is recognised to be of primary importance in so many affairs of life and the requirements of so many departments of the Navy, the Army and the Air Force include a knowledge of weather conditions, not only at the surface in the various parts of the globe but at elevations which have up to now been of interest to the meteorologist alone, some more comprehensive organisation is necessary.

"And it is felt that the steps towards this organization cannot be postponed until after the war. While on the one hand the war makes the development of the organization difficult on account of the difficulty of obtaining staff and materials for observatories and experimental work, yet, on the other hand, the war has shown the special importance of certain meteorological problems the solution of which cannot await the conclusion of hostilities."

We have long felt that the British Rainfall Organization, to which reference is made in the foregoing quotation, was fulfilling a duty of national importance which in all other countries has been undertaken by the Government. We believe that the courageous enterprise of Mr. G. J. Symons has established the rainfall observations in this country on a wider basis than has been accomplished by any State system in the world. The time is long past when the responsibility for the abandonment of rainfall research in this country to private enterprise could profitably be discussed, and we are happy to think that the passage we have quoted implies that the Government is no longer bound by the old tradition of with-holding recognition from the work which was a fresh outcast from official favour in the days before "Symons's Monthly Rain Circular" developed into "Symons's Meteorological Magazine." We should be glad to think that the time is ripe for the participation of the Rainfall Organization in a wider scheme of national meteorological organizations which should encourage local associations for the collection of data for headquarters as well as the dissemination of data from headquarters. For many years to come the shock of the war will continue to embarrass private enterprise and to throw in an increased degree upon the State the duty of sustaining those useful activities which in unbroken peace could safely be left to the more natural process of spontaneous development. Whether this be so or not we are very sure that the great body of voluntary rainfall Observers will continue to serve their country by collecting the information the enormous value of which is still far too little recognized by the public as a whole.

ERRATUM—Page 79, Table VII, Col. 2, January—*for* 8·8 *read* 0·8.

THAMES VALLEY RAINFALL. SEPTEMBER, 1918.



Symons's Meteorological Magazine

Watershed of River Thames above Teddington, and River Lee above Feildes Weir

Isohyetals

Face p. 108.

THE RAINFALL OF SEPTEMBER, 1918.

For many years past most parts of the British Isles have experienced a succession of comparatively dry Septembers and for the country as a whole it is certainly necessary to go back as far as 1896 for any parallel to the abnormal wetness of the month just completed. The table of rainfall on page 104 shows that the rainfall of the month was in excess of the average at every station quoted, representing all parts of the British Isles, and that it was double the average or more at 35 out of the 54 stations, including practically all those in England and Wales. The greatest excess occurred in England, particularly in the centre and south; more than three times the average fell at three stations in the north Midlands. More than twice the average also fell in most parts of Ireland, the total reaching 289 per cent. of the average at Courtown, in Co. Wexford. Scotland was relatively the least rainy of the countries, but more than twice the average fell in the south. The smallest percentage excess was 8 per cent. in Mull.

Parts of the east of Great Britain had rather less than 4 inches of rain during the month, but more than 6 inches fell over a number of isolated areas in the south-east, the largest of which extended from Chichester nearly to Canterbury. One or two stations in these areas had as much as 7 inches, but in no case did the rainfall reach the amounts recorded in the same district in September, 1896, when a considerable part of the south-eastern counties had more than 9 inches and some stations more than 10 inches. At Camden Square, however, the total fall of 5·68 in. was the largest recorded in September in 61 years' observations, exceeding that in 1896 by ·17 in. The duration of rainfall was 72·8 hours, or 47·4 hours above the average.

In September, 1918, more than 6 inches fell also over the whole of the western portion of Great Britain, save the Cheshire Plain and part of the North Wales coast. The whole of the interior of Wales, almost the whole of the Pennines, and parts of Dartmoor and Exmoor, had more than 10 inches, the total rising to more than 20 inches in the centre of the Lake District and to 30 inches on Snowdon. The West Highlands were not so wet, having more than 8 inches over the district generally and as much as 10 inches only in isolated patches. The total was less than 3 inches at one or two points on the east coast. The fall in Ireland exceeded 6 inches except in the centre and east and was less than 5 inches only on a narrow strip of the east coast, but the amounts recorded in the west were more moderate than was the case in England and Wales, and more than 10 inches was, as in Scotland, very local.

Taking the countries as a whole the general rainfall expressed as a percentage of the average was as follows :—England and Wales, 247 per cent.; Scotland, 150 per cent.; Ireland, 209 per cent.; British Isles, 207 per cent.

PUBLICATION POSTPONED BY ORDER OF CHIEF CENSOR, ADMIRALTY.

RAINFALL TABLE FOR SEPTEMBER, 1918.

STATION.	COUNTY.	RAINFALL. Aver. 1875—1909. in.	1918. in.	Diff. from Av. in.	Per cent. of Av.	Max. in 24 hours. in.	Date.	Nos. of Day
Camden Square	*London*	2·00	5·68	+3·68	284	1·23	29	23
Tenterden	*Kent*	2·25	6·26	+4·01	278	1·45	29	21
Arundel (Patching)	*Sussex*	2·58	7·46	+4·88	289	1·40	29	21
Fordingbridge (Oaklands)	*Hampshire*	2·39	5·70	+3·31	239	1·19	29	26
Oxford (Magdalen College)	*Oxfordshire*	1·98	4·58	+2·60	230	1·13	29	24
Wellingborough (Swanspool)	*Northampn*	2·13	4·77	+2·64	225	1·17	29	24
Bury St. Edmunds (Westley)	*Suffolk*	2·18	5·88	+3·70	270	1·27	29	25
Geldeston [Beccles]	*Norfolk*	2·13	3·73	+1·60	176	1·37	29	23
Polapit Tamar [Launceston]	*Devon*	3·11	8·40	+5·29	270	1·31	29	27
Rousdon [Lyme Regis]	,,	2·69	6·29	+3·60	235	1·40	29	27
Stroud (Field Place)	*Gloucester*	2·39	6·40	+4·01	268	1·26	30	24
Church Stretton (Wolstaston)	*Shropshire*	2·40	7·34	+4·94	306	·86	4	30
Boston	*Lincoln*	2·07	4·21	+2·14	204	·71	4	23
Worksop (Hodsock Priory)	*Nottingham*	1·84	4·26	+2·42	231	·61	15	26
Mickleover Manor	*Derbyshire*	2·11	6·35	+4·24	301	·84	4	25
Congleton (Buglawton Vic.)	*Cheshire*	2·67	5·62	+2·95	211	·55	1	30
Southport (Hesketh Park)	*Lancashire*	3·09	8·49	+5·40	274	1·35	15	29
Wetherby (Ribston Hall)	*York, W.R.*	2·11	6·95	+4·84	329	1·00	15	24
Hull (Pearson Park)	,, *E.R.*	2·05	4·14	+2·09	202	·70	15	26
Newcastle (Town Moor)	*North'land*	2·00	5·30	+3·30	265	1·48	15	25
Borrowdale (Seathwaite)	*Cumberland*	11·28	22·25	+10·97	197	...	...	...
Cardiff (Ely)	*Glamorgan*	3·61	10·69	+7·08	296	1·09	18	29
Haverfordwest	*Pembroke*	3·91	8·25	+4·34	211	1·21	29	28
Aberystwyth (Gogerddan)	*Cardigan*	3·89	9·90	+6·01	255	1·21	3	29
Llandudno	*Carnarvon*	2·50	6·95	+4·45	279	1·35	15	27
Cargen [Dumfries]	*Kirkcudbrt.*	3·34	7·29	+3·95	218	2·34	15	21
Marchmont House	*Berwick*	2·67	5·72	+3·05	214	1·86	15	20
Girvan (Pinmore)	*Ayr*	4·30	5·65	+1·35	131	·78	16	25
Glasgow (Queen's Park)	*Renfrew*	2·99	6·32	+3·33	211	1·16	17	22
Islay (Eallabus)	*Argyll*	4·49	7·51	+3·02	167	1·31	9	24
Mull (Quinish)	,,	5·20	5·61	+ ·41	108	1·12	7	22
Balquhidder (Stronvar)	*Perth*	5·81	8·03	+2·22	138	1·60	19	23
Dundee (Eastern Necropolis)	*Forfar*	2·34	3·85	+1·51	164	·91	15	16
Braemar	*Aberdeen*	2·73	4·54	+1·81	166	·75	15	23
Aberdeen (Cranford)	,,	2·69	4·42	+1·73	164	·77	10, 15	20
Gordon Castle	*Moray*	2·58	4·66	+2·08	181	...	...	...
Drumnadrochit	*Inverness*	2·94	4·70	+1·76	160	·50	7	25
Fort William	,,	6·66	7·88	+1·22	119	1·32	22	23
Loch Torridon (Bendamph)	*Ross*	7·28	9·39	+2·11	129	·95	7	23
Dunrobin Castle	*Sutherland*	2·51	3·45	+ ·94	137	·55	16	17
Glanmire (Lota Lodge)	*Cork*	3·20	6·63	+3·43	207	1·20	15	23
Killarney (District Asylum)	*Kerry*	3·79	7·59	+3·80	200	·82	16	30
Waterford (Brook Lodge)	*Waterford*	3·19	7·97	+4·78	250	1·44	3	25
Nenagh (Castle Lough)	*Tipperary*	3·16	7·37	+4·21	233	1·04	21	23
Ennistymon House	*Clare*	4·22	8·20	+3·98	194	1·22	21	27
Gorey (Courtown House)	*Wexford*	2·78	8·01	+5·23	289	1·41	15	23
Abbey Leix (Blandsfort)	*Queen's Co.*	2·93	5·47	+2·54	187	·78	15	24
Dublin (FitzWilliam Square)	*Dublin*	2·06	4·87	+2·81	236	1·26	15	26
Mullingar (Belvedere)	*Westmeath*	3·02	5·52	+2·50	183	·97	15	22
Crossmolina (Enniscoe)	*Mayo*	4·42	7·83	+3·41	178	·98	15	26
Cong (The Glebe)	,,	4·05	...	...	...	...	...	...
Collooney (Markree Obsy.)	*Sligo*	3·65	8·24	+4·59	226	1·21	16	27
Seaforde	*Down*	3·25	5·05	+1·80	155	1·72	15	27
Ballymena (Harryville)	*Antrim*	3·43	7·17	+3·74	209	1·70	15	26
Omagh (Edenfel)	*Tyrone*	3·39	7·18	+3·79	211	1·10	15	27

SUPPLEMENTARY RAINFALL, SEPTEMBER, 1918.

Div.	STATION.	Rain inches.	Div.	STATION.	Rain inches.
II.	Warlingham, Redvers Road..	5·69	XI.	Lligwy	7·29
,,	Ramsgate	4·29	,,	Douglas, Isle of Man	9·64
,,	Hailsham	6·77	XII.	Stoneykirk, Ardwell House...	5·92
,,	Totland Bay, Aston House...	5·05	,,	Carsphairn, Shiel	10·63
,,	Stockbridge, Ashley..	5·17	,,	Langholm, Drove Road	8·81
,,	Grayshott	6·23	XIII.	Selkirk, The Hangingshaw..	6·28
III.	Harrow Weald, Hill House...	4·84	,,	North Berwick Reservoir	4·69
,,	Pitsford, Sedgebrook	4·06	,,	Edinburgh, Royal Observaty.	4·40
,,	Woburn, Milton Bryant	4·92	XIV.	Biggar	4·78
,,	Chatteris, The Priory	5·37	,,	Maybole, Knockdon Farm ...	6·49
IV.	Elsenham, Gaunts End	4·61	XV.	Buchlyvie, The Manse	6·65
,,	Shoeburyness	4·33	,,	Ardgour House	9·29
,,	Colchester, Hill Ho., Lexden	3·66	,,	Oban	5·49
,,	Ipswich, Rookwood, Copdock	3·92	,,	Campbeltown, Witchburn ..	...
,,	Aylsham, Rippon Hall	4·94	,,	Holy Loch, Ardnadam	8·73
,,	Swaffham	5·41	,,	Tiree, Cornaigmore	...
V.	Bishops Cannings	6·10	XVI.	Glenquey	6·80
,,	Weymouth	5·77	,,	Loch Rannoch Dall	5·85
,,	Ashburton, Druid House..	10·92	,,	Blair Atholl	3·92
,,	Cullompton	7·46	,,	Coupar Angus	3·34
,,	Lynmouth, Rock House	9·81	,,	Montrose, Sunnyside Asylum.	2·72
,,	Okehampton, Oaklands..	9·10	XVII.	Balmoral	4·59
,,	Hartland Abbey	7·41	,,	Fyvie Castle	4·91
,,	St. Austell, Trevarna	7·95	,,	Keith Station	7·34
,,	North Cadbury Rectory	5·00	XVIII.	Rothiemurchus	4·43
VI.	Clifton, Stoke Bishop	10·61	,,	Loch Quoich, Loan	18·25
,,	Ledbury, Underdown	5·37	,,	Skye, Dunvegan	9·03
,,	Shifnal, Hatton Grange	5·26	,,	Fortrose	3·15
,,	Droitwich	4·98	,,	Glencarron Lodge	9.55
,,	Blockley, Upton Wold	5·64	XIX.	Tongue Manse	4·91
VII.	Grantham, Saltersford	3·72	,,	Melvich	4·18
,,	Louth Westgate	4·31	,,	Loch More, Achfary	8·99
,,	Bawtry, Hesley Hall	4·63	XX.	Dunmanway, The Rectory ..	9·31
,,	Whaley Bridge, Mosley Hall	9·35	,,	Mitchelstown Castle	7·03
,,	Derby, Midland Railway	5·35	,,	Gap of Dunloe Gearahameen	12·90
VIII.	Nantwich, Dorfold Hall	5·78	,,	Darrynane Abbey	7·86
,,	Bolton, Queen's Park	12·71	,,	Clonmel, Bruce Villa	7·18
,,	Lancaster, Strathspey	10·49	,,	Broadford, Hurdlestown	8·12
IX.	Langsett Moor, Up. Midhope	8·87	XXI.	Enniscorthy, Ballyhyland...	8·33
,,	Scarborough, Scalby	6·41	,,	Rathnew, Clonmannon	5·68
,,	Ingleby Greenhow	5·13	,,	Ballycumber, Moorock Lodge	5·33
,,	Mickleton	7·90	,,	Balbriggan, Ardgillan	4·91
X.	Bellingham, High Green Manor	5·84	,,	Castle Forbes Gardens	6·11
,,	Ilderton, Lilburn Cottage ...	5·39	XXII.	Ballynahinch Castle	7·55
,,	Keswick, The Bank	13·67	,,	Woodlawn	6·56
XI.	Llanfrechfa Grange	10·06	,,	Westport, St. Helens	4·70
,,	Treherbert, Tyn-y-waun	17·64	,,	Dugort, Slievemore Hotel ...	7·95
,,	Carmarthen, The Friary	9·76	XXIII.	Enniskillen, Portora	5·73
,,	Fishguard, Goodwick Station.	7·98	,,	Dartrey [Cootehill]	5·84
,,	Crickhowell, Tal-y-maes	8·00	,,	Warrenpoint, Manor House ..	4·28
,,	Gwernargllwydd	4·00	,,	Belfast, Cave Hill Road	5·72
,,	Birmingham WW., Tyrmynydd	11·64	,,	Glenarm Castle	7·97
,,	Lake Vyrnwy	13·88	,,	Londonderry, Creggan Res...	6·80
,,	Llangynhafal, Plas Drâw	5·35	,,	Milford, The Manse	7·36
,,	Rhwibryfdir	28·32	,,	Killybegs	9·80
,,	Dolgelly, Bryntirion	14·72			

Climatological Table for the British Empire, April, 1918.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain. Depth.	Total Rain. Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	69·4	25	31·4	19	53·4	38·0	...	87	114·6	24·9	3·24	20	8·7
Malta	71·8	20	52·0	10	64·7	55·9	...	81	129·0	42·5	·30	3	2·5
Lagos	90·3	12	70·2	5	88·2	75·3	74·1	74	150·4	68·0	4·15	10	7·5
Cape Town	97·4	5	43·0	10	76·6	53·3	52·3	65	...	...	1·03	6	3·7
Johannesburg	77·0	11	37·4	2	70·7	48·4	44·0	65	...	37·9	...	...	2·7
Mauritius	84·9	6	65·8	24	80·8	70·7	68·2	79	...	60·8	7·30	20	7·0
Bloemfontein	79·8	12	36·6	20	74·2	45·2	44·3	56	..	...	·01	1	2·2
Calcutta...	101·2	6	66·8	19	94·4	74·0	69·6	67	...	58·0	4·73	2	2·7
Madras	99·2	27	68·5	1	93·3	76·2	75·0	78	158·4	64·6	·00	0	1·7
Colombo, Ceylon ...	92·6	9	71·4	30	89·4	74·8	73·1	79	157·2	66·8	4·53	9	4·7
Hongkong	84·0	29	58·5	13	75·0	67·0	65·8	84	...	...	4·44	12	6·7
Sydney	83·6	4	51·4	30	71·3	56·1	56·9	80	132·0	46·5	4·71	24	5·4
Melbourne	76·4	11	40·6	21	66·0	51·0	49·2	71	127·9	30·4	1·61	15	6·4
Adelaide	83·4	12	45·7	17	72·1	54·8	50·1	61	144·0	35·5	·88	10	5·1
Perth	92·4	18	54·3	11	77·2	61·3	58·9	72	151·4	45·3	2·25	8	6·4
Coolgardie	88·0	18	45·0	24	75·7	56·4	52·0	61	152·0	42·4	3·56	10	5·3
Brisbane	86·2	6	53·7	29	76·5	58·7	58·1	72	146·4	49·1	1·70	10	4·2
Hobart, Tasmania ..	68·1	12	40·1	22	59·9	46·9	43·2	66	124·2	32·3	1·99	15	6·6
Wellington ...	61·4	7	48·9	26	52·9	58·2	51·4	78	145·0	29·1	3·53	16	6·9
Jamaica, Kingston ..	88·4	7	67·4	1	86·1	70·4	69·0	79	...	...	3·16	7	4·0
Grenada	86·0	2, 27	69·0	25	84·0	72·0	...	71	138·0	...	1·60	10	4·5
Toronto	69·0	15	22·7	19	53·0	34·3	28·8	64	121·2	19·0	1·41	10	5·2
Fredericton	71·0	28	18·0	*a*	52·7	27·5	27·3	57	...	...	2·73	4	4·1
St. John, N.B. ...	60·5	29	18·7	18	48·2	30·1	28·6	68	121·2	18·5	2·57	9	4·4
Victoria, B.C.	69·8	21	33·0	1	56·3	41·3	38·0	67	126·8	23·0	·35	5	3·8

a—3, 8, 12..

Johannesburg.—Bright sunshine 289·4 hours.

COLOMBO, CEYLON.—Mean temp. 82°·2, or 0°·4 below, dew point 1·5 below and R 2·65 in. below averages. Mean hourly velocity of wind 4·0 miles.

HONGKONG.—Mean temp. 70·4. Bright sunshine 158·6 hours. Mean hourly velocity of wind 10·6 miles.

Melbourne.—Temp. 1·0° below, and R ·67 in. below, averages.

Adelaide.—Mean temp. 0·6 in. below, and R ·97 in. below, averages.

Perth.—Cyclonic gale on 21st. Wind velocity 61 miles an hour

Coolgardie.—Temp. 0·9 in. above, and R nearly three inches above, average.

Brisbane.—Temp. 3°·3 below, and R 1·93 in. below, averages.

Hobart.—Mean temp. 1·7 in. below, and R 0·9 in. above, averages.

Wellington.—Mean temp. 0°·8 above, and R ·46 in. below, averages. Bright sunshine, 127·1 hours.

Symons's Meteorological Magazine.

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WORK AND WATER POWER.

By Hugh Robert Mill.

The force of gravity is the potent agent in doing several kinds of work. These examples will make this plain :—

(1.)—A glass bottle may be smashed into little pieces by means of a small hammer and any one who does so is conscious of doing quite a heavy piece of work, and the smaller the fragments into which the bottle is reduced the heavier is the work required in wielding the hammer. But if a bottle is placed on a first-floor window sill no appreciable work is required to push it over, and when it falls on the pavement below it will be smashed in pieces. If a bottle is similarly released from a second floor window the pieces into which it is smashed will be smaller ; and if from a third floor window smaller still. Hence it is obvious that the greater the height from which the bottle drops the smaller are the fragments into which it is broken, in other words, the greater is the amount of work expended in smashing it. This work was done by gravity bringing the bottle and the ground together ; but gravity is powerless to produce this effect unless the bottle and the ground were originally apart ; and this was effected by the person who did the work of carrying the bottle from the ground to the upper window. The more work done in raising the bottle above the ground, the more work was the weight of the bottle able to do when the bottle reached the ground by falling freely.

This is an uneconomical way of utilising gravity to transform energy which is the technical name for the power of doing work, because the person carrying the bottle to the upper window carries himself there too, and he being much heavier than the bottle, requires a much greater expenditure of energy in the process than is applied to the smashing of the bottle.

(2.)—A falling mass instead of being set to smash itself may be made to do other work. Thus the great wooden piles on which buildings are reared on marshy ground, or the piers of a bridge built in a river are driven into the ground by dropping a weight on them. The pile is placed in position below a lofty frame from which a mass of iron is dropped upon it. The force of the impact drives the pile a little distance into the ground and the mass of iron is raised again to the top of the frame by a couple of workmen turning a winch The energy they expend against gravity by raising the mass of iron is transformed into work done in driving home the pile. If the mass of iron is doubled and raised to the same height, twice as much work is done by it as it falls.

(3.)—A grandfather's clock is driven by the same power as a pile driver; that is to say, by the descent of weight that has been wound up to some definite height above the ground. But instead of being allowed to fall the whole distance at once, as in the pile-driving, the weight in the clock has its fall regulated by the escapement and pendulum, which allow it to fall so slowly that it takes a whole week to reach the ground. All the time it has been doing work against friction in turning the wheels of the clock and keeping the pendulum swinging against the resistance of the air. When the weight reaches the floor of the clock case it rests quietly upon it, for it has done its work in driving the clock and making the wheels go round. Thus it is obvious that the work of a raised weight falling under the influence of gravity can be made to turn machinery which in the case of the clock moves the hands or strikes the bell, though it could be made to run a sewing machine or turn a roast.

Passengers who land at Madeira to see the Mount Church frequently return to the lower town in a "running carro," a basket-work sledge which glides and sweeps over the polished pebbles paving the steep narrow lanes with no motive force but gravity, and is dexterously steered round the most alarming corners by the agile guide, who rides behind. But the exulting rush of the carro is only possible because it has been carried uphill on the head of a toiling porter, whose work done against gravity is the real source of energy.

(4.)—The steep railway which conveys stones from a quarry on the hill-side to the plain below is often so fitted that the loaded trucks descending by the action of gravity pull up the empty trucks the weight of which acts as a brake preventing the too rapid descent of the loaded waggons. The only mechanism required is a pulley at the top and a rope or chain passing round it and connecting the two sets of trucks. An elaboration of this simple arrangement is found in the funicular railways familiar at seaside resorts, in towns like Valparaiso and at mountain villages on the continent. Here a pair of cars running on a steep railway with safety devices to reduce risk are connected by a wire cable which passes round a wheel at the top. Passengers going down enter the top car, those going up enter the bottom car simultaneously, and if the top car has a smaller weight of passengers, water is allowed to flow into a tank which it carries until the increased weight counter-balances the lower car, which is drawn up as the other descends. Here we find water-power at last. It acts simply by its weight, like the falling bottle, the block of the pile-driver, the weight of the grandfather's clock, the passengers of the running carro, or the stones from the quarry.

Whatever the material may be that has been utilized by gravity to do work, it possessed the power of doing work in a potential form when it rested at the high level; it possesed the power of doing work in a moving or kinetic form when it was falling or sliding or rolling from the high level to the ground; but when it rested on the ground it possessed no power of doing work whatever. It has to be lifted up to a high level again before it regains its power of doing work, and the only means of doing this is by expending energy upon it in raising it against the resistance of gravity. The essential fact which has been ascertained is that gravity enables a falling body to do just as much work in descending from a given height as was expended in raising the body to that height; no more and no less.

No accounts can be kept of the expenditure of money without the use of units by which it may be measured, and the same is true of work. The unit by which work against gravity can be measured is compounded of the weight raised and the vertical distance or height through which it is raised. Any units can be employed, a gramme of weight and a centimetre of height, or a pound of weight and a foot of height; in either case we have an adequate measure, the centimetre-gramme, or the foot-pound. It is a matter of convenience only whether we use the smaller or the larger unit just as it is a matter of convenience only whether we count our money in francs, dollars or pounds. Keeping for the present to the old British units by which the laws of energy were first investigated we shall use the foot-pound as the unit of work. If the bottle in our example (1), weighed 1 lb. and the windows of each floor were successively 10 feet above the floor below, the work done in carrying the bottle (neglecting that done in carrying the person) to the first floor was 10 foot pounds, to the second floor, 20 foot pounds, and to the third floor, 30 foot pounds, and the work expended in smashing the bottle from the three positions was, 10, 20 and 30 foot-pounds respectively. So in example (2), if the height of the frame of the pile driver at first was 10 feet above the head of the pile, and the weight 100 lb., it would do 1,000 foot-pounds of work when it fell, or if the weight were 200 lbs. it would do 2,000 foot-pounds of work when it fell. Generalizing this we get the statement that the amount of work which a given weight can accomplish depends only on the height from which it falls; and conversely the amount of work which can be accomplished by a body falling from a given height depends only on its weight.

(*To be continued.*)

CLOUD FORMS.

By Lieut. A. S. Martin-Smith.

Not least among the luxuries which we have had to forego during the war is the daily issue of weather forecasts from the Meteorological Office. We have had to rely almost exclusively upon our own experience of sky indications, together with an individual use of the barometer.

If we ask ourselves—have we suffered a great deal of inconvenience thereby, I wonder how many of us can honestly answer that question in the affirmative. I do not think that I get caught unawares by the elements more frequently now than in the days when we had other people to think for us.

Surely it must have occurred to some of us that there is room for improvement, and that therefore in this, as in other spheres of activity, the time to act is now, not after the conclusion of peace. Possibly steps with that end in view may already have been taken, even so I venture to suggest that in the past there has not, by any means, been an adequate appreciation of the valuable service of which the intelligence to be derived from the systematic observation of clouds is capable of affording the professional meteorologist especially when engaged in forming his forecasts. If the forfeiture of my life depended upon the correctness or otherwise of a weather forecast for any given day I would prefer to rely on the one based upon cloud reports rather than that derived from the study of a similar number of barometer readings.

The recent publication by the Meteorological Office of an illustrated booklet on Cloud Forms must meet with the warm approval of all who consider it desirable to bring at least one branch of meteorological knowledge within the mental grasp of the ordinary man. The photographic reproductions therein of Mr. Clarke's cloudscapes do neither him nor themselves justice. Excessive intensification is so obvious.

After perusing the introductory remarks one is tempted to regret that reference is not made to the charming book of Cloud Studies by A. W. Clayden.

What is disappointing and tends to shake one's faith in the efficacy of isobaric charts is the frequent omission of any reference to the probability of an electrical disturbance in the forecast for a day during which takes place a particularly awe-inspiring display of Nature's fireworks. It can hardly be denied that pre-war forecasts betrayed a marked timidity in this respect.

I lay particular stress on the occurrence of thunderstorms because they are the most truly splendid and self-assertive of all meteorological phenomena in this country and possess a peculiar power of making themselves felt by every one. I can honestly say that during ten years or so of cloud study as a form of recreation, never have I had a thunderstorm take me by surprise, although I will not go so far as to assert that results have invariably justified the anticipation.

I am convinced that by the encouragement and development, along scientific lines, of the study of clouds, much useful work could be accomplished, more particularly with reference to the occurrence of thunderstorms and phenomena similarly elusive to the forecaster. With the notable exception of Mr. Fairgrieve's work, is there in existence a complete or anything approaching a complete and faithful record of the cloud history of any given thunder system? If not, why not?

The following suggestions are here put forward :—

(1.) That propaganda be instituted with a view to arousing an intelligent interest in things meteorological, particularly with regard to cloud study.

(2.) That a public appeal be made for photographs of clouds, and subsequently the formation at the Meteorological Office or elsewhere of a collection comprising a selection of the best available.

(3.) The establishment of an increasing number of auxiliary cloud stations and arrangements made for the telegraphic transmission of reports.

(4.) The thorough investigation of thunderstorm systems with particular reference to the cloud antecedents.

There are several thousands of voluntary rainfall Observers in this country and I am sure that from these alone some hundreds would be found both capable and willing to render this additional service.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

BAROMETRIC PRESSURE AND THUNDERSTORMS.

THOUGH thunderstorms—at least of the more intense type—are generally associated with hot weather, I think it is a mistake to suppose, as some people do, that they are independent of the barometer. According to my experience, thunder rarely develops, even in very hot weather, while the pressure is decidedly high.

I think records would show that thunder is most commonly experienced during cyclone or semi-cyclone weather (in the season of strong sun) or that, in other words, the majority of storms, even in summer, are of a semi-cyclonic nature. G. WESTON.

47, Chester Terrace, S.W. 1, August 22nd, 1918.

INFLUENZA AND WEATHER IN LONDON.

By Chas. Harding.

There is in most minds a lurking suspicion, if nothing more, that influenza is associated in some way with the weather, but a fairly close examination of several epidemics with the accompanying weather conditions fails to show any very definite connection. In the past 80 years there have been in London some 32 epidemics. Sir Arthur Mitchell and Dr. Buchan, in a discussion published in 1890, showed five epidemics in the 45 years from 1845 to 1890, and an examination of the Registrar General's returns from 1891 to 1918 shows 27 epidemics. Dealing with the records from 1891, the disease is considered epidemic when 20 deaths occur in a week and this number or more is maintained for successive weeks.

By far the majority of epidemics have occurred in winter and spring, but the disease seems in no way associated with cold weather. In the epidemics discussed by Mitchell and Buchan the authors say that the epidemics occur "rather with exceptionally warm weather, which manifests itself generally both before and during the epidemic." With the waning of the epidemic the temperature is generally much below the average. The epidemics subsequent to 1890 confirm this statement with regard to the accompanying weather, but in some cases the temperature was very variable.

Heavy rains commonly accompany the epidemics and the attack during the present summer was at its worst in July, when it will be remembered that the rainfall in South London was a record, not only for July, but there has only been one wetter month at any period of the year for the last 100 years. The present epidemic has occurred with exceptionally mild and humid weather, the night temperatures being frequently 10° above the average. It should be mentioned, however, that in London wet weather is as a rule by no means unhealthy, the rain washing the dust and impurities from the atmosphere; 1903, the wettest year on record, was one of the healthiest ever experienced; the deaths in London were 15,000 fewer than the average of the previous ten years.

Belville, in his journal for 1837, says: "The complaint known by the name of the influenza prevailed during January and February, attended by a great mortality—the deaths were alarming." The cold in March was said to be "more severe than ever known to have been felt." January and February were wet and fairly mild.

In the forty-five years dealt with by Mitchell and Buchan epidemics occurred in the years 1847-48, 1850-51, 1855, 1857-58 and 1889-90. During the forty-five years the total deaths due directly to influenza in London were 4,690, and the five epidemics yielded 2,687 deaths. In the more recent years, from 1891 to 1918 (to October 26th), deaths in London in the epidemics from influenza alone were 23,071.

Influenza sadly requires further enquiry. There is need for very special discussion. It has been asserted that the summer and present epidemics resemble greatly the epidemic of 1890; an examination of the facts, however, shows very many differences.

In 1890 the total deaths during the epidemic in London from influenza were 3 per cent. of the deaths from all causes; deaths from pneumonia were 8 per cent., and from bronchitis, 20 per cent. In the epidemic of 1892, which was apparently the worst prior to the present attack, the deaths were respectively 7, 8 and 22 per cent. In the epidemic during the past summer, 11 per cent. of all deaths occurred from influenza, 9 per cent. from pneumonia, and 4 per cent. from bronchitis. The autumn attack now in progress has from influenza 32 per cent. of the deaths from all causes, 11 per cent. from pneumonia, and 6 per cent. from bronchitis.

In the epidemics prior to the present year deaths occurred mostly at ages above 40 or 45 years. This year deaths were most numerous between the ages of 20 and 45. In the epidemic now in progress influenza deaths between the ages of 5 and 20 were 54 per cent. of the deaths from all causes at those ages, and between 20 and 45 were 53 per cent. of the total deaths at the respective ages, whilst between 45 and 65 the percentage was 22, from 65 to 75, 10 per cent., and above 75 years only 4 per cent. In the week ending October 26th, fully two-thirds of the total deaths between ages 5 and 45, were from influenza.

OUR RAINFALL TABLES.

We have received a great many letters from readers expressing regret, disappointment and indignation at the non-appearance of our Rainfall Tables. With these we fully agree, but it is not in our power to move the mountain which has blocked the way. Our correspondents make various guesses, most of them correct, as to the nature of this mountain, and several wish us to explain exactly what it is. We are reluctant to do this at present for two reasons. We do not wish to embarrass anyone who has important duties to attend to, and at present we cannot trust ourselves to write with editorial calmness on a subject on which we feel so intensely.

We hope to be able to say something to the purpose in our next issue, and we cordially thank those Observers who have not failed to send in their records in spite of the irritating and unnecessary postponement of publication.

Climatological Table for the British Empire, May, 1918.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain. Depth.	Total Rain. Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	87·5	21	38·9	9	69·1	47·8	...	76	127·5	33·1	2·11	11	6·0
Malta	78·3	26	56·2	1	70·7	60·7	...	77	133·5	52·5	·20	1	1·0
Lagos	91·4	14	70·0	24	88·6	74·9	73·7	73	148·3	69·0	7·85	16	7·2
Cape Town	83·6	19	39·7	30	66·9	52·0	50·1	73	...	...	4·61	12	5·4
Johannesburg	72·0	6	24·9	30	62·0	42·9	38·7	70	...	22·4	·21	3	2·2
Mauritius	81·8	4	57·8	28	77·9	64·8	63·5	78	...	50·0	3·73	20	5·3
Bloemfontein	72·1	6	21·0	30	63·0	37·5	38·7	71	..	...	1·17	5	2·4
Calcutta...	96 6	26	70·0	6	92·1	76·6	75·6	80	...	65·3	8·19	8	6·3
Madras	102·8	15	72·7	17	96·3	79·5	74·2	72	156·3	72·9	5·80	7	4·6
Colombo, Ceylon ..	89·5	4	71·2	18	86·4	76·2	74·1	82	161·8	70·9	12·14	21	7·8
Hongkong	86·9	31	66·3	5	80·3	73·1	71·4	84	...	...	6·66	19	8·5
Sydney	77·1	2	45·1	27	69·8	52·5	50·5	74	121·4	37·1	·53	7	3·3
Melbourne	75·7	10	37·1	27	63·2	49·4	47·1	71	127·2	31·9	3·11	14	6·3
Adelaide	86·0	4	43·5	26	70·3	54·7	49·9	63	143·0	35·4	3·37	15	7·0
Perth	78·4	20	40·6	15	68·4	54·4	52·6	74	135·0	30·5	6·36	18	6·4
Coolgardie	79·0	6, 7	38·5	15	68·3	47·5	45·6	61	140·0	32·0	·79	7	5·2
Brisbane	77·9	29	43·5	19	73·0	53·1	53·2	71	139·0	40·1	2·49	12	4·1
Hobart, Tasmania ..	72·0	9	35·2	26	58·7	45·8	41·3	64	113·8	30·2	2·41	16	6·4
Wellington	64·0	12	38·7	28	53·7	39·9	47·0	78	122·0	27·4	4·14	11	5·1
Jamaica, Kingston ...	90·6	17	68·6	14	86·3	71·2	70·9	84	...	...	3·44	7	6·6
Grenada	87·0	sev.	69·0	31	85·0	74·0	...	76	138·0	...	7·93	15	5·0
Toronto	82·0	22	30·0	11	68·6	45·7	45·8	73	132·5	24·3	2·64	13	5·8
Fredericton	89·5	18	26·0	5	65·7	41·6	42·0	64	...	...	2·70	11	5·7
St. John, N.B. ...	63·9	11*a*	32·5	5	55·6	41·5	39·9	74	125·6	27·5	2·07	14	6·4
Victoria, B.C.	68·5	27	40·5	20	59·2	45·0	43·0	72	139·0	35·5	·70	9	4·7

a—22.

Johannesburg.—Bright sunshine 272·3 hours.

COLOMBO, CEYLON.—Mean temp. 81°·3, or 1°·2 below, dew point 1°·3 below, and R ·37 in. below, averages. Mean hourly velocity of wind 5·3 miles.

HONGKONG.—Mean temp. 76°·2. Bright sunshine 124·5 hours. Mean hourly velocity of wind 12·6 miles.

Sydney.—Mean temp., 61°·2, the highest on record.

Melbourne.—Mean temp. 2°·3 above, and R ·93 in. above, averages.

Adelaide.—Mean temp. 4°·8 above, and R ·65 in. above, averages. The warmest May on record.

Perth.—R 2·03 in. above average.

Coolgardie.—Temp. 3° above, and R below, averages.

Brisbane.—Mean temp. 2°·1 below, and R ·41 in. below, averages.

Hobart.—Mean temp. 2°·3 above average.

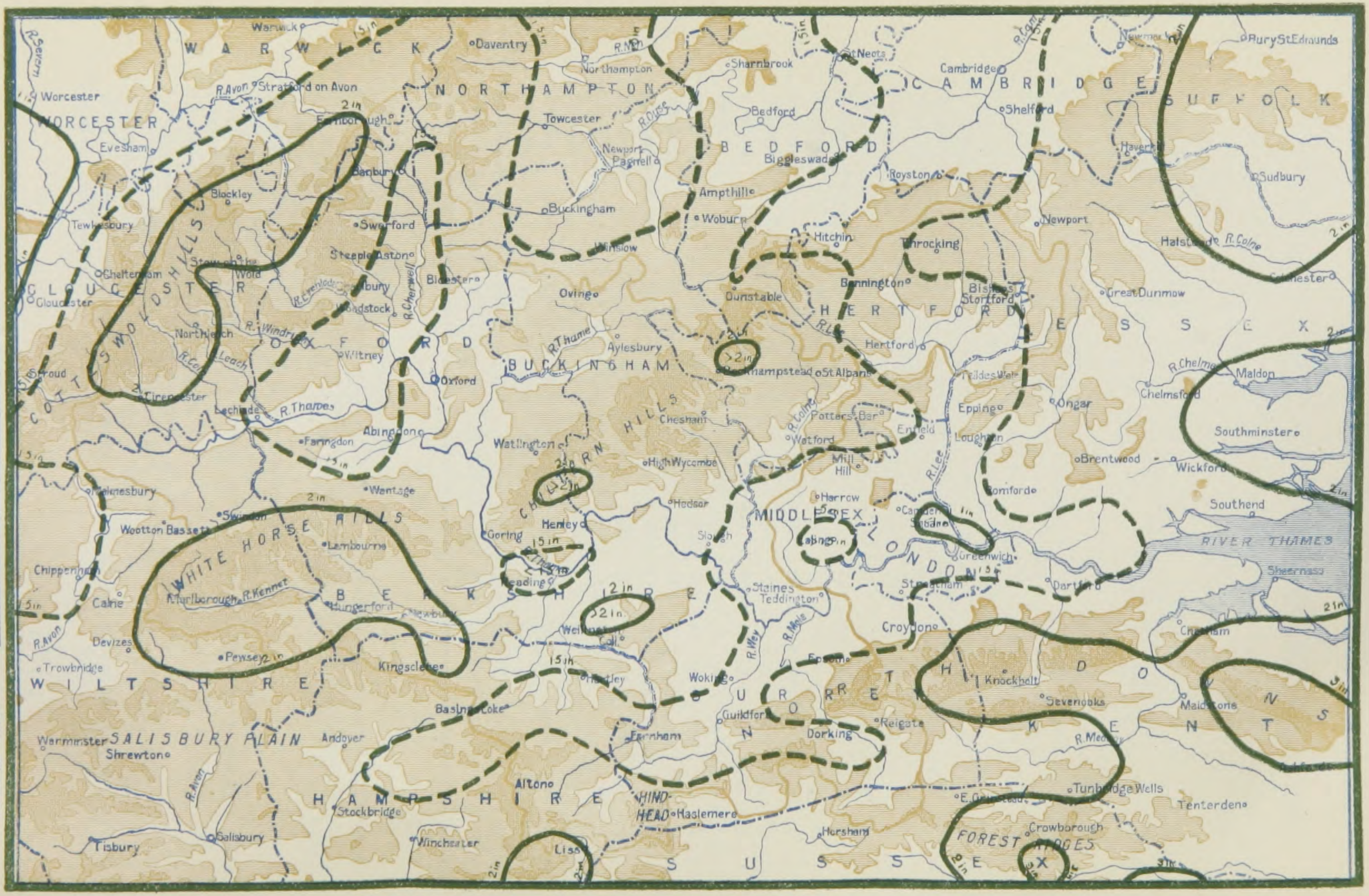
Wellington.—Mean temp. 0°·9 above, and R ·81 in. below, averages. Bright sunshine, 165·6 hours.

THAMES VALLEY RAINFALL. OCTOBER, 1918.

ALTITUDE SCALE

Below 250 feet	250 to 500 feet	500 to 1000 feet	Above 1000 feet

SCALE OF MILES: 0 5 10 15 20



Watershed of River Thames above Teddington and River Lee above Feildes Weir.

Isohyetals

PUBLICATION POSTPONED BY ORDER OF CHIEF CENSOR, ADMIRALTY.

RAINFALL TABLE FOR OCTOBER, 1918.

STATION.	COUNTY.	RAINFALL. Aver. 1875—1909. in.	1918. in.	Diff. from Av. in.	Per cent. of Av.	Max. in 24 hours. in.	Date.	Nos. of Day
Camden Square	*London*	2·72	1·23	—1·49	45	·19	11	16
Tenterden	*Kent*	3·48	2·35	—1·13	68	·56	20	17
Arundel (Patching)	*Sussex*	4·01	1·80	—2·21	45	·37	14	13
Fordingbridge (Oaklands)	*Hampshire*	3·97	1·91	—2·06	68	·33	10	18
Oxford (Magdalen College)	*Oxfordshire*	2·82	1·80	—1·02	64	·45	16	22
Wellingborough (Swanspool)	*Northampn*	2·60	1·40	—1·20	54	·27	11,14	13
Bury St. Edmunds (Westley)	*Suffolk*	2·72	2·28	— ·44	84	·94	11	16
Geldeston [Beccles]	*Norfolk*	2·84	2·71	— ·13	95	·83	11	20
Polapit Tamar [Launceston]	*Devon*	4·84	3·07	—1·77	63	·44	15	25
Rousdon [Lyme Regis]	,,	3·81	2·18	—1·63	57	·46	8	21
Stroud (Field Place)	*Gloucester*	3·21	1·08	—2·13	34	·13	9	19
Church Stretton	*Shropshire*	3·77	1·95	—1·82	52	·36	5	22
Boston	*Lincoln*	2·75	1·91	— ·84	69	·63	11	21
Worksop (Hodsock Priory)	*Nottingham*	2·77	1·14	—1·63	41	·18	9	17
Mickleover Manor	*Derbyshire*	2·81	1·24	—1·57	44	·35	9	16
Congleton (Buglawton Vic.)	*Cheshire*	3·10	1·48	—1·62	48	·32	9	24
Southport (Hesketh Park)	*Lancashire*	3·74	3·28	— ·46	88	·64	9	19
Wetherby (Ribston Hall)	*York, W.R.*	3·18	1·49	—1·69	47	·38	21	10
Hull (Pearson Park)	,, *E.R.*	3·19	1·17	—2·02	37	·44	9	17
Newcastle (Town Moor)	*North'land*	3·20	2·41	— ·79	75	·70	19	18
Borrowdale (Seathwaite)	*Cumberland*	12·71	15·55	+2·84	122	...	...	...
Cardiff (Ely)	*Glamorgan*	4·87	2·67	—2·20	56	·50	5	26
Haverfordwest	*Pembroke*	5·51	5·76	+ ·25	105	·83	31	28
Aberystwyth (Gogerddan)	*Cardigan*	5·38	5·31	— ·07	99	1·18	4	21
Llandudno	*Carnarvon*	3·78	2·38	—1·40	63	·35	5	22
Cargen [Dumfries]	*Kirkcudbrt.*	4·45	6·38	+1·93	143	·96	3	25
Marchmont House	*Berwick*	3·83	3·59	— ·24	94	·46	17,18	20
Girvan (Pinmore)	*Ayr*	5·38	6·82	+1·44	127	1·36	4	26
Glasgow (Queen's Park)	*Renfrew*	3·36	5·02	+1·66	150	·70	5	21
Islay (Eallabus)	*Argyll*	4·95	7·03	+2·08	143	·77	3	27
Mull (Quinish)	,,	5·87	8·14	+2·27	139	1·04	9	26
Balquhidder (Stronvar)	*Perth*	7·29	11·62	+4·33	160	2·00	6	22
Dundee (Eastern Necropolis)	*Forfar*	2·81	2·75	— ·06	98	·51	18	20
Braemar	*Aberdeen*	3·88	4·23	+ ·35	109	·80	18	15
Aberdeen (Cranford)	,,	3·23	2·59	— ·64	80	·30	4	23
Gordon Castle	*Moray*	3·38	1·73	—1·65	51	...	...	...
Drumnadrochit	*Inverness*	3·49	4·40	+ ·91	126	·94	6	22
Fort William	,,	7·32	11·33	+4·01	155	2·89	9	26
Loch Torridon (Bendamph)	*Ross*	8·38	13·02	+4·64	155	1·75	9	26
Dunrobin Castle	*Sutherland*	3·15	1·68	—1·47	54	·36	7	14
Glanmire (Lota Lodge)	*Cork*	4·35	3·57	— ·78	82	·60	3	19
Killarney (District Asylum)	*Kerry*	5·59	7·41	+3·82	133	1·33	5	26
Waterford (Brook Lodge)	*Waterford*	4·00	4·01	+ ·01	100	·97	3	20
Nenagh (Castle Lough)	*Tipperary*	3·48	5·62	+2·14	160	·87	5	21
Ennistymon House	*Clare*	4·40	6·96	+2·56	158	1·44	2	22
Gorey (Courtown House)	*Wexford*	3·75	4·01	+ ·26	107	1·05	3	19
Abbey Leix (Blandsfort)	*Queen's Co.*	3·53	3·70	+ ·17	105	·60	3	20
Dublin (FitzWilliam Square)	*Dublin*	2·88	2·36	— ·52	82	·41	3	21
Mullingar (Belvedere)	*Westmeath*	3·19	4·05	+ ·86	127	·61	6	21
Crossmolina (Enniscoe)	*Mayo*	5·27	7·92	+2·65	150	1·19	5	26
Cong (The Glebe)	,,	4·60	...	...	...	...	...	...
Collooney (Markree Obsy.)	*Sligo*	4·21	5·78	+1·57	137	·96	7	26
Seaforde	*Down*	3·65	3·62	— ·03	99	·82	8	25
Ballymena (Harryville)	*Antrim*	3·78	4·24	+ ·46	112	·55	8	27
Omagh (Edenfel)	*Tyrone*	3·76	5·46	+1·70	145	·63	2	25

PUBLICATION POSTPONED BY ORDER OF CHIEF CENSOR, ADMIRALTY.

SUPPLEMENTARY RAINFALL, OCTOBER, 1918.

Div.	STATION.	Rain inches.	Div.	STATION.	Rain inches
II.	Warlingham, Redvers Road..	2·52	XI.	Lligwy	5·05
,,	Ramsgate	2·14	,,	Douglas, Isle of Man	5·50
,,	Hailsham	3·08	XII.	Stoneykirk, Ardwell House...	4·24
,,	Totland Bay, Aston House...	1·91	,,	Carsphairn, Shiel	11·66
,,	Stockbridge, Ashley..	1·82	,,	Langholm, Drove Road	6·51
,,	Grayshott	1·75	XIII.	Selkirk, The Hangingshaw..	2·70
III.	Harrow Weald, Hill House...	1·32	,,	North Berwick Reservoir	2·07
,,	Pitsford, Sedgebrook	1·34	,,	Edinburgh, Royal Observaty.	2·78
,,	Woburn, Milton Bryant	1·56	XIV.	Biggar	4·69
,,	Chatteris, The Priory	1·06	,,	Maybole, Knockdon Farm ...	6·40
IV.	Elsenham, Gaunts End	1·66	XV.	Buchlyvie, The Manse	6·57
,,	Shoeburyness	1·78	,,	Ardgour House	14·73
,,	Colchester, Hill Ho., Lexden	1·70	,,	Oban	8·29
,,	Ipswich, Rookwood, Copdock	2·11	,,	Campbeltown, Witchburn ..	...
,,	Aylsham, Rippon Hall	2·75	,,	Holy Loch, Ardnadam	8·73
,,	Swaffham	1·82	,,	Tiree, Cornaigmore	...
V.	Bishops Cannings	1·96	XVI.	Glenquey	6·70
,,	Weymouth	1·33	,,	Loch Rannoch Dall	6·29
,,	Ashburton, Druid House..	3·34	,,	Blair Atholl	4·40
,,	Cullompton	1·98	,,	Coupar Angus	2·51
,,	Lynmouth, Rock House	2·99	,,	Montrose, Sunnyside Asylum.	2·20
,,	Okehampton, Oaklands	2·92	XVII.	Balmoral	3·03
,,	Hartland Abbey	2·83	,,	Fyvie Castle	2·23
,,	St. Austell, Trevarna	4·13	,,	Keith Station	3·16
,,	North Cadbury Rectory	1·65	XVIII.	Rothiemurchus	3·18
VI.	Clifton, Stoke Bishop	2·04	,,	Loch Quoich, Loan	27·13
,,	Ledbury, Underdown	1·17	,,	Skye, Dunvegan	10·54
,,	Shifnal, Hatton Grange	1·63	,,	Fortrose	2·41
,,	Droitwich	1·64	,,	Glencarron Lodge	...
,,	Blockley, Upton Wold	2·14	XIX.	Tongue Manse	2·66
VII.	Grantham, Saltersford	1·47	,,	Melvich	1·95
,,	Louth Westgate	1·39	,,	Loch More, Achfary	9·39
,,	Bawtry, Hesley Hall	·97	XX.	Dunmanway, The Rectory ..	7·20
,,	Whaley Bridge, Mosley Hall	2·73	,,	Mitchelstown Castle	3·80
,,	Derby, Midland Railway	1·25	,,	Gap of Dunloe Gearahameen	15·50
VIII.	Nantwich, Dorfold Hall	1·59	,,	Darrynane Abbey	6·37
,,	Bolton, Queen's Park	5·31	,,	Clonmel, Bruce Villa	3·33
,,	Lancaster, Strathspey	4·10	,,	Broadford, Hurdlestown	5·30
IX.	Langsett Moor, Up. Midhope	2·26	XXI.	Enniscorthy, Ballyhyland	5·30
,,	Scarborough, Scalby	1·48	,,	Rathnew, Clonmannon	2·88
,,	Ingleby Greenhow	...	,,	Ballycumber, Moorock Lodge	3·53
,,	Mickleton	2·80	,,	Balbriggan, Ardgillan	2·77
X.	Bellingham, High Green Manor	4·82	,,	Castle Forbes Gardens	4·85
,,	Ilderton, Lilburn Cottage	3·44	XXII.	Ballynahinch Castle	7·18
,,	Keswick, The Bank	9·66	,,	Woodlawn	3·71
XI.	Llanfrechfa Grange	3·07	,,	Westport, St. Helens	7·03
,,	Treherbert, Tyn-y-waun	7·44	,,	Dugort, Slievemore Hotel	10·81
,,	Carmarthen, The Friary	5·59	XXIII.	Enniskillen, Portora	3·95
,,	Fishguard, Goodwick Station.	7·19	,,	Dartrey [Cootehill]	4·31
,,	Crickhowell, Tal-y-maes	7·00	,,	Warrenpoint, Manor House	3·50
,,	Gwernargllwydd	1·60	,,	Belfast, Cave Hill Road	4·41
,,	Birmingham WW., Tyrmynydd	4·59	,,	Glenarm Castle	4·26
,,	Lake Vyrnwy	...	,,	Londonderry, Creggan Res...	5·15
,,	Llangynhafal, Plas Drâw	2·44	,,	Milford, The Manse	4·56
,,	Rhwibryfdir	16·99	,,	Killybegs	8·50
,,	Dolgelly, Bryntirion	6·18			

Symons's Meteorological Magazine.

No. 635. DECEMBER, 1918. Vol. LIII.

PEACE AND PROSPECTS.

The war has ended as all free and honourable peoples hoped and expected when it began. We concluded our first reference to the war in the number for September, 1914 (vol. **49**, p. 141) with the words referring to the introduction by the enemy of terrorist methods towards civilians :—

"May not the originator of such a policy fear that his name in history may be changed, like that of Pashur, the son of Immer, to Magormissabib—a terror to himself and to all his friends."

It seems now that the curse of Jeremiah has indeed fallen upon the German Kaiser in full measure.

In the winning of the war by force in the trenches and by mental toil on the Staff and in the scientific departments, meteorologists and Observers have done their part, like all their countrymen, and many have paid the utmost price. As members of the public we still know little of what the men in the Navy and the Army have done and suffered, for some reason unknown a little more has been allowed to appear regarding individual prowess in the Air Service.

The hatefulness of militarism as the guiding spirit of a nation has been proclaimed by the action of the German forces by land, sea and air, and the necessity of meeting force with force has brought the lesson nearer to us than the enemy was ever able to reach. The Defence of the Realm Act gave powers to public officials such as have never before been exercised in Great Britain, and all must agree that these powers were exercised with reason and moderation, and submitted to with a patriotic docility hardly to be expected from a people so much accustomed to their own way as we are. But while this is true, on the whole, there were, of course, inevitable instances of individual hardship and injustice that have been borne as parts of the evils of war, though felt the more deeply because the reason which made them inevitable was kept secret.

With the return of peace most of the grievances will gladly be forgotten or even forgiven. We cannot but wonder why the daily weather forecasts were allowed to be published for so long after all meteorologists recognized, and many had urged upon the Government, the importance of keeping such valuable information from the enemy. It was right and necessary that such information should be kept from those to whom predictions of the weather over the British Isles were essential in the planning of air-raids or attacks from the sea. But when at last the fighting forces understood the value of keeping useful information from the enemy their expert advisers unfortunately sometimes failed to distinguish between information useful only to ourselves, though not to the enemy, and that which was in some way helpful to the latter.

It was only in August, 1918, when the war was practically won, that we were warned by the Admiralty that the publication of monthly totals of rainfall was an offence against that Act, which the humourist cites as Dora, and our Rainfall Tables had accordingly to be suppressed until this month. To us this appeared to be not only an unnecessary but a stupid and humiliating proceeding. These Tables could not assist any scientific meteorologist to forecast the weather of the British Isles on any future day. The expert advisers of the Admiralty when they suggested the suppression of monthly rainfall figures were, we fear, either ignorant of the limitations which beset the powers even of German meteorologists, or they were actuated by motives not in any way connected with the Defence of the Realm. The embargo at one time seemed to threaten the continued existence of this Magazine, but its short duration has averted the fatal effect. We should, perhaps, not take it seriously but content ourselves with Ian Hay's suggestion that the orders issued by the Authorities are sometimes expedited through the Practical Jokes Department, and invite our readers to laugh with us at the breezy humour of the jolly old sea-dogs in the rollicking diversions of Jack ashore. In any case the suppressed Tables and maps are sent out with this number and we are free once more to serve the public by passing on the devoted work of the rainfall Observers to those who are waiting to apply it to the practical good of mankind.

The problems of collective scientific work after the war have now to be faced. At home it is obvious that progress which has been arrested or reduced to the minimum compatible with existence must be re-started and accelerated so as to make up as speedily as possible for lost time. In our own small department it seems to us that the main problem is the more effective organization of voluntary effort and the fuller public recognition of voluntary work. This should be done in such a way as to strengthen and derive strength from the various public services which have to do with the air and these are legion. Here there is neither occasion nor room for rivalry, but an abounding opportunity for union and co-operation.

A much more difficult problem is presented by the shattered systems of international co-operation. The suggestion has been made, and in some departments of science it might be possible, that future international co-operation for some time to come should exclude the people of what were the central empires. In meteorology this is impossible. Records from the whole surface of the Earth must be obtained and the systems of observing re-established and maintained. We have shattered the military system which was our enemy, and it is the duty of men of science to resume their work with no spirit of personal animosity.

METEOROLOGICAL NEWS AND NOTES.

THE ROYAL METEOROLOGICAL SOCIETY asks, through its Secretary, that readers who have spare copies of the following which they no longer require will be kind enough to return them to 70, Victoria Street, S.W.1 :—*Quarterly Journal*, Nos. 121 (Jan., 1902), 122 (April, 1902), 141 (Jan., 1907), 162 (April, 1912), and any previous to No. 28 (1878). Also *Phenological Report* reprints, especially previous to 1911.

THE DAILY WEATHER REPORT of the Meteorological Office was re-issued on November 20th, for the first time since August 22nd, at which date even deferred publication was prohibited by the Censor. The missing numbers have since been issued. At the same time weather reports are again appearing in the daily press, though with less prominence than formerly, *The Times* in particular not having resumed its full and valuable daily reports.

THE PROHIBITION OF WEATHER REPORTS during the war made it impossible to publish numerous interesting letters in our correspondence pages and we much regret that most of these must now be omitted on account of pressure on our space.

THE RELATION OF RAINFALL TO CONFIGURATION forms the subject of a paper by Mr. Carle Salter read before the Institution of Water Engineers on December 13th, in which it is shown that the average rainfall during 30 to 40 years is intimately dependent upon the land configuration in relation to prevailing winds. The causes of the variations in the relationship are examined in some detail. Another aspect of the same subject is touched upon in a recent paper on the Tata Hydro-Electric Works, Bombay, by Mr. R. B. Joyner, C.I.E., read to the Institution of Civil Engineers, in which it is claimed, we think without justification, that the monsoon rainfall is affected by the formation of large artificial lakes.

BRITISH RAINFALL, 1917.*

THE fourth volume of *British Rainfall* compiled under war conditions, and the fifty-seventh of the series, has been delayed in publication chiefly by the great difficulties of printing and engraving, and in a less measure by the continued absence on war service of several of the most experienced members of the staff of the Organization. Reference is made to the loss sustained by the death from wounds of Sec.-Lt. D. S. Salter, who had been for several years in charge of the cartographical work.

The absolute necessity for economy in money, labour and paper has compelled the restriction of the volume to the smallest limits compatible with the maintenance of all essential features, and this has been effected by the shortening of the letterpress, the reduction of the number of illustrations and by more compact type-setting of the tabular matter. The statistics are given in full in order to avoid any break of continuity with former volumes, and so are the monthly and annual maps of rainfall.

A feature of unusual interest is the discussion of two daily rainfalls of unprecedented magnitude, occurring respectively on June 16th, in London, and on June 28th, in the south-west of England. The latter, during which occurred a remarkable fall of 9·56 inches of rain during twenty-four hours, at Bruton, in Somerset, forms the subject of a special article, illustrated by a coloured folding map on the scale of 10 miles to an inch. Other remarkable rains of the year took place during the six days from July 29th to August 3rd, in the south-eastern counties, and during the last week of November in the West Highlands.

Articles by Mr. L. C. W. Bonacina, on the Snowfall of 1917, and by Mr. W. R. Nash, on the Variations of Rainfall with Height above the Ground, the latter based on the Greenwich records, and illustrated by diagrams, are also included.

The diminution in the number of rainfall records received for publication, which has been the inevitable result of the war, was smaller in 1917 than had been the case in 1916, and 5,085 complete records appear in Part III. We have every reason to hope that the near future will see this temporary set-back more than counterbalanced by the new impetus being given to scientific work in the period of national re-construction on the threshold of which we now stand.

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* *British Rainfall, 1917*, compiled from the records of more than 5,000 Observers in Great Britain and Ireland. By Hugh Robert Mill and Carle Salter, Joint Directors of the British Rainfall Organization. London, Stanford, Size, 9 × 6, pp. 288, 3 plates and 29 illustrations in text.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

CLOUD FORMS IN FORECASTING.

THE article by Lt. A. S. Martin-Smith in the November number advocating the more systematic study of clouds to supplement the data upon which forecasts are based is much to be commended. The study of clouds is a most attractive side of meteorology if only on account of the supreme beauty of many cloud-forms, and their groupings in the sky. I can thoroughly uphold a specific point which Lt. Martin-Smith makes, namely, that no diligent student of the sky need ever be caught unawares by a thunderstorm—at all events of the summer type. But I venture to criticise the contention implied in the following sentence :—" If the forfeiture of my life depended upon the correctness or otherwise of a weather forecast for any given day I would prefer to rely upon the one based upon cloud reports rather than that derived from the study of a similar number of barometer readings." Now frankly I would not, and for two reasons. Firstly, the distribution of barometric pressure bears a known mathematical relation to the force and direction of the wind, and what is wind, if not a part of the very weather itself? But I have yet to learn that any particular type of cloud has any such certain and invariable connection with the weather of which it is the precursor. Secondly, the record of a barometric height is an unambiguous statement of something, namely, the local pressure of the atmosphere which is measured with absolute precision, or with as much precision as is necessary. But to get a cloud record to vie in precision with a barometric reading, we should require either a photograph, a painting or an elaborate word-picture of the cloud, any of which would be hopelessly impracticable in synoptic meteorology. So we are driven to adopt a sort of short-hand system of cloud recording, classifying each individual cloud into one or other of a number of species and sub-species. But in all procedure founded on systems of classification there are two sources of trouble (1) Nature is so abhorrent at having her phenomena subjected to cut and dried schemes of classification, that she always leaves a number of intermediate forms to frustrate them, and, (2), no two minds will ever relegate natural objects to a number of types or species with anything like accordance. The real value of clouds in local weather prevision lies in the almost indescribable *picture* they present to the individual mind ; but it is very difficult to transmit such a picture to another mind, and even if it were easy, it would be impracticable to do so in official reports. By all means let us have cloud observations in official meteorology, but to supplement, not supplant, barometric readings.

Hampstead, December 4th, 1918. L. C. W. BONACINA.

THE USE OF WATER POWER.

THERE is an application of Water Power, which, I think, may be seen in the "peaceful" days to come. Might not the many disused corn-mills, in hilly districts, driven by either over-shot or under-shot water-wheels be harnessed to produce electricity in country places? In Devonshire coal costs so much that making electricity by means of it for farm work or cottage lighting is out of the question. Meanwhile, countless mills with water laid on and even machinery in order, to a certain extent, lie idle. L.J.B.G.

November 18th, 1918.

[We believe that our correspondent's suggestion is already being put into application in many parts of the country.—ED., *S.M.M.*]

UNUSUAL TEMPERATURE RANGE.

IN the number of your valuable Magazine for May last, Mr Dines mentions two instances of a daily temperature range of 41° and 42° respectively. I do not know what the world record is in this respect, but one thing of the kind which I experienced many years ago at the other side of the world I am tempted to mention, viz, a fall of 50° in one half-hour, on a summer afternoon, I think, in 1857, when on the third day of the well known Melbourne hot wind, blowing from N.N.W., the wind suddenly changed to S., and the temperature fell from 110° to 60°, with most refreshing result to the whole creation, animal and vegetable. W. M. COOPER.

Wroxall, Isle of Wight, September 21st, 1918.

ROYAL METEOROLOGICAL SOCIETY.

THE first monthly meeting of this Society for the present session was held on November 20th at the Society's Rooms, 70, Victoria Street, Westminster, Sir Napier Shaw, F.R.S., President, in the Chair.

A paper by Prof. R. de C. Ward, of Harvard College, Cambridge, Mass., entitled "The larger relations of climate and crops in the United States," was read by the Foreign Secretary in the absence of the author. For the purpose of his enquiry Prof. Ward divides the States into two major divisions separated by the mean annual rainfall line of 20 inches, which forms the eastern boundary of the Great Plains. These are again divided into agricultural districts or belts as a framework into which the larger facts of climate and crop distribution, and of types of farming are fitted. The eastern half of the country has sufficient rain in normal years and ordinary farming methods are followed. The western half, with generally inadequate rainfall, is a region of irrigation, of dry farming and of grazing. Here there are no great belts distinguished by certain dominant crops as in the east, the crops are very varied, often extremely localized. The crops in both divisions are discussed with much detail as to the influence of climatic factors. A comprehensive bibliography is appended.

A paper by Captain C. J. P. Cave, R.E., and Mr. J. S. Dines, entitled "Soundings with Pilot Balloons in the Isles of Scilly, November and December, 1911," was also read. The ascents were made to ascertain the wind structure in a place where the effect of land masses may be regarded as at a minimum. The Scilly Isles consist of a small group of islands 25 miles S.W. of Land's End. The greatest height above sea-level does not much exceed 150 feet. The period covered by the observations, November 22nd to December 8th, marked the setting in of a south-westerly type of pressure distribution with low pressure over Iceland. This type became well developed by November 30th and during the rest of the period several pronounced secondaries passed across the British Isles from the Atlantic. The ascents show that the changes in wind associated with the passage of these secondaries were more marked near the surface than at greater heights. Taking the mean of the ascents the layer in which surface friction made itself felt on the wind velocity was decidedly shallower than at inland stations. The majority of the balloons were followed with two theodolites and the vertical motion computed. The average rate of ascent is found to agree closely with the value given by the formula now generally adopted in this country. There was little change in the mean rate between the ground and 4 kilometres height. In this particular the results differ from those obtained at inland stations where the rate of rising has been found generally to be greater in the first half kilometre than at greater heights.

The following Candidates were elected Fellows of the Society :— Messrs. W. H. Allen, C. D. Anderson, E. H. Bowie, C. W. C. Browne, B. H. Clarke, L. J. Clements, P. T. Creswell, N. I. Curtis, C. B. Dall, Hassan Fahmy, J. Glasspoole, A. Gordon, E. O. Jones, H. Knox-Shaw, G. C. Lawson, T. H. Leadbetter, C. S. Meik, C. W. B. Normand, T. Ormiston, C. S. Payne, A. J. Prince-Cox, Lord St. Audries, S. N. Sen, E. C. Shankland, A. Sparrow, T. Spragg, R. S. Sugden, G. M. Thomas, H. L. de Loud Verry, T. Wain, L. Whitworth.

WORK AND WATER POWER.

By Hugh Robert Mill.

(*continued.*)

It is evident on reflection that foot-pounds do not give a sufficient measure of power. A million pounds of snow on the top of a mountain 10,000 feet high could do 10,000,000,000 foot-pounds of work by falling to sea-level: but if it took a year for the snow to melt and run down to the sea, work could only be done at the average rate of about 20,000 foot-pounds per minute, while if the snow melted and came down in a week it could do 1,000,000 foot-pounds of work per minute, that is to say it would develop about fifty times as much power for the time during which it was operative. Power being devised as the rate of doing work is measured by the number of units of work done in a unit of time. James Watt, for the purpose of stating the power of his steam-engines, introduced the horse-power as a unit, defining it as 33,000 foot-pounds per minute, and this unit of power has become universal for practical purposes. On the Continent it is usual to take the horse-power as equivalent to 4,500 kilogramme-metres per minute.

At this point a digression on units is desirable, though it has no immediate bearing on the scope of this article. The pound or gramme or any weight is not a perfect measure of force. In fact a mass of any material which has the weight of 1 lb. at sea-level in any particular latitude weighs more at sea-level in higher latitudes where the form of the Earth brings it nearer the centre, and less in lower latitudes where the equatorial bulge keeps it farther away. Similarly at distances above sea-level the weight diminishes with the diminishing force of gravity. The difference is not enough to disturb rough practical calculations of horse-power; but in theoretical discussions it is important. Hence for scientific purposes a system of units independent of the varying force of gravity has been devised, and these units are called absolute for that reason. It is a mere accident that the absolute system generally used is expressed in grammes and metres instead of pounds and feet, gravity could be cut out of the British unit of work in exactly the same way as out of the French. The absolute unit of force on the centimetre-gramme and second (C.G.S.) system is the dyne, and that amount of force is enough to produce a velocity of 1 centimetre per second in the mass of 1 gramme after acting upon that mass for 1 second. The unit of work or erg is 1 dyne acting through 1 centimetre, and as this is an extremely minute quantity it is convenient to use the joule, which is equal to 10,000,000 ergs. The unit of power on this system is the watt, which is 1 joule per second: but for convenience the kilowatt of 1,000 watts is generally used, and for all practical purposes 1 kilowatt may be taken as 1·34 horse-power, or 1 horsepower as 746 watts. If one may venture to refer to vulgar fractions in the same sentence as absolute units one could say with enough truth for most purposes that a kilowatt is $1\frac{1}{3}$ horse-power, and a horse-power is $\frac{3}{4}$ of a kilowatt.

This digression will necessarily fail to explain the essential difference between the two systems of reckoning to any one who did not understand it before; but it may convey a useful hint.

Returning from the discussion of arbitrary units to the real things which they are used to express, I wish to make clear the principles on which the horsepower of falling water can be calculated; but not to intrude on the domain of the engineer by treating of how the calculations are actually made.

It is desirable to bear in mind that although the potential energy possessed by water at a high level is equal to the weight of the water multiplied by the height through which it falls, it by no means follows that all this energy can be converted into useful work. Some is spent in friction of the water flowing along its channel, and some in friction in the machinery by which it is transformed into driving power or into electric energy. The proportion of the theoretical power available is a matter for the mechanical or electrical expert and depends largely on the perfection of the mechanism or processes employed. In an ordinary undershot or overshot water wheel a very large amount of the potential energy is lost; but in a modern turbine working either at low pressure with a large volume of water and a small fall, or at a high pressure with less volume but a high fall, the loss is much less. It may be assumed that over 80 per cent. of the theoretical power can be made available for mechanical use and about 70 per cent. can be transformed into electrical energy capable of being applied either to mechanical or chemical purposes, or for producing light or heat.

There is no way that can be seen at present of utilizing the power of falling rain-drops, and all that can be done is to make use of the water as it passes from a higher to a lower part of the land surface. The easiest way to do this is at a waterfall where a stream falls over a vertical rock. The waterfall itself is not usually led into the machinery; but water diverted from above the fall is led into a shaft provided with an outlet below the fall, the power station being built either on the higher or the lower level as may be more convenient. Or in cases where there is no actual waterfall water may be led from the upper part of the stream by a new channel to a place where a vertical fall can be provided, or it may be led in a strong pipe down a slope where no vertical fall can be provided and utilized farther down by taking advantage of the pressure in the pipe caused by the head of water. In many cases where only a little power is required, as for lighting a house or a village, the natural flow of the stream suffices, the smallest flow of the driest weather being enough to yield the power required.

(*To be continued.*)

THE WEATHER OF AUGUST, SEPTEMBER AND OCTOBER.

By F. J. Brodie.

THE following brief summaries of the weather during the three months in question serve to bridge over the gap due to the recent suppression of meteorological information :—

August.—Over the greater part of England the opening and closing weeks of August were rainy and unsettled. During the remainder of the month the weather was fine and sunny, and eminently favourable for the progress of the harvest. Temperature, which was, as a rule, above the average, reached its culminating point on the 22nd, when shade readings ranging between 85° and 90° were recorded over a large portion of the eastern, midland and southern counties ; at Canterbury the thermometer rose to 93°. The weather was at the time under the influence of southerly winds blowing in the front of a shallow cyclonic system which was advancing from the Atlantic. Next day, when the disturbance passed away to the eastward, the wind shifted to north, and an unusually rapid fall of temperature occurred. In Ireland and Scotland changeable showery weather prevailed throughout nearly the whole month. The mean temperature of August was everywhere above the average, but the duration of bright sunshine showed an excess only in the eastern parts of England ; in most of the western districts there was a large deficiency. Thunderstorms were somewhat rare for the time of year.

September.—In addition to its extraordinarily heavy rainfall (to which full reference is made on p. 103) the month was characterised by an abnormally low temperature. In Scotland it appears to have been the coldest September for at least sixty years. Between the 5th and 7th the thermometer rose a little above 70° in many parts of the United Kingdom and touched 75° at Manchester. At most other times the daily maxima were below 60°, and on the 29th there were many places in which the thermometer failed to reach 50°. Accompanying the frequent passage of cyclonic disturbances across the more northern districts the prevailing winds were westerly, and often very strong in force, with occasional gales on our western coasts. The mean temperature of the month was below the average, especially in the north. In Wales and the neighbouring English counties bright sunshine was very deficient, but in other parts of the Kingdom it was equal to, or slightly above, the average. Thunderstorms were unusually frequent, more especially in the earlier half of the month.

October, although not particularly wet, was for the most part dull, damp and cheerless. The opening week was also very stormy, the passage of deep depressions outside our western and northern coasts being marked by southerly and south-westerly gales of considerable severity. At Quilty (co. Clare) the wind on the 7th reached, in gusts, a velocity of 39 metres per second, or 85 miles per hour. The highest temperatures were recorded mostly around the 6th or the 10th, when the thermometer rose to 65°, or a trifle above it, at a number of places situated in nearly all parts of the country. Sharp touches of frost occurred from time to time in most districts ; on the surface of the grass several places experienced a ground frost on at least ten or a dozen nights, and at Hemel Hempstead on as many as fourteen nights. In the latter part of the month a good deal of wet fog prevailed over England and yielded in many instances perceptible quantities of water in the rain gauges. The mean temperature of the month was a trifle below the average, and the aggregate amount of bright sunshine was generally very deficient, few districts experiencing as much as one-fourth of the possible duration.

THE WEATHER OF NOVEMBER.

THE month opened with a week of mild cyclonic weather, and on the 2nd, the 5th and the 7th—8th, deep depressions moving over adjacent regions of the Atlantic caused strong gales from between south and west on many parts of our coasts. On the 2nd and again on the 7th and 8th, the wind rose in gusts to a velocity of 70 miles an hour and upwards at many places in the west and north, and on the 2nd reached a velocity of 78 miles an hour at Falmouth (Pendennis Castle). The highest temperatures were recorded, as a rule, on the 1st or 2nd, when the thermometer rose to 55° and upwards in most districts, and touched 60° at Holyhead. Between the nights of the 5th and 7th lightning was seen off the west coast of Scotland, and the north coast of Ireland.

After about the 9th a large anticyclone of considerable intensity appeared over the United Kingdom and remained in force until about the 20th. In many parts of the country no measurable quantity of rain fell for at least ten or twelve days, and in some few places the minimum limit of an absolute drought (fifteen consecutive rainless days) was attained. Over eastern and Central England, however, there was much fog during the night and early morning hours, and in several instances the air was sufficiently humid to deposit appreciable quantities of water in the rain gauges. Towards the middle of the anti-cyclonic spell the weather became very cold, and sharp night frosts were experienced. In many places the thermometer between the 17th and 19th failed to reach 40°, and at Glasgow on the former date it did not get above the freezing point. At night the thermometer in the screen fell below 25° at stations, a reading as low as 14° being reported at Eskdalemuir on the 20th. On the surface of the grass frost was unusually prevalent; at Kew, Aberdeen and Dublin it occurred on nineteen nights, and at Benson on as many as twenty-one nights. Towards the close of the month the anticyclone passed away to the westward, and mild southerly winds and unsettled rainy weather set in over the entire kingdom. Owing, however, to the long spell of cold which had previously been experienced the mean temperature of the month was everywhere below the average.

One of the most striking features in the weather of November was the prevalence of fog, more especially over the eastern and midland counties. Records made during the 20 years ended 1915 show that in an average November not more than 3 or 4 days are affected by this disagreeable visitant. Last month many places reported fog on at least 8 or 9 days. At Tynemouth it occurred on as many as 15 days, the number being more than four times the average, and twice as large as in any November of the previous 22 years.

The total duration of bright sunshine last month was, as a rule, not widely different from the normal; at the majority of stations there appears to have been a slight excess.

The distribution of total rainfall was normal, and no great departures from the average were observed. England had a rainfall slightly in defect nearly everywhere with less than 2 inches over the north midlands and north-east. More than 3 inches fell in patches in the south and south-west, and over part of the Pennines, but more than 6 inches was very local. Wales had more than the average in the west, and Scotland everywhere except in the north and north-east, and more than 10 inches fell widely in the west Highlands. Ireland was dry in the south and wetter in the north, more than 4 inches falling generally over the north-western half. The general rainfall for the countries, expressed as a percentage of the average, was :—England and Wales, 79; Scotland, 105; Ireland, 102; British Isles, 95.

In London (Camden Square) the mean temperature was 42°·9, or 0°·6 below the average for 50 years. The duration of bright sunshine was 22·3 hours, and the duration of rainfall, 63·3 hours. Evaporation, ·24 in.

RAINFALL TABLE FOR NOVEMBER, 1918.

STATION.	COUNTY.	RAINFALL. Aver. 1875—1909. in.	1918. in.	Diff. from Av. in.	Per cent. of Av.	Max. in 24 hours. in.	Max. in 24 hours. Date.	Nos. of Day
Camden Square	London	2·34	2·21	— ·13	94	·52	3	16
Tenterden	Kent	3·07	2·39	— ·68	78	·68	4	14
Arundel (Patching)	Sussex	3·54	2·00	—1·54	56	·54	4	11
Fordingbridge (Oaklands)	Hampshire	3·41	3·14	— ·27	92	1·11	4	17
Oxford (Magdalen College)	Oxfordshire	2·25	1·94	— ·31	86	·47	4	13
Wellingborough (Swanspool)	Northampn	2·22	1·94	— ·28	87	·46	3	14
Bury St. Edmunds (Westley)	Suffolk	2·40	2·10	— ·30	88	·95	3	14
Geldeston [Beccles]	Norfolk	2·49	1·42	—1·07	57	·61	3	15
Polapit Tamar [Launceston]	Devon	4·07	4·28	+ ·21	105	1·24	1	18
Rousdon [Lyme Regis]	"	3·51	2·42	—1·09	69	·61	4	13
Stroud (Field Place)	Gloucester	2·77	2·19	— ·58	79	·74	5	11
Church Stretton (Wolstaston)	Shropshire	2·94	1·55	—1·39	53	·50	4	11
Boston	Lincoln	2·05	2·11	+ ·06	103	·78	3	15
Worksop (Hodsock Priory)	Nottingham	1·98	1·40	— ·58	71	·32	3, 4	13
Mickleover Manor	Derbyshire	2·21	1·74	— ·47	79	·34	4	13
Congleton (Buglawton Vic.)	Cheshire	2·61	2·06	— ·55	79	·63	28	15
Southport (Hesketh Park)	Lancashire	3·16	1·97	—1·19	62	·32	30	15
Wetherby (Ribston Hall)	York, W.R.	2·34	1·56	— ·78	67	·29	4	7
Hull (Pearson Park)	" E.R.	2·34	1·51	— ·83	65	·45	3	11
Newcastle (Town Moor)	North'land	2·63	1·46	—1·17	56	·30	1	15
Borrowdale (Seathwaite)	Cumberland	13·59	10·51	—3·08	77	...	...	...
Cardiff (Ely)	Glamorgan	4·08	3·27	— ·81	80	1·01	4	18
Haverfordwest	Pembroke	5·16	5·25	+ ·09	102	1·40	1	16
Aberystwyth (Gogerddan)	Cardigan	4·50	4·61	+ ·11	102	1·05	10	17
Llandudno	Carnarvon	3·19	1·80	—1·39	56	·38	28	12
Cargen [Dumfries]	Kirkcudbrt.	4·35	4·62	+ ·27	106	1·00	4	14
Marchmont House	Berwick	3·21	*1·32*	—1·89	41	...	...	...
Girvan (Pinmore)	Ayr	5·24	6·08	+ ·84	116	1·20	5	18
Glasgow (Queen's Park)	Renfrew	3·63	3·58	— ·05	99	·62	5	19
Islay (Eallabus)	Argyll	5·33	6·99	+1·66	130	1·16	4	19
Mull (Quinish)	"	6·24	7·58	+1·34	121	2·01	7	20
Balquhidder (Stronvar)	Perth	7·87	9·49	+1·62	121	1·80	9	17
Dundee (Eastern Necropolis)	Forfar	2·62	1·63	— ·99	62	·50	1	20
Braemar	Aberdeen	3·76	3·41	— ·35	91	1·32	1	10
Aberdeen (Cranford)	"	3·29	1·99	—1·30	61	·75	4	10
Gordon Castle	Moray	2·85	...	...	...	...	...	...
Drumnadrochit	Inverness	3·41	3·72	+ ·31	109	1·25	4	15
Fort William	"	7·55	8·95	+1·40	119	1·42	9	19
Loch Torridon (Bendamph)	Ross	8·90	7·74	—1·16	87	1·31	6	17
Dunrobin Castle	Sutherland	3·25	3·17	— ·08	98	1·22	4	10
Glanmire (Lota Lodge)	Cork	4·45	3·11	—1·34	70	·85	7	16
Killarney (District Asylum)	Kerry	5·54	4·52	—1·02	82	1·06	1	20
Waterford (Brook Lodge)	Waterford	3·80	3·46	— ·34	91	1·07	1	15
Nenagh (Castle Lough)	Tipperary	3·88	3·54	— ·34	91	·97	1	16
Ennistymon House	Clare	4·62	4·21	— ·41	91	·60	27	19
Gorey (Courtown House)	Wexford	3·41	3·50	+ ·09	103	·68	7	14
Abbey Leix (Blandsfort)	Queen's Co.	3·28	3·02	— ·26	92	·90	1	17
Dublin (FitzWilliam Square)	Dublin	2·64	2·52	— ·12	95	1·20	1	14
Mullingar (Belvedere)	Westmeath	3·38	3·72	+ ·34	111	·73	4	16
Crossmolina (Enniscoe)	Mayo	5·75	6·48	+ ·73	112	1·40	1	19
Cong (The Glebe)	"	5·00	...	...	...	...	...	...
Collooney (Markree Obsy.)	Sligo	4·02	4·62	+ ·60	115	·78	4	20
Seaforde	Down	3·86	4·58	+ ·72	122	1·42	1	17
Ballymena (Harryville)	Antrim	3·95	5·69	+1·74	144	1·79	4	21
Omagh (Edenfel)	Tyrone	3·66	4·15	+ ·49	113	1·15	4	19

SUPPLEMENTARY RAINFALL, NOVEMBER, 1918.

Div.	STATION.	Rain inches.
II.	Warlingham, Redvers Road	2·72
,,	Ramsgate	2·20
,,	Hailsham	2·58
,,	Totland Bay, Aston House	2·47
,,	Stockbridge, Ashley	3·31
,,	Grayshott	3·87
III.	Harrow Weald, Hill House	2·20
,,	Pitsford, Sedgebrook	...
,,	Woburn, Milton Bryant	...
,,	Chatteris, The Priory	2·08
IV.	Elsenham, Gaunts End	2·10
,,	Shoeburyness	2·34
,,	Colchester, Hill Ho., Lexden	1·91
,,	Ipswich, Rookwood, Copdock	1·86
,,	Aylsham, Rippon Hall	2·00
,,	Swaffham	2·00
V.	Bishops Cannings	2·81
,,	Weymouth	2·28
,,	Ashburton, Druid House	5·51
,,	Cullompton	3·01
,,	Lynmouth, Rock House	4·66
,,	Okehampton, Oaklands	3·97
,,	Hartland Abbey	3·27
,,	St. Austell, Trevarna	4·63
,,	North Cadbury Rectory	2·54
VI.	Clifton, Stoke Bishop	2·05
,,	Ledbury, Underdown	1·86
,,	Shifnal, Hatton Grange	1·61
,,	Droitwich	1·74
,,	Blockley, Upton Wold	2·71
VII.	Grantham, Saltersford	1·96
,,	Louth Westgate	1·92
,,	Bawtry, Hesley Hall	1·15
,,	Whaley Bridge, Mosley Hall	2·71
,,	Derby, Midland Railway	1·39
VIII.	Nantwich, Dorfold Hall	2·11
,,	Bolton, Queen's Park	3·09
,,	Lancaster, Strathspey	2·55
IX.	Langsett Moor, Up. Midhope	1·48
,,	Scarborough, Scalby	1·35
,,	Ingleby Greenhow	1·86
,,	Mickleton	2·40
X.	Bellingham, High Green Manor	1·74
,,	Ilderton, Lilburn Cottage	1·35
,,	Keswick, The Bank	5·74
XI.	Llanfrechfa Grange	3·21
,,	Treherbert, Tyn-y-waun	8·87
,,	Carmarthen, The Friary	4·28
,,	Fishguard, Goodwick Station	8·82
,,	Crickhowell, Tal-y-maes	2·50
,,	Gwern-y-argllwydd	2·50
,,	Birmingham WW., Tyrmynydd	4·55
,,	Lake Vyrnwy	3·77
,,	Llangynhafal, Plas Drâw	2·13
,,	Rhiwbryfdir	7·15
,,	Dolgelly, Bryntirion	6·64
XI.	Lligwy	2·58
,,	Douglas, Isle of Man	4·33
XII.	Stoneykirk, Ardwell House	3·72
,,	Carsphairn, Shiel	9·37
,,	Langholm, Drove Road	3·64
XIII.	Selkirk, The Hangingshaw	2·94
,,	North Berwick Reservoir	1·35
,,	Edinburgh, Royal Observaty.	1·31
XIV.	Biggar	3·46
,,	Maybole, Knockdon Farm	5·06
XV.	Buchlyvie, The Manse	5·68
,,	Ardgour House	12·37
,,	Oban	7·04
,,	Campbeltown, Witchburn	...
,,	Holy Loch, Ardnadam	10·56
,,	Tiree, Cornaigmore	...
XVI.	Glenquey	3·30
,,	Loch Rannoch, Dall	7·27
,,	Blair Atholl	3·25
,,	Coupar Angus	1·65
,,	Montrose, Sunnyside Asylum.	1·85
XVII.	Balmoral	2·98
,,	Fyvie Castle	1·05
,,	Keith Station	2·30
XVIII.	Rothiemurchus	...
,,	Loch Quoich, Loan	22·60
,,	Skye, Dunvegan	7·73
,,	Fortrose	2·13
,,	Glencarron Lodge	6·59
XIX.	Tongue Manse	2·47
,,	Melvich	3·10
,,	Loch More, Achfary	5·21
XX.	Dunmanway, The Rectory	5·17
,,	Mitchelstown Castle	3·02
,,	Gearahameen	8·00
,,	Darrynane Abbey	5·69
,,	Clonmel, Bruce Villa	3·07
,,	Broadford, Hurdlestown	3·73
XXI.	Enniscorthy, Ballyhyland	4·27
,,	Rathnew, Clonmannon	2·65
,,	Ballycumber, Moorock Lodge	2·96
,,	Balbriggan, Ardgillan	2·27
,,	Castle Forbes Gardens	3·76
XXII.	Ballynahinch Castle	7·38
,,	Woodlawn	3·77
,,	Westport House	6·25
,,	Dugort, Slievemore Hotel	6·20
XXIII.	Enniskillen, Portora	4·41
,,	Dartrey [Cootehill]	4·09
,,	Warrenpoint, Manor House	3·27
,,	Belfast, Cave Hill Road	5·25
,,	Glenarm Castle	5·62
,,	Londonderry, Creggan Res.	3·84
,,	Milford, The Manse	4·19
,,	Killybegs	7·18

Climatological Table for the British Empire, June, 1918.

STATIONS.	Absolute.				Average.				Absolute.		Total Rain		Aver.
	Maximum.		Minimum.										
(*Those in italics are South of the Equator.*)	Temp.	Date.	Temp.	Date.	Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	83·2	2	41·0	17	71·2	48·3	48·5	67	90·8	39·0	1·30	11	5·9
Malta	88·7	29	61·2	1	75·9	65·0	...	65	137·0	57·0	·16	3	1·9
Lagos	88·0	10	70·1	2	83·5	73·5	72·3	82	147·0	68·1	18·13	21	8·2
Cape Town	74·9	6	39·8	15	62·8	48·5	50·5	82	...	...	4·80	13	6·9
Johannesburg	65·3	14	30·9	23	61·1	41·4	32·8	58	...	20·9	·02	2	1·3
Mauritius	77·3	2	57·0	...	74·9	62·3	61·0	79	...	51·0	2·66	26	5·6
Bloemfontein	67·2	25*a*	21·2	28	62·4	31·5	30·8	62	..	...	·00	0	3·1
Calcutta...	95·0	5	74·6	18	87·5	77·7	77·5	89	...	73·1	16·09	21	9·2
Madras	102·3	9	72·8	15	98·2	79·2	71·1	66	155·2	73·3	1·80	10	5·2
Colombo, Ceylon ...	87·1	7	73·1	17	85·8	77·9	73·7	80	156·1	71·3	5·04	21	7·2
Hongkong	89·9	29	72·8	17	83·6	76·5	74·7	86	...	...	24·80	22	8·0
Sydney	72·3	15	41·3	29	65·2	46·6	43·8	73	114·7	32·9	·55	4	2·6
Melbourne	65·2	2	40·2	30	57·8	46·8	44·4	74	108·2	30·3	1·76	16	6·8
Adelaide	66·9	2	38·0	8	62·1	47·9	47·8	78	121·0	29·0	2·71	15	...
Perth	74·0	1	43·1	28	65·4	53·3	51·8	78	127·6	57·0	10·50	27	7·0
Coolgardie	75·2	1	30·2	28	63·1	44·4	44·1	68	128·0	25·5	1·67	6	5·8
Brisbane	88·9	19	38·5	29	72·7	47·8	47·2	62	136·0	34·6	·20	3	2·5
Hobart, Tasmania ..	59·0	24	33·2	8	53·3	41·0	38·8	71	102·6	31·1	1·97	16	5·8
Wellington	61·9	3	32·9	30	56·1	44·8	44·5	79	120·0	20·8	7·08	16	6·1
Jamaica, Kingston ..	92·0	28	69·6	25	87·6	72·8	70·8	78	...	...	·84	8	4·2
Grenada	88·0	8	70·0	11*b*	83·0	73·0	...	77	136·0	...	11·26	21	4·6
Toronto	88·8	1	39·0	8	71·6	51·4	49·0	69	140·0	34·0	3·35	13	4·9
Fredericton	86·5	2	33·0	21	69·2	45·4	48·6	68	...	...	4·48	7	5·1
St. John, N.B. ...	80·5	3	40·3	19	62·8	46·4	46·5	76	135·4	35·0	4·48	11	5·7
Victoria, B.C.	79·5	5	41·9	2	66·4	49·4	46·0	69	138·0	33·2	·33	3	3·4

a—26. *b*—17

Johannesburg.—Bright sunshine 278·1 hours.

COLOMBO, CEYLON.—Mean temp. 81°·8, or 0°·1 above, dew point 1°·0 below, and R 2·61 in. below, averages. Mean hourly velocity of wind 5·8 miles.

HONGKONG.—Mean temp. 79°·5. Bright sunshine 147·6 hours. Mean hourly velocity of wind 7·6 miles.

Sydney.—The highest mean max. temp. on record for June.

Melbourne.—Temperature low with mild winter and almost complete absence of frosts.

Adelaide.—Mean temp. 1°·6 above, and R ·39 in. below, averages.

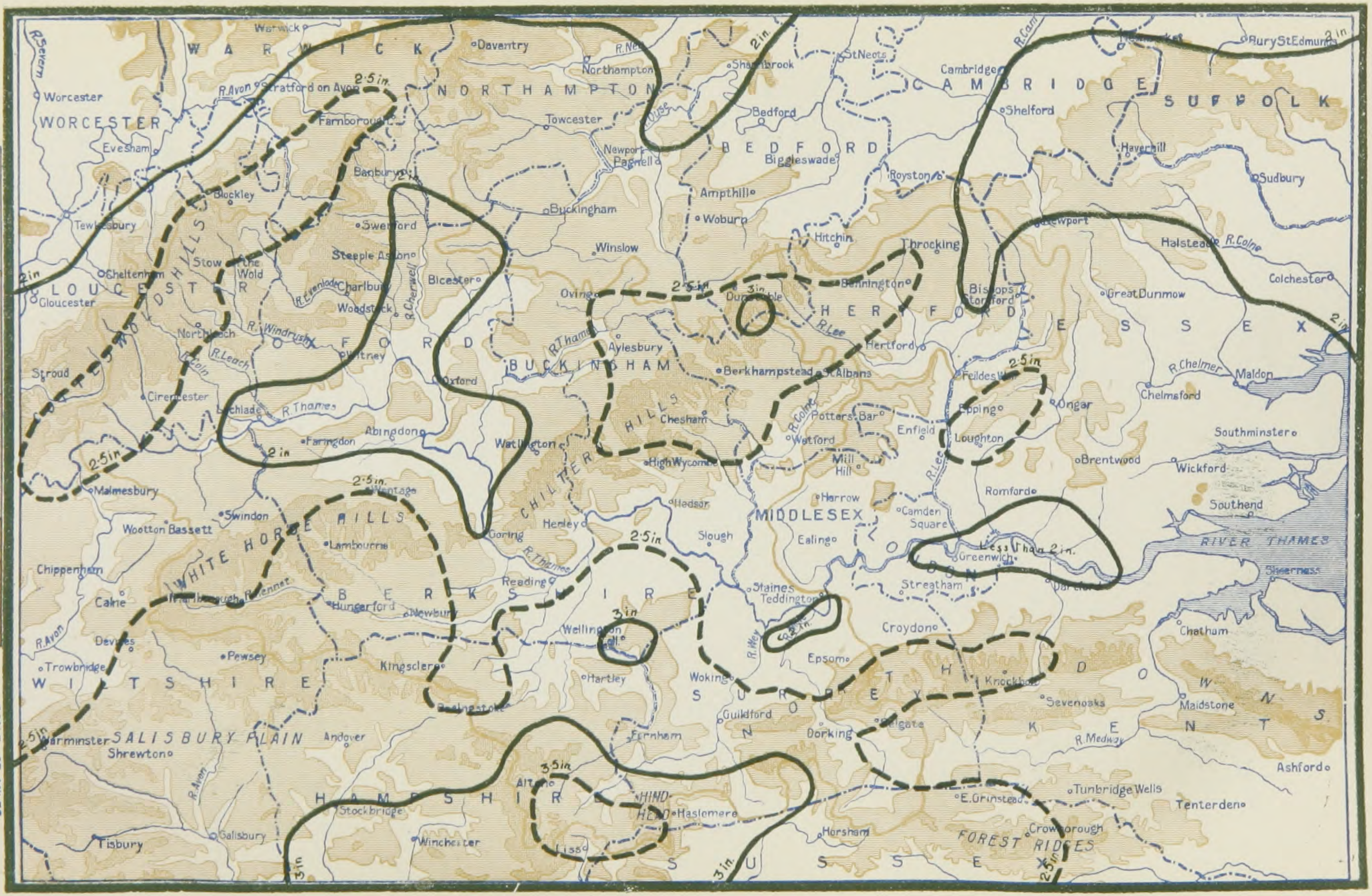
Perth.—Rainfall 3·67 in. above average.

Coolgardie.—Temp. 1°·2 above, and R about ·50 in. above, averages.

Brisbane.—Rainfall 2·39 in. below average. Frost on 8 days.

Wellington.—Mean temp. 1°·0 above, and R 2·06 in. above, averages. Bright sunshine, 110·6 hours. Frost on 11 days.

THAMES VALLEY RAINFALL. NOVEMBER, 1918.



ALTITUDE SCALE

Below 250 feet	250 to 500 feet	500 to 1000 feet	Above 1000 feet

SCALE OF MILES
0 5 10 15 20

Symons's Meteorological Magazine

Watershed of River Thames above Teddington, and River Lee above Feilden Weir.

Isohyetals

Symons's
Meteorological Magazine.

No. 636. JANUARY, 1919. Vol. LIII.

THE RAINFALL OF 1918.

By Carle Salter.

At the time of writing it is not possible to give more than a preliminary survey of the broader features of the rainfall distribution during 1918, based upon a selection from the 3,000 returns so far received. In doing so we follow the usual practice of comparing the total fall with the average of the 35 years 1875-1909. The general values are computed by taking the mean of a number of records distributed as equally as possible over the country.

The following table gives in summary form the general percentage values for each month :—

	England & Wales.	Scotland.	Ireland.	British Isles.
January ..	123	104	110	113
February ...	107	154	166	140
March ...	62	48	65	58
April ...	106	49	56	74
May	113	94	91	100
June	51	77	61	61
July ...	146	141	126	140
August ...	74	103	83	85
September	247	150	209	207
October ...	71	124	123	100
November	79	105	102	95
December	153	98	139	132

The outstanding feature of the year was the very unusual wetness of September, which was undoubtedly the most rainy since that of 1896. The wet February and July were also notable, but the spring and early summer were, generally speaking, dry, particularly in Scotland and Ireland, and, after September, the autumn months, although marked by lack of sunshine and prevalence of damp, foggy weather, were normal in regard to total rainfall. December was also damp and exceptionally mild, but with more rainfall generally.

The total rainfall for the year was nearly everywhere in excess of the average, the exceptions being the east of Scotland, the extreme north-east of England, part of the Midlands, and a narrow strip extending along nearly the whole of the south coast of England. There were very slight deficiencies at one or two stations in the east of Ireland. The deficiency was greater than 10 per cent. from Aberdeenshire to Northumberland, including part of the area in eastern Perthshire where the deficiency was more than 20 per cent. in 1917.

The areas over which the rainfall exceeded the average by more than 10 per cent. group themselves into three wide and roughly parallel bands running from south-west to north-east. The most westerly of these appears to have stretched unbroken from Co. Cork to Caithness. The only parts of this long strip with more than 20 per cent. excess seem to have been in Clare and Tipperary. A central and wider strip with more than 10 per cent. excess extended from north Cornwall and from Waterford to Scarborough and Glasgow, and embraced practically the whole of Wales and the Pennines. Considerable areas with more than 20 per cent. excess lay in North Wales, Lancashire, Yorkshire and the English Lake District, and one or two stations had as much as 30 per cent. more than the average. A third strip with excessive rainfall stretched with some breaks from Sussex to Norfolk. In this area there were no very remarkable departures from the average.

Summing up the rainfall of the larger divisions of the country in general values we find that in England the total for the year was 7 per cent. above the average, in Wales, 13 per cent., in Scotland, 6 per cent., and in Ireland, 11 per cent. For the British Isles as a whole there was an excess of 9 per cent.

CONGRESS OF SCANDINAVIAN GEOPHYSICISTS IN GOTHENBURG, AUGUST 28th—31st, 1918.

By Dr. Hans Pettersson.

At the invitation of Dr. G. Ekman, Prof. O Nordenskjöld, Prof. O. Pettersson and other scientists of Gothenburg, Sweden, a highly representative congress of about fifty Danish, Norwegian and Swedish geophysicists met in that city during the latter part of August, 1918. Representatives from Finland had also been invited, but were unable to be present.

At a public meeting, on August 28th, the Congress was opened by the representative of the King of Sweden. Prof. Hildebrandsson, of Upsala, was unanimously elected president supported by three vice-presidents, *viz.*, Director Ryden (Denmark), Prof. Bjerknes (Norway), and Prof. Nordenskjöld (Sweden); General Secretary, Dr. Hans Pettersson.

At the first general meeting which was open to the public, three papers were read. (i.) By Prof. Bjerknes, of Bergen, on "Weather Forecasting," describing a new and most successful method of short range prognostics for agricultural purposes established in West Norway during the summer of 1918, based on synoptic observations, especially of the wind, from a large number of meteorological stations along the west coast of Norway, the percentage of correct forecasts having been between eighty-five and ninety. (ii.) Prof. Knudsen, of Copenhagen, read a paper on "Hydrographical observations on the west coast on Greenland by the late Dr. T.

Wulff." (iii.) Prof. Arrhenius, of Stockholm, read a paper on "Some observations of the Aurora Borealis."

During the following days general and sectional meetings were held. In all thirty papers were read, many of these being of very great interest. One afternoon was devoted to the phenomena of the Aurora Borealis, a forenoon to weather forecasting, and the last afternoon was occupied by very animated discussions regarding future Scandinavian co-operation in different branches of geophysical science. Finally resolutions were moved and adopted by the Congress *in pleno*, and a committee formed with the object of calling together a second Congress in due course.

A publication, giving abstracts of the papers read before the Congress, and the resolutions adopted, will shortly be published.

Among the papers read were the following :—

August 28th :—Prof. Vegard (Christiania), "Results from observations of the Aurora Borealis, at Haldde"; Prof. Störmer (Christiania), "Photographic altitude measurements of the Aurora Borealis in Christiania, 1917 and 1918"; Dr. Stenqvist (Stockholm), "On the desirability of making observations of the polarization of diffuse daylight, especially in North Scandinavia"; Dr. K. Modin (Stockholm), "Observations of the Aurora Borealis in Sweden since 1881."

August 29th :—Prof. De Geer (Stockholm), "On a possible method of estimating post-tertiary solar activity"; Prof. Helland-Hansen (Bergen), "Investigations of surface-temperatures in the North Atlantic and their prognostic value"; Dr. A. Wallén (Stockholm), "Forecasting the flow of water in rivers"; Prof. Hesselberg (Christiania), "Turbulent motion in the atmosphere"; Dr. Wallén (Stockholm), "Atmospheric precipitation as dependent on the wind, the altitude and the geographical situation in south Sweden"; Dr. Sandström (Stockholm), "The distribution of atmospheric pressure and its causes"; Dr. Angström (Upsala), on "Temperature variations in the upper strata and their relationship with atmospheric transmission and solar activity"; Dr. Sondén (Stockholm), "Hygienic importance of vertical circulation"; Dr. Gaarder (Bergen), "Influence of the atmospheric variations over North Europe on hydrographic changes in the Christianiafjord"; Dr. Hans Pettersson (Gothenburg), "Vertical movements in the sea on the west coast of Sweden."

August 30th :—Dr. Wallén (Stockholm), "On the run-off and evaporation in the Lagan valley"; Dr. Sandström (Stockholm), "Weather forecasting for airmen"; Captain Wallgren (Stockholm), "Local weather forecasting according to simple observations"; Prof. Hamberg (Upsala), "Movements of the ice on Lake Sommen in February and March, 1918."

The afternoon of the 30th was devoted to an excursion to the Trollhättan waterfalls.

August 31st :—Prof. O. Pettersson, "Cosmic influences on the internal movements in the sea and the atmosphere"; Dr. Ahlmann and Dr. Sandström, "Geophysical studies in West Norway"; Prof. Hesselberg (Christiania), "Scandinavian co-operation in aërological science"; Prof. Helland-Hansen (Bergen), "Scandinavian co-operation in geophysical science."

Resolutions adopted by the Congress.

I.—In favour of an extension of the existing system of simultaneous photographic altitude measurements of the Aurora Borealis started by Prof. Störmer to comprise the whole of Scandinavia during the winter, 1918-19. (Moved by Prof. Störmer, of Christiania).

II.—In favour of the plan proposed by Prof. De Gerr, that measurements of the yearly deposits of loam occurring in lakes blocked by ice, and in shallow bights, which derive from the melting o Scandinavian and Arctic glaciers, should be carried out in conf nection with De Geer's geochronological measurements of the annual striæ in post-tertiary deposits of similar origin. (Moved by Prof. De Geer.)

III.—In favour of establishing a system of continuous synoptic observations of the internal movements in the sea round the coasts of Scandinavia compared with simultaneous meteorological phenomena and fishery statistics. (Moved by Dr. Hans Pettersson, Sweden, and others.)

IV.—In favour of the establishment of ærological observations in different parts of Scandinavia. (Moved by Prof. Hesselberg, Christiania.)

V.—Emphasizing the need for co-operation between the geophysicists of the Scandinavian countries, both with regard to laboratory and field research, which proposal the governments of these countries are requested to facilitate as much as possible.

VI.—In favour of the project that a first-class scientific institute shall be established in Gothenburg for oceanography, marine meteorology and aerology, with the object of studying the dynamics of the movements occurring in the atmosphere and the sea, which determine the climate and the weather of the Scandinavian countries, and of studying the influence of these factors on agriculture, fisheries, navigation and aëronautics. (Moved by Prof. O. Pettersson and seconded by ten representatives for Denmark, Sweden and Norway.)

WORK AND WATER POWER.

By HUGH ROBERT MILL.

(*concluded.*)

WHENEVER the full benefit of the natural water-power is wanted, nature must be assisted by some method of storage so that a uniform flow of water can be maintained either during normal working hours or throughout the twenty-four hours of every day in the year. Here the professional skill of the water-engineer is necessary before the mechanical or electrical engineer can make use of the natural power, and the water-engineer has to depend on certain natural laws and relationships which have been worked out by the scientific study of the results obtained by Observers of rainfall.

Let us suppose that there is a lake situated in a valley 500 feet above sea-level, with 50 square miles of land draining into it and a river flowing out by a steep course to the sea. An engineer on examining the district has fixed upon a site for a power-station at which 400 feet of fall can be utilized, and he proposes to build a dam across the outlet of the lake in order to raise its level and increase the storage of water so that he can draw off a uniform supply for the turbines at the power-station. Before he can decide on the amount of storage required or on the power which will be available he must know the average annual rainfall on the ground—this is necessary because it would take many years to measure the fluctuations in the flow of the stream. I have explained in some detail the way in which the rainfall of a gathering ground can be ascertained in a paper on "The Rainfall of the Forth Valley and the Construction of a Rainfall Map," in *British Rainfall, 1915,* to which the reader is referred for the manner of ascertaining the average rainfall of an area. It depends, of course, on long-continued records of rainfall, but the important fact, and one which is not generally realized, is that such records need not all be upon the area in question. Observations in contiguous, and sometimes even in rather remote areas, are necessary in order to give certainty as to the general distribution of rain over the country-side of which the gathering ground forms part. In this way the daily readings of a rain gauge in a little cottage garden may provide the essential data for determining the value of a water-power many miles away. Let us suppose that the general rainfall is 60 inches over the gathering ground for an average of 35 years. Experience has shown that the mean annual rainfall of the three driest years likely to occur consecutively is 80 per cent. of the average, and engineers have adopted this figure in calculating the water available in any gathering ground. A certain part of the annual rainfall is lost by evaporation from the surface, transpiration through vegetation and percolation into the ground. For this loss an amount equal to from 12 to 16 inches of rainfall is usually allowed, according to local conditions, and for our purpose we may take it as 14 inches. The available rainfall from our hypothetical area is thus 80 per cent. of 60 inches, less 14 inches; that is to say, 34 inches per annum. In the case of water taken for the supply of distant towns Parliament usually requires that from one-quarter to one-third of the available rainfall shall be returned to the streams by way of compensation for the water abstracted; but in power works, where the water may be diverted from the stream for only a short distance, no definite practice has yet been established, and, for the present, compensation water may be ignored.

Now 34 inches over 50 square miles is 1,700 square-mile-inches, and 1 square-mile-inch in a year is equivalent to very nearly 40,000 gallons per day, the whole available volume of water on the area would be 68 million gallons, or 680,000,000 lbs, in a day, or 472,000 lbs. per minute, day and night throughout the year. With an effective fall of 400 feet, as assumed, this would equal 188,800,000 foot-pounds per minute, or 5,721 horse-power, which, with 70 per cent. efficiency of the turbines and dynamos, would correspond to 4,000 electric horse-power, or 2,984 kilowatts continuously developed.

The work done by water falling down hill, is, as in the case of the bottle-smashing illustration, with which this article began, the exact equivalent of the work done in carrying the water up-hill to begin with. And since in our country water is always falling down-hill day and night all the year round, water to the same amount must be being carried up-hill all the time. It is carried through the air in the form of vapour mainly from the surface of the sea probably at great distances from the land, and it is all raised by the action of heat, the heat of the sun acting it may be as far away as the tropical ocean. However, it comes there we know with absolute certainty that every gallon of water dropped from the clouds on the top of Ben Nevis has required the expenditure of at least 44,000 foot-pounds of work to bring it there, and this is altogether independent of the heat required to change the water from the liquid to the gaseous state, or to move it horizontally against the friction of the air. It follows that the fall of the gallon of water from the top of Ben Nevis to the sea would, if it could all be utilized, produce 44,000 foot-pounds of work which could by appropriate means be transformed into an equivalent amount of any other form of energy. Hence, if we look on falling water as the weight which drives a clock, the heat of the sun is the hand that winds it up. As the winding up by the sun never ceases so the falling of water is a source of power which is always renewed.

Fuel as a vehicle of energy is equally a result of solar radiation, though in this case it is a slow business, for much time is required for the leaves of a plant to store up the carbon and hydrogen which the sun's light separates from the oxygen of carbonic acid gas and water, and an enormously greater time for vegetable matter to assume the density of coal. A very short time, indeed, suffices to re-unite the carbon and hydrogen with the oxygen of the air, hence mineral fuel as a source of energy can be exhausted if used to its full available extent, while water-power is renewed to its full extent for ever as long as the sun continues to shine. Burning coal is like living on capital, harnessing water-power is like living on income; but the source of capital, which is only saved income, and of current income alike is the sun.

There is a tendency for people to whom the value of water power is a new idea to exaggerate its utility. As compared with coal or other fuel water-power labours under the disadvantage that it can only be generated in places where the necessary fall can be obtained. Although electrical energy can be transmitted for 200 miles or more from the place where it is generated by water-power long transmission lines are very costly, and they may only be economically possible in cases where water-power can be utilized very cheaply and where the alternative use of fuel is very costly. In this country it may be said roughly that the proportion of the natural water-power which it would pay to utilize depends on the price of coal. As the cost of fuel rises it becomes worth while to draw on sources of water-power, which from remoteness, or cost of works, could never pay while coal is cheap.

The utilization of tidal power is quite different in character, for though water is the medium the work obtained from it through the tide-raising power of gravitation is taken not from solar heat but from the rotation of the Earth itself. In the long run a full utilization of tidal power would make the Earth rotate more slowly and increase the length of the day, although by an amount too slight to be perceptible in the probable duration of human existence.

METEOROLOGICAL NEWS AND NOTES.

PHENOLOGICAL OBSERVERS, ROYAL METEOROLOGICAL SOCIETY. —Fresh helpers would be greatly valued especially in the less populous regions in the west and north of Great Britain and in all parts of Ireland. Forms and a sample copy of the annual report will be gladly sent by the Assistant Secretary, 70, Victoria Street, S.W.1.

MR. H. E. CARTER, chief computer to the British Rainfall Organization, has, we are glad to report, returned from Germany, where he had been confined as a prisoner of war since March, 1918. He took up his duties in the Office of the Organization again on January 1st, 1919.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

WEATHER CONDITIONS ILLUSTRATED BY FLOWER PHENOLOGY.

My local flower counts for (*a*.) December, and (*b*.) the Christmas to New Year period, aim at determining the characteristics of the transition period from the old phenological season to the new. The former values (*a*) illustrate primarily the lingering on from the old, secondarily the amount of pre-seasonal stimulation for the new season by the number of flowers reasonably assignable to the same. The latter values (*b*.) indicate the extent of December influences in destroying the former and checking the latter. The value for this purpose is well brought out by the striking local contrast caused by the almost unprecedented warmth of last month, with 50° or above (57°·5 twice) on nineteen days and frost on the ground only on the 24th, 25th and 26th, compared with December, 1917, as exceptionally cold. In that year only three flowers opened first after November 30th, against sixteen in 1918.

Except to note the usefulness of roses, space will not allow further indicating the facts illustrated by the table; but comparison is easier as both years gave nearly the same December total and that differs little from the fourteen years mean.

Flowers in bloom at Purley (330-400 ft.), and Wild Flowers casually noted in District:—

	Wild Flowers	Roses.	Other Garden Flowers.	Total.	Fresh Season's Flowers.	
					Garden.	Wild.
1917.................. *a*	46	32	62	140	20	2
1917/8 .... *b*	11	2	30	43	...	...
1918.................. *a*	44	25	65	134	17	3
1918/9 .... *b*	37	16	56	109	...	...
4 years mean...... *a*	40	30	52	122	17	3½
,, ,, ... *b*	30	14	44	88	...	..

a—During December.
b—From Sunday before Christmas to Sunday of or after New Year's Day.

Asgarth, Purley, January 5th, 1919.

J. EDMUND CLARK.

BAROMETRIC PRESSURE AND THUNDERSTORMS.

In respect to Mr. Weston's letter in the November number I have often pointed out in this Magazine what I think is officially well-known, that in this country the real thunderstorms occur with a complex and irregular pressure distribution, especially in the neck or between anti-cyclones. Thunder showers or storms of a milder kind often occur with a definite cyclonic distribution; but, speaking generally, true cyclonic conditions involving much general wind motion are not favourable in this country to severe electrical development. Personally I never take a summer thunderstorm seriously if there is anything like a conspicuous amount of general surface wind on the day in question, and I find it a golden rule. Mr. Weston might study the condition attending the series of terrific thunderstorms that characterized the two very hot Mays of 1917 and 1918. L. C. W. BONACINA.

Hampstead, December 4th, 1918.

CLOUD BURST NEAR HEMEL HEMPSTEAD.

At 18h. 20m., upon the roof of the small conservatory off my dining-room, there was a sound as of a violent hail-storm. There was, however, no hail, but rain in veritable sheets, so thick that I could hardly see the clouds which were very low and sombrely threatening. The duration of rain was about three minutes. At 21h. the rain was standing on the lawn, and I measured 8·3 mm.

The total duration of rain between 9h. and 21h. was at the outside an hour, from 17½h. to 18½h., and the rain was ordinary rain fairly heavy, nearly the whole of the rain falling in the three minutes of the cloud-burst.

The squall marked the passage of the trough of a depression, the motion of which across the Midlands appears to have been rather irregular. Heavy rain occurred at Amersham (about 18h. 15m.), and at Aylesbury. There was also rain in some parts of London between 18h. and 19h., though none was recorded at Kew Observatory or at the Meteorological Office. The squall occurred at Richmond at 18h. 33m., when the maximum wind speed was 19 miles per second, and the wind direction changed from W.S.W. to W.N.W.; not only was there an absence of rain, but another characteristic feature of the true line squall was lacking in the South Kensington record; there was no sudden drop of temperature, but a slight rise from 18h. to 19h., though this was followed by a steady fall of 2°·5 (centigrade) in the next hour.

Reference must also be made to a remarkable difference in character between the barometric conditions before and after the passage of the squall. During the period when the pressure was falling generally, there were continuous oscillating disturbances so that the microbarogram for South Kensington is marked by a series of serrations. A rapid rise of pressure took place about 9h. 40m. (?), and from 19h. 50m. onwards there was hardly any variation.

I do not understand the rapid rise at 9h. 40m. as my barograph shows roughly a fall of half an inch between 0 and 6h. on the 18th, was steady from 6h. to 11½h., fell nearly half an inch from 11½h. to 18h., and then exhibited a slight steady rise.

Golden Parsonage, Hemel Hempstead. ELLIOTT KITCHENER.

VOLUNTARY OBSERVERS AND THE NEW STAR.

Anent your interesting paragraph, "Voluntary Observers and the New Star," in the *Meteorological Magazine* for September, one at any rate of the 5,000 odd Observers connected with the British Rainfall Organization was an independent "discoverer" of the new star in Aquila. That Observer was myself. From my youth up astronomy and astronomical phenomena have had a fascination for me, and on that eventful Saturday night, June 8th, as is almost invariably my nightly custom, I went out of doors about 10.40 o'clock (G.M.T.) to look round the sky and at the weather.

It was a fine starlit night, and on gazing eastward among a number of bright, familiar orbs, I was attracted by a specially bright one I could not name. I knew it was not a planet, and I could think of no such brilliant star (just a trifle fainter than Altair, near by) at that particular spot. I was convinced then and there that I was looking at a *nova* and, on going indoors, settled the matter by reference to books. It was a rather startling discovery, and equally a piece of rare good luck.

The next night the increased brightness was further confirmation of the fact that a brilliant new star had apparently suddenly blazed out. The question was : When had it been first seen? for no outside news of the discovery had so far come. I had to wait for the answer until the Tuesday morning when Monday's English papers came to hand, then I knew that I had been among the earliest to see the intruder.

Miss Grace Cook, of Stowmarket, was credited with being the first to see the stranger light. This she did at 9.30 G.M.T., and rather more than an hour later I was fortunate enough to detect it myself. Had I telegraphed my discovery to Greenwich Observatory on the Sunday morning I should perhaps have figured with other Observers in the Astronomer Royal's letters to *The Times*. But I did not do so, and consequently lost the chance of honourable mention in connection with an astronomical event so exceedingly interesting and so rare. BASIL T. ROWSWELL.

Les Blanches, St. Martin's, Guernsey, October 28th, 1918.

HEAVY RAIN IN CEYLON.

I HAVE an interesting record which has been sent to me by my brother in Ceylon, Mr. T. H. Chapman, Director of Public Works, Columbo. He tells me that on November 17th, at Jaffna, there were 20·63 in. of rain in 16 hours. Previous records at the same gauge are :—1884—9·92 in. in 24 hours ; 1913—9·64 in. in 24 hours.

SAMUEL C. CHAPMAN.

Town Hall, Torquay, January 7th, 1919.

ROYAL METEOROLOGICAL SOCIETY.

A MEETING was held on December 18th, at 70, Victoria Street, S.W., Sir Napier Shaw, F.R.S., President, in the Chair.

A paper was read by Capt. C. J. P. Cave, R.E., entitled, "A Cloud Phenomenon." On April 15th, 1915, a cloud, with an approximately straight front, approached South Farnborough from the north-west, coming overhead at 9.33 a.m., after which the sky was overcast. At all stations in the eastern and south-eastern counties the record was similar, though the times of cessation of sunshine differed considerably. By comparing the records it was possible to draw an isochronous map showing the times when the cloud front was approximately overhead. At 9 a.m. the line ran from the Isle of Wight to Cromer, at 10 a.m. from the east end of the Isle of Wight, through south-east London, to the sea north off Yarmouth, and at 2 p.m. from between Pevensey and Bexhill to Westgate. The map showed the travel of the cloud front from 7 a.m. to 3 p.m. moving at about 12 miles per hour.

Mr. J. E. Clark, Capt. Wilson-Barker, Mr. R. H. Hooker, Mr. Carle Salter and the President, took part in the discussion, in which the analogy with the isochronous lines of the snow-storm of December 25th-26th, 1906, was referred to (*See British Rainfall*, 1906, p. 25).

A paper by Mr. C. E. P. Brooks, on "A Meteorological Journal at Wei Hai Wei, kept by Comm. A. E. House, 1910 to 1916," was also read. Wei Hai Wei, in the north of China, has a cool summer with a moderate rainfall and a dry bracing winter. Meteorological observations were taken by Comm. House four times daily and include pressure, temperature, humidity, rainfall, wind and weather. These have been summarized and discussed, with notes on the relation of the various elements to wind direction, and on the general climatology and possibilities of Wei Hai Wei.

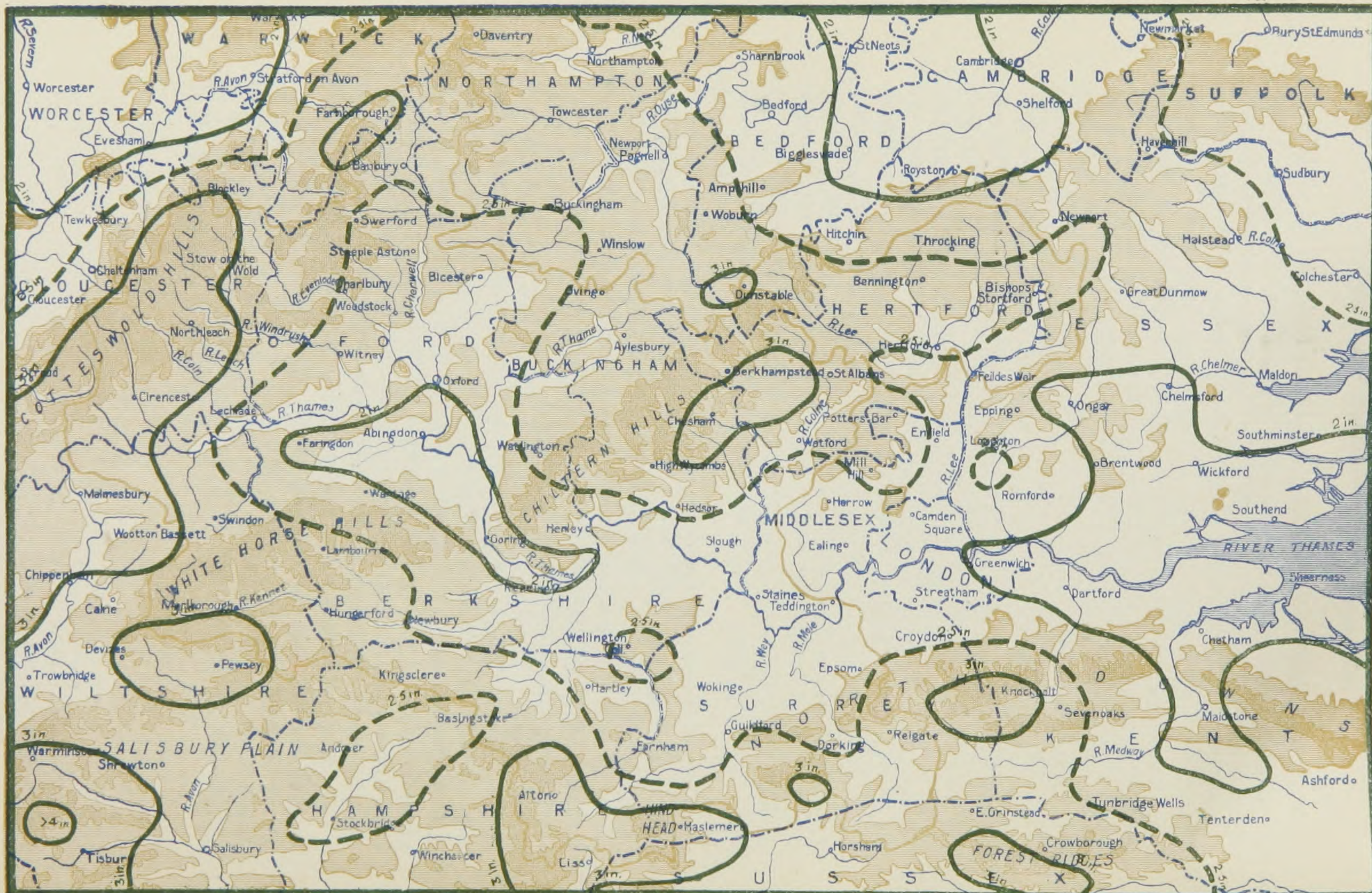
Sir Napier Shaw in expressing the indebtedness of meteorologists to Comm. House, and to Mr. Brooks for enabling these valuable results to be placed on record, suggested that climatologists were apt to push too far the principle of the monsoon as a factor of climate and as a consequence to neglect other important features.

A paper on "Annual Symmetrical Variation and the Choice of Seasons," was read by Capt. E. H. Chapman, R.E. The mean monthly temperatures for the Midland counties are most symmetrical for the year from February to January. The mean monthly values of various meteorological elements are symmetrical for the calendar year January to December. Mean weekly temperatures for the Midland counties are symmetrical for a year commencing with the 5th week of one year and ending with the 4th week of the following year. The method used to show annual symmetry was to draw the first half of the curve forwards and the second half backwards along the ordinates of the first half, the nearness of the two portions of the curve showing the degree of symmetry. Annual symmetrical variation makes the division of the year into seasons a difficult matter. There is evidence in favour of making March a winter month. The usual meteorological three monthly seasons are too early in the year, while the astronomical seasons are too late. An alternative suggestion of three monthly seasons, from the middle of December to the middle of March, etc., was put forward.

An animated discussion took place turning on the choice of seasons for meteorological purposes. Mr. C. Harding strongly advocated calling December a winter month and March a spring month, relying principally upon temperature and sunshine data. Mr. L. C. W. Bonacina spoke of the contrasts between the weather of the solstitial seasons, and Dr. C. Chree of the seasonal magnetic variations suggesting November to January as the true winter period. Major Taylor called attention to the earlier temperature seasons in the atmospheric strata at a level of 14 kilometres above the Earth. Sir Napier Shaw in deprecating any attempt to define too rigidly the seasonal limits mentioned that these varied widely in different parts of the globe, and also that the names of the seasons had a traditional significance in literature which they would probably retain in spite of any attempt to restrict their meaning for particular purposes.

The following candidates were balloted for and elected Fellows of the Society :—Miss M. Proctor, Messrs. G. E. Barton, F. L. Halliwell, J. Morrison, A. Payze, W. H. Rose, W. A. Ru Keyser, G. F. Simpson, W. H. G. Spindler, J. S. Turner, J. F. Woodroffe, J. B. Williamson, L. Whitwam.

THAMES VALLEY RAINFALL DECEMBER, 1918



ALTITUDE SCALE

Below 250 feet	250 to 500 feet	500 to 1000 feet	Above 1000 feet

SCALE OF MILES 0 5 10 15 20

Watershed of River Thames above Teddington, and River Lee above Feildes Weir

Isohyetals

THE WEATHER OF DECEMBER.

THE ruling feature, so far, in the weather of the present winter, has been the almost ceaseless arrival on our shores of Atlantic storm systems, bringing with them volumes of air, usually mild and very humid, and, in short, of distinctly oceanic origin.

In the earlier half of December most of the disturbances passed northward or north-eastward, beyond the Irish and Scottish coasts. The prevailing winds were therefore southerly or south-westerly, often strong in force, and reaching a gale in the west between the 10th and 12th, when the gusts at Falmouth (Pendennis Castle), and Quilty (Co. Clare) attained a velocity of seventy miles per hour. The weather was, as a rule, extremely mild, more especially in the opening week, and again on the 12th or 13th. On each occasion the midday temperatures reached 55°, or more, in nearly all parts of the country, a reading as high as 60° being recorded at Dublin on the 4th, at Scarborough on the 5th, and at Birr Castle on the 8th. Scarcely any frost was expérienced over England and Ireland, but in Scotland the nights of the 10th and 11th were seasonably cold, the shade temperature at two high level stations, Balmoral and West Linton, falling respectively to 24° and 25°.

In the latter half of the month, when the centres of the Atlantic disturbances advanced more directly over the United Kingdom, the wind occasionally got round to W. or N.W., and although mild weather still predominated, the fluctuations in temperature were rather considerable. The deepest depressions were those of the 19th to 20th, the 23rd and the 30th. In each case the wind rose to a gale on many parts of the coast, and at Aberdeen, on the 23rd, the gusts from the north-westward reached a velocity of 72 miles per hour. Sharp frost occurred in Scotland on the nights of the 19th and 20th, when the sheltered thermometer fell slightly below 20° in several places. On the grass a reading as low as 15° was recorded at Balmoral, and a reading of 14° at Eskdalemuir and West Linton. During a short spell of clear brisk weather which occurred over England, most opportunely, just at Christmas, frost was experienced further south, shade temperatures slightly below 25° being recorded at several English stations. Over North Britain the minimum readings were in many cases below 20°, and in a few places very little above 15°. Towards the end of the month mild southerly and south-westerly winds again became general, and on the 28th the midday temperature was in many districts as high as 55°.

The mean temperature of December was well above the average, the excess being greatest over eastern, central and southern England. Owing to an occasional brilliantly fine day the total duration of recorded sunshine differed but little from the normal.

Aurora was seen rather frequently in Scotland, and a brilliant display occurred on the 25th, not only over northern districts generally, but as far south as Norfolk and Worcestershire.

The total rainfall was, on the whole, excessive, falling below the average only in the east and centre of Scotland and in a small part of the south of England. More than 50 per cent. above the average fell in the north-west of England, in South Wales and part of the south of Ireland, and the total reached double the average at one or two stations in the north-west of England. Less than 3 inches fell over most of the south-east of England, and almost the whole of the east of Scotland, but hardly anywhere in Ireland. More than 6 inches was general over western districts, and the fall rose to more than 10 inches widely in Wales and other mountainous areas.

The general rainfall, expressed as a percentage of the average, was :— England and Wales, 153 ; Scotland, 98 ; Ireland, 139 ; British Isles, 132.

In London (Camden Square), the mean temperature was 45°·6, or 5°·9 above the average, and the highest value with two exceptions recorded in December in 61 years. The duration of sunshine was 12·1 hours, and of rainfall 60·1 hours. Evaporation, ·24 inches.

RAINFALL TABLE FOR DECEMBER, 1918.

STATION.	COUNTY.	RAINFALL. Aver. 1875—1909. in.	1918. in.	Diff. from Av. in.	Per cent. of Av.	Max. in 24 hours. in.	Date.	Nos. of Day
Camden Square	*London*	2·13	2·34	+ ·21	110	·41	10	25
Tenterden	*Kent*	2·77	2·08	— ·69	75	·32	17	27
Arundel (Patching)	*Sussex*	2·91	2·50	— ·41	86	·44	9	23
Fordingbridge (Oaklands)	*Hampshire*	3·35	3·10	— ·25	93	·48	10	26
Oxford (Magdalen College)	*Oxfordshire*	2·06	1·99	— ·07	97	·29	22	24
Wellingborough (Swanspool)	*Northampn*	2·13	2·24	+ ·11	105	·42	18	25
Bury St. Edmunds (Westley)	*Suffolk*	2·14	3·01	+ ·87	141	·54	18	25
Geldeston [Beccles]	*Norfolk*	2·07	3·08	+1·01	149	·43	28	27
Polapit Tamar [Launceston]	*Devon*	4·46	6·54	+2·08	147	·55	4	30
Rousdon [Lyme Regis]	,,	3·68	3·19	— ·49	87	·47	21	27
Stroud (Field Place)	*Gloucester*	2·71	2·94	+ ·23	109	·78	20	15
Church Stretton (Wolstaston)	*Shropshire*	2·99	4·67	+1·68	156	·48	2	19
Boston	*Lincoln*	1·88	2·62	+ ·74	139	·41	28	27
Worksop (Hodsock Priory)	*Nottingham*	2·17	2·65	+ ·48	122	·45	19	20
Mickleover Manor	*Derbyshire*	2·38	3·87	+1·49	162	·54	22	23
Congleton (Buglawton Vic.)	*Cheshire*	2·89	5·09	+2·20	176	·60	28	28
Southport (Hesketh Park)	*Lancashire*	3·10	6·68	+3·58	215	·88	15	27
Wetherby (Ribston Hall)	*York, W.R.*	2·27	5·08	+2·81	224	1·08	22	16
Hull (Pearson Park)	,, *E.R.*	2·32	3·10	+ ·78	134	·43	15	23
Newcastle (Town Moor)	*North'land*	2·46	3·60	+1·14	146	·77	30	18
Borrowdale (Seathwaite)	*Cumberland*	15·14	33·83	+18·69	223	...	...	...
Cardiff (Ely)	*Glamorgan*	4·70	7·03	+2·33	150	·85	26	30
Haverfordwest	*Pembroke*	5·18	8·06	+2·88	156	·93	2	27
Aberystwyth (Gogerddan)	*Cardigan*	4·66	8·09	+3·43	174	·87	2	26
Llandudno	*Carnarvon*	2·84	3·50	+ ·66	123	·54	15	25
Cargen [Dumfries]	*Kirkcudbrt.*	4·84	5·41	+ ·57	112	·85	30	24
Marchmont House	*Berwick*	2·83	2·26	— ·57	80	·56	22	16
Girvan (Pinmore)	*Ayr*	5·48	6·82	+1·34	124	·65	23	28
Glasgow (Queen's Park)	*Renfrew*	3·95	3·98	+ ·03	101	·83	23	23
Islay (Eallabus)	*Argyll*	5·73	7·79	+2·06	136	·73	22	31
Mull (Quinish)	,,	6·59	8·40	+1·81	127	·89	19	29
Balquhidder (Stronvar)	*Perth*	8·83	...	...	...	...	...	..
Dundee (Eastern Necropolis)	*Forfar*	2·67	1·65	—1·02	62	·28	22	19
Braemar	*Aberdeen*	3·13	2·10	—1·03	67	·70	24	19
Aberdeen (Cranford)	,,	3·43	2·36	—1·07	69	·49	22	23
Gordon Castle	*Moray*	2·72	2·50	— ·22	92	·32	30	21
Drumnadrochit	*Inverness*	3·76	2·95	— ·81	78	·44	11	23
Fort William	,,	9·41	7·72	—1·69	82	·65	11	26
Loch Torridon (Bendamph)	*Ross*	9·86	9·07	— ·79	92	·73	26	27 *
Dunrobin Castle	*Sutherland*	3·09	4·13	+1·04	130	·55	22	17
Glanmire (Lota Lodge)	*Cork*	5·29	6·84	+1·55	129	1·02	7	27
Killarney (District Asylum)	*Kerry*	6·92	9·56	+2·64	138	·95	7	30
Waterford (Brook Lodge)	*Waterford*	4·32	5·50	+1 18	127	·65	14	22
Nenagh (Castle Lough)	*Tipperary*	4·34	7·18	+2·84	165	·80	18	25
Ennistymon House	*Clare*	5·03	8·21	+3·18	164	1·28	21	30
Gorey (Courtown House)	*Wexford*	3·42	6·20	+2·78	181	1·35	15	22
Abbey Leix (Blandsfort)	*Queen's Co.*	3·41	4·89	+1·48	143	·68	18	24
Dublin (FitzWilliam Square)	*Dublin*	2·27	2·53	+ ·26	111	·58	15	23
Mullingar (Belvedere)	*Westmeath*	3·39	4·16	+ ·77	123	·60	2	22
Crossmolina (Enniscoe)	*Mayo*	6·11	7·67	+1·56	125	·95	17	30
Cong (The Glebe)	,,	5·42	7·01	+1·59	129	·68	17	29
Collooney (Markree Obsy.)	*Sligo*	4·34	6·45	+2·11	148	·64	28	29
Seaforde	*Down*	3·77	4·89	+1·12	130	1·06	28	25
Ballymena (Harryville)	*Antrim*	3·97	5·10	+1·13	128	·71	28	29
Omagh (Edenfel)	*Tyrone*	3·91	5·06	+1·15	129	1·00	28	25

SUPPLEMENTARY RAINFALL, DECEMBER, 1918.

Div.	STATION.	Rain inches.	Div.	STATION.	Rain inches
II.	Warlingham, Redvers Road..	3·15	XI.	Lligwy	6·56
,,	Ramsgate	1·75	,,	Douglas, Isle of Man	...
,,	Hailsham	2·65	XII.	Stoneykirk, Ardwell House...	7·50
,,	Totland Bay, Aston House...	2·68	,,	Carsphairn, Shiel	9·57
,,	Stockbridge, Ashley..	2·82	,,	Langholm, Drove Road	5·32
,,	Grayshott	3·30	XIII.	Selkirk, The Hangingshaw..	2·06
III.	Harrow Weald, Hill House...	2·15	,,	North Berwick Reservoir	1·38
,,	Pitsford, Sedgebrook	2·41	,,	Edinburgh, Royal Observaty.	1·50
,,	Woburn, Milton Bryant	2·62	XIV.	Biggar	2·63
,,	Chatteris, The Priory	1·68	,,	Maybole, Knockdon Farm ...	4·69
IV.	Elsenham, Gaunts End	2·69	XV.	Buchlyvie, The Manse	...
,,	Shoeburyness	...	,,	Ardgour House	12·10
,,	Colchester, Hill Ho., Lexden	2·65	,,	Oban	8·11
,,	Ipswich, Rookwood,Copdock	2·88	,,	Campbeltown, Witchburn ..	...
,,	Aylsham, Rippon Hall	3·75	,,	Holy Loch, Ardnadam	9·39
,,	Swaffham	3·79	,,	Tiree, Cornaigmore	...
V.	Bishops Cannings	3·52	XVI.	Glenquey	5·20
,,	Weymouth	2·59	,,	Loch Rannoch, Dall	4·94
,,	Ashburton, Druid House..	8·34	,,	Blair Atholl	2·76
,,	Cullompton	4·83	,,	Coupar Angus	1·36
,,	Lynmouth, Rock House	7·19	,,	Montrose, Sunnyside Asylum.	1·70
,,	Okehampton, Oaklands	7·65	XVII.	Balmoral	2·34
,,	Hartland Abbey	5·66	,,	Fyvie Castle	2·72
,,	St. Austell, Trevarna	7·59	,,	Keith Station	3·28
,,	North Cadbury Rectory	3·15	XVIII.	Rothiemurchus	2·13
VI.	Clifton, Stoke Bishop	4·39	,,	Loch Quoich, Loan	18·50
,,	Ledbury, Underdown	2·30	,,	Skye, Dunvegan	9·69
,,	Shifnal, Hatton Grange	3·59	,,	Fortrose	2·34
,,	Droitwich	1·97	,,	Glencarron Lodge	7·84
,,	Blockley, Upton Wold	3·26	XIX.	Tongue Manse	4·64
VII.	Grantham, Saltersford	2·50	,,	Melvich	4·70
,,	Louth Westgate	3·46	,,	Loch More, Achfary	8·18
,,	Bawtry, Hesley Hall	2·74	XX.	Dunmanway, The Rectory ..	12·41
,,	Whaley Bridge, Mosley Hall	8·37	,,	Mitchelstown Castle	5·77
,,	Derby, Midland Railway	3·78	,,	Gearahameen	18·00
VIII.	Nantwich, Dorfold Hall	4·96	,,	Darrynane Abbey	5·92
,,	Bolton, Queen's Park	9·76	,,	Clonmel, Bruce Villa	4·81
,,	Lancaster, Strathspey	7·51	,,	Broadford, Hurdlestown	7·35
IX.	Langsett Moor, Up. Midhope	5·48	XXI.	Enniscorthy, Ballyhyland...	6·02
,,	Scarborough, Scalby	5·25	,,	Rathnew, Clonmannon	4·04
,,	Ingleby Greenhow	3·59	,,	Ballycumber, Moorock Lodge	4·49
,,	Mickleton	3·90	,,	Balbriggan, Ardgillan	3·30
X.	Bellingham, High Green Manor	2·91	,,	Castle Forbes Gardens	4·53
,,	Ilderton, Lilburn Cottage ...	2·15	XXII.	Ballynahinch Castle	7·70
,,	Keswick, The Bank	6·97	,,	Woodlawn	4·64
XI.	Llanfrechfa Grange	5·45	,,	Westport House	2·44
,,	Treherbert, Tyn-y-waun	...	,,	Dugort, Slievemore Hotel ...	7·21
,,	Carmarthen, The Friary	8·73	XXIII.	Enniskillen, Portora	4·76
,,	Fishguard, Goodwick Station.	6·47	,,	Dartrey [Cootehill]	4·40
,,	Crickhowell, Tal-y-maes	7·50	,,	Warrenpoint, Manor House ..	4·24
,,	Gwern-y-argllwydd	3·80	,,	Belfast, Cave Hill Road	4·86
,,	Birmingham WW., Tyrmynydd	10·91	,,	Glenarm Castle	4·69
,,	Lake Vyrnwy	11·05	,,	Londonderry, Creggan Res...	5·43
,,	Llangynhafal, Plas Drâw	3·91	,,	Milford, The Manse	5·42
,,	Rhiwbryfdir	16·97	,,	Killybegs	8·78
,,	Dolgelly, Bryntirion	9·23			

Climatological Table for the British Empire, July, 1918.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain Depth.	Total Rain Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	83·5	1	46·1	4	73·3	54·1	53·8	73	92·3	42·9	4·74	18	6·2
Malta	93·6	23	67·5	8	79·6	72·6	...	77	144·0	...	·00	0	1·4
Lagos	87·5	25	72·0	3	82·4	73·8	71·7	81	148·2	70·0	1·03	11	8·0
Cape Town	77·0	14	38·6	25	61·4	48·9	48·0	79	...	...	3·66	12	5·1
Johannesburg	68·2	18	25·1	28	59·6	41·1	34·0	64	...	24·1	·30	3	3·6
Mauritius	75·9	3	53·8	31	73·2	60·3	59·2	78	...	46·1	3·88	26	5·8
Bloemfontein	71·3	20	19·4	25*c*	60·5	33·8	33·6	68	..	...	1·74	5	3·3
Calcutta...	97·0	17	75·2	14	91·4	80·1	78·7	83	...	74·5	7·64	13	8·3
Madras	103·2	12	75·9	2	99·0	80·2	70·2	61	162·4	74·3	·65	5	4·8
Colombo, Ceylon ...	87·7	11	75·2	15*d*	86·4	78·1	73·2	77	153·6	72·5	3·11	13	7·6
Hongkong	91·2	14	74·2	1	86·5	78·4	76·5	84	...	...	11·64	19	7·9
Sydney	70·6	5	37·4	11	61·6	44·5	41·7	72	113·9	28·0	8·26	11	3·6
Melbourne	61·8	5	31·0	21	54·7	42·3	40·7	73	115·1	21·4	1·74	13	7·0
Adelaide	62·5	3	36·3	21	58·4	42·7	44·0	78	122·5	25·1	2·62	15	5·9
Perth	69·6	7	40·1	15	63·7	46·6	45·9	73	126·2	30·9	3·37	6	3·3
Coolgardie	76·8	7	35·5	16	61·0	41·6	39·9	62	131·0	29·2	·62	4	5·5
Brisbane	...	...	...	...	...	...	...	...	...	...	...	...	...
Hobart, Tasmania ..	58·9	6	31·9	22	52·5	39·7	37·3	68	107·0	26·9	3·20	27	6·3
Wellington ...	59·0	8	30·1	27	51·6	39·4	38·6	77	115·0	17·7	4·99	20	5·4
Jamaica, Kingston ..	92·7	11	70·6	9	90·0	73·5	70·6	74	...	...	·24	4	3·4
Grenada	87·0	17*a*	70·0	7	83·0	74·0	...	77	137·0	...	10·57	18	4·0
Toronto	92·4	21	48·0	2	80·5	58·8	58·8	73	144·8	45·0	2·32	7	4·8
Fredericton	91·5	27	48·0	25	74·7	56·8	60·1	82	...	...	7·35	21	6·8
St. John, N.B. ...	78·0	17*b*	39·0	30	61·2	45·4	45·0	83	133·3	31·3	2·25	13	7·0
Victoria, B.C.	78·5	17	46·0	2	66·6	51·2	51·0	77	136·0	39·0	·48	4	5·1

a—26, 29. *b*—12, 31. *c*—26. *d*—27.

Johannesburg.—Bright sunshine 260·7 hours.

COLOMBO, CEYLON.—Mean temp. 82°·2, or 1°·1 above, dew point 0°·8 below, and R 3·17 in. below, averages. Mean hourly velocity of wind 5·7 miles.

HONGKONG.—Mean temp. 81°·8. Bright sunshine 174·8 hours. Mean hourly velocity of wind 9·9 miles.

Sydney.—The lowest July temperature since 1890.

Adelaide.—Mean temp. 1°·0 below, and R ·30 in. below, averages.

Perth.—Rainfall 3·21 in. below average, lowest for July since 1889.

Coolgardie.—Temp. 0°·3 above, and R about ·25 in. below, averages.

Hobart.—Rainfall 1·21 in above average.

Wellington.—Mean temp. 1°·3 below, and R ·97 in. below, averages. Bright sunshine, 127·4 hours.