Symons's Meteorological Magazine.

No. 572. **SEPTEMBER, 1913.** Vol. XLVIII.

THE SUMMERS OF 1912 AND 1913.

The contrast between the rainfall of the summers of 1912 and 1913 was remarkable over the whole of the British Isles. The table on page 138 gives the totals, with their relation to the average, for the three months June to August in each year. The stations are evenly distributed over the British Isles so that the mean value represents the country with a fair degree of accuracy. In 1912 about half the area of the British Isles received more than 50 per cent. in excess of the average for the three months ; only a part of the west of Scotland had less than the average, whilst in many parts of England the excess was more than 100 per cent. For the same period in 1913 nearly half the area of the British Isles had a deficiency of 50 per cent. and only on the extreme south-east was the average exceeded. The latter was probably entirely the effect of the heavy rain on the south coast at the end of August.

The positions of the relatively wet and dry areas for 1913 are almost the reverse of those for 1912. For example, the mean percentage of the average for the three months in 1912 was 148 and this was exceeded in the south and east of Ireland and in England, except the north-west and lower Thames valley. The mean percentage of the average for the same period in 1913 was 55, and the areas with less than 55 per cent. in 1913 correspond roughly with those with more than 148 per cent. in 1912. The following summary shows for each of the great divisions the striking nature of the contrast between the two summers :—

Rainfall June to August as Percentage of Average.

	England.	Wales.	Scotland.	Ireland.	British Isles.
1912…………	166	179	114	145	148
1913…………	51	68	57	53	55

In reviewing *British Rainfall*, 1912, *The Times* (and later, by what we may perhaps term a retarded coincidence, the *Irish Times* in identical words) found fault with that volume and with Meteorologists in general for not producing comprehensive generalisations. We find it no easy matter to avoid hasty generalisations such as the foregoing figures suggest that a wet summer is followed by a dry summer, but we feel sure that only by securing accurate data over wide areas can we hope ultimately to arrive at a sound theoretical meteorology. Signs are not wanting that this will be attained in due time, but that time will not be hastened by premature attempts to leap further than we can look.

	Aver. June-Aug.	June-Aug., 1912.	Diff.	Per cent.	June-Aug., 1913.	Diff.	Per cent.	June-Aug. 1913, diff. from 1912.
	in.	in.	in.		in.	in.		in.
Camden Square ...	7·24	9·56	+ 2·32	132	4·32	—2·92	60	— 5·24
Tenterden	6·66	10·58	+ 3·92	159	3·63	—3·03	55	— 6·95
Patching	7·11	13·06	+ 5·95	184	7·64	+ ·53	107	— 5·42
Oxford	7·14	10·76	+ 3·62	151	2·02	—5·12	28	— 8·74
Wellingborough ...	7·02	13·75	+ 6·73	196	3·65	—3·37	52	—10·10
Shoeburyness	5·24	6·54	+ 1·30	125	3·07	—2·17	59	— 3·47
Westley..............	7·41	13·32	+ 5·91	180	4·21	—3·20	57	— 9·11
Polapit Tamar......	8·09	17·86	+ 9·77	221	3·09	—5·00	38	—14·77
Rousdon...	7·70	13·45	+ 5·75	175	2·33	—5·37	30	—11·12
Stroud	8·08	19·53	+11·45	242	2·97	—5·11	37	—16·56
Wolstaston	8·60	14·35	+ 5·75	167	3·64	—4·96	42	—10·71
Coventry	7·93	14·39	+ 6·46	181	2·08	—5·85	26	—12·31
Boston	6·69	13·77	+ 7·08	206	2·71	—3·98	41	—11·06
Hodsock Priory ...	6·96	14·13	+ 7·17	203	3·02	—3·94	43	—11·11
Macclesfield	10·02	14·34	+ 4·32	143	6·49	—3·53	65	—17·85
Southport	8·91	13·75	+ 4·84	154	4·92	—3·99	55	— 8·83
Arncliffe	14·00	*20·10*	+ *6·10*	*144*	5·65	—8·35	40	—14·45
Ribston Hall	7·51	14·21	+ 6·70	189	3·68	—3·83	49	—10·53
Hull	7·53	13·23	+ 5·70	176	1·99	—5·54	26	—11·24
Newcastle	8·14	12·84	+ 4·70	158	3·01	—5·13	37	— 9·83
Seathwaite	27·32	33·89	+ 6·57	124	20·77	—6·55	76	—13·12
Cardiff	10·35	20·91	+10·56	202	4·28	—6·07	41	—16·63
Haverfordwest ...	10·34	17·96	+ 7·62	174	5·03	—5·31	49	—12·93
Gogerddan	11·88	19·99	+ 8·11	168	11·29	— ·59	95	— 8·70
Llandudno...........	7·65	13·14	+ 5·49	172	6·56	—1·09	86	— 6·58
Cargen	10·27	18·19	+ 7·92	177	5·44	—4·83	53	—12·75
Marchmont	9·22	11·15	+ 1·93	121	5·15	—4·07	56	— 6·00
Girvan	11·31	12·59	+ 1·28	111	5·58	—5·73	49	— 7·01
Inveraray	14·38	12·56	— 1·82	87	10·38	—4·00	72	— 2·18
Quinish	12·42	13·44	+ 1·02	108	5·87	—6·55	47	— 7·57
Dundee	8·24	9·58	+ 1·34	116	3·24	—5·00	39	— 6·34
Braemar	8·46	9·55	+ 1·09	113	2·90	—5·56	34	— 6·65
Aberdeen	8·09	9·62	+ 1·53	119	3·42	—4·67	42	— 6·20
Fort Augustus......	8·57	9·60	+ 1·03	112	6·32	—2·25	74	— 3·28
Bendamph............	16·03	13·75	— 2·28	86	11·43	—4·60	71	— 2·32
Dunrobin Castle ...	7·72	11·37	+ 3·65	147	5·71	—2·01	74	— 5·66
Wick	7·23	8·06	+ ·83	111	4·26	—2·97	59	— 3·80
Killarney	11·02	16·48	+ 5·46	150	5·98	—5·04	54	—10·50
Waterford...........	9·65	15·86	+ 6·21	164	4·61	—5·04	48	—11·25
Castle Lough	9·76	13·48	+ 3·72	138	5·75	—4·01	59	— 7·73
Ennistymon	11·76	14·97	+ 3·21	127	7·59	—4·17	65	— 7·38
Courtown House ...	8·80	16·66	+ 7·86	189	2·63	—6·17	30	—14·03
Abbey Leix	9·51	15·11	+ 5·60	159	5·15	—4·36	54	— 9·96
Dublin	7·68	10·93	+ 3·25	142	2·77	—4·91	36	— 8·16
Mullingar	9·88	15·34	+ 5·46	155	5·71	—4·17	58	— 9·63
Enniscoe	11·11	12·42	+ 1·31	112	6·48	—4·63	58	— 5·94
Cong	11·60	13·36	+ 1·76	115	5·78	—5·82	50	— 7·58
Markree..............	10·77	15·23	+ 4·46	141	6·42	—4·35	60	— 8·81
Seaforde..............	9·84	16·38	+ 6·54	166	4·19	—5·65	43	—12·19
Dundarave	9·90	13·10	+ 3·20	132	6·11	—3·79	62	— 6·99
Omagh	10·38	15·55	+ 5·17	150	6·12	—4·26	59	— 9·43
Mean	**9·59**	**14·19**	**+ 4·60**	**148**	**5·24**	**—4·35**	**55**	**— 8·95**

THAMES VALLEY RAINFALL —— AUGUST, 1913.

Symons's Meteorological Magazine.

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

Rainfall Stations reporting

Isohyetals

THE WEATHER OF AUGUST.

THE month opened with an increase in the intensity of the anticyclonic system which lay over the British Islands at the close of July, and during the first eight days the general distribution of pressure remained unchanged, with light winds from between north-west and north-east. Mean temperature was below the average in all parts of the country, the greatest deficiency being in the east and south-east of England. On the 3rd, the temperature rose to 82° at many places in the north-east of England including Durham, West Witton and York, a similar high reading being at Bawtry on the 3rd. Minima as low as 35° occurred on the 8th at Colmonell and Cally in the west of Scotland, and sharp ground frosts (as low as 27° at Fulbeck) were recorded in widely separated localities. Over the kingdom generally, very little rain fell, and at some stations there was none. On the 9th, the anticyclone had passed out into the Atlantic, the British Isles being under the influence of a shallow depression which was associated with thunderstorms at Southampton on the 8th, and at several places in the south and east of England on the 9th when an inch of rain fell at Bath. During the week ending the 16th, dull and unsettled weather prevailed over the whole of our islands, temperature agreed closely with the normal, and little rain fell except in the English Channel, where on the 11th, 1·47 in. fell at Scilly, thunderstorms occurring on this day at Nottingham, Folkestone and Cambridge. From the 14th to the 23rd, during which period anticyclonic conditions in general prevailed, a good deal of fog was reported on the western coasts and in the Bay of Biscay. Bright sunshine and rainfall were deficient. By the morning of the 21st, the greater part of the country was under the influence of a somewhat deep depression, central off the west of Iceland, which on this and the following day was associated with heavy rains in the west of Scotland, and the north-west of England and Wales, 2 inches being reported at Poltalloch on the 22nd. Thunderstorms occurred at a few stations on the 23rd, and a gale at Malin Head on the 24th. By the 26th, a short spell of fine weather had set in with a rise of temperature, which on the 28th reached 82° at Bath, and 79° at Kew. High night minima exceeding 60° at many coastal stations were frequent during the last week. On the 28th, a shallow depression covered the Bay of Biscay, Brittany, and the western portion of the Channel, which by the morning of the 30th embraced England, the Netherlands and northern France. On this day thunderstorms passed over Yorkshire, heavy hail fell in and around Leeds, and many houses at Doncaster were struck by lightning. On the last day of the month, a torrential downpour visited the south-eastern and southern coasts, with nearly 2½ inches of rain at Worthing and close on 3 inches at Folkestone.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

RAINFALL COMPARISONS.

I THINK the enclosed comparison between the rainfall here for the past three months and the same period last year may be of interest to you.

	1912. Wet Days.	1912. Rainfall. in.	1913. Wet Days.	1913. Rainfall. in.
June	20	6·90	12	1·85
July	23	4·06	9	·58
August	28	10·77	10	·48
	71	21·73	31	2·91

Of the total for August, ·08 in. fell on September 1st between 5 and 6 a.m., so August really only had a total of ·40 in.

MABEL FOSTER.

Lanwithan, Lostwithiel, September 3rd, 1913.

THE contrast between the summer rainfall of 1912 and 1913 is certainly remarkable.

	1912 in.	1913. in.
June	4·84	·41
July	3·96	1·08
August	7·75	1·26
	16·55	2·75

H. C. BOUTFLOWER.

Hampton, Evesham, Worcestershire, September 2nd, 1913.

THE rainfall of the past four months, but for the inch which fell on August 30th and 31st, would have been the least in 50 years.

	in.		in.		in.
1864	4·79	1885	4·62	1911	4·06
1870	4·79	1906	4·26	1913	4·47
1884	4·78				

The wet spring, however, together with the dull skies and low temperature of July and August, made the drought very much less severe than in 1911, the contrast in the two years being curiously like that between 1884 and 1885, and grass land has only quite recently begun to turn brown.

J. E. MACE.

View Tower, Tenderden, September 2nd, 1913.

PARTIAL DROUGHT—SUNSETS.

The partial drought here of 33 days, May 30th to July 1st, inclusive, has been followed by a similar period of 34 days, July 20th to August 22nd, inclusive, with a total rainfall of ·32 inches on seven days.

Last year a note was sent on the unusual absence of fine sunsets during most of July and all August. That was traced later to the Aleutian eruption as probable cause. This year there has been from June onwards a very marked contrast, with especial frequency of the suffused delicate rosy glow which was so typical of the post-Krakatoa sunsets. Six such were recorded in June, 7 in July (6 of these in the Ober-harz district of Germany), and 5 in August. It will be interesting should it be shown that these effects are associated with the finer material left behind from the dust-cloud which was responsible for the absence of sunsets and clear heavens last late summer and autumn.

J. E. CLARK.

Asgarth, Riddlesdown Road, Purley, Surrey, 30th August, 1913.

A GREAT DROUGHT.

An absolute drought from July 9th to August 9th, 31 days, ended with ·07 in. of rain on the 9th and ·06 in. on the 10th inst. The rain from May 14th to August 9th, 87 days, was 1·23 in. It is 20 years, 1893, since I have anything to equal the above. In the spring of that year we had the following rain in Hampshire: March, ·63 in., and April, ·04 in. (·67 in. in 61 days); May, ·78 in. (1·45 in. in 92 days), and June, ·81 in., making a total of 2·26 in. in 122 days.

ARTHUR F. PARBURY.

Mamhead, Kenton, Nr. Exeter, 12th August, 1913.

THE CLIMATE OF TORQUAY.

The Torquay winter climate is given a bad name by Sir John Edwards-Moss (p. 129), who finds it, after six years, "terribly wet, sunless and windy." It may be well to remember that his place is on high ground to the north of the town, near Watcombe; that Torquay has really a variety of climates, according to position; that it has many well-sheltered nooks; that it is considerably warmer near the sea than on high ground at the back; and that, according to official figures, the mean humidity is 79, as against Margate and Folkestone 82, Brighton 83, Falmouth 84, Newquay 86, etc. From experience of last winter, I may say, that while as elsewhere the season was very wet, there was for a Londoner no cold to speak of. And I am inclined to think that, not only from the climatic but various other points of view, there is no more delectable health resort in this island of Britain to pass the winter in.

ALEX. B. MACDOWALL.

Hollocombe, Rowdens Road, Torquay.

RAIN DAYS IN 1913.

THIS district, Blundellsands, which normally boasts of a comparatively light rainfall, can beat the number of rain days in 1913 as given by your correspondent, Mr. John Dover, in your June issue :—

	Wet Days.		Rainfall.
January to May, 1913	97	......	12·76 in.

Last year, although the rainfall for the same period was 11·81 in., the number of rain days was only 71 ; the great difference in the number of rain days here was largely due to the extraordinary drought we experienced in April, 1912, when rain was recorded on only 4 days, as against 20 in April, 1913.

HUGH MONTGOMERY, F.R.Met.Soc.

"Myra," St. Anthony's Road, Blundellsands, nr. Liverpool.

WINTER FLUCTUATIONS OF TEMPERATURE IN ENGLAND AND SCOTLAND.

IN reply to Mr. Single I would say that the fluctuations of temperature are more sudden and rapid in the north because the changes of wind and weather are quicker as one approaches the centre of a low pressure region like the North Atlantic. Mr. Single's suggestion bears rather upon snowfall than fluctuation of temperature ; but concerning the probable causes, in addition to the higher latitude, of the much heavier snowfall in the north of England and Scotland than in the south of England. I shall have something to say at a more appropriate season. Meanwhile let us enjoy the summer.

In connection with the greater instability of weather in north of Scotland then in the south of England, it is interesting to note that the extremes of pressure in winter, the season of greatest range, are much greater in the former regions, so that while its cyclonic minima are deeper in Scotland, as one would expect in a region of lower average pressure, the anticlyconic maxima are higher. Thus at Aberdeen the barometer in winter sometimes exceeds 31 in. and falls below 28, but in London, so far as I am aware it has never once reached 31·0 in. or fallen as low as 28·0.

L. C. W. BONACINA.

Hampstead, N.W., 25th June, 1913.

A HEAVY RAIN IN FRANCE.

THE following notes on a heavy rain in Southern France at the beginning of June may interest your readers.

We left Millau, altitude 1243 ft., at the confluence of the Tarn and Dourbie, on May 30th, and followed the valley of the Dourbie against a very furious squally and warm S.E. wind, under a sky overcast much as one sees in Algeria when a sirocco has been blowing for one or two days. On May 31st the wind, still S.E., was less violent but more steady. At 4 p.m. we reached, in wet fog, the Col de l'Esperou, 4034 ft. on the watershed between the Bay of Biscay and the Mediterranean. The fog got denser and about dusk turned to rain which continued till 4 p.m. next day, a *very* rapid driving rain with small drops; wind still from S E. and temperature ranging from 47° to 50°. At 7 p.m. it began again more heavily than before, with thunder and lightning, and continued without intermission till 4 p.m. on June 2nd, when it suddenly ceased, turning to thick fog again.

The next morning, passing the Col de Sereyrède at 9 a.m. I was lucky enough to see the rain being measured. The measuring glass was filled seven times and the total was 1·67 in. But this was only since 9 a.m. on June 2nd. To the credit of June 1st there had been 2·83 in., and to May 31st 2·31 in., or 6·81 in. in the 44 hours, of which *about* 2·75 in. may have fallen in the first of the two rains and *about* 4 in. the second.

On June 4th we visited the famous Observatory on the top of Mt. Aigonal, 5140 ft., where they kindly allowed me to copy several interesting figures. The big rain just described had been considerably less at the Observatory, only 4·00 in. against the 6·81 in. at the Col de Sereyrède, which is but 2½ miles distant.

Looking at the Observatory records for 1911 and 1912 I saw that 1911 had been as remarkable there for summer heat and drought as it was in England, and that 1912 was as pre-eminent for chill and wet. The rainfall for June, July and August was 8·63 in. in 1911, and 23·27 in. in 1912. In 1912 the absolute maximum in shade was but 72°·7 Fahr., and that occurred on May 13th; but in 1911 June had 74°·1, July 77°·4, and August 81°.

There was a note against the summer of 1912—"The coldest and wettest summer in 40 years"; and against August in particular—"The wettest August since 1900." The rainfall for the whole year was 99·41 in. on 165 days.

H. A. BOYS, F.R.Met.Soc.

North Cadbury Rectory, August 4th, 1913.

PROFESSOR BJERKNES ON DYNAMIC METEOROLOGY AND HYDROGRAPHY.*

By L. C. W. BONACINA.

IT will be remembered that Professor Bjerknes of Christiania delivered a course of learned lectures on this subject at University College, London, during May, 1910. The substance of them is now embodied in a handsome work, constituting Publication No. 88 of the Carnegie Institution of Washington. It consists of two separate volumes, Parts I. and II., together with a large atlas of charts to illustrate concrete examples of conditions discussed in the text. The work is a fine attempt to construct, upon the basis of the known laws of physics, a comprehensive scheme for the co-ordination of meteorological observations with a view to their ultimate utility in the solution of the great problem of the weather, and as such must take high rank in the philosophy of meteorology. It is hopeless to try to review within the limits of a magazine article the mathematical contents, including the discussion of wave motion, of the various chapters of the two volumes before us, and it must suffice to outline the essential points to be grasped in studying Professor Bjerknes' method of handling the abstruse problems presented to us in the phenomena of the atmosphere and hydrosphere. Part I., entitled *Statics*, discusses hydrostatic problems of air and ocean, whilst Part II., *Kinematics*, introducing the element of time, leads on to the representation of the actual variable states of atmosphere and hydrosphere. A few words must be said concerning the system of units which Professor Bjerknes and his collaborators have found it advisable to adopt. Since, for the purposes of dynamic meteorology and hydrography, the centimetre and gramme are too small as units of length and mass respectively, the metre and metric ton are chosen—the latter quantity being the mass of a cubic metre of water at maximum density. The second, though far too small, is, owing to practical difficulties in the way of making a change, retained as the unit of time; and the system thus becomes named the *metre-ton-second* or *m.t.s.* system, from which are derived naturally the units of velocity, acceleration, momentum, force, &c. An important consideration for meteorologists is the unit of pressure in this new system. This is the pressure of the unit force = force giving mass of a ton the acceleration of 1 metre per second ($M\,L\,T^{-2}$) exerted over the area of a square metre, and is equal to 10,000 c.g.s. units of pressure or 10,000 dynes per square centimetre. The megadyne per square centimetre is approximately equal to the pressure of the atmosphere, and it has often been proposed to introduce it as a practical unit of pressure, and to designate it by some such name as

* We follow Professor Bjerknes in the use of the Scandinavian form "Hydrography," though we cannot do so without a protest that *Oceanography* should be used to avoid adding a third aspect to the ambiguity which already besets Hydrography as a geographical term.—ED. *S.M.M.*

a "bar." The m.t.s. unit of pressure will then be the centi-bar, and the c.g.s. the micro-bar.

If we take pure water at maximum density, and neglect its compressibility, we find that 1 bar = pressure of 1 dynamic decametre of water, 1 deci-bar = that of 1 dynamic metre of water, 1 centi-bar = that of 1 dynamic decimetre of water, 1 milli-bar = that of 1 dynamic centimetre of water, and that the c.g.s. unit the micro-bar = pressure of 10 dynamic microns of water. The millibar is the most convenient technical unit for replacing the present universally used millimetre, or inch of mercury, in reading the barometer. The pressure exerted by 1 inch of mercury at 0° C. (on the assumption that its density is 13·59545 and that the value of gravity at the place is 9·80617) is 1·333193 millibars, so that the scale divisions of a barometer which gives direct readings in millibars are ·756079 mm. apart, or say ·76 mm. Barometric readings in inches, or millimetres, have hitherto served perfectly well because pressure records have been used for *qualitative* purposes only, but they no longer avail when meteorological data are employed *quantitatively*, *i.e.*, to serve for the pre-calculation of ensuing atmospheric changes, in accordance with the avowed aim of the new method. Professor Bjerknes aptly styles the millibar a *rational* unit as contrasted with the inch or millimetre which are both purely arbitrary, and as such would cause endless trouble if used in complicated calculations.

It is necessary now to turn to some general considerations on the object and methods of dynamic meteorology and hydrography. The problem must, of course, be considered from the mathematical point of view, and consequently it becomes necessary to define our independent and dependent variable quantities. The so called independent variables are *co-ordinates*, viz.; latitude, longtitude, and height with reference to a certain level like that of the sea surface, and *time*. The dependent variables will be the quantities required for defining the state of the atmosphere and hydrosphere, or formulating the laws of change, and will be designated meteorological or hydrographic *elements*, the distribution in space of any of these elements being called its *field*. At least five fields must enter into the adequate description of atmospheric states, namely, those of pressure, mass, temperature, humidity and motion, of which the first four quantities are *scalars*, and the fifth a *vector*. The five corresponding fields for the hydrosphere are the same except that salinity takes the place of humidity. For the complete representation of atmospheric states we should no doubt have to introduce electric, magnetic, and even other fields, but it is wise at first not to complicate the problem with more fields than are fundamentally necessary. The fields of pressure, temperature, humidity and salinity, are described by the values observed in different points of space; that of mass is described either by the scalar element mass per unit volume (density), or by the scalar element volume of unit mass (specific volume), while the field of motion is described either by the vector element velocity, or specific momentum. With this definition of the variables the problem of meteorology and hydrography can be concisely stated as the *investigation of the meteorological and hydrographic elements as functions of co-ordinates and time.*

We can now proceed along one of two ways, which lead to essentially different branches of meteorological and hydrographic science. If we give constant values to the co-ordinates, we can examine the effect of letting time vary. This introduces us to the *climatological* method, to be forthwith explained. If, on the other hand, we give constant value to time, we may study the result of allowing the co-ordinates to vary. This is the *dynamic* method, to be herewith explained likewise. The climatological method is already familiar in the system of self-recording instruments which are set up at a number of fixed points in the atmosphere and hydrosphere, and whose records show directly the effect of letting the time vary while the co-ordinates have constant values defining a certain station. When these records are examined great irregular changes appear, but there are also indications of regular variation, and when averages are formed the irregular changes more or less disappear. The regular changes will then, for the most part, present a periodical character corresponding to diurnal and seasonal changes, sunspot periods, and perhaps other unknown cosmic phenomena. In addition slow secular changes may be discovered. The averages of the elements thus formed may be called the *climatological* elements for atmosphere or hydrosphere, and from a comparison of the average elements at different stations climatological maps may be prepared. The irregular phenomena are, as we have just seen, eliminated in the process, but the investigation of their nature or causes leads us to the other method—the dynamic. In this the records obtained from the same set of self-recording elements may be used, but, time given a certain constant value, the values of the meteorological or hydrographic elements at this epoch are read off from all the records, and a continuous synoptical representation of the field of each element drawn.

A new constant value is next given to time, and a synoptical representation of the elements made for the second epoch, and so on. "A series of pictures," to quote the following passage direct from Professor Bjerknes as being of great importance and containing the gist of the whole matter, "being produced, the next step will be to make them the subject of a comparative investigation. This comparative investigation of the successive states must lead to the solution of the ultimate problem of meteorological or hydrographic science, viz., that of discovering the laws according to which an atmospheric or hydrographic state develop out of the preceding one. We shall call this the *dynamic* method; for in virtue of the laws of hydro-dynamics and thermo-dynamics which govern atmospheric or hydrospheric phenomena, preceding states are in relation of causality to subsequent states. Inasmuch as we know the laws of hydrodynamics and thermo-dynamics, we know the intrinsic laws according to which the subsequent states develop out of the preceding ones. We are therefore entitled to consider the ultimate problem of meteorological and hydrographic science, that of the precalculation of future states, as one of which we already possess the *implicit* solution, and we have full reason to believe that we shall succeed in making this solution an *explicit* one according as we succeed in finding the methods of making full practical use of the laws of hydro-dynamics and thermo-dynamics." In this connection the present writer, whilst making no claim to have done any laborious constructive work like that under discussion, ventures to remark that as far back as May, 1904, and subsequently, he drew emphatic attention in articles published in this Magazine to the causal relationship that must subsist between successive states of weather and which represents the unknown hydro-dynamic laws which govern the subsequent movements of a fluid like the ocean or the atmosphere once set in motion and change by external agencies acting upon it, namely, solar radiation, the rotation of the Earth, and the physical differences of land and water. But if the intervals between the epochs of time in Professor Bjerknes' dynamic method of investigation of atmospheric states were small enough, our knowlege of physics would, according to him, enable us to calculate the development of one atmospheric state out of another—in other words, it would enable us to bridge our ignorance of the manner in which a circulating body like the atmosphere or ocean breaks up into streams and eddies when initially set in motion through inequalities of temperature. Here it is evidently necessary to indicate roughly the preliminary organization of the observations which Bjerknes would establish. In the first place, the dynamic method requires simultaneous, or practically simultaneous, observations, and the next questions are those of the *distribution in space* of each set of simultaneous observations, and the *distribution in time* of the successive epochs of observation. The fundamental laws of hydro-dynamics and thermo-dynamics have the form of partial differential equations which give relations between the *continuous* space-variations and time-variations of the different elements, and hence in practice it is necessary to realize *continuity* in time and space as far as possible. In other words, it is important that the distances in space between the points of observation, and the distances in time between the epochs of observation, be small enough to be used with a certain degree of approximation as line-differentials and time-differentials respectively. With regard to the distribution in space of the points of observation, the condition is fulfilled by the possibility of drawing synoptical maps, giving continuous representation of the fields of the different elements observed. The distances to be allowed in the net of observations will therefore depend upon the space variations of the elements, and so the network must be satisfactory for that element, namely, wind, which has the strongest space variations. For the lowest strata of the atmosphere the network of observations actually existing in Europe, the United States and India is on the whole fairly satisfactory. In the upper air observations need not be so close as on the ground where the local influences of configuration increase the variation of meteorological elements horizontally; but experience alone can show how close the aerological stations should be.

As regards the distances in time between the epochs of observation, a suitable time-differential must be determined by a comparison of synoptic charts representing the field of the same element at successive epochs, and must be chosen so as to suit the element which has the most rapid time-variation—in this case also the velocity of the wind. The changes which the element has undergone from epoch to epoch will, if small enough, enable approximate values of the time-derivative of the element to be found. From preliminary experience of certain charts (discussed in Chapters XII. and XIII. of Part II.), Professor Bjerknes thinks it reasonable to try time-differentials of three hours for the element of wind (velocity), while differentials of double the length may be used for the other elements.

In regard to hydrography, it need only be said here that although oceanographic observations are not yet organized systematically, the general principles will be the same as those for the meteorological observations. Following an analogy afforded by medical terminology, Professor Bjerknes calls the representation of the fields of the different elements the problem of *diagnosis*, whilst the problem of the precalculation of future states from existing ones, he names the *prognosis*. To quote Professor Bjerknes, his own statement of the latter problem is, "The present state being diagnosticated, the final problem is that of the precalculation of future states. The solution of this problem will involve the simultaneous use of all intrinsic relations of hydro-dynamic and thermo-dynamic origin, to be used in connection with the initial conditions, the surface conditions, and data regarding exterior effects of terrestrial or cosmic origin. Evidently the problem is of enormous complexity. But in order to prepare its solution, we shall solve one by one a series of partial problems belonging to it. For every equation introduced we shall examine its prognostic as well as its diagnostic value. In kinematics we shall meet with the first partial problem of prognosis, for the definition of the fundamental kinematic vectors involves the idea of time. When we know the instantaneous velocity of a moving particle, we shall know the place of this particle a differential of time later. The changes of place of the moving particle can therefore be determined in the first approximation by purely kinematic principles. The solution of this problem of kinematic prognosis is the first step in the solution of the general problem."

Concerning the method of research, suffice it to say, in conclusion, that if the refractory problem of meteorology eventually yields to this mode of attack, it is Professor Bjerknes who will surely be recognised as the pioneer in so far as any individual in a co-operative science like meteorology can claim the lion's share of the honours due.

REVIEWS.

The Atmosphere, by A. J. BERRY, M.A., Lecturer in Chemistry at Downing College, Cambridge. University Press, 1913. Size $6\frac{1}{2} \times 5$, pp. vi. + 146. Price 1s. net.

METEOROLOGY is expressly excluded from this little volume which deals with air rather than the atmosphere. The author's standpoint is the historical development of the chemistry of air, which extends from the horror of a vacuum to radio-activity and ionisation, furnishing a concise and accurate little handbook. The concluding chapter on the probable composition of the atmosphere in early geological time might, we think, have been excluded, as the speculations dealt with are indeterminate and controversial.

Weather Bound, by RUPERT TUBERVILLE SMITH. Birmingham, Cornish Brothers, Ltd. Size $10 \times 6\frac{1}{2}$, pp. iv.+320. Price 15s.

MR. R. T. SMITH shows himself in this book to be an enthusiastic meteorological observer, and the pages bear evidence that the compilation of the work was a labour of love and a source of pleasure to the author. In these respects we think that the book will interest and stimulate others like-minded with Mr. Smith; but we hope that they will not feel themselves compelled to prepare their observations in book form without first consulting some competent meteorological authority, as, in our opinion, a record to be worth the bestowal of such labour in presentment requires to be very long and very homogeneous, as well as very accurate.

The greater part of the volume consists of a twenty-seven years' meteorological diary and discussions, statistical and graphic of the various observations made successively at Round Oak, Rowley Regis, West Bromwich, Handsworth and Tettenhall. The dates of removal from one station to another are occasionally but not always, as far as we can see, recorded in the diary, and the author treats the whole period of twenty-seven years as if it were a homogeneous record. Although he points out that at some of his stations the exposure of the instruments was good, while in one at least it was bad. The data are discussed with reference to sunspot periods and terrestrial magnetism.

The introductory letterpress includes some rather disjointed quotations and opinions on meteorological matters, not always accurate, *e.g.*, the statement on p. 29, "evaporation from a still surface of water is equal to the rainfall," this is certainly not the case in the British Isles. Again, on p. 31, it is inaccurately stated that "the keeping of records of rain-spells has now been discontinued by the rainfall authorities. See *British Rainfall*." The reverse is the case, rain-spells are now more systematically treated than formerly.

UPPER AIR EXPLORATION IN AUSTRALIA.

SOME interesting details of the upper air investigations which Mr. H. A. Hunt, the Commonwealth Meteorologist, has been pursuing in Victoria, are contained in the Melbourne newspaper, *The Age*, for July 9th last. The primary object of the investigations has been to determine the height of the lower limit of the stratosphere in southern latitudes. During May and June last 13 sounding balloons were liberated in Melbourne, of which 8 were found and returned to the Weather Bureau. It is to be regretted that lack of the necessary equipment, and the difficulty of obtaining supplies of pure hydrogen, have so far confined the experiments to ascents from Melbourne, but it appears probable that before long simultaneous ascents may be made from the Universities in the various States of the Commonwealth.

The first balloon liberated, owing to leakage, did not reach any great altitude, but later ascents were much more successful. No. 5, liberated on May 14th in a south-east wind, reached the stratosphere at a height of six miles, at which altitude the temperature was —58° F., and at seven and a half miles, the greatest height reached, it was —50°. No. 7, which was liberated on May 20th with a south-west wind blowing, was found at Rose River on June 20th, and in spite of the fact that the instrument had been exposed to the weather for a month, the trace was still clearly decipherable. This meteorograph indicated the height of the commencement of the stratosphere as eight and a half miles, at which the temperature was —77°, and at the greatest height reached, nine miles, the temperature was —74°. No. 8, liberated on May 23rd, was found the same day, and showed at the lower limit of the stratosphere, seven miles, a temperature of —76°. This balloon reached a height of nearly eleven miles, where the temperature was —71°. No. 12, liberated on June 10th, and found at Pastoria East, reached the commencement of the strathsphere at a height of eight miles, and the temperature at that point was —65°. The greatest height reached was ten and a half miles, where the temperature was —60° Six small pilot balloons were also liberated for the purpose of studying the strength and direction of flow of air currents at various altitudes.

Of the four balloons liberated when a south-west wind was blowing, only one was recovered. This is attributable to the fact that the greater part of the north-east of Victoria, in which part the balloons probably fell, is mountainous and heavily timbered. The other two balloons which were not recovered were liberated when the wind was northerly. Two of the balloons were found in tree tops, and attention was doubtless drawn to them by the attached red silk ribbons.

Mr. Hunt and the staff of the Commonwealth Weather Bureau are to be congratulated on the success of these initial experiments in Victoria. When the field of operations is extended so as to embrace the whole of the Australian continent, we may look forward to the acquisition of much valuable data.

INTERNATIONAL BALLOON ASCENTS.

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

December 10th, 1910.

Starting Point.	Country.	A (H_c) miles.	B (T_c) ° F.	C miles.	D ° F.	E miles.	F
Pyrton Hill......	England ..	5·8	—69	8·1	—71	38	N.W.
Brussels	Belgium ..	7·7	—86	9·5	—75	79	N. by W.
Lindenberg......	Germany..	7·6	—78	9·4	—70	9	E.S.E.
Strassburg	,, ..	6·0	—69	7·2	—72	40	N.N.W.
Munich	,, ..	—	—	6·6	—81	11	N.W.
Vienna..........	Austria ...	7·9	—86	12·6	—76	11	S. by E.
Pavlovsk	Russia	6·6	—90	8·6	—79	45	N.E.
Nishni Olchedaeff	,, ...	6·6	—56	9·7	—69	39	S.S.E.

A low pressure area lay over the Channel and moved across the Bay of Biscay the next day. An extensive anticyclone lay over Russia.

The low temperature of —90° over St. Petersburg is remarkable, as the high latitude and comparatively low value of H_c are both usually associated with a higher temperature.

January 5th, 1911.

Starting Point	Country.	A (H_c) miles.	B (T_c) ° F.	C miles.	D ° F.	E miles.	F
Manchester......	England ..	6·5	—67	10·5	—62	80	S.
Pyrton Hall	,, ..	5·2	—58	6·6	—62	28	S.S.W.
Brussels	Belgium ..	5·9	—69	10·7	—57	64	S.W.
Hamburg	Germany..	5·4	—59	9·2	—61	39	W. by S.
Lindenberg......	,, ..	6·1	—61	9·6	—59	33	N W.by W.
Paris	France ...	5·5	—70	6·4	—62	31	S.S.W.
Strassburg	Germany..	5·6	—71	6·1	—65	27	S.W by W.
Munich	,, ..	5·6	—77	6·0	—70	14	N.W.
Vienna..........	Austria....	6·2	—67	8·6	—62	44	N. by W.
Pavlovsk	Russia	6·3	—77	8·3	—73	40	N.W. by N.
Nishni Olchedaeff	,, ..	6·6	—74	7·4	—66	46	N.E.

A Height in miles of commencement of isothermal column.
B Temperature, F°., at bottom of column.
C Greatest height of reliable record in miles.
D Temperature, F°., at greatest height.
E Distance in miles of point where balloon fell.
F Bearing of falling point from starting point.

On January 4th a low pressure area lay over the west of the Mediterranean and remained stationary for some days. There was a very deep depression over Iceland and a very high pressure over Russia.

RAINFALL TABLE FOR AUGUST, 1913.

STATION.	COUNTY.	Lat. N. ° ′	Long. W. [*E.] ° ′	Height above Sea. ft.	RAINFALL OF MONTH. Aver. 1875—1909. in.	1913. in.
Camden Square	*London*	51 32	0 8	111	2·39	1·43
Tenterden	*Kent*	51 4	*0 41	190	2·42	1·46
Arundel (Patching)	*Sussex*	50 51	0 27	130	2·52	3·83
Fawley (Cadland)	*Hampshire*	50 50	1 22	52	2·85	...
Oxford (Magdalen College)	*Oxfordshire*	51 45	1 15	186	2·44	·76
Wellingborough (Croyland Abbey)	*Northampton*	52 18	0 41	174	2·38	1·71
Shoeburyness	*Essex*	51 31	*0 48	13	1·74	·35
Bury St. Edmunds (Westley)	*Suffolk*	52 15	*0 40	226	2·52	1·72
Geldeston [Beccles]	*Norfolk*	52 27	*1 31	38	2·22	...
Polapit Tamar [Launceston]	*Devon*	50 40	4 22	315	3·17	1·06
Rousdon [Lyme Regis]	,,	50 41	3 0	516	2·84	1·30
Stroud (Upfield)	*Gloucestershire*	51 44	2 13	226	2·90	1·29
Church Stretton (Wolstaston)	*Shropshire*	52 35	2 48	800	3·43	1·32
Coventry (Kingswood)	*Warwickshire*	52 24	1 30	340	2·81	·49
Boston	*Lincolnshire*	52 58	0 1	11	2·39	·90
Worksop (Hodsock Priory)	*Nottinghamshire*	53 22	1 5	56	2·55	1·43
Macclesfield	*Cheshire*	53 15	2 7	501	3·76	2·22
Southport (Hesketh Park)	*Lancashire*	53 38	2 59	38	3·73	1·49
Arncliffe Vicarage	*Yorkshire, W.R.*	54 8	2 6	732	5·62	2·06
Wetherby (Ribston Hall)	,, ,,	53 59	1 24	130	2·78	1·10
Hull (Pearson Park)	,, *E.R.*	53 45	0 20	6	3·05	·72
Newcastle (Town Moor)	*Northumberland*	54 59	1 38	201	3·20	1·13
Borrowdale (Seathwaite)	*Cumberland*	54 30	3 10	423	11·47	7·19
Cardiff (Ely)	*Glamorgan*	51 29	3 13	53	4·54	1·63
Haverfordwest	*Pembroke*	51 48	4 58	90	4·21	1·84
Aberystwyth (Gogerddan)	*Cardigan*	52 26	4 1	83	4·88	3·16
Llandudno	*Carnarvon*	53 20	3 50	72	3·16	2·26
Cargen [Dumfries]	*Kirkcudbright*	55 2	3 37	80	4·23	1·65
Marchmont House	*Berwick*	55 44	2 24	498	3·54	1·56
Girvan (Pinmore)	*Ayr*	55 10	4 49	207	4·54	1·92
Glasgow (Queen's Park)	*Renfrew*	55 53	4 18	144	3·62	1·19
Inveraray (Newtown)	*Argyll*	56 14	5 4	17	6·02	3·35
Mull (Quinish)	,,	56 34	6 13	35	5·00	2·11
Dundee (Eastern Necropolis)	*Forfar*	56 28	2 57	199	3·34	1·37
Braemar	*Aberdeen*	57 0	3 24	1114	3·63	1·02
Aberdeen (Cranford)	,,	57 8	2 7	120	3·07	1·38
Cawdor	*Nairn*	57 31	3 57	250	3·05	·75
Fort Augustus (S. Benedict's)	*E. Inverness*	57 9	4 41	68	3·52	1·21
Loch Torridon (Bendamph)	*W. Ross*	57 32	5 32	20	6·61	2·60
Dunrobin Castle	*Sutherland*	57 59	3 56	14	2·71	1·19
Wick	*Caithness*	58 26	3 6	77	2·73	1·27
Killarney (District Asylum)	*Kerry*	52 4	9 31	178	4·57	1·78
Waterford (Brook Lodge)	*Waterford*	52 15	7 7	104	3·73	2·24
Nenagh (Castle Lough)	*Tipperary*	52 54	8 24	120	4·04	1·62
Ennistymon House	*Clare*	52 57	9 18	37	5·01	2·60
Gorey (Courtown House)	*Wexford*	52 40	6 13	80	3·31	·97
Abbey Leix (Blandsfort)	*Queen's County*	52 56	7 17	532	3·94	1·00
Dublin (FitzWilliam Square)	*Dublin*	53 21	6 14	54	3·08	·94
Mullingar (Belvedere)	*Westmeath*	53 29	7 22	367	4·00	1·36
Crossmolina (Enniscoe)	*Mayo*	54 4	9 16	74	4·68	1·43
Cong (The Glebe)	,,	53 33	9 16	112	4·70	·92
Collooney (Markree Obsy.)	*Sligo*	54 11	8 27	127	4·30	1·58
Seaforde	*Down*	54 19	5 50	180	3·64	·99
Bushmills (Dundarave)	*Antrim*	55 12	6 30	162	4.06	2·57
Omagh (Edenfel)	*Tyrone*	54 36	7 18	280	4·22	1·21

RAINFALL TABLE FOR AUGUST, 1913—*continued.*

RAINFALL OF MONTH (*con.*)					RAINFALL FROM JAN. 1.				Mean Annual 1875-1909.	STATION.
Diff. from Av. in.	% of Av.	Max. in 24 hours. in.	Date.	No. of Days	Aver. 1875—1909. in.	1913. in.	Diff. from Aver. in.	% of Av.	in.	
— ·96	60	·53	31	11	15·92	14·41	—1·51	91	25·11	Camden Square
— ·96	60	·55	30	11	16·07	15·52	— ·55	97	27·64	Tenterden
+1·31	152	2·32	31	11	17·44	23·62	+6·18	135	30·48	Patching
...	...	...	...	...	18·58	...	...	...	31·87	Cadland
—1·68	31	·22	24	8	15·47	12·95	—2·52	84	24·58	Oxford
— ·67	72	1·11	29	10	16·06	14·62	—1·44	91	25·17	Croyland Abbey
—1·39	20	·12	30	8	11·47	10·86	— ·61	95	19·28	Shoeburyness
— ·80	68	·76	31	8	15·96	13·95	—2·01	87	25·40	Westley
...	...	...	...	...	14·20	...	...	...	23·73	Geldeston
—2·11	33	·37	31	12	21·79	25·52	+3·73	117	38·27	Polapit Tamar
—1·54	46	·64	31	9	19·85	19·03	— ·82	96	33·54	Rousdon
—1·61	44	·33	26	14	18·73	19·14	+ ·41	102	29·81	Stroud
—2·11	38	·57	22	9	20·31	23·64	+3·33	116	32·41	Wolstaston
—2·32	17	·10	29	9	18·16	17·36	— ·80	96	28·98	Coventry
—1·49	38	·42	31	12	14·60	12·47	—2·13	85	23·35	Boston
—1·12	56	·80	22	8	15·70	13·55	—2·15	86	24·46	Hodsock Priory
—1·54	59	1·23	22	12	21·93	22·37	+ ·44	102	34·73	Macclesfield
—2·24	40	·84	22	9	19·61	18·59	—1·02	95	32·70	Southport
—3·56	37	·76	21	8	37·59	39·17	+1·58	104	61·49	Arncliffe
—1·68	40	·25	23	10	16·97	14·31	—2·66	84	26·87	Ribston Hall
—2·33	24	·53	22	6	16·52	12·84	—3·68	78	26·42	Hull
—2·07	35	·49	29	12	17·65	16·08	—1·57	91	27·94	Newcastle
—4·28	63	4·32	21	12	76·76	84·49	+7·73	110	129·48	Seathwaite
—2·91	36	·34	30	15	25·02	28·07	+3·05	112	42·28	Cardiff
—2·37	44	·68	22	9	27·05	30·48	+3·43	113	46·81	Haverfordwest
—1·72	65	1·76	22	12	27·03	37·16	+10·13	137	45·46	Gogerddan
— ·90	72	·71	22	8	18·05	20·02	+1·97	111	30·36	Llandudno
—2·58	39	·98	21	10	26·49	31·32	+4·83	118	43·47	Cargen
—1·98	44	·61	29	14	21·22	17·76	—3·46	84	33·76	Marchmont
—2·62	42	·55	22	12	29·37	27·12	—2·25	92	49·77	Girvan
—2·43	33	·35	21	9	22·04	22·59	+ ·55	102	35·97	Glasgow
—2·67	56	1·55	21	12	40·06	42·63	+2·57	106	68·67	Inveraray
—2·89	42	·69	21	13	32·67	32·15	— ·52	98	56·57	Quinish
—1·97	41	·44	30	10	18·20	16·42	—1·78	90	28·64	Dundee
—2·61	28	·28	24	11	21·43	21·95	+ ·52	102	34·93	Braemar
—1·69	45	·37	30	14	20·09	17·77	—2·32	88	32·73	Aberdeen
—2·30	25	·39	24	4	18·70	13·10	—5·60	70	29·33	Cawdor
—2·31	34	·61	21	9	26·72	27·08	+ ·36	101	44·53	Fort Augustus
—4·01	39	·77	21	12	49·51	48·43	—1·08	98	83·93	Bendamph
—1·52	44	·24	25	11	19·90	14·13	—5·77	71	31·90	Dunrobin Castle
—1·46	47	·21	23	17	18·11	13·03	—5·08	72	29·88	Wick
—2·79	39	·43	30	11	32·97	34·84	+1·87	106	54·81	Killarney
—1·49	60	1·30	16	9	24·26	26·52	+2·26	109	39·57	Waterford
—2·42	40	·35	21	12	24·57	27·53	+2·96	112	39·43	Castle Lough
—2·41	52	·82	10	10	28·25	30·10	+1·85	107	46·52	Ennistymon
—2·34	29	·40	22	11	21·63	20·94	— ·69	97	34·99	Courtown Ho.
—2·94	25	·21	10	11	22·77	25·78	+3·01	113	35·92	Abbey Leix
—2·14	31	·30	9	10	17·83	16·67	—1·16	93	27·68	Dublin
—2·64	34	·35	20	12	23·17	25·28	+2·11	109	36·15	Mullingar
—3·25	31	·33	20	13	31·32	36·00	+4·68	115	52·87	Enniscoe
—3·78	20	·25	10	10	29·83	32·87	+3·04	110	48·90	Cong
—2·72	37	·31	20	12	26·49	29·10	+2·61	110	42·71	Markree
—2·65	27	·30	21	10	24·38	22·75	—1·63	93	38·91	Seaforde
—1·49	63	·91	23	10	22·83	19·18	—3·65	84	37·56	Dundarave
—3·01	29	·27	21	10	24·66	25·92	+1·26	105	39·38	Omagh

SUPPLEMENTARY RAINFALL, AUGUST, 1913.

Div.	STATION.	Rain inches	Div.	STATION.	Rain inches.
II.	Warlingham, Redvers Road	1·96	XI.	Lligwy	1·18
,,	Ramsgate	·92	,,	Douglas	·78
,,	Hailsham	2·15	XII.	Stoneykirk, Ardwell House	1·59
,,	Totland Bay, Aston House	1·74	,,	Dalry, The Old Garroch	2·20
,,	Stockbridge, Ashley	1·04	,,	Beattock, Kinnelhead	1·87
,,	Grayshott	1·35	,,	Langholm, Drove Road	2·56
,,	Caversham, Rectory Road	1·05	XIII.	Meggat Water, Cramilt Lodge	1·67
III.	Harrow Weald, Hill House	·98	,,	North Berwick Reservoir	1·41
,,	Pitsford, Sedgebrook	·39	,,	Edinburgh, Royal Observaty.	1·44
,,	Woburn, Milton Bryant	·86	XIV.	Maybole, Knockdon Farm	1·32
,,	Chatteris, The Priory	1·98	XV.	Ballachulish House	2·37
IV.	Colchester, Hill Ho., Lexden	·52	,,	Campbeltown, Witchburn	1·55
,,	Newport, Belmont House	...	,,	Holy Loch, Ardnadam	2·65
,,	Ipswich, Rookwood, Copdock	·77	,,	Islay, Eallabus	2·21
,,	Blakeney	1·49	,,	Tiree, Cornaigmore	1·96
,,	Swaffham	·81	XVI.	Dollar Academy	1·22
V.	Bishops Cannings	2·60	,,	Balquhidder, Stronvar	1·48
,,	Winterbourne Steepleton	...	,,	Glenlyon, Meggernie Castle	1·32
,,	Ashburton, Druid House	1·62	,,	Blair Atholl	1.01
,,	Cullompton	1·95	,,	Coupar Angus	1·26
,,	Lynmouth, Rock House	1·27	,,	Montrose, Sunnyside Asylum.	1·40
,,	Okehampton, Oaklands	1·41	XVII.	Alford, Lynturk Manse	1·22
,,	Hartland Abbey	1·05	,,	Fyvie Castle	2·37
,,	Probus, Lamellyn	1·12	,,	Keith Station	1·38
,,	North Cadbury Rectory	1·66	XVIII.	Alvey Manse	1·39
VI.	Clifton, Pembroke Road	1·61	,,	Loch Quoich, Loan	5·70
,,	Ross, The Graig	1·05	,,	Drumnadrochit	·99
,,	Shifnal, Hatton Grange	1·98	,,	Skye, Dunvegan	3·51
,,	Droitwich	1·36	,,	N. Uist, Lochmaddy	...
,,	Blockley, Upton Wold	1·06	,,	Glencarron Lodge	3·29
VII.	Market Overton	1·45	XIX.	Invershin	1·35
,,	Market Rasen	1·29	,,	Melvich	·99
,,	Bawtry, Hesley Hall	1·16	,,	Loch Stack, Ardchullin	1·78
,,	Derby, Midland Railway	2·15	XX.	Skibbereen Rectory	1·11
,,	Buxton	2·01	,,	Dunmanway, The Rectory	1·37
VIII.	Nantwich, Dorfold Hall	1·77	,,	Glanmire, Lota Lodge, No. 1	2·48
,,	Chatburn, Middlewood	2·03	,,	Mitchelstown Castle	1·86
,,	Cartmel, Flookburgh	2·06	,,	Darrynane Abbey	1·51
IX.	Langsett Moor, Up. Midhope	1·41	,,	Clonmel, Bruce Villa	·90
,,	Scarborough, Scalby	1·08	,,	Newmarket-on-Fergus, Fenloe	1·86
,,	Ingleby Greenhow	...	XXI.	Laragh, Glendalough	1·61
,,	Mickleton	1·10	,,	Ballycumber, Moorock Lodge	1·04
X.	Bellingham, High Green Manor	2·06	,,	Balbriggan, Ardgillan	·41
,,	Ilderton, Lilburn Cottage	1·97	XXII.	Woodlawn	1·77
,,	Keswick, The Bank	2·16	,,	Westport, St. Helens	1·48
XI.	Llanfrechfa Grange	1·74	,,	Dugort, Slievemore Hotel	2·25
,,	Treherbert, Tyn-y-waun	3·77	,,	Mohill Rectory	1·18
,,	Carmarthen, The Friary	1·46	XXIII.	Enniskillen, Portora	...
,,	Castle Malgwyn [Llechryd]	1·55	,,	Dartrey [Cootehill]	1·27
,,	Crickhowell, Tal-y-maes	3·50	,,	Warrenpoint, Manor House	·76
,,	New Radnor, Ednol	1·81	,,	Banbridge, Milltown	·81
,,	Birmingham WW., Tyrmynydd	2·21	,,	Belfast, Cave Hill Road	1·15
,,	Lake Vyrnwy	...	,,	Glenarm Castle	1·64
,,	Llangyhanfal, Plâs Draw	2·57	,,	Londonderry, Creggan Res.	2·08
,,	Dolgelly, Bryntirion	3·64	,,	Dunfanaghy, Horn Head	1·75
,,	Bettws-y-Coed, Tyn-y-bryn	1·67	,,	Killybegs	2·85

METEOROLOGICAL NOTES ON AUGUST, 1913.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Temp. for Temperature; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow; F for number of days Frost in Screen; f on Grass.

LONDON, CAMDEN SQUARE.—A changeable month, but for the most part fine and sunny. Almost half the rain for the month fell on the last two days. Mean temp. 61°·8 or 0°·5 below the average. Duration of sunshine 140·4* hours, and of R 22·4 hours. Evaporation 2·11 in. Shade max. 82°·6 on 28th; min. 45°·2 on 25th. F 0, f 0.

TENTERDEN.—A dull month with 11 days with temp. above 70°. Very dry until the last two days. Shade max. 83°·0 on 28th; min. 43°·0 on 9th. F 0, f 0.

TOTLAND BAY.—Duration of sunshine 179·9* hours, or 21·3 hours below the average. Absolute drought from July 20th to August 8th. Shade max. 72°·8 on 26th; min. 45°·9 on 6th. F 0, f 0.

MILTON BRYANT.—A hot and dry month. Shade max. 74°·0 on 27th; min. 47°·0 on 29th.

IPSWICH, COPDOCK.—A very dry and cool month as a whole; last ten days warmer. Northerly winds predominated and many low minima were noted. Mean temp. 59°·1. Duration of sunshine 159·4 hours, Shade max. 80°·8 on 30th; min. 39°·3 on 7th, the coldest night ever recorded here in August, the grass min. fell to 29°·0. F 0, f 1.

POLAPIT, TAMAR.—The driest August since 1870. Very hot until towards the end of the month. Shade max. 77°·9 on 3rd; min. 36°·5 on 7th. F 0, f 0.

ROSS.—A dry month. Shade max. 82°·0 on 23rd; min. 42°·6 on 6th. F 0, f 0.

HODSOCK PRIORY.—A dull month, very dry for the first three weeks, but with few hot days. Shade max. 83°·7 on 3rd; min. 36°·9 on 5th. F 0, f 1.

SOUTHPORT.—Remarkably calm month. Much damage from frost on 19th on the adjacent moss lands. Duration of sunshine 197·0* hours, or 13·0 hours above the average. Duration of R 37·9 hours. Evaporation 2·55 in. Mean temp. 58°·9, or 0°·2 below the average. Shade max. 75°·0 on 29th; min. 41°·0 on 19th. F 0, f 2.

HULL.—Trees and vegetation suffering much from the long drought which continued to 22nd. TSS 24th and 29th. Duration of sunshine 119·4 hours. Shade max. 79°·0 on 3rd and 30th; min. 43° 0 5th. F 0, f 0.

CARMARTHEN.—A fine, bright and warm month. Water supplies running low. Wheat and oats well harvested, but barley backward.

LLANDUDNO.—Shade max. 71°·0 on 29th; min. 46°·0 on 20th.

EDINBURGH.—Shade max. 76°·1 on 16th; min. 45°·9 on 11th. F 0, f 1.

ARDNADAM.—First 20 days very dry. Notices of scarcity of water sent out on 1st. Shade max. 71°·4 on 20th; min. 41°·0 on 20th. F 0, f 1.

COUPAR ANGUS.—An abundance of sun without any spell of excessive heat, 10 days with temp. above 70°·0 Mean temp. 56°·5. Shade max. 81°·0 on 2nd; min. 35°·0 on 19th.

LOCH STACK.—Duration of sunshine 85·8 hours.

DARRYNANE ABBEY.—A very fine and hot month.

WATERFORD.—Shade max. 81°·0 on 14th; min. 44°·0 on 25th.

ARDGILLAN.—The driest August recorded here. R 3·24 in. below the average. Pastures much burnt up and springs failing. Shade max. 75°·8 on 14th; min. 44°·0 on 12th. F 0, f 0.

MARKREE.—A fine, warm, and generally dry month. Shade max. 73°·0 on 4th; min. 38°·0 on 5th. F 0, f 4.

* Campbell-Stokes. † Jordan.

Climatological Table for the British Empire, March, 1913.

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	59·3	6	26·0	18	52·0	38·1	39·6	81	95·7	20·8	2·29	21	7·2
Malta	69·3	23	45·8	4	61·8	53·3	...	82	133·4	..	1·38	3	5·9
Lagos	97·5	16	71·3	25	89·3	77·3	74·2	71	150·5	69·0	1·05	2	5·4
Cape Town	95·7	3	54·0	22	80·9	60·5	57·4	67	...	...	·11	3	2·7
Natal, Durban ...	79·0	22	63·0	4	74·2	67·0	67·3	83	...	...	21·09	16	5·5
Johannesburg	80·5	6	42·8	2	71·7	52·6	52·0	79	150·5	41·3	4·47	15	5·6
Mauritius	87·2	10	63·8	16	84·0	71·1	70·5	80	156·0	56·1	2·89	12	5·8
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta...	98·7	28	57·3	1, 2	89·2	68·3	64·3	64	...	50·6	·87	2	1·6
Bombay...	89·1	23	67·3	2	85·1	71·3	67·1	71	125·4	59·3	...	..	0·6
Madras	97·2	30	69·2	26	92·0	73·1	70·5	72	141·5	65·3	·00	0	1·0
Colombo, Ceylon ...	91·9	1	68·4	15	89·0	73·0	73·8	81	161·4	60·9	8·07	8	4·9
Hongkong	77·7	20	49·6	24	65·8	58·5	55·8	79	...	...	6·95	16	8·4
Sydney	94·0	6	49·0	28	77·5	62·0	55·8	63	151·2	39·9	8·88	12	3·4
Melbourne	95·6	3	44·5	17	70·0	54·3	50·1	61	147·1	40·0	5·14	23	7·2
Adelaide	100·1	2	48·7	30	78·1	58·8	53·1	57	156·7	40·8	1·20	7	4·5
Perth	98·0	7	50·3	12	81·4	61·3	58·9	62	159·4	41·5	·52	5	3·1
Coolgardie	101·6	21	47·2	12	84·1	58·8	49·2	44	164·0	42·0	·06	4	4·2
Hobart, Tasmania ..	86·0	3	40·0	16	64·4	49·2	45·3	66	135·8	32·1	1·91	15	7·1
Wellington ...	72·4	22	43·0	25	66·8	55·7	53·5	76	136·4	33·0	2·83	16	6·8
Auckland	78·0	14,17	49·5	24, 30	72·1	58·1	58·3	80	147·0	46·0	2·34	9	5·0
Jamaica, Kingston ..	90·2	2	66·1	3	86·5	69·3	66·3	72	...	...	·47	3	3·8
Grenada	83·0	sev.	68·0	17	81·4	70·9	...	72	137·0	...	3·42	21	3·0
Toronto	64·2	24	—2·7	7	41·9	24·7	25·5	78	...	—3·3	4·08	18	6·0
Fredericton	60·0	21	—9·0	8	39·3	21·3	...	84	...	...	6·00	18	6·1
St. John, N.B. ...	52·3	31	—4·8	8	39·5	26·6	29·0	81	...	...	7·60	19	6·4
Edmonton, Alberta ...	51·5	7	-15·0	19	30·3	9·1	...	65	109·5	-20·0	·48	11	5·9
Victoria, B.C.	56·6	7	22·7	20	47·6	35·1	36·0	82	...	...	2·00	16	5·9

MALTA.—Mean temp. of air 56°·8. Average daily sunshine 7·5 hours.

LAGOS.—Intensely hot throughout the month.

Natal, Durban.—Rainfall caused floods and damage.

Johannesburg.—Bright sunshine 222·2 hours.

Mauritius.—Mean temp. of air 0°·3, and R 6·39 in., below averages. Mean hourly velocity of wind 10·2 miles or 0·2 miles below average.

COLOMBO.—Mean temp. of air 81°·0 or 0°·5 below, of dew point 1°·2 above, and R 4·56 in. above, averages. Mean velocity of wind 3·5 miles per hour. TSS on 9 days.

HONGKONG.—Mean temp. of air 61°·7. Mean hourly velocity of wind 14·5 miles. Bright sunshine 96·7 hours.

Sydney.—R 3·68 in. above, temp. of air 0°·6 above, averages.

Melbourne.—Mean temp. of air 2°·5 below, and R 2·96 in. above, averages.

Adelaide.—Mean temp. of air 1°·5 below, and R ·14 in. above, averages.

Perth.—Temp. 0°·8 below, and R ·19 in. below, averages.

Hobart.—Mean temp. of air 2°·7 below, and R ·26 in. above, averages.

Wellington.—Mean temp. of air 0°·8 above, and R ·63 in. below, averages. Bright sunshine 170·2 hours.